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**INTERNATIONAL JOURNAL OF ELECTRONICS, MECHANICAL and
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From the President

It is our great pleasure to publish fifth issue of international journal, “International Journal of Electronics, Mechanical and Mechatronics Engineering” (IJEMME) of Istanbul Aydin University. Our sustainable strategy is to demonstrate new trends in science and technology subject to high quality standards by ensuring a stringent peer review process.

The scope of the International Journal of Electronics, Mechanical and Mechatronics Engineering (IJEMME) covers the novel scientific papers about Electronics, Image Processing, Information Theory, Electrical Systems, Power Electronics, Control Theory, Embedded Systems, Robotics, Motion Control, Stochastic Modeling, System Design, Multidisciplinary Engineering, Computer Engineering, Optical Engineering, Design Optimization, Material Science, Metamaterials, Heat and Mass Transfer, Kinematics, Dynamics, Thermo-Dynamics, Energy and Applications, Renewable Energy, Environmental Impacts, Structural Analysis, Fluid Dynamics and related topics of the above subjects.

Manuscripts reporting original theoretical and/or experimental work and tutorial expositions of permanent reference value are highly welcome.

I sincerely wish to thank the editor in chief, members of the editorial board, and authors of the fifth issue who have generously contributed their time and knowledge to the work and the mission of the journal.

Dr. Mustafa AYDIN
President

From Editor

In this issue of “International Journal of Electronics, Mechanical and Mechatronics Engineering (IJEMME)”, we have especially selected the scientific areas which will cover future prospective Engineering titles such as Robotics, Mechanics, Electronics, Telecommunications, Control systems, System Engineering, Biomedical, and renewable Energy Sources.

We have selected only a few of the manuscripts to be published after a peer review process of many submitted studies. Accepted papers are as follows:

- Sertan AKARLAR, Mustafa YAGIMLI “Target Recognition with Color Components and Sobel Operator”
- Ayse KOCALMIS BILHAN, Erhan AKBAL “Modelling and Simulation of Two-Level Space Vector PWM Inverter Using Photovoltaic Cells As DC Source”
- Sibel KAHRAMAN, Refiye YANARDAG “Antioxidant Activity of Ethanolic Extract From Rumex Cristatus Dc ”
- Pelin GORGEL, Ahmet SERTBAS, Osman N. UCAN “Feature Extraction Based Wavelet Transform in Breast Cancer Diagnosis Using Fuzzy and Non-fuzzy Classification”
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Prof. Dr. Osman N. UCAN
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TARGET RECOGNITION WITH COLOR COMPONENTS AND SOBEL OPERATOR

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Abstract- The present study aims to develop a target recognizing software by comparing the image obtained through the camera and the images in the data base using a SOBEL operator and color components which are used to detect the shapes of objects. In the developed target recognition system, the image obtained through the camera and the images in the data base are first compared via SOBEL operator in terms of their shapes, and in case that the images are equal or highly similar to the determined similarity percentage, their color components are compared. If this comparison also provides expected similarity percentages, the target is considered to be recognized, thus enabling the control of both the shape and the color of the target. C# programming language is used in the developed software.

Keywords: Color Component, Target Recognition, Image Processing, SOBEL Operator

1. INTRODUCTION

Objects are required to be recognized automatically in many fields such as security systems, industrial applications and defense technologies. Today, there are many methods and algorithms developed for target recognition.

Some characteristics of the target such as the color, motion, shape and texture are used for its recognition [1]. Background subtraction (BS) is a method commonly used for the detection of moving objects when the camera is fixed. In this method, a reference image is taken as the background and then compared to the next image, thus detecting the changes occurring at the reference background [2-3-4]. Optical flow subtraction is a generalized gradient model which uses the relationship between a series of two-dimensional image and the speed [5]. Temporal Difference Method [6] is based on the detection of the differences of the sequential video frames. Another method is the active contour model, which is an edge-based segmentation method [7-8]. This method is based on the framing of the edges of an object with a closed frame by the energy function within the object area [9]. Methods

such as mean shift algorithm [10] which is based on the principle of analyzing the multiform property space and of using its property set are primary image processing methods used in target recognition. SOBEL operator is an edge detection operator which is used commonly in the detection of the edges of the objects in digital image processing applications [11-12]. This operator is based on a Gauss low pass filter gradient (first order derivative), and uses a 3x3 convolution core [13].

This study aims to use the target recognition software by making use of the colors and shapes of objects so that it can be used in a tracking system with video cameras. For this purpose, images obtained through the camera are compared to the target images in the data base, thus enabling the target recognition.

2. SYSTEM STRUCTURE

In the target recognition system, the camera monitors the medium where the possible targets are present, and the camera image is transmitted to the real-time target recognition system. The transmitted image is filtered via

SOBEL operator. The edges of the image are contoured as a result of the filtering, thus obtaining an overall data regarding the image of the object. Similarly, images in the data base are also filtered and then compared to the filtered camera image. If this comparison is successful, the original versions of the compared images are compared using RGB values. Otherwise, the whole process starts over. If the comparison of the colors is successful, the object in the camera image with the highest similarity rate is considered to be the same with the image in the data base to which it is compared, and thus target recognition is realized. Block diagram of the system structure is shown in Figure 1.

3. IMAGE PROCESSING

Image processing part is the part in which the image is transmitted to the computer and filtered so that they can be filtered via the developed software, thus obtaining the RGB values. The image is transmitted to the computer via a USB port through a 320x240 resolution webcam. A forge dynamic library developed to be used in image processing applications is used in transmitting and filtering the digital image obtained through the camera.

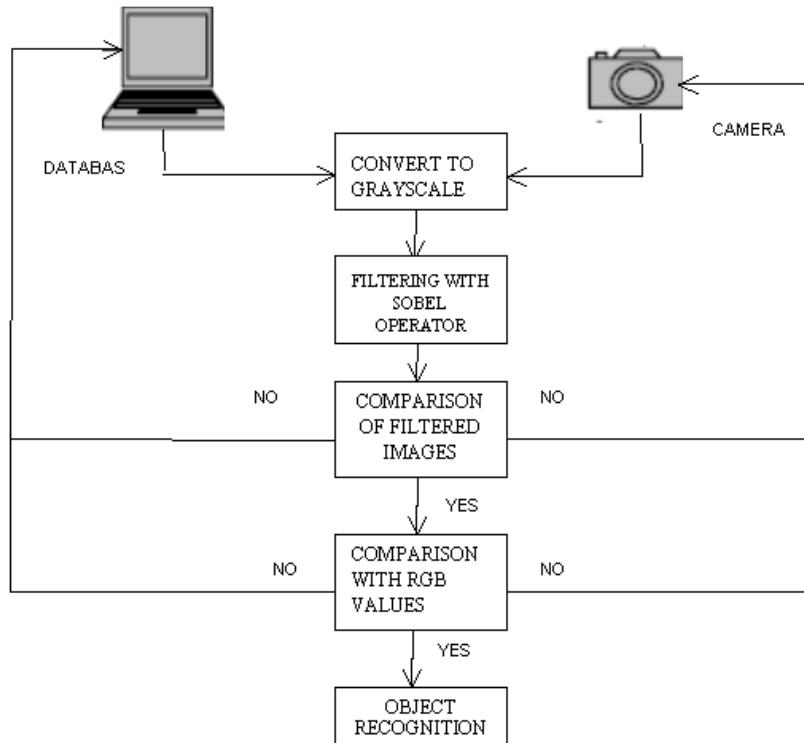


Figure 1. The structure of the system

3.1 SOBEL Operator

The shape of an object is detected using the edges via a SOBEL operator. SOBEL operator is a two-dimensional (horizontal and vertical) gradient operator which is used to determine the edges by detecting significant changes in the magnitude of the image. SOBEL operator uses two 3x3 masks on the X and Y axes [14].

These masks are shown in Figure 2. The image is subject to 3×3 G_x and G_y masks, and to the processes stated in the Equations 1 and 2.

$$G_x = (Z_7 + 2*Z_8 + Z_9) - (Z_1 + 2*Z_2 + Z_3) \quad (1)$$

$$G_y = (Z_3 + 2*Z_6 + Z_9) - (Z_1 + 2*Z_4 + Z_7) \quad (2)$$

Putting G_x and G_y in the Equation 3,

the magnitude of the gradient vector is calculated.

$$G = (G_x^2 + G_y^2)^{1/2} \quad (3)$$

Z ₁	Z ₂	Z ₃
Z ₄	Z ₅	Z ₆
Z ₇	Z ₈	Z ₉

Z ₁	Z ₂	Z ₃
Z ₄	Z ₅	Z ₆
Z ₇	Z ₈	Z ₉

-1	-2	-1
0	0	0
1	2	1

Figure 2. A 3x3 region of an image and Sobel Mask a. A 3x3 Region of an image b. G_x mask c. G_y mask

With the application of the operator to the whole image in 3x3 areas, the color of the unchanged areas deepens, while the color of the areas whose magnitudes have changed lightens. The image filtered via SOBEL operator is shown in Figure 3 and Figure 4.



Figure 3. The Orijinal image



Figure 4. The filtered version of the image with SOBEL Operator .

3.2 Target Recognition

After 20 target images which are previously uploaded to the computer via the developed software are compared to their filtered version via SOBEL operator, the equal or similar values are considered to be successful, and then they are compared using color components.

As a result of the comparison of the filtered version of the image obtained through the camera to their filtered version, the filtered images whose magnitudes are between +40 and -40 are considered to be equal. Therefore, the effect of noise in the images is reduced. If similar number of pixels is 70% or more of the total pixel number, the comparison is considered to be successful, and then they are compared with color components. In case that the comparison is unsuccessful, the image obtained through the camera is compared to the next data base image.

Successful images as a result of the comparison of shape are then compared in terms of their colors. In these comparisons, RGB values for pixels are obtained. The images are considered to be equal, if the RGB values of the image obtained through the camera are between the range of +40 and -40 of the RGB values of the image in the data base. If similar number of pixels is 70% or more of the total pixel number, the comparison is considered to be successful.

In case that more than one successful result are obtained as a result of both comparisons, the second comparison with the highest similarity percentage is taken into consideration. The

target in the image obtained through the camera is recognized as the target in the image in data base.

Equation 4 is used in order to determine the similarity percentages of both comparisons in the developed target recognition system.

$$B = \left(\frac{a}{c} \right) * 100 \quad (4)$$

B, a and c represent the similarity percentage, pixel number and the total scanned pixel number, respectively.



Figure 5. Comparison of same objects

Images obtained through the camera and in the data base are compared first in terms of their shapes and then of their color components (Figure 5). Scanned pixel number of the most successful comparison is 76.800. Similar pixel number is 66.561, and different pixel number is 10.239. Similarity percentage was calculated to be 86.668% using Equation 4. Similarity percentage was calculated to be 86.668% using Equation 4.

$$B = \left(\frac{66561}{76800} \right) * 100 = \% 86.668$$

As the images with a similarity percentage of 70% are considered to be the same, the system indicates that the images are the same.

Camera image of an object that is not in the data base in Figure 5 is subject to the processes mentioned above. Scanned pixel number of the most successful comparison is 76.800. Similar pixel number is 33.232, while different pixel number is 43.568. Similarity percentage is

calculated to be 43.271% using Equation 4.

$$B = \left(\frac{33232}{76800} \right) * 100 = \% 43.271$$

As the images with a similarity percentage of 70% are considered to be the same, the system indicates that the images are the same. In figures 6, left, middle and right images indicate to the camera image, the image in the data base and the filtered image via the SOBEL operator.

4. FURTHER STUDIES AND CONCLUSION

The success of the algorithm developed in the target recognition system depends on the richness of the data base used. Moreover, the more the number of the target images taken in different dimensions and angles, the more the system success. The developed system enabled target recognition, and further studies aims to follow the target. The use of such a system enables engagement by recognizing a target without the need of an operator. Moreover,

such a system may be used in the automatic detection of a target using optic sensors in a

command and control system.



Figure 6. Comparison of different objects

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MODELLING AND SIMULATION OF TWO-LEVEL SPACE VECTOR PWM INVERTER USING PHOTOVOLTAIC CELLS AS DC SOURCE

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Abstract- A space vector PWM method for a two level inverter is proposed in this paper. A two level inverter using space vector modulation strategy has been modeled and simulated with a passive R-L load. Photovoltaic cells are used as DC source for input of two-level inverter. Simulation results are presented for various operation conditions to verify the system model. In this paper, MATLAB/Simulink package program has been used for modeling and simulation of PV cells and two-level space vector pulse width modulation (SVPWM) inverter.

Keywords: Two -level inverter, space vector pwm, photovoltaic cell

1. INTRODUCTION

Renewable energy source become one of the most widely studied electric power applications since fossil fuels are decreasing and oil prices and global warming are increasing. Hydrogen energy, wind turbines and photovoltaic cells are the most popular renewable sources. A photovoltaic system has advantages such as being static and quite since it has no moving parts. So that, it has little operation and maintenance costs. The output characteristic of photovoltaic cells depends on parameters as temperature, the solar insolation and output voltage [1].

Inverters are power electronics devices which converter DC power to AC power [2]. In many power electronic applications, it is desired to control output frequency and voltage level. AC voltage can be produced at desired output frequency and voltage level by using inverters. Recently, developments in power electronics and semiconductor technology have lead improvements in power electronic systems [3].

Inverters can be classified to two main

topology as voltage source inverters (VSI) and current source inverters (CSI). When load has high impedance against to harmonic current, VSI must be used there, while the load with small impedances against to harmonic current requires CSIs to be used. In this work, three phase two-level inverter has been simulated in order to convert DC output power of solar panels [4 - 5].

Six switches are used to constitute a two-level inverter where each phases are commutated by only two switches [6].A schematic drawing of a three phase six step inverter is shown in Fig. 1 Where the S1, S3 and S5 switches stand for upper switches while S2, S4 and S6 switches are down switches. Three-phase output voltage waveforms are generated by various switching combination of the switches in six step inverter resulting at output phase voltage waveforms as +VDC/2 and -VDC/2 [7].

In recent years, various pulse width modulation (PWM) techniques have been developed beside inverters. The total harmonic distortion of output voltage can be controlled by PWM techniques. Also load current waveforms can be controlled too.

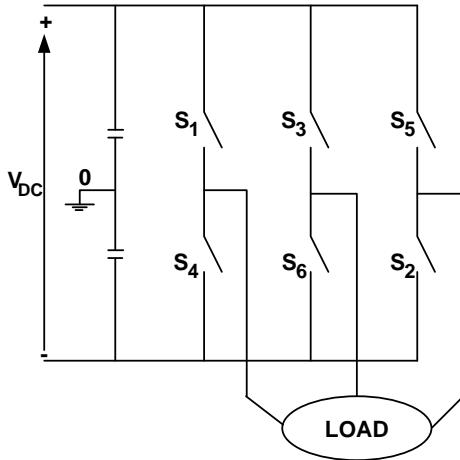


Figure 1. Two-level inverter

The most known PWM technique is Sinusoidal PWM (SPWM) technique [8-9]. In this technique, switching pulses are generated by comparing a sinusoidal waveform with a reference triangle waveform. The comparison waveforms and switching signals have been shown in Fig. 2.

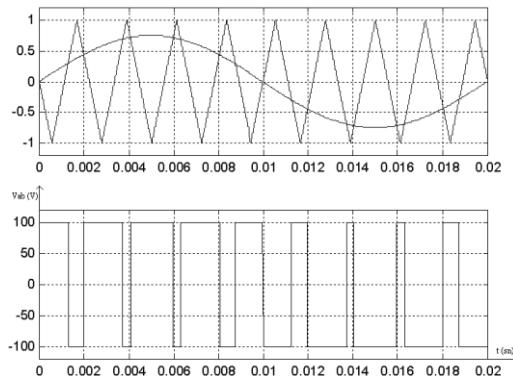


Figure 2. Two level sinusoidal PWM (SPWM)

However it is difficult to regularly sampling of sinusoidal waveform for digital application. For this reason, interest in other PWM techniques has been increased. Selective Harmonic Elimination PWM (SHEPWM), minimum current ripple PWM, third harmonic injection PWM (THIPWM) are some alternatives of the PWM techniques. However space vector PWM (SVPWM) technique is recently showing popularity for inverter applications.

2. SPACE VECTOR PWM (SVPWM)

Two level inverters switching states are shown in Fig. 3.

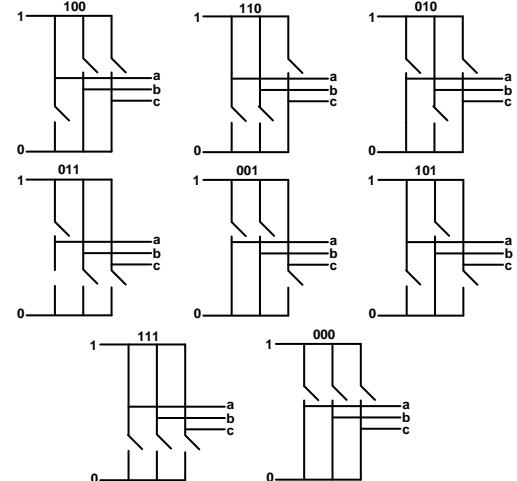


Figure 3. Switching states of two level inverter

In two level inverters, there are $2^3 = 8$ possible states [10]. Two of them are (000 and 111) zero voltage vectors and others are active voltage vectors. "1" switching state represents $+V_{DC}/2$ and "0" switching state represents $-V_{DC}/2$ [11].

The principle of SVPWM method is that the command voltage vector is approximately calculated by using three adjacent vectors. The duration of each voltage vectors obtained by vector calculations [12];

$$T_1 \cdot V_1 + T_2 \cdot V_2 + T_0 \cdot V_0 = T_s \cdot V_{ref} \quad (1)$$

where V_1 , V_2 , and V_0 are vectors that define the triangle region in which V_{ref} is located. T_1 , T_2 and T_0 are the corresponding vector durations and T_s is the sampling time. In a two-level inverter, space vector diagram is divided into 6 sectors (A-...-F). A typical space vector diagram of two-level inverter has been shown in Fig. 4. SVPWM for two-level inverters can be implemented by considering the following steps;

- Sector identification,
- Calculate the switching times, T_1 , T_2 , T_0
- Find the switching states.

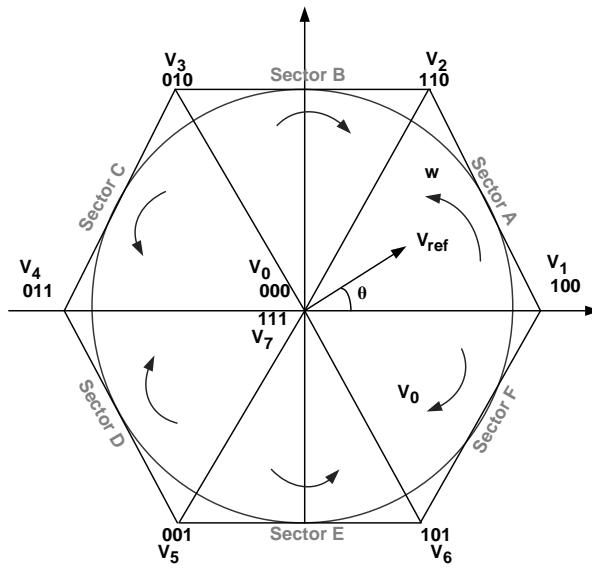


Figure 4. Space vector diagram of two-level inverter

Orthogonal coordinates to represent the 3-phase voltage in the phasor diagram. A three-phase-voltage vector can be expressed as;

$$V_{ref} = V_d + V_q = \frac{2}{3} \left(V_{an} + V_{bn} e^{j\frac{2\pi}{3}} + V_{cn} e^{-j\frac{2\pi}{3}} \right) \quad (2)$$

and θ angle is calculated by;

$$\theta = \arctan \left(\frac{V_q}{V_d} \right) \quad (3)$$

where, V_{an} , V_{bn} and V_{cn} are three phase voltages and V_{ref} (reference voltage vector) rotates at angular speed of $w = 2\pi f$.

2.1. Sector Identification

Sector determination according to θ angle has been shown in Table 1.

Table I. Sector Determination

Angle (θ)	Sector where V_{ref} is placed
$0^\circ \leq \theta < 60^\circ$	Sector A
$60^\circ \leq \theta < 120^\circ$	Sector B
$120^\circ \leq \theta < 180^\circ$	Sector C
$180^\circ \leq \theta < 240^\circ$	Sector D
$240^\circ \leq \theta < 300^\circ$	Sector E
$300^\circ \leq \theta < 360^\circ$	Sector F

2.2 Calculating the Switching Times

V_{ref} is calculated by using two active voltage vector and one zero voltage vector. If V_{ref} is located in Sector A, V_{ref} is synthesized by V_1 , V_2 and V_0 . According to this approach T_1 , T_2 and T_0 can be calculated as;

$$T_1 = \frac{\sqrt{3}V_{ref}}{V_{DC}} \cdot T_s \cdot \sin \left(\frac{\pi}{3} - \theta \right) \quad (4)$$

$$T_2 = \frac{\sqrt{3}V_{ref}}{V_{DC}} \cdot T_s \cdot \sin \left(\frac{\pi}{3} \right) \quad (5)$$

$$T_0 = T_s - T_1 - T_2$$

If T_1 , T_2 and T_0 switching times for all sector can be generalized, they can be calculated by;

$$T_k = \frac{\sqrt{3} \cdot \frac{T_s}{2} V_{ref}}{V_{DC}} \cdot \left(\sin \left(\frac{\pi}{3} - \theta + \frac{k-1}{3}\pi \right) \right) \quad (6)$$

$$T_{k+1} = \frac{\sqrt{3} \cdot \frac{T_s}{2} V_{ref}}{V_{DC}} \cdot \left(\sin \left(\theta - \frac{k-1}{3}\pi \right) \right) \quad (7)$$

$$T_0 = T_s - T_1 - T_2$$

where $k = 1 \dots 6$ (Sector A-...-Sector F) and $0 \leq \theta \leq 60^\circ$.

2.3. Finding Switching States

Switching states for Sector A has been shown in Figure 5.

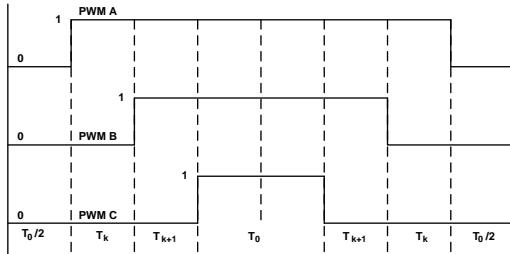


Figure 5. Switching states of Sector A

All switching states has been given in Table 2.

Table II. Switching states for Two level inverter

Sectors	Switching States
Sector A	$V_0 V_1 V_2 V_7 V_7 V_2 V_1 V_0$
Sector B	$V_0 V_3 V_2 V_7 V_7 V_2 V_3 V_0$
Sector C	$V_0 V_3 V_4 V_7 V_7 V_4 V_3 V_0$
Sector D	$V_0 V_5 V_4 V_7 V_7 V_4 V_5 V_0$
Sector E	$V_0 V_5 V_6 V_7 V_7 V_6 V_5 V_0$
Sector F	$V_0 V_1 V_6 V_7 V_7 V_6 V_1 V_0$

3. MODELLING AND SIMULATION OF TWO-LEVEL INVERTER

MATLAB/Simulink packed program is used to model and simulate the two-level inverter. Fig. 5 shows Simulink model of the whole drive system including a R-L load. “Angle Calculation” block in Fig. 5 calculates θ according to the demand inverter output frequency and modulation index. Then, the sector in which the vector falls into according to rules given in Table 1 is found by using the value of θ in “Sector Determination” block.

SVPWM block calculates the switching times according to Eq. 6 and Eq. 7 and it generates SVPWM signals as explained in Table 2.

Inverter block represents the two level inverter model using ideal switches. Three phases R-L load is modeled as shown in Fig. 5.

PV Panel generates VDC voltage input of two-level inverter and its model has been given in Fig. 6. Two photovoltaic cells are used for obtaining DC source of two-level inverter. Each cell produces 110V for 500W.

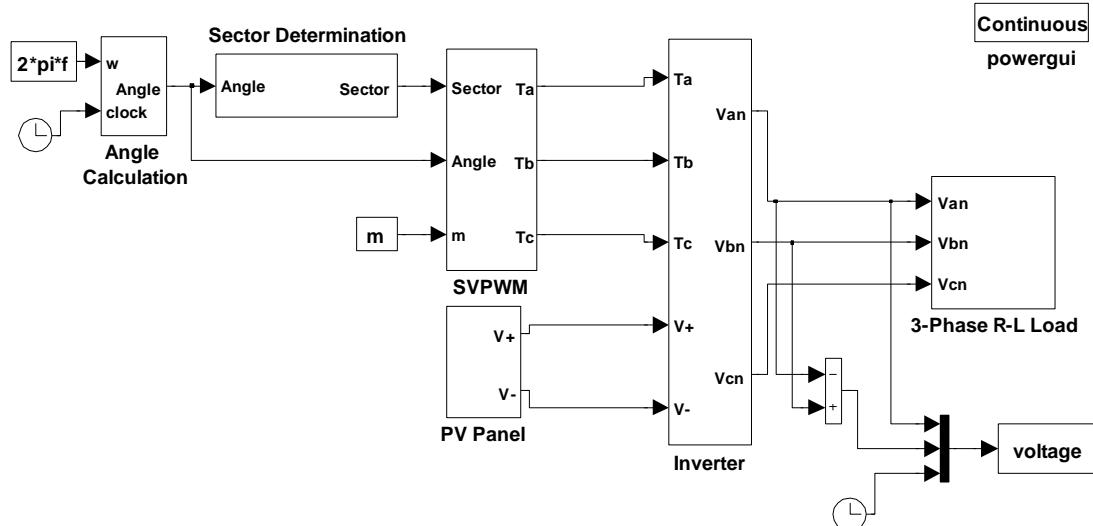


Figure 5. Simulation block of whole system.

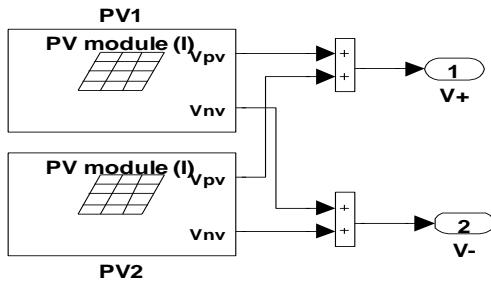


Figure 6. Structure of “PV Panel”

4. SIMULATION RESULTS

Simulation results have been taken for various operating conditions feeding a passive load for $R=100\Omega$ and $L=0.1H$. Switching frequency of 1kHz was used in the model. DC link voltage of the two-level inverter was taken as 220V from photovoltaic cells. Simulation results shown in Fig. 7 through Fig. 9 have been obtained for modulation index of 0.2 and output frequency of 10Hz. Fig. 7 illustrates output line voltage of the inverter (V_{ab}) which is applied to an R-L load. As can be seen the output voltage waveform has two levels. Corresponding single phase line current and three-phase line currents are shown in Fig. 8 and Fig. 9, respectively. Although 1kHz of switching frequency is used the current waveforms have sinusoidal shape.

The line voltage waveform and its frequency spectra are demonstrated in Fig.10. As can be seen the output voltage waveform has main harmonic at 10Hz. The other harmonics are around switching frequency.

The simulation has been repeated for an output frequency of 50Hz and modulation index of 0.8. The results for the line output voltage and single phase and three phase current waveforms are given in Fig. 11, Fig. 12 and Fig. 13, respectively.

The line voltage waveform and its frequency spectra are demonstrated in Fig.14 for 50 Hz output frequency. As can be seen the output voltage waveform has main harmonic at 50Hz. The other harmonics are around switching frequency.

5. CONCLUSION

In this paper a two-level inverter has been modelled and simulated using Simulink/MATLAB package program.

Simulation results have been given for various operating using 1 kHz switching frequency and a passive load. Photovoltaic cells are used for DC voltage supply of two-level inverter.

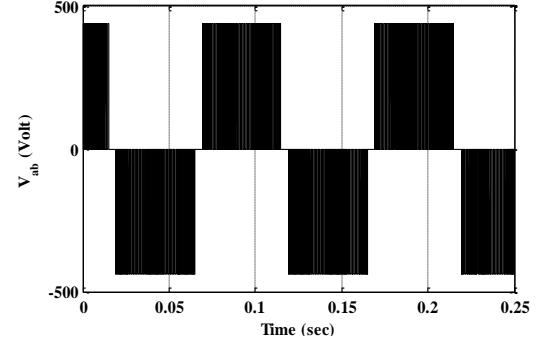


Figure 7. The line output voltage waveform for $f_0=10\text{Hz}$ and $m=0.2$

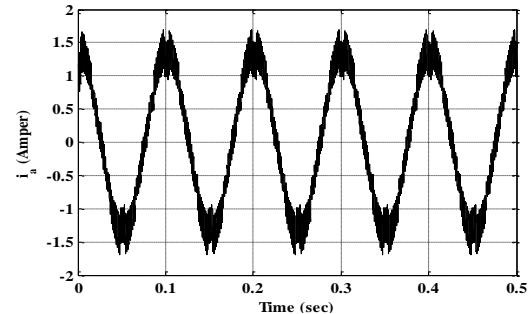


Figure 8. Single phase line output current waveform (i_a) for $f_0=10\text{Hz}$ and $m=0.2$

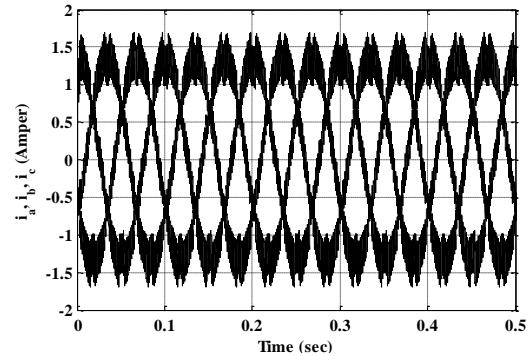


Figure 9. Three-phase line output current waveforms for $f_0=10\text{Hz}$ and $m=0.2$

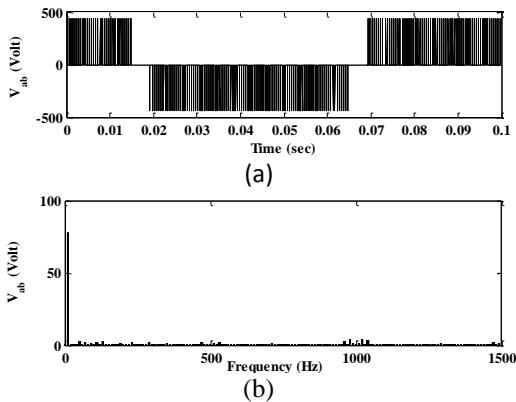


Figure 10. The line output voltage waveform and its spectrum for $f_o=10\text{Hz}$ and $m=0.2$

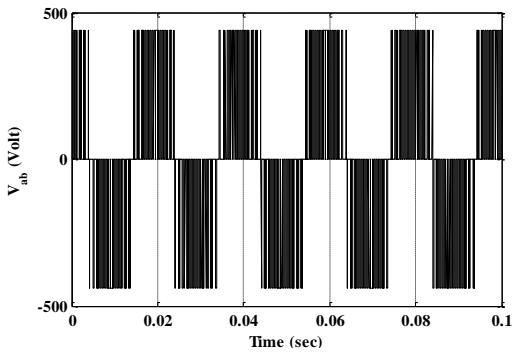


Figure 11. The line output voltage waveform for $f_o=50\text{Hz}$ and $m=0.8$

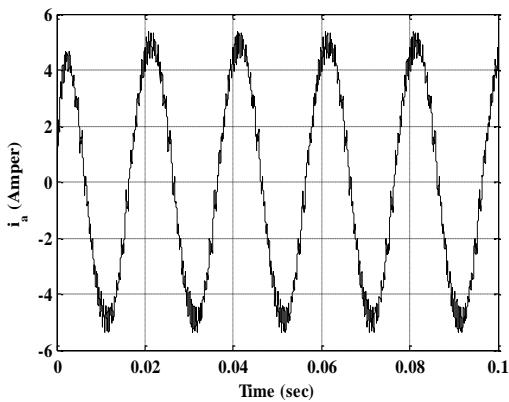


Figure 12. Single phase line output current waveform (i_a) for $f_o=50\text{Hz}$ and $m=0.8$

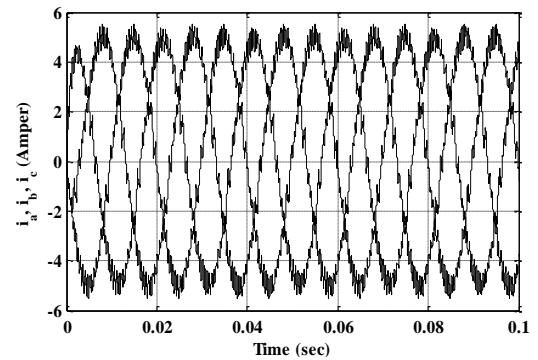


Figure 13. Three-phase line output current waveforms for $f_o=50\text{Hz}$ and $m=0.8$

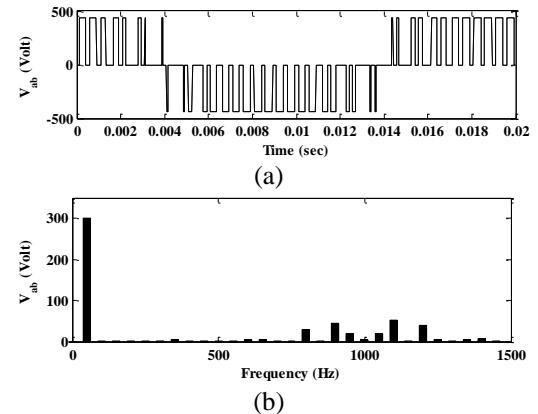


Figure 14. (a)-The line output voltage waveform (b)-its spectrum for $f_o=50\text{Hz}$ and $m=0.8$

The proposed control algorithm can be easily applied in the two-level inverter. It has been shown that high quality waveforms at the output of the two-inverter can be obtained even with 1kHz of low switching frequency. Photovoltaic cell is one of the most known renewable sources. It has very wide application area. In this work, it has been shown that photovoltaic cells can be used as DC source for inverters and it has efficient working area for power electronic applications.

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ANTIOXIDANT ACTIVITY OF ETHANOLIC EXTRACT FROM RUMEX CRISTATUS DC

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Abstract- Plants have been used for many years as a source of traditional medicine to treat various diseases and conditions. *R. cristatus* DC (*Polygonaceae*) is widely spread in Turkey and used as both herbal medicine and food. This study examined the antioxidant activities of ethanolic extract of *R. cristatus* DC using different tests. The antioxidant activity of ethanolic extract of *R. cristatus* leaves was analyzed for total phenolic, flavonoid, ascorbic acid and β -carotene contents, reducing power and DPPH radical scavenging activity. The results were compared with natural and synthetic antioxidants. The results suggest that consumption of *R. cristatus* DC can be beneficial effects due to its antioxidant properties

Keywords: Antioxidant activity, *Rumex cristatus* DC, free radicals, scavenging activity

1. INTRODUCTION

Free radicals play an important role in some pathogenesis of serious diseases, such as arteriosclerosis and cancer [1]. About 95% of the pathologies observed in people above 35 years of age are associated with production and accumulation of free radicals [2].

Consumption of various types of fruits and vegetables provides excellent health benefits because they are a rich source of phytochemicals that are good for disease risk reduction. High intake of fruits and vegetables has been reported to be associated with a lower incidence of chronic diseases such as cardiovascular disease [3, 4] and cancer [4, 5]. These health benefits are attributed to the antioxidant capacity derived from the phenolic compounds present in edible plants [6].

Phenolic compounds are constituents of both edible and nonedible parts of plants. Many have antioxidant activity, which delays the oxidation of various "important for life" compounds by inhibiting the initiation or propagation of oxidising chain reactions. Ascorbic acid and β carotene levels of the

extract as indicative of antioxidant capacity was aimed.

Natural antioxidants endogenous to food of plant origin can scavenge reactive oxygen and nitrogen species (RONS); evidence suggests that these may be of great importance in preventing the onset of oxidative diseases in the human body [7, 8].

The genus Rumex L., (*Polygonaceae*) is contains roughly 200 species, is widespread throughout the world and 23 species and 5 hybrids in Turkey [9]. The Rumex genus comprises several species, of which leaves and roots have been used in traditional medicine for inflammation, blood purification, constipation, purgative and tonic in Turkish traditional medicine [10]. Phytochemical screenings of Rumex species have revealed the presence of antroquinone derivatives, flavonoids, terpenes, organic acids and naphthalene derivatives [11].

In this study, we have investigated the antioxidant activity of the ethanolic extract from *Rumex cristatus* DC. The total phenolic and flavonoid contents were also determined to find out the relationship between free radical scavenging assays. Additional determination of water instead of plant extract

and same procedure applied respectively. Absorbances of the solutions measured by using a UV-vis.

MATERIAL AND METHODS

2.1. Chemicals

2-Deoxy-D-ribose, butylated hydroxyanisole (BHA), butylated hydroxytoluene (BHT), 3 - (2-pyridyl) - 5,6-bis (4-phenyl-sulfonicacid) - 1,2,4-triazine (ferrozine), 2,2'-azino-bis (3-ethyl benzothiazoline - 6 - sulfonic acid) diammonium salt (ABTS), 6-hydroxy-2,5,7,8-tetramethylchroman-2-carboxylic acid (Trolox), (+) catechin hydrate were purchased from Fluka Chemical Co. (Buchs, Switzerland). 2,2-diphenyl-1-picryl-hydrazyl (DPPH), α -tocopherol and pyrocatechol were obtained from Sigma Chemical Co. (St. Louis, MO, USA). Trichloroacetic acid (TCA), ferric chloride were obtained from Merck. All other reagents used in this study were of analytical grade.

Plant materials

R. cristatus DC leaves were collected in May from Avcilar campus area of Istanbul University and identified by Prof. Dr. Kerim Alpinar (Faculty of Pharmacy, Istanbul University). Leaves were washed with distilled water and dried at room temperature. Dried leaves were stored in a deep freeze at -20 °C.

2.3. Preparation of extract

Dried rumex leaves (25 g) were extracted by soxhlet extraction system with ethanol for 4 hours. The extract was then filtered and evaporated to dryness under reduced pressure and controlled temperature (40-50 °C) in a rotary evaporator. The extracts were kept in -20 °C until use.

2.4. Determination of total phenolic content

Total phenolic content of *Rumex cristatus* DC extract was determined according to Slinkard and Singleton method [12] with some slight modifications. 0.1 mL aliquots of diluted plant extract were transferred to test tubes. Then diluted with 4.5 mL of distilled water and 0.1 mL Folin-Ciocalteu reagent added. After 3

min 0.3 mL of 2 % Na₂CO₃ solution added to these mixtures. All the solutions were vortexed and allowed to stand in a dark place for 2 h. Blank solution is also prepared with 0.1 mL distilled spectrophotometer at 760 nm against blank. Total phenolic content of plant extract was calculated with the standard curve of pyrocatechol and expressed as μ g pyrocatechol equivalent. The samples were analyzed in triplicate.

Determination of Total Flavonoid Content

Total flavonoid content was measured using the previously developed method by Zhishen [13]. A 0.25 mL aliquots of *Rumex cristatus* extract were mixed with 1.25 mL distilled water and 75 μ L of 5 % NaNO₂ solution. Then incubated at room temperature for 6 min. After incubation 150 μ L of 10 % AlCl₃ solution added to each test tube. All the test tubes incubated again for 5 min, 0.5 mL of 1 M NaOH solution and 275 μ L distilled water added to the mixtures respectively. All the solutions vortexed and absorbance of the resulting solution was read at 510 nm against blank. Blank was prepared using distilled water instead of plant extract. Samples were analyzed in triplicate and flavonoid content expressed as μ g (+)-catechin equivalent.

2.6. Determination Of Ascorbic Acid Content

Ascorbic acid was determined according to the method of Omaye [14]. 5 mg of plant extract was extracted with 5 mL 1 % metaphosphoric acid solution for 45 min at room temperature and then filtered. The filtrate (2 mL) was mixed with 1 mL of 2,6-dichlorophenol indophenol solution (0.1 mg /mL) and absorbance was measured within 15 seconds at 520 nm against a blank. Content of ascorbic acid was calculated on the basis of the calibration curve of L-ascorbic acid. Ascorbic acid content of extract was calculated by using this standart curve. Result was expressed as μ g ascorbic acid per gram of plant extract.

Determination of β -carotene content

25 mg extract of ethanol is solved with 10 mL acetone-hexane mixture (4:6) , shaked for 1 min and then filtered. Absorbance of filtrate

was measured at 435, 505 and 663 nm [15]. The result of β -carotene content was calculated according to following formula;
 β -carotene (mg/100 mL plant extract) = (0.216 x A663) - (0.304 x A505) + (0.452 x A453)

2.8. Reducing power

The reducing power of extract was determined according to the method described of Oyaizu [16]. 1 mL of various concentrations of *R. cristatus* water extracts were mixed with 2.5 mL of 200 mmol/L phosphate buffer (pH 6.6) and 2.5 mL of 1% potassium ferricyanide solution. The mixture was incubated at 50°C for 30 min. After the incubation 2.5 mL of trichloroacetic acid (10 % , w/v) was added. Then vortexed and centrifuged at 3000 rpm for 10 min. 2.5 mL of the supernatant was mixed with 2.5 mL of distilled water and 0.5 mL of ferric chloride 0.1 %. The absorbance was measured at 700 nm, higher absorbance indicates higher reducing power. α -Tocopherol acetate were used as standart antioxidant.

2.9. DPPH radical scavenging activity

To determine the hydrogen donating ability of the extract a method based on the reduction of a methanolic solution of the coloured free radical DPPH to the nonradical form was used.

The DPPH (1,1-diphenyl-2-picrylhydrazyl) radical scavenging activity was determined by the method of Brand-Williams [17]. Briefly, 1.5 mL of 20 mg/L DPPH radical in methanol solution was put into test tubes, then 0.75 mL of plant extract at various concentrations added. The mixture was shaken vigorously and allowed to stand in the dark at room temperature for 5,10,30,60 min. The decrease in absorbance of the resulting solution was then measured spectrophotometrically at 517 nm against methanol. The ability to scavenge DPPH radical was calculated by using the formula:

$$\text{DPPH radical scavenging activity (\%)} = (A_0 - A_1 / A_0) \times 100$$

where A_0 is the absorbance of DPPH• in methanol solution without an antioxidant, and A is the absorbance of DPPH• in the presence

of an antioxidant. Synthetic antioxidants; BHA and BHT used as standarts.

2.10. Hydroxyl radical scavenging activity

The effect of extract on hydroxyl radicals was assayed by using the deoxyribose method [18].

The reaction mixture contained 0.45 ml of 0.2 M sodium phosphate buffer (pH 7.4), 0.15 ml of 10 mM 2-deoxyribose, 0.15 ml of 10 mM FeSO₄-EDTA, 0.15 ml of 10 mM hydrogen peroxide, 0.525 ml of distilled water and 0.075 mL of extract solution in a tube. The reaction was started by the addition of hydrogen peroxide. After incubation at 37°C for 4 h, the reaction was stopped by adding 0.75 ml of 2.8 % TCA and 0.75 ml 1.0 % of thiobarbituric acid. The mixture was boiled for 10 min, cooled in an ice bath and then measured at 520 nm. Hydroxyl radical scavenging activity was calculated in the following equation:

$$\text{Hydroxyl radical scavenging activity (\%)} = (A_0 - A_1 / A_0) \times 100$$

A_0 is the absorbance of the control reaction,
 A_1 is the absorbance of sample.

3. RESULTS AND DISCUSSION

3.1. Total Phenolic, Total Flavonoid, B-Carotene And Ascorbic Acid Content

Herbs, fruits, spices and vegetables are important natural antioxidant [19]. Their antioxidant activity has been attributed to the presence of polar phenolic compounds. Many phenolic compounds have been attributed an array of health-promoting benefits, and they are of current interest due to their important biological and pharmacological properties, especially the antioxidant, antiinflammatory, antimicrobial, anti-allergenic, antimutagenic, anticarcinogenic, cardioprotective and vasodilatory effects [20]. The total phenolic content of *R. cristatus* ethanol extract was shown in Table 1. Total phenolic content of the extract obtained from leaves of the *R. cristatus* was determined using Folin-Ciocalteu colorimetric method by using the regression equation of pyrocatechol calibration curve. The amount of phenolics per each extract concentration was expressed as pyrocatechol equivalent. The results obtained

from the assay were expressed as means standard deviation of triplicate analyses and are presented in Table 1. Variations in total phenolic contents among the investigated *R. cristatus* extracts increased with increasing concentration. The highest total phenolic content (32.22 ± 5.34 mg pyrocatechol/mL) was found at the highest concentration. Phenolic compounds may indicate that the high antioxidant activity of *R. cristatus* extract may be associated with its total phenolic content.

Table 1. Total phenolic compounds (TPC) as pyrocatechol equivalents and Total flavonoids as catechin equivalents of ethanol extract from *Rumex cristatus* DC

Extract	TPC as pyrocatechol µg/mL	Flavonoids as catechin equivalents (µg/mL)*
concentration	pyrocatechol equivalents (µg/mL)*	catechin equivalents (µg/mL)*
1000	7.69 ± 2.58	32.94 ± 31.36
2000	22.10 ± 6.74	93.66 ± 47.43
3000	24.25 ± 4.41	128.96 ± 24.48
4000	32.22 ± 5.34	218.24 ± 92.50

*Mean ± SD

Flavonoids are the most common and widely distributed group of plant phenolic compounds, which usually are very effective antioxidants [22]. Flavonoids, including flavanols, flavones and condensed tannins, are plant secondary metabolites. Therefore dietary intake of flavonoid-containing foods was suggested to be of benefit for the preservation from free radical damage. Consumption of the flavonoid-containing fruits and vegetables has been linked to protection against cancer and heart disease [23]. We found flavonoid content of *R. cristatus* ethanol extract as

218.24 ± 92.50 µg/mL as catechin equivalent (Table 1). The results revealed that ethanolic extract of *R. cristatus* contains significant amount of phenols and flavanoids.

Small molecular weight antioxidants, such as ascorbic acid and carotenoids also play important roles in preventing free radical damage. Ascorbic acid is one of the most important water soluble antioxidants in cells, efficiently scavenging reactive oxygen species such as superoxide, hydroxyl radicals and singlet oxygen, also vitamin C was shown to act as a chain breaking scavenger for peroxy radicals. Carotenoids are very powerful antioxidant agents involved in the scavenging of two of the reactive oxygen species, singlet oxygen and peroxy radicals. A number of epidemiological studies have revealed that an increased consumption of a diet rich in ascorbic acid and carotenoids is correlated with a diminished risk for several degenerative disorders, including various cancer, cardiovascular and various different diseases [24, 25].

In this study, ascorbic acid content of *Rumex* extract was found as 114.53 ± 5.58 µg/g. β-carotene content in our plant extract was found as 0.66 ± 0.05 mg/100 mL.

3.2. DPPH radical scavenging activity

The scavenging of the stable DPPH radical was widely used to evaluate antioxidant activity of phenolic compounds extracted from fruit, vegetable, cereal grain, wine, etc. [26]. It is based on the measurement of the reducing ability of antioxidants toward DPPH [27, 28]. The method is based on the reduction of methanolic DPPH solution in the presence of a hydrogen donating antioxidant, due to the formation of the non-radical form DPPH-H by the reaction. The extract was able to reduce the stable radical DPPH to the yellow-coloured diphenylpicrylhydrazine. Fig 1. shows, the dose response curves of DPPH radical scavenging activity of the extract from *R. cristatus*. The extract was capable of scavenging DPPH radicals in a concentration-dependent manner. BHA, and BHT were used as references for radical scavengers. The scavenging activity of *R. cristatus*, BHA, and BHT on DPPH radicals increased between 12.5-50 µg/mL concentrations. Extract showed the highest radical scavenging activity at 60 min. DPPH radical scavenging activity

of ethanol extract (% 25.75) is lower than the standards used BHA (% 83.75) and BHT (% 52.05) for 60 min. However, we found a good correlation between total phenolic content and DPPH radical scavenging activity. Correlation values of 5,10,30,60 min are ($r^2= 0.978$, 0.988 , 0.951 and 0.992) respectively. The scavenging effect increased with increasing concentration of the extract. Scavenging abilities on DPPH radicals were in descending order: BHA > BHT > ethanolic extract.

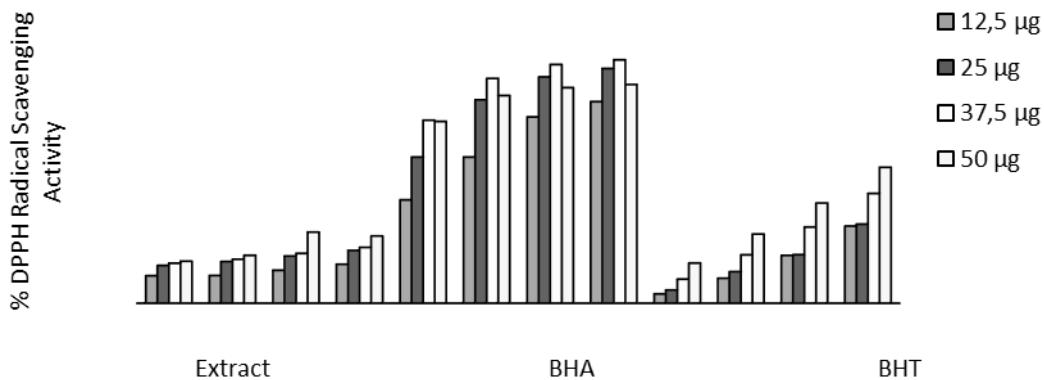


Figure 1. DPPH radical scavenging activity of the ethanol extract from *Rumex cristatus* DC. BHA and BHT were used as reference antioxidants.

This suggested that scavenging effect of *R.cristatus* extract may depend on hydrogen atom donating by the different polyphenolic and flavonoid compounds and their hydrogen donor capacity, most probably accounts in large part for the antioxidant activity and may provide a basis for the pharmacological activity and therapeutic applications of this extract.

3.3 Reducing power

The principle behind reducing power assay is based on its electron donating activity, which is an important mechanism of phenolic antioxidant action [29]. The reducing ability

of *R. Cristatus* extract was measured and was found to increase with increasing concentration of plant extract (Fig 2). The striking aspect of deoxyribose assay is that it involves the hydroxyl radical which is the most active reactive oxygen species [30]. The effect of extracts and fraction in scavenging OH radicals to prevent oxidative degradation of deoxyribose substrate was determined. The reducing ability of extract, in the range 0–200 µg/mL, was greater than that of α -tocopherol acetate. The total phenolic content was correlated with reducing power for ethanol extract and correlation value of extracts was found ($r^2= 0.949$).

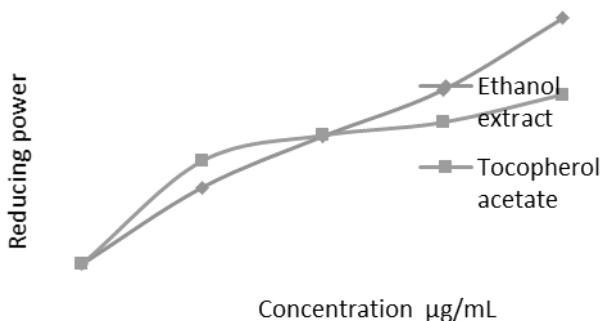


Figure 2. Reducing power of ethanol extract from *R. Cristatus*

3.4. Hydroxyl Radical Scavenging Activity

Hydroxyl radical is the most reactive among ROS and possesses the shortest half-life period. Hydroxyl radical causes oxidative damage to DNA, proteins, lipids [31]. The effect of *R. cristatus* on inhibition of free radical-mediated deoxyribose damage was assessed by means of the Fe²⁺ dependent DNA damage assay. The Fenton reaction generates hydroxy radical, which degrades DNA deoxyribose, using Fe²⁺ salts as a catalyst. Hydroxy radical may attack DNA either at the sugar or the base, giving rise to toxic products. Fig. 3 shows, the dose response curves of radical scavenging activities of the extract and reference antioxidants on the hydroxyl radicals and can be formed from superoxide anion and hydrogen peroxide in the presence of metal ions such as copper or iron. Rumex extract scavenged hydroxyl radicals by 22.37 ± 11.63 % at 300 μg/ml. Tocopherol acetate exhibited higher scavenging activity of 35.76 ± 8.94 % at a concentration of 300 μg/ml. These results suggested that *R. cristatus* extracts might be used to provide a hydroxyl radical scavenger for humans.

4. CONCLUSION

Several reports have conclusively shown close relationship between total phenolic contents and antioxidative activity of the fruits and vegetables [32]. Since the chemical composition and structures of active extract components are important factors governing the efficacy of natural antioxidants, the antioxidant activity of an extract could not be explained on the basis of their phenolic content, which also needs their characterization [33]. These results from various free radical-scavenging systems revealed that the *R. cristatus* DC had significant antioxidant activity and free radical-scavenging activity.

Therefore the leaves of *R. cristatus* could be a good source of antioxidant phenolics. Thus, it can be concluded that ethanol extract can also be used as an accessible source of natural antioxidants with consequent health benefits. Further in vivo studies are needed for a better understanding of their mechanism of action as antioxidant. The findings of this work are useful to further research to identify, isolate and characterize the specific compound which is responsible for higher antioxidant activity.

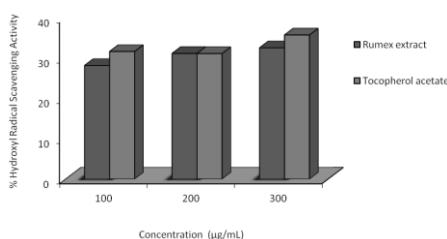


Fig 3. Hydroxyl radical scavenging activity of the ethanol extract from *R. cristatus*.

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FEATURE EXTRACTION BASED WAVELET TRANSFORM IN BREAST CANCER DIAGNOSIS USING FUZZY AND NON-FUZZY CLASSIFICATION

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Abstract- This study helps to provide a second eye to the expert radiologists for the classification of manually extracted breast masses taken from 60 digital mammograms. These mammograms have been acquired from Istanbul University Faculty of Medicine Hospital and have 78 masses. The diagnosis is implemented with pre-processing by using feature extraction based Fast Wavelet Transform (FWT). Afterwards Adaptive Neuro-Fuzzy Inference System (ANFIS) based fuzzy subtractive clustering and Support Vector Machines (SVM) methods are used for the classification. It is a comparative study which uses these methods respectively. According to the results of the study, ANFIS based subtractive clustering produces ??% while SVM produces ??% accuracy in malignant-benign classification. The results demonstrate that the developed system could help the radiologists for a true diagnosis and decrease the number of the missing cancerous regions or unnecessary biopsies.

Keywords: Breast cancer, Fuzzy subtractive clustering, ANFIS, Wavelet transform, Support vector machines

1. INTRODUCTION

Breast cancer is among the most life-threatening cancer especially in developed countries nowadays. The death rate is exceedingly growing because of the late detection. Early detection of breast cancer provides patients the chance to recover. The most widely used imaging method in the diagnosis of breast cancer is digital mammography. It is very crucial to detect both the malignant and benign masses accurately in the mammograms. In some situations due to small masses or thick breast tissue the expert radiologists may miss the suspicious regions and so the diagnosis can fail. To deal with this problem computer aided studies are implemented so far. In Sung J. et al, [1] developed a system for the classification of mammographic masses as malignant or benign by adaptive k-means and ANFIS LVQ method. They achieved a classification accuracy of 86.6 %, and raised it by ANFIS LVQ method to %87.6. In their study they used backpropagation unsupervised learning method in ANFIS. Görgel P. [2] developed a system to diagnose the breast cancer. In this study Spherical Wavelet Transform (SWT) was used to obtain the features of the masses

Support Vector Machines (SVM) for the diagnosis. According to the mass-tissue classification she achieved 96% accuracy rate and the number of the false positives per image was 0.05. The highest sensitivity was 88% and specificity was 98%. A CAD system was developed by Delogu et al. [3] for the classification of mammographic masses as malignant or benign. They used twelve features based on shape, intensity and size of the segmented masses. In the study by Rangayyan et al. [4] combined speculation index, three shape factors, fractional concavity and compactness and achieved classification accuracy of 81.5%. Cascio et al. [5] used geometrical features about shape parameters for each region of interest to classify the masses. They used supervised neural network which achieved a sensitivity value of 82%. Tralic et al. [6] calculated three shape factors, namely Fourier descriptors, compactness and moments. Classification was performed using both single layer and multilayer perceptron neural networks and the highest accuracy was 91.5%.

This paper is organized as follows: In Section II, Fast Wavelet Transform which is used before the feature extraction is explained. Furthermore subtractive clustering method,

ANFIS architecture and SVM are stated. In Section III the data set of mammogram masses is mentioned and the obtained experimental results are presented and discussed. Finally Section IV draws the conclusion and gives some final remarks.

2. MATERIALS AND METHODS

2.1. Pre-Processing for Classification

2.1.1. Fast Wavelet Transform (FWT)

Wavelets are counted as a powerful signal processing foundation of Mallat [7] in 1987. The Fast Wavelet Transform is a computationally efficient form of the discrete wavelet transform (DWT) [8]. It is a multi-resolution analysis method that provides frequency decomposition of the images or signals using scaling ($\varphi_{j,k}(x)$) and wavelet ($\psi_{j,k}(x)$) functions.

$$\varphi_{j,k}(x) = 2^{j/2} \varphi(2^j x - k) \quad (1)$$

$$\psi_{j,k}(x) = 2^{j/2} \psi(2^j x - k) \quad (2)$$

In the above equations j and k determines the scaling and wavelet functions' width and the position respectively while the value $2^{j/2}$ controls the amplitude. (3) and (4) illustrate the approximation and detail coefficients respectively in the two-dimensional wavelet transform. $f(x,y)$ is used for the image and m and n are for the image size. The index i is H for horizontal, V for vertical and D for diagonal details.

$$W_\varphi(j,m,n) = \frac{1}{\sqrt{MN}} \sum_{x=0}^{M-1} \sum_{y=0}^{N-1} f(x,y) \varphi_{j,m,n}(x,y) \quad (3)$$

$$W_\psi^i(j,m,n) = \frac{1}{\sqrt{MN}} \sum_{x=0}^{M-1} \sum_{y=0}^{N-1} f(x,y) \psi_{j,m,n}^i(x,y) \quad (4)$$

The FWT is implemented via digital filters and downsamplers as formulated in (5) and (6). After a FWT, four sub-images one of which is the approximation image and the others are

horizontal, vertical and diagonal detail images are obtained. Low pass ($h_\varphi(n)$) and high pass ($h_\psi(n)$) filters are used for the approximation and detail coefficients respectively. After the filtering step, downsampling is implemented for the scale changing as seen in Fig. 1. The fast wavelet transform is continued until the sub-images reach the optimum contrast.

$$W_\psi(j,k) = h_\psi(n) * W_\varphi(j+1,n) \quad (5)$$

$$W_\varphi(j,k) = h_\varphi(n) * W_\varphi(j+1,n) \quad (6)$$

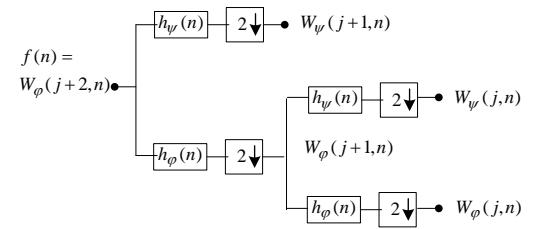


Figure 1. A two scale Fast Wavelet Transform

2.1.2. Feature Extraction

In this study we extract some features about the mass size, geometrical shape and boundary after applying the FWT. The preferred features related with size are as follows (Table I): In a region *Area* is the actual scalar number of pixels, *Centroid* is the center and *BoundingBox* is the smallest rectangle containing the region. *Filled Area* is the number of on pixels in filled image and *Equiv Diameter* ($\sqrt{4 * Area / \pi}$) is the diameter of a circle with the same area as the region. The features related with geometrical shape are as follows: *Euler Number* is the number of objects in the region minus the number of holes in those objects and *Extrema* is the extremal points in the region. *Convex Hull* is the smallest convex polygon that can contain the region. *Solidity* is the proportion of the pixels in the convex hull that are also in the region. Finally the features related with the boundary are as follows: *Major Axis Length* is the length (in pixels) of the major axis of the ellipse that has the same second-moments as the region while *Minor Axis Length* is the length (in pixels) of the minor axis of the ellipse that has the same second-moments as the region.

Table I. Extracted features

Area	Bounding Box
Centroid	Filled Area
Extrema	Convex Hull
Eccentricity	Major Axis Length
Orientation	Minor Axis Length
Symmetry	Mean Center-Border Distance
Solidity	Equiv Diameter
Extent	Euler Number

Eccentricity is the eccentricity of the ellipse that has the same second-moments as the region and it is the ratio of the distance between the foci of the ellipse and its major axis length. *Orientation* means the angle (in degrees) between the x-axis and the major axis of the ellipse that has the same second-moments as the region. *Extent* represents the proportion of the pixels in the bounding box that are also in the region. We also develop two further features which one is boundary based *Mean Center-Border Distance* representing the similarity between a circle and the mass and the other is shape based *Symmetry*. These calculated numeric features listed below provide feature matrices to the fuzzy inference system.

2.2. Classification and Diagnosis

2.2.1 Fuzzy subtractive clustering

The subtractive clustering is used to determine the number of clusters of the data being proposed, and then generates a fuzzy model [9]. The purpose of this algorithm is to estimate both the number and initial locations of cluster centers [10]. The subtractive clustering method partitioned the training data into groups called clusters. By the end of clustering, a set of fuzzy rules will be obtained. The FIS is generated with minimum number of rules. The clustering is carried out in a multidimensional space; the related fuzzy sets must be obtained. Let the cluster set be Z_1, Z_2, \dots, Z_n for n data. The subtractive clustering algorithm steps are as follows:

- The initial potential value for each data point (Z_i) as in (7) is computed.

$$P_i = \sum_{j=1}^n e^{-d(Z_i - Z_j)} \quad (7)$$

In (7) d is equal to $4/r^2$ where r is the neighborhood for each cluster. If the point falls outside this neighborhood region it has little influence to the potential value.

A point is the first center if its potential value $P(1)$ is equal to the maximum of initial potential value

$(P(1))^*$ as demonstrated in (8).

$$(P(1))^* = \max(P(1)(Z_i)) \quad (8)$$

A threshold (δ) is defined for the decision to continue or stop the cluster center search.

$$\delta = \mu \times P(1)^* \quad (9)$$

In (9) μ is the reject ratio and $P(1)^*$ is the potential value of the first cluster center.

The previous cluster center from further consideration is subtracted and the remaining points' potential values are adjusted using (10).

$$P_i = P_i - P(k)^* e^{-d(Z_i - Z_k^*)^2} \quad (10)$$

Where Z_k^* the point of the kth is cluster center and $P(k)^*$ is its potential value. This procedure is continued until the maximum potential value in the current iteration is equal to or less than the threshold δ .

2.2.2. ANFIS Architecture

The ANFIS is the abbreviated of adaptive neuro-fuzzy inference system [11]. This method is a fuzzy inference system (FIS) using a backpropagation tries to minimize the Root Mean Square Error (RMSE). As in the artificial neural network systems the input passes through the input layer (by input membership function) and the output could be seen in output layer. The fuzzy rules are learned by the system with through the training process of the ANFIS. Assume that the considered FIS has two inputs x and y and one output f (Fig. 2). For Sugeno fuzzy model, a common rule set with two fuzzy if-then rules is as follows:

Rule 1: If x is A_1 and y is B_1 , then
 $f_1 = p_1x + q_1y + r_1$

Rule 2: If x is A_2 and y is B_2 , then
 $f_2 = p_2x + q_2y + r_2$.

The necessary processes are implemented in five layers as seen in Fig. 3 and the overall output is calculated.

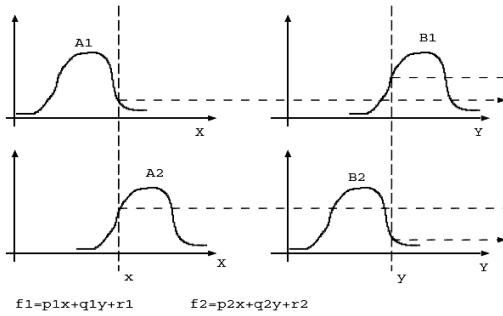


Figure 2. Sugeno fuzzy model

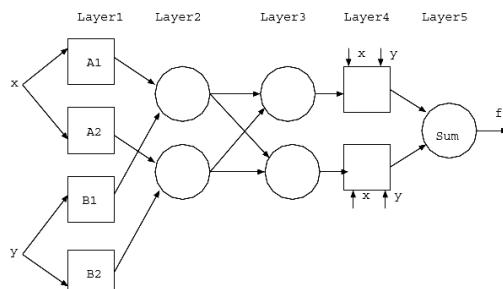


Figure 3. ANFIS architecture with two inputs and an output

2.2.3. Support Vector Machines (SVM)

Support Vector Machine (SVM), introduced by V. Vapnik in 1995 [12], is a method to estimate the data classification function [13]. The basic idea of SVM is to construct a hyperplane as the decision surface in such a way that the margin of separation between positive and negative examples is maximized [14]. A classification task usually involves separating data into training and testing sets. Each instance in the training set contains one target value and several attributes. The goal of SVM is to produce a model (based on the training data) which predicts the target values of the test data given the test data attributes only. SVM uses a kernel function in which the nonlinear mapping is implicitly embedded. In Cover's theorem, a function can be considered as a kernel provided that it satisfies Mercer's

conditions [15]. The following relation should be maximized to optimize the SVM classifier boundary in a given training set of instance-label pairs $(x_i, y_i), i=1, \dots, l$ where $x_i \in R^n$ and $y \in \{1, -1\}^l$:

$$L(c) = \sum_{i=1}^l c_i - \frac{1}{2} \sum_{i,j=1}^l y_i y_j c_i c_j K(x_i, x_j), \quad 0 \leq c_i \leq P \quad (11)$$

While

$$\sum_{i=1}^l y_i c_i = 0, \quad w = \sum_{i=1}^N c_i y_i x_i, \quad c_i [y_i (w^T x_i + b) - 1 + \xi_i] = 0 \quad (12)$$

where P is a user-specified positive parameter to control tradeoff between the SVM complexity and the number of non-separable points, l shows number of samples and $K(x_i, x_j)$ is the SVM kernel. Here a solution to $c = (c_1, c_2, \dots, c_l)$ is obtained where c_i is a Lagrange coefficient. The slack variables ξ_i are used to relax the constraints of the canonical hyperplane equation. In a typical SVM the kernel function plays an important role in implicitly mapping the input vector into a high-dimensional feature space, in which better separability can be achieved.

2.3. Proposed Algorithm

Firstly both of the malignant and benign masses are passed through a two scale FWT in the classification of breast masses. Because it has been experienced that the sub-images become too blurred after the second scale decomposition. We obtain 8 different coefficient matrices using a two scale FWT. These are approximation (A), horizontal (H), vertical (V) and diagonal (D) coefficient matrices for the first and second scales labeled $A_1, H_1, V_1, D_1, A_2, H_2, V_2$ and D_2 . Since the first scale detail coefficients are generally composed of poor information, only the mean of those matrices ($M(H_1, V_1, D_1)$) is used. Consequently, six coefficient matrices are used totally for each mass. The next step feature extraction is applied to those matrices separately. The pre-processed mass images are then classified for diagnosis. For the classification subtractive clustering based ANFIS and SVM methods are implemented respectively to make a

comparison. The flow chart of the proposed algorithm is illustrated in Fig. 4.

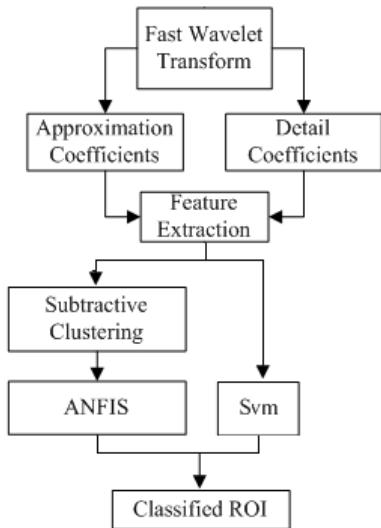


Figure 4. The flow chart of the proposed method.

In fuzzy subtractive – ANFIS method, the fuzzy rules are trained maximum 50 epochs until RMSE converges to zero. A reject ratio of 0.5 is used and the radius is specified as 0.6. In Eq.13 x_i , y_i and N demonstrate targets, outputs and data size respectively in the ANFIS.

$$RMSE = \sqrt{\frac{\sum_{i=1}^N (x_i - y_i)^2}{N}} \quad (13)$$

3. THE DATASET AND EXPERIMENTAL RESULTS

The digital mammogram dataset used for this study consists of 35 malignant and 43 benign masses (Fig. 5,6). The mammograms are acquired from the patients of Istanbul University Faculty of Medicine Hospital in Turkey.

Table II. Number of the masses in training and test sets

	Train set	Test set
Malignant	23	12
Benign	29	14

The malignant and benign masses have been pre-extracted by a radiologist manually. One-third of the data set (26 masses) was used for testing and the others were used for training. 14 masses are benign and the others are malignant among 26 test masses (Table II). Using these data sets 47 fuzzy rules are extracted in the whole test process. Before the ANFIS training process the initial error was 0.14. As seen in Table III, when the network is trained 50 epochs which produce best classification, the training error is decreased to 0.012 and the classification accuracy reaches to 92%. If the epoch number is increased or decreased, the error changes but the accuracy becomes stable at 88% each time. In Table IV the confusion matrices are given obtained after different training epochs.

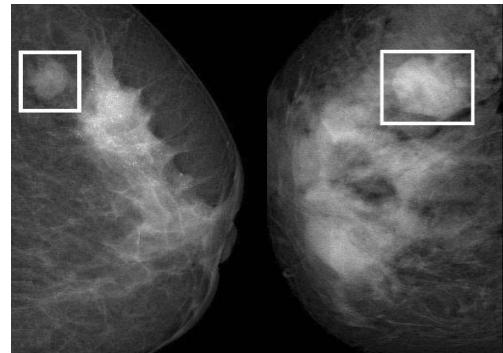


Figure 5. Samples from the dataset with framed benign masses

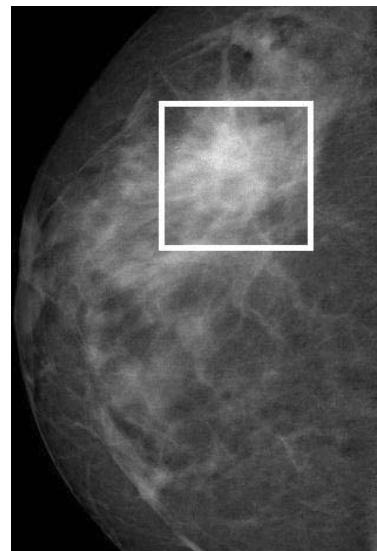


Figure 6. Samples from the dataset with framed malign mass

Table III. Experimental results of the Fuzzy Subtractive - ANFIS method. (Tr.Ep. : Training epoch, Tr. Err. : Training error, A_z : Area under the ROC curve, Sen.(Rec.) : Sensitivity (Recall), Spe. : Specificity, Pre. : Precision, FMs. : FMeasure, Acc. %: Accuracy)

Tr. Ep.	Tr. Err.	A_z	Sen. (Rec.)	Spe.	Pre.	FMs.	Acc. %
20	0.041	0.88	75	100	100	86	88
30	0.032	0.88	83	93	91	87	88
40	0.024	0.89	100	79	80	89	88
50	0.012	0.93	100	86	86	92	92
60	0.020	0.89	100	79	80	89	88
70	0.028	0.89	92	86	85	88	88
80	0.035	0.88	83	93	91	87	88

Table IV. Confusion matrix of the Fuzzy Subtractive - ANFIS method (Tr.Ep.: Training epoch, TP: True Positives, TN: True Negatives, FP: False Positives, FN: False Negatives)

Tr. Ep.	Tr. Ep.	Tr. Ep.	Tr. Ep.	Tr. Ep.	Tr. Ep.	Tr. Ep.	
20	30	40	50	60	70	80	
TP	9	10	12	12	12	11	10
TN	14	13	11	12	11	12	13
FP	0	1	3	2	3	2	1
FN	3	2	0	0	0	1	2

Additionally SVM method with 3-fold cross validation is applied to the pre-processed masses. The comparative results are demonstrated in Table V-VI.

Table V. The comparative results (Sensitivity (Recall), Spe.: Specificity, Pre. : Precision, FMs. : FMeasure, Acc. %: Accuracy)

	Sen. (Rec.)	Spe.	Pre.	FMs.	Acc. %
Fuzzy Subtractive ANFIS	100	86	86	92	92
SVM	92	85	86	89	88

Table VI. Confusion matrix of two methods (TP: True Positives, TN: True Negatives, FP: False Positives, FN: False Negatives)

	TP	TN	FP	FN
Fuzzy Subtractive ANFIS	12	11	2	1
SVM	12	12	2	0

4. CONCLUSION

Computer aided diagnosis systems used for medical decision provide medical data to be examined in shorter time and in more detail and early diagnosis. The research presented in this article aims to decrease the mortality rate related to breast cancer by reducing the number of malignant masses which radiologists may miss by means of computer aided techniques. We developed a program in MATLAB 7.6 using FWT and feature extraction for pre-processing. Fuzzy subtractive clustering based ANFIS and SVM methods were used respectively for the classification as malignant or benign. According to the results the best accuracy is performed as 92% by fuzzy subtractive based ANFIS with 50 epochs. On the other hand the highest accuracy of the SVM method is 88%. The performance difference depends to the ANFIS architecture which enables the system to learn the problem until the error decreases to a desired value. Consequently one can see that this method is efficient for solving the real world problems related with breast cancer diagnosis using FWT multi-resolution decomposition and ANFIS rule extraction and learning methods. The satisfying performances demonstrates that this study is valuable to improve early diagnosis and reduce the number of unnecessary biopsies.

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COMPUTABILITY OF DESIGN BY MEANS OF ITS COGNITIVE CONTENT

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Abstract-*Design activities based on intuition and induction cannot, presently, be substituted by computational means. Computers can only assist designers by providing examples, precedents, case studies, prototypes and their derivatives adapted specifically to the context of the problem. However choosing and adapting the appropriate solution remains a human prerogative. The failure to automate design as a whole is due, in a large measure, to the difficulty of finding computational means that can support learning, creativity, and judgment, which comprise much of the cognitive aspects of design. Computer support for innovative design must overcome the problem that designers necessarily make extensive use of situated tacit understanding while computers can only store and display explicit representations of information. This paper aims to understand tacit to explicit knowledge transformations in computed aided architectural design process.*

Keywords: Tacit / explicit knowledge, design knowledge, design process, computability of design, knowledge based computer aided design

1. INTRODUCTION

Architectural Design is much more integrated with computer, than it was twenty years ago. Computation directs the whole part of the process. But this method brings us many problems to deal with. One of the most important issue is how to tackle with the tacit / explicit knowledge transformations. There has been many researchers pointing out this problem. Gerry remarked that computer support for innovative design must overcome the problem that designers necessarily make extensive use of situated tacit understanding while computers can only store and display explicit representations of information. The automation techniques used for routine design are not applicable: techniques are needed to support creative, tacit human understanding with explicit computer representations. [Stahl, p.3] Likewise, in their book "Knowledge-Based Computer-Aided Architectural Design" editors Carrara and Kalay pointed out that design activities based on intuition and induction cannot, presently, be substituted by computational means. Computers can only assist designers by providing examples, precedents, case studies, prototypes and their derivatives adapted specifically to the context

of the problem. However choosing and adapting the appropriate solution remains a human prerogative [Carrara, Kalay, p.151]. They address the difficulty of finding computational means that can support learning, creativity, and judgment, which comprise much of the cognitive aspects of design.

Cognition in architectural design process is the central issue for computation, pointing out in this paper. Challenge for understanding the many facets of design has been the target in attempting to computationally define design processes and knowledge. [Kalay, Swerdlof, p. 47]

In means of computation, the most used tools are CAD programs in architecture. From education to professional life their extended use shapes the contemporary architecture. But while these programs exhibit remarkable levels of compactness, efficiency, sophistication, and power unthinkable only a few years ago, they fail to support the cognitive aspects of design. In fact, the use of current CAD tools forces architects to use a more precise and systematic mode of design, which follows the logic and methodology offered by available software, rather than a model more suitable for the non-deductive,

often irrational and not easily computable architectural design process [Carrara, Kalay, p.393].

Nigel Cross in his book “Designerly Ways of Knowing” also points out the importance of cognition in architectural design. He mentions where the goal is to develop interactive systems that support designers, then knowledge of the human designer’s cognitive behaviour obviously is of fundamental importance, because the users of the interactive systems (that is designers) must be able to use them in ways that are cognitively comfortable. So the systems must be designed on the basis of models of the cognitive behaviour of the system uses. [Cross, p.40]

2. KNOWLEDGE FOR ARCHITECTURE

In order to deal with knowledge representation in computation, first it would be useful to understand the process of architectural design. The process of architectural design aims to define a physical form that will achieve certain functional and behavioral objectives in a particular context. It comprises three distinct, but highly interrelated, operations:

Definition of the desired objectives

Production of alternative design solutions

Evaluation of the expected performances of the solutions and comparing them to the predefined objectives. [Carrara, Kalay, p. 147] Likewise Cross defines 5 aspects of designerly way of thinking as follows:

Designers tackle ill defined problems.

Their mode of problem solving is solution focused.

Their mode of thinking is constructive.

They use codes that translate abstract requirements into concrete objects.

They use these codes to both read and write in object languages. [Cross, p. 12]

According to Mitchell, It is useful to regard architectural design as a special kind of problem-solving process, and to discuss design within the framework of a general theory of problem-solving. The view of problem-solving that will be introduced is one which has gained wide currency in recent years. It assumes that we can construct some kind of a representation of a system that interests us, and that problem solving can be characterized as a process of searching through alternative states of the representation

in order to discover a state that meets certain specified criteria. This view is not without its limitation, but it provides an appropriate starting point for discussion. [Mitchell, p.27]

2.1. Explicit and Tacit Knowledge In Design

Knowledge can be classified broadly as either explicit or tacit. The dictionary (Merriam-Webster, 1991) provides the following definitions:

Tacit knowledge; expressed or carried on without words or speech; implied or indicated but not actually expressed.

Explicit knowledge; fully revealed or expressed without vagueness, implication, or ambiguity; leaving no question as to meaning or intent; verbal plainness and distinctness such that there is no need for inference and no room for difficulty in understanding.

Explicit knowledge consists of facts, rules, relationships and policies that can be faithfully codified in paper or electronic form and shared without need for discussion. By contrast, tacit knowledge (or intuition) defies recording. This kind of knowledge underlies personal skill, and its transfer requires face-to-face contact or even apprenticeship. [Wyatt, p.6]

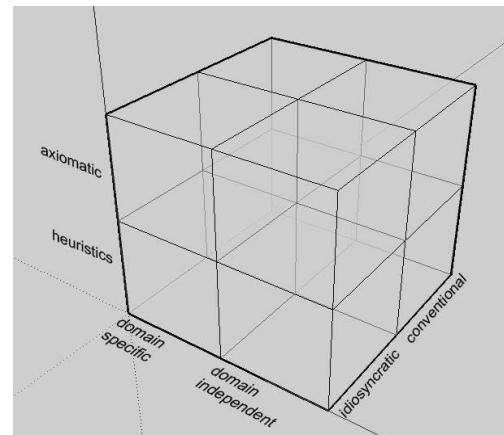


Figure 1.Three of six categories of knowledge as a three-dimensional space [Coyne, p.141]

Table I. Comparison of strategies to manage explicit and tacit knowledge

Comparison of strategies to manage explicit and tacit knowledge [Hansen]		
	Codification for explicit knowledge (people to documents)	Personalization for tacit knowledge (people to people)
Intended result for organization	Uniform, high quality solutions to most problems; contain current risks and costs	Unique, appropriate, creative solutions to strategic problems; exploit opportunities and contain future costs and risks
Type of problem targeted and solution preferred Knowledge management goal	Routine, short-term, low-risk problem for which a good enough solution is available but is not usually applied Re-use of explicit knowledge by capturing, codifying, classifying and making available knowledge to support routine problem solving	One-off, medium to long-term, high risk, strategic problem with no precedent needing a novel, customized solution Sharing of tacit knowledge by helping staff to identify relevant experts and enhance conversations to create novel solution

3. UNDERSTANDING INTERPRETATION: THREE METHODOLOGIES IN DESIGN

The process by which designers transform their **tacit** preunderstanding into **explicit** knowledge is termed “*interpretation*” [Stahl, p.3]. To say that interpretation is central to innovative design is to stress that in order to design the designer must to some degree understand and be able to articulate the significance of the artifact being designed. All of this takes place primarily in *tacit* ways. However, one’s tacit understanding of something can be partially articulated or expressed *explicitly* in spoken, written, or graphical language—either to deepen one’s own understanding or to communicate with others. Two aspects of the process of interpretation can be distinguished: There is a tacit *preunderstanding* based on previous background knowledge; items

from this preunderstanding can be articulated explicitly.

There is the possibility of revising that preunderstanding based on *discoveries* that are opened up by it. [Stahl, p.10]

The process of understanding in design has the following three features:

Understandings of a design arise from interactions with the *situation* of the task in the world;

The designer’s unique interpretive *perspectives* grow out of traditions which pass on viewpoints for relating to the world, skills for behaving in the world and languages for talking about the world; and

Explicit articulations of interpretations in *language* emerge from situated, tacit understanding and then re-submerge.

Table II. The structure of human interpretation [Stahl, p.12]

	(a) situated	(b) perspectival	(c) linguistic
(1)preunderstanding	expectations	focus	conceptualization
(2)discovery	surprises	deliberations	refinements

Table III. Computer-based mechanisms to support interpretation in design [Stahl, p.14]

	(a) situated	(b) perspectival	(c) linguistic
(1)reuse	hypermedia network	perspectives mechanism	end-user language
(2)plasticity	revising representations	merging multiple perspectives	defining new expressions

Although computers cannot understand things the way people do, they can serve as a

computational medium to support people’s interpretive processes. The computer support mechanisms listed in Table 2-3 can augment

cooperative design in a number of ways, including:

- a-1 As a long-term memory or repository for information that was created in past designing and is now available to be shared by designers using the repository.
- a-2 As an external memory for representing and revising designs to see how alternative variations appear.
- b-1 As a retrieval mechanism for organizing and managing design knowledge and filtering through just what is relevant.
- b-2 As a display mechanism to define new personal and shared views of designs.
- c-1 As a linguistic medium for expressing knowledge in a canonical form that can be used for computations by the software.
- c-2 As a communication medium to generate new knowledge to be shared with others.

A comparison of Table 2-1 and Table 2-2 shows that *the mechanisms of computer support are based on the structure of unaided human interpretation*. The computer support is intended to extend the power of designers to operate under conditions of “information overload,” in which it is becoming increasingly difficult to work effectively without the use of computers. [Stahl, p. 15]

Stahl points out in his dissertation the insights of three people who have provided insightful and influential interpretations of the design process: Christopher Alexander, Horst Rittel, and Donald Schön. Significantly, each has been concerned at some point with the issue of providing computer support for design. Also, they emphasize the themes of this paper: Alexander focuses particularly on the problem of representation; Rittel emphasizes the consequences of people's differing perspectives; and Schön is concerned above all with how explicit reflection arises from tacit understanding. Alexander recognizes the need to combine mathematical methods and analysis of patterns with intuitive sense grounded in architectural practice [Alexander, 1964]. In pushing the paradigm of objective analysis as far as he can, he is nevertheless frank about the limits of empirical research and the importance of prioritizing human needs that are less susceptible to empirical evaluation. Finally, the pattern language he proposes is meant as a basis for every culture and every person to build their own unique and appropriate representations of design situations. Rittel's analysis of the “wicked”

problems of design does not suggest the elimination of method in favor of arbitrary personal whim. Rather, it stresses the complexity of continually framing the problem and solving it in parallel. One's interpretation of the problem must not only be based in the specifics of the situation, but must also grow out of the exploration of potential solutions. The argumentative process of design is not simply one in which everyone is entitled to their own opinion. Rather, it is a process in which initial prejudices are supposed to be subjected to critique from other viewpoints so that they will be refined. At the same time, Rittel recognizes that people have differing perspectives for various legitimate reasons, and that agreement will not always be possible even with the best processes of deliberation [Rittel & Webber, 1973].

Schön can be seen as a resolution of the objective and subjective approaches, for he stresses the interplay or dialogue between the designer (who brings tacit skills and personal perspectives) and the materials of a design situation (which provides surprises for the moves of the designer that could not have been anticipated but that constrain the design) [Schön, p. 52]. Schön's theories about the roles of tacit knowing and explicit reflecting, drawing upon important philosophical sources, flesh out both Alexander's notion of intuition and Rittel's sense of how judgments can be deliberated. Schön's theory of design focuses on the movement between the designer's skillful preunderstanding (“knowing-in-action”) and explicit articulation (“reflection-inaction”). This is precisely the movement that is called interpretation.

3.1. Alexander: The Structure of Design Situation

Deliberation on the question of whether and how computers should be used to support the work of designers has raged for several decades. In the beginning of the 1960's Alexander (1964) pioneered exploration of this possibility by running a series of computer programs for the hierarchical decomposition of systems into subsystems, diagrams, or patterns. This kind of decomposition was central to the methods he proposed for design, and it seemed logical and necessary to use computationally powerful

equipment to implement such analysis. However, within several years, Alexander was discouraged about the use of computers to support design. He complained that, “the people who are messing around with computers have obviously become interested in some kind of a toy. They have definitely lost the motivation for making better buildings” (Alexander, 1971, p.309). In his 1971 Preface to the paperback edition of his original work, he characterized the problem with attempts at computer support in terms of a broader problem of separating the study of design methodology from the practice of designing (Alexander, 1964).

The issues surrounding the appropriate use of computers go to the heart of what design is and should be. In his now classic *Notes on the Synthesis of Form*— which presents his dissertation work incorporating the early computer programs— Alexander reviews the history and even the prehistory of design in order to argue that the field reached a second watershed in the mid-twentieth century. The profession of design had originally emerged when society started to produce new needs and innovative perspectives too rapidly to allow forms to be developed through “unselfconscious” activities of slowly evolving traditions. Now, the momentum of change has reached a second qualitatively new stage: Today more and more design problems are reaching insoluble levels of complexity. (Alexander, 1964, p.3)

Alexander’s patterns provide the representational or computational basis today for computerization. In an obvious sense, computers are a natural tool for storing large amounts of information. But at a deeper level, computer languages and applications are designed to manage complexity. It is no coincidence that the movement toward structured programming was contemporaneous with Alexander’s emphasis on functional decomposition.

Alexander saw a major advantage of the systematic use of structures or patterns in what he referred to as a “loss of innocence”. Recognizing the power of both formal representations and non-formalizable tacit knowledge, he did not propose that design methods substitute for the practice of design or for the designer’s practical intuitions. Rather, he recognized that intuition and rationalism were equally necessary, and

argued for a proper balance: “Enormous resistance to the idea of systematic processes of design is coming from people who recognize correctly the importance of intuition, but then make a fetish of it which excludes the possibility of asking reasonable questions”. Alexander felt that the fetishism of intuition as some kind of inalienable artistic freedom of the designer functioned as a flimsy screen to hide the individual designer’s incapacity to deal with the complexity of contemporary design problems. While computers may be necessary to manage this complexity, the tacit knowledge of human designers must also be brought to bear with their intuitions.

3.2. Rittel: Deliberating From Perspectives

When Rittel declared in his *Dilemmas in a General Theory of Planning* that “planning problems are inherently wicked” (Rittel & Webber, 1973, p.160), he thereby spelled out that characteristic of planning and design tasks that has subsequently become the central source of perplexity in trying to imagine a computer system that can effectively support the challenging aspects of design. Computer programs have traditionally been devised in accordance with the classical example of *tame* science and engineering problems—precisely the paradigm that Rittel argued is not applicable to the problems of open societal systems with which planners and designers are generally concerned. This inadequate approach assumes that a problem can first of all be formulated as an exhaustive set of specifications. Then, based on such a problem statement, possible solutions can be evaluated to see which are optimal solutions to the problem. Computer programs based on this paradigm must represent in advance the space of problems and solutions for a well-defined type of design problem in an explicit, comprehensive, and non-controversial (objective) manner. However, as Rittel points out, in order to program such a computer system, you would have to anticipate all potential deontic judgments ahead of time before the machine could run. But if you did that you wouldn’t need the computer because you would have had to have thought up all the solutions ahead of time. Therefore it is almost ridiculous to claim that there will be a

designing machine if design is thought of in this sense. (Rittel, 1972, p.323) Rittel claimed that the wicked problems of planning could not begin to be understood in the first place until one had already started to explore directions for solutions. He described what Heidegger calls the *hermeneutic circle* of understanding when he argued, “that you cannot understand the problem without having a concept of the solution in mind; and that you cannot gather information meaningfully unless you have understood the problem, but that you cannot understand the problem without information about it” (Rittel, 1972, p.321). Suppose, for instance, that you are asked to plan a mission to the moon for four astronauts for a period of 45 days. According to NASA, the purpose has been specified as: to explore long-term stays for crews of international backgrounds and mixed gender and to conduct some scientific research and some site work to prepare for future moon bases. In thinking about the design of the lunar habitat for this mission, you might begin to discuss the importance of privacy issues with other people on your design team. You might feel that not only was some physical privacy needed for cultural reasons, but psychologically there would be a need to structure a careful mix of public and private spaces and opportunities. These privacy issues might become paramount to your design even though they had not been included in the original problem statement. In this way, the set of issues to be investigated and concerns to be balanced would emerge and evolve as the planning process took place. Your ability to interpret the problem as one of privacy would have been based on your tacit preunderstanding of privacy as part of human life.

Computer systems may be useful for storing, organizing, and communicating complex networks of argumentation—as long as they do not stifle innovation by imposing fixed representations of the ideas they capture or limiting diversity of interpretive viewpoints. Computer support for planning and design processes as Rittel conceived of them must allow team members to articulate their individual views and judgments, to communicate these to each other, and to forge shared perspectives. It must support deliberation or argumentation. Rittel concluded that the proper role for computers and information systems generally is that of an

enhancer of natural (human) intelligence, not an artificial substitute for it. In *Designing Crutches for Communication* (Kunz & Rittel, 1984), he uses the image of prosthetic devices like crutches or eye glasses: “The glasses do not see instead of you, or on your behalf. Neither does the automobile relieve you from traveling. They are prosthetic devices which support, reinforce, enhance some capacity or activity”. Because the role of information science is not to automate problem-solving but to augment human problem-solving, it must be based on an analysis of how people use information and solve their problems: “Here lies the central task of information science: to develop methods for exploring its users' knowledge and their modes of reasoning, i.e., the systems analysis of problem solving and information”. Given Rittel's view of design as argumentation from perspectives, this means computers should support people's perspectival interpretation processes.

3.3. Schön: Tacit Knowing and Explicit Language

Schön argues in his seminal work, *The Reflective Practitioner* (1983), that much design knowledge is tacit, rather than being rule-based. He views the design process as a dialogue-like interaction between the designer and the design situation, in which the designer makes moves and then perceives the consequences of these design decisions in the design situation (e.g., in a sketch). The designer manages the complexity that would be overwhelming if all the constraints and possibilities were formulated as explicit symbolic rules by using professionally-trained skills of visual perception, graphical sketching, and vicarious simulation. Note that these skills bypass the process of analyzing everything into primitive elements and laying it out in words and propositions.

Schön recently addressed the question of computer support for design in an article descriptively entitled *Designing as Reflective Conversation with the Materials of a Design Situation* (Schön, 1992). He argued for a necessarily limited role for computers in design because one of the most important things that designers do is to construct the design situation itself. Not only is this something that computers cannot do by themselves, but it also precludes programmers

of computer systems from predefining a generic design situation for the computer, prior to the involvement of the designer with the task.

4. COMPUTER SUPPORT FOR ARCHITECTURAL DESIGN

4.1. Supporting Situated, Perspectival, Linguistic Interpretation

The analysis of interpretation mentioned before suggests that computer support for design should:

Capture computer representations of tacit situated understanding at the points when it becomes articulated as explicit interpretations.

Provide multiple perspectives for analyzing and understanding designs.

Allow users to evolve and refine interpretive expressions in language without starting from scratch or accepting predefined frameworks.

Accordingly, three hermeneutic principles will be adopted in trying to develop computer-based environments to support the work of designers:

Provide facilities so designers can create representations of the design situation

during the process of solving the task.

Provide facilities so designers can define multiple interpretive *perspectives* on design problems.

Provide facilities so designers can articulate explicit conceptualizations in *language* expressions for their work and submerge this new knowledge into tacit forms of knowledge for future use.

Therefore, a computational method in design must feature;

An extensible *computational medium for representing and evolving artifact constructions, design rationale, computational critics, and other forms of design knowledge*.

A mechanism for sharing *group and personal interpretive perspectives* to support collaboration and deliberation.

A *language for explicitly defining computations* and for hiding information that can then function in a tacit way.

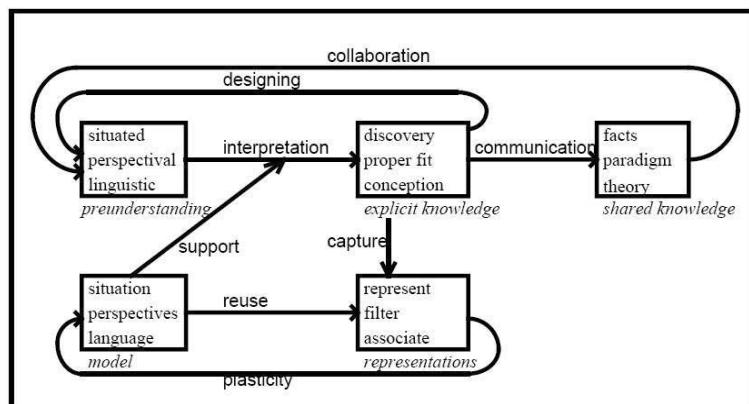


Figure 2. Computer support for interpretation in design. [Stahl, p.220]

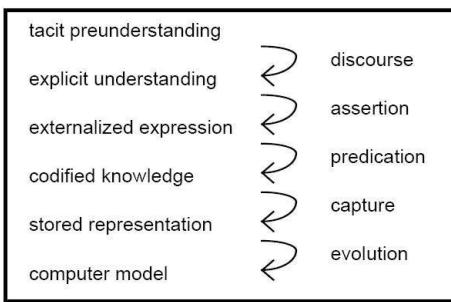


Figure 3. Successive transformations of knowledge.

The left-hand column lists consecutive forms of information. The right-hand column indicates the transformation processes from one form to another.[Stahl,p.200]

5. CONCLUSION

The key concept for a theory of computer support is interpretation. Support for interpretation is the ingredient missing from most traditional AI programs.

Knowledge-based system design inevitably raises the question of the nature of knowledge. First, the varieties of knowledge or information have been categorized in terms of their origins in various phases of the process of interpretation. This includes not only tacit and explicit understanding, but also shared understanding and captured computer representations. Second, the idea of domain knowledge has been critiqued. Not only does knowledge in a design domain change as the related technologies and styles change and as the expertise of the field matures and grows, but every designer and every design team has their own domain knowledge. It is not simply that they each have different pieces of an underlying knowledge. Rather, to know is to know from a perspective, so *there is no objective body of domain knowledge independent of what people know in their own ways*, within their many perspectives. Third, the role of language in expressing knowledge has been emphasized. [Stahl, p.386] *The emergence of interpersonal or operationalized knowledge from tacit experience takes place through discourse and assertion within situated interpretation.* Correspondingly, an end-user language has an important role to play in computer support.

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GARDENING IN OTTOMAN TURKS

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Abstract- Within this study, the art of gardening in Ottoman Turks has been examined in four periods: 1. The period starting with the establishment of the Ottoman Empire till the conquest of the Byzantine capital of Constantinople by the Turks (1300-1453) 2. The period starting with the conquest of Istanbul till the Tulip Era (1706) 3. The Tulip Era (1703-1730) 4. The period starting with the Tulip Era (1730) till the establishment of the Republic (1923) In the first period, Ottoman Turks remained under the influence of Seljuk art and were partly in contact with the Byzantine works. When miniatures showing the palace life are examined, often the importance given to the atrium garden could be seen. A significant development in the art of gardening was experienced during the period starting with the conquest of Istanbul till the Tulip Era. The Tulip Era has been a very productive period in terms of fine art in Ottoman history. Major improvements and innovations in poetry, literature, music, civil architecture and especially in the art of gardening has emerged. Till the Tulip Era, the unique natural landscape of Istanbul was equipped with the top works of art of Ottoman Turks. The art of gardening in Ottoman Turks has entered a new period with the end of the Tulip Era in 1730. This period, has been the period in which foreign influence started to affect Ottoman gardens. The most important works of the second period; the Topkapi Palace Garden and the Yıldız Palace garden, which was mostly established in a natural layout and has been the latest example of Ottoman palace gardening, were examined within this study. The structuring of the Ottoman gardens has changed and developed during the historical process depending on various effects such as life styles of the period and the artistic-cultural structure of the period.

Keywords: Turkish garden, garden of Yıldız palace, garden of Topkapi palace

1. INTRODUCTION

Turks, economically being dependent on agriculture, have had a close relationship with their environment and continued this relationship. Also agriculture was required great effort as it was not always possible for soil to be so rich. For this reason, when Turks ended migratory period and settled in Seljuk and Ottoman Eras, they had both informal relationship with the soil and a formal link with scary respect because of the dominant character [1].

If we take the first patriot and modern step of development on creating a garden in all old and new civilizations into consideration, it comes to light that Turkish gardening had a background dating back to earlier eras. It is a fact that the abundance of Turkish and especially Ottoman specialists, grown formerly, on gardening and floriculture entirely measures swords with the other nations' [2].

1.1. General Quality Of Turkish Garden

In Turkish-Ottoman gardens, there are generally alive and inanimate materials like four-cornered marble pools, shade trees and fruitful big trees, bowers with ivy and wisterias, terrace and stairs, water dispensers and jets, fountains and lion statues which water floods of their mouths, rose gardens, tulip and fenugreek garden. In the conception of Turkish – Ottoman gardens, the heaven description of Islam-as it is emphasized that heaven is a kind of garden in which there are flooding waters, big pools and waterfalls with different type of trees just like palms and vineyards-has a great role in using various kinds of alive materials besides water resistant inanimate materials like pools, jets, dispensers, fountains, statues which water floods of their mouths. In Ottomans, the desire of creating heaven in the world and wearing gardens with various alive and inanimate materials shaped Ottoman gardens. In the gardens, ornaments, as alive elements, like

platanus, fraxinus, tilia, ulmus, celtis, laurus, cercis as big trees and rose, tulip, hyacinthus, dianthus as plants can be seen [1].

In the Turkish gardens, on axles made up to connect different places of the garden to each other with using suitable flooring elements, edited roads, ramps and stairs, transport elements which are divided into two water elements as static and moving, compressed soil and tartan, created herbal materials flooring elements for aesthetics, lighting elements to increase visual impact in the dark are elements creating Turkish landscape [3].

The natural convenience in Turkish gardens represents the main source of beauty. While perception is provided with a few main axle or axles in contemporary Western gardens, in Turkish gardens, there are a lot of or softened axles, or none. Turks gave great importance to living in outer space as a relic of nomadic life. Therefore, from the smallest house to the palace, general location, slope, and view of the land were regarded [1].

Half covered ledge of the building, pergola or pavilion with small structures which are frequently used in Turkish gardens, and the fusion of interior and exterior were surely achieved. The ideal connection between the portion of the building directly over the stone garden, with stony-called semi-open spaces, garden and building [4].

Water is an important element used in Turkish garden. Even it is small, pool in an indispensable element in the garden changing according to the seasons. As plant species and use, flowers have a special place in the design of Turkish garden. Instead of creating colour patterns and composition, it can not be seen the complexity of colour and class with flowers that are used for smell and eye-pleasing appearance in Turkish garden [5].

In Turkish gardens, tree species like platanus, fraxinus, tilia, ulmus, celtis, quercus trees were used [6].

2. THE GARDEN OF YILDIZ PALACE

Yıldız Palace consists of corps of palaces and pavilions which are formatted according to the Turkish civil architecture. Yıldız Palace has interior and exterior gardens in various sizes. Interior garden includes Has garden, Harem garden, Prince and Sultan gardens and Şale (Chalet) palace garden. Yıldız palace, including buildings and gardens, located on a

500 000 square meter area. It consists of pools, islands designed in different sizes and forms, the greenhouse and conservatory, pavilions, flowers shaped like metal umbrellas and vase, and arbors [7].

The gardens of Yıldız Palace were planned naturally and achieved naturalistic English garden style. The main lines and major elements of plant tissue survived until today. Woods around the palace garden area have been considered as an extension of the garden. The gardens of Yıldız Palace bears increasingly the transfrom from formal style of garden to the natural style. The natural convention here is not in the form of transformation from formal to natural, but in the form of giving way to the formal style of garden in natural style [7].

2.1. Interior Garden (Has Garden and Harem Garden)

Interior gardens, especially Has garden, was made in the era of Abdulhamid II. In the same period, it is indicated that German, French, Italian garden experts was appointed, the most of ornamental seedlings were brought from abroad, native seedlings which were removed through forests in the country were used in the garden. In Has garden and other interior gardens, the greenhouses of ornament and production were built and a winter garden under the root of small Mabeyn was established. Winter garden was generally used in winter months as it had opportunity to be heated, and in hot spring and summer days, pavilions were used both in summer and winter, and summerhouses in the hot days of spring and fall in addition to summers. The integrity of the use of the gardens was created by making them utilizable in all the seasons of the year [7].

Sultan Abdülhamid II had a large and exotic looking pool with his name built in the interior garden of the palace. The mansion located on the island in the pool looks like an animal cage. Various bird species and ornamental fish were grown in this mansion. These animals creating colourful environment in Yıldız Palace, conflated with exotic cascades in well-kept gardens, swimming pools, islands and the fitted-in-nature buildings of Abdülhamid era. In the Year 1909 with the deposition of Abdulhamid II, those animals were distributed, and life lasting in those gardens

ended. Today almost all of the animal cages became extinct or fell into disuse [6].

Selamlık garden was designed in the form of romantic-picturesque style. The main motif of the garden is an artificial lake which is in the middle of the small garden. Hamid Pool, 300 m. length, 15-40 m. in width, 1.20 m. deep, constitutes the axis of Has garden. The artificial lake within Selamlık garden, resembles a river. The bridges over the lake, grotto and cascade near the end of the lake shore are like in the typical naturalistic English garden. [7].

The roads, providing circulation in the garden of Yıldız Palace, were planned in accordance with curves. Hard surface material, as well as in our other palace gardens, is a mixture of gravel and sand, Bozhane sand. Today the mixture material, in the third atrium of the garden in Şale pavillion, is covered with gravel. In the vicinity of pools and ponds, compressed soil is used. The significant exotic trees and shrubs, used in the interior landscape of Yıldız Palace, are over 100 year-old of monumental size *taxus baccata* L. *Fastigata*, *Cephalotaxus harringtonia*, *Calocedrus decurrens* and channel-shaped swimming pool stretching from the edge of the marquee tent, *Quercus ilex* whose size and habitus are great. In addition to these, Ottoman palace grass, which grew in the shadow of tall trees and succeeded in reaching today, occurs in the gardens of palace as an important species of place ground [7].

2.2. Exterior Garden (Yıldız Grove)

Exterior garden was also designed in the shape of pool pond. The naturalistic English garden showed its effect on the garden with used tree community, herbal compositions, meandering paths, the terrain slopes, descend. In the floral arrangement of the garden, the natural structure of wood and vegetation was not interfered too much except for the immediate vicinity of the garden and pavillions. In the 19th century, the wood which was used by only the sultan and close community, was linked Çırağan Palace to his new Yıldız Palace with a bridge, standing today and from the road nearby the sea by Abdülhamid II. During this period, the woods and parks in which some foreign gardeners and architects worked, finalized being shaped with different organization [1].

The most important feature that separates Yıldız Palace, Has garden from the other formal Western style gardens is that, in the organization of Has garden, symmetry is not included. In the design of the garden of Yıldız Palace, statues were not included as architectural elements. The pergola and other architectural elements were decayed and not available due to the maintenance problems.

3. THE GARDEN OF TOPKAPI PALACE

In the period from the conquest of Istanbul to the beginning of the Tulip Revolution (1976), a significant development of the Garden Art has standed out. Topkapı Palace is one of the most considerable trace of this period. Also, Topkapı Palace is one of the biggest palaces of the world. The palace has five atrium gardens.

3.1.Atrium I

Atrium I, as wide and tree-lined, is reached from the main entrance, Coup d'Hümâyün. Atrium I is the ceremonial place. Gateway pictures are drawn here. This atrium, which is possible for public to enter easily, is a social area. In this atrium, surrounded by buildings, the Byzantine Church of Hagia Eirene stands. Atrium I, as a gateway in between the inner and outer places of the palace, was lessened with the buildings attached later [7].

In this atrium, a functional and informal group of tree, linking important doors is dominant. The plane is preferred more in the yard. Still there are platanus trees, some of which is 400 year-old. The body of one of the platanus tree is 14 meters around in the yard, except for trees in the surrounding, along the path, which are linking two gates, landscape elements are not included [8].

3.2.Atrium II

Atrium II, which is called Divan Square, is smaller, but more beautiful. Fountains were decorated with shaded paths with cypress and grasses with ghazals. Atrium II is surrounded by a portico. It is paved with stone and pitched in the middle [8].

3.3.Atrium III

From the second atrium, it is moved to the third yard in which the private parts of the

palace occur with the gate of "Bâb-ı Saadet". It is a smaller peristil than the second yard. This yard is surrounded with the important buildings of the palace as Harem, the Treasury and Supply room. At the same time, the third yard was a university where the precious artists and scholars belonging to the palace lived, worked. It was called Enderun. The entry of Harem is from this yard [7].

In this atrium, as seen in the first and second yard, a few 100-year-old trees stand on a platform which grass and flowers are taking place on. There are some yards and stony places in Harem which is linked to the third yard. In accordance with the traditions, Harem is a withdrawn collection of buildings, containing own outer space and safa gardens. The most important ones of Harem gardens are Valide Sultan Garden, Concubine's garden and The garden of Princes. From the atrium of the Princes, the garden would be looked. There is a big pool in the garden. That pool is in the same plane with the smaller pool, under a building and in-between struts, Sultan Ibrahim used to feed fish with pearls as bait, but not united. In the garden at the bottom of the big pool, there is a building where wild animals are fed. The pavilion of Sultan Osman III and the yard which the room of Sultan Selim III opens, maintains that garden. This last atrium is made up of marble and has a pool with fountain in the middle. Also, for the flower beds, in flooring, openings are left. In addition to the slopes on the marble flooring, the water ways left for drainage are remarkable [8].

3.4.Atrium IV

The outside of the first three places of the palace atrium is called the fourth yard, but this space is a collection of the gardens in which there are pavilions, rather than a atrium. The fourth atrium is a natural garden which is built on four terraces. Buildings are located in this atrium in the form of very elegant pavilions. In the garden, well-formed pools take place. The fourth atrium is a place dominated on a unique landscape to the horizon of Marmara, the beauty of the Bosphorus and Golden Horn. The arrangement style of this garden completely comes from the need of life and function. Although the main residential structures are on the top of hills, on the slopes of gardens, one pavilion is linked together

with the other one and a relationship with coastal palaces is extended to the sea. The slope is dammed. This part with the view of the Sea of Marmara and the Bosphorus and the breeze from the sea, is the most suitable space for the location of the safa gardens. The fourth atrium, as the highest degree of privacy held by the sultan and his family and harem, and the most prestigious venue, is reached with the corps away from the monumental unlike the entrance of other yards, by treasury ward and created using the stairs and ramps in the 19th century. The fourth atrium, also known as Tulip garden, Tulip garden, rather than atrium; surrounded by Baghdad Kiosk, Sofa Kiosk, Hekimbaşı tower and restricted with Mecidiye, is a kind of open nature garden overlooking the pool stony terraces among the palace pavilion, with the water lily pool seen from the terrace where figs and its lower-level garden, that Istanbul's unique skyline can be watched, in sets where the sultan's personal views of the pool pavilion [8].

It can be accepted as the focus of the fourth atrium that the most prominent landscape element of the atrium is the carefully processed marble fountain in the middle of the pool which is in stony square, in 14mX15m size. In Turkish garden, in order to strengthen the relationship between buildings and the wall and decorate and revive the wall, alcoves, as another element of the landscape, are used to bring mobility to the space. The fourth atrium, with the advantage of being in the dominant location of the Bosphorus, differing from the others, has a design of landscape with the trees like *fraxinus*, *tilia*, *ulmus*, *celtis*, *quercus*, *laurus*, *cercis*, such as purple and pear which composed the nature of Bosphorous, and rose, hyacinth and tulips arranged according to the prestigious venue [8].

3.5.Tulip Garden

From the terrace, with the stairs, tulip garden, which has a pool with fountain on one of its corners, is reached. tulip garden which is mistakenly known as Tulip Garden, is limited along with on the one hand the Treasury Department, on the other side with Mustafa Paşa Pavilion.

Şimsirlik pavilion, with the axial symmetric two pools, is went down with the ladder. Şimsirlik Pavilion has two floors, and the ground floor, which is among struts, is in the

shape of small stony place on the both sides of the stairs. The garden has a large pool in the part near the Baghdad Pavilion [8].

3.6.Sofa Garden (Safa Garden)

There were mansions and palaces, which the sultans had them built as summer house, in the sofa gardens and by the sea. There were also the mansion of Sultan Mehmet III in the north of Çinili pavilion, the first element of the group of palaces, around Ağa Garden called as Kalferi, across and in the place of Archaeological Museum, there was Kum Square, in which javelin games can be watched through Kum and Çinili pavilion. Outside there is Alay pavilion next to the door opening to Soğukçeşme, known as found in the wood in the era of Sultan Murad III. Where the sultans watched the pass of the sultan's army, and holiday festivities, engagement and wedding of the sultan, to be adopted by grand vizier for the regiment of foreign ambassadors. In the gardens, at the beginning of the fourth yard, there are Baghdad and Revan Pavilions, built with inspiration at the wartime of Baghdad of Sultan Mehmed. The terrace, surrounded by Baghdad, Revan and Sünnet Pavilions, is one of the most beautiful outdoor space of the collection of the palaces. The use of marble for flooring, fountains and bars by the seaward, gives unity to the expression of the space. İncir garden and the garden under it are viewed from the terrace, including a small pavilion on the mid-edge, which is called İftariye, but the most beautiful sights of it are the sea and Istanbul, with its unique scene. The large pool next to Sünnet Pavilion, is a cold and nice corner among the staves of the structure, being behind itself [8].

That the functional gardens are next to the sofa gardens can be seen in European gardens. Park and gardens, whose samples could be found in the 17th and 18th centuries, are in accordance with the collections of Turkish palaces like Topkapı. Whereas the palace structure, in European samples, can be seen as in a large land, without having relation with the land and impact to the general location, In Turkish samples, the gardens follow the structures of the palaces, that's to say, structure first comes, and garden follows it [8].

3.7.Sofa-I Hümayun Gardens

In this yard, some sultans did some sports such as javelin, wrestling and archery. This field is the part under the marble terrace and the flower garden of Sofa Pavilion, and Hisarpeçe, which in front of the sultan flat, marble terrace-as well-surrounded by walls. It is also a place where the stony-throne sultans, belonging to the period of Murat IV, in front of Hekimbaşı Tower, watch the activities. In the part of this garden, which has the view of The Marmara Sea, there were various pavilions and buildings as of the 15th century. Also, there are huge gates, providing passing to the third yard and the other big gardens of the palace from this space. Today Sofa Mosque, built in the 19th century, Mecidiye Pavilion, which was built by Sultan Abdülmecid almost in 1859 and Esvap Room, related to Mecidiye Pavilion, stand in this garden. It is known that there was a pavilion-Fatih Sultan Mehmed had it constructed-and also a construction, known as Çadır Pavilion, providing entrance to the bottom gardens [8].

3.8. Has Garden

Has garden, surrounding the collections of the palaces in the north, south and east, is a park, as Gülhane Park, which is served for public. This wide part was in fact departed for hunting and sport activities, but it collected flower, fruit and vegetable gardens within itself. Has garden term is generally used for the private garden of the sultan, but there were any other buildings and shops where art and science were taught in Topkapı Has garden.

This has garden was totally a kind of academy of the art and science of its period. The architects such as Architect Sinan and Mehmed, were brought up in it. Growing flowers in Has garden was an important desire in all of the periods. Most of the sultans including Fatih, were interested in gardens and full of the love of the garden. They were also interested in the selection of the species of the flowers and, brought roses from Edirne and lilies from Halab. They wanted to see especially lilacs, carnations, tulips in their gardens. As all of us knew, the love of the tulip was so much that it named a period [8].

4. CONCLUSION AND SUGGESTIONS

Today Yıldız and Topkapı Palace Gardens, having historic worth, are spaces, lived, used and investigated with taste. Also, they have versatile, meaningful and effective functions. It is necessary that palace gardens be accepted as live cultural statues, depending on biological aspect and, relating past, now and future to each other [9].

The gardens of the Topkapı and Yıldız Palace come into monumental value like constructions in times. For this reason, they are a part of the historical, cultural landscape and architecture of Istanbul. Palace gardens have a complex feature, functionally and aesthetically, which is coming from the design of the herbal and architectural elements, either combined or distinct. They also have a form of documentary as they reflect the concept of outdoor life of the past, and bring it so far.

The palace gardens, as heritages, bringing the cultural and natural aspects of the past so far and transforming them to the future, are needed to be protected and rated. Although most of the countries are legally saving historical gardens, any law code has not been set in our country so far. However, it is seen that European communities have started to become conscious, and interested in protecting historical gardens recently. Thus, English Garden in Munich, Herrenhausen in Hannover, Campton Court near London and Versailles palace gardens in Paris are the first sightseeing places, attracting attention of local and alien tourists, parks and gardens, with precious historical buildings, are obliged to be restored, in fact [9].

Palace gardens are precious historical ones which make Istanbul gain importance. They annex Istanbul to fame and quality. It is possible to divide the problems of arrangement and maintenance of the palace gardens into two groups [10].

The problems which are caused by the changes of the architectural elements (such as walls, steps, floor, pool, mid-morning, grotto etc.)

The problems, in the private and general character of the garden, which are caused by the decline of plant because of the lack of care and ageism, and the adding of herbal materials.

Palace gardens are taken up as an element of construction and settled. Inventory work in the

palace garden must be established by a special committee of experts, which will conduct relief and research-planning activities. The necessary maintenance and repair works must be continued in order to protect present situation until the beginning of the works of the restoration. In the palace gardens, the existing and blasted species of trees and bushes must be listed, and a special nursery for these species must be set up. in this nursery, large and mature plant species must be grown.

The planning and implementation must be made in order to brighten the concept of Turkish garden, which is just about to disappear as of the 18th century. The species of trees in the palace garden are critically important in terms of maintenance, repair and restoration. Planting a same sample in the similar size instead of a dried bush is not matter. Recreating a hash ground plant is not a hard job, as well, but putting a new one instead of a centennial tree is not really easy. If this tree is alike a kind of statue of nature, experts, mastering on maintenance and repair techniques, are needed in order to protect it for long years.

The existence of this kind of tree, reflecting a long past, must be protected from the impacts of negative conditions, created by the time and urbanization. These negative conditions will have effects on the trees in the palace gardens such as on the existence of the trees by the roads of the cities. For this reason, we confront with an important problem as making the trees, having dominant character in the gardens of palaces live long and healthy without changing their forms. This will be possible on condition that the works of maintenance and repair are done [11].

The gardens of the palaces, sustaining the general characters of Turkish and European gardens, must be inherited in good repair with all the special features. For it, the subject matter is needed to be undertaken with the methods of traditional and scientific protection.

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APPLICATION OF HIDDEN MARKOV CHAINS IN QUALITY CONTROL

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Abstract- *The ever growing technological innovations and sophistication in industrial processes require adequate checks on quality. Thus, there is an increasing demand for simple and efficient quality control methods. In this regard the control charts stand out in simplicity and efficiency. In this paper, we propose a method of controlling quality based on the theory of hidden Markov chains. Based on samples drawn at different times from the production process, the method obtains the state of the process probabilistically. The main advantage of the method is that it requires no assumption on the normality of the process output.*

Keywords: Quality Control, Hidden Markov Chains, Control Charts, Assignable Causes, Transition Probability

1. INTRODUCTION

Controlling the quality of products is of paramount importance in the manufacturing as well as service sectors. Even though quality control has been practiced from time immemorial, either directly or indirectly, a quantitative approach was started only after World War II.

With the rapidly changing technologies and modern day fierce competition, the need for statistical process control (SPC) is felt more than ever. SPC is a procedure by which sample data is collected from the production process, organized, analyzed, and interpreted so as to ensure that the current level of quality of the production process is maintained or improved further. Modern day quality control experts have used several tools such as graphical methods, reliability methods, neural network methods, and control charts in their quest to control quality.

Walter A. Shewhart first proposed the general theory of control charts which is a graphical tool to monitor the activity of an ongoing process. He realized that variability is a part of any ongoing process. The process variability can be broadly classified into two categories: variability caused by assignable causes which are not part of the process affecting only some of the items. Typical examples are defective raw materials and untrained operator. The

purpose of the control charts is to detect the presence of such causes if they exist so that immediate remedial action can be carried out. The other variability is due to what are known as chance causes which are inherent in any process and cannot be totally eliminated. Examples are small voltage fluctuations and vibration of machines. Shewhart called a process operating only under chance causes as a process under statistical control.

Normal distribution plays a crucial role in the detection of assignable causes. The crux of control charts is the fact that when the process is under statistical control, the variations in the output can be captured with probabilities.

The control charts provide a base line for initiating and measuring quality improvements. Apart from the fact that quality improves productivity, SPC can also help in cutting various costs. They provide valuable signals about why the company incurs cost and reveal opportunities to cut costs (Roth (2005)). An important assumption in the design of control charts is the assumption that the measurable quality characteristic is normally distributed or reasonably normal. However, in many situations we may have reasons to believe that the underlying distribution is far from normal. Amhemad (2010) used a positively skewed distribution to

show the effect of non normality on the significance levels of the control charts. He showed that the sign and size of error in significance level depends on the sample size. With the technological advancement and sophistication in products, there is a need for more methods of controlling their quality, although there is no single method which can be used for all products at all times. In this paper, we propose a new method of quality control based on the theory of hidden Markov chains. The proposed method uses the information provided by all the previous samples to check whether the process is under statistical control or not. We wish to state that since the method proposed is new, the determination of some of the process parameters of the method are still not clear. Much work needs to be done to bring the method to a working order. In section two, we give a brief outline of the basic ideas of hidden Markov chains that are needed in our formulation.

2.HIDDEN MARKOV CHAINS

Since Andrei Andrevich Markov introduced the concept of Markov dependence in stochastic processes in 1906, the theory of Markov processes has made great strides and is being applied in every branch of science and arts. Markov chains are discrete time, discrete state stochastic processes $\{X_n, n = 0, 1, 2, \dots\}$ which take on a finite or a countable number of states and possesses the Markov property. The A model of the preceding type in which the sequence of signals S_1, S_2, \dots are observed while the sequence of underlying Markov chains states X_1, X_2, \dots are unobserved, is called a hidden Markov chain model" (Ross (2006)). At this point we wish to observe that although the sequence $\{X_n, n = 1, 2, 3, \dots\}$ is a Markov chain, the sequence of signals transition probabilities and are basic in the study of Markov chains. The transition probabilities are generally written in the form of matrix known as one step transition probability matrix which is given below;

$$P = \begin{bmatrix} P_{00} & P_{01} & \vdots & \dots \\ P_{10} & P_{11} & \vdots & \dots \\ \vdots & \vdots & P_{ij} & \dots \\ \vdots & \vdots & \vdots & \dots \end{bmatrix}$$

The following relation which can be easily established shows that the matrix P together with the initial distribution completely specifies a Markov chain.

$$\begin{aligned} P(X_r = a, X_{r+1} = b, \dots, X_{r+n-2} = i, X_{r+n-1} = j, X_{r+n} = k) \\ = P_{ab}x \dots x P_{ij}x P_{jk}x P(X_r = a) \end{aligned} \quad (2)$$

Markov chains have been applied in diverse fields like communication, weather prediction, and production to mention a few. A good treatise on Markov chains can be found in Ross, M. Sheldon (1996). In this section, we present some basic ideas of hidden Markov chains.

Consider P_{ij} as transition probabilities for a Markov Chain $\{X_n, n = 0, 1, 2, \dots\}$ which has initial state probabilities $p_i = P\{X_1 = i\}, i \geq 0$. Consider a finite set of signals γ , and whenever a signal is emitted from γ , then the Markov chain enters state j , independently of the previous signals and states of the Markov chain, the emitted signal is s with probability $P(s|j)$, with $\sum_{s \in \gamma} P(s|j) = 1$. It means that, if the n^{th} signal emitted is represented by S_n , then

$$\begin{aligned} P\{S_1 = s | X_1 = j\} &= p(s|j) \\ P\{S_n = s | X_1, S_1, \dots, X_{n-1}, S_{n-1}, X_n = j\} &= p(s|j) \end{aligned} \quad (3)$$

A model of the preceding type in which the sequence of signals S_1, S_2, \dots are observed while the sequence of underlying Markov chains states X_1, X_2, \dots are unobserved, is called a hidden Markov chain model" (Ross (2006)). At this point we wish to observe that although the sequence $\{X_n, n = 1, 2, 3, \dots\}$ is a Markov chain, the sequence of signals $\{S_n, n = 1, 2, 3, \dots\}$ is not a Markov chain.

Consider a random vector of the first n signals as $S^n = (S_1, S_2, \dots, S_n)$. Let $s_k = (s_1, s_2, \dots, s_n), k \leq n$ for a specified sequence of signals s_1, s_2, \dots, s_n . Now define $S^n = s_n$ as the conditional probability of the Markov chain state at time n . It is well known (Ross (2006), page 258) that

$$F_n(j) = P\{s_n | j\} \times \sum_i F_{n-1}(i) \times P_{ij} \quad (4)$$

where $F_n(j) = P\{S^n = s_n, X_n = j\}$, and note that

$$P\{X_n = j | S^n = s_n\} = \frac{F_n(j)}{\sum_i F_n(i)}$$

(5)

We can use equation (4) recursively to obtain $F_2(i)$, $F_3(i)$, ..., $F_n(i)$, starting with $F_1(i) = P\{X_1 = i, S_1 = s_1\} = p_i \times p(s_1 | i)$.

In order to calculate $P\{S^n = s_n\}$ we employ the identity $P\{S^n = s_n\} = \sum_i F_n(i)$ where $F_n(i)$'s are obtained recursively using (4).

As a second prediction problem, let us consider the sequence of states as a single entity and choose our objective as to select sequence of states whose conditional probability given the sequence of signals is a maximum. For instance in signal processing, while X_1, X_2, \dots, X_n may be the actual message sent, S_1, S_2, \dots, S_n are the signals that are received so that our objective is to predict the actual message in its entirety. A similar problem arises in quality control. For instance X_1, X_2, \dots, X_n may represent the actual states of the system, while S_1, S_2, \dots, S_n are the sample values taken from the system at each of the time points. Based on the sample values the quality control engineer is interested in determining the states of the system. We present below an algorithm to find the most likely sequence of states given a prescribed sequence of signals, which is known in the literature as Viterbi Algorithm. Defining the vector of the first k stats as $X_k = (X_1, X_2, \dots, X_k)$, the problem is to find the sequence of states i_1, i_2, \dots, i_n which maximizes $P\{X_n = (i_1, i_2, \dots, i_n) | S^n = s_n\}$.

In order to solve this problem, let for $K \leq n$, $V_k(j) = \max_{i_1, i_2, \dots, i_{k-1}} P\{X_{k-1} = (i_1, i_2, \dots, i_{k-1}), X_k = j, S^k = s_k\}$

(6)

It is well known (Ross (2006), page 262) that

$$V_k(j) = p(s_k | j) \times \max_i P_{ij} \times V_{k-1}(i)$$

(7)

In order to calculate $V_n(j)$, one can start with

$V_1(j) = P\{X_1 = j, S_1 = s_1\} = p_j \times p(s_1 | j)$, and then use equation (7) recursively to determine $V_2(j)$; then $V_3(j)$; and so on, up to $V_n(j)$ for each j .

In the following, we will briefly mention a few interesting areas which have found applications of hidden Markov chains. In a tutorial Rabiner R. Lawrence (1989) has applied hidden Markov chains to select problems in machine recognition of speech. A similar application of the theory was made to image processing problems by Derrode *et al.* (2006). A major area of application of the theory is in bioinformatics. Chadeau-Hyam Marc *et al.* (2010) have applied hidden Markov models to predict the scale of French variant Creutzfeldt – Jakob disease epidemic in France.

3.APPLICATION

In this section, we analyze how the ideas of hidden Markov chains could be usefully applied to process control. In order to explain the motivation as well as understand the procedure, we present below an example which clearly brings out the analogy between quality control and hidden Markov chains.

Suppose that we are interested in controlling a particular quality characteristic of a production process which could be in one of the two states, under control (state 1) and out of control (state 2). Samples are drawn from the output at specific instants of time $t_0, t_1, t_2, \dots, t_n$.

We will call the sample of observations at various instants as signals. The signals are restricted to two types namely, acceptable (*a*) and unacceptable (*u*) quality. Let us assume that we are in possession of the following probabilities. (i) The probability of a transition of the process from one state to another in a time period (t_{n-1}, t_n) and (ii) The probabilities that the process produces acceptable and unacceptable product quality when it is in one of the two states. In our example that is to follow, we propose one possible way in the selection of these probabilities. If the state of the process namely under or out of control is unobservable then, we have the conditions for a hidden Markov chain model in which the state of the process

progresses according to a Markov chain. The signal is the status of the item produced (which is observed from the sample) and has the value either a or u , depending on whether the item is acceptable or unacceptable. Existing results in hidden Markov chain theory will help us in extracting the following information.

Given the vector (S_1, S_2, \dots, S_n) of the first n signals, we can also find the most likely states of the process at the n time points when the samples were drawn.

Given the sequence of signals (S_1, S_2, \dots, S_n) , by regarding the sequence of states as a single entity, we will be able to choose that sequence of states (X_1, X_2, \dots, X_n) whose probability is maximal.

In order to illustrate the above ideas as well as to propose a method for the choice of the model parameters, we present an illustration here and discuss it in detail.

Let us consider a production process whose output is normally distributed with mean $\mu = 3$ and standard deviation $\sigma = 1.5$. In case σ is unknown, one can take samples and use the estimate for population standard deviation $\hat{\sigma} = \frac{\bar{R}}{d_2}$ where \bar{R} is the mean of the sample ranges. Let samples of size $n=8$ be drawn from the output at equally spaced intervals. The 2σ control limits are given by

$$UCL = \mu + 2 \frac{\sigma}{\sqrt{n}} = 4.060$$

$$LCL = \mu - 2 \frac{\sigma}{\sqrt{n}} = 1.939$$

We have chosen to work with 2σ limits because of the reduction in the number of samples to be drawn to detect out of control points. However, the method works as well with 3σ limits. As remarked at the beginning of this section, we need to determine the probability of a transition of the process from one state to another in a time period (t_{n-1}, t_n) and the probabilities that the process produces acceptable and unacceptable product quality when it is in one of the two states. We propose that the latter probabilities can be estimated as follows: Recall the fact that the two types of errors in quality control decision making are type I and type II errors. Since the decision of out of control process is made on the basis of the sample, it is not unreasonable to assume

that the sample drawn produced unacceptable quality. Thus,

$$P(\text{Type I Error}) = P(\text{unacceptable} / X = 1) = P(\bar{x} > 4.06 \text{ or } \bar{x} < 1.939 | \mu=3) = 0.0466$$

$$\text{Hence, } P(\text{acceptable} / X=1) = 1 - P(\text{unacceptable} / X=1) = 0.9534.$$

In the computations for $P(\text{Type II Error})$, we need to know the level to which the out of control process has shifted to. One possible way will be to use the level to which the process usually shifts to, known from experience. In our example we have used the value of $\mu=3.2$ as the shifted value. Now,

$$P(\text{Type II Error}) = P(\text{under control} / X=2) = P(1.939 < \bar{x} < 4.06 | \mu=3.2) = 0.9387.$$

Using a similar logic as above after noting that the probability of a defective item being produced when the system has gone out of control must be high, we choose

$$P(\text{unacceptable} / X=2) = 0.9387 \text{ so that}$$

$$P(\text{acceptable} / X=2) = 0.0613.$$

Next, in order to generate the one-step transition probabilities of the Markov chain X_n whose state spaces are under control (state 1) and out of control (state 2), we proceed as follows: Since the output of the process under study is normally distributed with mean 3 and standard deviation 1.5, we generated 210 data points of the above distribution using the Arena input analyzer program. The data points are provided in Table I.

Table I: Generated Data Points In Order to Get the One-Step Transition Probability Matrix

4.456	3.025	2.532	2.968	1.956	3.731	2.664	2.442	5.754	0.621
3.115	2.645	3.041	2.515	3.951	1.915	3.385	0.000	3.104	4.298
2.717	1.836	2.547	5.539	5.921	2.022	3.179	1.264	2.214	6.272
3.822	2.138	2.692	3.367	2.492	4.850	1.383	1.959	5.007	4.116
0.000	4.712	6.092	3.841	4.038	3.331	1.464	1.964	1.377	1.235
2.509	2.277	1.395	5.304	1.241	2.994	3.119	2.406	2.686	1.572
0.495	2.640	1.674	0.399	1.389	4.820	0.877	3.599	3.814	4.630
4.611	3.643	3.145	0.801	2.912	3.632	0.718	2.077	0.793	5.328
6.346	0.000	2.200	3.448	4.356	4.421	3.907	3.667	2.706	2.989
3.404	0.678	4.575	1.464	2.701	3.309	2.003	2.757	2.564	2.959
3.391	2.576	3.464	2.183	4.053	4.067	1.825	4.537	3.555	3.704
5.054	4.916	4.441	4.985	4.721	2.383	3.252	3.518	2.873	4.550
5.204	4.703	3.635	4.493	3.090	3.139	0.000	3.437	0.553	2.670
3.759	2.344	5.310	3.423	6.325	1.381	4.998	3.629	3.471	4.074
5.277	3.474	1.885	2.976	2.876	3.742	1.069	2.904	3.473	2.996
4.258	2.083	5.948	0.830	1.227	2.099	1.232	4.212	0.216	2.518
1.212	2.447	1.389	6.102	4.584	2.142	2.735	2.863	2.800	5.946
3.380	2.742	0.442	3.864	4.141	2.027	2.986	2.731	4.748	6.182
5.610	2.992	5.109	5.525	3.237	3.773	1.079	2.018	2.940	4.122
1.999	3.778	2.134	3.841	4.146	3.821	1.881	1.673	0.953	2.368
2.815	4.437	4.254	0.973	3.363	5.752	0.953	2.498	2.658	2.415

We have computed the average proportion of points which lie within the 2σ limits (state 1) before an out of control point (state 2) is encountered which turns out to be 0.67262 (or 113/168). This value can reasonably be taken to be the probability P_{11} of a transition from state 1 to the same state. Consequently, the probability of a transition from state 1 to state 2 denoted by P_{12} is given by $1-P_{11} = 0.32738$ (or 55/168). Once the process enters an out of control state it remains there until remedial action is taken so that $P_{22} = 1$. Thus, we arrive at the one-step transition probability matrix of X_n given below;

$$P = \begin{bmatrix} 0.6726 & 0.3274 \\ 0.0000 & 1.0000 \end{bmatrix}$$

Now we are in possession of all the model parameters, we proceed to explain the procedure of actual quality control.

The process controller takes samples of size 8 at various time points and uses the sample average as the signals. For instance if the sample averages fall within the 2σ limits, the signal received is that of acceptable quality. On the other hand if the sample averages fall outside the limits the signal is perceived to be of unacceptable quality. In order to generate various samples, Arena-input analyzer program was run and the respected sample

averages were calculated until an unacceptable quality signal was received. The data is shown in Table II. In the following, we will explain the various information about the process status which, can be obtained from the samples generated.

3.1.The Status Of The Process At Each Of The Instants Of Sampling

The most important question that a quality control engineer faces is the determination of the status of the process on the basis of the sample. In the case of control charts the process status is determined from only one sample which was drawn at the time of determination while the previous samples have no effect on the status. On the other hand, the process control using hidden Markov chains proposed here uses the information of all the previous samples. More specifically, using equations (4) and (5) we obtain

$$\begin{aligned} F_I(1) &= P\{X_1 = 1, S_1 = s_1\} = \\ &= P(X_1 = 1) \times p(s_1 | 1) = 0.955 \times 0.9534 \\ &= 0.910497 \\ F_I(2) &= P\{X_1 = 2, S_1 = s_1\} = \\ &= P(X_1 = 2) \times p(s_1 | 2) = 0.045 \times 0.0613 \\ &= 0.0027585 \end{aligned}$$

So that

$$P\{X_1 = 1 | s_1\} = \frac{F_I(1)}{F_I(1) + F_I(2)} = 0.9969795$$

Similarly

$$\begin{aligned} F_2(1) &= p(s_2|1) \times [F_1(1) \times P_{11} + F_1(2) \times P_{21}] \\ &= P(a|1) \times \left[0.910497 \times \frac{113}{168} + 0.0027585 \times 0 \right] \\ &= 0.5838790 \end{aligned}$$

$$\begin{aligned} F_2(2) &= p(s_2|2) \times [F_1(1) \times P_{12} + F_1(2) \times P_{22}] \\ &= P(a|2) \times \left[0.910497 \times \frac{55}{168} + 0.0027585 \times 1 \right] \\ &= 0.018441361 \end{aligned}$$

So that

$$P\{X_2 = 1 | s_2\} = \frac{F_2(1)}{F_2(1) + F_2(2)} = 0.9693828$$

Similar computations up to the 16th sample yield the information about the status of the process summarized in Table III.

Table III: Probabilities of the state of the process based on the samples

$P(X_1 = 1 s_1) =$	0.9969795	$P(X_9 = 1 s_9) =$	0.9665550
$P(X_2 = 1 s_2) =$	0.9693828	$P(X_{10} = 1 s_{10}) =$	0.9665550
$P(X_3 = 1 s_3) =$	0.9668246	$P(X_{11} = 1 s_{11}) =$	0.9665550
$P(X_4 = 1 s_4) =$	0.9665807	$P(X_{12} = 1 s_{12}) =$	0.9665550
$P(X_5 = 1 s_5) =$	0.9665574	$P(X_{13} = 1 s_{13}) =$	0.9665550
$P(X_6 = 1 s_6) =$	0.9665552	$P(X_{14} = 1 s_{14}) =$	0.9665550
$P(X_7 = 1 s_7) =$	0.9665550	$P(X_{15} = 1 s_{15}) =$	0.9665550
$P(X_8 = 1 s_8) =$	0.9665550	$P(X_{16} = 1 s_{16}) =$	0.08445395

From the table we see the probability that the process is under control when the 16th sample was drawn suddenly drops to a very small value indicating that the status of the process has undergone a change. Another possible indicator of the change in the state could be where $P(X_k = 1)$ becomes smaller than $P(X_k = 2)$.

In Table IV, we present the values of the probabilities of the state of the process (states 1 and 2) for each of the sample. It can be seen that for samples 1 to 15, the probability that the system is under control far exceeds the probability that the system is out of control. For sample 16, the inequality is reversed, thereby indicating the shift of the process state.

Table IV: State probabilities based on the samples

k	$P(X_k=1 / S^k = s_k)$	$P(X_k=2 / S^k = s_k)$	k	$P(X_k=1 / S^k = s_k)$	$P(X_k=2 / S^k = s_k)$
1	0.9969795	0.0030205	9	0.9665550	0.0334450
2	0.9693828	0.0306172	10	0.9665550	0.0334450
3	0.9668246	0.0033175	11	0.9665550	0.0334450
4	0.9665807	0.0334192	12	0.9665550	0.0334450
5	0.9665574	0.0334425	13	0.9665550	0.0334450
6	0.9665552	0.0334448	14	0.9665550	0.0334450
7	0.9665550	0.0334450	15	0.9665550	0.0334450
8	0.9665550	0.0334450	16	0.08445395	0.9155461

3.2. Predicting The Sequence Of States As A Single Entity

In the first part of the prediction problem, we dealt with the probability of the state of the

system at every instant of sampling. However, in this part given the information about the first k states (X_1, X_2, \dots, X_k). To illustrate we first compute

$$V_1(1) = P\{X_1 = 1, S_1 = s_1\} = p_1 \times p(s_1|1) = 0.9104970$$

$$V_1(2) = P\{X_1 = 2, S_1 = s_1\} = p_2 \times p(s_1|2) = 0.0027585$$

first k samples, the problem is predicting the

Using these values, $V_k(j)$ are calculated successively using equation (7) for $k = 2, 3, \dots, 16$.

These are provided in Table V.

Table V: Values of $V_k(j)$

$V_1(1) =$	0.9104970	$V_5(1) =$	0.1539770	$V_9(1) =$	0.026039526	$V_{13}(1) =$	0.004403624
$V_1(2) =$	0.0027585	$V_5(2) =$	0.00481865	$V_9(2) =$	0.000814896	$V_{13}(2) =$	0.000137809
$V_2(1) =$	0.5838790	$V_6(1) =$	0.098741598	$V_{10}(1) =$	0.016698496	$V_{14}(1) =$	0.002823934
$V_2(2) =$	0.0182723	$V_6(2) =$	0.003090079	$V_{10}(2) =$	0.000522572	$V_{14}(2) =$	0.000088373
$V_3(1) =$	0.3744270	$V_7(1) =$	0.063320518	$V_{11}(1) =$	0.010708328	$V_{15}(1) =$	0.001810918
$V_3(2) =$	0.01171755	$V_7(2) =$	0.001981597	$V_{11}(2) =$	0.000335112	$V_{15}(2) =$	0.000056671
$V_4(1) =$	0.2401107	$V_8(1) =$	0.040605865	$V_{12}(1) =$	0.006866983	$V_{16}(1) =$	0.000056761
$V_4(2) =$	0.0075142	$V_8(2) =$	0.001270744	$V_{12}(2) =$	0.000214899	$V_{16}(2) =$	0.000556517

From the above table we see that given the information about the first 16 samples namely $S^{16} = (S_1, \dots, S_{16})$, the most possible set of states $(X_1, \dots, X_{16}) = (1, 1, 1, \dots, 1, 2)$. This is in conformity with our earlier findings.

4.CONCLUDING REMARKS

This paper attempts to propose a new method for process quality control using the theory of hidden Markov chains. The features of the proposed model are as follows:

Unlike control charts, the present method of quality control does not assume the normality or near normality assumption of the output.

2) The control chart methods require several charts to monitor different process characteristics of interest. However, this difficulty is overcome using the present method.

3) The decision on whether the process is operating under statistical control or not using traditional control chart methods is based on the last sample drawn. However, in the present method we take into consideration not only the last sample but

also the previous ones in making our decision.

Several information on the status of the process namely under or out of control can be extracted from the hidden Markov chain model. One is the probability of the status of the process at each of the instant when the samples are drawn. Another is the most likely states of the process at various instants of sampling.

Parameters like the elements of the one-step transition probability matrix of the state of the process $\{X_n\}$ and the conditional probabilities of the signals given the state could be determined based on the experience of the quality control engineer. But such estimates are empirical and hence a more scientific way of estimation will be useful.

The method computes the probability of the state of the system only. However, one needs to know the critical level for these probabilities below which we could safely conclude that the process has gone out of control.

The illustration provided deals with a variable quality characteristic. However, the method works as well when the quality characteristic is an attribute. This is because the classification of acceptable and unacceptable output quality is made naturally as defective

or non defective output. Thus, there is no need for the use of 2σ limits for such a classification.

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THE EFFECTS OF DIGITALIZATION ON TURKISH CARICATURE

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Abstract- Years of 2000's can be defined as "the digiral century". In this digital century, it is seen that digitallization creates new concepts and approaches and it even affects our daily lifes. Digitalization will be analyzed with the relationship between art and technology. Changes have seen on different areas of art both on style and contentment with digitalisation. In this study, it is aimed to underline digitalization, to investigate its effects on caricature, humor and the magazines in Turkey and to comment on what digitalization brings. Online books, online articles, online humor magazines are becoming popular. Internet makes caricature achievable freely and with the aid of social networking sites, digital caricatures can reach more people than the published ones.

Keywords: art, caricature, digitalization, humor

1. INTRODUCTION

The fundamental problem of communication is that of reproducing at one point either exactly or approximately a message selected at another point. Frequently the messages have *meaning*; that is they refer to or are correlated according to some system with certain physical or conceptual entities. These semantic aspects of communication are irrelevant to the engineering problem. The significant aspect is that the actual message is one *selected from a set* of possible messages. The system must be designed to operate for each possible selection, not just the one which will actually be chosen since this is unknown at the time of design.

If the number of messages in the set is finite then this number or any monotonic function of this number can be regarded as a measure of the information produced when one message is chosen from the set, all choices being equally likely. As was pointed out by Hartley the most natural choice is the logarithmic function. Although this definition must be generalized considerably when we consider the influence of the statistics of the message and when we have a continuous range of messages, we will in all cases use an essentially logarithmic measure.

The logarithmic measure is more convenient for various reasons:

1. It is practically more useful. Parameters of engineering importance such as time, bandwidth number of relays, etc., tend to vary linearly with the logarithm of the number of possibilities. For example, adding one relay to a group doubles the number of possible states of the relays. It adds 1 to the base 2 logarithm of this number. Doubling the time roughly squares the number of possible messages, or doubles the logarithm, etc.
2. It is nearer to our intuitive feeling as to the proper measure. This is closely related to (1) since we intuitively measures entities by linear comparison with common standards. One feels, for example, that two punched cards should have twice the capacity of one for information storage, and two identical channels twice the capacity of one for transmitting information¹.
3. It is mathematically more suitable. Many of the limiting operations are simple in terms of the logarithm but would require clumsy restatement in terms of the number of possibilities.

The choice of a logarithmic base corresponds to the choice of a unit for measuring information. If the base 2 is used the resulting

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units may be called binary digits, or more briefly *bits*, a word suggested by J. W. Tukey. A device with two stable positions, such as a relay or a flip-flop circuit, can store one bit of information. N such devices can store N bits, since the total number of possible states is $2N$ and $\log_2 2N = N$.

$$\log_2 2N = N \quad (1)$$

If the base 10 is used the units may be called decimal digits. Since a digit wheel on a desk computing machine has ten stable positions and therefore has a storage capacity of one decimal digit. In analytical work where integration and differentiation are involved the base e is sometimes useful. The resulting units of information will be called natural units. It consists of essentially five parts:

1. An *information source* which produces a message or sequence of messages to be communicated to the receiving terminal. The message may be of various types:
 - (a) A sequence of letters as in a telegraph or teletype system;
 - (b) A single function of time $f(t)$ as in radio or telephony;
 - (c) A function of time and other variables as in black and white television — here the message may be thought of as a function $f(x,y; t)$ of two space coordinates and time, the light intensity at point (x,y) and time t on a pickup tube plate;
 - (d) Two or more functions of time, say $f(t)$, $g(t)$, $h(t)$ —this is the case in “three dimensional” sound transmission or if the system is intended to service several individual channels in multiplex;
 - (e) Several functions of several variables—in color television the message consists of three functions $f(x,y; t)$, $g(x,y; t)$, $h(x,y; t)$ defined in a three-dimensional continuum—we may also think of these three functions as components of a vector field defined in the region — similarly, several black and white television sources would produce “messages” consisting of a number of functions of three variables;
 - (f) Various combinations also occur, for example in television with an associated audio channel.
2. A *transmitter* which operates on the message in some way to produce a signal suitable for transmission over the channel. In telephony this operation consists merely of changing sound pressure into a proportional electrical current. In telegraphy we have an encoding operation which produces a sequence of dots, dashes and spaces on the channel corresponding to the message. In a

multiplex PCM system the different speech functions must be sampled, compressed, quantized and encoded, and finally interleaved properly to construct the signal. Vocoder systems, television and frequency modulation are other examples of complex operations applied to the message to obtain the signal.

3. The *channel* is merely the medium used to transmit the signal from transmitter to receiver. It may be a pair of wires, a coaxial cable, a band of radio frequencies, a beam of light, etc.
4. The *receiver* ordinarily performs the inverse operation of that done by the transmitter, reconstructing the message from the signal.
5. The *destination* is the person (or thing) for whom the message is intended.

Teletype and telegraphy are two simple examples of a discrete channel for transmitting information. Generally, a discrete channel will mean a system whereby a sequence of choices from a finite set of elementary symbols S_1, \dots, S_n can be transmitted from one point to another. Each of the symbols S_i is assumed to have a certain duration in time t_i seconds (not necessarily the same for different S_i , for example the dots and dashes in telegraphy). It is not required that all possible sequences of the S_i be capable of transmission on the system; certain sequences only may be allowed. These will be possible signals for the channel [1]. Thus in telegraphy suppose the symbols are:

- (1) A dot, consisting of line closure for a unit of time and then line open for a unit of time;
 - (2) A dash, consisting of three time units of closure and one unit open;
 - (3) A letter space consisting of, say, three units of line open;
 - (4) A word space of six units of line open.
- We might place the restriction on allowable sequences that no spaces follow each other (for if two letter spaces are adjacent, it is identical with a word space). The question we now consider is how one can measure the capacity of such a channel to transmit information. In the teletype case where all symbols are of the same duration, and any sequence of the 32 symbols is allowed the answer is easy. Each symbol represents five bits of information. If the system transmits n symbols per second it is natural to say that the channel has a capacity of $5n$ bits per second. This does not mean that the teletype channel will always be transmitting information at this

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rate — this is the maximum possible rate and whether or not the actual rate reaches this maximum depends on the source of information which feeds the channel, as will appear later. In the more general case with different lengths of symbols and constraints on the allowed sequences, we make the following definition:

Definition: The capacity C of a discrete channel is given by

$$C = \lim_{T \rightarrow \infty} \frac{\log N(T)}{T} \quad (2)$$

where $N(T)$ is the number of allowed signals of duration T .

It is easily seen that in the teletype case this reduces to the previous result. It can be shown that the limit

in question will exist as a finite number in most cases of interest. Suppose all sequences of the symbols¹

S_1, \dots, S_n are allowed and these symbols have durations t_1, \dots, t_n .

If $N(t)$ represents the number of sequences of duration t , we have

$$N(t) = N(t - t_1) + N(t - t_2) + \dots + N(t - t_n) \quad (3)$$

The total number is equal to the sum of the numbers of sequences ending in S_1, S_2, \dots, S_n and these are

$$N(t - t_1), N(t - t_2), \dots, N(t - t_n) \quad (4)$$

respectively.

According to a well-known result in finite differences, $N(t)$ is asymptotic for large t to X_0^t where X_0 is the largest real solution of the characteristic equation:

$$X^{-t_1} + X^{-t_2} + \dots + X^{-t_n} = 1 \quad (5)$$

Mathematical theory of Shannon-Weaver is the first theory that defines communication as science and on mathematical scale. Mathematical Theory is also describing the systems as 1 or 2 due to its logical function ($\log_2 2N = N$) and it is the exact definition of digitalization. Digital systems are based on Shannon-Weaver's mathematical theory.

2. DIGITALIZATION

Digitalization is the conversion of analog information (word, image, letter) to electronic

signals that can be stored in the process of individual beats. Digitalization can be considered as the most important technological advancement contributing to many different areas. The integration of information can be possible with the digitalization of sound, image and text forms. Effects of digitalization has exceeded the limits of telecommunications. The ability to use sound, image and text together provides multimedia applications on computing systems. Communication devices such as music, photography, radio, television and computer are also digitalized [2].

3. DEFINITION AND THE HISTORY OF CARICATURE

A caricature is a simple image showing the features of its subject in a simplified or exaggerated way. In literature, a caricature is a description of a person using exaggeration of some characteristics and oversimplification of others. A caricature is the satirical illustration of a person or a thing, but a cartoon is the satirical illustration of an idea.

Cenap Sehabettin, the poetry of Servet-i Fünün, defines caricature as the reality of life. For Semseddin Sami Kamus-ı Türkî, caricature is the modified picture made for entertainment and fun. For Cemil Cem, one of the greatest caricaturists of Ottoman, defines caricature as the most valuable part of art [3-4].

Some of the earliest caricatures are found in the works of Leonardo da Vinci, who actively sought people with deformities to use as models. The point was to offer an impression of the original which was more striking than a portrait. Caricature experienced its first successes in the closed aristocratic circles of France and Italy, where such portraits could be passed about for mutual enjoyment. While the first book on caricature drawing to be published in England was Mary Darly's A Book of Caricaturas (c. 1762), the first known North American caricatures were drawn in 1759 during the battle for Quebec. These caricatures were the work of Brig.-Gen. George Townshend whose caricatures of British General James Wolfe, depicted as "Deformed and crass and hideous" (Snell), were drawn to amuse fellow officers. Elsewhere, two great practitioners of the art of

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caricature in 18th-century Britain were Thomas Rowlandson (1756–1827) and James Gillray (1757–1815). Rowlandson was more of an artist and his work took its inspiration mostly from the public at large. Gillray was more concerned with the vicious visual satirisation of political life. They were, however, great friends and caroused together in the pubs of London. See the Tate Gallery's exhibit "James Gillray: The Art of Caricature". In a lecture titled The History and Art of Caricature (September 2007, Queen Mary 2 Lecture theatre), the British caricaturist Ted Harrison said that the caricaturist can choose to either mock or wound the subject with an effective caricature. Drawing caricatures can simply be a form of entertainment and amusement – in which case gentle mockery is in order – or the art can be employed to make a serious social or political point. A caricaturist draws on (1) the natural characteristics of the subject (the big ears, long nose, etc.); (2) the acquired characteristics (stoop, scars, facial lines etc.); and (3) the vanities (choice of hair style, spectacles, clothes, expressions, and mannerisms).

Today, caricature has fans and readers from all over the world and can be sold as books and articles. Shannon-Weaver's mathematical theory can be considered as the starting point of digitalization. With digitalization, the most popular humour articles of Turkey (Uykusuz, Penguen,etc.) have their own official websites, fan pages on social networking sites (facebook, twitter,etc.) and they have formats that can be downloaded from internet. Also, there are completely online articles (Fenamizah, Obur mizah, etc.). Caricature and humour are digitalized in many ways.

4. THE RELATIONSHIP BETWEEN ART AND TECHNOLOGY

Art is to be changed and developed with technology from the period of drawing pictures of animals on cave walls to bronze age, from the ancient Greek and Egyptian period to renaissance, from Leonardo Da Vinci to Andy Warhol. Relationship between art and technology goes back to the paleolithic ages. The first examples of the art of painting, cartoon and caricature may be found in paleolithic ages. With the discovery of fire,

the pots and pans were produced and the production of ceramics had started. Metal ores were processed by melting and glass was formed from sand. After human being were able to come over their needs such as food, housing, etc., "aesthetic" and "beauty" concepts became important for them.

One of the best examples of the relationship between art and technology is the industrial revolution and modernism concept affecting our lives even today. Modernism is a result of the industrial revolution in the 18th century. By industrial revolution iron-steel, textile industries were born, mechanization was begun and the agricultural society had converted to industrial society. Labor class and the capitalism were born. Technological advances have changed the social life and art completely.

5. INDUSTRIAL REVOLUTION

The Industrial Revolution was the transition to new manufacturing processes that occurred in the period from about 1760 to some time between 1820 and 1840. This transition included going from hand production methods to machines, new chemical manufacturing and iron production processes, improved efficiency of water power, the increasing use of steam power and development of machine tools. The transition also included the change from wood and other bio-fuels to coal. The Industrial revolution began in Britain and within a few decades spread to Western Europe and the United States [5].

The Industrial Revolution marks a major turning point in history; almost every aspect of daily life was influenced in some way. Most notably, average income and population began to exhibit unprecedented sustained growth. In the words of Nobel Prize winner Robert E. Lucas, Jr., "For the first time in history, the living standards of the masses of ordinary people have begun to undergo sustained growth ... Nothing remotely like this economic behavior has happened before" [6].

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Figure 1. William Bell Scott, Iron and Coal, 1855-1860

The period of time covered by the Industrial Revolution varies with different historians. Eric Hobsbawm held that it 'broke out' in Britain in the 1780s and was not fully felt until the 1830s or 1840s, while T. S. Ashton held that it occurred roughly between 1760 and 1830 [7-8].

Some 20th-century historians such as John Clapham and Nicholas Crafts have argued that the process of economic and social change took place gradually and the term revolution is a misnomer. This is still a subject of debate among historians[9-10] . GDP per capita was broadly stable before the Industrial Revolution and the emergence of the modern capitalist economy [11]. The Industrial Revolution began an era of per-capita economic growth in capitalist economies [12]. Economic historians are in agreement that the onset of the Industrial Revolution is the most important event in the history of humanity since the domestication of animals and plants [13].

The First Industrial Revolution evolved into the Second Industrial Revolution in the transition years between 1840 and 1870, when technological and economic progress gained momentum with the increasing adoption of steam-powered boats, ships and railways, the large scale manufacture of machine tools and the increasing use of steam powered factories [14-16].

The causes of the Industrial Revolution were complicated and remain a topic for debate, with some historians believing the Revolution was an outgrowth of social and institutional changes brought by the end of feudalism in Britain after the English Civil War in the 17th century. As national border controls became more effective, the spread of disease was lessened, thereby preventing

the epidemics common in previous times [17]. The percentage of children who lived past infancy rose significantly, leading to a larger workforce. The Enclosure movement and the British Agricultural Revolution made food production more efficient and less labour-intensive, forcing the surplus population who could no longer find employment in agriculture into cottage industry, for example weaving, and in the longer term into the cities and the newly developed factories.

The colonial expansion of the 17th century with the accompanying development of international trade [18], creation of financial markets and accumulation of capital are also cited as factors, as is the scientific revolution of the 17th century [19].

Until the 1980s, it was universally believed by academic historians that technological innovation was the heart of the Industrial Revolution and the key enabling technology was the invention and improvement of the steam engine [20]. However, recent research into the Marketing Era has challenged the traditional, supply-oriented interpretation of the Industrial Revolution [21].

Lewis Mumford has proposed that the Industrial Revolution had its origins in the Early Middle Ages, much earlier than most estimates [22]. He explains that the model for standardised mass production was the printing press and that "the archetypal model for the industrial era was the clock". He also cites the monastic emphasis on order and time-keeping, as well as the fact that medieval cities had at their centre a church with bell ringing at regular intervals as being necessary precursors to a greater synchronisation necessary for later, more physical, manifestations such as the steam engine.

The presence of a large domestic market should also be considered an important driver of the Industrial Revolution, particularly explaining why it occurred in Britain. In other nations, such as France, markets were split up by local regions, which often imposed tolls and tariffs on goods traded among them [23]. Internal tariffs were abolished by Henry VIII of England, they survived in Russia till 1753, 1789 in France and 1839 in Spain.

Governments' grant of limited monopolies to inventors under a developing patent system

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(the Statute of Monopolies 1623) is considered an influential factor. The effects of patents, both good and ill, on the development of industrialisation are clearly illustrated in the history of the steam engine, the key enabling technology. In return for publicly revealing the workings of an invention the patent system rewarded inventors such as James Watt by allowing them to monopolise the production of the first steam engines, thereby rewarding inventors and increasing the pace of technological development. However, monopolies bring with them their own inefficiencies which may counterbalance, or even overbalance, the beneficial effects of publicising ingenuity and rewarding inventors [24]. Watt's monopoly may have prevented other inventors, such as Richard Trevithick, William Murdoch or Jonathan Hornblower, from introducing improved steam engines, thereby retarding the industrial revolution by about 16 years [25].

Industrial revolution brings new terms to art such as modernism. It is a great example of the relationship between art and technology.

6. MODERNISM AND POSTMODERNISM

Modernism, in its broadest definition, is modern thought, character, or practice. More specifically, the term describes the modernist movement in the arts, its set of cultural tendencies and associated cultural movements, originally arising from wide-scale and far-reaching changes to Western society in the late 19th and early 20th centuries. In particular the development of modern industrial societies and the rapid growth of cities, followed then by the horror of World War I, were among the factors that shaped modernism. In art, modernism explicitly rejects the ideology of realism and makes use of the works of the past, through the application of reprise, incorporation, rewriting, recapitulation, revision and parody in new forms. Modernism also rejects the lingering certainty of enlightenment thinking, as well as the idea of a compassionate, all-powerful creator [26]. In general, the term modernism encompasses the activities and output of those who felt the "traditional" forms of art, architecture, literature, religious faith, social organization and daily life were becoming outdated in the

new economic, social, and political conditions of an emerging fully industrialized world. The poet Ezra Pound's 1934 injunction to "Make it new!" was paradigmatic of the movement's approach towards the obsolete. Another paradigmatic exhortation was articulated by philosopher and composer Theodor Adorno, who, in the 1940s, challenged conventional surface coherence, and appearance of harmony typical of the rationality of enlightenment thinking. A salient characteristic of modernism is self-consciousness. This self-consciousness often led to experiments with form and work that draws attention to the processes and materials used. The modernist movement, at the beginning of the 20th century, marked the first time that the term *avant-garde*, with which the movement was labeled until the word "modernism" prevailed, was used for the arts.

Postmodernism is a general and wide-ranging term which is applied to literature, art, philosophy, architecture, fiction, and cultural and literary criticism, among others. Postmodernism is largely a reaction to the assumed certainty of scientific, or objective, efforts to explain reality. In essence, it stems from a recognition that reality is not simply mirrored in human understanding of it, but rather, is constructed as the mind tries to understand its own particular and personal reality. For this reason, postmodernism is highly skeptical of explanations which claim to be valid for all groups, cultures, traditions, or races, and instead focuses on the relative truths of each person. In the postmodern understanding, interpretation is everything; reality only comes into being through our interpretations of what the world means to us individually. Postmodernism relies on concrete experience over abstract principles, knowing always that the outcome of one's own experience will necessarily be fallible and relative, rather than certain and universal [27]. Postmodernism is "post" because it denies the existence of any ultimate principles, and it lacks the optimism of there being a scientific, philosophical, or religious truth which will explain everything for everybody - a characteristic of the so-called "modern" mind. The paradox of the postmodern position is that, in placing all principles under the scrutiny of its skepticism, it must realize that even its own principles are not beyond

questioning. As the philosopher Richard Tarnas states, postmodernism "cannot on its own principles ultimately justify itself any more than can the various metaphysical overviews against which the postmodern mind has defined itself."

7. ANALOG PERIOD OF CARICATURE IN TURKEY

Analog period of caricature in Turkey is starting with the Republican period to 1990s. With the technological advances in 1990s, analog period is almost ended and digital period is shown up. To discuss the history of caricature in Turkey, Teodor Kasap was the first caricaturist who published *Diyojen* in 1870. Caricature developed lately in Turkey as a result of the monarchic system in Ottoman Empire. It was hard for caricature to develop in a system opposite to criticism [28]. Caricature is based on the idea of criticism. Cem, Ramiz, Rıfkı and Münif Ferim were the other caricaturists before the foundation of Republic of Turkey. Cem was the first caricaturist with its criticizing attitude and his caricatures were on a level of international scale. Cemal Nadir was the first professional caricaturist that helped caricature to spread around Turkey as a discipline. He drew caricatures in *Aksam*, newspaper. Orhan Ural, Alexis, Sevki Cankaya, Sedat Nuri İleri were other names of caricature art.



Figure 2. A caricature of Kozma Togo in Republican period.

Ramiz-Cemal Nadir were popular in the Republican period of Turkish caricature. Ramiz as a caricaturist grown in the last years of the empire. He was an art teacher at the village school, while Cemal Nadir was drawing caricatures for the Turkish daily newspaper as an innovation in caricature. By the 1940s, Turkey had started to show progress on caricature. Selma Emoğlu, Mim

(Mustafa), Ali Ulvi, Semih Balçioğlu, Turhan Selçuk were the names of caricaturists that drew for humor magazines. In 1950s, caricaturists were named as "50th Generation" in Turkey. 50th Generation brought new concepts and applications to caricature with improved democracy in Turkey and caricature had found its place as an active expression language. Ferruh Dogan, Suat Flame, Cetin Yalcın, Nehar Tüblek, Tonguc Yasar, Bedri Koraman, Oguz Aral were powerful caricaturists of 50th Generation [28].

In 1960s, Turkish caricature entered a period of stagnation. The interest of readers decreased to caricature. Newspapers and magazines started to publish the caricatures of international caricaturists and only the famous caricaturists in Turkey. Young artists could not find enough chance and opportunity. One of the factors that caused stagnation in the level of caricature was graphic art, the expression became more complex with transmit symbols and new drawing techniques. Caricaturists were unable to find ideas to draw, caricaturists strated to illustrate the daily news. The idea of caricature for entertainment replaced with the caricature for the idea of philosophy. As a result, humor magazines had less number of readers. By 1970s, caricature became popular again. Semih Balçioğlu, Turhan Selçuk and Ferti Ongoren established The Cartoonists Association. In the process of self-renewal in the early 1970s cartoon, young artists had the chance to publish their caricatures in different magazines. In 1975, Turkey's first Cartoon Museum was founded in Istanbul. In 1980 to 1990, political events and economical crisis had affects on Turkish caricature. In 1980, *Gırgır*, one of the most demanded magazine of Turkey was closed. By 1990s, libertarian atmosphere is formed politically and caricature occurred as an important communication tool.

8. DIGITAL PERIOD OF CARICATURE IN TURKEY

The starting point of digital period of caricature in Turkey can be considered as 1990s with the development of technology especially computing systems. Digital period is started with 1990s and affecting today's caricature perceptions. Due to Jean Baudrillard's simulation theory, computer

technology refers to the changing perception of reality. Even the political processes in the world can be explained by simulation theory. In 1990s, the presence of computer technology affected Turkish caricature with changes in the formal and contextual. As it is defined in the mathematical theory of Shannon-Weaver as in Eqn.1, systems can be expressed with binary digital codes. The effectiveness of the digitalization is increased in the 2000s.



Figure 3. A caricature of Aziz Yavuzdogan in Digital period [29].



Figure 4. A caricature of Bahadir Ucan in Digital period.

In the 2000s, the popular humor magazines such as Uykusuz, Penguen, Gırgır and Leman have digital formats both on internet as official websites and both on social networking sites as new media products. Then, magazines had the opportunity to reach higher number of readers with digital formats than published, analog formats. In addition, the caricatures have been used as interactive communication tools that readers have the chance to comment on them. Online magazines are available such as Fenamizah, Obur mizah in Turkey that can be read freely. 21th century is the century of information and communication. The digitalization has become part of people's daily lives. More and cheaper devices, mobile phones, computers,

tablets, 3D televisions are produced. Also with the advantage of social networking sites, as well as the digitization of technological convenience mission, socializing on issues such as human relations have become a platform utilized and has become indispensable. All of these innovations and rapidly digitalized world, has its effects on humor and caricatures. Carticatures become one of the most demanded sharing units on social networking sites. With the emergence of e-magazines and new drawing techniques, humor and caricature had serious changes.

9. NEW DRAWING TECHNIQUES ON CARICATURE

Turkish caricature is affected by the process of digitalization as an art discipline.

With digitalization, caricature is started to be presented on computers. In Turkey, before 1980s the usage of computers were limited and especially on the Republican period, caricatures were hand-craft products and not colored. Crayons or guache paints were used for coloring but colorless works were preferable on the Republican period.

In 2000s, revolutionary changes are obtained in Turkish caricature. With the introduction of digitalization in our lives, the caricaturists began to transfer their works to computers or tablets either than manual ways. Drawing and animation programs such as photoshop, illustrator are being used to take the advantages of technology and near-perfect digital coloring is chosen rather than coloring manually. With computers and programs, caricaturists have the opportunity to fix the errors of classical methods. In addition, with animation programs caricaturists and graphic designers start to model 2d or 3d characters with computing systems. Characters of caricatures have the chance to be animated for films, commercials, etc. New sectoral formations occur as a result of technological advances and digitalization.

10. INTERNET AND E-MAGAZINES ON CARICATURE AND HOMOUR

In the digitalized world, in humor and caricature contextual and formal changes have taken place. Political and social events of the 2000s, advances in technology and

informatics, the ease of accessing to information have altered people's sense of humor that led caricature and humor to modification in terms of content. To examine the changes in substance and in forms, with digitalization the period of new media and e-magazines have begun. Published caricatures on the internet and the shared caricatures on the social networking sites met the millions. In this sense, social media has created a free market for caricatures and comics. When the numbers of readers of published Penguen, Uykusuz, Girgir, Leman compared with their digitalized formats, digitalized Uykusuz, Penguen, Girgir and Leman can reach much more people. Internet provides access to caricatures freely and widely.



Figure 5. E-magazines Fenamizah [30] and Puhuu Magazine [31]

11. DIGITALIZATION ON COMICS

Digitalization is supported with Eqn. 1. Also Eqn. 3 and 4 are the definitions of digitalization on electronics. On the side of art, comic heroes are major elements of the digitalized world. Comic heroes are on posters, books, magazines, computer games, movies, television and both on every printed or digital production and gain serious place in the world of cartoons. The developments in 3D technology, holograms result with more realistic visuals of animation.

Comics is an artistic medium in which images incorporate text or other visual forms of information in order to express a narrative or idea. Comics frequently takes the form of juxtaposed sequences of panels of images. Textual devices such as speech balloons, captions, and sound effects (onomatopoeia) are often used to indicate dialogue and other information. Elements such as the size and placement of panels control the pacing of the narrative. Cartooning and similar forms of illustration are the most common means of

image-making in comics, while fumetti is a form which uses photographs. Common forms of comics include comic books, comic strips, editorial and gag cartoons, graphic novels and webcomics.

The history of comics has followed divergent paths in different cultures. American comics emerged as a mass medium in the early 20th century with the advent of newspaper comic strips; magazine-style comic books followed in the 1930s. By the mid-20th century, comics became popular in periodical and book form, especially in the US, western Europe (particularly France and Belgium), and Japan. Since the late 20th century, bound volumes such as graphic novels and comics albums have become increasingly common. Comics has had a lowbrow reputation for much of its history, but towards the end of the 20th century began to find greater acceptance with the public and within academia.

The English term comics derives from the humorous or comic work which predominated in early American newspaper comic strips, though usage of the term has become standard for non-humorous works as well. It is common in English to refer to the comics of different cultures by the terms used in their original languages, such as manga for Japanese comics, or bandes dessinées for French-language comics. There is no consensus among theorists and historians on a definition of comics, with some emphasizing the combination of images and text, some sequentiality, and others historical aspects such as mass reproduction or the existence of recurring characters [32].

12. PROBLEM OF HAVING LIMITED COMIC HEROES IN TURKEY

There are not sufficient numbers of comic heroes in Turkey and as a result, sectoral development on animation cannot be achieved with insufficient numbers of television and cinema products of animation. In this sense, there can be obtained some examples of comic heroes such as Peppee, Keloglan in recent years but those examples are unable to meet the expectations. There can be said that Turkey has a problem of having limited heroes. There are some examples of tv animation channels in Turkey such as TRT Cocuk, D Cocuk contributing to Turkish

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animation. Even though, it is not possible to notice sectoral development and advance in Turkey. Other reasons can be listed as high investment costs, hardness on establishing team work, rivalry between caricaturists and animators and the needed time to produce a cinema film. In the digitalized world, Turkey is not able to put international samples of animations and export animation films.

13. CONCLUSION

Communication can be defined with mathematics and binary codes with mathematical theory of communication. It can be considered as the starting point of digitalization period. As a communication language and also as a discipline of art, caricature is also digitalized with 1990s. After 1990s, computing systems are developed and affected on different areas such as art, society and even on politics. As it is mentioned in the simulation theory of Shannon-Weaver, reality concept has changed and simulations take place of physical realities.

Digitalization becomes as one of the most important concepts of the 21th century. Digitalization causes significant improvements on science, art and technology and also on our daily lives. Considering the impact of digitalization in the world of comic, cartoon drawing techniques have altered, social media and e-magazines are occurred and comic heroes of cartoons become important actors in digital world. Digitalization on caricature and humour decreases the sales of published magazines with increasing the number of readers of e-magazines, caricatures on internet and social media. In the following years, it is predicted that people will be adopted to digital versions of caricature and humour and the classical reading habits will be modified to visual culture and digital systems in Turkey. Turkey is a country that is open to innovations with its young population. However, Turkey is not an active player in animation with limited numbers of comic heroes. With some channels such as TRT Cocuk, some activities have started to be shown but there is not sectoral development on animation. Animations are mostly used for commercials not for televisions or cinemas. On that point, Turkey should be on the side of

one of the most effective countries with its potential.

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PRIMARY SCHOOL FIFTH GRADE STUDENTS IN MATH ARE DONE TO COMPREHEND TOPICS TEACHING SMART BOARD APPLICATIONS FOR STUDENT FEEDBACK

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Abstract- *The purpose of this study in teaching primary fifth grade students in math are done to comprehend topics is to their views about the smart boards applications. Research Working Group has established, in the education year 2012-2013, on 111 students in a primary school studying in Istanbul, Fatih. The scanning model was used in the research. In this application, aritmatik mean and standard deviation values were used in the distribution of the students view. In the students views about Smart Board Practices in math lesson, 'ttest' was used to determine if there is a meaningful difference in gender thinking. According to the research findings, through the use of the smart board in the course of mathematics, students told that they had better understood the phrase the lesson, had been getting the increase in their interest and wasn't bored in the lesson. Another result obtained in research, students opinions has not been significantly different according to gender*

Keywords: smart board, primary school, views of students

1. INTRODUCTION

Tecnology is developing continuously at the present day and it has important role in our life. Social life is shaped according to this development and technological devices take part in daily life. If traditional method and techniques are used on during education-teaching, students who get into technolgy may not show an interest that lesson. Using visual and audotory devices in class increases success of students. Using material on education is very important for helping teacher and permanent education. Consequently education materials are benefitted from understanding subjects on education-teaching, teaching main points about subjects and increasing interests on lessons [5]

One of the using devices on class is smart board. It becomes widespread on developed country in recent years. Smart board contents a computer, a projection apparatus and a panel like a board has active surface.

Smart board is computurized This programme is enabled to using pictures, maps, formulas and easy artwork during lesson. Smart board can be used a computer screen with a pencil like a computers's mouse. Thanks to this lots of presentations loading computers or in flash

memory (video, animations office programmes) are opened and used easily [1].

2. AIM TO SEARCHING

This article's aim is expressing primary fifth class students' views about using smart board on math lessons. In this way important of smart board is understood according to other technological devices. Answers will be searched these questions:

1. What are primary fifth class students' views about using smart board on math lessons?
2. Is there any difference male or female students' views about using smart board on math lessons?

3.METHOD

Scanning model is used durig searching. Scanning model is an approach describing an event in past or at the present. A person, an object or an event is described literally during searching [6].

3. WORKING GROUP

The research population consisted of students are in Istanbul,Fatih at Aksaray Mahmudiye

primary school in 2012-2013 education and training year. Distributions of the students participating in the study by gender are given in Table I.

Table I: Sexes of working group

SEX	FEMALE		MALE		TOTAL
	f	%	F	%	
	56	50,5	55	49,5	111

Table II: Students with or without computer and internet connection at home

	Yes		No		TOTAL
	f	%	f	%	
with a computer at home	111	100	0	0	111
with connection interne at home	104	93,7	7	6,3	

As in the table-2 working group of %100 has a computer at home. Also working group of %93,7 has a connection internet and %6,3 has no connection internet at home. As in the table-2 families of working group think that computer and internet are necessary so they provide computer and internet facilities to their children.

4. DATA COLLECTION DEVICES

Overall survey is made by Ates (2010). The reliability and validity study which was used scale on searching was carried out. KMO coefficient of overall survey is 0.78, validity coefficient, Cronbach Alpha, is 83. These

results is shown that overall survey is too real and valid.(Büyüköztürk, 2010) The Overall survey which contents 20 expressions and Likert model was ordered and graded 'agree(3)', 'ambivalent(2)', 'disagree(1)'. Triple Likert model was chosen because fifth class students in working group can be answered the questions obviously.

5. ANALYSIS OF DATA

Arithmetic average and standard deviation was used with using smart board on math lesson of fifth class students' views."Independent sample T-Test " was used to carry out if there is difference according to sex or not.

Table III: The students in using smart board avarage and standard deviation of answer which given answers to understand

TITLES	X	SD
1. If my teacher uses a smart board on math lesson, subjects can be understood well.	2,87	0,46
2 .If smart board is used on math lessons subjects can be understood easily.	2,9	0,4
GENERAL AVARAGE	2,88	

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As in the table 1.3 using smart board on lessons of views with understanding are 2.88. This avarage is shown that most of the students

agree with these views If i look the title one by one, titles are similar to each other.

Table IV : The students in using smart board avarage and standard deviation of answers which given answers to technical advantage

TITLES	X	SD
3. My teacher's writing and drawing are understood with a smart board.	2,73	0,59
4. I can understand the subjects well with smart board and visual and audiotory materials	2,92	0,37
5. I can learn a subject different kind of resources thanks to smart board	2,98	0,4
GENERAL AVARAGE	2,87	

As in the table 1.4 the fifth class students in using smart board on lessons technological advantages of views are 2.87. This avarage is

shown that most of the students agree with these views. If i look the titles one by one, the titles are similar to each other.

Table V: Answers' avarage and standard deviation about teaching lessons with a smart board

TITLES	X	SD
10. I prefer lessons with a smart board	2,83	0,54
20. According to me, classic board isn't very different from smart board	1,27	0,63
GENERAL AVARAGE	1,95	

As in the table 1.5 views about using smart board on lessons are 1.95. This avarage is shown that students agree with these views in

middle level. Most of the students prefer using smart board to classical education.

Table VI: The students in using smart board avarage and standard deviation of answers which given answers to use smart board

TITLES	X	SD
8. I like using smart board in the class	2,92	0,37
9. I use smart board difficulty	1,15	0,48
11.Using smart board for showing my project to the class is disturbed me	1,18	0,51

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GENERAL AVERAGE	1,75
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As in the table 1.6 using smart board on lessons of views are 1.75. This avarage is

shown that students agree with these views in middle level.

Table VII: The students in using smart board avarage and standard deviation of answers which given answers about motivation

TITLES	X	SD
12. If lesson is taught with smart board, I can concentrate well.	2,7	0,68
13. If my teacher uses smart board, I will join the lesson more and more.	2,81	0,48
14. lessons are more interesting and amusing with smart board	2,91	0,36
15. I can pay attention with smart board easily	2,77	0,49
16. My motivation increases with smart board on math lessons	2,67	0,62
GENERAL AVERAGE	2,77	

As in the table 1.7 using smart board of views with motivation are 2.77 Most of the students agree with these views.

This result is shown that students' motivation increases with smart board.

Table VIII: The students in using smart board avarage and standard deviation of answers to plan lessons

TITLES	X	SD
18.If smart board is used, lessons will be planned and organised.	2,84	0,47
19.If smart board is used, we w,ll spend less time and learn more subjects in short time.	2,66	0,56
GENERAL AVERAGE	2,75	

As in the table 1.8 using smart board on lessons of views with planning the lessons are 2.75.

This avarage is shown that most of the students agrre with these views.

Table VIII: The students in using smart board on lessons avarage and standard deviation of answers which used smart board to carry out problems

TITLES	X	SD
6. I see hard time to time if sun lights are averted and there is defect of video	1,96	0,68
7. smart boards are often broken down and they can be corrected hard	1,81	0,7
17. I can't keep up to lesson when my teacher uses smart board	1,27	0,53
GENERAL AVARAGE		1,68

As in the table 1.9 the students in using smart board on lessons of views with planning the lessons are 1.68.

These avarage is shown that students agree with these views in middle level.

Table X: Views of using smart board according to sex

	Gender	N	Ort.	SD	S.error Avg.
Avarage	1,00	56	2,4134	,17825	,02382
	2,00	55	2,3918	,16771	,02261

As in the table 1.10 the fifth claas students' views about using smart board on math lessons aren't different from sex to sex.

6. CONCLUSION

The students in survey are happy about using smart board on lessons thanks to this they can understand the subjects well. Also if smart board is used on lessons, they can motivate easily and teacher's drawing and wrting are more understandable. Most of the students prefer learning a subject with smart board. Furthermore they like using smart board and showing their project to he class but they use smart board hard. They emphasise problems which is not being averted sun lighths and defect of video. Anyway teacher teachs a subject quicker with smart board and students can't pay attention that kind of quick lessons. But they say that lessons are more planned with smart board. Finally views aren't different from sex to sex.

7. DISCUSSIONS

Seminars for teachers should be given regarding the use of smart board and it is ensured an effective usage. Not only using for

pp presentation but also users are encouraged to use the other facilities of the smart board. It is suppoted to promote by making scientific research. Teachers shouldn't think that they are only owners of the boards. They should allow to students to use them. Teachers shouldn't study fast when they explain the lesson on the board. Gains should be finished in the limited time.

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CUSP FORMS AND NUMBER OF REPRESENTATIONS OF POSITIVE INTEGERS BY DIRECT SUM OF BINARY QUADRATIC FORMS

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Abstract-In this study, we calculated all reduced primitive binary quadratic forms which are $F_1 = x_1^2 + x_1x_2 + 8x_2^2$, $\Phi_1 = 2x_1^2 + x_1x_2 + 4x_2^2$, $\Phi'_1 = 2x_1^2 - x_1x_2 + 4x_2^2$. We find the theta series Θ_Q , Eisenstein part of Θ_Q and the generalized theta series which are cusp forms by computing some spherical functions of second order with respect to Q . We obtain a basis of the subspace of $S_4(\Gamma_0(31))$. Explicit formulas are obtained for the number of representations of positive integers by all direct sum of three quadratic forms $F_1 = x_1^2 + x_1x_2 + 8x_2^2$, $\Phi_1 = 2x_1^2 + x_1x_2 + 4x_2^2$, $\Phi'_1 = 2x_1^2 - x_1x_2 + 4x_2^2$.

Keywords: Positive Definite Quadratic Forms, Spherical Functions, Theta Series, Cusp Forms, Eisenstein Series

1. INTRODUCTION

Modular forms have played an significant role in the mathematics of the 19th and 20th centuries, mostly in the theory of elliptic functions and quadratic forms. Quadratic forms occupy a central place in number theory, linear algebra, group theory, differential geometry, differential topology, Lie theory, coding theory and cryptology.

In this study, we focus on how to find a formula which solve problem of representation numbers of quadratic forms with discriminant -31 . All calculations have been done by Maple.

Here, we will follow the method described in [1,2,6] to determine the number of representations of some direct sum of quadratic forms of discriminant -31 .

Let Δ be a negative integer such that

$$\Delta = \begin{cases} 4d & \text{if } d \equiv 2,3 \pmod{4} \\ d & \text{if } d \equiv 1 \pmod{4} \end{cases}$$

where d is square-free integer. It is called fundamental discriminant. Let $r(n; Q)$ denote the number of representations of n by Q .

Let $r(n; Q)$ denote the number of representations of n by Q . It is known that there exists a one-to-one correspondence between $SL(2, \mathbb{Z})$ equivalence classes of positive definite binary quadratic forms

$$Q = ax^2 + bxy + cy^2$$

with integral coefficients of fundamental discriminant Δ and ideal classes of imaginary quadratic field $Q(\sqrt{d})$. In this correspondence, the number $r(n; Q)$ of representations of integer n by Q

$$Q = n$$

is equal to the number w of roots of 1 in $Q(\sqrt{d})$ times the number of ideals in the corresponding ideal class of norm n . Let

$$\Theta_Q(q) = \sum_{(x,y) \in \mathbb{Z} \times \mathbb{Z}} q^{Q(x,y)} = \sum_{n=0}^{\infty} r(n; Q) q^n$$

be the theta function associated to positive definite quadratic form Q .

In this formulas Φ_1 can be replaced by its

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It is known that it is a modular form of weight 1 with Dirichlet character

$$\chi(a) = \left(\frac{\Delta}{a} \right)$$

expressed by Kronecker symbol. In fact it is Legendre symbol if a is an odd prime.

There exist 3 inequivalent classes of binary quadratic forms of discriminant -31 whose reduced primitive binary quadratic forms are

$$F_1 = x_1^2 + x_1x_2 + 8x_2^2$$

$$\Phi_1 = 2x_1^2 + x_1x_2 + 4x_2^2$$

$$\Phi'_1 = 2x_1^2 - x_1x_2 + 4x_2^2$$

Here, F_1 is the identity element. Φ'_1 is the inverse of Φ_1 .

Since -31 is prime number then there is only one genus, i.e., the principal genus.

F_k, Φ_k denote the k direct sum of F_1, Φ_1 respectively for $k \geq 1$. These binary quadratic forms form a group whose order is 3 such that

$$\Phi_1, \Phi_1^2 = \Phi'_1, \Phi_1^3 = F_1$$

In this paper, formulas for $r(n; Q)$ are derived for any positive integer associated tot he following quadratic forms

$$Q = F_4, \Phi_4, F_1 \oplus \Phi_3, F_2 \oplus \Phi_2, F_3 \oplus \Phi_1.$$

inverse Φ'_1 .

2. POSITIVE DEFINITE FORMS

Let $Q = ax^2 + bxy + cy^2$. A binary quadratic form is primitive if the integer a, b and c are relatively prime. Moreover, if $\Delta = b^2 - 4ac < 0$ and $a > 0$ then $Q(x, y)$ is positive definite. $M_k(\Gamma_0(N), \chi_\Delta)$ denotes the space of modular forms on $\Gamma_0(N)$ of weight k , with character χ_Δ . $S_{k+2}(\Gamma_0(N), \chi_\Delta)$ denotes the space of all cusp forms of weight k , with character χ_Δ . Definition 1 Let Q be a positive definite quadratic form of $2k$ variables

$$Q = \sum_{1 \leq i \leq j \leq 2k}^{2k} b_{ij} x_i x_j, b_{ij} \in \mathbb{Z}$$

and the matrix A defined by

$$a_{ii} = 2b_{ii}, a_{ji} = a_{ij} = b_{ij} \text{ for } i < j$$

Let D be the determinant of the matrix A and A_{ij} the cofactors of A for $1 \leq i, j \leq 2k$. If $\delta = \gcd\left(\frac{A_{ii}}{2}, A_{ij} \text{ for } 1 \leq i, j \leq 2k\right)$, then

$N := \frac{D}{\delta}$ is the smallest positive integer, called the level of Q , for which NA^{-1} is again an even integral matrix like A . $\Delta = (-1)^k D$ is called the discriminant of the form Q .

Theorem 1 Let $Q: \mathbb{Z}^{2k} \rightarrow \mathbb{Z}$ be a positive definite integer valued form of $2k$ variables of level N and discriminant Δ . Then

1. The theta function

$\theta_Q(q) = \sum_{(n_1, n_2, \dots, n_k) \in \mathbb{Z} \times \mathbb{Z} \times \dots \times \mathbb{Z}} q^{Q(n_1, n_2, \dots, n_k)} = 1 + \sum_{n=1}^{\infty} r(n; Q) q^n, q = e^{2\pi iz} (*)$
is a modular form on $\Gamma_0(N)$ of weight k and character χ_Δ , i.e., $\theta_Q \in M_k(\Gamma_0(N), \chi_\Delta)$, where $\chi_\Delta(d) := \left(\frac{\Delta}{d} \right)$, $d \in (\mathbb{Z}/N\mathbb{Z})^\times$, $\left(\frac{\Delta}{d} \right)$ is the Kronecker character.

2. The homogeneous quadratic polynomials in $2k$ variables $\varphi_{ij} = x_i x_j - \frac{1}{2k} \frac{A_{ij}}{D} 2Q, 1 \leq i, j \leq 2k$ are spherical functions of second order with respect to Q . (**)

3. The theta series $\Theta_{Q, \varphi_{ij}}(q) = \sum_{n=1}^{\infty} (\sum_{Q=n} \varphi_{ij}) q^n$ is a cusp form in $S_{k+2}(\Gamma_0(N), \chi_\Delta)$. (***)

4. If two quadratic forms Q_1, Q_2 have the same level N and the characters $\chi_1(d), \chi_2(d)$ respectively, then the direct sum $Q_1 \oplus Q_2$ of the quadratic forms has the same level N and the character $\chi_1(d), \chi_2(d)$.

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Now, let's look at the positive definite quadratic forms of discriminant -31 .

1- For the quadratic form
 $F_1 = x_1^2 + x_1x_2 + 8x_2^2,$

$$2F_1 = 2x_1^2 + 2x_1x_2 + 16x_2^2 = (x_1, x_2) \begin{pmatrix} 2 & 1 \\ 1 & 16 \end{pmatrix} \begin{pmatrix} x_1 \\ x_2 \end{pmatrix}$$

the determinant of the matrix and cofactors are $D = 31, A_{11} = 16, A_{12} = A_{21} = -1, A_{22} = 2.$
So $\delta = 1, N = D = 31$ and the discriminant is $\Delta = (-1)^{2/2}31 = -31.$ The character of F_1 is the Kronecker Symbol $\chi(d) = \left(\frac{-31}{d}\right).$

2. For the quadratic form
 $\Phi_1 = 2x_1^2 + x_1x_2 + 4x_2^2,$

$$2\Phi_1 = 4x_1^2 + 2x_1x_2 + 8x_2^2 = (x_1, x_2) \begin{pmatrix} 4 & 1 \\ 1 & 8 \end{pmatrix} \begin{pmatrix} x_1 \\ x_2 \end{pmatrix}$$

the determinant of the matrix and cofactors are $D = 31, A_{11} = 8, A_{12} = A_{21} = -1, A_{22} = 4.$
So $\delta = 1, N = D = 31$ and the discriminant is $\Delta = (-1)^{2/2}31 = -31.$ The character of Φ_1 is the Kronecker Symbol $\chi(d) = \left(\frac{-31}{d}\right).$

Consequently, F_1, Φ_1 are quadratic forms whose theta series are in $M_1\left(\Gamma_0(31), \left(\frac{-31}{d}\right)\right).$
Hence $F_2, \Phi_2, F_1 \oplus \Phi_1$ are quadratic forms whose theta series are in $M_2\left(\Gamma_0(31)\right).$
Obviously there are only two inequivalent cusps $i\infty$ and 0 for $\Gamma_0(31).$

Theorem 2 Let Q be a positive definite form of $2k$ variables, $k = 4, 6, 8, \dots$, whose theta series Θ_Q is in $M_k\left(\Gamma_0(p)\right)$, p prime, then the Eisenstein part of Θ_Q is

$$E(q; Q) = 1 + \sum_{n=1}^{\infty} (\alpha \sigma_{k-1}(n) q^n + \beta \sigma_{k-1}(n) q^{pn})$$

Where

$$\alpha = \frac{i^k p^{k/2} - i^k}{\rho_k p^{k-1}}$$

$$\beta = \frac{1}{\rho_k} \frac{p^{k-1} p^{k/2}}{p^{k-1}}$$

$$\rho_k = (-1)^{k/2} \frac{(k-1)!}{(2\pi)^k} \zeta(k)$$

Corollary 1 Let Q be a positive definite quadratic form of 8 variables whose theta series Θ_Q is in $M_4\left(\Gamma_0(31)\right)$, then the Eisenstein

part of Θ_Q is

$$E(q; Q) = 1 + \sum_{n=1}^{\infty} (\alpha \sigma_3(n) q^n + \beta \sigma_3(n) q^{31n})$$

Where

$$\rho_4 = \frac{3!}{(2\pi)^4} \zeta(4) = \frac{1}{240}$$

$$\alpha = 240 \frac{31^2 - 1}{31^4 - 1} = \frac{120}{481}$$

$$\beta = 240 \frac{31^4 - 31^2}{31^4 - 1} = \frac{115320}{481}$$

3.SELECTION OF SPHERICAL FUNCTIONS

In order to find the generalized theta series corresponding to spherical functions, we will determine the spherical functions of second order with respect to Q , see [3,9].

1. For the quadratic form

$$2F_2 = 2x_1^2 + 2x_1x_2 + 16x_2^2 + 2x_3^2 + 2x_3x_4 + 16x_4^2$$

$$= (x_1, x_2, x_3, x_4) \begin{pmatrix} 2 & 1 & 0 & 0 \\ 1 & 16 & 0 & 0 \\ 0 & 0 & 2 & 1 \\ 0 & 0 & 1 & 16 \end{pmatrix},$$

the determinant $D = 31^2, A_{11} = 16 \cdot 31.$

$$\varphi_{11} = x_1x_1 - \frac{1}{4} \frac{A_{11}}{D} 2F_2 = x_1^2 - \frac{8}{31} F_2$$

which will be spherical function of second order with respect to $F_2.$

2. For the quadratic form

$$2\Phi_2 = 4x_1^2 + 2x_1x_2 + 8x_2^2 + 4x_3^2 + 2x_3x_4 + 8x_4^2$$

$$= (x_1, x_2, x_3, x_4) \begin{pmatrix} 4 & 1 & 0 & 0 \\ 1 & 8 & 0 & 0 \\ 0 & 0 & 4 & 1 \\ 0 & 0 & 1 & 8 \end{pmatrix},$$

the determinant

$$D = 31^2, A_{11} = 8 \cdot 31, A_{12} = -31$$

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$$\begin{aligned}\varphi_{11} &= x_1x_1 - \frac{1}{4} \frac{A_{11}}{D} 2\Phi_2 = x_1^2 - \frac{4}{31}\Phi_2 \\ \varphi_{12} &= x_1x_2 - \frac{1}{4} \frac{A_{12}}{D} 2\Phi_2 = x_1x_2 + \frac{1}{62}\Phi_2\end{aligned}$$

which will be spherical functions of second order with respect to Φ_2 .

3. For the quadratic form

$$2(F_1 \oplus \Phi_1) = 2x_1^2 + 2x_1x_2 + 16x_2^2 + 4x_3^2 + 2x_3x_4 + 8x_4^2$$

$$= (x_1, x_2, x_3, x_4) \begin{pmatrix} 2 & 1 & 0 & 0 \\ 1 & 16 & 0 & 0 \\ 0 & 0 & 4 & 1 \\ 0 & 0 & 1 & 8 \end{pmatrix},$$

the determinant

$$D = 31^2, A_{11} = 16.31, A_{12} = -31, A_{33} = 8.31$$

$$\varphi_{11} = x_1x_1 - \frac{1}{4} \frac{A_{11}}{D} 2(F_1 \oplus \Phi_1) = x_1^2 - \frac{8}{31}(F_1 \oplus \Phi_1)$$

$$\varphi_{12} = x_1x_2 - \frac{1}{4} \frac{A_{12}}{D} 2(F_1 \oplus \Phi_1) = x_1x_2 + \frac{1}{62}(F_1 \oplus \Phi_1)$$

$$\varphi_{33} = x_3x_3 - \frac{1}{4} \frac{A_{33}}{D} 2(F_1 \oplus \Phi_1) = x_3^2 - \frac{4}{31}(F_1 \oplus \Phi_1)$$

which will be spherical functions of second order with respect to $(F_1 \oplus \Phi_1)$.

Now, we will construct a basis of a subspace $S_4(\Gamma_0(31))$ of dimension 6. The general information about the modular forms $M_k(\Gamma_0(N), \chi)$ of weight k of the group $\Gamma_0(N)$ with Dirichlet character χ and the cusp forms $S_k(\Gamma_0(N), \chi)$ of weight k of the group $\Gamma_0(N)$ with Dirichlet character χ are given in details in [5,3,4,8].

Theorem 3 *The set of the following generalized 6 generalized theta series is a basis of the subspace of $S_4(\Gamma_0(31))$ spanned by all generalized theta series of the form (**) induced by spherical functions of the form (***)*.

$$\Theta_{F_2, \varphi_{11}} = \frac{1}{31} \sum_{n=1}^{\infty} \left(\sum_{F_2=n} 31x_1^2 - 8F_2 \right)$$

$$\Theta_{\Phi_2, \varphi_{11}} = \frac{1}{31} \sum_{n=1}^{\infty} \left(\sum_{F_2=n} 31x_1^2 - 4\Phi_2 \right)$$

$$\Theta_{\Phi_2, \varphi_{12}} = \frac{1}{62} \sum_{n=1}^{\infty} \left(\sum_{F_2=n} 62x_1x_2 + \Phi_2 \right)$$

$$\Theta_{(F_1 \oplus \Phi_1), \varphi_{11}} = \frac{1}{31} \sum_{n=1}^{\infty} \left(\sum_{F_2=n} 31x_1^2 - 8(F_1 \oplus \Phi_1) \right)$$

$$\Theta_{(F_1 \oplus \Phi_1), \varphi_{12}} = \frac{1}{62} \sum_{n=1}^{\infty} \left(\sum_{F_2=n} 62x_1x_2 + (F_1 \oplus \Phi_1) \right)$$

$$\Theta_{(F_1 \oplus \Phi_1), \varphi_{33}} = \frac{1}{31} \sum_{n=1}^{\infty} \left(\sum_{F_2=n} 31x_3^2 - 4(F_1 \oplus \Phi_1) \right)$$

Proof. The series are cusp forms because of Theorem 1.

Therefore, the generalized theta series associated to spherical functions can be calculated as follows:

$$\Theta_{F_2, \varphi_{11}} = \frac{1}{31} \sum_{n=1}^{\infty} \left(\sum_{F_2=n} 31x_1^2 - 8F_2 \right)$$

$$= \frac{1}{31} (30q + 60q^2 + 120q^4 + 300q^5 + \dots)$$

$$\Theta_{\Phi_2, \varphi_{11}} = \frac{1}{31} \sum_{n=1}^{\infty} \left(\sum_{F_2=n} 31x_1^2 - 4\Phi_2 \right)$$

$$= \frac{1}{31} (30q^2 - 4q^4 - 18q^5 - 68q^6 - 26q^7 + \dots)$$

$$\Theta_{\Phi_2, \varphi_{12}} = \frac{1}{62} \sum_{n=1}^{\infty} \left(\sum_{F_2=n} 62x_1x_2 + \Phi_2 \right)$$

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$$= \frac{1}{31} (4q^2 + 16q^4 - 52q^5 + 24q^6 - 20q^7 + \dots)$$

$$\Theta_{(F_1 \oplus \Phi_1), \varphi_{11}} = \frac{1}{31} \sum_{n=1}^{\infty} \left(\sum_{F_2=n} 31x_1^2 - 8(F_1 \oplus \Phi_1) \right)$$

$$= \frac{1}{31} (46q - 32q^2 + 28q^3 + 120q^4 - 116q^5 + 236q^6 - 112q^7 + \dots)$$

$$\Theta_{(F_1 \oplus \Phi_1), \varphi_{12}} = \frac{1}{62} \sum_{n=1}^{\infty} \left(\sum_{F_2=n} 62x_1x_2 + (F_1 \oplus \Phi_1) \right)$$

$$= \frac{1}{31} (q + 2q^2 + 6q^3 + 8q^4 + 15q^5 + 24q^6 + 7q^7 + \dots)$$

$$\Theta_{(F_1 \oplus \Phi_1), \varphi_{33}} = \frac{1}{31} \sum_{n=1}^{\infty} \left(\sum_{F_2=n} 31x_3^2 - 4(F_1 \oplus \Phi_1) \right)$$

$$= \frac{1}{31} (-8q + 46q^2 + 76q^3 - 64q^4 - 58q^5 + 56q^6 + 6q^7 + \dots)$$

4.CONCLUSION

According to (*) we can obtain $\Theta_{F_1} = 1 + 2q + 2q^4 + \dots$ and

$$\Theta_{\Phi_1} = 1 + 2q^2 + 2q^4 + 2q^5 + 2q^7 + \dots.$$

Then we can obtain theta series of quadratic forms $F_4, \Phi_4, F_1 \oplus \Phi_3, F_2 \oplus \Phi_2, F_3 \oplus \Phi_1$ by direct sum of Θ_{F_1} and Θ_{Φ_1} . By subtracting any one of these theta series by Eisenstein series, we get a linear combination of the generalized theta series.

$$r(n; Q) = \Theta_Q(q) - E(q; Q) =$$

$$c_1 \Theta_{F_2, \varphi_{11}}(q) + c_2 \Theta_{\Phi_2, \varphi_{11}}(q) + c_3 \Theta_{\Phi_2, \varphi_{12}}(q) + c_4 \Theta_{F_1 \oplus \Phi_1, \varphi_{11}}(q) + c_5 \Theta_{F_1 \oplus \Phi_1, \varphi_{12}}(q) + c_6 \Theta_{F_1 \oplus \Phi_1, \varphi_{33}}(q)$$

By equating the coefficients of q^n in both sides for $n = 1, 2, 3, 4, 5, 6, 7$, we can find out

$$c_1, c_2, c_3, c_4, c_5, c_6.$$

From these identities, we get the formulas for $r(n; F_4), r(n; \Phi_4), r(n; F_1 \oplus \Phi_3), r(n; F_2 \oplus \Phi_2), r(n; F_3 \oplus \Phi_1)$.

(See [6])

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EVALUATION OF THE UNIVERSITY STUDENTS' OPINIONS ON ENVIRONMENTAL AWARENESS USING DATA MINING ASSOCIATION RULE

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Abstract- Environment is an indispensable surrounding atmosphere for the living things to survive. However, there has begun to emerge some problems in parallel with the increase in the number of living things on earth. Especially, when the harm people give to the environment is taken into consideration, it is seen that people aren't given adequate training on environment. If the damage to the environment isn't prevented, it is inevitable to expect major dangers. Environment conscious individuals should be educated from childhood. But since people tend to change their ideas over time, education on environment should be set in a specific structure. In this work, the survey carried out with the candidate teachers about the effect of environmental awareness on those who instruct and their views on environmental education is evaluated.

Keywords: Environmental awareness, environmental education, data mining, association rule

1. INTRODUCTION

Environment, in general, is defined as the surrounding for living things. Ecologically, it is a term that covers everything related to the individual either alive or dead [1].

Natural environment is the environment where natural activities and natural forces are formed and where human effect isn't seen. People are constantly in interaction with nature. Throughout their lives, by developing technology and doing various economical activities, they have constituted an unnatural environment [2].

The main reason for the emergence of environmental problems is human. To overcome these problems, people must be taught the responsibilities incumbent upon them. Achieving this will only be possible with an effective environmental education [3].

The Constitution of 1982, 56th article stipulates that "Everyone has the right to live in a healthy and balanced environment, and improving the environment, preserving it and preventing the environmental pollution are the duties of every citizen and the state." According to this article in the Constitution, people's living in a healthy and a proper environment depends upon their fulfilling their responsibilities. The most effective way to make people gain environmental awareness is to increase and generalize environmental education. Environmental education should cover all the society to increase the sensitivity of people about

the environment and gain permanent changes in their behaviors. The main objective of environmental education is to contribute to the people who have completed their education to be equipped with incentive knowledge and skills on being sensitive to the environmental issues [4].

Primary and secondary education institutions are responsible for providing training on environmental issues. But on the other hand, basic content and courses related to the environment are not available in higher education. When the faculties of education are examined, it is seen that only a few number of branches teach the environmental issues. These departments are Science Education, Social Studies Education, Primary School Education, Biology Education and Geography Education departments. Courses include no more than Environmental Science, Environmental Issues, Environmental Education, and Contemporary World Issues. It can be said that the situation is not enough to create environmental awareness over students [5].

So far a lot of studies have been done on environmental awareness and environmental education, and these studies were analyzed in different methods and dimension. Girls are found to be more sensitive than boys according to some sources, but some others reported that it did not change according to gender and that environmental awareness is not in the desired level. Studies have shown that, the sensitivity to the environment vary in different age groups but not too much [5,6]. In

addition, it has been stated that the most important factor in creating environmental awareness is environmental education [7,8], and that the education on environment should be extended [9]. Women are seen to be more interested in the training given on environment and the training is also stated to be useful [10]. In all educational levels from pre-school to university, according to variables such as students' gender and age, changes in their attitude and behavior were investigated [11]. In increasing the sensitivity to the environment, especially primary school students' project-based educational system has been observed to be more effective [5,12].

Computer-based education system is becoming more common in environmental education. Providing training to people in a virtual environment promotes learning. Furthermore, mobile devices offer a variety in environmental education. The electronic notes provide students with important opportunities in learning. Mobile devices are quite useful because they are easily portable. In particular, environmental education and eco-tourism projects can easily be used [13].

In another study, it has been found out that students contribute to environmental sensitivity by sharing the photos they have taken and sending these photos via messages. In this study, men are found to be more sensitive than women. Besides these, environmental awareness has been reported to vary according to age and their average marks [14].

2. DATA MINING

Data mining is a field of computer science and statistics that has been developed for exploration and analysis of large quantities of data to discover meaningful patterns and rules. Data mining includes various techniques including decision tree, statistics, neural networks, genetic algorithm and visualization techniques.

2.1. Association Rule

In data mining association rule learning is a popular and well researched method for discovering interesting relations between variables in large databases. Piatetsky-Shapiro defines analyzing and presenting strong rules discovered in databases using different measures of interestingness [16]. Based on the concept of strong rules, introduced association rules for discovering regularities between products in large-scale transaction data recorded by point-of-sale (POS) systems in supermarket. For example the rule {onions,potatoes} \Rightarrow {burger} found in the sales data of a supermarket would indicate that if a customer buys onions and potatoes together, he or she is likely to also buy hamburger meat. Following the original definition by Agrawal et al.

The problem of association rule meaning is defined as: $I=\{i_1, i_2, \dots, i_n\}$ Let be a set of n binary attributes called items. Let $D = \{t_1, t_2, \dots, t_m\}$ be a set of transactions called the database [17].

2.2. Apriori Algorithm

Witten I. H. at al said "Apriori algorithm meet minimum support and confidence for generating association rules. Apriori follows a generate-and-test methodology for finding frequent item sets and generating successively longer candidate item sets. Each different size of candidate item set requires a scan through the dataset to determine whether its frequency exceeds the minimum support threshold. Although some improvements to the algorithm have been suggested to reduce the number of scans of the dataset, the combinational nature of this generation process can prove costly and particularly" [18].

3. WAIKATO ENVIRONMENT FOR KNOWLEDGE ANALYSIS (WEKA)

Weka, developed by the University of Waikato containing machine learning algorithms, is an open source data mining program [19]. WEKA contains a variety of data pre-processing, classification, regression, clustering, association rules, and visualization tools. Algorithms can be applied directly to dataset or it can be called from java code [20]. We can see some menus about weka in figure 1. Explorer menu is the most widely used menu in weka. It enables to perform some processes step by step in visual environment. When you open the Explorer menu, open the screen shown in Figure 2. The data can be imported to weka as arf, csv and C4.5 formats and also attribute selection and filtering can be done on this screen. Simple CLI menu provides run to command mode and knowledge flow provides to achieve the project using drag and drop method.

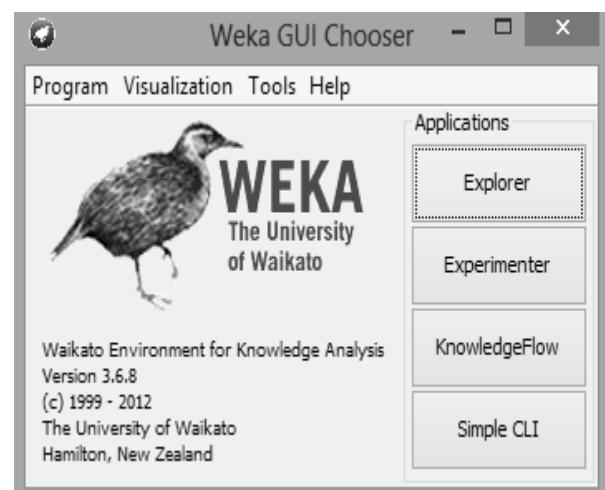


Figure 1: Weka start-up screen

4. METHOD

4.1. Data Sources

In this study, students studying in the spring semester of the 2010-2011 academic year in Samsun Ondokuz Mayıs University in the Faculty of Education (234 female, 130 male) with a total of 364 were randomly chosen. The number of students according to their gender is presented in Table I.

Variable	Level	N	%
Gender	Female	234	64.29
	Male	130	35.71
	Total	364	100.0

Table I : The sample distribution by gender

4.2. Data Collection

In the study, a questionnaire consisting of 39 questions and 2 sections were used. First section is Personal Information Form. Second section is Awareness on The Environment Scales. The second part was divided into 5 categories [21]. These sections are:

1. Opinions about environmental issues
2. Environmental awareness
3. Sensitivity to the environment
4. Precautions to be taken on environmental issues
5. Authorities' efforts on environmental challenges;

In the students' personal information form, there are questions which aim to determine the independent variables related to him and his family.

1. Gender

2. Departments

3. The region they came from

4. Number of siblings

4.3 Data Evaluation

In this study, data on the results of the survey were used in excel. The data is then converted to csv format and then according to the data mining association rule they are evaluated with Weka 3.6 software. Apriori algorithm is used in evaluation and analysis has been done by trying different combinations of attributes. Minimum support is used as 0.1 in analysis part. Different values are tried on confidence and some rules are revealed shown in Figure 3.

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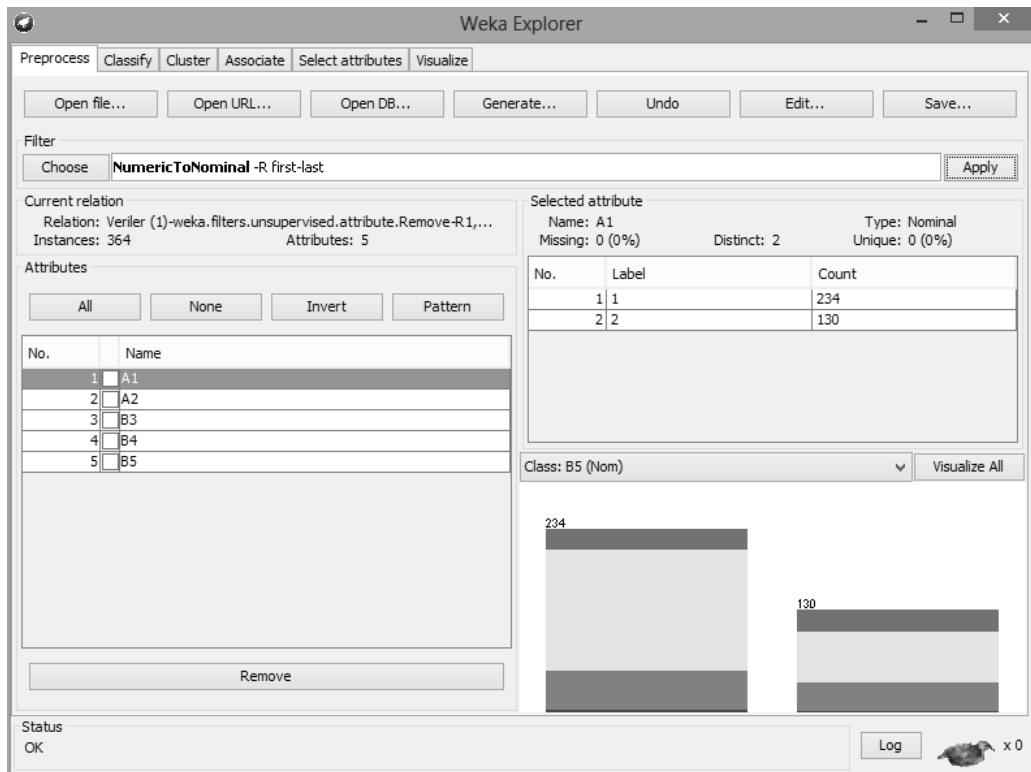


Figure 2: Training Set Sample

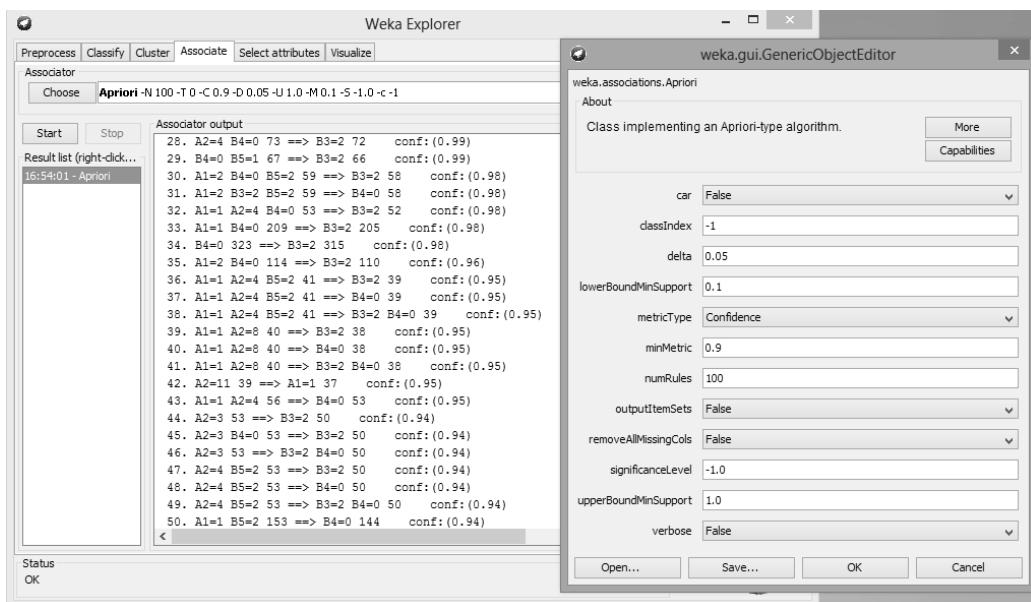


Figure 3: Association rule results

4.4. Findings

	Level	F	%	Variable	Level	F	%
Gender	Female	234	64.29	Regions	Black See	223	61.26
	Male	130	37.71		Marmara	47	12.91
	TOTAL	364	100.0		Aegean	11	3.02
Departments	Social Studies	7	7.2		Mediterranean	18	4.94
	Science	18	11.0		Southeastern Anatolia	12	3.29
	Elementary Education	53	9.7		Central Anatolia	44	12.08
	Turkish Education	78	14.4		Eastern Anatolia	9	2.50
	Chemistry	41	7.4		Total	364	100.0
	Mathematics	68	12.4	Number of Siblings	Blank	1	0.27
	Educational Science	14	11.7		None	14	3.84
	Computer Edu.	41	7.4		1-2	186	51.10
	Preschool Ed.	39	7.0		3-4	115	31.60
	Others	5	0.9		5-6	34	9.34
	Total	364	100.0		7	14	3.85

Table II: Teacher candidates' personal information

According to table II; it is found that;

The majority of the sample was composed of female students to become teachers,
 Participation among departments is mostly from Turkish education,
 There are many students who come from the Black Sea Region to the university.
 Most of them have two siblings.

In the evaluation done according to the association rule ,the results are as follows:

60% of those who come from smaller towns and who know the causes of environmental pollution and who care to throw away their rubbish into dustbins warn the ones who pollute the environment.

60% of the women coming from cities know the causes of environmental pollution and cares to throw their wastes into dustbins.

Men from the Black Sea region, although they are not a member of an environmental non-governmental organization throw their waste into the trash.

90% of men coming from provinces are not a member of any civil society organizations.

46% of the women who have been trained related to the environment got an average grade between 4 - 3.5.

Although the rate of those who pay attention to throw their rubbish into rubbish boxes and who think this will contribute to the economy is % 85,they are not a member of a non-governmental organization.

The rate of those who think it's not given enough attention to the environment by the visual and written media and who think environmental education should begin in pre-school is 86% .

91% of those who know the causes of environmental pollution and throw their waste into the trash want their wastes to be collected separately.

78% of female students find the efforts of the authorities on environmental awareness insufficient.

72% of the female students collect electronic waste and batteries and send them to the factories to be recycled.

91% of male students who pay attention to planting seedlings is not a member of a non-governmental organization.

89% of the female students who cannot take environment-related training and who take pains to planting is not a member of a non-governmental organization.

78% of those who know the reasons of environmental pollution without receiving any training and who pay attention to the quality of fuel used in the houses or in vehicles is female.

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72% of female students is partly paying attention to the quality of fuel used in the home or in vehicles.

93% of female students studying at the Department of Mathematics is thinking that environmental education should begin in pre-school.

78% of female students who has taken environmental training says that family is more important in gaining environmental awareness.

71% of people interested in environmental issues say the environment pollution caused by solid waste is more than the others.

5. CONCLUSION

According to the data analysis over 364 data, it has been found out that there is a meaningful structure on the views of the university students in terms of environmental awareness. It has been identified that female students are more sensitive to the environment than male students. It has been proved that students' attitudes towards the environment doesn't depend on their cities, number of siblings, their classes, level of education, the school they graduated and their families according to the program they are attending students were found not to have different views about the environment.

In the analysis study done due to data mining association rule, students are found to be highly sensitive to the environment despite not being a member of a non-governmental organization. From this, it can be inferred that non-governmental organizations working on environment are not so important in gaining environmental awareness.

People who lived in cities or towns before coming to university can be said to have almost the same sensitivity towards the environment.

Most of the people think that environmental awareness should be taught before pre-school that is, it should be given by the family. Here it is understood that the education given by the families to gain awareness of environment at a young age is much more effective.

Students have stated that, visual and printed media doesn't give enough importance on environment, adding that most university students haven't gained environmental awareness and that they do not find the works done both by the authorities and the universities on environmental awareness enough. From here, we can infer that the environment education is not enough but poor and therefore it doesn't meet the needs.

It can be said that there aren't any direct relationships between the average grade points of the students and their sensitivity to environmental problems.

It has been found that students can differentiate between waste and recycling and most of them want the wastes to be collected separately. Besides these, from the results of the data, we can say that

most students think waste can contribute to them economically.

Especially female students were found to give more attention to recycling. Many of them contribute to the recycling of waste batteries and electronic waste.

Male students give more importance on planting trees and most of them do this without being a member of any civil organisations.

The environment-conscious students say that pollution caused by solid waste is much more than others.

6. DISCUSSIONS

On the same subject, research has been conducted of 575 students and data was evaluated using SPSS 12 program. As a result of the research, the sensitivity of male students to the environment was seen to be higher. In addition, differences have been observed in terms of environmental awareness according to different departments. Especially students who study at pre-school department were found to be more sensitive than other students. In parallel with this, it has been concluded that environmental education should start at pre-school period [20].

According to the studies reviewed were not given proper training on environmental issues. Environmental education in Turkey has been given since 1991. But up to now in the process on a regular plan, not prepared in this regard. But shall be effected by experts in the field of a quality education. However, given by experts in the field of environmental education and the situation in this way, when the students have detailed information about the environment issues.

According to the results of this study, we can say that it should be given more importance on education in creating environmental awareness. In the study, female students' being more sensitive to the environment may be due to their delicate structure. Again, people think that visual and written media do not give enough importance on environmental awareness and so it can be said that not making people environment conscious could lead to major problems in the future. Awareness about the environment will be more effective in the visual media. Because the ads to be published in an effective manner, may be more persistent in people's minds. In terms of environmental awareness, the training given by especially pre-school education and families will contribute to the future and help to grow up environment conscious individuals at a very young age. But the training should not be limited just before school. It should be continued throughout peoples' lives in certain periods and in accordance with the individual. In addition, currently not very active civil societies should re-organize their activities exclusive to

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different age groups and do facilities as to improve environment consciousness.

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COMPARISON OF RENEWABLE AND CONVENTIONAL ENERGY COSTS BY WAVELET TECHNIQUES

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Abstract- This paper aims to compare the cost of renewable energy to conventional energy sources in production. It is argued that advantage in cost of production would support competitiveness of Turkish manufacturing industry in international trade. In this paper an export model has been developed to forecast competitive advantage of Turkish manufacturing industry on international trade by using renewable energy in production. Data on the cost of energy on Turkish manufacturing industry and export performance in past 10 years were processed. This study utilizes 1D wavelet packets and continuous wavelets on historical cost and export values in Turkey. Wavelet and regression analysis have been applied to define variation in temporal and spatial patterns. Wavelet techniques detect sudden changing, increasing and decreasing trends of data and define the role of factors small and large scale effects. Actual share of energy usage in production cost and usage of renewable energy instead of conventional energy values were compared to other countries data analyses.

Keywords: Cost of renewable energy, wavelet analysis, cost advantage, competitiveness, international trade

1. INTRODUCTION

Turkey export has been following high and rapid growth since 1980. This growth is considered as highly successful development in comparison to the period prior to 1980. However, the driving forces behind this successful export are still a matter of debate. Some of the economists attributed this success to liberal policies on international trade while others aggressive foreign exchange policies. In this article, competitive advantage of export commodities in the foreign markets is considered as one of the important reason of the growth. It is argued the lower cost of production had contributed competitive advantage for a long time. In this analysis, contribution of lower energy cost to supply of products exported has been analyzed.

2. BASIC FACTORS UNDERLYING EXPORT & COMPETITIVENESS

Income level of target export market is important determinant of the export level. In early years of 1980s, demand originated in Middle East countries are considered as

important factor for rapid growth of export. These export markets were the upper middle and upper income level countries (Arslan, I and Winjbergen, 1991). The Customs Union between Turkey and the European Union (EU) has been considered as an important source of export growth since all tariffs and quotas were removed in trade between the EU and Turkey. On the other hand, exporting country should have capacity for competing in these markets. A large number of definitions for competitiveness have been proposed in the economic and business literature.

Firstly, Adam Smith explained international trade due to the differences among the nations and specialization on production of good countries has absolute advantage. Later, Ricardo extended the analysis of international trade theories by adding wages and productivity concepts to the absolute cost advantage in determination of competitiveness. Ricardo argued trade would be beneficial even if the first country held an absolute cost advantage over the other country in both commodities at his two nations-two commodities example (Ricardo,1814(1932;111).In simple one factor

Ricardian model, labor is the only important resource for production. Labor productivity only varies across countries depending on differences in technology. But labor productivity in each country is constant across time as well the supply of labor is constant. Only two goods are important for production and consumption. Labors receive competitive wage due to their productivity (Krugman and Obstfeld, 2006:26). The benefits of higher productivity in one country can be transmitted from one country to another through trade. Therefore, movements of goods provide a substitute for movements of factors between countries. And each can employ its own resources where they are relatively most efficient or relatively least inefficient.

Although, comparative advantage is the cornerstone of the original theory of international trade, it was not able not explain what goods would be exported and imported. Later, by introduction of the terms of trade comparative advantage provides the answer to problems of country's both growth and efficiency in resource allocation (Wexler, 1972:54). If one country has an absolute advantage in the production of both goods (as assumed by Ricardo) then real wages of workers (i.e., the purchasing power of wages) in that country will be higher in both industries compared to wages in the other country. Workers in the technologically advanced country would get a higher standard of living than in the technologically inferior country since in the country that is more productive, workers get higher wages.

A substantial explanation of the causes underlying trade and competitiveness has grown by Heckscher-Ohlin (H-O) Model. Based on two essential assumptions that countries are differently endowed with productive resources and in perfectly competitive markets, H-O model argues that trading countries would benefit by exporting those goods that are relatively intensive in the country's abundant factor and import those goods that are relative intensive in the use of the country's scarce factor. When society decides to produce more of capital intensive good, they have to produce less of labour intensive good. H-O model says differences in labour skills, physical capital and land between countries cause productive differences leading to gains from trade (Krugman and Obstfeld, 2006:51).

The Stolper Samuelson Model criticizes the H-O model and states a rise in the price of a good will increase the real price of the factor used intensively in the sector and decreases the real price of the other factor. The crucial effects on income of an opening of trade depend on the flexibility of the affected factors.

The Rybczynski theorem explains the relationship between changes in national factor endowments and changes in the outputs of the final goods in 1950s (Winters, 1991:39). According to theorem, an increase in country's endowments of a factor will cause an increase in output which uses that factor intensively and a decrease in the output of the other good. Therefore, countries produce and export more of labour intensive goods.

Although, the traditional general equilibrium approach to international trade is considered as powerful intellectual analytical structure explaining and providing many useful insights about a trading world economy, Helpman and Krugman (1985) explain four major subjects in which traditional trade theory seems to be inadequate in explaining the empirical observations: failure to explain the volume of trade, the composition of trade, the volume and role of intra-industry trade and direct foreign investment and the welfare effects of trade liberalization (Helpman and Krugman, 1985:2).

Balassa (1995) focused on the essential characteristics of producers in competition for market share and profits and the ability to export. Durand and Giorno (1987) argued the ability to compete depends on price ratios and cost competitiveness. Turner and Gollup (1997) and Siggel (2007) introduced more complex and multi-dimensional indicators about competitiveness. Kotan and Sayan (2001) showed a relatively higher price charged by an exporter will reduce its market share relative to other in the case of the technology intensive products in Turkey. High prices are considered due to high cost.

Traditionally, cost of production is considered as main factor determining competition. Labor wage, cost of raw materials and energy used in production would be considered as main factors of production. Besides labour cost and cost of raw material, energy is an important factor contributing to production. Here, mainly cost of energy has been analyzed to compare cost effectiveness of renewable

energy. Electricity, fuel oil, coal has been used to generate electricity in Turkey.

In practice, nearly half of the world's trade consists of trade between industrial countries that are relatively similar in their factor endowments. Further both the share of trade among industrial countries and the share of this trade in these countries incomes rose for the last decades, even as these countries were becoming more similar by most measures. In some cases, the government policies would restructure some of the adverse effects of these market imperfections (Stiglitz, 1989:197). If commodity price are chosen properly to reduce the risks that producers may face, this price may lead to higher level of production and investment. One of the factor determining the price is cost, in Turkey, large part of cost seems to be in energy cost. The Energy markets are in general imperfectly competitive markets. In this case, the government would support the producers to reduce energy prices by different kind of incentives given to energy producers. Government may also eliminate some taxes that worsen the risks facing energy producing firms. At that time this would be considered as positive role of government for the economy through taxes and subsidies (Stiglitz, 1989:197). Subsidies given to the producers who use renewable energy resources would provide sustainable production and export opportunities to the countries.

According to argument of Baldwin, new trade theory is that a country may increase its welfare through strategic trade-policy behaviour when its firms are competing in imperfectly competitive international markets (Baldwin, 1992:806). Additionally, this net gain earned by the firm in imperfectly competitive domestic market may behave strategically, the net gain from the international trading will be more than the net gain under the perfectly competitive markets. The most controversial suggestion by the new trade theory was that government intervention can raise national welfare by shifting monopoly rents from foreign to domestic firms (Brander, 1981).

Trade policy can serve for a given country as a tool or obtaining as large a share of these international profits as possible. Brander states implementing strategic policies might allow the country to capture rents that would

otherwise go elsewhere" (Brander, 1988). The government should play more active role in international trade by following two basic policies : Shifting rents supporting and more external economies. Energy is one of the important example of external economies. Either its production or consumption has direct and indirect influences on economy, ecology and society. Traditionally, sustainability has been framed in the three pillar model: Economy, ecology and Society are all considered to be interconnected and relevant for sustainability (BMU, 1998). The relationship between RE and sustainability can be viewed as a hierarchy goals and considerations. The energy sector has generally been perceived as key to economic development with an economic growth and expansion of energy consumption. Indicators such as GDP or per capita GDP have been used as proxies for economic development for several decades such as in integrated models. The United Nations Conference on Environment and Development (UNCED) held in Rio de Janeiro, Brazil, in June 1992 stated target of worldwide sustainable development. The goal of sustainable development cannot be realized without major changes in the World's energy system. Accordingly, Agenda 21, called for "new policies or programs, as appropriate, to increase the contribution of environmentally safe and sound environmentally safe and sound and cost effective energy systems, particularly new and renewable ones, through less polluting and more efficient energy production, transmission, distribution and use" (Johansson, T. Kelly H. Amulya K.N. Reddy, R. Williams, 1993)

If the world economy expands to meet the objectives of countries all over the World, energy demand is likely to increase even if energy use should be more efficient. Given adequate support, renewable energy technologies can meet much of the growing demand at prices lower than those usually forecast for conventional energy. By the middle of the 21st century, renewable sources of energy could account for three fifths of the world's electricity market and two fifths of the market for fuels used directly. Moreover, making a transition to renewable intensive energy economy would be reduced to 75 percent of their 1985 levels provided that

environmental and other benefits not measured in standard economic accounts. Renewable energy systems have benefited from developments in electronics, biotechnology, material sciences and in other energy areas. Renewables can play major roles in the global energy economy in the decades ahead. In the global energy demand scenario adopted for this study, global electricity

3. CONVENTIONAL ENERGY RESOURCES AND THEIR COST IN PRODUCT

Unfortunately, energy resources are not sufficient in Turkey. National energy resources would only meet 35% of the energy demand in Turkey. It is also forecasted this ratio would decrease to 25% while energy demand for manufacturing industry is forecasted as the amount more than 4 times required in 2000s. Turkey need to find out energy resources at cheaper prices and renewable to maintain sustainable growth, development and export (Under Secretariat of Treasury, R.T. 2010: 1)

Turkey has hard coal, lignite, asphalt, petroleum, natural gas, hydroelectric energy, and geothermal energy sources. Turkey does not have own large fossil fuel reserves (Akan, Dogan, Isik, 2011:). Baris (2011) analyzed the current and future role of coal in energy strategy of Turkey and the compatibility of energy policies of Turkey to the EU policies. Coal and hydropower are considered as the most important indigenous energy sources in Turkey since their supplies are stable. Turkish government set targets to fully utilize coal reserves of the country in next decades. Electricity production of Turkey was 46.998 in 2010. It was largely based on thermic sources (59 %); hydro sources (33 %) and wind (3.8%). Baris(2011) forecasted the capacity for electricity would increase 2014 to 55.691. The share of hydro and wind sources would increase to 36%.

production would more than double by 2025 and more than triple by 2050. By 2050, renewable energy sources can play a central role in the world energy markets. They can do this even if world energy prices increase very slowly and without subsidies or credits to reflect external benefits not tracked in standard economic accounting.

The cost of renewable energy declined over the past thirty years due to efficiency obtained in thermal energy; reduction in manufacturing cost; developed architectural designs (Sovacool, 2007: 111) New wind technologies are operating at lower wind speeds and employing stronger materials and dollar technologies have greatly improved efficiency, lowered cost and enhanced performance (Sovacool, 2007: 111). The competitiveness of renewable energy technologies has been further heightened by improvements in energy storage (Sovacool, 2007: 111)

There are several alternative technological ways to generate electricity and reduce green house gas emissions cost effectively. Sometimes plant design would offer more efficient power generation conversion of fossil fuels, greater use of renewable energy or nuclear power and the capture and disposal of CO₂. The choice in terms of cost saving and carbon emission reduction benefit. The global electricity sector has the potential to lower its carbon emission reductions by between 1.5-4.7% by 2010 and 8.7-18.7% by 2020 (Sims, Hans and Gregory, 2003:1324). Gokcecinar and Uyumaz (2008), compared endogenous and exogenous cost of coal, natural gas and wind, coal has 4.8 endogenous cost but its exogenous cost is 5.0; natural gas has 4.0 endogenous cost but its exogenous cost is 2.5 and wind has the lowest exogenous cost 0.1

Figure 1: Comparison of Alternative Energy Cost / 2008

Energy Source	Typical Installation	Cost Per Kilowatt Peak and Per Kilowatt hour
Fuel Cells	1-200 kilowatts	1500-3000 kwp 5-10 cents per kWh (Lower number associated with larger Wind Farms)
Biomass Generator	1-1 Megawat-Multi mW	\$1500-\$1800 per kWp 5-10 kWh

Source: Gokcecinar and Uyumaz, 2008

The figure below shows the cost per kilowatt hour. Renewable energy cost is more than fuel cells source.

Figure 2: Comparison of Alternative Energy Cost 2012

Energy Source	Typical Characteristics	Typical Energy Cost (US cents kilowatt hour)
Large Hydro	10 MW-18.000 MW	3-5
Small Hydro	1-10 MW	5-12
On Shore Wind	1.5-3.5 Rotor Diameter: 60-100 m	5-9
Off Shore Wind	1.5-3.5 MW; Rotor diameter: 70-125 m	10-20
Biomass Power	1-20 MW	5-12
Geothermal Power	1-100 MW	4-7
Solar PV	Crystalline 12-19 %;thin film 4-13 %	
Solar PV (Concentrating)	25%	
Rooftop Solar PV	2-5 kW peak	17-34
Utility- Scale Solar PV	200 kW to 100 MW	15-30
Concentrating Solar Thermal Power	50-500 MW to 10-20 MW (tower)	14-18

Source: Sabuncu and Colakoglu, 2012

Fossil fuels continue to dominate as the main sources of energy produced and consumed worldwide despite the growth of the share of renewables in both production and consumption. However, the use of fossil fuels has stalled when it comes to electricity production through its use has continued to dominate the transport sector. Oil is the main fossil fuel used and has remained so since the end of the Second World War. It has a near monopoly as the main source fuel for the transport sector. However, the use of petroleum fuels to produce electricity has drastically declined with the exception of natural gas. This is due to the oil shock of 1973-1974 that decreased economic growth in every oil importing nation and lead to a drastic hike in electricity tariffs.

As nations like Japan and Germany plan to shut down their nuclear power plants. Many developing nations like Nigeria, Jordan and Ghana are making plans to build nuclear power plants thus in future most nuclear power plants may be located in developing countries in future. However, in all nations renewables are taking a larger and larger share of energy produced and consumed. However, in all nations, renewables are taking a larger and larger share of energy produced and

consumed. Already in Paraguay, 100% of all the electricity generated is from hydropower. Spain, in its efforts to reduce reliance on fossils in energy production has some of the largest solar and wind power projects in the world. Germany exports wind power energy to the EU. Morocco, Egypt and Kenya have large wind power plants which are helping them keep up with the growing energy consumption as the USA, Indonesia, Iceland and Kenya are making strides in developing geothermal energy.

The 9.8 magnitude earthquake in Japan just made nuclear energy producers to rethink their energy resources in all countries all over the World. The most significant reaction was from Germany and Italy. German government declared that the life span of the Country's 17 nuclear power plants, which originally had to be closed for 12 years on average. However, the Fukushima crisis introduced a change in plans. Initially, the German government closed the nuclear reactors built before 1980. 23% of German electricity comes from nuclear power. However, even German government takes the risk to import electricity and changed their production for renewable energy.

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World energy consumption has been on the rise worldwide as developing nations begin to industrialize and as consumers in developed national buy more energy consuming appliances to make life more comfortable. If the current trends continue, we may face an energy shortage in future. In Turkey, the renewable energy sector and government policies have interacted and changed at drastic speed over the last few years. Supporting renewable energy has been a great experiment for policymakers all around the world. Policy reversals in the US, Germany, Italy and Spain

have already started to reduce investment in despite the global financial crisis, the renewable energy sector has achieved important advances in technology and power project development over the past few years. In 2010, 195 GW of new power generation capacity was established globally and approximately half of this capacity is based on renewables. Renewables constitute nearly 25% of global installed capacity, whereas in power generation the share of renewables is around 20% (Sabuncu and Colakoglu, 2012)

Figure 3: Renewable Energy Share of Global Final Energy Consumption, 2009

Type of Energy Resource	%
Nuclear	2.8 %
Renewables	16.2%
Fossil Fuels	81%

Source: Renewables 2011 Global Status Report,(Sabuncu and Colakoglu, 2012)

As it is shown at figure 3 and 4, the use of renewable energy resources growing so rapidly. However, at 2009 statistics, fossil

energy resources were still the largest energy resources consumed.

Figure 4: Growth Rates of Renewable Energy Capacity and Production, 2005-2010

Type of Energy Resource	Annual Average Growth Rate
Biodiesel Production	38 %
Ethanol Production	23 %
Solar hot water –heating	16 %
Hydropower	3%
Geothermal Power	4%
Concentrating Solar Thermal Power	25%
Wind Power	27%
Solar PV	60%
Solar PV	49%

Source: Enerji Piyasaları Düzenleme Kurulu, Energy Markets Regulating Board
http://www.epdk.gov.tr/documents/elektrik/rapor_yayin/Elektrik_Piyasasi_Gelisim_Raporu_2011.pdf

Turkey energy demand will increase more than past demand in the future depending on

its target expected change in demand in economy and technology.

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Figure 6: Electricity Demand Forecast During the Period Between

2011	227.000
2012	241.300
2013	257.060
2014	273.900
2015	291.790
2016	310.730
2017	330.800
2018	352.010
2019	374.430
2020	398.160

Source: Electricity Market Development Report, 2011
http://www.epdk.gov.tr/documents/elektrik/rapor_yayin/Elektrik_Piyasasi_Gelisim_Raporu_2011.pdf

4. APPLICATION OF WAVELET TECHNIQUES

Second part of this study is based on wavelet techniques and their applications on energy prices and economic parameters (export and crude oil prices). In this section, the basic definitions has been given about the wavelet transform. Wavelets are families of small waves generated from a single function $f(t)$ which is called the mother wavelet. A sufficient condition for $f(t)$ to qualify as a mother wavelet is given as below (Meyer, 2000; Siddiqi et al., 2002; Kenisarina et al. 2006; Aslan and Caglar, 2011, Aslan and Gencoglu, 2000; Tolun et al., 1995; Turksoy 1995):

$$\int_{-\infty}^{\infty} |f(t)|^2 dt < \infty \quad 2(a)$$

The Fourier transform F of $f(t)$ is defined as

$$F(w) = \int_{-\infty}^{\infty} f(t)e^{iwt} dt \quad 2(b)$$

A function $\psi(t)$ satisfying the following condition is called a continuous wavelet:

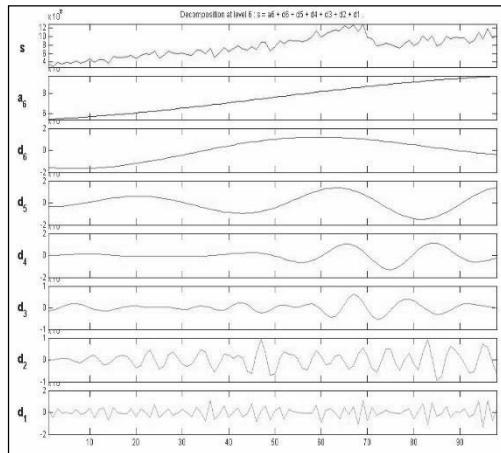


Figure 1a: Monthly Export, January 2003 – February 2011, 1D Wavelet, DMeyer, Level 6

$$\int_{-\infty}^{\infty} |\psi(t)|^2 dt = 1 \quad 3(a)$$

and

$$\int_{-\infty}^{\infty} |\psi(t)| dt = 0 \quad 3(b)$$

It may be observed that the scalogram can be represented either as three-dimensional plot or as a two-dimensional grey scale image. As mentioned above, a , b parameters represent the scaling factor and the location in time, (Siddiqi et al., 2005). Different variability of time scales from inter-monthly fluctuations (2,0 – 3,1 months) to decadal – centennial changes (10,6-110,7 years) have been considered to analyze data. In the following sections, $f(t)$ will be considered as monthly and annual average values of export and crude oil prices in Turkey.

4.1 Wavelet Analyses of Export

Figures 1 (a-d) show wavelet analyses of export. Fig. 1a shows an increasing trend all period. Some decreasing trend has been observed in 2008. Amplitudes of small (d_1 , high frequencies) and large scale (d_6 , low frequencies) influences on monthly export in Turkey increase in the second part of the period.

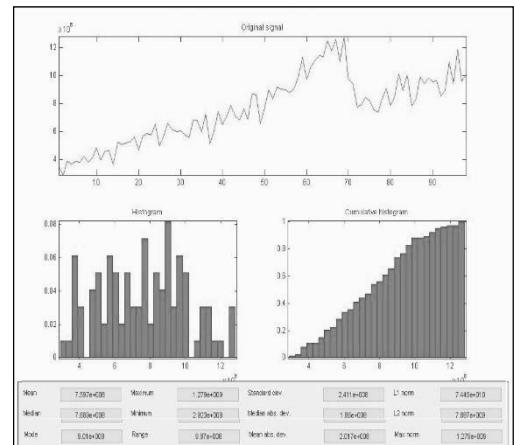


Figure 1b: Statistical Descriptive of Monthly Export, January 2003 – February 2011

Frequency distribution of export values does not show a very well bell shape distribution. There is a negative skewness, (Fig. 1.b).

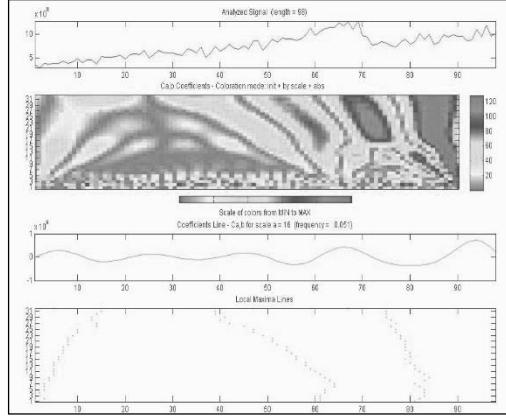


Figure 1c: Analyses of continuous wavelet 1-D, Morlet, Level 1, Monthly Export, and January 2003 – February 2011

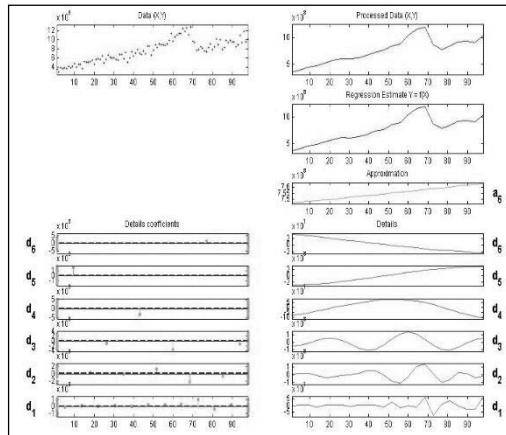


Figure 1d: Analyses of Regression estimation for export, Fixed design 1-D, DMeyer, Level 6.

Figure 1c shows the role of different scale effects on monthly export values. In 2008 there are large scale factors on this variation with the periodicity of 20 to 30 months (inter-annual variations). Regression estimation explains the linearly increasing trend of export data (Fig. 1d).

4.2 Wavelet Analyses of Crude Oil Prices

Figures 2 (a-d) show wavelet analyses of monthly crude oil prices. Fig. 2.a shows an

increasing trend in most part of the period. Some decreasing trend (similar trend in Fig. 1) has been observed in 2008.

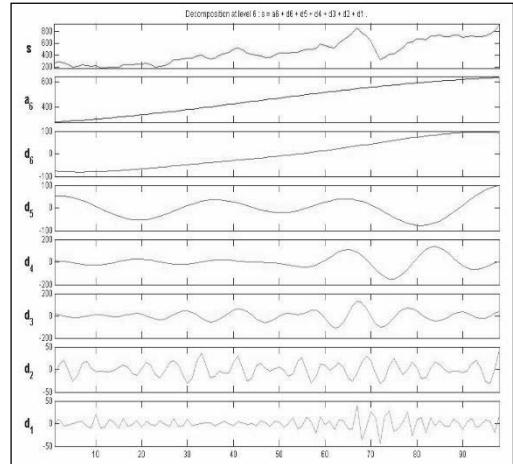


Figure 2a: Monthly variation of crude oil prices, January 2003 – February 2011, 1D Wavelet, DMeyer, Level 6

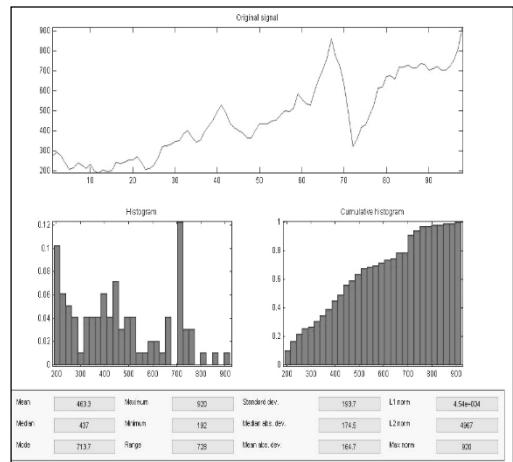


Figure 2b: Statistical descriptive of monthly crude oil prices, January 2003 – February 2011

Amplitudes of small (d_1 , high frequencies, medium scale (level d_4) and large scale (d_6) influences on monthly crude oil prices in Turkey increase in the second part of the period. Frequency distribution of crude oil does not show a very well bell shape distribution. There is a three modal distribution, (Fig. 2b).

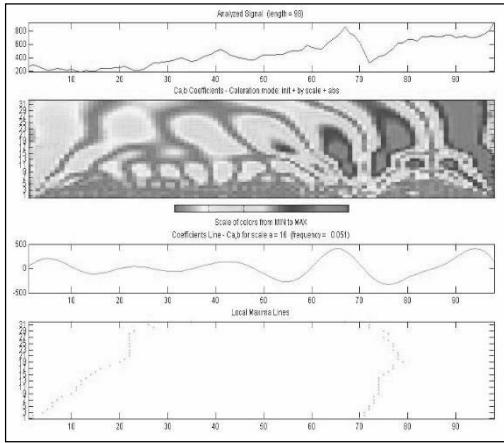


Figure 2c: Analyses of continuous wavelet 1-D, Morlet, Level 1, monthly crude oil prices, January 2003 –February 2011

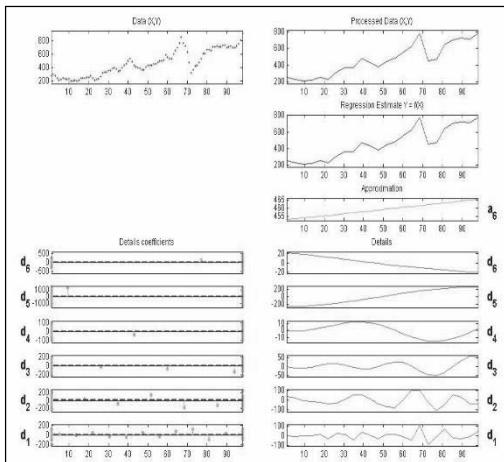


Figure 2d: Analyses of regression estimation for crude oil prices, fixed design 1-D, DMeyer, Level 6.

Figure 2c shows the role of different scale influences on monthly variation of crude oil prices. In 2008 there is a large scale influence on this variation with the periodicity of 7 to 30 months. Roles of large scale effects on export follow observation of similar effects on crude oil prices in figure 2c. These variations are associated with semi-annual cycle and inter annual variations. Regression estimation explains the increasing trend of crude oil prices except the period between November 2008 and February 2009, (Fig. 2d).

5. CONCLUSION

Despite serious development in renewable energy technologies, renewable energy sources are still at competitive disadvantage. However, not only for increasing the level of export but also international agreements are binding for Turkey, Turkey has to use renewable energy source more. Due to obligations arises with Kyoto Protocol, Turkey should limit CO₂ emission together with other greenhouse gases. Coal is a very important domestic energy source for Turkey but new policies have to be developed and adopted immediately, and more realistic targets for the country should be set accordingly.

The first part of this study covers multiple regression analyses of export, energy price and label cost. There is sufficient evidence ($\alpha=0.05$) to support a linear correlation amongst these variables. In the model set in this article sets clearly, the negative relationship between the energy cost and level of export. If Turkey succeeds to decrease cost of energy, the level of export will increase. The competitive cost advantage is one of the important factors, however, the international agreements and sustainable development policies also require clean and sustainable energy policies.

Crude oil prices and other economical parameters analyzed above by using wavelet techniques seem will be persist in longer term. As a result of these analyses installation of renewable energy systems (like solar and wind) will support national energy consuming as environmentally friendly energy sources. The total number of wind power plants under operation in Turkey is 41 (TWEA, 2011). In general at Aegean Sea Region at different 41 wind parks, there are 700 wind energy converting systems (WECS) and they transfer 1414, 50MW wind energy to interconnected system. Furthermore, 19 different Wind Parks with 750MW generating capacity is under construction in Turkey.

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FIBER OPTIC LIGHTING SYSTEMS*

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Abstract - Recently there have been many important and valuable developments in the communication industry. The huge increase in the sound, data and visual communications has caused a parallel increase in the demand for systems with wider capacity, higher speed and higher quality. Communication systems that use light to transfer data are immensely increased. There have recently many systems in which glass or plastic fiber cables were developed for light wave to be transmitted from a source to a target place. Fiber optic systems, are nowadays widely used in energy transmission control systems, medicine, industry and lighting. The basics of the system is, movement of light from one point to another point in fiber cable with reflections. Fiber optic lighting systems are quite secure than other lighting systems and have flexibility for realizing many different designs. This situation makes fiber optics an alternative for other lighting systems. Fiber optic lighting systems usage is increasing day-by-day in our life. In this article, these systems are discussed in detail.

Keywords: Optic, Photonics, Illumination

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1. INTRODUCTION

Light wave communication was first considered more than 100 years ago. The implementation of optical communication using light waveguides was restricted to very short distance prior to 1979. Coming glass company achieved a breakthrough in 1970 by producing a fused silica(SiO₂) fiber with a loss approximately 20 dB/km. The development of semiconductor light source also started to mature at about that time, allowing the feasibility of transmission over a few kilometers to be demonstrated. Since 1970, the rate of technological progress has been phenomenal, and optical fibers are now used in transoceanic service. Besides the long-distance routes, fibers are used in inter exchange routes, and the subscriber loop in the final link in what will eventually be the global interconnection chain. Optical fibers are associated with high-capacity communications. A lot of attention is presently being given to optical fibers to provide a very extensive broadband ISDN.

Fiber optics is defined as that branch of optics that deals with the transmission of light through ultrapure fibers of glass, plastic or some other form of transparent media. From a decorative standpoint most of us are familiar with the fiber optic lamp, which uses bundles of thin optical fibers illuminated from the base end of the lamp by a light source [1].

The light source is made to vary in color, which can be seen at the opposite ends of the fiber as tree of illuminating points radiating various color of the transmitted light. Although the lamp is used for decorative purposes only, it serves as an excellent model of how light can be transmitted through the fiber.

2. FIBER OPTIC LIGHTING

Fiber Optic Lighting is used to provide intense, cool illumination for a number of optical or imaging applications. Fiber Optic Lighting often consists of fiber optic illuminators integrated with one or more light guides that direct illumination towards a specific application. Fiber Optic Lighting offers multiple illumination tools with only a single light source through the selection of various adapter heads for fiber optic light guides [2].

2.1 How Fiber Optic Lighting Works

A light shines into the end of the fiber optic tube, making a beam that travels down. As it moves down the fiber optic line, the beam scatters but the coating reflects it back, sending it down the tube without losing any light. When the light reaches the end of the fiber optic tube, it continues to travel forward, making a little point of light. If a section of the cable is uncovered, some of the light will

leak out of it, since there is no reflective coating to send it back into the cable [3].

2.2 Types of fiber

There are two types of light emitting fiber.

2.2.1 End-Emitting Fiber

This fiber has a transparent core with a thin transparent cladding or exterior that traps all the light in the core so that all the light directed into the fiber make it out the other end. This insures that maximum light is transmitted through the fiber to the light fixture on the other end.

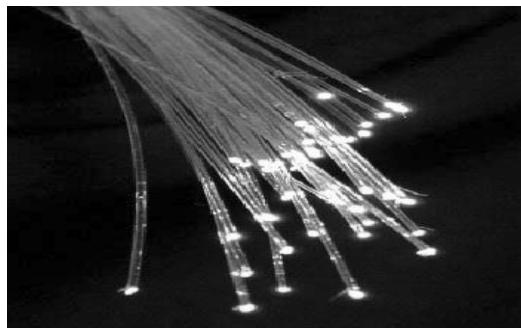


Figure 1: End-Emitting Fiber

2.2.2 Edge-Emitting Fiber

This fiber is very similar to the end-emitting fiber except that cladding or exterior does not trap all the light and allows some of the light to escape the fiber. This causes the fiber to glow and looks very much like a neon light tube [4].

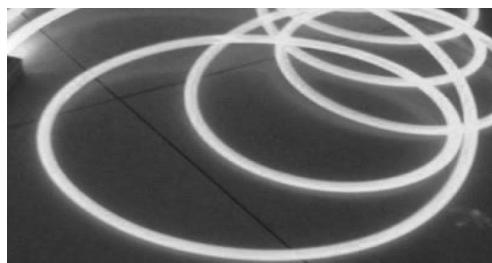


Figure 2: Edge-Emitting Fiber

2.3 Basic Elements of Fiber Optic Illuminating System

Fiber optic illuminating system basically consists of two parts as light generator and fibre Cable harness used for transmitting this light.

Connectors (Muff, multi connector) are used to mount fibre cable harness to the light source.

Connectors function as a metal compression (jointer) ring. When the fibres coming out of the connectors are needed to be used for illuminating different areas meters apart from each other, then the fibres going to the same goal can be grouped in one case in order to ease the application.

If requested, terminator and lens systems can be used on the end of the optic cable harness, depending on the need and the place of use of the setup.

On cutting off the optic fibres, special cutter devices are used on the end of fibre to prevent any malformations which cause loss of light. After cutting the fibres, before it combines to the light generator in a multiple connector (connecting muff), the ends should be rubbed up and brightened in order to transmit the light more homogeneously. Sections of the fibre optic illuminating system are shown in Figure 3.

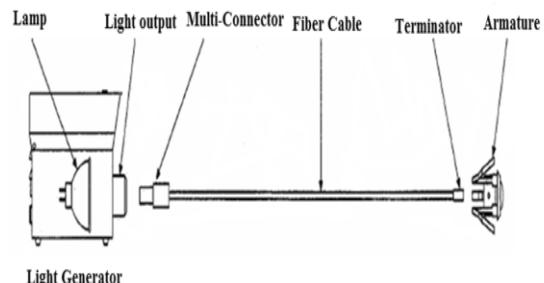


Figure 3: Sections of the fibre optic illuminating system

2.3.1 Light Generator

Light generator is the heart of the fibre optic illuminating system and is equipped with a special source of light. Fibre cable harness, designed and produced as for meeting the very need, connects to the light generator from outlet through multiple connectors. Generally two different kinds of bulbs can be used in light generators; 1) high pressure white heat halogen lamp containing halogen gasses or 2) a metal type lamp with Hi-Intensity Discharge (HID). Color circle in a closed box. The fan used inside, prevents the cable harness to be damaged because of the heat in the light source by ventilating the hot air out of the generator and prolongs the system's life expectancy. Depending

on the diameter of a fibre which is used, It is possible to transmit light from a light generator ranging to almost 1000 points. Reflector helps to focus and send the light coming from the Intensive Light smart bulbs to the multiple connector (combining muff) on the head end of the fibres. Generally 12V lamps with 30, 50, 75 and 100 W halogen and 150-250 W metal halogen formed lamps are used in a light generator. Light generators are produced in suitable types for inside and outside atmosphere. Outer metal sections are painted with electrostatic paint, and inner parts are nikel plated by electrolysis. Connectors of light generators in which the fiber optic cables to connect, are manufactured by aluminium for the reason of being resistant to heat. Light sources of medium and high power has focus setting. Also, light generators possess soil protection, severe heat protection and current limiting fuses. Besides standard mono Color illuminating, to attain more dynamic and attractive illuminating image, Color discs are placed in the system. Generally a Color engine functioning about 2 to 4 RPM revolutions is used to revolve the Color disc. Certain Color changings with certain gaps, color changings according to music rhythm or time, speed of Color change, its order and the choice of the Color steps are all adjusted according to the color engine features.

Light Generator	Fiber Type	Fiber Diameter	The maximum Length	Application Area
30-50W	End-to-Radiance	1-6 mm	3-6 m	Stars effect or 2-3 m showcase
75W/9-10mm	End-to-Radiance	2-6 mm	9-12 m	Decorative or functional lighting
75W 25mm	End-to-Radiance	4,5-6 mm	6-8 m	Room lighting, decorative lighting
150W	End-to-Radiance	4,5-6 mm	16-18 m	Outdoor lighting front, beam
150W	End-to-Radiance	3-6 mm	10- 13 m	Decorative lighting, big star effect
75W/9 mm	Sideways Radiance	>4,5 mm	12-20 m	Decorative lines,
75W/9 mm	Sideways Radiance	4.5 mm	9-12 m	Low-ligting (for example cinema) linear
75 W/28 mm	Sideways Radiance	>4.5 mm	9-14 m	Low light levels linear
75 W/28 mm	Sideways Radiance	4.5 mm	7-12 m	Low-ligting(for example cinema) linear

2.3.2 Halogen Light Generators

Light is produced by halogenic bulbs in Halogen light generators. Generally they are designed with 20W, 35W, 50W, and 75 W power potencies. Bulbs life expectancy ranges within 3000-5000 hours. Light generators of over 35 W are cooled with axial flow fans, and make almost 30 dB noise. These generators can be designed in different types according to intensity of light ranging to 6.000 cd and 16 000 cd. Color temperatures of 3000-3200 Kelvin are standard but it is possible to reach 5000 Kelvin color temperature with special bulbs.

2.3.3 Metal Halide Light Generators

In Metal Halide Light generators light is produced by metal halide bulbs. They are generally designed with 75W, 100 W, 150 W and 250 W power potencies. Life expectancy of the bulbs differentiates within 6000-8000 hours. Metal halide light generators are cooled by axial fans and make about 40 dB noise. They can be designed in different types ranging 24000 cd - 160 000 cd according to the light intensity. Their standard Color temperature is 4000-5000 Kelvin [5].

150 W	Sideways Radiance	>4.5 mm	12-18 m	Decorative effects
150 W	Sideways Radiance	4.5 mm	10-16 m	Decorative effects
150 W	Sideways Radiance	4.5 mm	15-20 m	Decorative effects
150 W	Sideways Radiance	4.5 mm	15-20 m	Decorative effects
150 W	Sideways Radiance	>4.5 mm	20-28 m	Decorative effects, colored lights

Table I.
Lengths and application

areas of optic cables according to the light generator.

2.3.4 Optic Cable Harness

Optic Cable harness is used for carrying the produced light from light generator to the area of use. In optic fiber illuminating system, both acrylic (PMMA) (plastic) and glass fibres are used, but plastic fibres are preferred more frequently to make the application easier and durable. The fibres in a fiber harness can be of different lengths and thickness. The system is totally formed according to the desired target points' light level and form.

Fibres are produced by making the highly heated sticks thin in the revolving mills and covering them with other shield during this process. In fiber optic illuminating applications, generally 1 mm active diameter cables (except case) are used, if requested, fiber number can be increased to 15 mm diameters. Work temperature of plastic optic fibres used in illuminating ranges between -50 degrees to + 70 degrees. moreover they can bear up, in short time period (less than a minute) to 100 degrees temperature. Glass optic fibres with 110 degrees work temperature are more durable against heat. In addition, plastic optic fibres have protective case retarding burning, and glass optic fibres have firefree feature.

One of the most important points to be taken care while planning a fibre optic illuminating project is the choice of suitable wavelength to use optic fibres. While plastic optic fibres carry light better at 600 nm wavelength (blue/green Color spectrum), glass optic fibres have the feature of carrying light better at 670 nm wavelength (Red/yellow Color spectrum)

Both types of the optic fibre can be useable for about 20 years unless they are not exposed to demolishing external effects.

Along side the features stated above, glass optic fibres are more attenuating than plastic optic fibres.

For both types of optic fibres, attenuation comparison measured according to the length is presented in further chapters. Despite the superiorities, plastic optic fibres are preferred more in illuminating rather than glass optic fibres because they are cheaper due to their raw material and production technique.

There are two different options for applying fibres to the multi connector. The first is to place the multi connector to the harness output in classical method. Second and more developed method is called random layout method. By laying the different diameters' fibre ends of a harness out randomly into multi connector, more homogeneous light can be achieved from 2 mm and more diameter fibres. By this means more homogeneous light delivery can be possible at points where general illuminating and spot effect usage is subjected [6].

2.4 Fiber Optic Lighting Advantages

No electricity at the point of illumination- fiber optic cables carry only light to the point of illumination. The illuminator and the electricity that powers it can be many yards away from the objects or areas being lit.

No heat at the point of illumination - fiber optic cables carry no heat to the point of illumination

No UV rays at the point of illumination - fiber optic cables carry no destructive UV rays to the point of illumination, which is why the world's great museums often use fiber optic lighting to protect their ancient treasures. For preserving fragile and precious items, fiber optic systems provide bright but gentle light.

Easy and/or remote maintenance - whether the issue is access or convenience, fiber optic systems can make re-lamping a breeze. For fixtures that are

difficult to access, the illuminator can be located in a place that's easier to reach, and for multiple small lights (stair lights, paver lights or chandeliers) changing a single illuminator lamp re-lamps every light at once [7].

3.EXPERIMENTS OF MEASURING FIBER OPTIC LIGHTING

3.1 The Power Consumption of the Light Source [8]

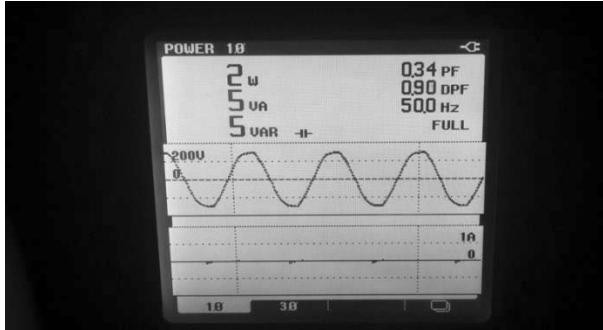


Figure 4: The power consumption of the light source(Istanbul Aydin University LED Lighting Laboratory)

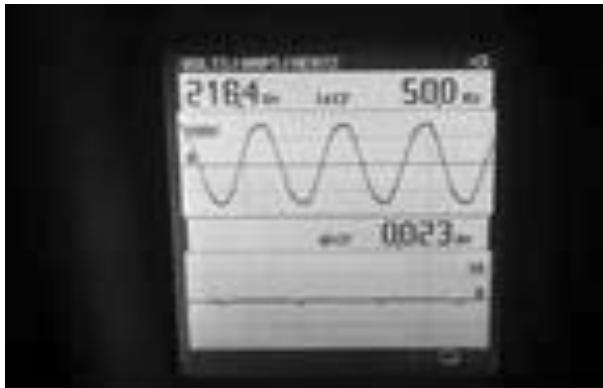


Figure 5: Volts/Amps/Hertz(Istanbul Aydin University LED Lighting Laboratory)

3.2. Measurement of all the Fibers (Sphere System)



Figure 6: Measurement of all the Fibers (Istanbul Aydin University LED Lighting Laboratory)

Derived Data	
Parameter	Scan 1
Radiant Flux (Watts)	0,03
Luminous Flux (lumens)	9,51
Scotopic Luminous Flux (lm')	19,88
Chromaticity x coord	0,3166
Chromaticity y coord	0,3258
Peak Wavelength (nm)	453,7
Center Wavelength (nm)	454
Full Width Half Max Bandwidth (nm)	21,4
Excitation Purity (%)	6,2
Correlated Color Temperature (deg. K)	6311
Luminous Efficacy (lm/W)	4,75
Measured DUT Current (A)	N/A
Measured DUT Voltage (V)	N/A
Spectral Data	

Table II. Table of values (Istanbul Aydin University LED Lighting Laboratory)
 Optical fiber source from the light source total lum/flux value 9.5 lumen. color temperature is 6311 Kelvin. Luminous efficiency was calculated as 4.75 [9].

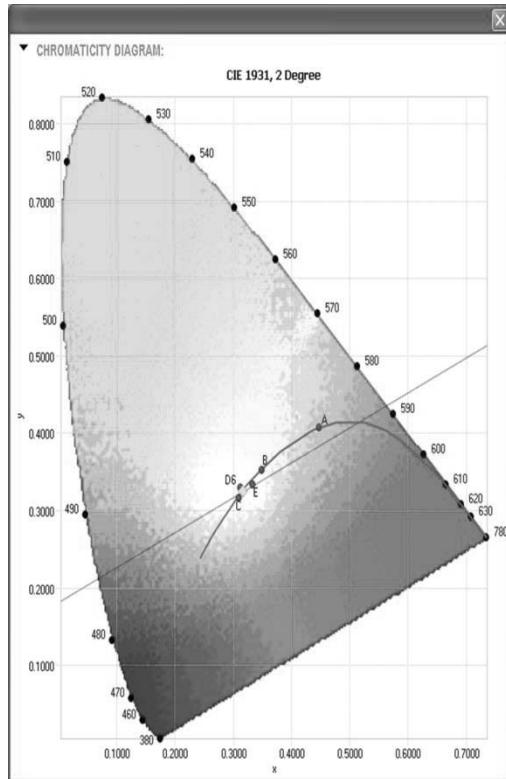


Figure 7: Chromaticity diagram(Istanbul Aydin University LED Lighting Laboratory)

Looking at the graph x and y chormacity is clear that values greater than 0.3.[10]

3.3. Measurements of 1 Watt LED (Sphere System)

Derived Data	
Parameter	Scan 1
Radiant Flux (Watts)	0,11
Luminous Flux (lumens)	35,07
Scotopic Luminous Flux (lm ⁰)	75,37
Chromaticity x coord	0,3115
Peak Wavelength (nm)	453,6
Center Wavelength (nm)	453,8
Full Width Half Max Bandwidth (nm)	21,6
Correlated Color Temperature (deg.K)	6666
Luminous Efficacy (lm/W)	17,5
Measured DUT Current (A)	N/A
Measured DUT Voltage (V)	N/A

Table III. Table of values (Istanbul Aydin University LED Lighting Laboratory)

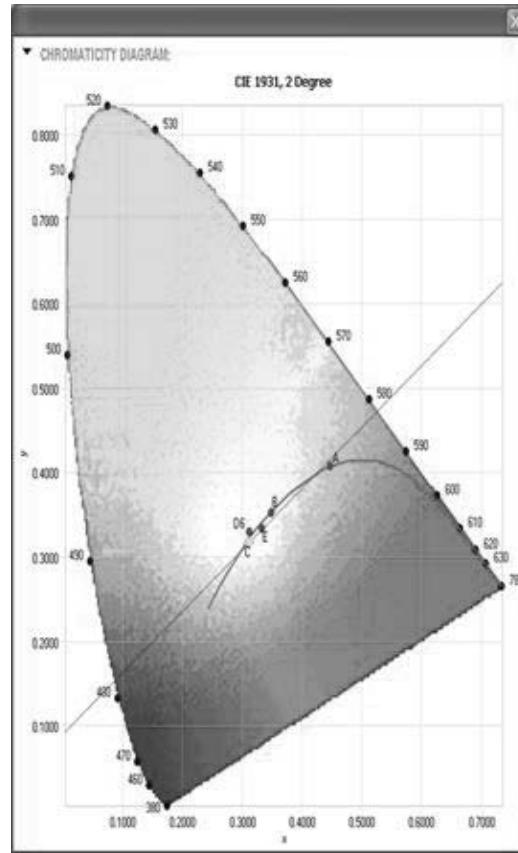


Figure 8: Chromaticity diagram (Istanbul Aydin University LED Lighting Laboratory)

Chormacity values slightly greater than 0.3 [11].

4. CONCLUSION

In conclusion, Fiber Optic Technology is coming of age as a useful tool in the lighting designers kit. With knowledge and consideration in the design and specification and a quality product installed correctly, Fibre Optics can achieve some otherwise apparently impossible lighting results. It is not a universal solution for all our design problems and reliance on suppliers selected on cheapest price basis to provide solutions for complex problems with minimal guidance from lighting designers can result in unsuccessful installations.

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