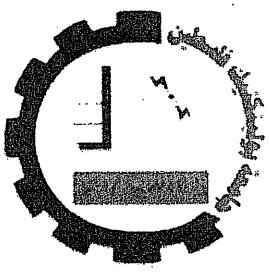
Palestine Polytechnic University



College of Engineering & Technology
Electrical & Computer Engineering Department

Software Graduation Project
ECG Intelligence

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This project was prepared to complete the requirements of graduation in Computer System Engineering major in Palestine Polytechnic University-College of Engineering and Technology

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%end
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Abstract

echnology provides several [redacted]ervices in medical Diagnosis system, because of it's
d accuracy. Since speed an[redacted] accuracy are important to keep human life; therefore
chnology in this project fo[redacted] ECG diagnose. It is necessary to have computer
helps doctors to diagnose h[redacted]art problem as prompt as possible in less time and in
ult. In this system we need [redacted]itially to read an ECG image which size is 467x274
ion .gif, after that several pr[redacted]processing and conditioning are applied on this image
ıg, splitting and creating a [redacted]nowledge based on using wavelets since the wavelet
technique gives results m[redacted]re accurately than other techniques such as Fourier
o it is a new tool for signal [redacted]nalysis and then diagnosis by comparing the extracted
the wavelets components in [redacted]e knowledge base using K-Nearest neighbor rule. The
ments in this project are that [redacted]ve have proved that Wavelets can be used to represent
al images efficiently. It has [redacted]en proved that Wavelets can be used to diagnose and
ages by comparing it with a [redacted]nowledge base of known cases, so it can be easily used
rnet.

Dedication

To our dear parents and families……..

To whom who have taught us any letter, word or information…….

To our perfect Supervisor Dr. Salman Talahmeh ……

To our instructors, friends,……

To our holy land …Palsetine ……..

We dedicate this Project

Project Team

Acknowledgment

By finishing this project, we stop for a moment to thank every body who has been a great help to us to complete this moderate work.

First, we are deeply grateful to the excellent guidance and attention given to us by Dr. Salman Talahmeh, without which it is difficult to reach the objectives of this project. Also we would like to express our full appreciation to his wonderful method and style of teaching which made us easily grasp the many complete concepts and ideas.

Also we want to thank all the libraries that helped us by providing us with the needed books and magazines.

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Problem initiation

Electrocardiograph (ECG) is an instrument which is vital to diagnose heart disease and chest pain. ECG is used to record the electrical activities of heart and to measure the rate and regularity of heartbeats .ECG also measures the size and position of the chambers and the presence of any damage to the heart. Add to that it is an important instrument to check the effect of medication on the heart. Readily determine the immediate effects of changes in activity or medication level.

In Palestine many people suffer from heart diseases due to stress .These diseases are spreading rapidly, due to the fact that doctors have a lot of problems in ECG readings and analyzing the heart wave, which is prone to error, tedious for giving rapid result, inaccuracy diagnosis and taking a lot of time. An early detection of heart disease cans safe people from different heart disease.

It is necessary to have computer software which helps doctors to diagnose heart problems as promptly as possible in a short time and with an accurate result. In diagnostic operation we need several calculations, such as rate of pulse, P-wave of ECG, QRS complex of ECG (contraction of ventricles), T-wave of ECG (relaxation of ventricles), and other calculations. This project will assist experienced doctors to enhance their ability and their knowledge in less effort. It also provides practice guidelines for non experienced doctors. So this program can be implemented in many private and public clinics, in addition to Palestinian hospitals.

Chapter

1

Introduction

Chapter One

Introduction

1.1 Introduction to ECG

New diagnostic concepts are derived from the recent ECG literature. It is important to recognize that the mastery of ECG interpretation, one of the most useful clinical tools in medicine, can only occur if one acquires considerable experience in reading ECG's and correlating the specific ECG finding with the path physiology and clinical status of the patient.

An ECG is a quick, painless test that measures the electrical activity of the heart. Every time the heart beats, it produces a tiny amount of electricity. Electrodes (sticky patches with snaps) applied to your child's body detect this electrical activity. The information is sent from the electrodes to the ECG machine through wires called leads. No electricity goes from the machine to your child.

The recording of ECG provides information about:

- how quickly the heart is beating (heart rate)
- whether the heartbeat is regular (rhythm)
- whether the electrical activity occurs in a normal pattern
- whether the heart muscle is in normal size

The type of ECG depends on the number of leads used to collect the information. A larger number of leads mean that more information can be collected. The most common type of

ECG used for a child with a heart condition, is a 12-lead ECG. There are also 3-lead and 4-lead ECGs. ECG stands for electrodiogram, or electrocardiograph. In some countries, the abbreviation used is EKG.

Clinical diagnosis depends mainly on patient's history, and in a lesser extends on the physical examination. The ECG is essential for the diagnosis; therefore the management of abnormal cardiac rhythms helps to diagnose the cause of chest pain.

ECG has a variety of instrument types such as 1-channel, 3-channel and 6-channel as shown in figure 1.1, so there are different forms of ECG paper as shown in figure 1.2

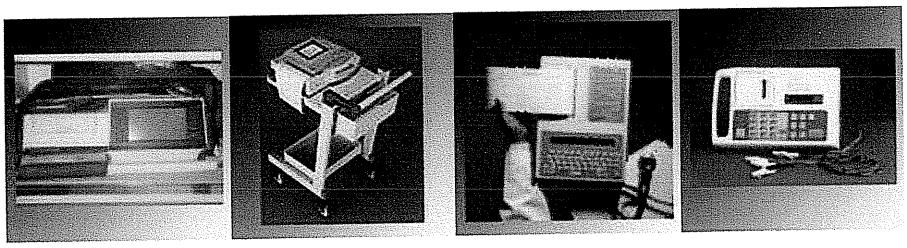

Figure1.1: Different Type of ECG Equipment

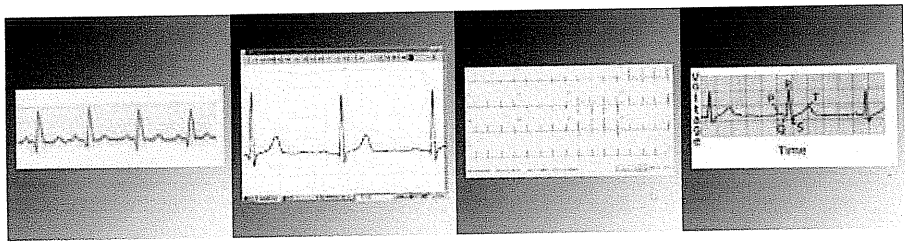

Figure 1.2: Different form of ECG Paper

1.1.1 Features and Benefits

ECG provides a lot of benefits such as early diagnosis, which is the ultimate diagnostic solution for chest pain patients. It is revolutionized the identification and treatment of heart attack of patients. Prime ECG body surface maps allow physicians to identify quickly and accurately the type of heart attack, and area which is involved to produce both better treatment decisions and patient outcomes .Also ECG features an easy-to-apply disposable electrode vest with an increased diagnostic detection area about the torso for a more complete view of the heart's electrical activity. In addition, ECG allows early diagnosis for more patients and more rapid treatment. This can reduce heart muscle damage decreasing morbidity and reducing mortality.

1.1.2 Heart Disease - Enlarged Heart

High blood pressure is one of the major factors which contribute in heart failure. In patients with heart failure, the heart cannot adequately continue pumping all the blood that circulates through it, resulting in a back-up of blood into the veins and fluid accumulation in the body. In response to an elevated blood pressure, the heart works harder and harder, eventually leading to compensatory enlargement of the left ventricle.

The heart is a muscular pump about the size of a clenched fist. An enlarged heart is not a condition in itself, but a symptom of an underlying problem that is causing the heart to work harder than normal. The range of underlying problems falls generally into two main categories - pathological (linked to actual disease of the heart muscle disease) and physiological (linked to other causes which are overworking the heart muscle, such as high blood pressure or thyroid diseases). Old people are at incredible increased risk.
An enlarged heart is diagnosed by using Electrocardiogram which measures the electrical activity in the heart and can help diagnose an enlarged heart.

1.1.3 Heart Disease in Palestine

For many years Palestinians have lived in a state of an extreme bad economical, political and health conditions, due to the Israeli occupation. The occupation lead to bad economic conditions which have caused several dangerous illnesses such as heart diseases .The stress and depression are the main cases of heart illness, which increase rapidly.

According to PCRF (the International Palestine Cardiac Relief Organization) , almost three-quarters of Palestinians now live on less than 2 dollars (#1.22) a day, which is below the United Nations poverty line, the utilization of up-to-date technology and software are not enough to diagnoses ECG graph . So heart diseases are increasing rapidly in Palestine. This project will help doctors to diagnose the heart diseases in less time to reduce the risk of the disease.

1.1.4 ECG Diagnose Using Computer

The Computer Assists Medical Diagnosis system (ADM - Aide au diagnostic Medical) is a large knowledge base covering all the medical domains, because of its high speed and accuracy.

The steady expansion of medical knowledge has made it more difficult for the physician to remain abreast of medicine outside a narrow field. Consultation with a specialist is a solution when the clinical problem lies beyond the physician's competence, but frequently, an expert opinion is either unavailable or not available in a timely fashion. They have been made to develop computer programs that can serve as a consultant for diagnosis.

Diagnosis has been and will be the most important problem of medicine, and the accuracy of achieved diagnosis in certain historical periods determines mainly the state-of-the-art in medical science.

As the human body is very complicated and it is characterized into practical infinite number of disease symptoms, symptoms and clinic of a disease are greatly influenced by the individual features of a patient and knowledge of specialists is limited. Medical diagnosis, nowadays, is not a science but rather an art of few highly qualified professionals.

After computers have appeared and applied mathematics has developed, and works related to attempts to formalize the diagnosis process using mathematical models boomed. The results of these works mainly did not come up to expectations and rare successes are connected either to the relative simplicity of the problem (to differentiate diseases sufficiently remote from each other in the symptoms space) or with its inadequate simplification. As a result, at best models of diagnosing a disease are not worse than an average doctor appeared.

Principal difficulties in simulation of "large" systems (to which medical diagnosis systems also belong) made it necessary to look for roundabout ways. One of these ways being developed intensively at present is the creation of expert medical system. An expert system is a computer system which incorporates with a formalized knowledge of specialists in certain concrete subjects, and is able to take expert decisions within this subject (to solve problems in such a way as a man-expert would do it).

Efficiency of operation of the expert system depends in the first place on the quantity and quality of the information available in its knowledge base. This is a weak point of expert systems because (1) knowledge base is formed on the basis of subjective ideas of experts whose knowledge is limited and (2) specialists are not able to formalize their knowledge as clear rules. All in all, many of them are not aware of what rules they should follow.

According to previous information, the computer system as a program is the most demanded to use in diagnosing diseases. Therefore, the computer proved its quality, Efficiency, accuracy, etc..., which can obtain these characteristics in diagnosing the diseases.

1.1.5 Important of Fast and Accurate Diagnosis of Diseases

To reduce the risk of the diseases, we need a fast and more accurate diagnosis of all diseases specially heart diagnosis. It is important to provide rapid, accurate and precise diagnosis.

Also we need the agility & accuracy of diagnosis to reduce study time and decrease patients waiting time during the treatment in the clinic or in out in all illness duration, so diagnose could give a faster examination procedure to reduce the diseases risks.

The diagnose must be as accurate as possible to determine any diseases. It means the accuracy has a big importance to save human life and reduce risk on their health and also decrease the death rate between people who suffer from any diseases.

There is a relationship between accuracy and agility in diagnose. So if the accuracy is available, the doctors need little time to diagnose and also to deal with the disease to decrease patients suffering, however we need a system to permit us to use these two properties (accuracy, agility) to make disease diagnosing more easily and to make this we need to use a computer.

The computer technology is used today in many fields some of these fields is the medical fields because of its speed and its accuracy, so we must use software to be enable to diagnose diseases in high accuracy and little time.

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1.1.6 Important Charts of Diseases Diagnose

Diagnosis chart is intended to be as a guide to point the user in the right general direction. Also the charts has a big role in diagnosing in any disease and the important of these charts, lies in giving proceeding accurate results to all doctors before they give any treatment which could be valid or invalid and it may sometime could cause a big risk.

Due to the fact that pathology symptoms in all diseases can manifest themselves in more than a way, we have the space to describe and allocate resources to where ever possible, no matter where the chart eventually points you to; the chart could make the diagnose easier and more accurate to reduce the risk of diseases, specially in heart diseases by reaching to the solution in a faster time.

Although there is some doctor's doubt in what appear in this chart and its accuracy, the chart can never be 100% successful due to variation in symptoms, but it can help doctors decided in many cases to eliminate a possible heart problems.

1.2 Image Processing Using Wavelets

Everywhere around us are signals that can be analyzed. For example, there are seismic tremors, human speech, engine vibrations, medical images, financial data, music, ECG graph and many other types of signals. Wavelet analysis is a new and promising set of tools and techniques for analyzing these signals.

This project is based on wavelet technology; which is needed to read several signals and to transform them in to the feature extraction, to obtain the coefficient of each signal (ECG graph) by using the wavelet mathematical technique. It is also a new tool for signal analysis.

Wavelet Transform

Mathematical transformations are applied to signals to obtain further information from that signal which is not readily available in the raw signal. There are a number of transformations that can be applied, among the most well known is the Fourier transforms.

Wavelet Applications

Wavelets have scale aspects and time aspects; consequently every application has scale and time aspects. To clarify them we try to untangle the aspects somehow arbitrarily.

For scale aspects, we present one idea around the notion of local regularity. For time aspects, we present a list of domains. When the decomposition is taken as a whole, the de-noising and compression processes are center points.

Scale Aspects

As a complement to the spectral signal analysis, new signal forms appear. They are less regular signals than the usual ones. The cusp signal presents a very quick local variation. Its equation is with t close to 0 and $0 < r < 1$. The lower r the sharper the signal. To illustrate this notion physically. Imagine taking a piece of aluminum foil; the surface is very smooth, very regular. You first crush it into a ball, and then you spread it out so that it looks like a surface. The asperities are clearly visible. Each one represents a two-dimensional cusp and analog of the one dimensional cusp. If you crush again the foil, more tightly, in a more compact ball, when you spread it out, the roughness increases and the regularity decrease. Several domains use the wavelet techniques of regularity study: Biology for cell membrane recognition, to distinguish the normal from the pathological membranes Metallurgy for the characterization of rough surfaces Finance (which is more surprising), for detecting the properties of quick variation of values In Internet traffic description, for designing the service sizes.

1.2.1 Wavelet Decomposition as a Whole

Many applications use the wavelet decomposition as a whole. The common goals concern the signal or image clearance and simplification, which are parts of de-noising or compression.

We find many published papers in oceanography and earth studies. One of the most popular successes of the wavelets is the compression of FBI fingerprints.

When trying to classify the applications by domain, it is almost impossible to sum up several thousands of papers written within the last 15 years. Moreover, it is difficult to get information on real-world industrial applications from companies. They understandably protect their own information.

Some domains are very productive. And Medicine is one of them. We can find studies on micro-potential extraction in EKGs, on time localization of His bundle electrical heart activity, in ECG noise removal. In EEGs, a quick transitory signal is drowned in the usual one. The wavelets are able to determine if a quick signal exists, and localize it. There are attempts to enhance mammograms to discriminate tumors from calcifications.

Another prototypical application is a classification of Magnetic Resonance Spectra. The study concerns the influence of the fat we eat on our body fat. The type of feeding is the basic information and the study is intended to avoid taking a sample of the body fat. Each Fourier spectrum is encoded by some of its wavelet coefficients. A few of them are enough to code the most interesting features of the spectrum. The classification is performed on the coded vectors. So there are many techniques used to analyze signals some of these techniques:

1.Fourier analysis

Signal analysis has already at their disposal an impressive arsenal of tools. Perhaps the most well known of these is Fourier analysis, which breaks down a signal into constituent sinusoids of different frequencies. Another way to think of Fourier analysis is as a mathematical technique for transforming our view of the signal from time-based to frequency-based as show in figure 1.3.

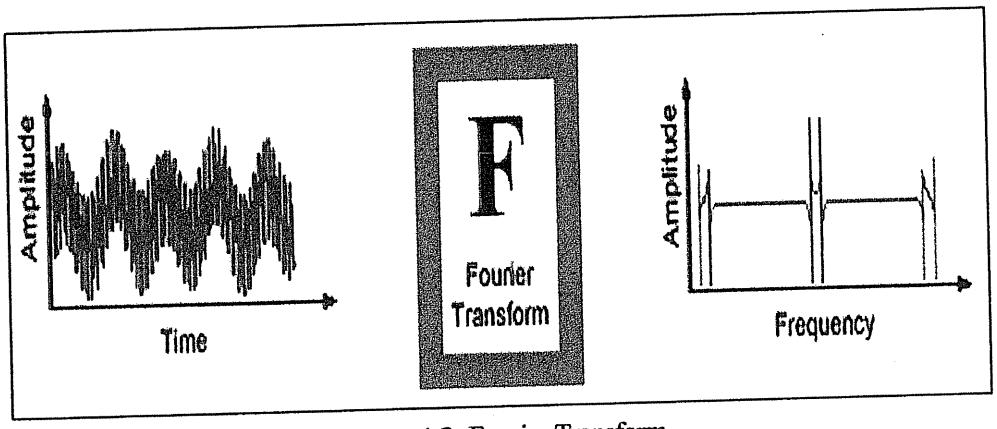

Figure 1.3: Fourier Transform

For many signals, Fourier analysis is extremely useful because the signal's frequency content is of great importance.

Fourier analysis has a serious drawback. In transforming to the frequency Domain, time information is lost. When looking at a Fourier transform of a signal, it is impossible to tell when a particular event took place.

If the signal properties do not change much over time — that is, if it is what is called a stationary signal — this drawback isn't very important. However, most interesting signals contain numerous no stationary or transitory characteristics: drift, trends, abrupt changes,

and beginnings and ends of events. These characteristics are often in the most important part of the signal, and Fourier analysis is not suitable to detect them.

2. Short-Time Fourier analysis

As an effort to correct this deficiency in the Fourier analysis, a technique called windowing the signal is adapted (Gonzalez, 2002). It called Short-Time Fourier Transform (STFT) and Figure 1.4 shows the mapping of a signal into a two-dimensional function of time and frequency (Kaiser, 1994).

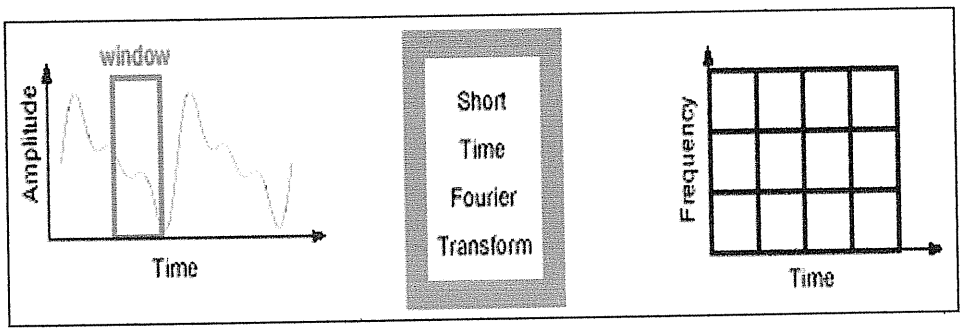

Figure 1.4: Short-Time Fourier Transform

The STFT represents sort of compromise between the time- and frequency-based views of a signal. It provides some information about both when and at what frequencies a signal event occurs. While the STFT compromise between time and frequency information can be useful, the drawback is that once we choose a particular size for the time window, that window is the same for all frequencies. Many signals require more flexible approach where we can vary the window size to determine more accurately either the time or frequency (Gonzalez, 2002).

3. Wavelet Analysis

The wavelet transform or wavelet analysis is probably the most recent solution to overcome the shortcomings of the Fourier transform. A wavelet is a waveform of an effectively limited duration that has an average value of zero (Kaiser, 1994). Wavelet analysis is the breaking up of a signal into shifted and scaled versions of the original (or mother) wavelet. The use of a fully scalable modulated window solves the signal-cutting problem. The spectrum is calculated for the window in each time it shifts. Then this process is repeated many times with a slightly shorter (or longer) window for every new cycle (Mallat, 1989). Wavelet analysis allows the use of long time intervals where we want to get more precise low-frequency information and shorter regions where we want to get high-frequency information. After that, the result will be a collection of time-frequency representations of the signal with different resolutions. Because of this collection of representations, it is called multi-resolution analysis. Figure 1.5 shows wavelet transformations mechanism (Kaiser, 1994). Wavelet transform can also be seen from a signal decomposition view point. In this case, a signal is decomposed into a set of basis functions which are called wavelets and are the core of wavelet analysis.

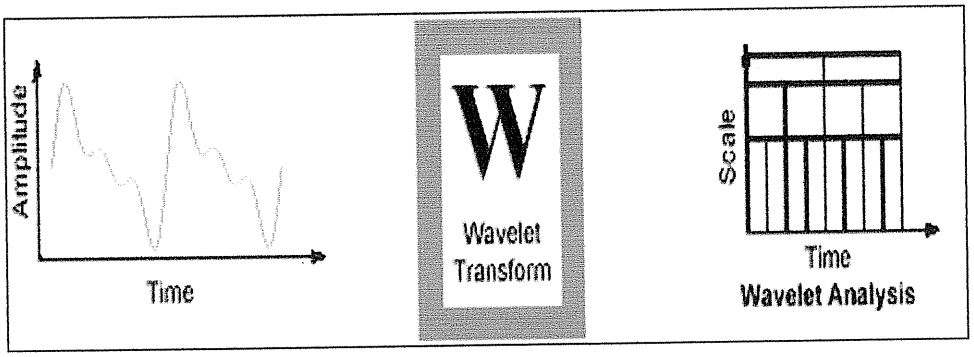

Figure 1.5: Wavelet Transform

The large scale can be defined as the big picture, while the small scales show the details. Thus, going from the large scale to the small scale is in this context equal to zooming in. One major advantage afforded by wavelets is the ability to perform local analysis, that is, to analyze a localized area of a larger signal (Kaiser, 1994). Add to that it provides a different view of data than those presented by traditional techniques. Wavelet analysis can often compress or de-noise a signal without appreciable degradation. There are many families of wavelets that have proven to be useful such as Haar, Daubechies, Biorthogonal, Coiflets, Symlets, and Mexican Hat (Kaiser, 1994).

In many signals, the low-frequency content is the most important part. It gives the signal its identity. The high-frequency content, on the other hand, imparts flavor or nuance. In wavelet analysis, they are called approximations and details. The approximations are the high-scale, low-frequency components of the signal. The details are the low-scale, high-frequency components. Wavelet analysis is based on three properties: orthogonal, quadratic filter and filter bank.

1.2.2 The Continuous Wavelet Transform

The continuous wavelet transform was developed as an alternative approach to the STFT to overcome the resolution problem. The wavelet analysis is done in a similar way as the STFT analysis, in a sense that the signal is multiplied by a function, the wavelet, similar to the window function in the STFT, and the transform is computed separately for different segments of the time-domain signal. The continuous wavelet transform of a continuous function *f(x)*, relative to a wavelet, $\Psi(t)$, is defined as follows:

$$W_{\psi}(s,\tau) = \int_{-\infty}^{\infty} f(x)\psi_{s,\tau}(x)dx$$

Where,

$$\psi_{s,\tau} = \frac{1}{\sqrt{s}}\psi\left(\frac{x-\tau}{s}\right)$$

Here, s is the scale factor τ is the translation factor and the factor $s^{-1/2}$ is for energy normalization across the different scales. This equation shows how a function f(x) is decomposed into a set of basis functions $\Psi(t)$ called the wavelets. The wavelets are generated from a single basic wavelet $\Psi(t)$, the so-called *mother wavelet*, by scaling and translation. The continuous transform can be viewed as a set of transform coefficients $\{W_{\psi}(s,\tau)\}$ that measure the similarity of *f(x)* with a set of basis functions, $\{\psi_{s,\tau}\}$.

Figure 1.6 describes the filtering process, at its most basic level. The decomposition process can be iterated with successive approximations being decomposed in turn, so that one signal is broken down into many lower resolution components (Kaiser, 1994; Mallat, 1989).

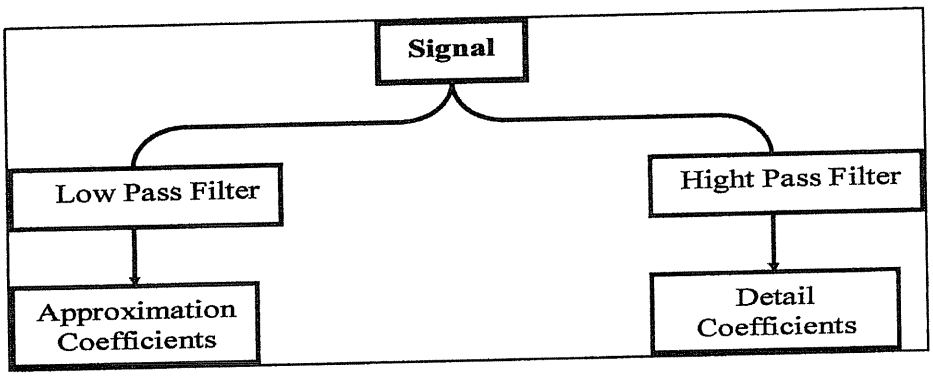

Figure 1.6: Filtering Process in Wavelet Analysis

These signals A and D which appear from low pass filter and high pass filter successively are interesting, but we get 2000 values instead of the 1000 that we had. There exists a more subtle way to perform the decomposition using wavelets. By looking carefully at the computation, we may keep only one point out of two in each of the two 2000-length samples to get complete information. This is the notion of down sampling.

1.2.3 Five Easy Steps to a Continuous Wavelet Transform

The continuous wavelet transform is the sum of all time signals multiplied by scale, shifted versions of the wavelet. This process produces wavelet coefficients that are a function of scale and position.

It's really a very simple process. In fact, here are the five steps of an easy recipe for creating a CWT:

- Take a wavelet and compare it to a section at the start of the original signal.
- Calculate a number C that represents how closely correlated the wavelet is with this section of the signal. The higher C is the more similar, and more precise. If the signal

energy and the wavelet energy are equal to one, C may be interpreted as a correlation coefficient.

Similarly, the continuous wavelet transform (CWT) is defined as the sum over all time of the signal multiplied by scaled, shifted versions of the wavelet function Ψ:

$$C(scale.position) = \int_{-\infty}^{\infty} f(t)\psi(scale.position,t)dt$$

Note that the results will depend on the shape of the wavelet you choose.

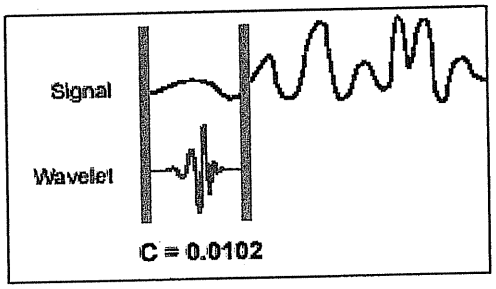

Figure 1.7: Wavelet function

- Shift the wavelet to the right and repeat steps 1 and 2 until you've covered the whole signal.

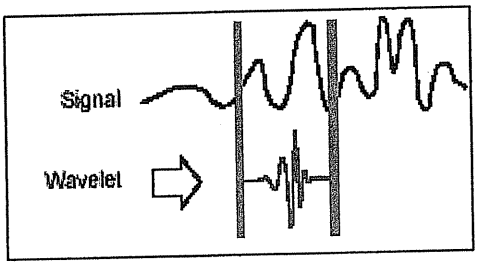

Figure 1.8: Shifted Wavelet function

- Scale (stretch) the wavelet and repeat steps 1 through 3.

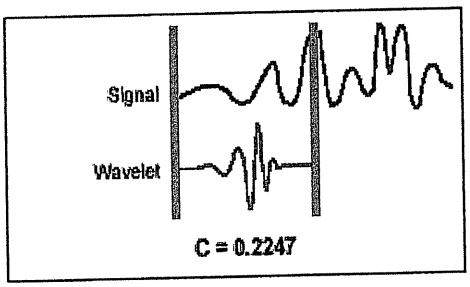

Figure 1.9: Scale Wavelet function

The process on the right, which includes down sampling, produces DWT Coefficients.

To gain a better appreciation of this process, let's perform a one-stage discrete wavelet transform of a signal. The signal will be a pure sinusoid with high-frequency noise added to it.

1.2.4 Multiple-Level Decomposition

The decomposition process can be iterated with successive approximations being decomposed in turn, so that one signal is broken down into many lower resolution components. This is called the wavelet decomposition tree.

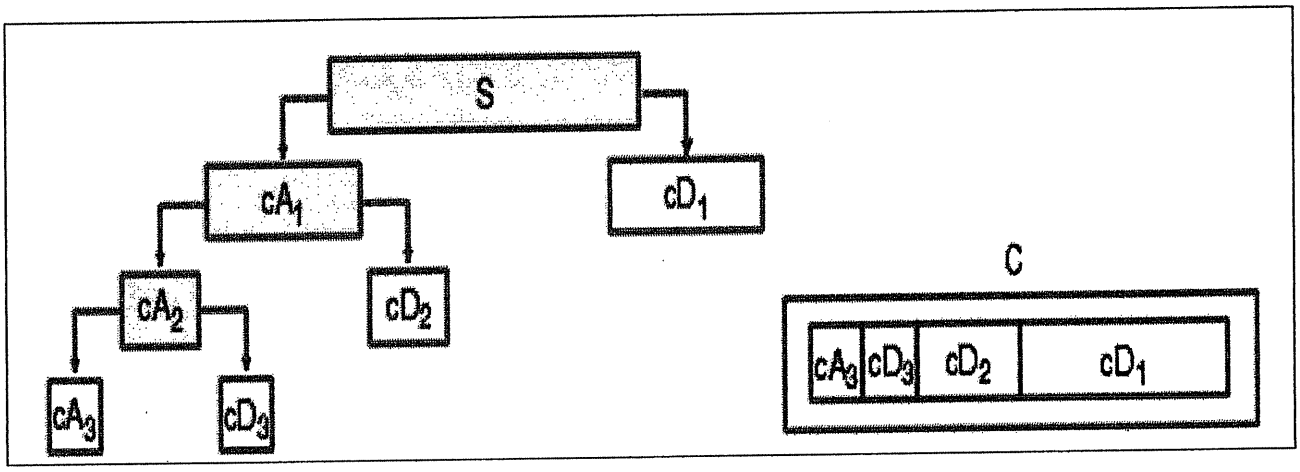

Figure 1.10: Multiple-Level Decomposition

Number of Levels

Since the analysis process is iterative, theoretically it can be continued indefinitely. In reality, the decomposition can proceed only when the individual details consist of a single sample or pixel. Practically, you'll select a suitable number of levels based on the nature of the signal, or on the suitable criterion.

Wavelet Packet Analysis

The wavelet packet method is a generalization of wavelet decomposition that offers a richer range of possibilities of signal analysis.

In wavelet analysis, a signal is split into an approximation and a detail. The approximation itself then split into a second-level approximation and detail, and the process is repeated. For n-level decomposition, there are n+1 possible ways to decompose or encode the signal.

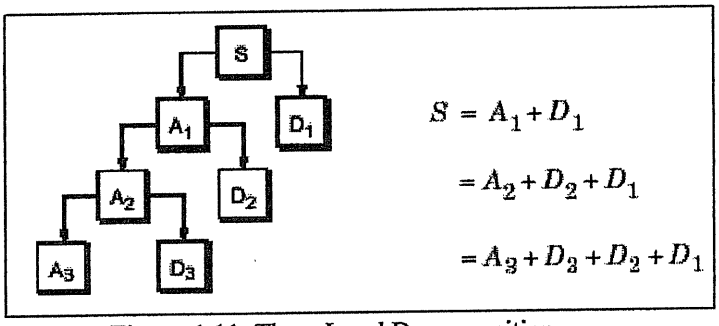

Figure 1.11: Three-Level Decomposition

In wavelet packet analysis, the details as well as the approximations can be split. This yields more than 2 to power n-1 different ways to encode the signal. This is the wavelet packet decomposition tree.

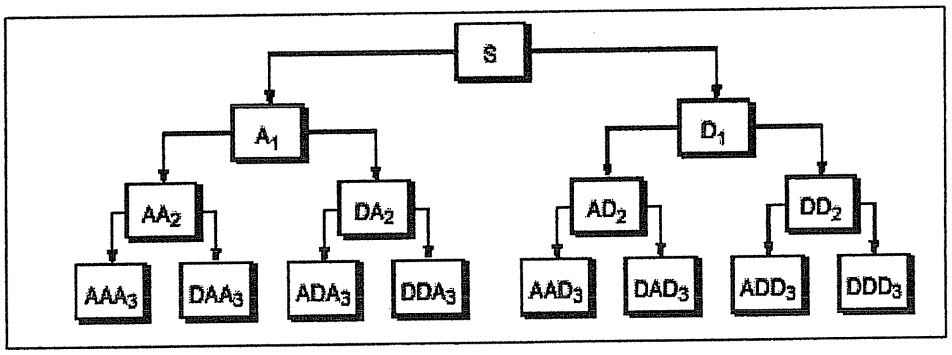

Figure 1.12: Wavelet Decomposition

1.3 Introduction to Classification

The task of classification occurs widely in human activity. At its broadest, the term could cover any context in which some decisions or forecasts are made on the basis of current available information, and a classification procedure is then some formal method for repeatedly making such judgments in new situations. a classification task originally include mechanical procedures for sorting letters on the basis of machine-read postcodes, assigning

individuals to credit status on the basis of financial and other personal information, and the preliminary diagnosis of a patient's disease in order to select immediate treatment while awaiting definitive test results. In fact, some of the most urgent problems arising in science industry and commerce can be regarded as classification or decision problems using complex and often very extensive data.

1.3.1 Why A classification Procedure is Important

- Mechanical classification procedures may be much faster; For example, postal code reading machines may be able to sort the majority of letters, leaving the difficult cases to human readings.
- A mail order firm must be decided on the granting of credit purely on the basis of information supplied in the application form: human operators may well have biases.
- In the medical field, we may wish to avoid the surgery that would be the only sure way of making an exact diagnosis, and whether reliable diagnosis can be made on purely external symptoms.
- The Supervisor previously mentioned may be the verdict of history, as in meteorology or stock-exchange transaction or investment and loan decisions. In this case the issue is a one forecast issue.

1.3.2 Classifier Issues

There are also many issues of concern to the would-be classifier:

- **Accuracy:** There are reliable, and usually represented by the proportion of correct classifications. Although some errors are more serious than others, it is important to control the error rate to some key class.

- **Speed**: In some circumstances, the speed of the classifier is a major issue. A classifier with 90% accuracy is preferred than that with 95% accuracy if it is 100 times faster in testing (and such differences in time-scales are not uncommon in neural networks for example). Such considerations would be important for the automatic reading of postal codes or automatic fault detection of items on a production line for example.

- **Comprehensibility:** If it is a human operator that must apply the classification procedure, the procedure must be easily understood that others mistakes will be made in applying the rule. It is also important, that human operators believe in the system. An oft-quoted example is the Three-Mile Island case where the automatic devices correctly recommended a shutdown, but this recommendation was not acted upon by the human operators who did not believe that the recommendation was well founded. A similar story applies to the Chernobyl disaster.

- **Time to Learn:** Especially in a rapidly changing environment, it may be necessary to learn a classification rule quickly, or make adjustments to an existing rule in real time. "Quickly" might imply also that we need only a small number of observations to establish our rule.

1.3.3 Example of Classification

1- Fisher's linear discriminates

This is one of the oldest classification procedures, and it is the most commonly implemented in computer packages. The idea is to divide sample space by a series of lines in two dimensions, planes in 3-D and, generally hyper planes in many dimensions. The line dividing two classes is drawn to bisect the line joining the centers of those classes; the direction of the line is determined by the shape of the clusters of points.

2 -Decision tree and Rule-based methods

One class of classification procedures is based on recursive partitioning of the sample space. Space is divided into boxes, and at each stage in the procedure, each box is examined to see if it may be split into two boxes, the split usually being parallel to the coordinate axes.

3- k-Nearest-Neighbor Rule

We illustrate this technique on the Iris data. Suppose a new Iris is to be classified. The idea is that it is most likely to be near to observations from its own proper population. So we look at the five nearest observations from all previously recorded Irises, and classify the observation according to the most frequent class among its neighbors.

The K-Nearest rule is always used in statistical pattern recognition suppose the library contains feature vector for K-sample, each sample is represented by I features. The matching can be performed as follows:

1- Calculate the distance between the test feature vector and each feature vector in the library as follow:

$$di=\sqrt{\sum_{j=1}^{K}(Xj-Tj)^2}$$

Where

i: # of samples.

K: # of coefficients.

Xj: coefficients for each sample.

Tj: coefficient for test.

2- Compare the result distance. The test sample is consigned to the sample creating the smallest distance

Example: Using the K-Nearest neighbor rule.

Let us assume that the library contains the following feature vectors:

Sample 1

$$\begin{pmatrix} 1 \\ 2 \\ 3 \\ 4 \end{pmatrix}$$

Sample 2

$$\begin{pmatrix} 2 \\ 3 \\ 4 \\ 5 \end{pmatrix}$$

Sample 3

$$\begin{pmatrix} 4 \\ 6 \\ 8 \\ 10 \end{pmatrix}$$

Sample 4

$$\begin{pmatrix} 2 \\ 4 \\ 6 \\ 8 \end{pmatrix}$$

Test

$$\begin{pmatrix} 2 \\ 5 \\ 8 \\ 11 \end{pmatrix}$$

Solution:

$$di=\sqrt{\sum_{j=1}^{k} (Xj-Tj)^2}$$

$d1=\sqrt{(1-2)^2+(2-5)^2+(3-8)^2+(4-11)^2} = 9.16$

$d2=\sqrt{(2-2)^2+(3-5)^2+(4-8)^2+(5-11)^2} = 7.48$

$d3=\sqrt{(4-2)^2+(6-5)^2+(8-8)^2+(10-11)^2} = 2.45$

$d4=\sqrt{(2-2)^2+(4-5)^2+(6-8)^2+(8-11)^2} = 3.74$

Result:

The test is similar to sample # 3, because the distance between the test and sample 3 is smaller than the other distances.

4-Correlation

Correlation is a statistical technique which can show whether and how stronger pairs of variables are related. Correlation coefficient measure the degree of linear relationship between two variables. While in regression the emphasis is on predicting one variable from the other, in correlation the emphasis is on the degree to which a linear model may describe the relationship between two variables. In regression the interest is directional. One variable is predicted and the other is the predictor; in correlation the interest is non-directional, and the relationship is the critical aspect.

1.3.4 General Structure for Classification Problem

There are three essential components to a classification problem

- The relative frequency with which the classes occur in the population of interest is, expressed formally as the prior probability distribution.
- An implicit or explicit criterion for separating the classes: we may think of an underlying input/output relation that uses observed attributes to distinguish a random individual from each class. The cost associated with making a wrong classification.

  Most techniques implicitly confound components. For example, producing a classification rule that is derived from conditional of a particular prior distribution and cannot easily is adapted to a change class frequency; however, theoretically each of these components may be individually studied, and then the results are formally combined into a classification rule.

Chapter

2

System Specification

Chapter Two

System Specification

2.1 Introduction

In this section the system specifications will explain and identify it in more technical terms. This section will cover:

- Objectives: where the main purpose is to help the doctors to diagnose and analysis ECG graph.
- Project benefits for doctors, developing team , and society
- Functional and Non-Functional Requirements with a brief description of each one.
- Project constrains that mentioned all constrains and validation that system must contain.
- Cost of all requirement system development for HW, SW, Humans, Books, and Others. By limiting the number of units the system needs, its cost, and its availability.
- The project cost benefit analysis and the time needed to cover the cost, then making a justification for each one if it is tangible or non-tangible benefits.
- Project Feasibility Study by explaining its alternatives (Economic Feasibility, Technical Feasibility, Legal Feasibility ....)
- Project Risk Evaluation: Talks about the possible risks, and the solution for each possible risk with high descriptions.
- Scheduling for the entire project and giving a period of time to each step.
- Finally will be the summery and recommendation.

2.2 Objectives

These are the main objectives of this project:

- Making diagnostic easier for any heart illness to decrease patients suffering in less time.
- Provide the capability to analyze ECG charts, decision supporting for expert doctor and diagnose ECG graph for inexpert doctor.
- Provide accurate and fast diagnostic of ECG charts.
- Building knowledge base for ECG diagnostic.
- Provide of an online (Web) service for ECG diagnostic.
- Use matlab6.5 to read ECG graph, preprocessing and splitting it.
- Use wavelets to decompose and represent ECG charts.

2.3 Benefits

Project benefits for users

- Enhance the ability of doctors to analyze ECG graphs
- Improving doctor-patient relationship
- More accuracy in analysis and diagnosis
- More rapid in reading
- Make a decision by a more confidence way.

Project benefits for the development team

- We will accept a new knowledge about heart diseases.
- Obtain knowledge in pre-processing, wavelets, ECG graph and other technologies.
- Enhance our self in use the computer program in medicine fields.

- Enhance our self in many languages such as ASP.NET, VB.NET, and SQL SERVER.
- Increase our ties with visited doctors.

Project benefits for society

More security for the patients

- More rapid in taking treatment
- More save for patients in receiving treatment
- The patients will not deterioration if there's a rapid diagnosis
- Depending on the above mention points this will decrease the cost of the treatment of the patients.
- New service is provided by the private, public clinics and Palestinian hospitals.

2.4 Functional Requirements

There are two main modules in the project:

1- Knowledge base module

2- Diagnostic and Reporting module

The main function and description for each one is provided as follows:

2.4.1 Knowledge Base

- **Administrator Login**

  Use to enable administrator to login the web application

- **Change administrator Password**

  This function enables the administrator to change his login password

- **Reading a stored image and related data**

  Read ECG graph and the information which it contains.

- **Verify type and size**

  Verify type of ECG image has extension .GIF and its size 467*274.

- **Preprocessing an image**

  The image is preprocessing to increase its usefulness. Image processing includes removing noise, unrelated data and background of an image.

- **Splitting**

  Split each ECG image to 12 charts. This represents the ECG graph.

- **Wavelets Extraction**

  Extract each chart to obtain features and coefficient that represents the signal.

- **Formatting**

  Grouping data to be more suitable with database structure

- **Saving data**

  Save features of coefficient that represent an ECG graph to build knowledge database.

2.4.2 Diagnostic and Classifier

- **Physician Login**

  Use to enable physician to login the web application

- **Change Physician Password**

  This function enables the physician to change his login password

- **Upload ECG image and related data**

  Load ECG graph and the related information from storage folder on the computer.

- **Verify type and size**

  Verify that the type of ECG image has extension .GIF and its size 467*274.

- **Preprocessing an image**

  The image is preprocessing to increase its usefulness; image processing includes removing noise, unrelated data and background of an image.

- **Splitting**

  Split each ECG image to 12 charts. This represents the ECG graph.

- **Wavelets Extraction**

  Extract each chart to obtain features and coefficient that represent the signal.

- **Classification**

  To make map (comparison) between knowledgebase and process ECG graph by using k_nearest neighbors rule and classify the observation according to the most frequent class among its neighbors.

- **Diagnose and Reporting:**

  After all above operation mentions, the program can diagnose the type of heart disease and the result can be reported.

2.5 Non-Functional Description

Non-functional requirements define system main properties.

2.5.1 Product Requirement

- **Ease of use**: the system must provide a user-friendly interface to make it easy to deal with.
- **Integrity**: the system must be integrated with the existing systems and databases.
- **Accuracy**: the system must provide a high level of accuracy.
- **High efficiency**: efficient results must be given to user to surprise the system capability of work.
- **High reliability**: the system must be reliable and its results must be correct.

- **High portability:** The system could be used without difficulties in the platform differences.
- **Trapping errors**: The error could be detected easily.
- **Fast:** Obtaining the result in a short time.
- **Simple (understandable)**: The system must be understandable for simple users.

2.5.2 Process Requirements

The system and its documents must be delivered at the end of semester.

2.5.3 External Requirements

- **Ethical requirements**: the system must prevent the unethical transactions.
- **Legislative Requirements:** Privacy: the system must satisfy the privacy requirement, by keeping personal information as secure as possible.
- Safety: the system must maintain a full, secure and non corrupted data by applying different authentication and backup methods.
- Security: the system must maintain its data when administrator or physician login as encrypted format.

- **High portability:** The system could be used without difficulties in the platform differences.
- **Trapping errors**: The error could be detected easily.
- **Fast:** Obtaining the result in a short time.
- **Simple (understandable)**: The system must be understandable for simple users.

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- Security: the system must maintain its data when administrator or physician login as encrypted format.

2.6 Project Constraints

This section lists the constraints that exist in the project and a description of each one:

- Login IDs (for both administrator and doctors should be unique to increase the security.
- Login IDs should contain at least six Characters (Alpha Numeric Mixture is preferred) to increase the security and the difficulty to steal.
- Login ID should start with letters.
- Passwords (for both administrator and doctors) contain at least six Characters (Alpha Numeric Mixture is preferred) to increase the security and the difficulty to be stolen.
- Password must be different from the login.
- Build knowledgebase module by using MATLAB 6.5
- Diagnostic and Reporting module will process online web-bases application with ASP.NET.
- Use ECG graph type 4 sinus rhythms.
- The type of ECG image has extension (.gif) and size 467*274.
- This project builds knowledgebase, based on kind of heart disease (Attrial Enlargement).
- Features extraction using wavelets.
- Image reading, preprocessing, feature extraction using MATLAB 6.5.
- Build at least 100 charts in knowledgebase.

2.7 Allocation and Trade Offs

Function	Type
Administrator Login	SW(web)
Change administrator Password	SW(web)
Read image and unrelated data	SW(web)
Verify size and type	SW(web)
Preprocessing image	SW(web)
Splitting	SW(web)
Features extraction	SW(web)
Classifier (comparison) the coefficient to each others	SW(web)
Report the result	SW(web)
Doctors login	SW(Web)
Change password	SW(Web)

Table2.1: Allocation and Trade Offs (Cont.)

2.8 Development Requirements and Cost

2.8.1 Hardware

The following table lists the costs of the hardware that needed to develop this project:

Item	Number of Units	Unit Cost	Available	Total
Desktop computers "P4, 2GHz, 512 MB, RAM, 20G HD	3	$500	Yes	$1500
Total				$1500

Table 2.2: Development Hardware Cost

2.8.2 Software

The following table lists the software of that needed to develop this project and their costs:

Item	Number of Units	Unit Cost	Available	Total
Visual Studio.NET 2003	1	$1799	Yes	$1799
Microsoft Word 2003	1	$229	Yes	$229
Total				$2028

Table 2.3: Development Software Cost

2.8.3 Humans

The following table lists the costs of the hardware that needed to develop this project:

Member	Number	Cost/Month $	Available	Total/months
Eng.Students	3	$250	Yes	$750
Supervisor	1	$400	Yes	$400
Total				$1150

Table 2.4: Development Human Costs

2.8.4 Books

Many books requires to this project such as book in visual studio.NET (VB.NET, ASP.NET), many book in ECG, books in ADO.NET and SQL Server.

The following table lists the costs of the books that needed:

Book Name	Type	Number	Cost $	Total
ASP.NET	Hard copy	1	$50	$50
VB.NET	Hard copy	1	$60	$60
SQL Server	Hard copy	1	$80	$80
Total				$190

Table2.5: Cost Benefit Analyses

2.8.5 Others

There is another $800 to cover other areas (transportation, internet cards, printing papers and pens....etc).

The following table summarizes the development cost.

Type	Total
HW	$1500
SW	$2028
Humans	$1150
Books	$190
Others	$800
Total	$5668

Table 2.6: Development Cost Summary

2.9 Cost Benefit

In this system there are two benefits that are return to the team and to the society, the team achieved several benefits from build this system some of these benefits: understand the ECG images and how diagnoses them completely understand how to program in ASP.NET and MATLAB, understand how to write an documentation for software projects, on the other hand this system is introduce several benefits to the society some of these benefits provide society new program for diagnose ECG images especially the hospitals, strong the decisions of doctors since is provide true results, keep human life since is diagnose heart diseases in more speed and accuracy.

2.10 Feasibility Study

- **Economic Feasibility**

  As it is pointed in the Development Requirements and Cost, the total cost of the project is $5668.The hardware, software, humans and other requirements are all available so the project could complete in a satisfying way.

- **Technical Feasibility**

  This project requires good programming capabilities, methods experience in designing web pages, dealing with the database and some knowledge about ECG graph and analysis it. All these capabilities are available in the work team, who has an experience in many programming languages such as C, VB.NET, ASP.NET, and Java…etc, and in database application such as access, oracle and SQL server.

- **Legal Feasibility**

  In the regular situation, there are no limitations or policies in building such medical project, so we do not need to take a license to implement this project, and there is no illegal issue.

2.11 Risk Evaluations

These sections discuss the risks that may appear during project development and the possible solutions:

- **Hardware Failure**

To avoid this risk we will make a continuous daily backup of the project on flashes and other hard disks.

- **Shortage of development time** We all hope that the project will terminate in the determined time .The project team will divide the course time in good way to finish it. In case of shortage, working time will be doubled.

- **Closure of roads**

We all hope that the situation stay good and we could see the supervisor continuously. In the case of closure the team will continue working out the campus.

- **Illness of a project team member**

We all wish the healthiness for the project team, but in the illness case the other members should try to take his rule.

- **Users dissatisfaction**

We all hope that the doctors could use the project in an easy way without any difficulties.

To do this a continuous feedback is taken from the doctors during the development time, and making sure that functions discussed with them before implementing.

2.12 Project Plan and Scheduling

ID	Task Name	Duration	Start	Finish
1	Literature survey(data gathering)	1week	Thu 9/21/04	Thu 9/28/04
2	System Specification	1week	Wed 9/29/04	Wed 10/6/04
3	Software Requirement Specific	1week	The 10/7/04	The 10/14/04
4	Design Specification	1week	Sat 10/15/04	Sat 10/22/04
5	Implementation of Database	2weeks	Sun 10/23/04	Thu 11/7/04
6	Implementation of all modules	7weeks	Wed 11/8/04	Thu 12/27/04
7	Testing	2weeks	Sat 12/28/04	Thu 1/12/04
8	Documentation	14weeks	Wed 9/29/04	Thu 1/12/04

Table 2.7: Project Plan

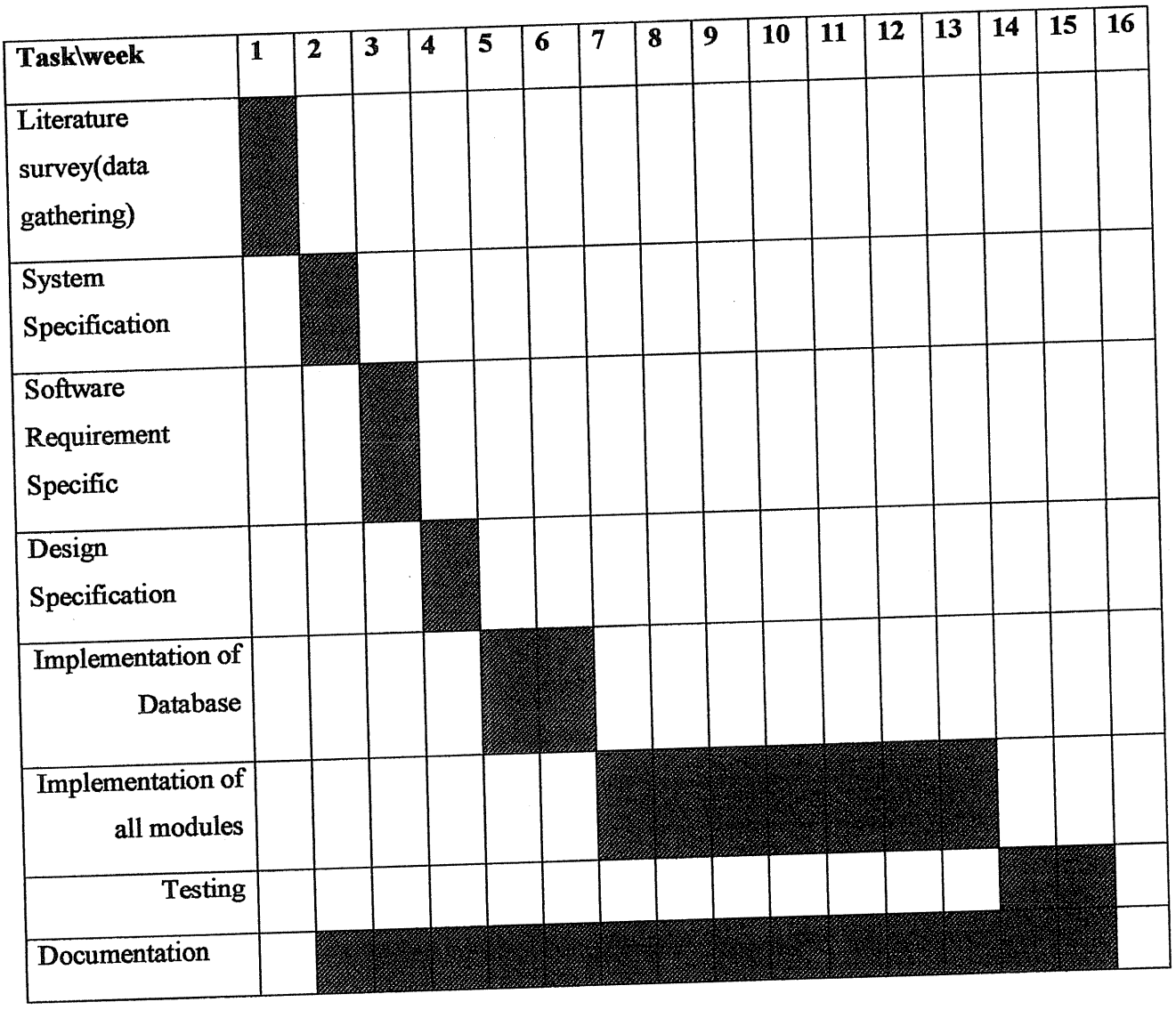


Figure 2.1: Time scheduling

Chapter

3

Software Requirement Specification

Chapter Three

Software Requirements Specification

3.1 Introduction

In this section the software requirements specification will be addressed and identified in more technical terms, so the data were collected and analyzed to confine the specification of the required software.

This chapter will cover the detailed functional descriptions, data flow diagram, data dictionary which contain a complete description of each entity system, database requirements and database knowledge.

3.2 Functional Description

This section lists the major function in the project and a description for each knowledgebase In addition there are two main functions I this module which are classifies, diagnose, and reporting which descrying below

3.2.1 Functional Description for Knowledge Base

Name: Administrator Login Id.

Description: Use to enable administrator to login the web application.

Input: Login name and password

Source: web Form.

Output: main form.

Destination: nothing

Require: nothing.

Pre-condition: Registered administrator.

Post-condition: administrator signs in to be able to perform special tasks.

Procedure: This function will request login name and password, then the expression validation will be applied on the inputs, if the validation does not succeed, an error message will be displayed. Else main web form will send to the administrator.

Validation: Login Id and Password are given, and there is no special character.

Name: Administrator Change password.

Description: This function enables the administrator to change his login and password.

Input: New password, password confirmation, old password and login id.

Source: Web Form.

Output: Password confirmation.

Destination: Data base.

Require: Login page

Pre-condition: Already logged in administrator.

Post-condition: New password can be used.

Procedure: This function will request the new password, then an expression validation will be applied on the password, if the validation does not succeed an error message will be displayed, else the new password will be send to the database.

Validation:

- Old password must be written
- Write a new password and confirm it.
- Check that the user enters the new password and confirm it.

Name: Reading a stored image and related data

Description: Read ECG graph and its related information (characteristics).

Input: ECG graph, rate pulse and QRS.

Source: Folder of ECG images.

Output: ECG graph.

Destination: Temporary table in Matlab.

Require: Matlab.

Pre-condition: Insert ECG graph on a secondary storage (folder).

Post-condition: Obtains ECG graph.

Procedure: This function uses to read an image and its characteristic, and then saved them in matlab directory.

Validation: The image must available in a folder on the hard disk.

Name: Verify type and size

Description: Verify that the type of ECG image has extension .GIF and its size 467*274.

Input: ECG graph.

Source: Matlab.

Output: Web form.

Destination: Matlab.

Require: Matlab & ASP.NET.

Pre-condition: Read ECG graph.

Post-condition: Verify the size is 467*274 and type has extension .gif. Of an entered ECG image.

Procedure: Read ECG graph, then verify if have the same type and size of an ECG graph.

Validation: the image should be available in the folder on hard disk.

Name: Pre-processing an image.

Description: The image is pre-processing to increase its usefulness; image processing includes removing noise, unrelated data and background of an image.

Input: ECG graph that have been read.

Source: Matlab.

Output: ECG signals without any noises.

Destination: Temporary table.

Require: Matlab.

Pre-condition: reading an ECG graph.

Post-condition: obtained pure image that represent the actual ECG graph.

Procedure: Read an ECG graph then preprocessing this graph by using matlab and prepared it to make splitting operation.

Validation: The image must available in a folder on hard disk.

Name: Filtering an image.

Description: The image is filtering to increase its usefulness; image filtering includes removing noise, and smoothing the signal, so the output of filtering image is pure image.

Input: Enhanced ECG graph that have been preprocessed.

Source: Matlab.

Output: Pure ECG signals without any noises and it is smoothly.

Destination: Temporary table.

Require: Matlab.

Pre-condition: reading an enhanced ECG graph.

Post-condition: obtained pure image that represent the actual ECG graph and this image should be more smoothly.

Procedure: Read an enhanced ECG graph after preprocessing this graph by using matlab and prepared it to make filtering operation to obtain on the pure image that will be using in the splitting operation.

Validation: A pure ECG graph should be found on the hard disk with size of 467*274 and has extension .gif.

Name: Splitting.

Description: Split each ECG image to 12 charts, which represent the ECG graph.

Input: Enhanced image.

Source: Matlab.

Output: Obtained 12_charts that represent ECG graph.

Destination: Matlab.

Require: Matlab.

Pre-condition: Preprocessing should be completed that given pure ECG graph.

Post-condition: Obtain pure 12_charts.

Procedure: Read the preprocessed image then each signal will split into 4 charts, while ECG has 4 signals, so it will produce 12 charts by using Matlab.

Validation: 12-charts must be available in a folder on hard disk.

Name: Wavelet Extraction.

Description: Extract each chart to obtain features of coefficient in order to represent signal.

Input: One charts in binary.

Source: Matlab.

Output: Features of coefficient that represent ECG graph.

Destination: Matlab.

Require: Matlab.

Pre-condition: Split the ECG graph into 12-charts.

Post-condition: Obtained the features coefficients of 12-charts.

Procedure: This function uses matlab to obtain the features of coefficient, and then store it in data base.

Validation: The obtained coefficients must be available in the folder on hard disk.

Name: Formatting.

Description: Grouping of data to be more suitable with knowledge database structured.

Input: Features of coefficient.

Source: Matlab.

Output: Suitable grouping data.

Destination: Data base.

Require: Matlab.

Pre-condition: Coefficient should be ready from wavelet.

Post-condition: The Suitable grouping data should store in the knowledge database.

Procedure: This function obtained the features extraction of coefficient; therefore store them in a knowledge database.

Validation: The formatted features extraction should be available on knowledge database.

Name: Saving coefficients.

Description: Save features of coefficient that represent an ECG graph to build a knowledge database.

Input: Formatted features of coefficient.

Source: Temporary table.

Output: Store the coefficient in data base.

Destination: Data base.

Require: Matlab.

Pre-condition: Features of coefficient should be completed and more suitable.

Post-condition: The data should store in the knowledge database.

Procedure: This function obtained the formatted features extraction of coefficient then store coefficient in a knowledge database.

Validation: The coefficients should be available on a knowledge database.

3.2.2 Functional description for diagnostic and classifier

There are many functions for diagnostic and classifier module (login physician, upload ECG image and related data, verify size and type, preprocessing an image, splitting and wavelet extraction) all these functions are like the above functions that mention in building knowledgebase. In addition there are two main functions in this module which is classification and diagnose and reporting which is describing below:

Name: Classification

Description: This function comparison (map) between storage and process ECG graph using k-nearest neighbors rule and classify the observation according to the most frequent class among its neighbors.

Input: Features of coefficient.

Source: Database.

Output: determine the most nearest vector between stored features coefficient and the coefficients of an ECG graph you want to diagnose it.

Destination: ASP.NET

Require: ASP.NET.

Pre-condition: Features of coefficient should be founded which is represent entered ECG graph to compare them with the Features of coefficient of the knowledge database.

Post-condition: Find the nearest vector of an ECG graph from storage knowledge database.

Procedure: This function compares between the features coefficients of stored knowledge database and the features coefficients of load ECG graph that you want to

Name: Diagnose and Reporting

Description: This function is needed to diagnose an ECG graph, therefore reporting the results.

Input: Result that obtain from classification which indicates nearest vector to load image.

Source: Database.

Output: Final report which is contained diagnoses the type of heart disease, pulse rate, QRS and some information about patient.

Destination: Final report.

Require: ASP.NET.

Pre-condition: Classification vectors.

Post-condition: Report that contain diagnose.

Procedure: This function is diagnosing dependent on the compare between the features coefficients for stored and load ECG graph, and then report the results of the heart diseases.

Validation: Diagnose of an ECG graph should be reporting on web form.

3.3 Project Constraints

This section lists the constraints that exist in the project and a description of each:

- Login IDs (for both administrator and users) should be unique to increase the security.
- Login IDs should contain at least six Characters (Alpha Numeric Mixture is preferred) to increase the security and the difficulty to be stolen.
- Login ID should start with letters and must not be accepted unless ensuring that the user typed at least 6 characters not containing irregular characters.
- Login ID is never shared with another persons.
- Passwords (for both administrator and users) should contain at least six Characters (Alpha Numeric Mixture is preferred) to increase the security and the difficulty to be stolen.
- Password must be different from the login.
- The database shall only be accessible by administrator.
- Access to the database shall only be granted after the user types an authorized password.
- Knowledgebase module (reading stored image, preprocessing, splitting, wavelets extraction, formatting and save data) in Matlab 6.5.
- Diagnostic and Reporting module will process online web-bases application with ASP.NET.

- There is different type of ECG instruments; in this project will use ECG graph type 4 sinus rhythms, which have speed25 mm/s and the scale is 10 mm/mv since it is the most popular instruments.
- The type of ECG image has extension (.gif), since the most existing ECG graph in (.gif) and the size of image 467*274.
- There is a lot and many different kinds of heart disease, so in this project builds knowledgebase, based on kind of heart diseases such as enlargement heart diseases.
- The system should follow an efficient algorithm in comparison (classification) between knowledgebase and image that diagnose it to obtain good and accuracy result in ASP.NET.
- Features extraction using wavelets.
- At least 100 charts in knowledgebase.
- The project must be completed at the end of semester.

3.4 System Data Flow Diagram

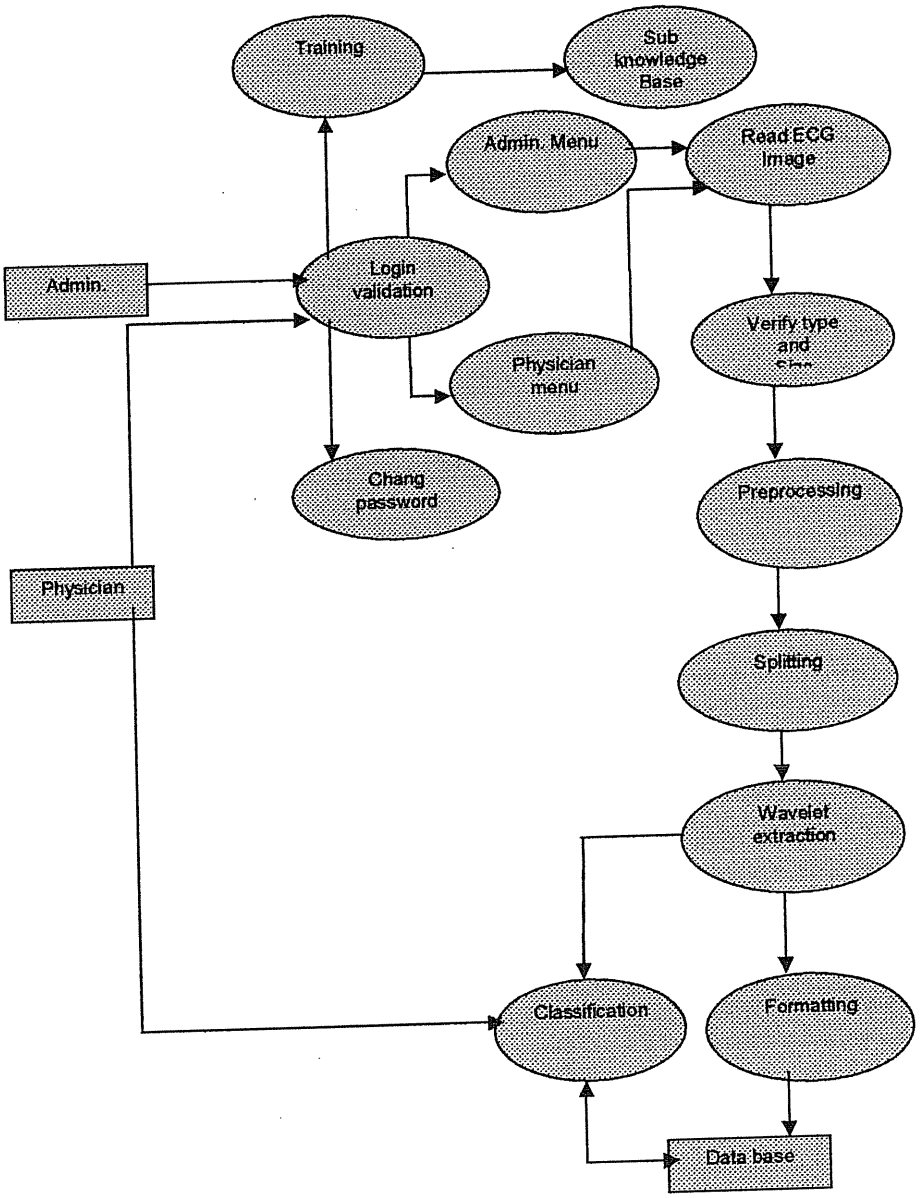


Figure 3.1: System Data Flow Diagram

3.5 Data Dictionary to Data Flow Diagram

Entity name	Description
ECG	Electrocardiograph is an instruments which is vital to diagnose heart disease and chest pain
k-Nearest-Neighbor rule	Technique that classify the observation according to the most frequent class among its neighbors
Wavelets	New technology uses to analysis signal in best way.
Administrator Login	Verify administrator password and user name.
Change administrator Password	This function enables the admin to change their login password
Physician Login	Use to enable physician to login the web application
Change Physician Password	This function enables the physician to change his login password
Reading a stored image	Read ECG graph and the information which it's contain
Verify type and size	Verify that the type of ECG image has extension .GIF and its size 467*274.
Preprocessing an image	The image is preprocessing to increase its usefulness; image processing includes removing noise, unrelated data and background of an image.
Splitting	Split each ECG image to 12 charts, which represent the ECG graph.
Wavelet Extraction	This function extracts each leads then obtain features and

	coefficient to represent signal.
Formatting	Grouping data to be more suitable with database structured.
Save data	Extract each chart to obtain features and coefficient that represent the signal
Classification	To make map (comparison) between storage and process ECG graph using k_nearest neighbors rule.

Table 3.1: Data Dictionary to Data Flow Diagram

3.6 Database Requirements

3.6.1 Administrator Information (Login ID, Password, Status)

Login ID: the administrator name.

Password: key to authenticate the administrator.

Status: if the administrator is login or not.

User (Login ID, Password, Status)

Login ID: the name of the physician.

Password: key to authenticate the physician.

Status: if the physician is login or not.

Features of coefficients (coefficients, diagnose of heart disease)

Coefficients: Features of coefficients that represent ECG graph.

Diagnose of heart disease: each coefficients represent state of heart disease

3.6.2 Database Data Dictionary

Data Item	Type
Administrator Login	String
Administrator password	Encoded
Administrator Status	Boolean
Physician Login	String
Physician password	Encoded
Physician Status	Boolean
Coefficients	Double
Diagnose of heart disease	String

Table 3.2: Database Data Dictionary

3.7 Project Constraints

This section lists the constraints that exist in the project and a description of each:

- Login IDs (for both administrator and users) should be unique to increase the security.
- Login IDs should contain at least six Characters (Alpha Numeric Mixture is preferred) to increase the security and the difficulty to be stolen.
- Login ID should start with letters and must not be accepted unless ensuring that the user typed at least 6 characters not containing irregular characters.

- Login ID is never shared with another persons.
- Passwords (for both administrator and users) should contain at least six Characters (Alpha Numeric Mixture is preferred) to increase the security and the difficulty to be stolen.
- Password must be different from the login.
- The database shall only be accessible by administrator.
- Access to the database shall only be granted after the user types an authorized password.
- Knowledge base module will process an image (read an image, convert to binary, splitting it, and extra wavelets an image to obtain features of coefficients) in Matlab 6.5.
- Diagnostic and Reporting module will process offline web-bases application with ASP.NET.
- There is different type of ECG instruments; in this project will use ECG graph type 4 sinus rhythms, since it is the most popular instruments.
- The type of ECG image has extension (.gif), since the most existing ECG graph in (.gif).
- There is a lot and many different kinds of heart disease, so in this project builds knowledgebase, based on kind of heart diseases such as enlargement heart diseases.
- The system should follow an efficient algorithm in comparison (classification) between knowledgebase and image that diagnose it to obtain good and accuracy result.
- The project must be completed at the end of semester.

3.8 Data dictionary for Project Constrains

Entity name	Description
Administrator Login	Verify administrator password and user name.
Change administrator Password	This function enables the admin to change their login password
Read image and related data	This function enables the administrator to add ,or delete ECG graph
Read binary array	This function read ECG graph and the information which it's contains.
Preprocessing an image	This function read binary array of ECG graph which reading the above function mention.
Splitting	This function split each binary array to 12 leads, which represent the ECG graph.
Wavelet Extraction	This function extracts each leads then obtain features and coefficient to represent signal.
Save data	Save features of coefficient on data base to use them in comparison process.
Classification	To make map (comparison) between storage and process ECG graph using k_nearest neighbors rule.
Reporting	After all above operation mention the result can report.

Table 3.3: Data Dictionary for Project Plan

3.9 Summary

- Each function described in details: the function name, description, its input and source, output, destination, require, pre-condition, post-condition, procedure and its validation.
- The section lists the whole possible constraints that may exist, and also describes each one.
- Login for both (administrator and user) must be unique and contain at least six characters (Alpha Numeric Mixture) and should start with letters.
- Password must contain six characters (Alpha Numeric Mixture) but different from login to maintain the security and difficulty to be stolen.
- The authorized personnel are the lone can access the database only using his/her own password.
- The data flow diagram describes the general form for the system, the relations between those entities, and the map at the time the user (administrator or user) begins to use the system up to display results.
- The data dictionary implies the whole entity names of the system with their type and description.
- The database data dictionary table explains the type of each data item in the system either string, integer, Boolean, encoded or double.

3.10 Recommendation

All requirement specifications are discussed in details according the project supervisor permission which could give the team the ability passing to the next chapter.

Chapter

4

Design

Chapter Four

Design

4.1 Introduction

In this section the functions design will be implemented using flowchart to design every function or procedure.

This section will cover the following:

- **Input /output design:** a design for the input /output screens.
- **Database design:** a complete design for the database tables includes all tables and their fields, this includes the ER module.
- **Functions design:** where each function will be designed by using a flow chart.

4.2 Input/Output Design

- **Main Page**

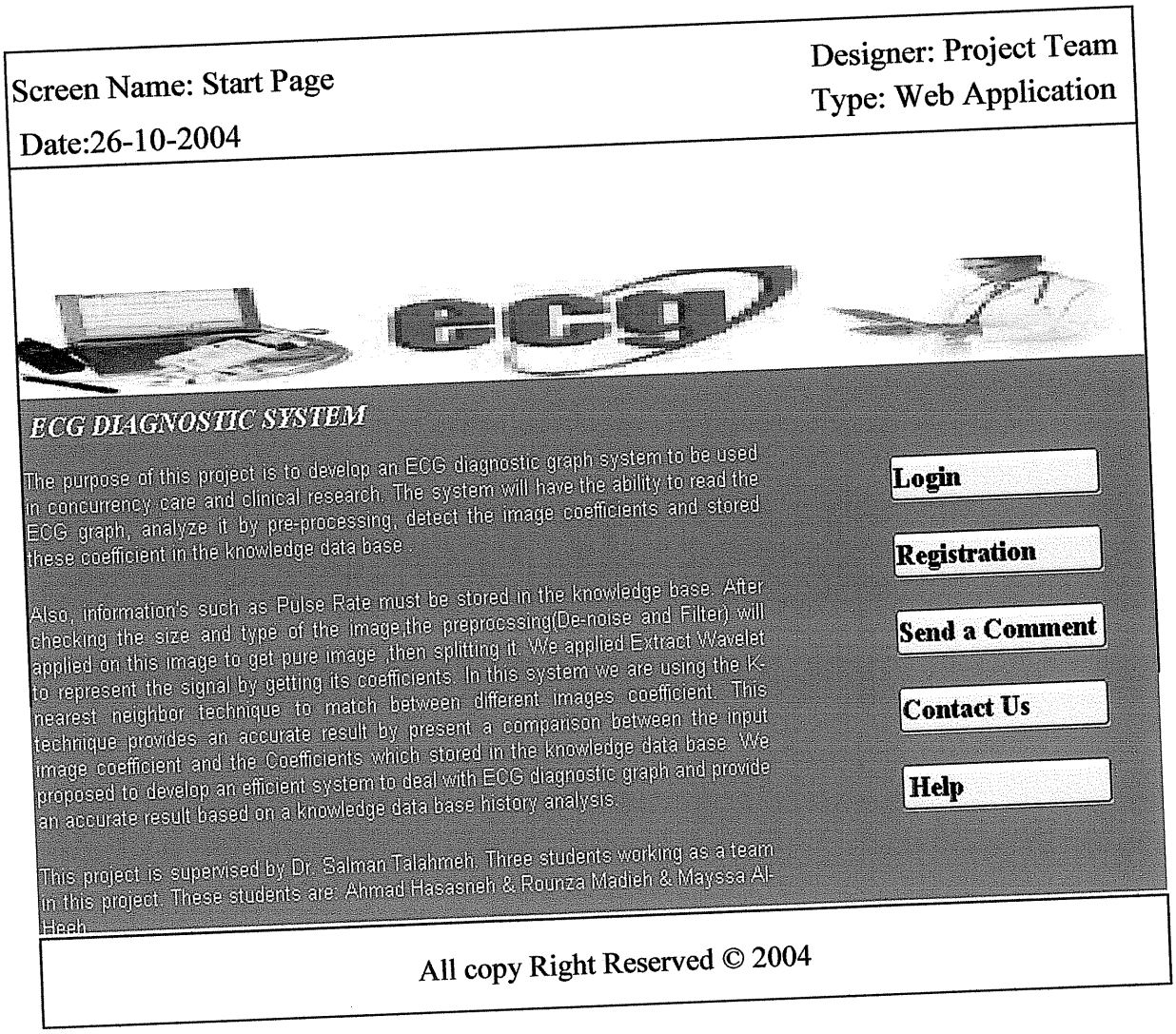


Figure 4.1: Main Page

- **Login**

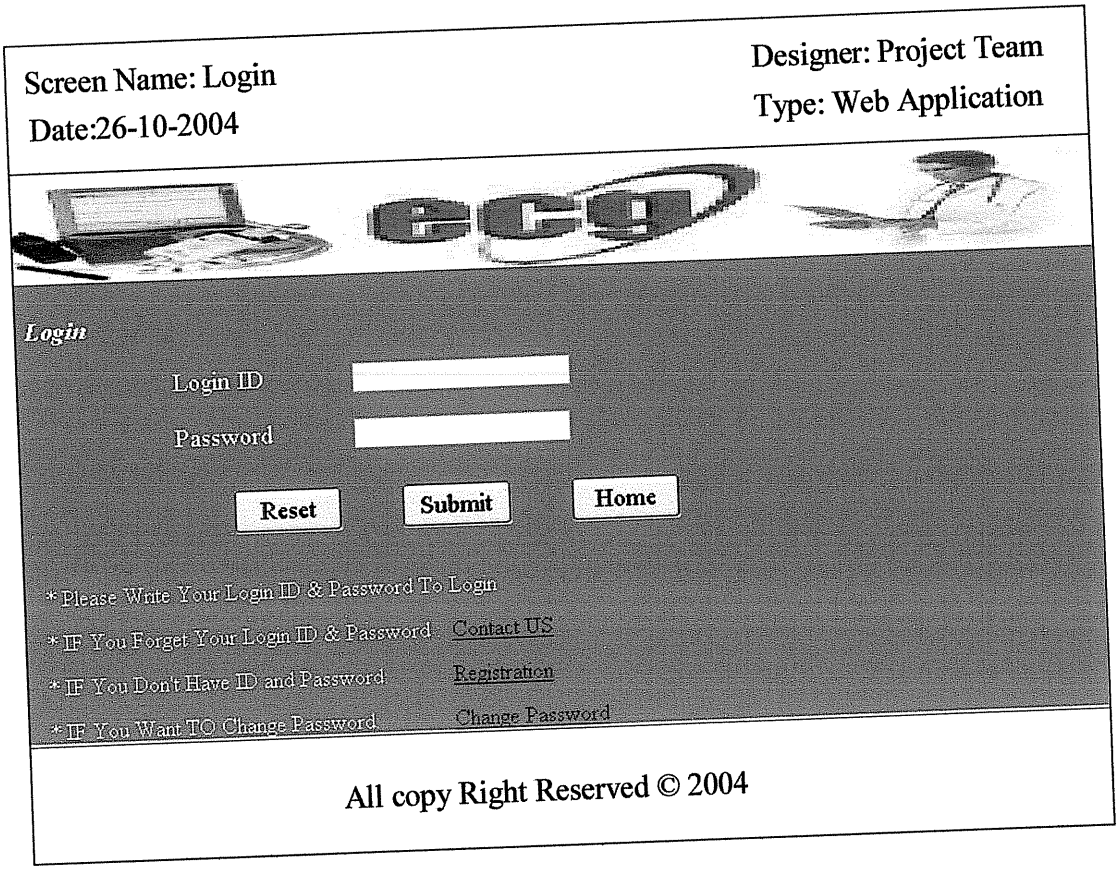


Figure 4.2: Login ID Page

- **Change Password**

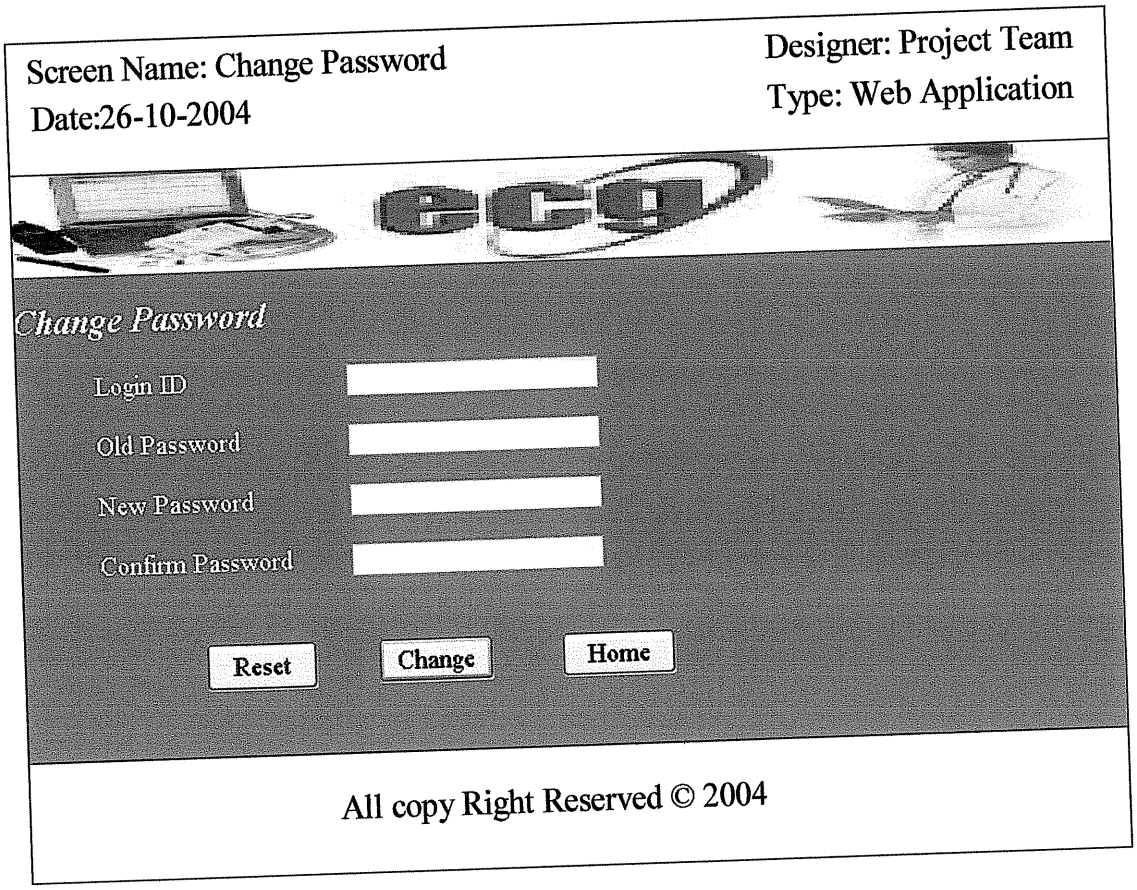


Figure 4.3: Change Password Page

- **Registration**

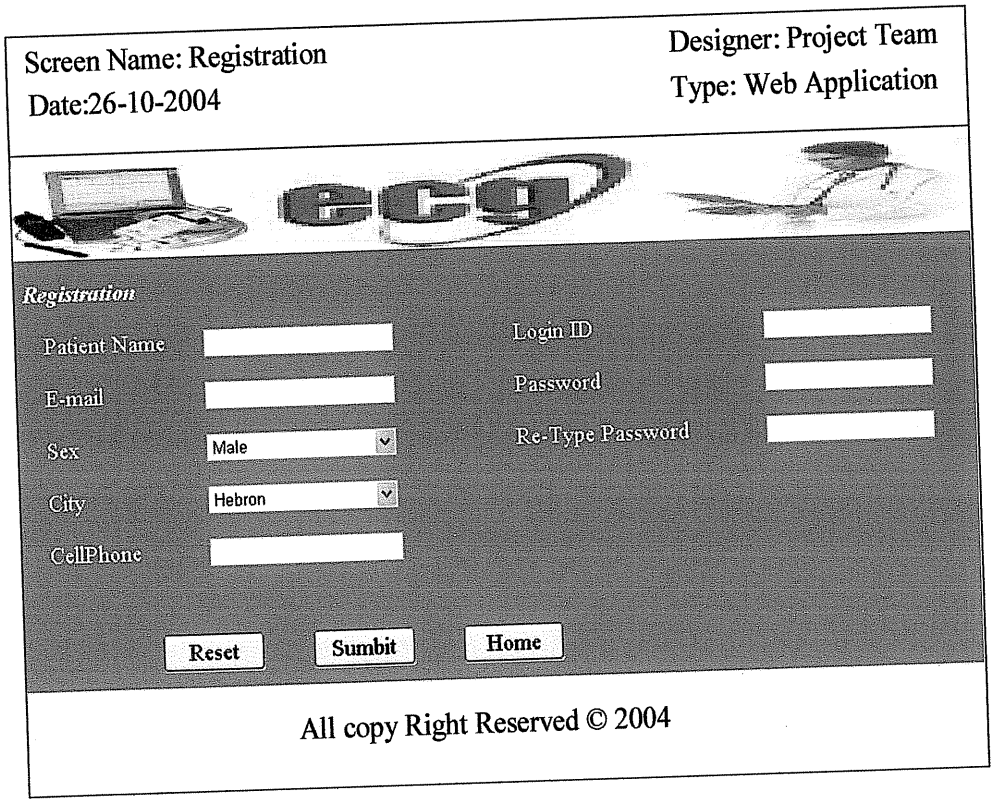


Figure4.4: Registration Page

- **Send Comment**

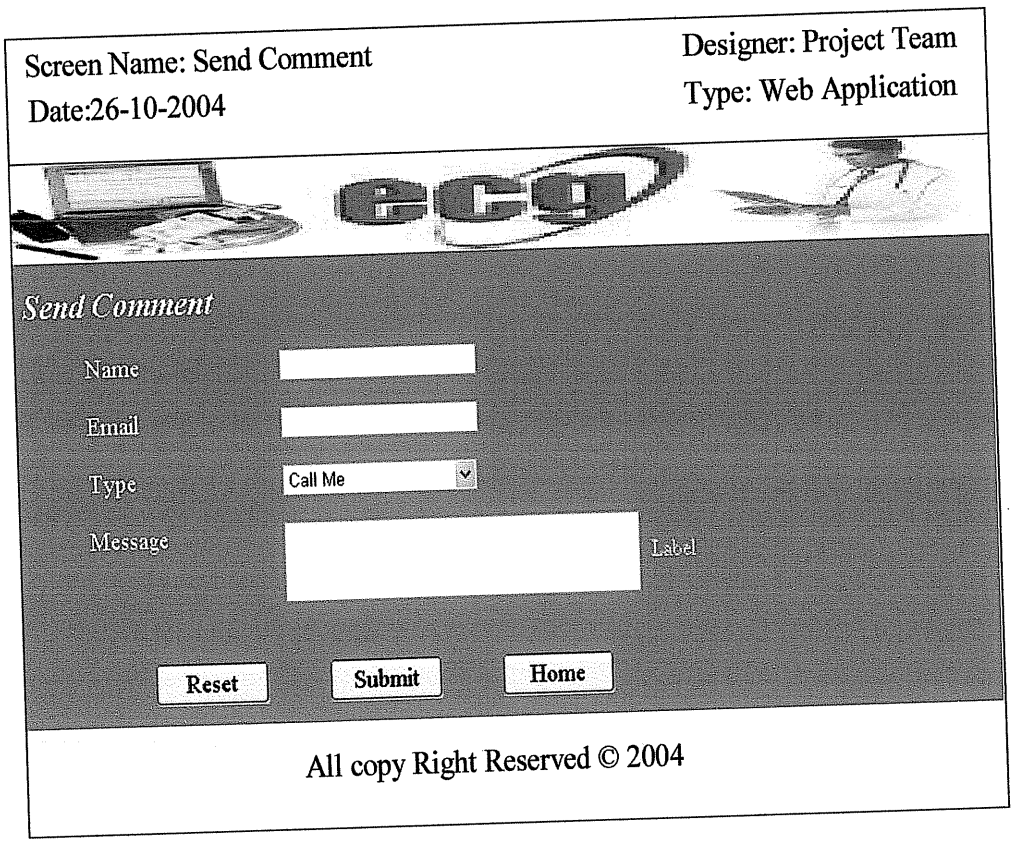


Figure4.5: Send Comment Page

- **Disclaimer**

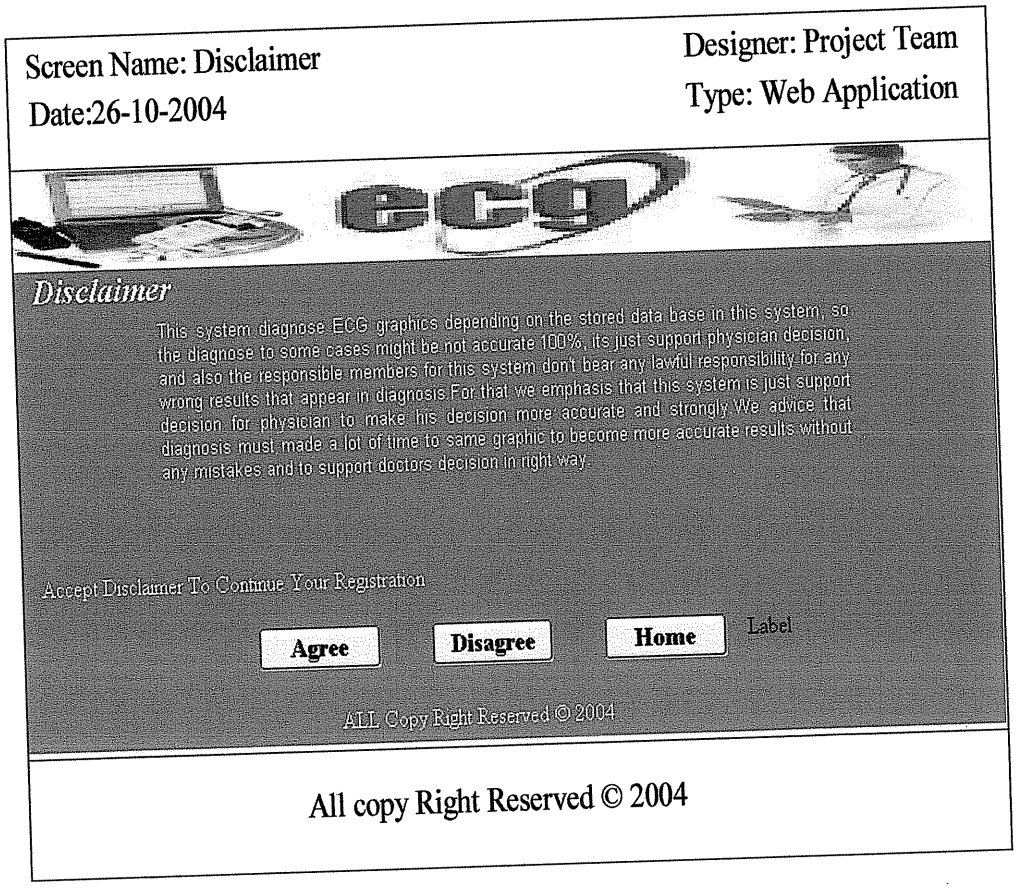


Figure4.6: Disclaimer Page

- **Contact Us**

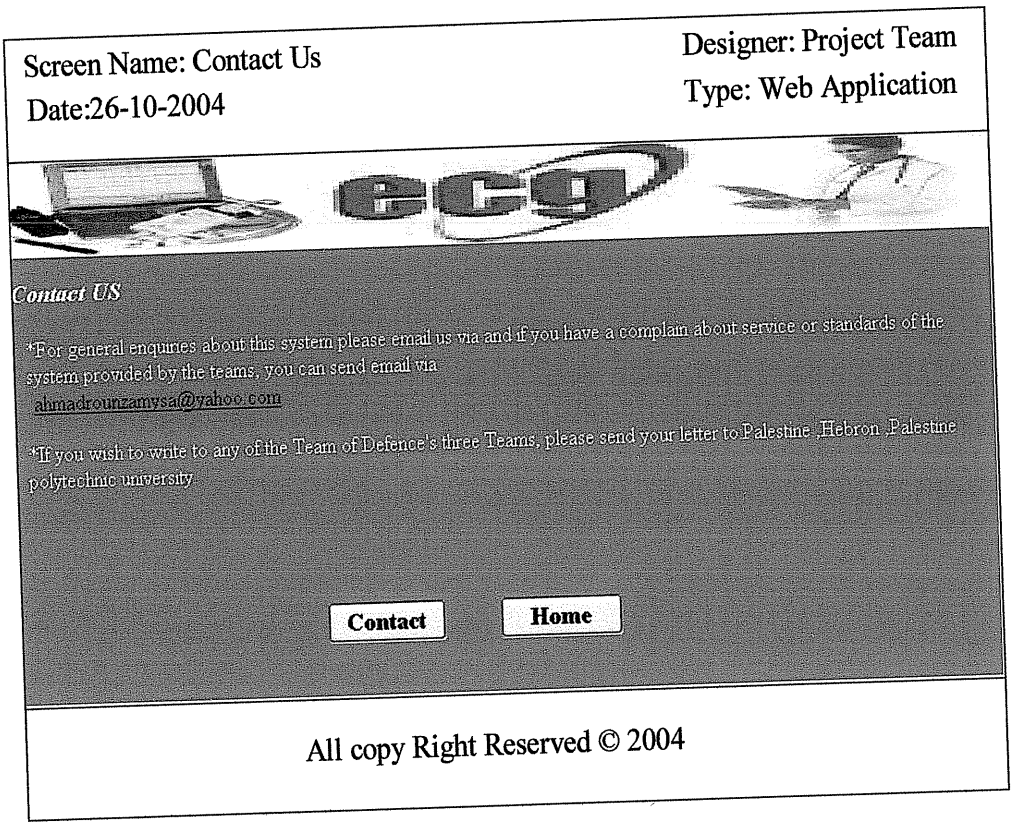


Figure 4.7: Contact Us Page

- **Help About**

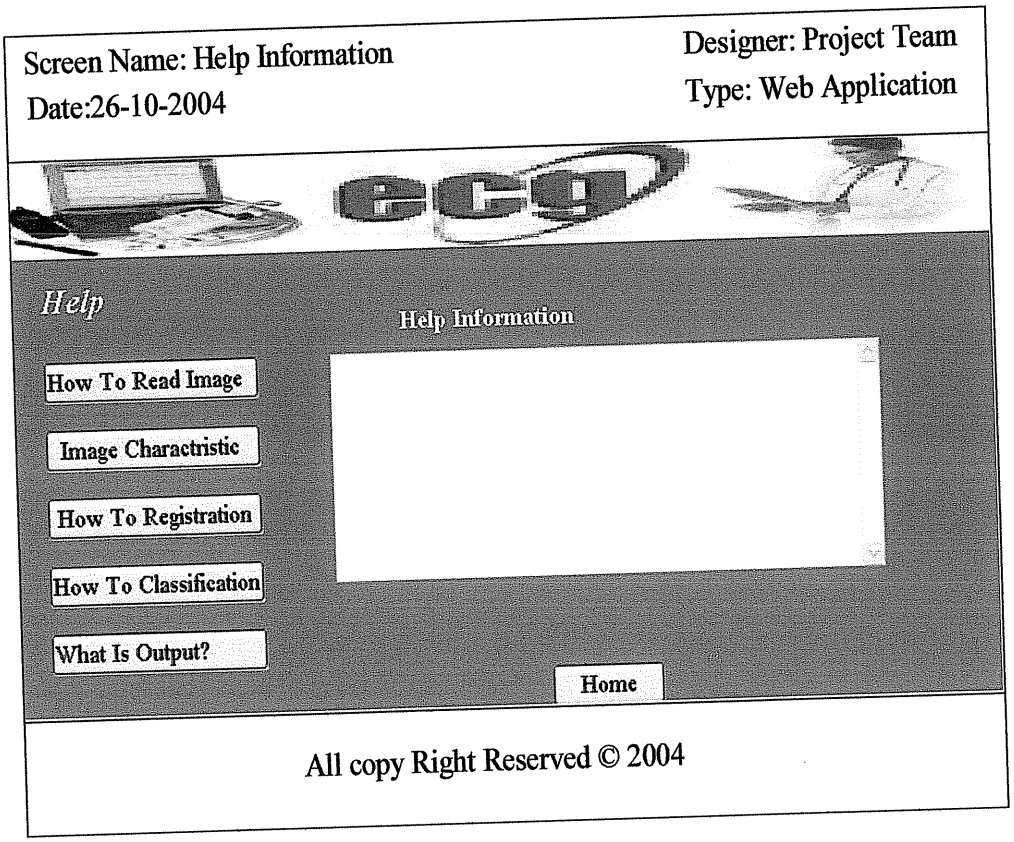


Figure 4.8: Help about Page

- **Read Image**

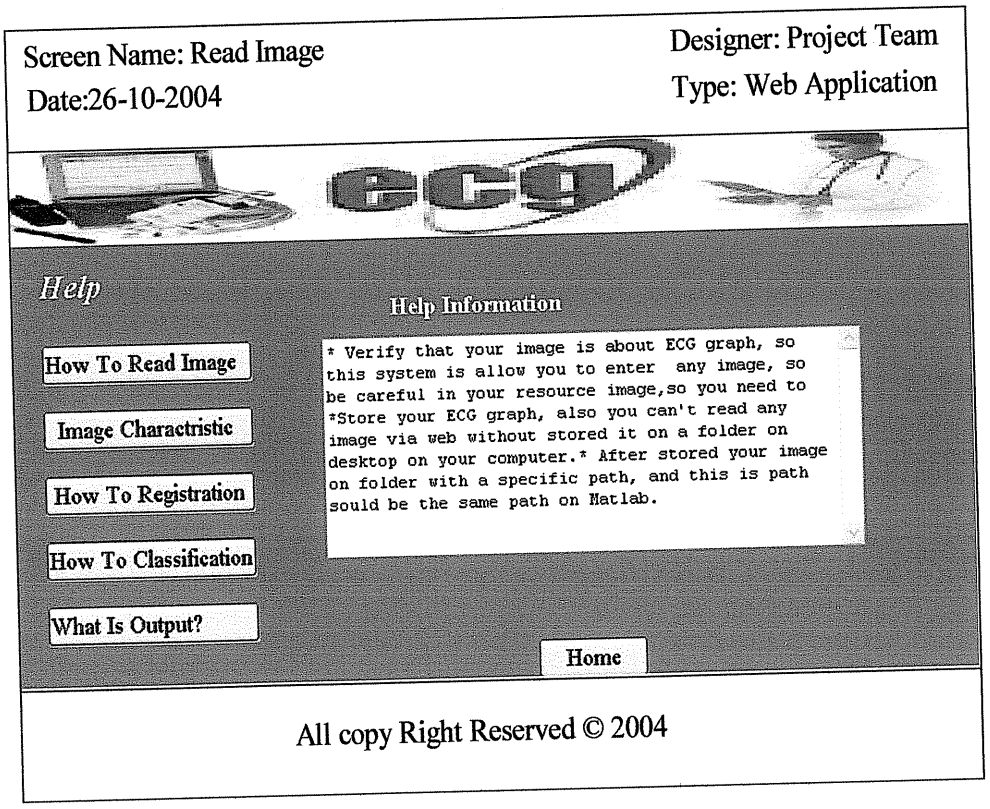


Figure 4.9: Read Image Page

- **Characteristic Image**

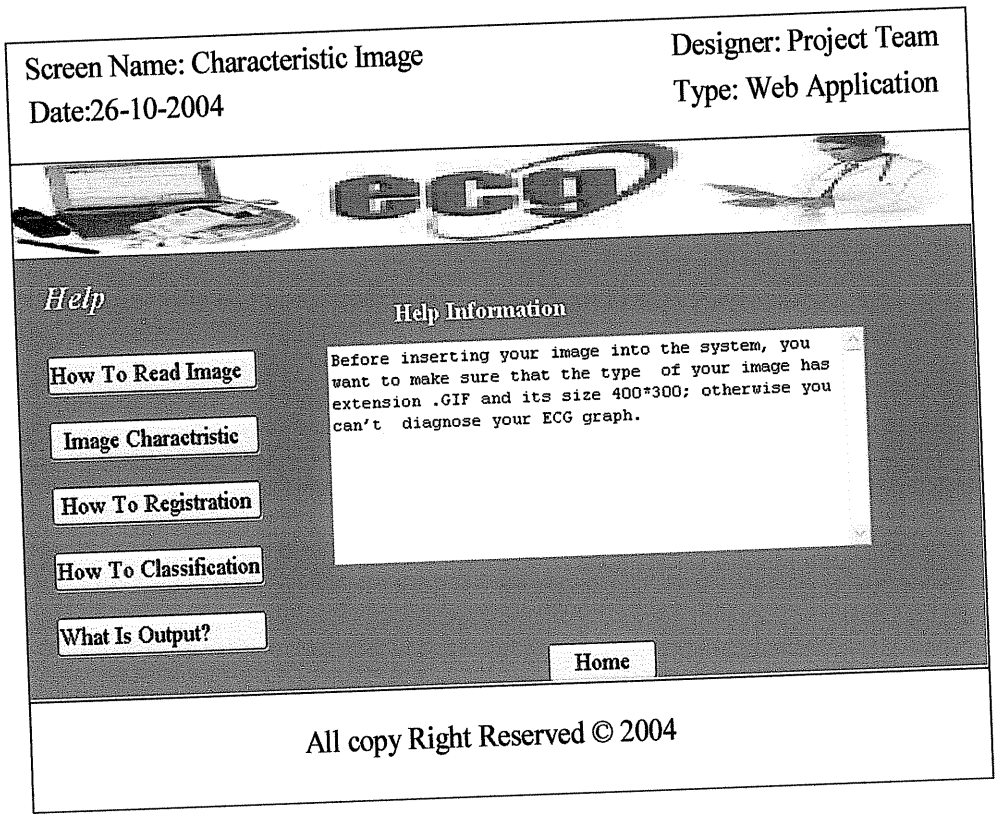


Figure 4.10: Characteristic Image Page

- **What is Output for help**

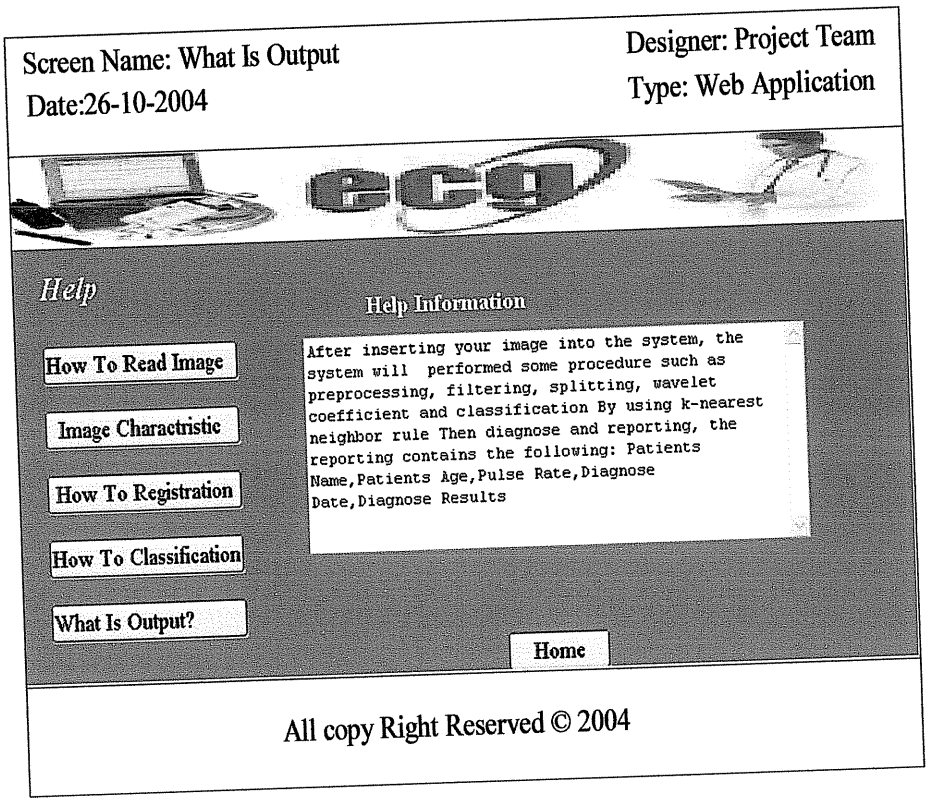


Figure 4.11: Help Output

- **Administrator Control Panel**

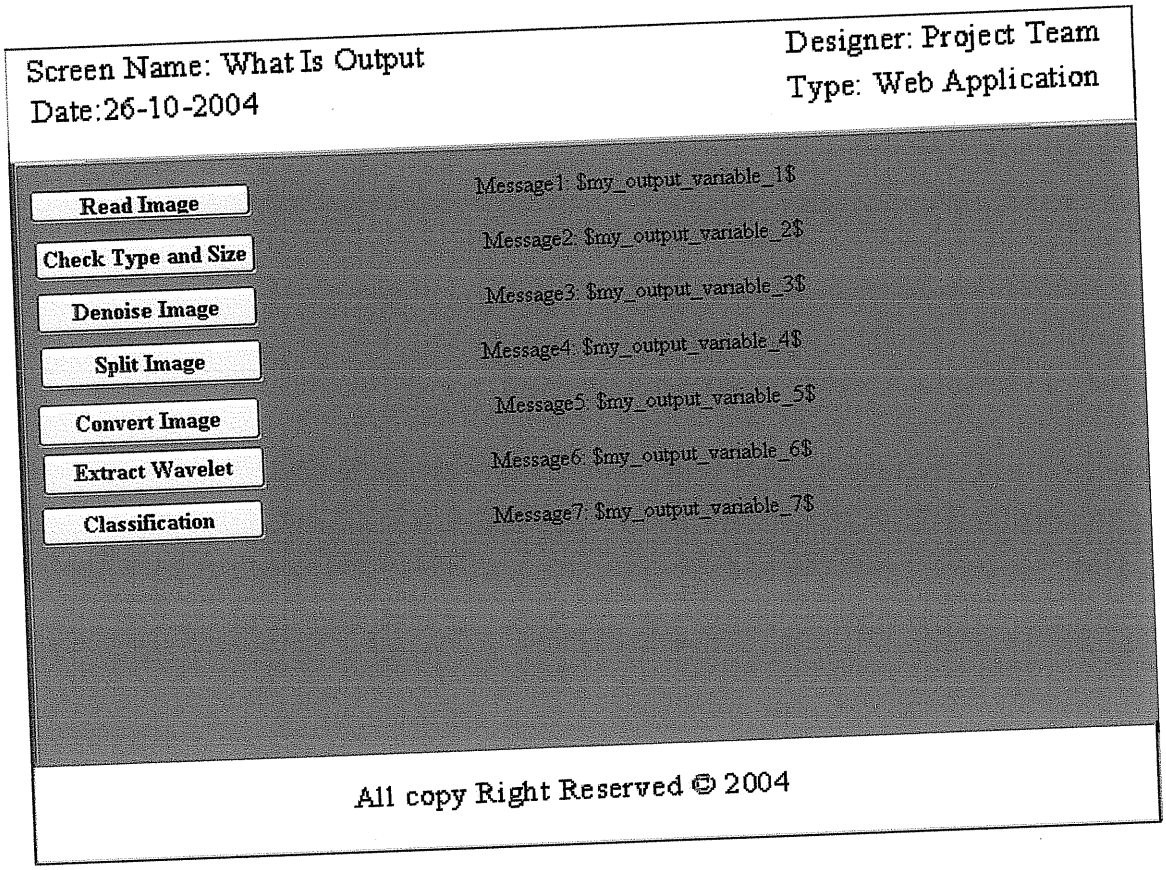


Figure 4.12: Administrator Control Panel

- **Physician Control Panel**

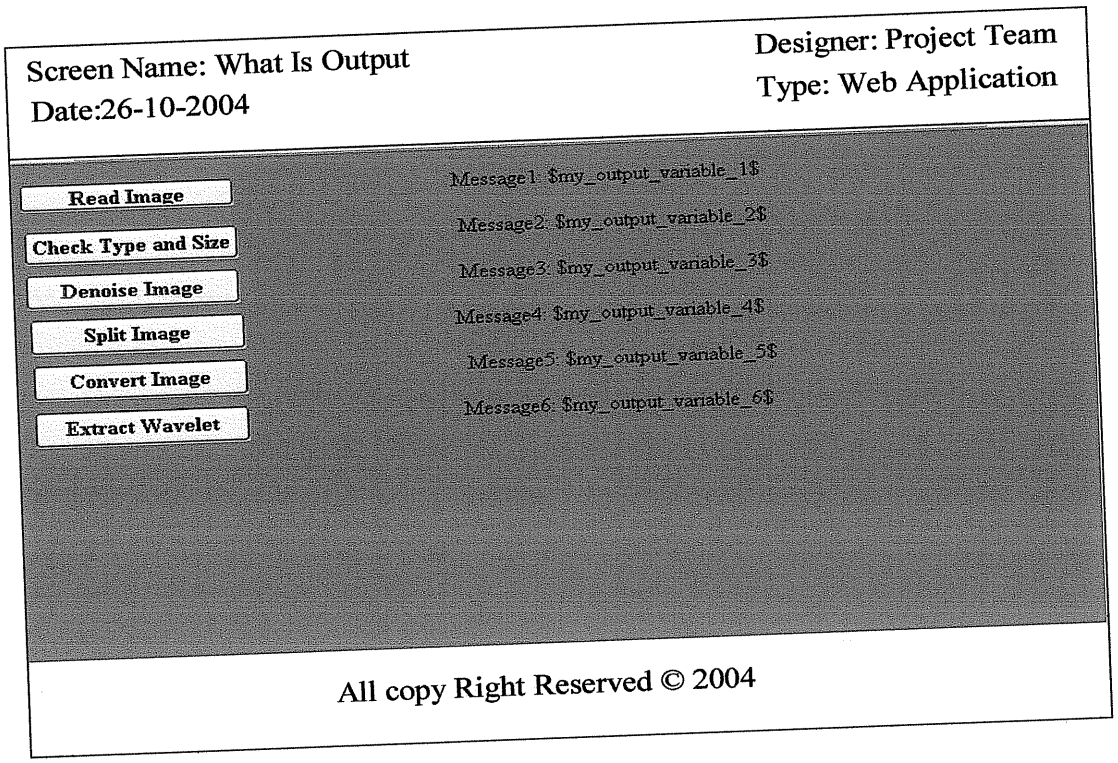


Figure 4.13: Physician Control Panel Page

- **Diagnose**

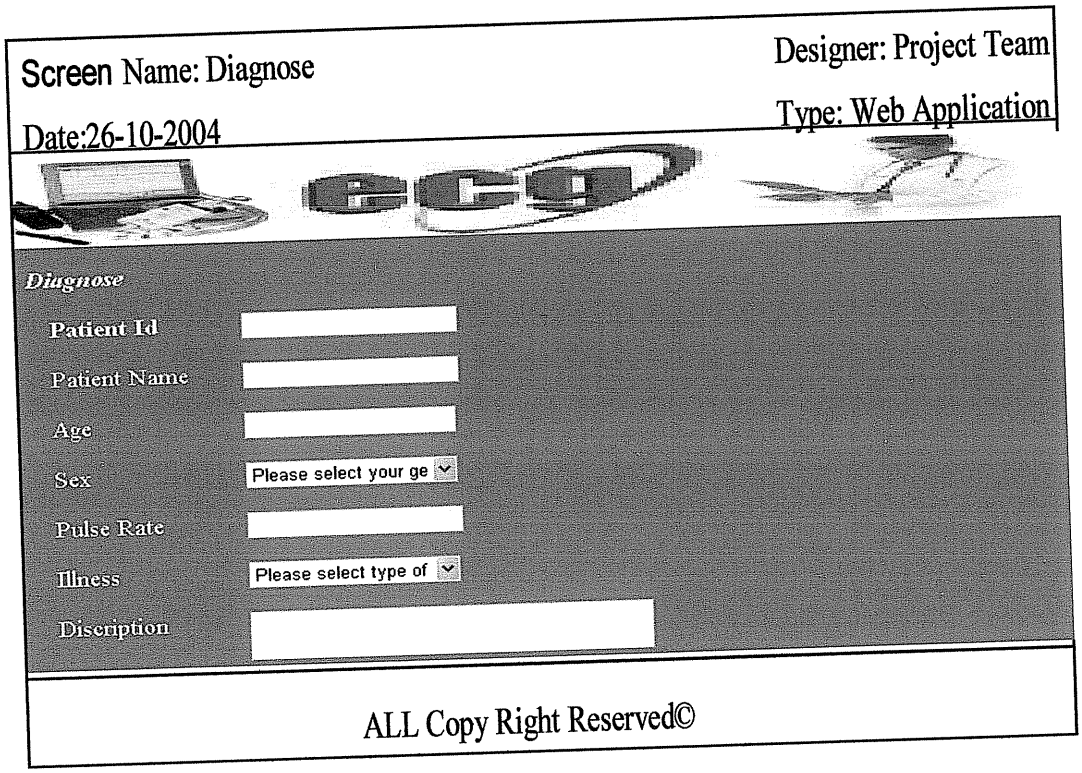
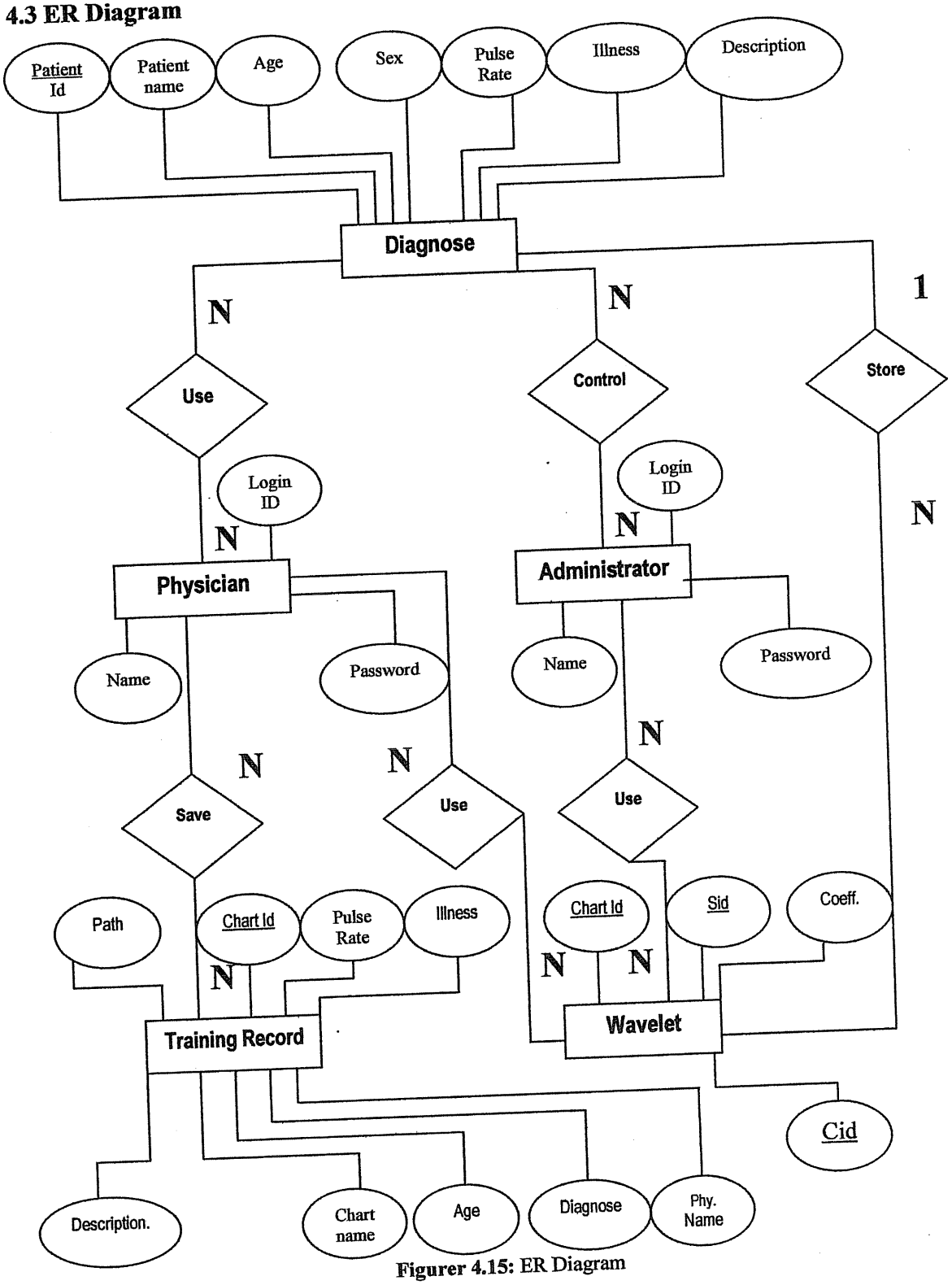


Figure 4.14 Diagnose and Reporting Page

4.3 ER Diagram



Figurer 4.15: ER Diagram

4.4 Database Design

- **Diagnose**

Field Name	Type	Control
Patientid	Int(4)	PK
Patientname	Varchar(50)	Allows null
Age	Floate(8)	Allows null
Sex	Varchar(50)	Allows null
Pulse rate	Int(4)	Allows null
Illness	Varchar(50)	Not null
Description	Varchar(50)	Not null

Table 4.1: Master Record Table

- **Physician**

Field Name	Type	Control
Login ID	Int(4)	PK
Password	Varchar(50)	Not null

Table 4.2: Physician Table

- **Administrator**

Field Name	Type	Control
Login ID	Int(4)	PK
Password	Varchar(50)	Not null

Table 4.3: Administrator Table

- **Wavelet**

There are 12 tables of wavelet which are describing the splitting of ECG image.

Field Name	Type	Control
Chart id	Int(4)	PK
Sid	Int(4)	PK
Cid	Int(4)	PK
Coefficient	Float	Not null

Table 4.4: Wavelet Table

- **Send comment**

Field Name	Type	Control
Name	Varchar(50)	Not null
Email	Varchar(50)	Not null
Type	Varchar(50)	Not null
Massage	Varchar(50)	Not null

Table 4.5 : Send Comment Table

- **Registration**

Field Name	Type	Control
Login id	Int(4)	PK
Password	Varchar(50)	Not null
Name	Varchar(50)	Allows null
Sex	Varchar(50)	Allows null
City	Varchar(50)	Allows null
Cell phone	Varchar(50)	Allows null

Table 4.6: Registration Table

- **Training record**

Field Name	Type	Control
Path	Varchar(50)	Not null
Chart id	Int(4)	PK
Pulse rate	Int(4)	Allows null
Describe patient	Varchar(50)	Allows null
Age	Int(4)	Allows null
Illness	Varchar(50)	Allows null
Physician name	Varchar(50)	Allows null

Table 4.7: Training Record Table

4.5 Function Design

The system consists of two main designs

4.5.1 Knowledgebase

- **Administrator Login**

This function verifies administrator password and user name.

1. Interface

- **Input:** Login name and password.
- **Output:** Main form.

2. Constraints

- Administrator Login contains letters or number to increase the security.
- Administrator Login and Passwords should contain at least six characters (Alpha Numeric Mixture is preferred) to increase the security and the difficulty to be stolen.

3. Validation

Login Id and Password are given, and there is no special character.

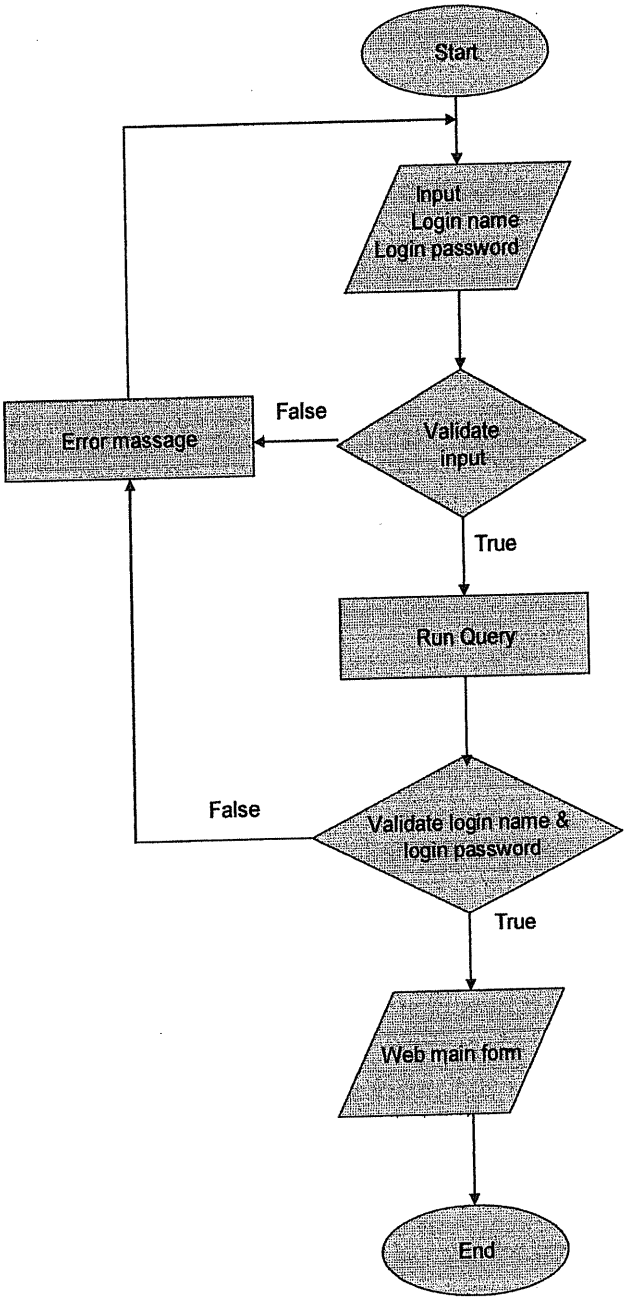


Figure4.16: Administrator Login Flowchart

Note:

This flowchart is common between knowledge base and diagnostic.

- **Administrator Change Password**

This function enables the administrator to change his login password.

1. **Interface**
    - **Input:** new password, password confirmation, old password, login id.
    - **Output:** password confirmation.
2. **Constraints**
    - Old password must be written
    - A new password and confirmation to it must be given.
    - The new password must not the same the old password.
3. **Validation**

New password must be available for the administrator

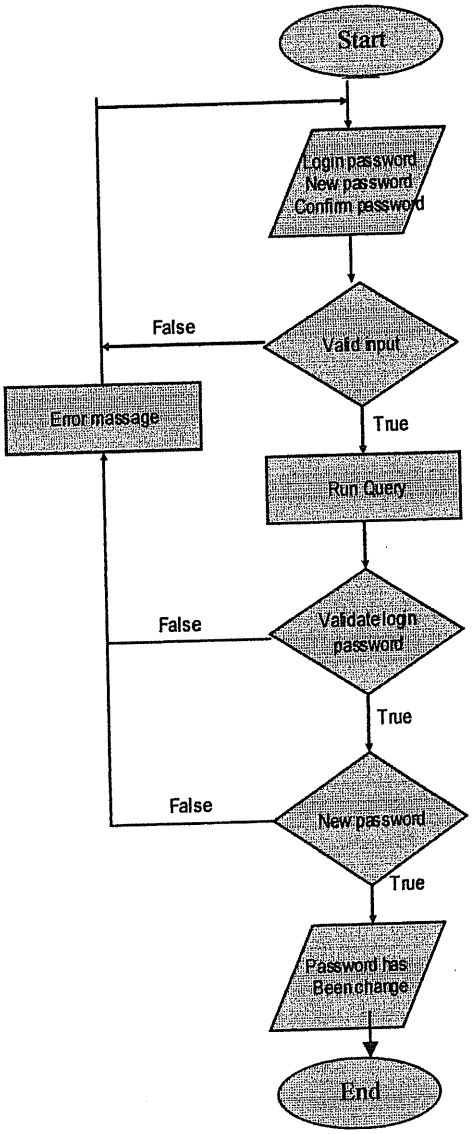


Figure 4.17: Administrator Change Password Flowchart

Note:

This flowchart is common between knowledge base and diagnostic.

- **Reading ECG chart image**

This function read ECG graph and its related information (characteristics)

Such as (QRS, pulse Rate).

1. Interface

- **Input:** ECG graph, rate pulse, QRS, path, chart id, illness describe patient, chart name and diagnose.
- **Output:** ECG graph.

2. Constraints

This function enable the administrator to change (add, modify and delete) an image in knowledge database.

- Read: read an image.
- Modify: modify an image.
- Delete: delete an image.

Enable the physician to load image.

3. Validation

The image must be available in folder on hard derive.

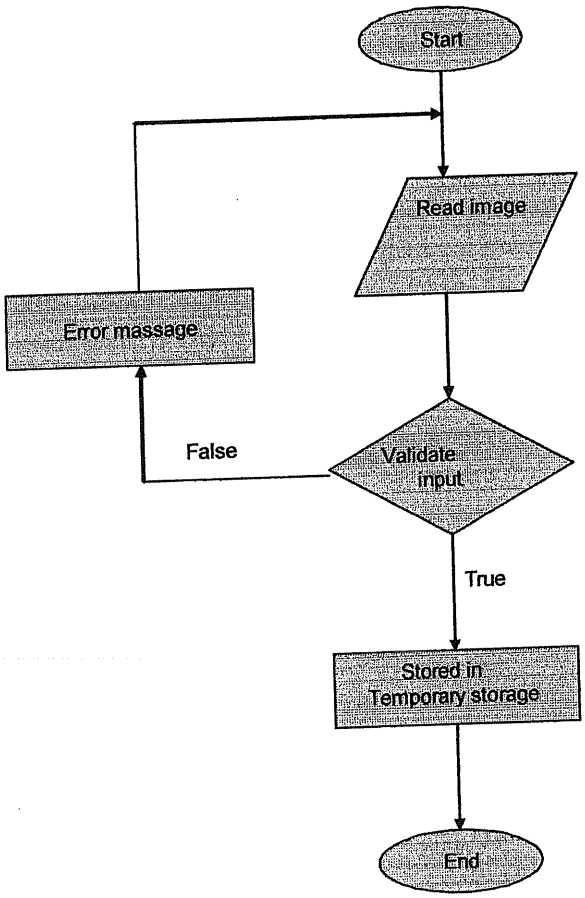


Figure 4.18: Reading ECG chart image Flowchart

Note:

This flowchart is common between knowledge base and diagnostic.

- **Verify type and size**

Verify that the type of a reading an ECG image has extension .GIF and its size 467*274.

1. Interface

- **Input:** ECG graph.
- **Output:** Web form.

2. Constraints

The image should have extension .gif and its size 467*274.

3. Validation

The image must be available in folder on hard derive.

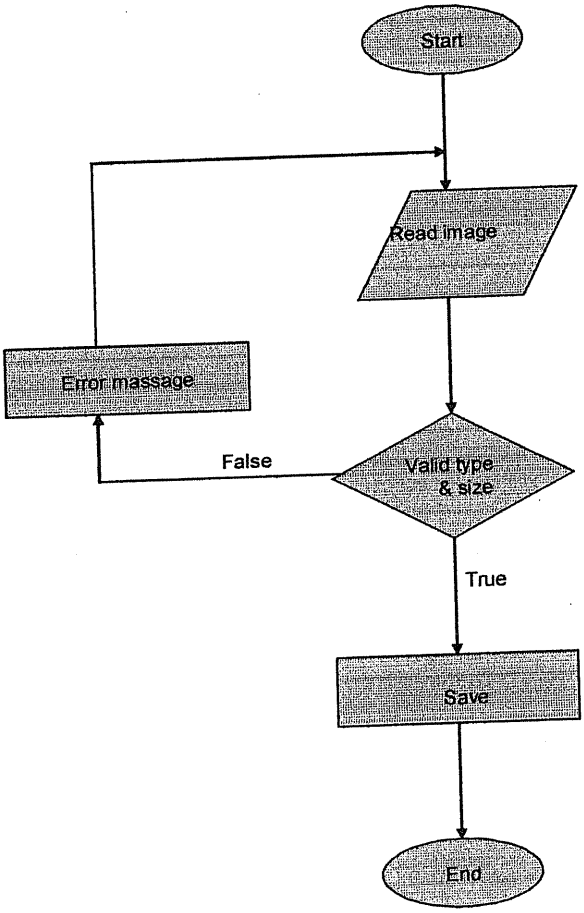


Figure 4.19: Verify type and size Flowchart

Note:

This flowchart is common between knowledge base and diagnostic.

- **Pre-processing an image**

The image is pre-processing to increase its usefulness; image processing includes removing noise, unrelated data and background of an image.

1. Interface

- **Input:** ECG graph that has been read.
- **Output:** ECG signals without any noises.

2. Constraints

The image should be reading with size 467*274 and has extension .gif.

3. Validation

The enhanced image must available in a folder on hard derive.

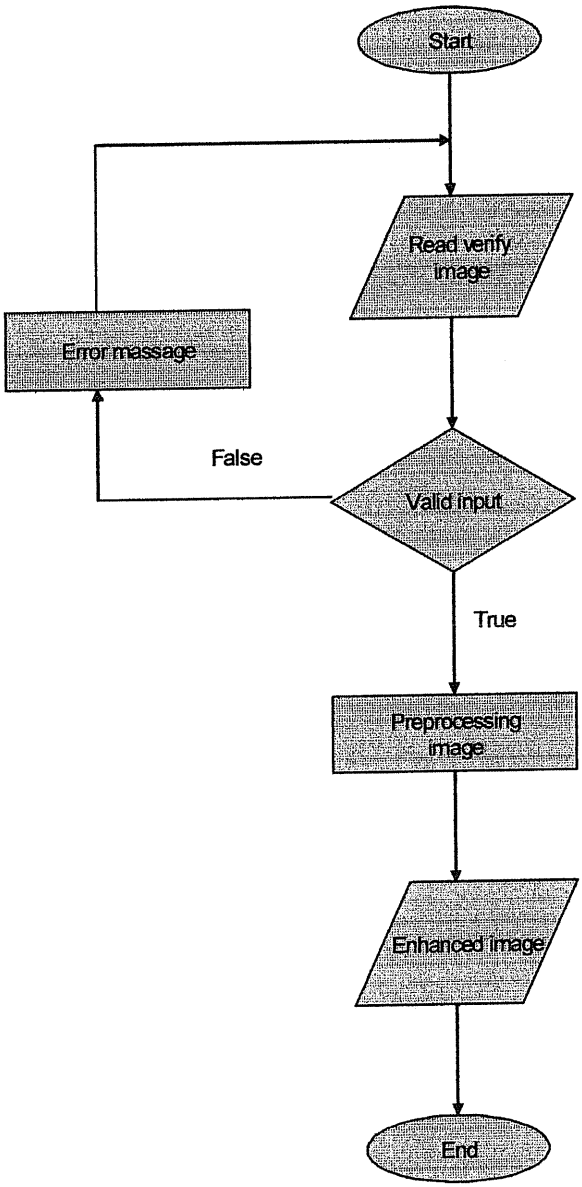


Figure 4.20: Pre-processing an Image Flowchart

Note:

This flowchart is common between knowledge base and diagnostic.

- **Filtering**

The image is filtering to increase its usefulness; image filtering includes removing noise, and smoothing the signal, so the output of filtering image is pure image.

1. Interface

- **Input: :** Enhanced ECG graph that have been preprocessed
- **Output:** Pure ECG signals without any noises and it is smoothly.

2. Constraints

A pure ECG graph should be found on directory with size of 467*274 and has extension .gif.

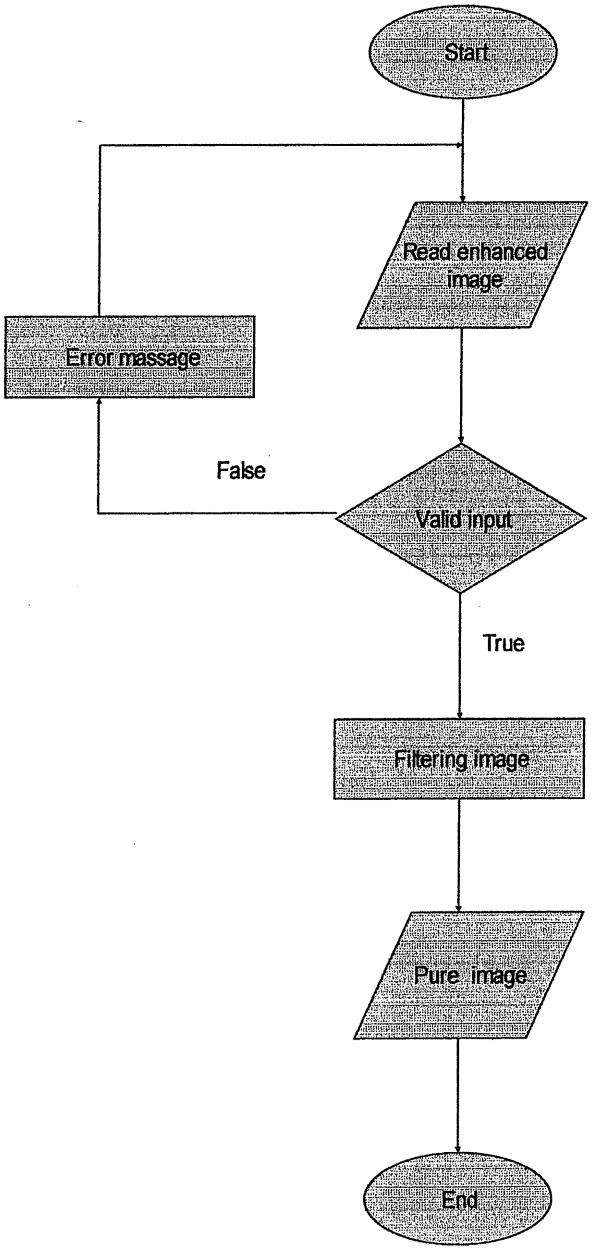


Figure 4.21: Filtering Flowchart

Note:

This flowchart is common between knowledge base and diagnostic.

Splitting

Split each enhanced ECG image into 12 charts, which represent the ECG graph.

1. Interface

- **Input:** Enhanced image.
- **Output:** Obtained 12_charts that represent ECG graph.

2. Constraints

Verify the image size and type; also this image must be preprocessed

3. Validation

12_charts must be available in folder on the desktop.

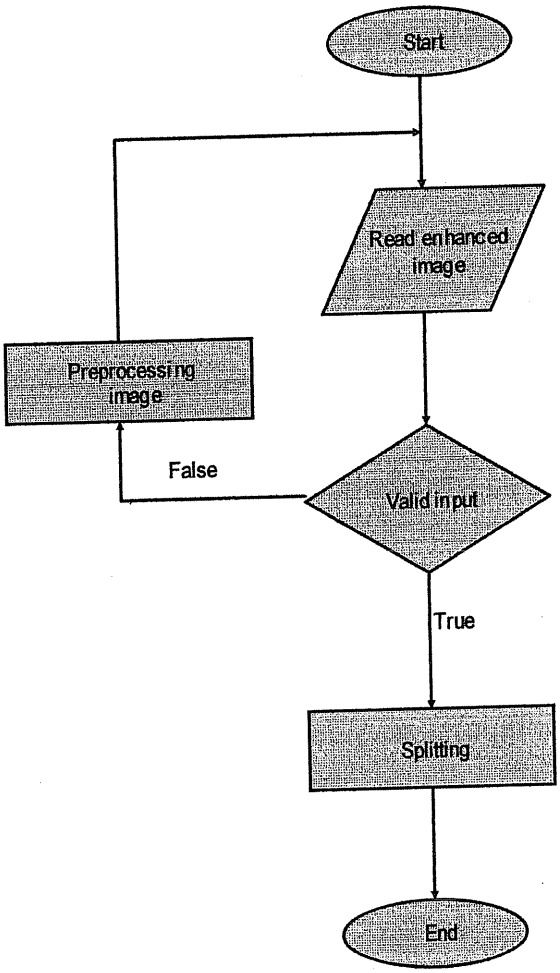


Figure 4.22: Splitting Flowchart

Note:

This flowchart is common between knowledge base and diagnostic.

- **Wavelet extraction**

Extract each chart to obtain features extraction of coefficient in order to represent signal.

1. .Interface

- **Input:** ECG charts.
- **Output:** Features of coefficient that represent ECG graph.

2. Constraints

- The charts must be available in the folder which is stored on the desktop.
- The obtained extraction must be in level three.

4. Validation

The obtained coefficient must be available on the hard derive.

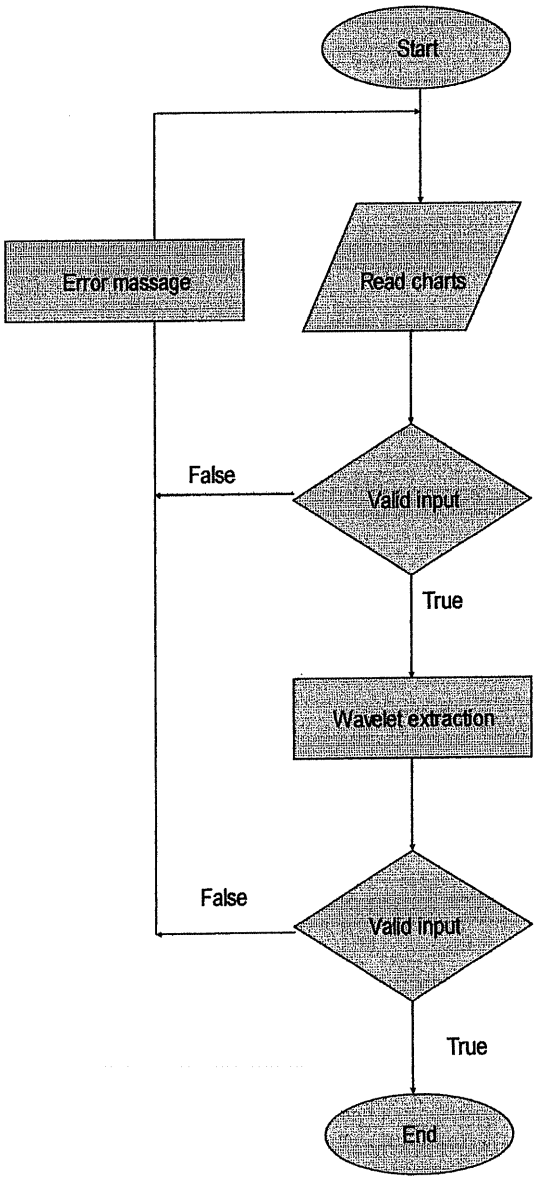


Figure 4.23: Wavelet Extraction Flowchart

Note:

This flowchart is common between knowledge base and diagnostic.

- **Formatting**

Grouping of data to be more suitable with knowledge database structured.

1. Interface

- **Input:** Features of coefficient.
- **Output:** Suitable grouping data.

2. Constraints

The features of coefficient must be available on folder on the desktop.

3. Validation

Make sure that data is arranged according field in database.

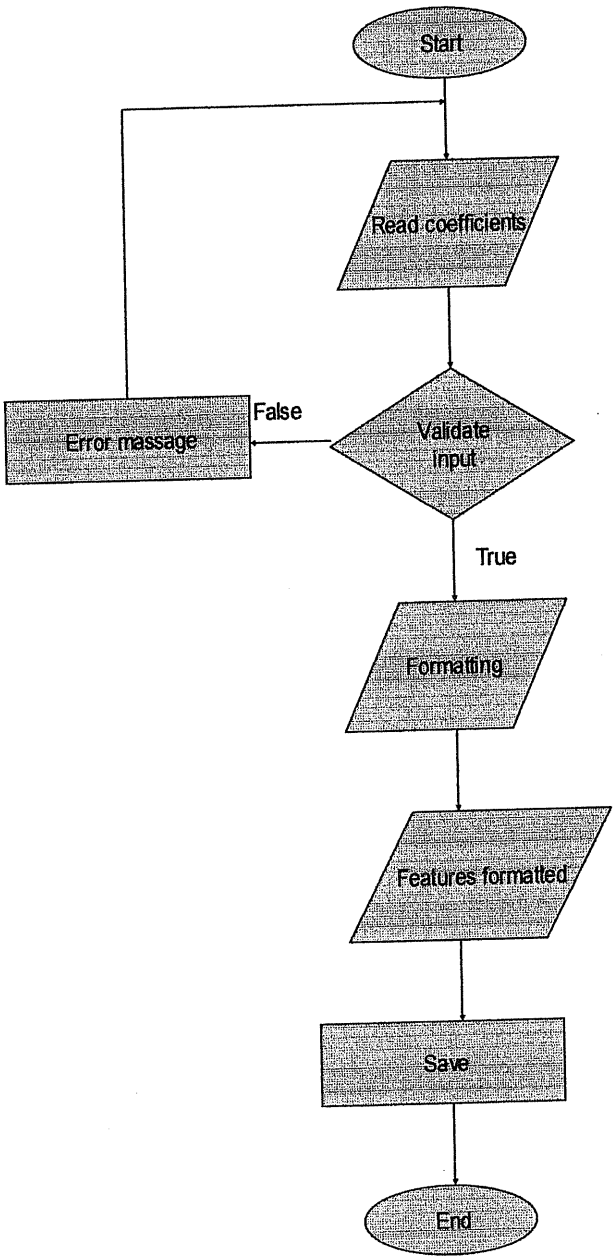


Figure 4.24: Formatting Flowchart

Note:

This flowchart is common between knowledge base and diagnostic.

- **Saving coefficients**

Save features of coefficient that represent an ECG graph to build a knowledgebase.

1. Interface

- **Input:** Formatted features of coefficient.
- **Output:** Store the coefficient in data base.

2. Constraints

The coefficient must be available on folder on the desktop.

3. Validation

The coefficients should be available on a knowledgebase.

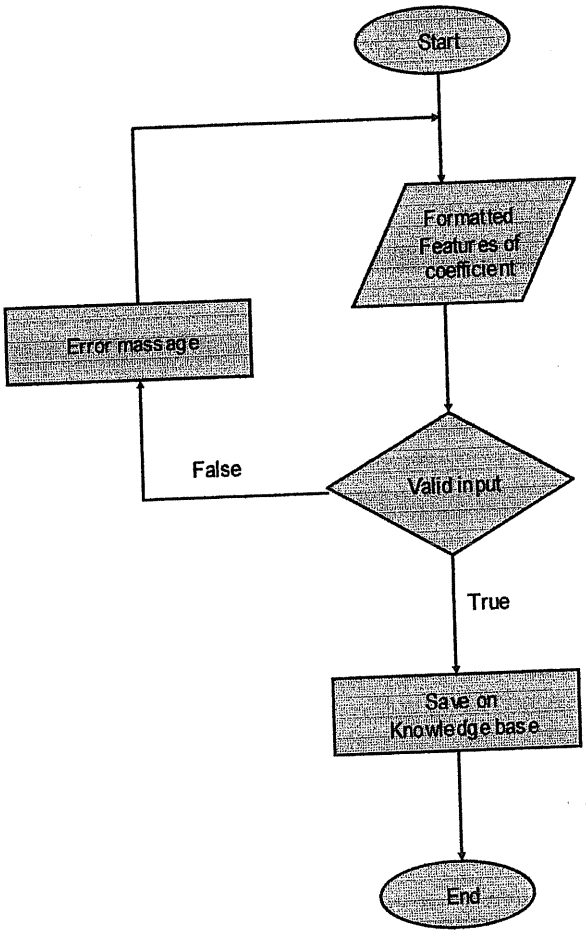


Figure 4.25: Saving Coefficient Flowchart

Note:

This flowchart is common between knowledge base and diagnostic.

4.5.2 Functional Design for Diagnostic and Classification Module

- **Classification**

This function is used to compare (map) between storage knowledgebase and process ECG graph using k-nearest neighbors rule and classify the observation according to the most frequent class among its neighbors.

1. Interface

- **Input:** Features of coefficient.
- **Output:** determine the most nearest vector between stored features coefficient and the coefficients of an ECG graph you want to diagnose it.

2. Constraints

The coefficient of diagnose signals must available on folder on desktop although the coefficients of knowledgebase must be available on folder to performed the map (comparison).

3. Validation

The results of classification must be available on web form.

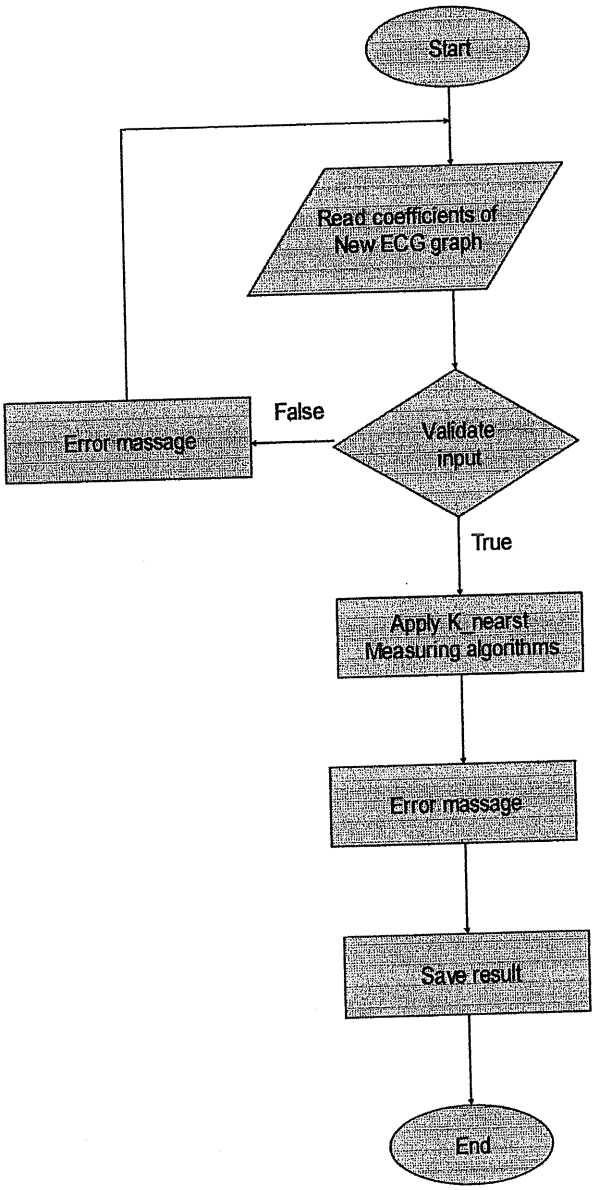


Figure 4.26: Classification Flowchart

Note:

This flowchart is common between knowledge base and diagnostic.

- **Diagnose and Reporting**

This function is needed to diagnose an ECG graph, therefore reporting the results.

1. Interface

- **Input:** Results were obtained from classification which indicates nearest vector to load image.
- **Output:** Final report which is containing diagnoses the type of heart disease, pulse rate, QRS and some information about patient.

2. Constraints

The map (comparison) result should be available on the web form.

3. Validation

Diagnose of an ECG graph should be reporting on web form.

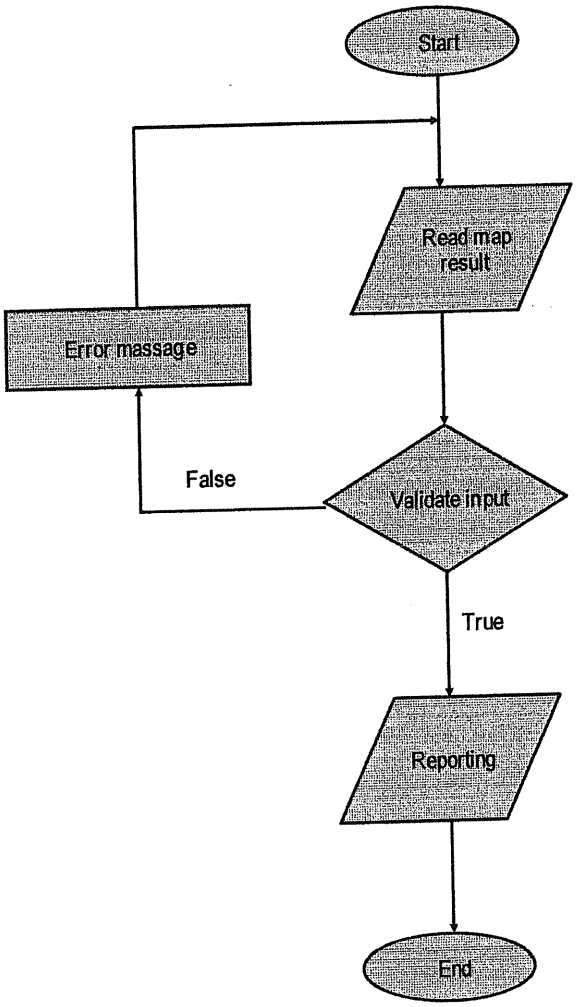


Figure 4.27: Diagnose and Reporting Flowchart

Note:

This flowchart is common between knowledge base and diagnostic.

4.6 Summary and Recommendation

- Each function is implemented and designed accordingly using flowcharts
- Each function is designed for its input /output screens.
- There is a complete design for the database includes all tables and their fields.
- All constraints and validation are explained clearly in this section to omit any ambiguity.

All system design requirements are discussed in details. And according to the project supervisor permission the team has the ability to pass to the next chapter.

Chapter

5

Coding and Implementation

Chapter Five

Coding and Implementation

5.1 Introduction

In this chapter the coding and implementation of the system will identified, where the environment of the coding process and implementation will determine, each function will be implemented and coded, the database and its relations, constraints, also will be implemented.

5.2 Coding Programming Language

This system is requires implementation using MATLAB and ASP.NET however the system is used MATLAB in reading image, verify type and size, process image, split image and extract wavelet to represent ECG image, on the other hand this system is implement using ASP.NET to enter to the system, registration, diagnose and classification using k-nearest neighbor rule .

MATLAB and MATLAB server

MATLAB is a high-level technical computing language and interactive environment for algorithm development, data visualization, data analysis, and numerical computation. Using MATLAB, you can solve technical computing problems faster than with traditional programming languages, such as C, C++, and FORTRAN.

You can use MATLAB in a wide range of applications, including signal and image processing, communications, control design, test and measurement, financial modeling and analysis, and computational biology. Add-on toolboxes (collections of special-purpose MATLAB functions, available separately) extend the MATLAB environment to solve particular classes of problems in these application areas.

MATLAB provides a number of features for documenting and sharing your work. You can integrate your MATLAB code with other languages and applications, and distribute your MATLAB algorithms and applications.

The important of MATLAB server is appearing in connect between web pages and MATLAB, in this technique we can call functions in MATLAB and send the results to web pages, such as in this project there is a function in MATLAB which it is name "reading image", and in ASP.Net there is a button which it is name "reading image", when we are click on this button then MATLAB Server call MATLAB function and make it process then return result to web pages.

At the beginning, in order to install MATLAB Web Server we need to perform some configuration of PC, and then copy CGI_BIN file in 'C' driver which is contain this files: matweb, matlab server, the important of this file is to interface between WebPages (ASP.Net) and MATLAB programs.

The MATLAB Web Server is installing as follows:

1. Copy the license file
2. Insert the MATLAB CDROM in the drive. It should automatically load a startup window. If not, then open a Windows Explorer window, click on the CDROM drive, and double click on the setup.exe file
3. Click on Next
4. In the Customer Information box enter I!S&T for the Name and Massey University for the Company
5. Click on the box which indicates a concurrent license installation. Click on Next
6. For the Location of the License File, enter the path for the license file (c:\temp\licence.dat)
7. Select the MATLAB components you wish to install. For the Institute, we have licenses Click on Next.
8. The program will then install. Just before completion of the installation the program will ask if you wish to install the license manager.
   Click on No.
9. When the program finishes it will display the Setup Complete dialog box.

ASP.Net

*ASP.Net

ASP.net is a new powerful technology for creating dynamic web pages. ASP.net application support more than one of the most popular internet programming languages, one of them is VB.net (Visual Basic.net internet programming language).

VB.net is a programming language which designed to create applications that work with Microsoft .net framework, and make use of its benefits to maximize the use of the dynamic concept when producing an internet application.

*Prerequisite for installing ASP.net

Before you installing ASP.net or the .net framework, you will need to install windows XP, then active IIS and ensure that is work correctly.

ASP.NET one of the programming languages that are used in .NET so we are chooses this language in this project because it is:

- Reduced Development Time.
- Reduced Development Cost.
- Ease of use.
- High Compatibility with Windows Environment.

5.3 Database System

-Structured Query Language (SQL)

SQL is a database language used in queering, updating, and margining relational database. Moreover, it is not like the same sense as other programming language such as C or Pascal, SQL can either be use in formulating interactive queries or be embedded in an application as instruction for handling data. SQL also contains component for defining, controlling, altering and securing data. SQL provide easy and flexibility way for using it, so both technical and non-technical users can use it.

SQL server 2000 which used in database implementation have more than one features which strongly support the database configurations management, this feature consider the reason for which the SQL server 2000 conceder as the most popular and reliable database application, some of this feature which use in this system is:

Enterprise manger

It is an administrative application that provides split-screens representation of SQL server management capability, it is display the console tree and tools, and it is used to create new SQL server group, databases, options and property for each SQL server component.

1. **Database Diagram**

   Diagram are used to constructing actual database, it is concise and understandable representation of ER data model.

2. **Stored Procedure**

   This feature of the SQL server 2000 allow to perform many action and event on the database which may take time and effort to be done by the designer or the programmer, the stored procedure reduce time and bandwidth need to perform the action since it is stored in the local server.

3. **Security**

   SQL server 2000 allows making user and granting them a specific or data basing administrator privileges in order to control the access of the database resource according to the nature of migration.

4. **Migration**

   It is the process of moving one database information to another in the same application or from one database application to another.

The implementation of the SQL server 2000

1. Installation of SQL server 2000
2. Change password of the default user account.
3. Create the user account to use it instead of default account.

5.4 Establishment of Development Environment.

5.4.1 Hardware Needed

Hardware component to help of implement:

-Three Pentium IV PC's of these features:

Speed 2400MHz, 256MB RAM, 40GB H.D.

-Three mini flash disk.

-Scanner.

-Printer.

-Internet connection (modem, telephone cable).

-Input and output devices (keyboard, mouse, screen).

5.4.2 Software Environment.

The software development environment consists of the following:

Windows XP professional

The application which is used to develop this system, is ASP.net require a special platform or operating system to be usable, the XP operating system is one of the best platform which could be used beside this, XP provide the following features which consider as important issue to run the ASP.net:

-Operating System Implementation

Starting the implementation of the software by installing windows XP professional, because it have capabilities to provide many service to client that is important to implementation the other software needed.

-Windows XP professional installing:

Steps for installing:

1. Run setup program.
2. Run setup wizard.
3. Installing windows XP professional networking.
4. Complete the setup program.

-IIS (internet information service)

IIS used to connect the system parts (D.B, ASP.net application) and brows it in the internet explorer, and enable us to publish our web page on the internet.

Internet information service (IIS) installing:

1. Open control panel.
2. Double click on add/remove programs.
3. Click on add/remove windows components.
4. Check the internet information server (IIS).
5. Click next then setup then start to copy the required file t the hard disk.
6. Click finish to close the windows components wizard.
7. Close the add/remove programs window.

Office XP

After installing windows XP it was chosen suitable office which was installed, that help to write documentation in word and drown some figure on power point.

MATLAB

We install MATALAB 6.5 in PC and its document (help), after installing it we install MATALAB web server and make necessary configuration.

This program is very important to complete this project, because it is using to read ECG image and do wavelet to produce coefficients.

- High-level language for technical computing.
- Development environment for managing code, files, and data.
- Interactive tools for iterative exploration, design, and problem solving.
- Mathematical functions for linear algebra, statistics, Fourier analysis, filtering, optimization, and numerical integration.
- 2-D and 3-D graphics functions for visualizing data.
- Tools for building custom graphical user interfaces.

ASP.Net

This software was used to program all screens which used in this project that include administrator screens and physician screens.

Also this software was done very important part of this project which is classification and compare between coefficients it used to program K_nearst classification method.

ODBC

An ODBC driver is a standard PC interface that enables communication between database management systems and SQL-based applications.

SQL Server and MATLAB

- Build a New Database in SQL server.
- Connect SQL Server to ODBC driver.
- Click control panel-> Administrative Tools -> Data Source (ODBC).
- Click Add.
- Build tables for your data.
- Click "SQL server enterprise manager".
- Write this command into MATLAB.

INSERT (CONNECT, TABLENAME, FIELDNAMES, DATA).

CONNECT: is a database connection handle structure.

TABLENAME: is the database table.

FIELDNAMES: is a string array of database column names.

DATA: is a MATLAB cell array.

Conn = database ('datasourcename', 'username', 'password') connects a MATLAB session to a database via an ODBC driver, returning the connection object to conn. The data source to which you are connecting is datasourcename. You must have previously set up the data source--for instructions. Username and password are the username and/or password required to connect to the database. If you do not need a username or a password to connect to the database, use empty strings as the arguments.

5.5 Database Creation and Configuration

Data base in this project are stored in these tables, so this section is describe the tables, their primary key, and the indexes of each table.

-Diagnose

This table contains many field, patient id, patient name, age, sex, pulse rate, illness and description.

Field Name	Type	Control
Patientid	Int(4)	PK
Patientname	Varchar(50)	Allows null
Age	Floate(8)	Allows null
Sex	Varchar(50)	Allows null
Pulse rate	Int(4)	Allows null
Illness	Varchar(50)	Not null
Description	Varchar(50)	Not null

Table 5.1: Master Record Table

-Physician and administrator

These are two different tables but have the same field, login id, password and name.

- **Physician**

Field Name	Type	Control
Login ID	Int(4)	PK
Password	Varchar(50)	Not null

Table 5.2: Physician Table

- **Administrator**

Field Name	Type	Control
Login ID	Int(4)	PK
Password	Varchar(50)	Not null

Table 5.3: Administrator Table

-Wavelet

This table is copy to 12 tables which are the same and have the same field; this is a result of splitting ECG graph into 12 parts. The fields are chart id, sid, cid and coefficient.

Field Name	Type	Control
Chart id	Int(4)	PK
Sid	Int(4)	PK
Cid	Int(4)	PK
Coefficient	Float	Not null

Table 5.4: Wavelet Table

-Send comments

This table has these fields name, email, type and massage.

Field Name	Type	Control
Name	Varchar(50)	Not null
Email	Varchar(50)	Not null
Type	Varchar(50)	Not null
Massage	Varchar(50)	Not null

Table 5.5: Send Comment Table

-Registration

This table contains these fields' login id, password, name, sex, city and cell phone.

Field Name	Type	Control
Login id	Int(4)	PK
Password	Varchar(50)	Not null
Name	Varchar(50)	Allows null
Sex	Varchar(50)	Allows null
City	Varchar(50)	Allows null
Cell phone	Varchar(50)	Allows null

Table 5.6: Registration Table

5.6 Coding and Unit Testing

We make test to design screen in ASP.NET that show as below:

The following I/O screens are describe you how to use this system, how deal ECG signal such that this signal has extension .gif and it is size 467*274 in order to obtain the diagnostic of this signal.

1. Login

This screen is allow you to enter to the system via your Login ID, Password, and Name, thus the password in this screen is must be at least 6 characters.

This screen is allow you to contact us if you are forget your account, therefore it is allow you to built a new account by click on Registration, and you can change your password by click on change password.

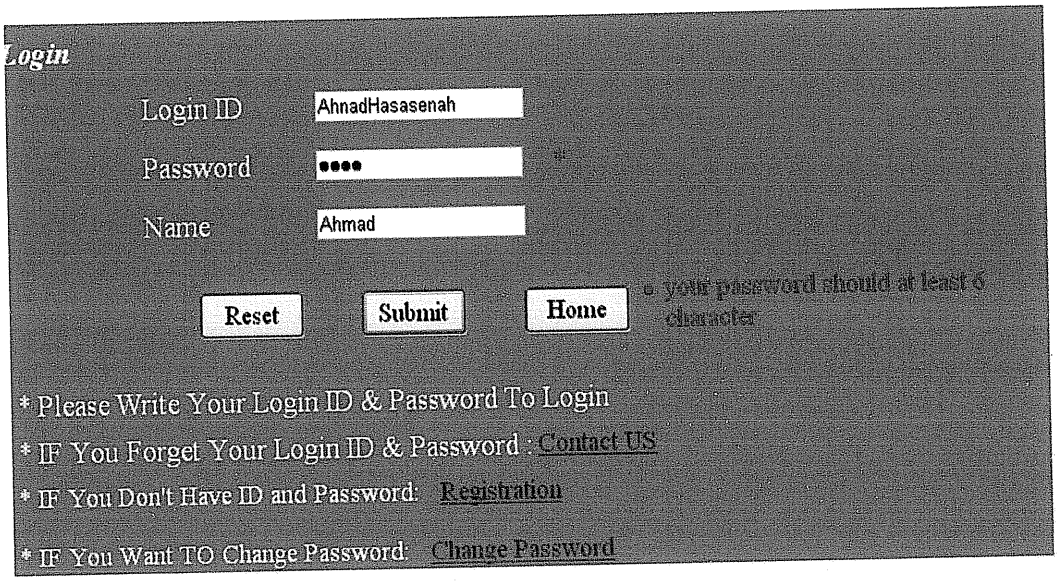


Figure 5.1: Login Test

2. 2. Registration

This screen is allow you to make a new account by clicking on the Registration icon in the Login screen, so you need to put your name, E-mail, sex "gender", city, telephone, Login ID, password, and re-type password, therefore your password should be at least 6 characters, and the re-type password should be the same password and you need to type all label to built your account.

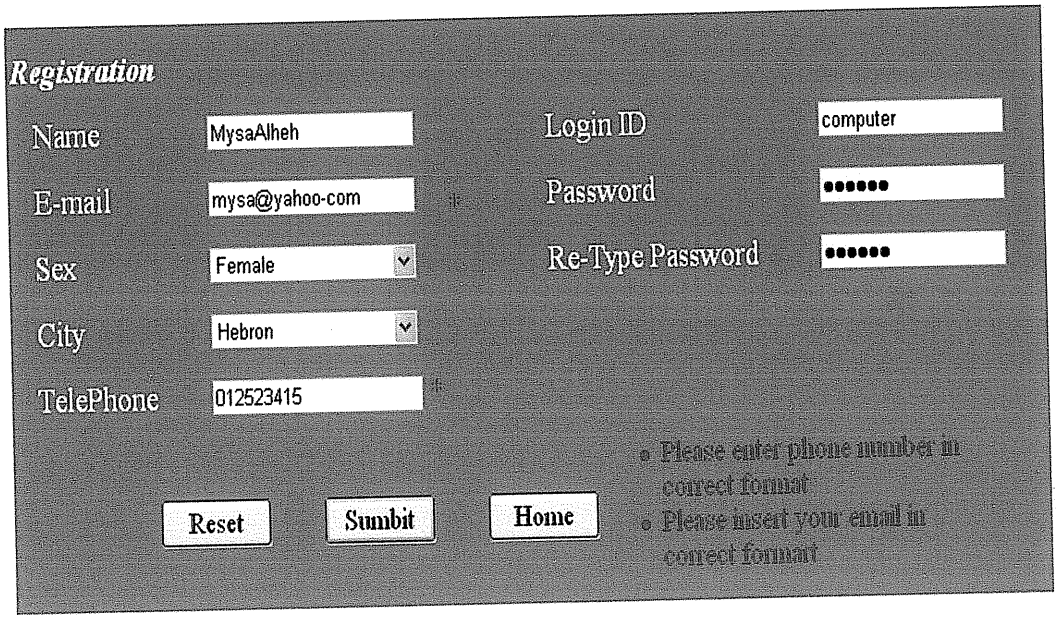


Figure 5.2: Registration

1. Change password

This screen is allow you to change your password by type a new Login ID, Old password, new password, and confirm password, so your password must match with confirm password, so you can't change any password without true old password.

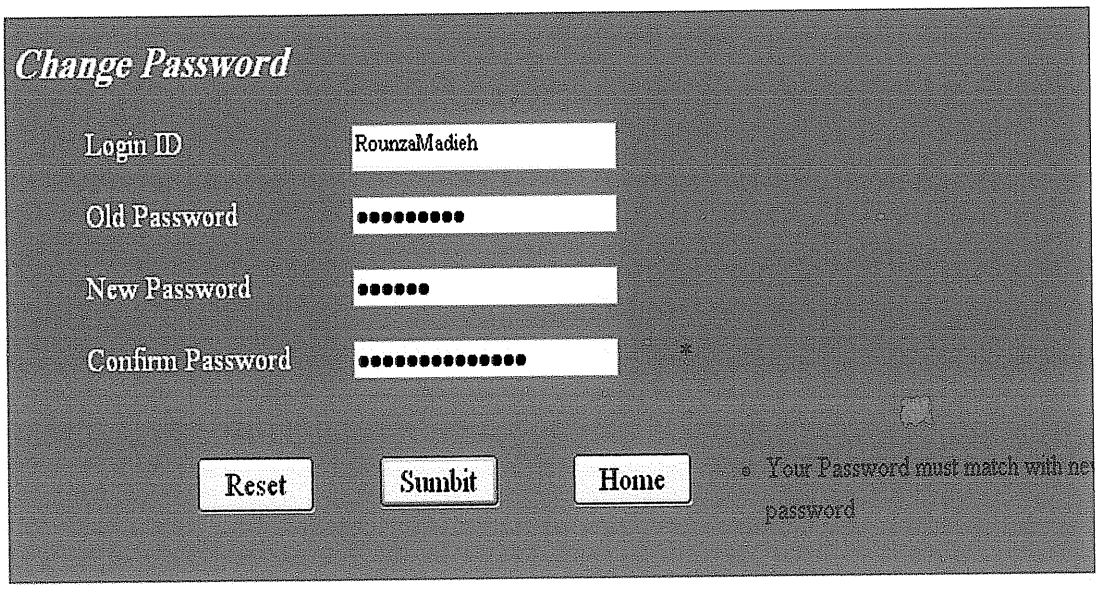


Figure 5.3: Change Password Test

2. Diagnose

In this screen you need to write all patient information such as patient name, pulse rate of his/her heart, sex, age, illness, description, and date in order to make diagnose and record the results in the report.

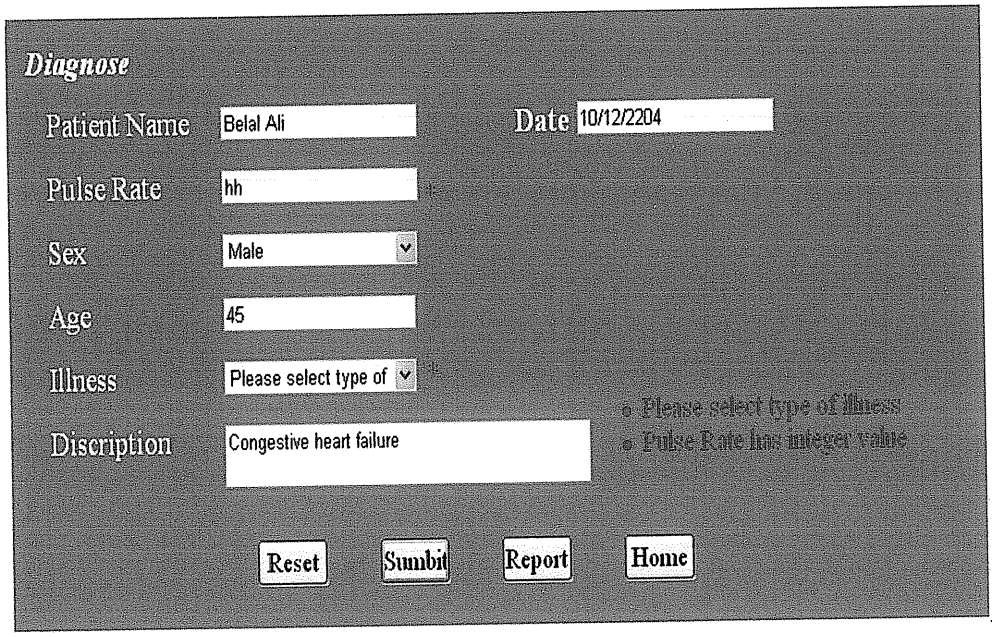


Figure 5.4: Diagnose Test

3.Send comment

In this screen you can send us any comments about our system by type your name, Email, message type, and your comments.

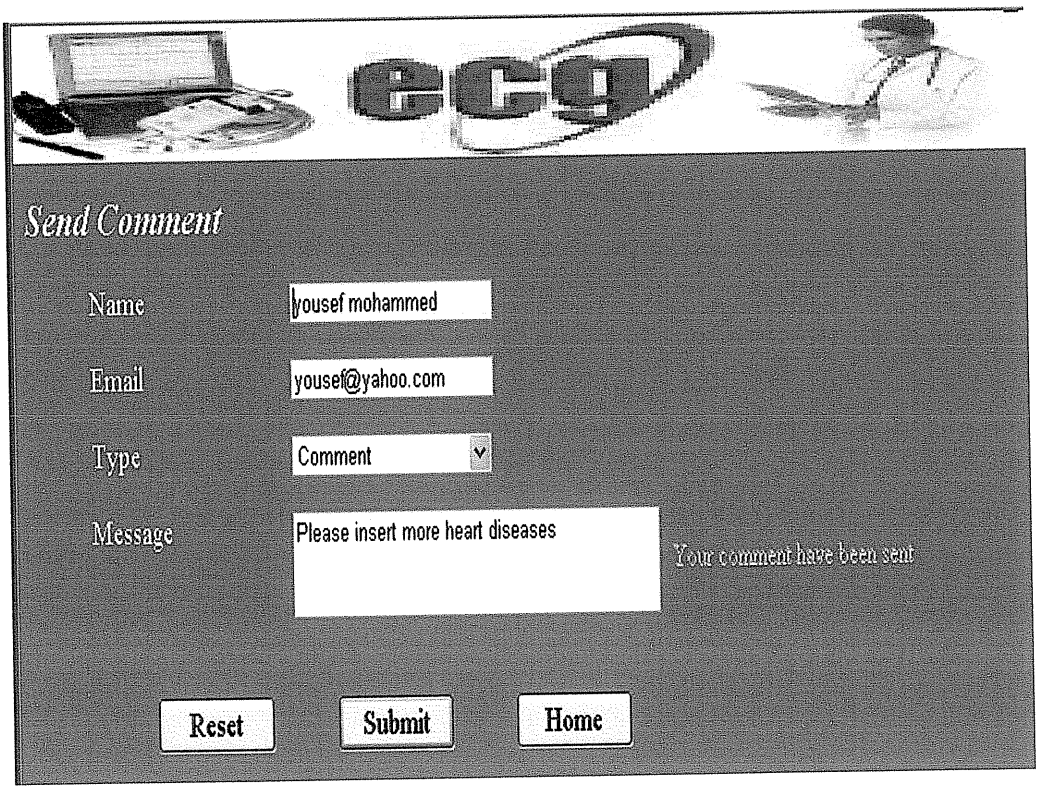


Figure 5.5: Send Comment Test

5. Help

This screen is contain help information about how to read image characteristic, how to registration, how to classification, and what is the output. So you can click on any icon to show the help information for it.

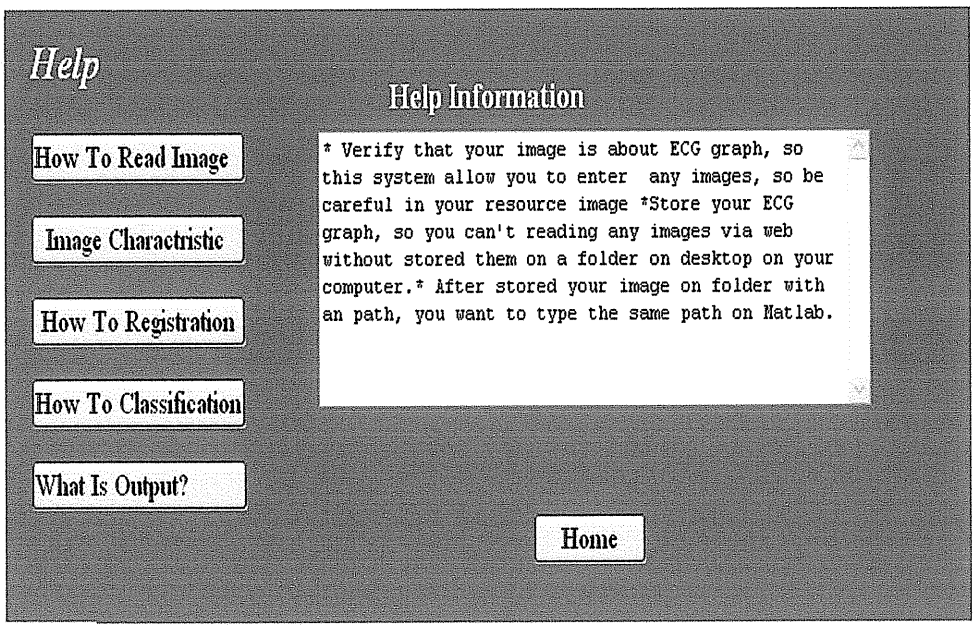


Figure 5.6: Help Test

5.7 Stored procedures and MATLAB functions

5.7.1 Stored procedures

The stored procedures are very useful tutorial for creating and using them with asp applications.

A stored procedure is nothing more than an SQL statement stored inside a database. The database can be SQL Server or MS Access as well as others ... A stored procedure is compiled by your database (for the most part) one time, when it is entered. These results in faster database executions and overall performance updates, it further separates the SQL statement from your asp leaving you with more readable code. So let's get on with it.

So by using stored procedures you can fine the error in more fast than write this code in ASP web application especially in code behind page.

So in this system we are use couple of stored procedures and these procedures can be describe as follow:

Diagnose procedure

This procedure was build for diagnose an ECG image has extension .gif and it is size is 467X274 which include the patient number, his name, his age, his sex, his illness, pulse rate of his ECG, and description about this patient.

```
CREATE PROCEDURE diagnose1  @patientid  int ,@patientname
nvarchar(50),@age float,@sex nvarchar(50),@pulserate int,
@illness  nvarchar(50),@discription  nvarchar(50)

AS
insert into  diagnose  (patientid,patientname,age,sex,pulserate,illness,discription)
values (@patientid,@patientname,@age,@sex,@pulserate,@illness,@discription)
GO
```

Import procedure

This procedure was build to return the maximum number of ECG image that added on the knowledge database to diagnose this image dependent on it is number.

```
CREATE PROCEDURE  import
```

```
AS
SELECT MAX(chartid)
FROM w1
GO
```

Registration procedure

This procedure was build to perform the registration screen which any one who wants to apply this screen he is want his login id, password, name, sex, city, cell phone, and his mail.

```
CREATE PROCEDURE registration1  @loginid  int ,@passwordp
varchar(50),@namep varchar(50),@sex varchar(50),@city varchar(50),
@cellphone varchar(50),@mail varchar(50)

AS
insert into  registration  (loginid,passwordp,namep,sex,city,cellphone,mail)
values (@loginid,@passwordp,@namep,@sex,@city,@cellphone,@mail)
GO
```

Send comment procedure

This procedure was build to enable user to send us any comments about our system and this comments should be include the name of user, user email, and his message.

```
CREATE PROCEDURE sendcomment1  @namepa  varchar(50) ,@email
varchar(50),@type varchar(50),@message varchar(50)
 AS
insert into  sendcomment  (namepa,email,type,message)
values (@namepa,@email,@type,@message)
GO
```

5.7.2 MATLAB functions

As we were mention in the previous chapters this system used two programming language, MATLAB and ASP.net. for implementation; MATLAB is used to deal the ECG images , however the main purpose of using MATLAB programming return to it is accurate results for image processing ,so that this system was used several MATLAB functions to perform this issue and these functions are mention in the appendix at the end of this document.

5.8 Summary and Recommendation

After preparing all things which mention above expect that making connection between SQL server and MATLAB after install the MATLAB server and describe how to connect between web server and MATLAB server

Also the connection between SQL server and ASP.net was performed dependent on preparing all things which mention above.

So any user can use this system if he has account with password and user name.

Chapter 6

Testing

Chapter Six

Testing

6.1 Introduction

After we had completed coding and implementation stage and building the knowledge based for this system, the system must be tested by this section is concerned with testing the system to ensure that it performs as expected to be, so that in this section the testing stage will test all coding and database which were built.

6.2 Test Plan

- **Module and Unit Code Testing:** where each operation was tested individually to ensure that it operates as expected, so that each function, code, and operation, will tested by itself to make sure that each function or operation is true.
- **System Integration Testing:** here the integration of all objects was tested to ensure that the whole system performs as expected, so that the system will tested as a unit to make sure that all operations do with each other and there is a match between all of them.

6.2.1 Module and unit code testing

The testing of this system has two parts, MATLAB testing and ASP.NET testing so we need to test each part by itself to make sure that work successfully without any mistakes.

MATLAB unit testing

Read image

At the beginning we need to call MATLAB function (read image) ,this function will read the image which stored in work directory ,so to test this function that it is work correctly the reading image will store in the specified directory.

After execute this function we found this image in the directory which specified and this image is shown below:

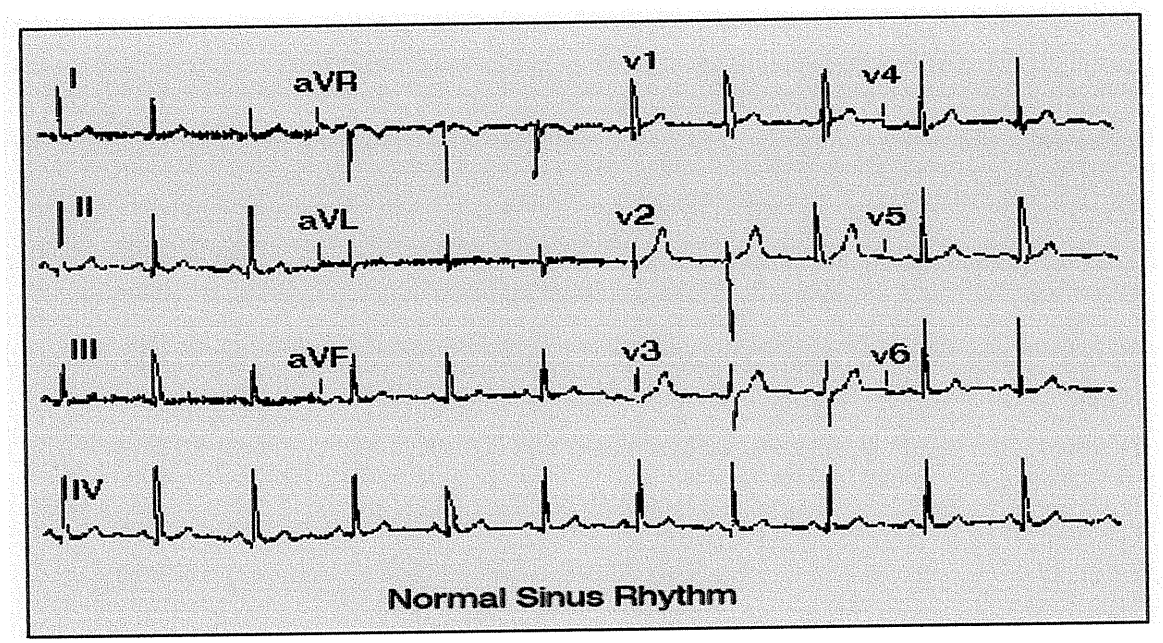


Figure 6.1: ECG image

Verify size and type

This function will check the size and type of reading image which it must be 467*274 and has extension .GIF and this function don't work without reading image except that this function will display error message ,and this message will explain as below:

1- The message "your reading image has extension .gif and it is size 467*274" will display if reading image correct its type and size.
2- The message "check image size and type" will display if reading image incorrect type and size.
3- The message "please enter the image" will display if execute verify size and type function before execute image read or execute without reading the image.

De-noise image

This function will remove all unrelated data and addition information such as: red background, pulse rate, QRS, speed of ECG instrument etc……

This function can't execute without reading image and verify it.

The output of this function pure and enhance ECG image which contain the signal only without any noise and this image is shown below.

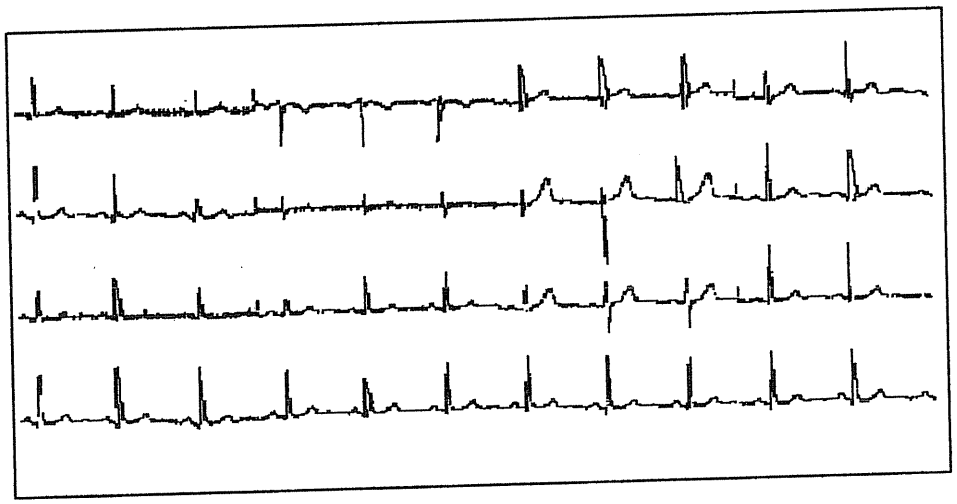


Figure 6.2: ECG pure image

Filter Image

This function will make the ECG image more smoothly, very enhanced and continuously image, and you can't execute this function before execute the de-noise function.

The image that will obtain after execute this function is shown as below:

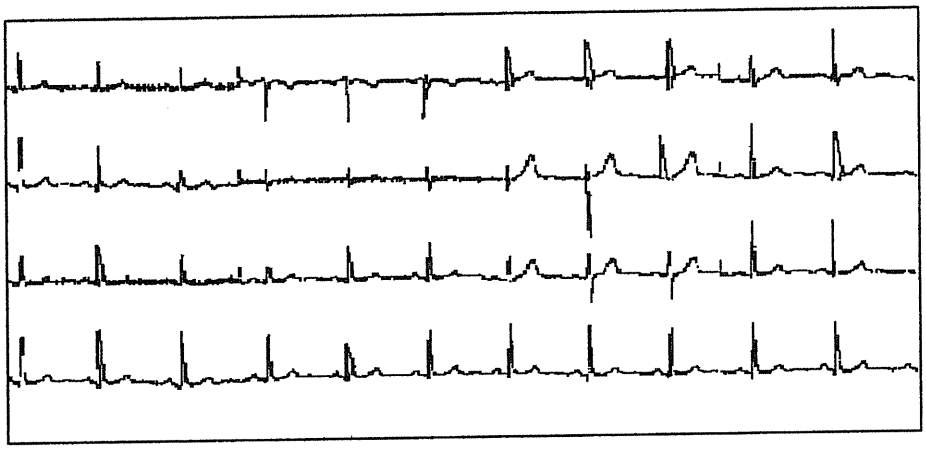


Figure 6.3: ECG filter image

Splitting Image

This function will split (segment) the pure ECG image into 12 charts, each ECG has 4 channels and each channel will split into 4 charts it is mean this function will ignore the fourth channel; the image must be filter before split it, the output of this function is shown as below:

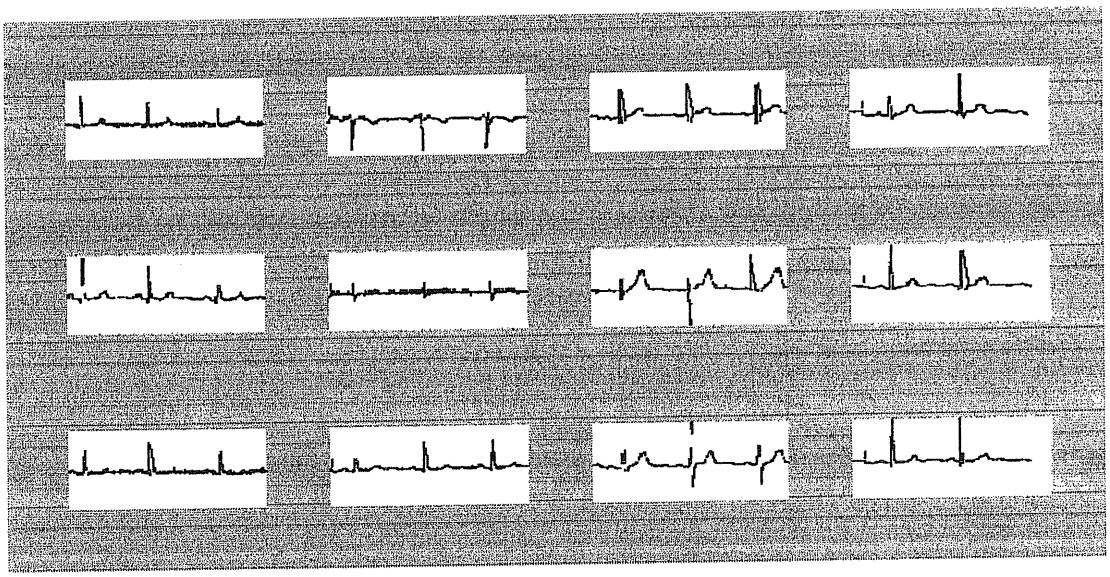


Figure 6.4: ECG split image

Convert Image

This function enables us to convert 12 charts from two dimensional arrays into one dimensional array; this function is needed because the extraction wavelet is deal with one dimensional, also this function will perform after execute the split function. he convert charts shown as below:

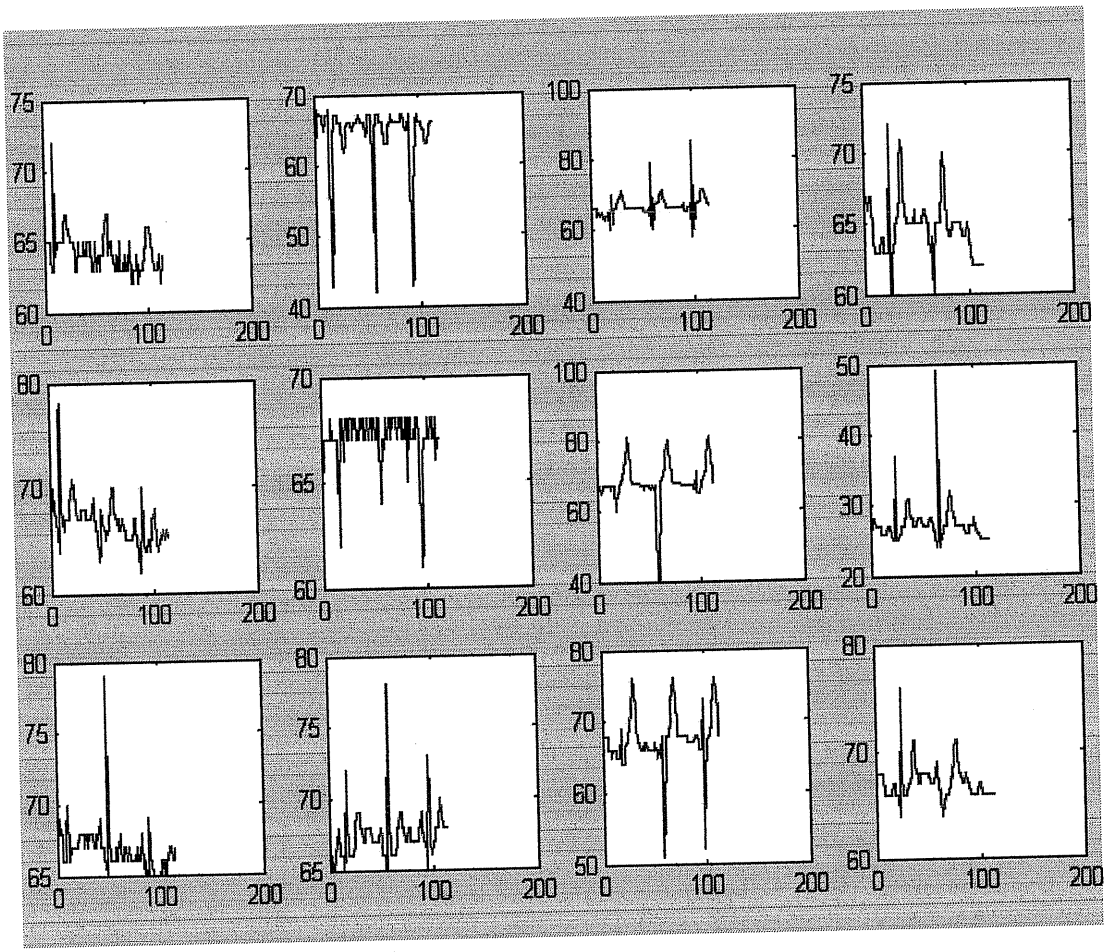


Figure 6.5: ECG convert image

Extract Wavelet

The wavelet technique is a new technology that uses to represent the image in coefficients, so that this function was executed to show the coefficients which are represent the 12 charts. To test this function that work correctly we reconstruct these coefficients so will obtain the same original charts, also this function will perform after execute the convert function to get the 12 charts in one dimensional array. After executed this function the reconstruct of these coefficients are represent in 12 charts as shown below:

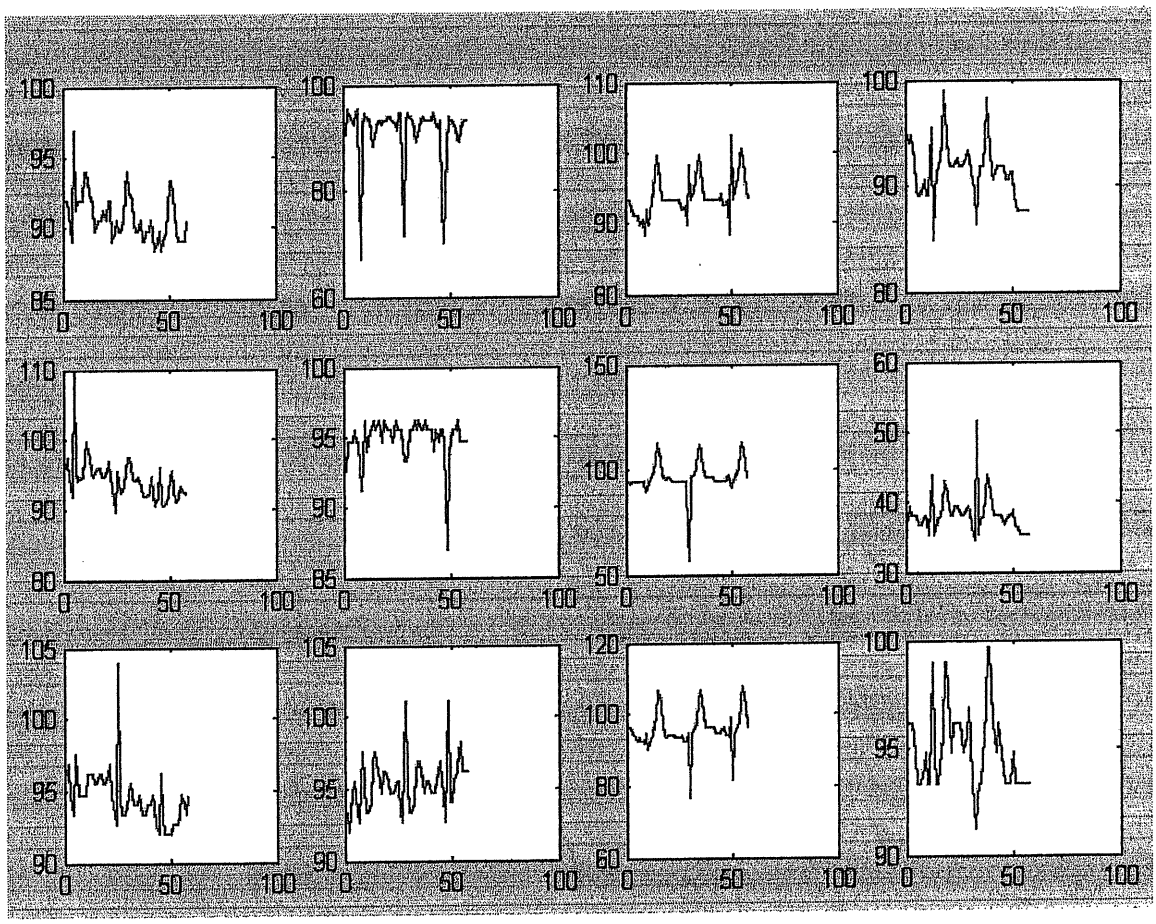


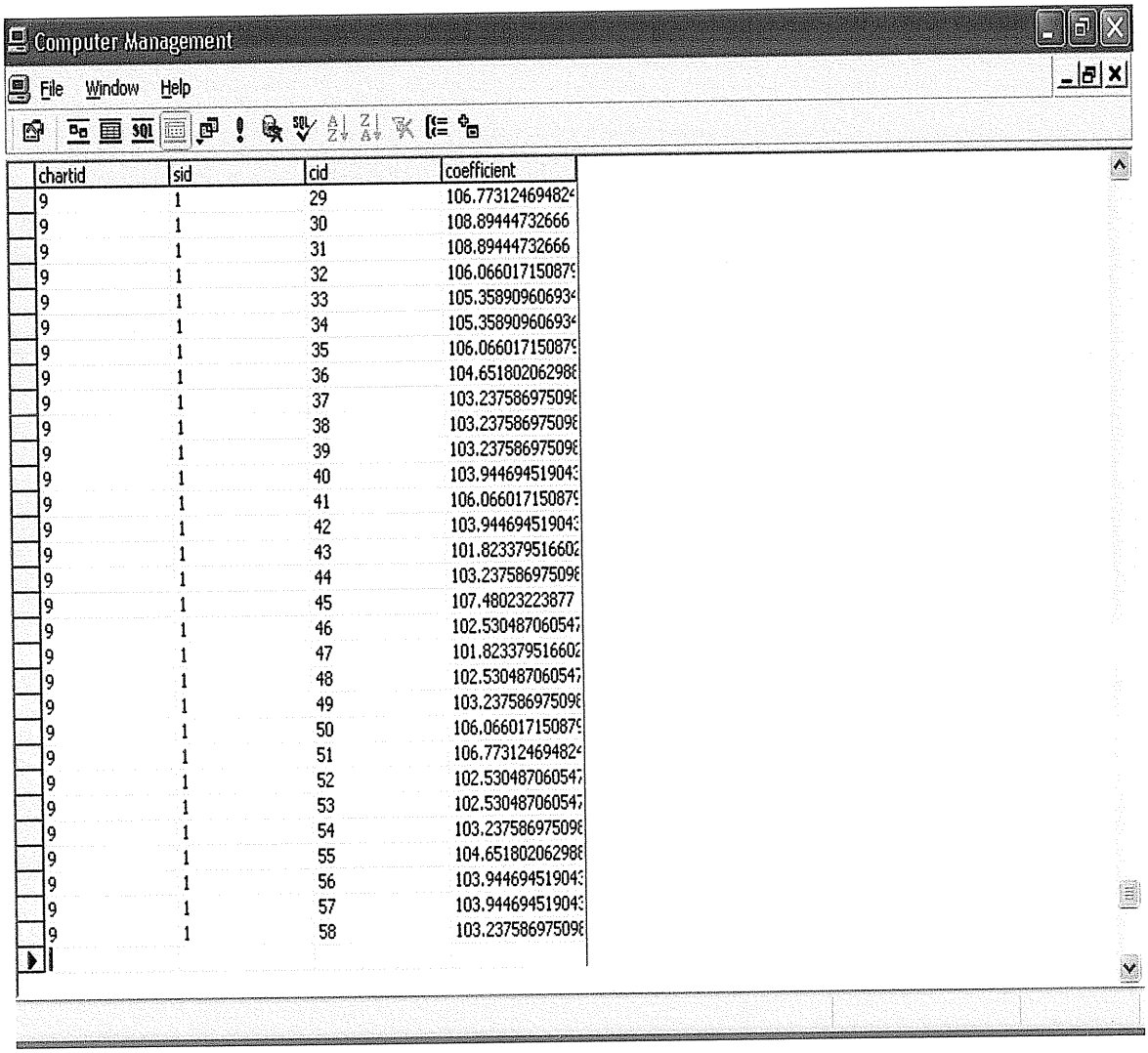
Figure 6.6: ECG convert image

Connect MATALAB to SQL Server

This function enables us to send the obtained coefficients from the previous function into 12 tables which are store in knowledge database, each table will accept 58 coefficients which represent one chart; it is mean 12 tables will accept 58*12=696 coefficients which represent one ECG image, so we need to know the last ECG image number which stored in the knowledgebase to assign this number by adding one to the next ECG image , to explain that here we have an example about this function, so if we have 9 images were stored their coefficients in knowledgebase and we need to send the coefficients of 10^{th} image into knowledgebase, this will performed as below:

Before Testing

This knowledgebase is describing one the 12th tables, it is mean the coefficients in this table represent the 9th image for the first chart (split chart).

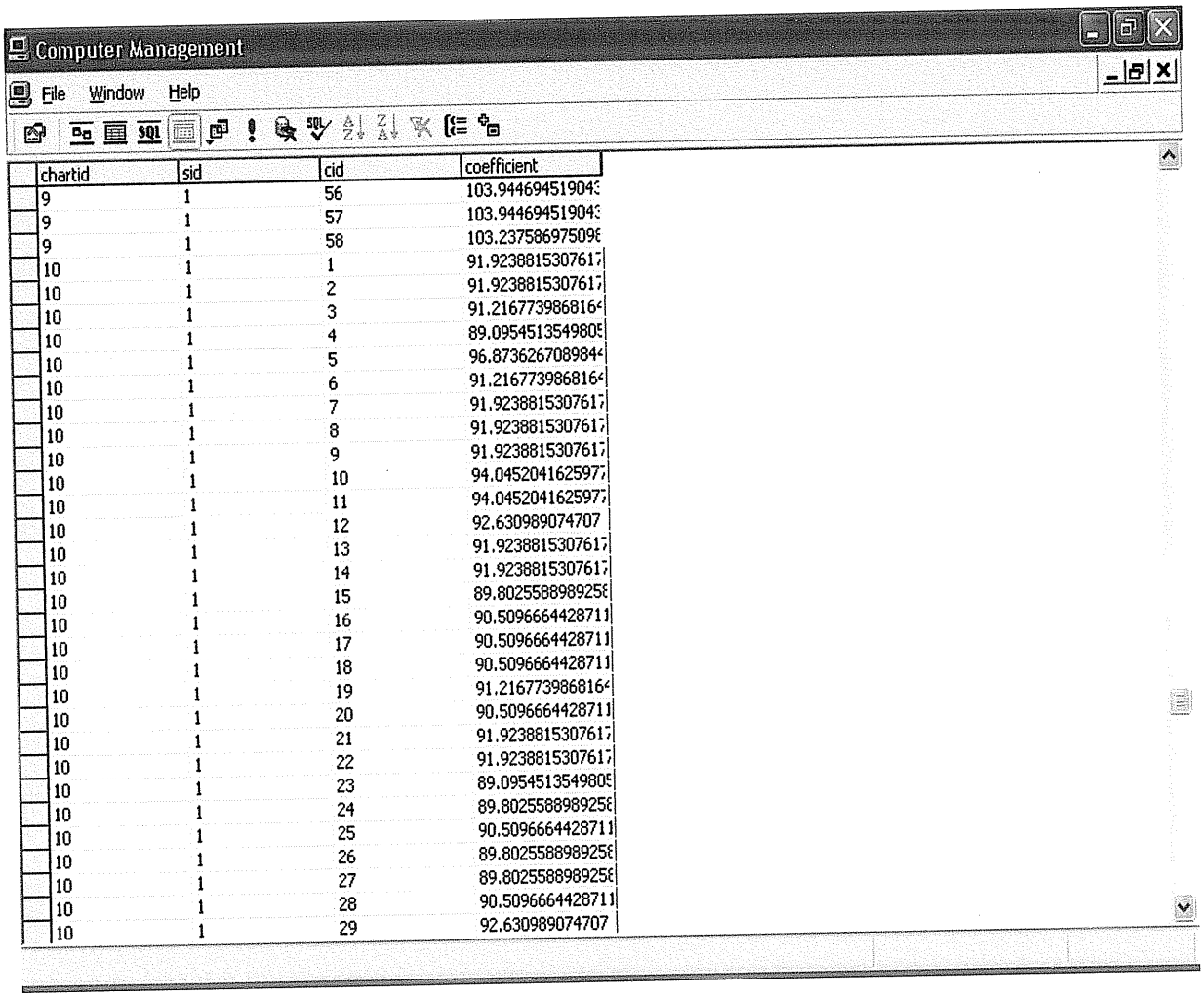


chartid	sid	cid	coefficient
9	1	29	106.77312469482
9	1	30	108.89444732666
9	1	31	108.89444732666
9	1	32	106.06601715087
9	1	33	105.35890960693
9	1	34	105.35890960693
9	1	35	106.06601715087
9	1	36	104.65180206298
9	1	37	103.23758697509
9	1	38	103.23758697509
9	1	39	103.23758697509
9	1	40	103.94469451904
9	1	41	106.06601715087
9	1	42	103.94469451904
9	1	43	101.82337951660
9	1	44	103.23758697509
9	1	45	107.48023223877
9	1	46	102.53048706054
9	1	47	101.82337951660
9	1	48	102.53048706054
9	1	49	103.23758697509
9	1	50	106.06601715087
9	1	51	106.77312469482
9	1	52	102.53048706054
9	1	53	102.53048706054
9	1	54	103.23758697509
9	1	55	104.65180206298
9	1	56	103.94469451904
9	1	57	103.94469451904
9	1	58	103.23758697509

Figure 6.7: 1st split chart coefficients for 9th image

After Testing

This knowledgebase is describing one the 12th tables, it is mean the coefficients in this table represent the 10th image for the first chart (split chart) so we note after execute the connect function for 10th image, the coefficients of this image is added in the knowledgebase.



chartid	sid	cid	coefficient
9	1	56	103.94469451904
9	1	57	103.94469451904
9	1	58	103.237586975096
10	1	1	91.9238815307617
10	1	2	91.9238815307617
10	1	3	91.2167739868164
10	1	4	89.0954513549805
10	1	5	96.873626708984
10	1	6	91.2167739868164
10	1	7	91.9238815307617
10	1	8	91.9238815307617
10	1	9	91.9238815307617
10	1	10	94.0452041625977
10	1	11	94.0452041625977
10	1	12	92.630989074707
10	1	13	91.9238815307617
10	1	14	91.9238815307617
10	1	15	89.8025588989258
10	1	16	90.5096664428711
10	1	17	90.5096664428711
10	1	18	90.5096664428711
10	1	19	91.2167739868164
10	1	20	90.5096664428711
10	1	21	91.9238815307617
10	1	22	91.9238815307617
10	1	23	89.0954513549805
10	1	24	89.8025588989258
10	1	25	90.5096664428711
10	1	26	89.8025588989258
10	1	27	89.8025588989258
10	1	28	90.5096664428711
10	1	29	92.630989074707

Figure 6.8: 1st split chart coefficients for 10th image

ASP.NET unit testing

In this system we are designed several screens using ASP.NET to enable persons to enter to this system under several condition so that in this section we need to check that every screen is doing without any problem and it is performed as expected.

The following are some samples for module testing and its associated results:

Login before testing

This screen enables you to login to the system, so you need to type a valid login ID and password

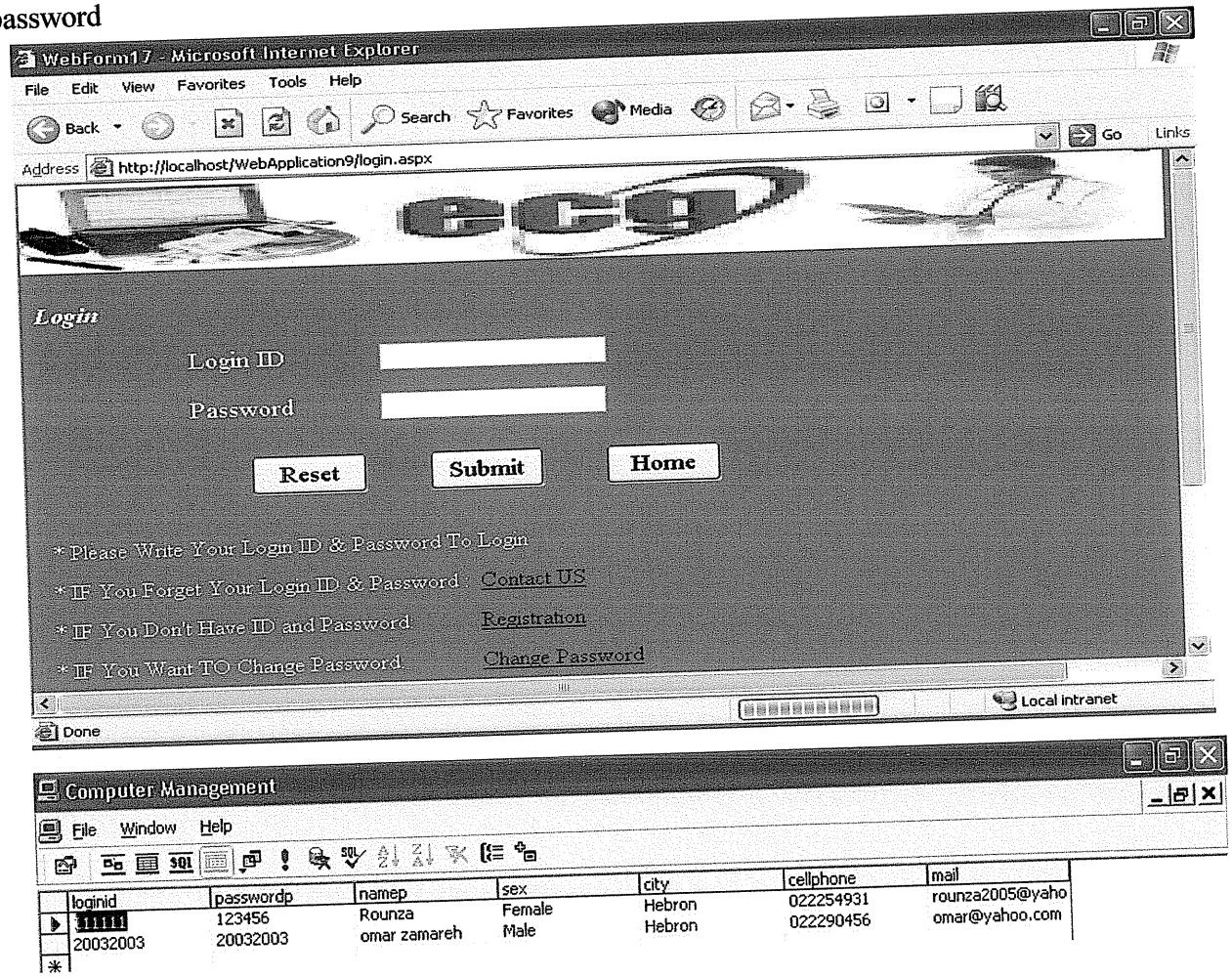


Figure 6.9: Login before testing

Login after testing

After enter valid login ID and password, the system allow you to enter to it by compare the enter login with database.

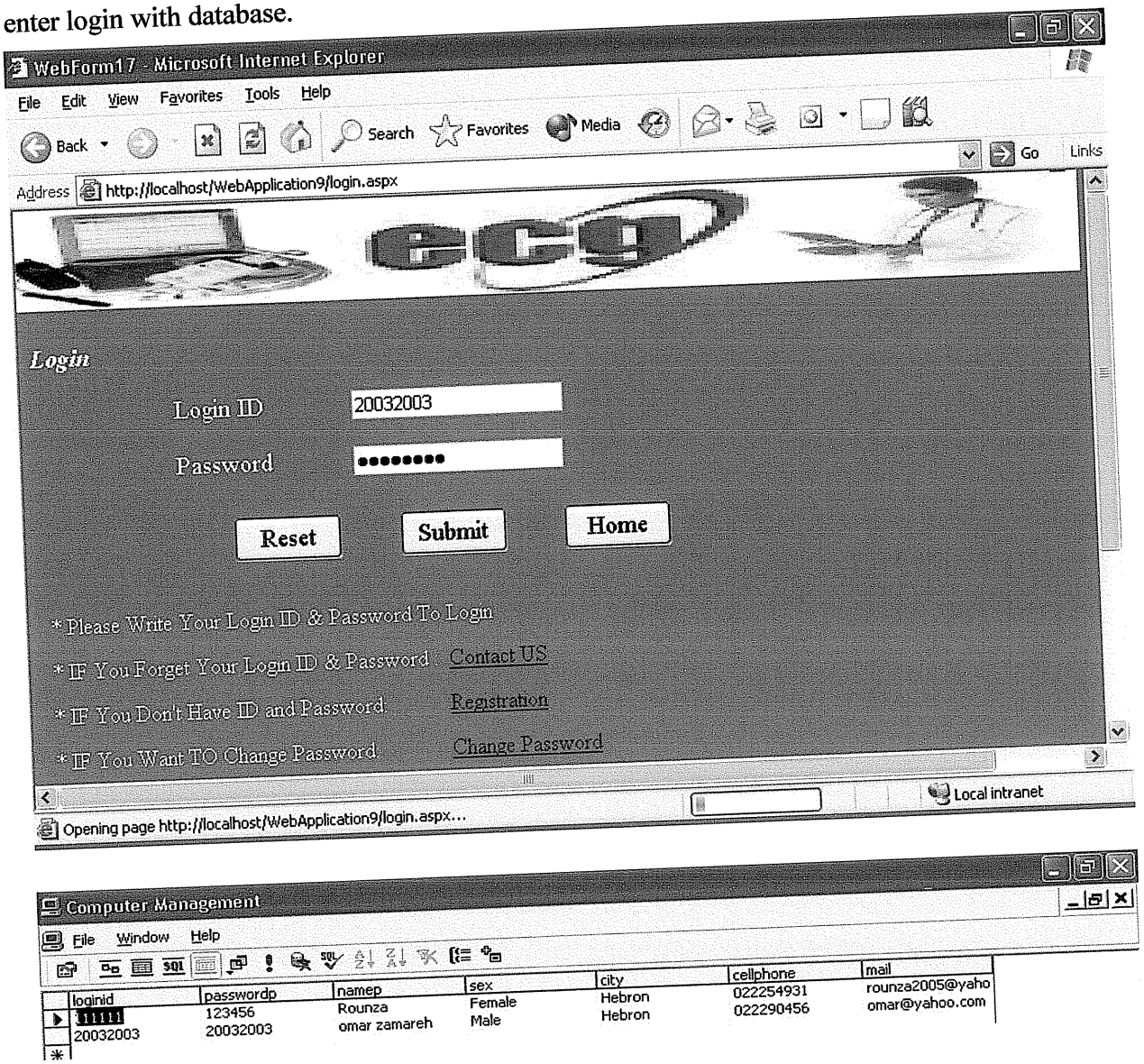


Figure 6.10: Login after testing

Diagnose before testing

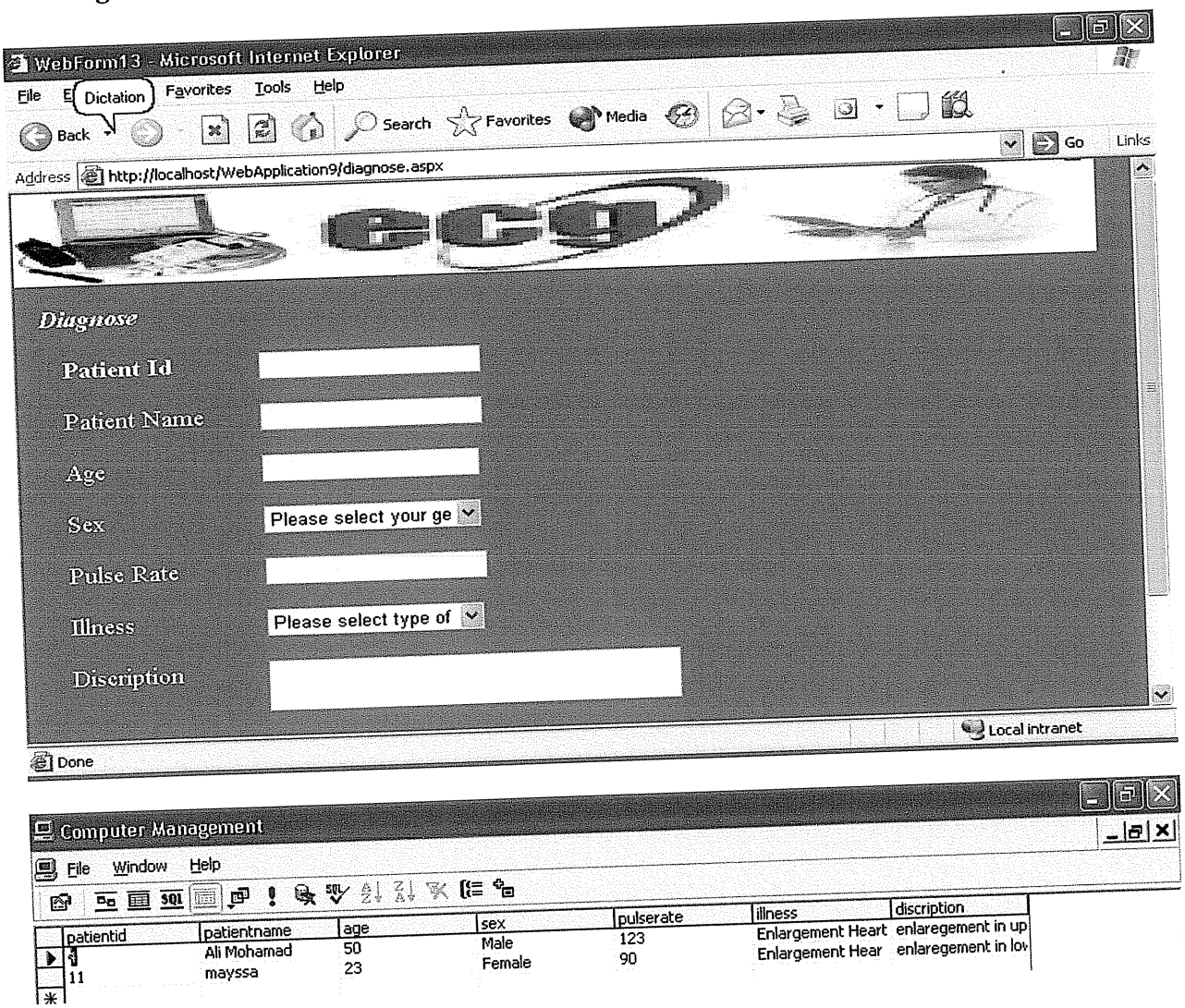


Figure 6.11: Diagnose before testing

Diagnose after testing

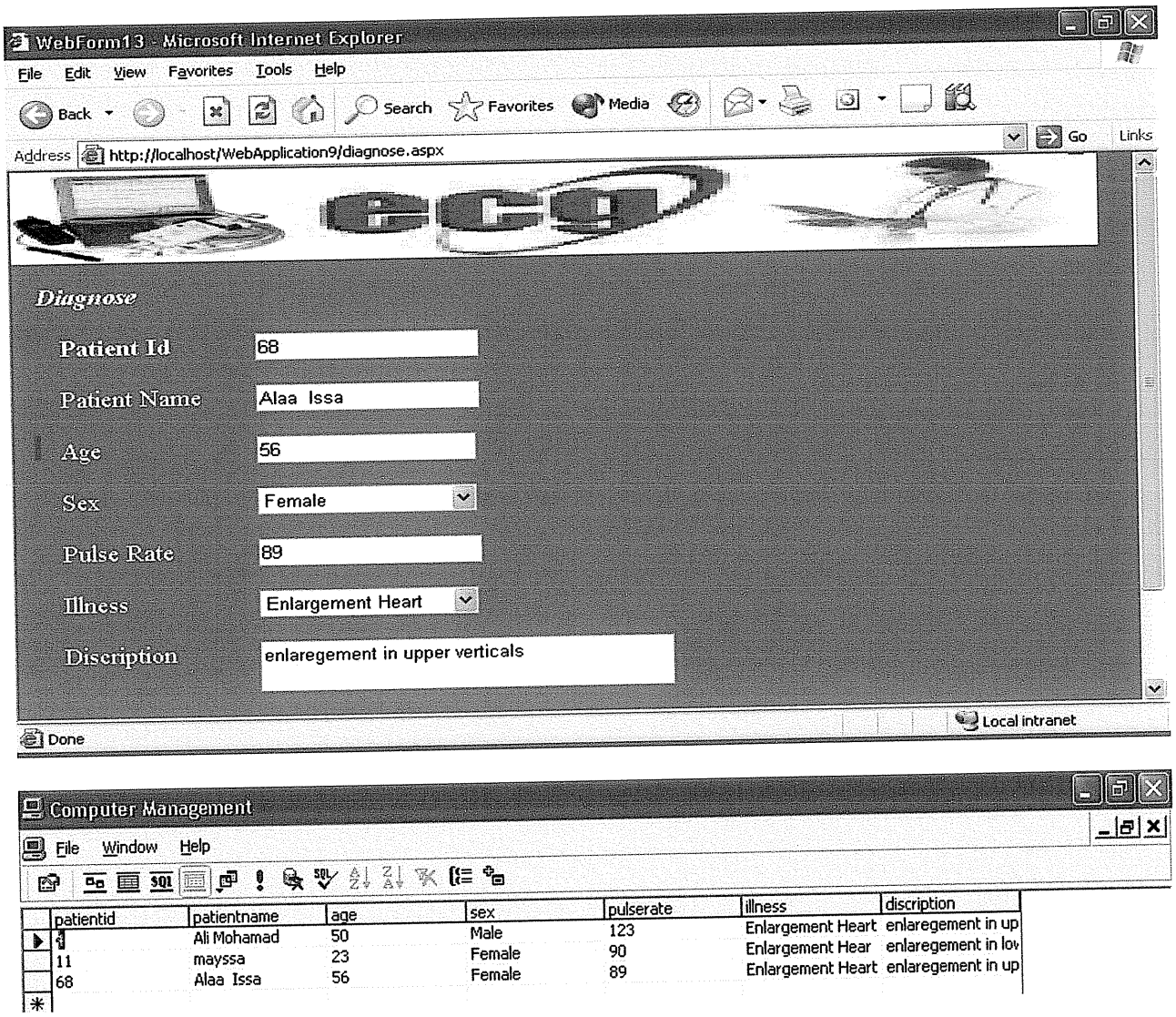


Figure 6.12: Diagnose after testing

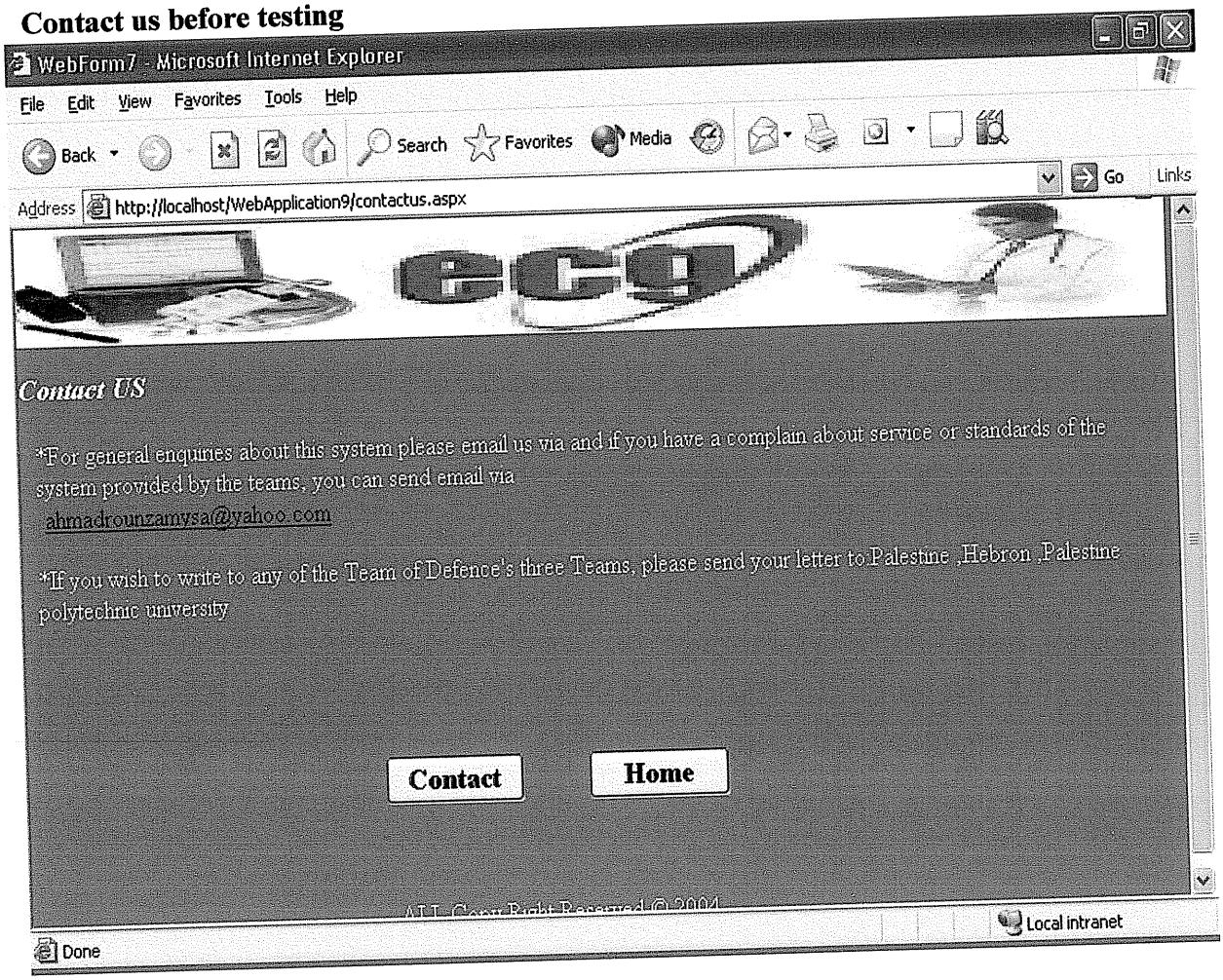


Figure 6.13: Contact us before testing

Contact us after testing

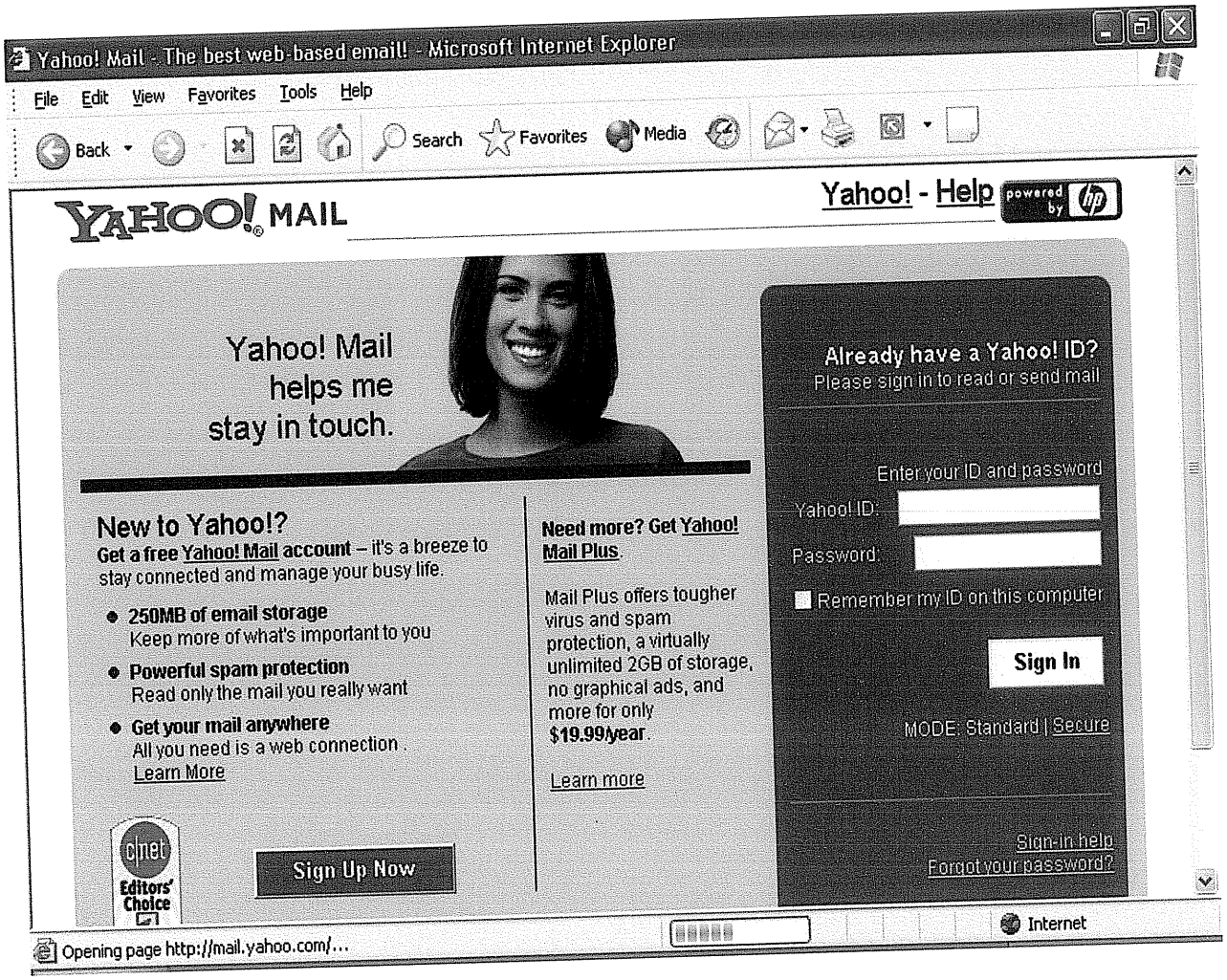


Figure 6.14: Contact us after testing

Registration before testing

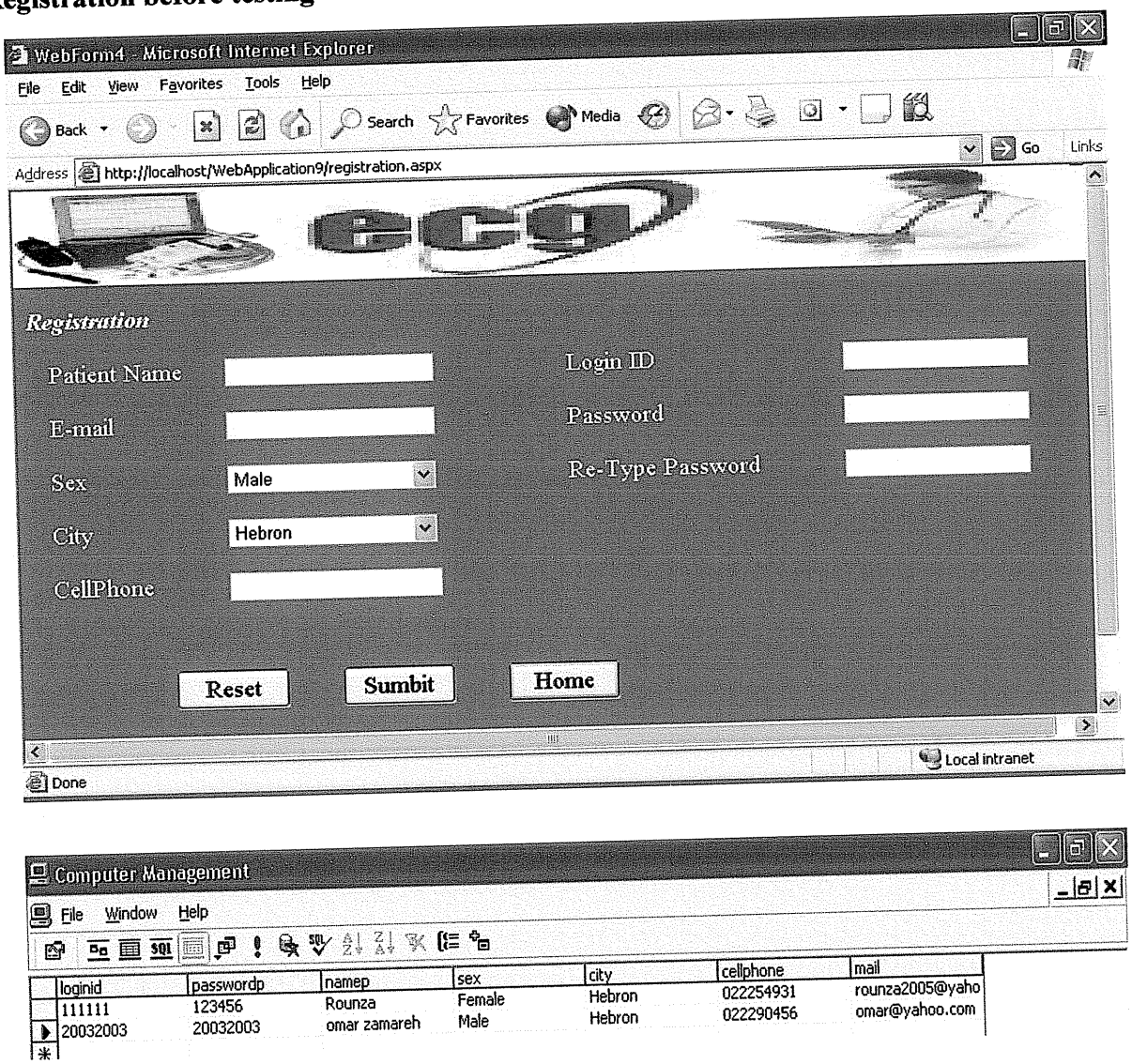
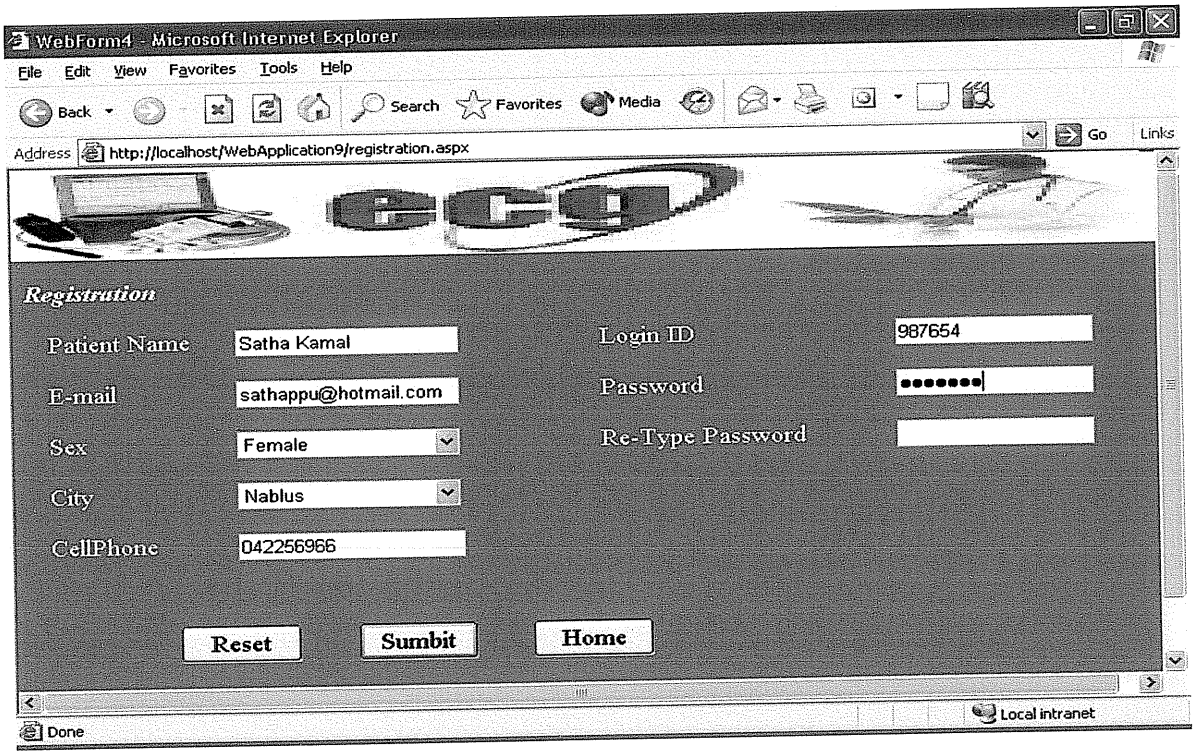


Figure 6.15: Registration before testing

Registration after testing



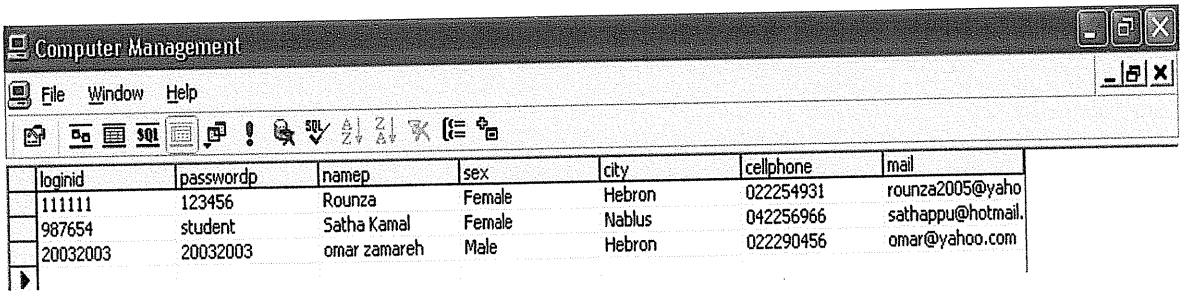


Figure 6.16: Registration after testing

Change Password before testing

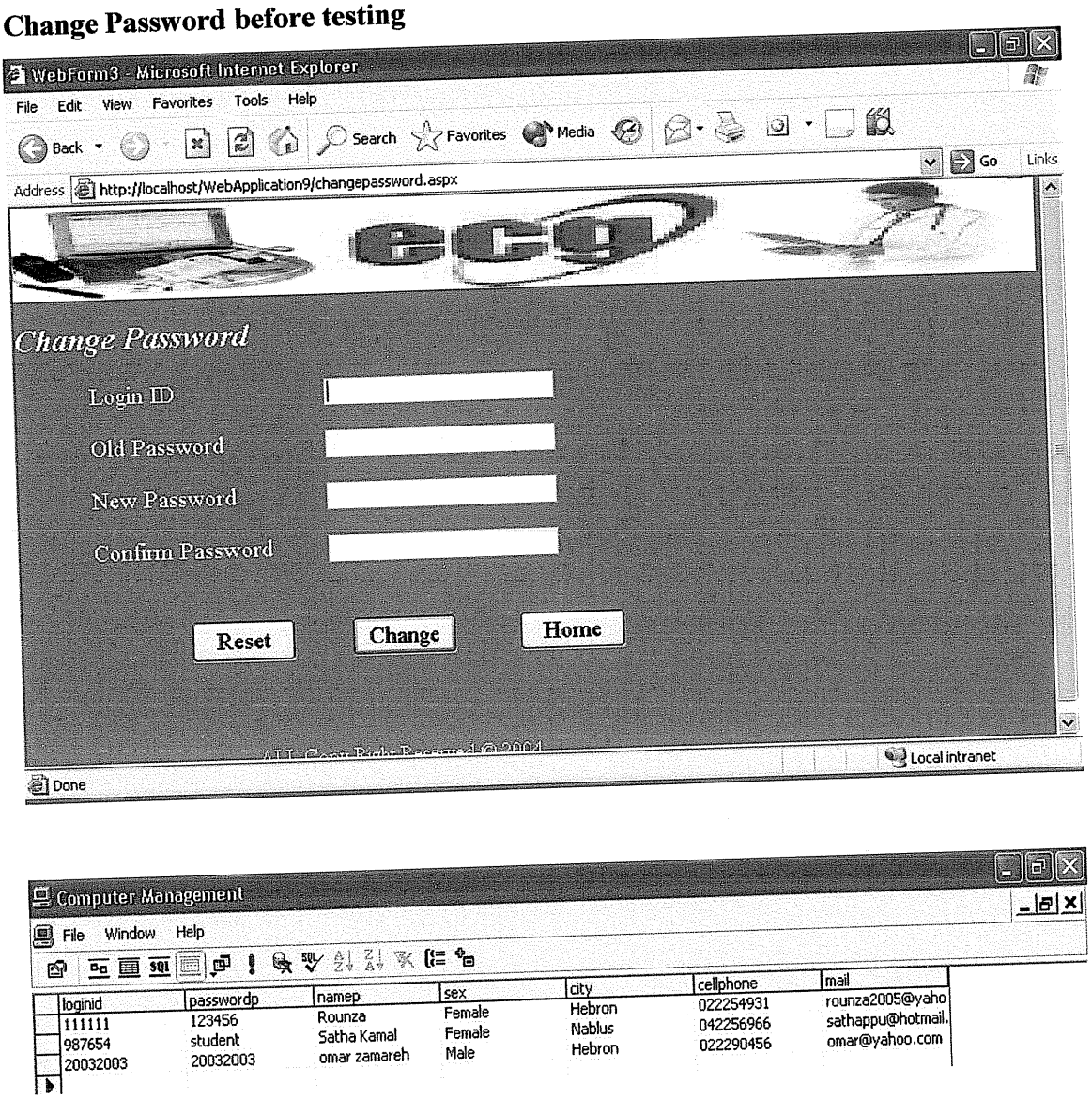
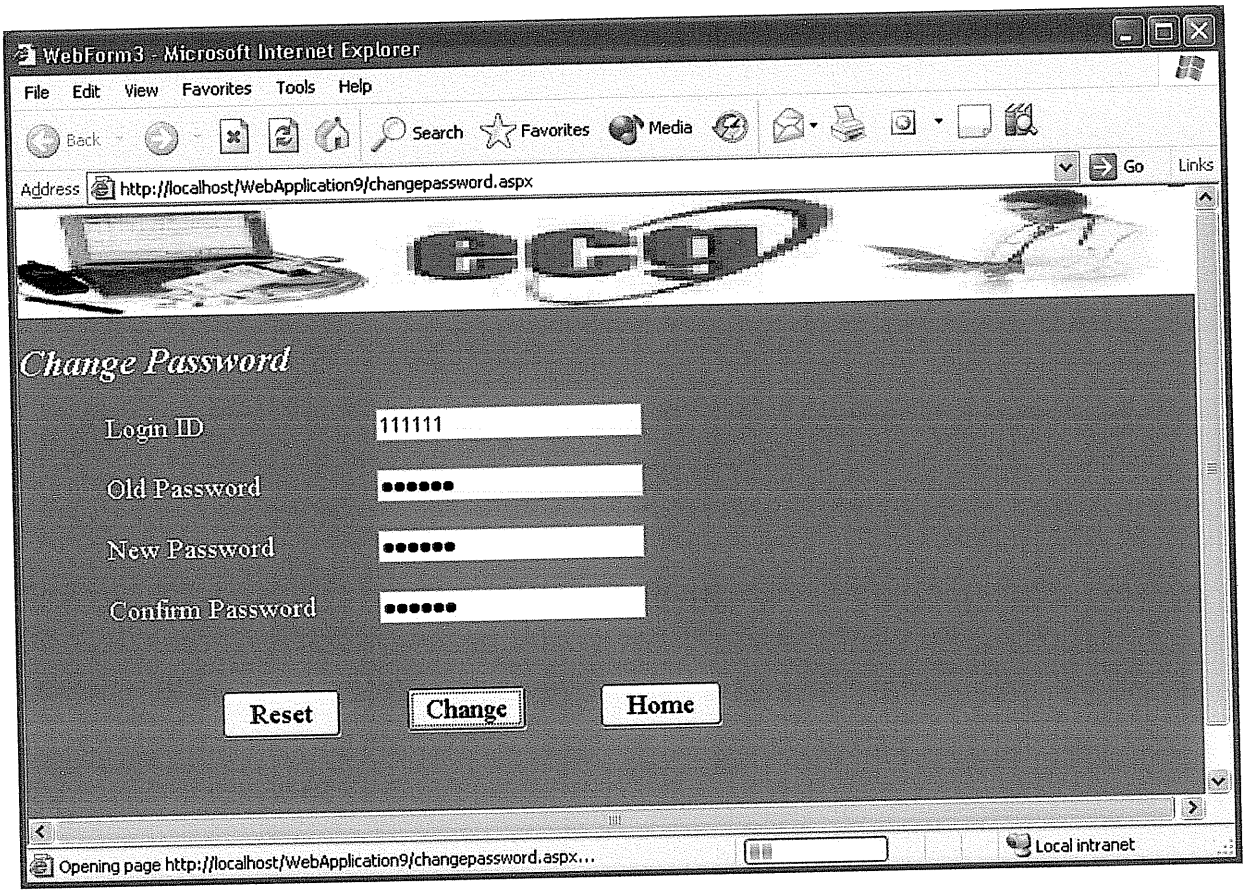
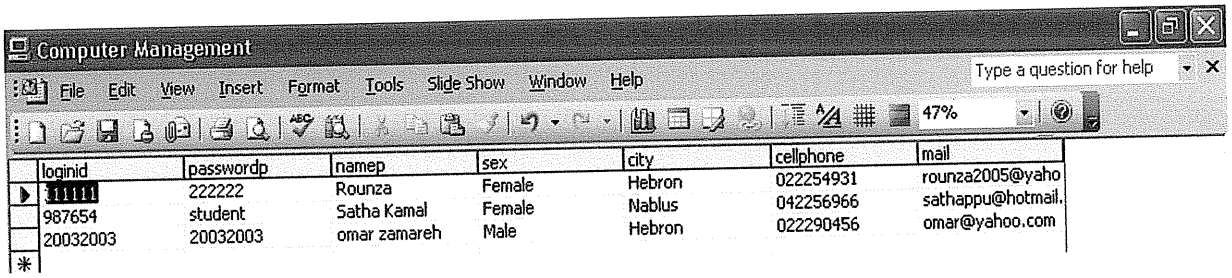


Figure 6.17: Change Password before testing

Change Password after testing





loginid	passwordp	namep	sex	city	cellphone	mail
11111	222222	Rounza	Female	Hebron	022254931	rounza2005@yaho
987654	student	Satha Kamal	Female	Nablus	042256966	sathappu@hotmail.
20032003	20032003	omar zamareh	Male	Hebron	022290456	omar@yahoo.com

Figure 6.18: Change Password after testing

Send Comment before testing

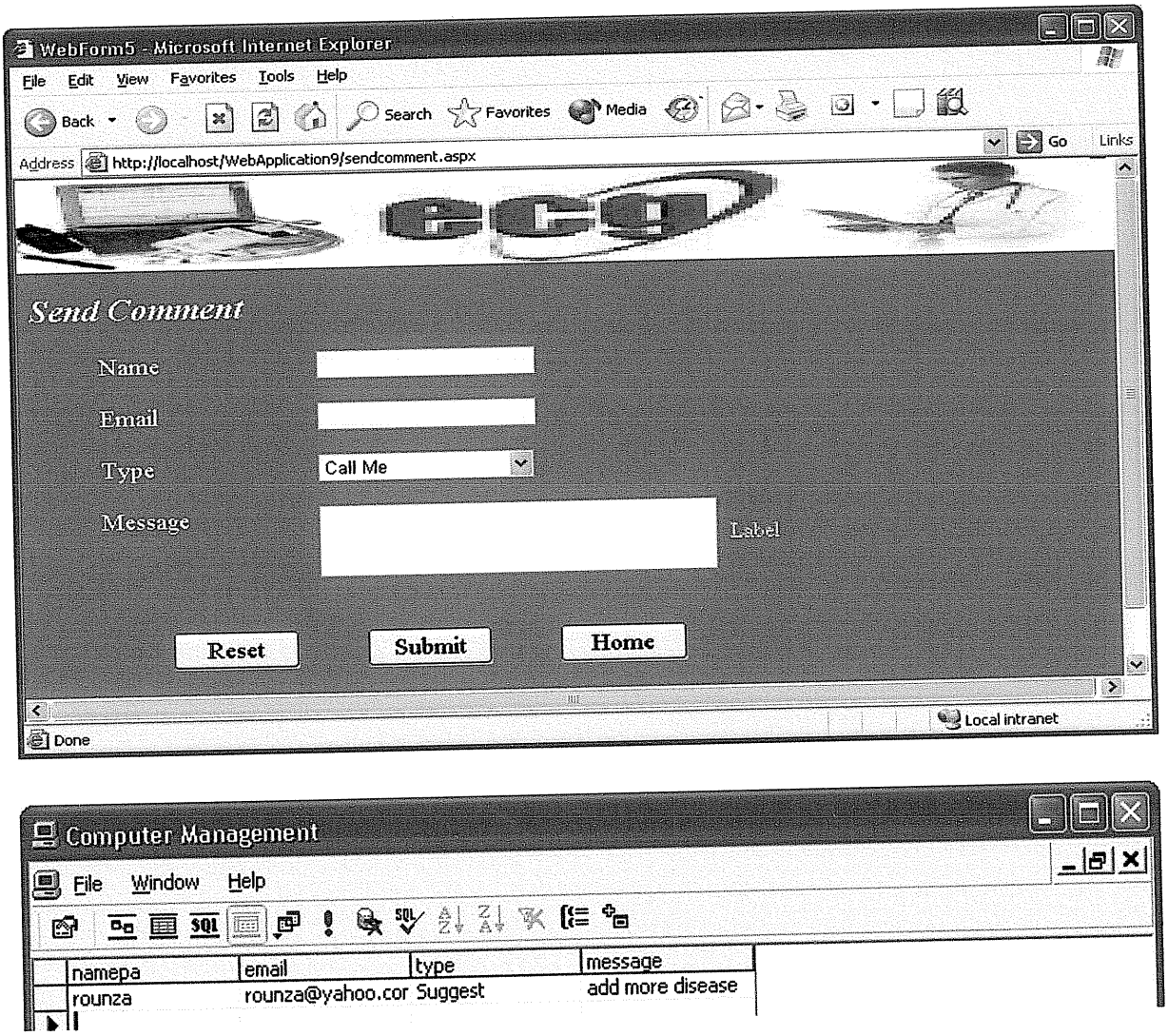


Figure 6.19: Send Comment before testing

Send Comment after testing

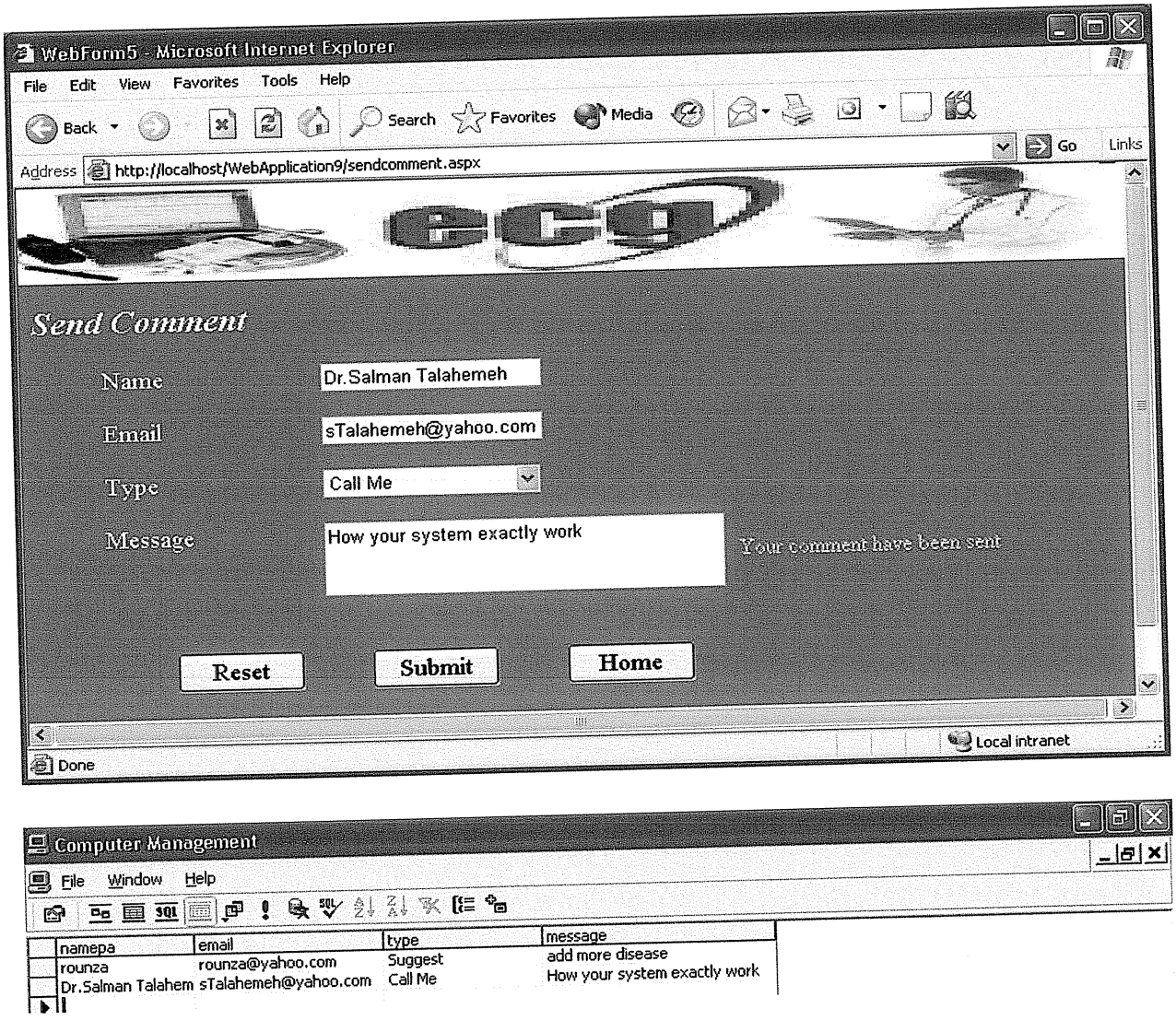


Figure 6.20: Send Comment after testing

Help before testing

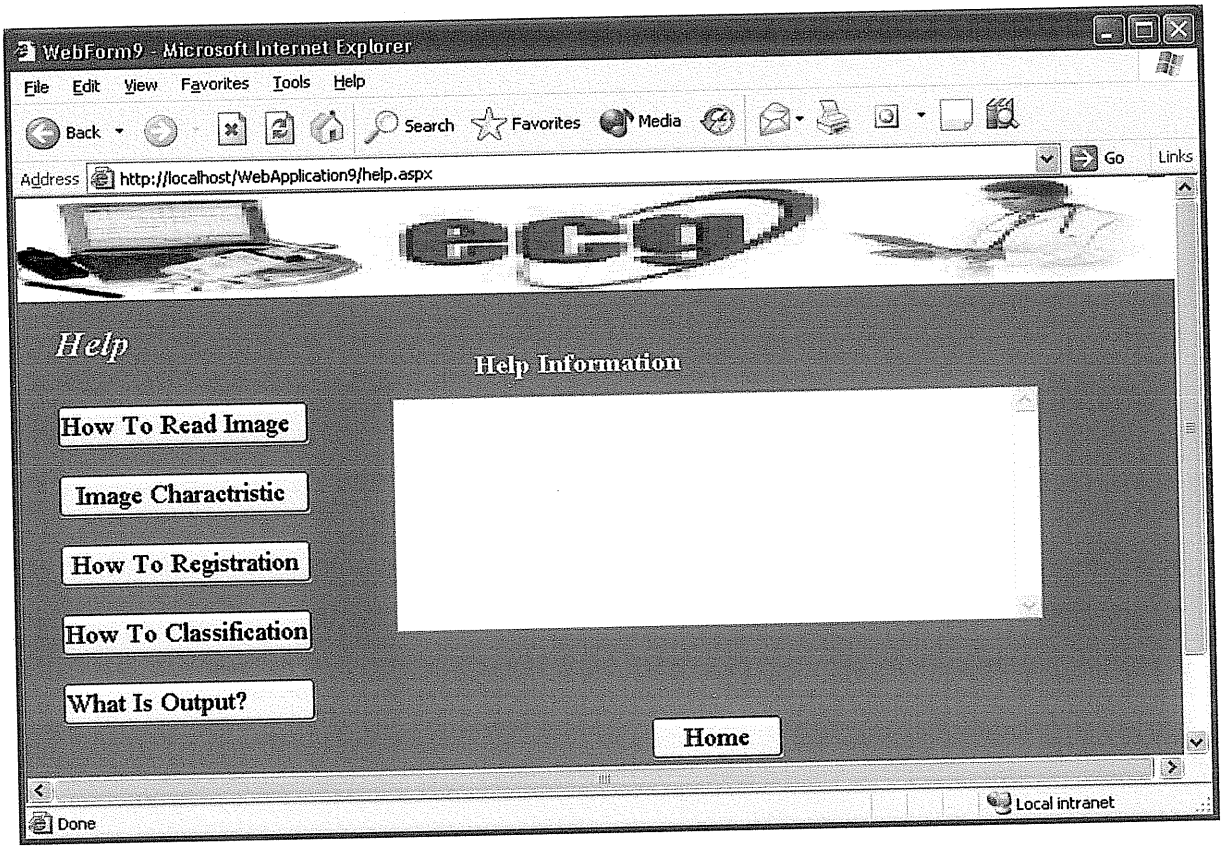


Figure 6.21: Help before testing

Help after testing

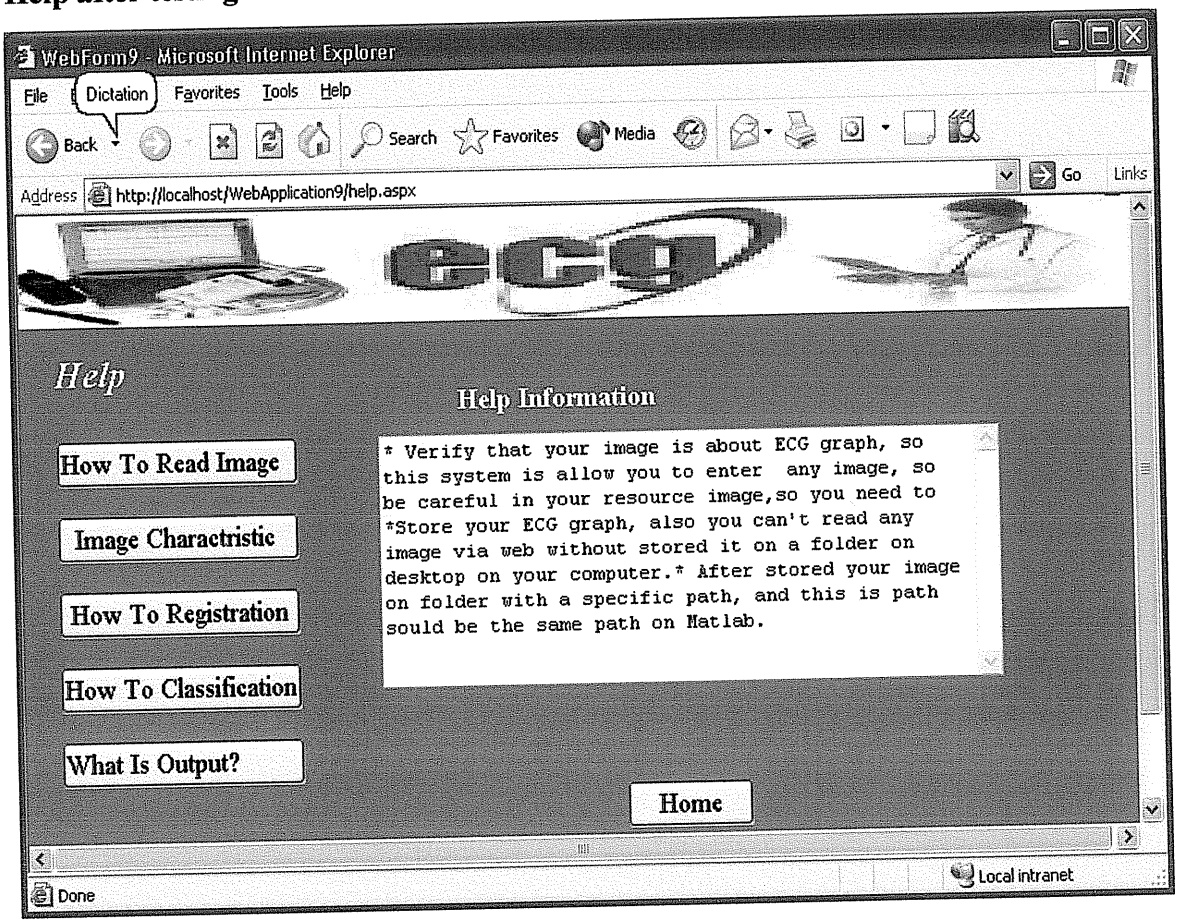


Figure 6.22: Help after testing

Register Now Test Case

Test cases	Test data							Expected output	Actual output
	Name	Login ID	Password	Re-type password	E-mail	Address	Cell-phone		
A-B-C-D-E-F-G-H-I	Ahmad	121	123456	123456	ahmadhasasneh@yahoo.com	Hebron	2560592	User profile created " accepted user"	User profile created " accepted user"
A-M-N	Ahmad	?22	123456	123456	ahmadhasasneh@yahoo.com	Hebron	2560592	Invalid input format	Invalid input format
A-B-C-L-N	Rounza	123	654321	654321	Engineer@yahoo.com	Hebron	2219499	Password confirmation does not match	Password confirmation does not match
A-B-C-D-E-F-G-H-I	Mayssa	124	987654	987654	Computer@yahoo.com	Hebron	2219555	User profile created " accepted user"	User profile created " accepted user"
A-B-C-D-E-K-N	Ahmad	121	123456	123456	ahmadhasasneh@yahoo.com	Hebron	2560592	Existing user	Existing user

TABLE 6.1: Register Now Test Cases

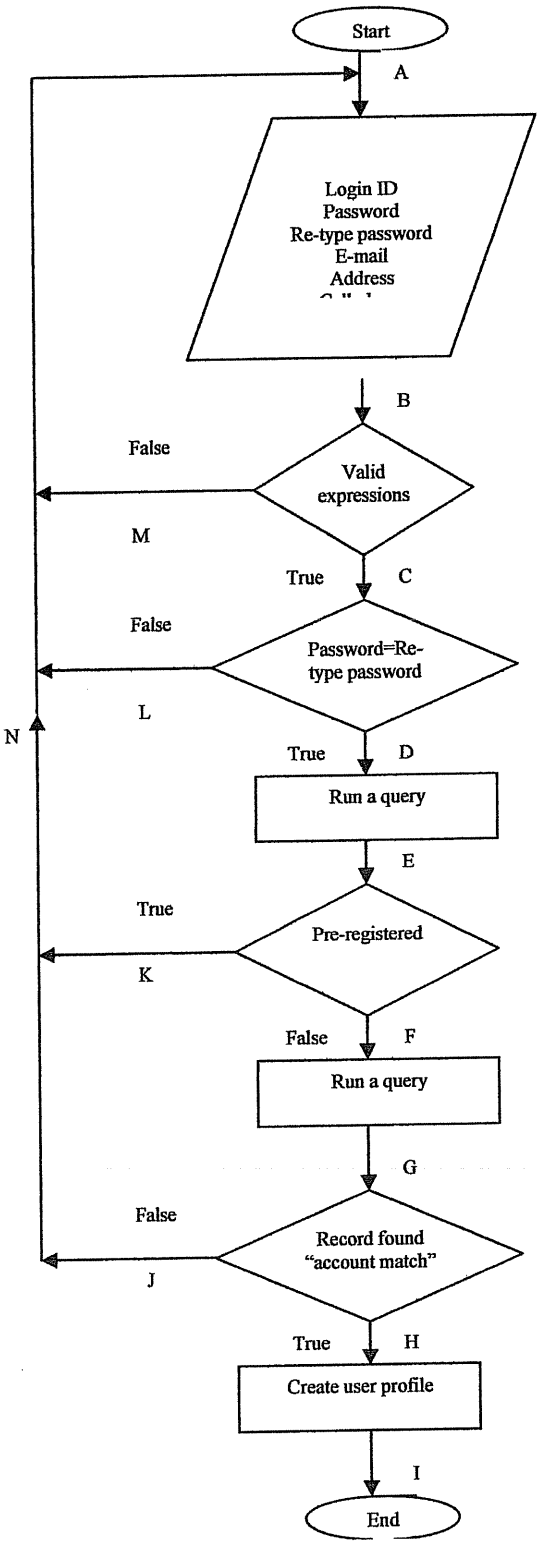


Figure 6.23: Register Now Testing Flowchart

2-The testing for "Login" module.

Testing Method: thread testing

Conformance to specifications: testing results showed that the module performs as expected.

Test cases	Test data		Expected output	Actual output
	Login name	password		
A-B-C-D-E-F-G	Ahmad	123456	User desktop" accepted user"	User desktop" accepted user"
A-B-C-D-H-J	Ahmad	12345	Invalid username or password	Invalid username or password
A-B-I-J	Rounza	654321	invalid format	invalid format

TABLE 6. 2: Login Test Cases

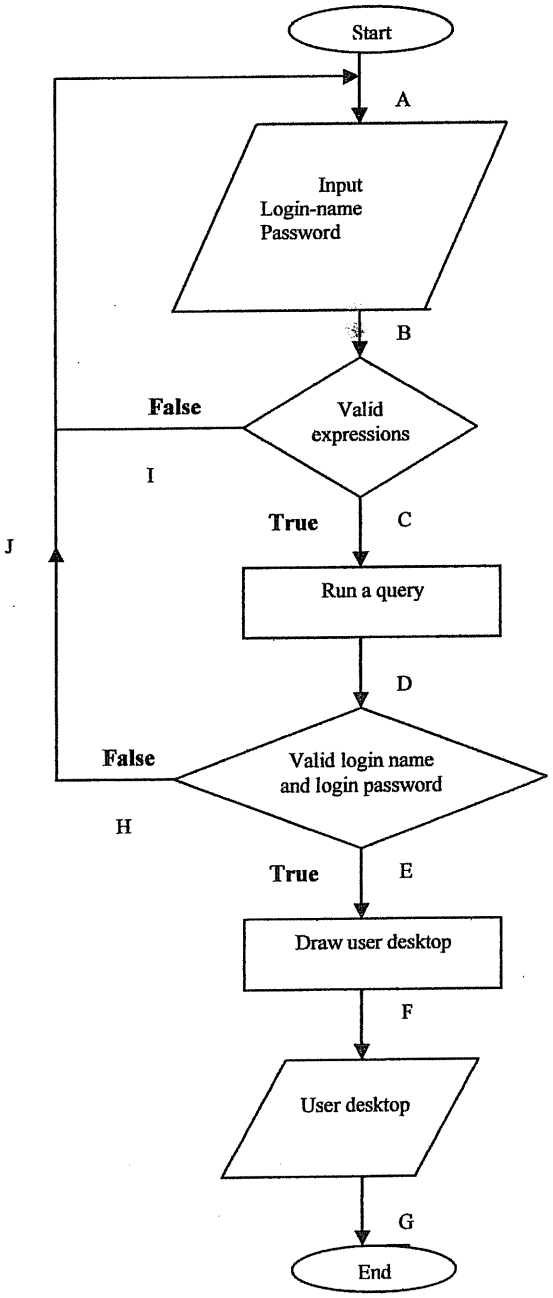


Figure 6.24: Login Testing Flowchart

3-The testing for "Change Password" module.

Testing Method: thread testing.

Conformance to specifications: testing results showed that the module performs as expected.

Test cases	Test data			Expected output	Actual output
	Old password	New password	Confirm password		
A-B-C-D-E-F-G	1234567	7654321	7654321	Set a new password	Set a new password
A-B-C-D-H-J	9876543	123456	123456	Invalid old password	Invalid old password
A-B-I-J	Jk89765	??std500	Std5000	Invalid format	Invalid format
A-B-C-D-E-K-J	577ppu	592ppu	577ppu	Password confirmation failed	Password confirmation failed

Table 6. 3: Change Password Test Cases

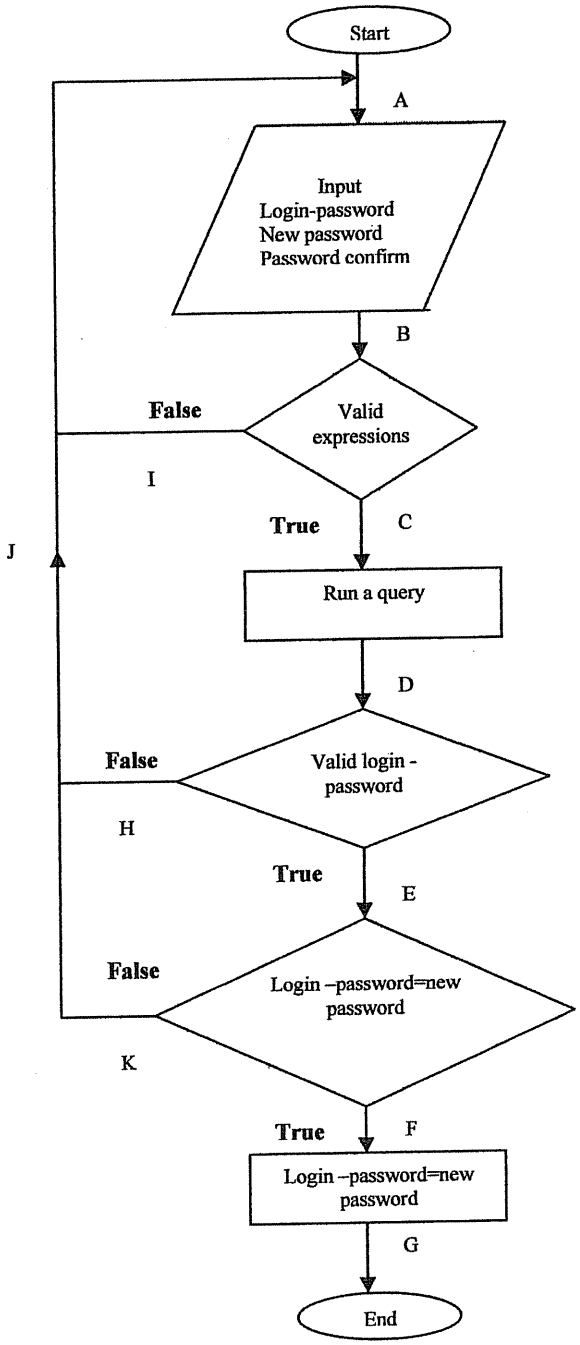


Figure 6.25: Change password flowchart

6.3 System Integration Test

Here the integration of all modules was tested to ensure that the whole system performs as expected.

So that as we were mentioned in the unit testing that the system parts were tested as unit to make sure that they works without any problem, so we were tested our system through two programming language, MATALAB and ASP.NET.

So via MATALAB, were used couple of functions in this language and were performed as expected while ASP.NET several screens were designed using ASP.NET to enable persons to enter to this system under several condition so that after the team make sure that every things were goes well ,after that the team make a join between MATALAB and SQL-server in order to send coefficients to knowledge based in SQL-server, then the team used these coefficients in the diagnose, where the diagnose was performed via ASP.NET , that mean the interface between the system as a whole is work as expected.

6.3 Testing Plan Results

The results of each function in MATALAB programming performs as expected when tested separately, also The results of each screen in windows application performs as expected when tested separately, also the whole system operate as expected when the application operated as a unit and process the administrator needs.

The forms of web application side also perform as expected when each one tested separately. The web application gives its results correctly when operated as an integrated environment and process the public and power users.

Finally, the testing of the system integration indicated that the system performs as expected.

6.2 Summary and Recommendation

The system was tested against its requirements specifications as follow:

- Each operation for MATALAB or ASP.NET was tested separately to ensure that it operates as expected.
- The integration of all objects was tested to ensure that the whole system performs as expected.
- The testing results indicate that the system works correctly and in more successfully.
- The results before and after testing show for some process for the user and in the database system.
- The system operation as a unit ensures that the whole ECG system performs as expected to be.

All system testing requirements were discussed in details with the supervisor. The supervisor gave his permission to pursue work for Maintenance.

So the result testing of the system indicated that the system performs as expected.

7

Chapter Seven

Maintenance

Chapter Seven

Maintenance

7.1 Introduction

This chapter describes how to start working with the system; in this section the Implementation Plan which contain three methods of planning (direct, pilot, and parallel planning), Establishment of Production Environment, Migration and Deployment Plan, ECG system management, Security guidelines for this system, System Updating, Error handling, and maintenance log will be explain by itself.

Also the errors and mistakes in the system requirements are discovered during the operation time of the program and execute the MATLAB programs.

In order to handle these errors and mistakes, the team with their supervisor builds the useful subroutines to discover these errors and maintain them in order to succeed the system perfectly.

This section aims to maintain any error or mistake will appear in any programs or subroutines without any changes in the results to keep the system is work correctly and introduce the services.

7.2 Implementation Plan

The Maintenance Plan describes the scope of the maintenance activity for this project. It generally contains details of: change control and the handling of change orders; configuration management of code and documentation; testing; user and design documentation; installation of new releases; mechanism for informing users of recently discovered problems.

There are three main methods of implementation planning. These methods decide the relation between the system and the literature review systems, they are:

1. **Direct Plan**

A method for building a new system or replaces the old one completely if existence.

2. **Pilot Plan**

Mixing parts of the old system with the new one to get a complete system and run as a unit.

3. **Parallel Plan**

Running the old and the new systems in parallel at the same time for a period of time, this used to test and verify the new system.

The ECG system used the direct method since it is a new system.

7.3 Establishment of Production Environment

The ECG system aims to provide a new service for ECG images diagnose to the hospital generally and to the clinical medical especially when this system is works over Internet. The following steps show how to install this system (product) as a certain environment for the client and server is to be established from any where in the world

- Operating system
- PC's Microsoft Windows server family or XP
- Microsoft office Family
- MATLAB web server
- Enterprise manager security
- Internet Information Service (IIS)

- .NET Framework
- SQL Server 2000
- Connect to the server that is connected to the Internet to host (internet explorer)

So that all these prerequisites that needed for the operating environment to help the administrators configures and operate the system on the internet.

7.4 Migration and Deployment Plan

Migration Plan

A detailed plan for migrating from the current environment to the planned environment. Include files, templates, macros, training, and support. If various versions of Office or its applications need to exist on the system for some period of time, address the coexistence plan here.

Deployment Plan

The Deployment Planning Guide provides important planning and technical product information to assist teams in charge of deploying Windows 2000 Server and Windows XP.

To put the ECG system in production, the following steps must be done:

1. Install MATLAB server on the internet.
2. Connect MATLAB server with web server.
3. Build the application (BIN directory and DLL file will be created).
4. Copy the following files to the production server (BIN directory, web forms (.aspx), user controls (.ascx), XML files (.asmx), web.config, global.asax, changes of machine.config).
5. Create a virtual directory using IIS.

6. Register your domain name with one of the team.
7. Any update for this system, the team must apply this update on the system.

ECG system management

The system provides the administrator a full control over the system.

a- Open the start page form.

b- The form gives you the ability to:

1- Login the system using login ID and password.

2- Click on the Registration to make a new ECG account.

3- Use helps control understand how the system works.

4- Change the administrator password.

5- Contact us for more information via E-mail.

6- Starts the ECG system for diagnose.

7- Generate (browse) ECG image with new number will assign to this image and stored it in specified directory.

8- The browsing image can diagnose after enter the patient ID, patient name, age, sex, pulse rate, illness, and description in the diagnose form, then you can click on the diagnose button to perform this work.

9- The ability of send comments to the team if there is any claimer.

Security guidelines

This system should be more secure in order to keep it from any changes that may effect on it, so any changes on this system must be under administrator control, in order to make this system more secure the following steps should be achieved:

1- Keep administrator name and password as secure as possible.
2- Maintain the stored password database in encrypted manner to keep it from hackers and to keep the system from any changes.
3- Use mixture of alphanumeric characters in password code to maintain security.
4- Try to use password which contains at least six characters where use more than six characters is given more secure for the system from any attack.
5- Try to Change administrator password from time to time.

System Updating

Most software systems are evolving during their life time. The spectrum of software change is wide and ranges from introducing program corrections or performance improvements of existing system components to complex changes of the overall functionality and structure of the system necessary to adapt the system to new user requirements. Traditionally, the system parts to update have to be stopped and a system shutdown for a maintenance break follows, in which the system functionality is heavily degraded or even not available at all.

The possibility of changing (adding or removing) some of the program requirements may be appeared in some cases. When that occurs, the client must call the administrator, telling him what's new.

If the required update needed within the state study of the team, the maintenance is the responsibility of the programmers' team. Otherwise, the update cost is the responsibility of the program owner (purchaser).

However when the system is update, then the infrastructure shall fulfill the following requirements:

- The loss of system functionality during the update is minimized.
- A process of the system upgrade needs minimal human intervention.
- The update capabilities of software do not significantly impact the effort software.
- The system update is reliable.

The elements of the infrastructure are described as follows:

- Dynamic Update Facility (DUF) provides basic mechanisms enabling component replacing at system runtime, like dynamic loading of components, component state storing/restoring or inter-component reference management.
- Platin Platform is a CORBA-based TINA DPE. Extended with the DUF facility, the platform forms a complete execution environment for distributed software components capable of being dynamically updated.
- Development support environment consists of a set of development tools which support the programmer to develop updateable components. Their aim is to minimize the effort of providing components with dynamic update capability.

The ECG system can update dependent on the Development support environment, where dependent on the programmers.

Error Handler

During the implementation and design the system, if an error occurs, the error message and its description will be displayed on the screen, and then the client must deal with the message in a way telling the administrator about the error.

Although during execute or writing in MATLAB functions, if there are any errors , the MATLAB will displayed error message and its description on the screen to the administrator, then the administrator must deal this errors dependent on the error that will appear.

After the vendor completes repairing the error, he should make unit testing, integrating and system testing to ensure that the system work in a correct way, without damaging or changes the other functions.

Finally, the corrected pages must be published to the web server to maintain

Software Change Request Form

Software Change Request (SCR) **Requirement #_____** **Date:_____**

Type:

( ) New Requirement ( ) System Problem ( ) Suggestion for Improvement
( ) Requirement Change ( ) User Interface Problem ( ) other:_____
( ) Design Change ( ) Documentation Correction

Description:

Please attach supporting documentation for the requested change
(Screen/report printouts, document pages affected, etc.)

Table7. 1: Software Change Request Form

7.5 Maintenance Plan

- **Maintenance Log**

Page No: _____ Log Date: ____/____/____

System Name:										
Request No	Reqmnt No	Date Submitted	Approval			Status				
			Change Approved	Change Not Approved	Hold (Future Enhancement)	Technical Evaluation Phase	Change In-Progress	Canceled	Target Date	Date Complete

Table 7. 2: Maintenance log.

INSTRUCTIONS FOR COMPLETING THE MAINTENANCE LOG

This change control log form is included as a suggested format for recording and maintaining software change request data, including changes to documentation. A Detailed Status Information form is available to record supplementary details. The log and software change requests should be maintained in the Systems Project Notebook.

FIELD	DEFINITION	
Page #:	Enter the appropriate page number of the log sheet.	
Log Date:	Enter the date control log was started.	
System Name:	Enter the name and acronym of the system to be managed.	
Request #:	Enter the unique sequential number assigned to each request on the request form (i.e., software change request form, etc.)	
Reqmnt #:	Enter the unique number of the requirement to be changed (if known) on the request form.	
Date Submitted:	Enter the date the request was submitted to the maintenance team.	
Approval:	This area is for recording request approval information obtained from the request form.	
	Change Approved:	Enter the date the request was approved.
	Change Not Approved:	Enter the date the request was disapproved.
	Hold (Future Enhancement):	Enter the date the request was placed on "Hold."
Status:	This area is for recording basic information about the status of a request.	
	Technical Evaluation Phase:	Enter the date the technical evaluation of the request commenced.
	Change In-Progress:	Enter the date work began on the request. Usually, the areas "Technical Evaluation Phase" (if applicable) and "Change Approved" should be entered prior to posting the "Change In-Progress" date. Work on most requests should not be initiated without a technical evaluation and formal approval in the request form.
	Canceled:	Enter the date the request was canceled.
	Target Date:	Enter the estimated date that the request will be completed and ready for release/implementation.
	Date Complete:	Enter the actual date the request was implemented.

Table 7. 2: Maintenance log (Cont.)

Maintenance Log - Detail Status Information

Page #: _____ **Log Date:** ___/___/___

Request #:	System Name:

Table 7. 2: Maintenance Log - Detail Status Information

7.6 Summary and recommendation

The maintenance is important for any system because it is keep to given a correct and successful results, so it is recommended to build a page for all errors that may occur, and it's recommended for the system purchaser to report the errors for the programmer, also when these errors will display at another time the programmer will deal them for a short time.

Appendix

1- Image read

```
('img,map]=imread('customerID.gif]
(i,j]=size(img]
('IMWRITE(img,map,'new.gif','bmp
```

2- verify

```
[i,j]=size(img);
if i==274
  if (i==274 && j==467)%the size of the read image should be 274*467
 em = 'your reading image has extension .gif and it is size 467*274'
      img1=img;
   em=0;%used 0 for reading image
else%if the size of the image is not 274*467
   em ='check image size and type '
end;%end second if statement
else%if there is no image to be reading
   em='please enter the image '
   em=1;%used 1 for un-read image
end;%end first if statment
```

3- Denoise

```
b=im2bw(img,map,0.4);
%disp(b);
 for i=240:274
for j=150:450
if(b(i,j)==0)
b(i,j)=1;
end;
end;
end;
for i=19:35
for j=19:35
if(b(i,j)==0)
b(i,j)=1;
end;
end;
end;
for i=19:35
for j=60:200
if(b(i,j)==0)
b(i,j)=1;
end;
```

```
end;
end;
for i=8:27
for j=200:280
if(b(i,j)==0)
b(i,j)=1;
end;
end;
end;
for i=19:35
for j=350:400
if(b(i,j)==0)
b(i,j)=1;
end;
end;
end;
for i=200:220
for j=19:35
if(b(i,j)==0)
b(i,j)=1;
end;
end;
end;
for i=130:150
for j=19:35
if(b(i,j)==0)
b(i,j)=1;
end;
end;
end;
for i=50:90
for j=19:35
if(b(i,j)==0)
b(i,j)=1;
end;
end;
end;
for i=80:100
for j=70:263
if(b(i,j)==0)
b(i,j)=1;
end;
end;
end;
for i=80:100
for j=350:369
if(b(i,j)==0)
b(i,j)=1;
end;
end;
```

```
end;
for i=120:160
for j=350:369
if(b(i,j)==0)
b(i,j)=1;
end;
end;
end;
for i=140:155
for j=250:270
if(b(i,j)==0)
b(i,j)=1;
end;
end;
end;
for i=130:160
for j=100:150
if(b(i,j)==0)
b(i,j)=1;
end;
end;
end;
imshow(b)
```

4- Filter Image

```
if em==1
'errormessage='there is no image to make smooth function
‘em=1
else
‘cp=b
‘count=0
‘('a=imread('b.bmp%
‘a=b
‘c=a
while count ~=0 loop
‘count=0
‘for i=2:19
‘for j=2:19
... if a(i,j)==0 and  a(i-1,j-1)==1 and a(i-1,j)==1
and a(i,j-1)==1 and a(i+1,j-1)==1 and a(i+1,j)==1
‘c(i,j)=1;count=count+1
... elseif a(i,j)==0 and  a(i-1,j)==1 and a(i-1,j+1)==1
and a(i,j+1)==1 and a(i+1,j+1)==1 and a(i+1,j)==1
‘c(i,j)=1;count=count+1
... elseif a(i,j)==0 and  a(i,j-1)==1 and a(i,j+1)==1
and a(i+1,j-1)==1 and a(i+1,j)==1 and a(i+1,j+1)==1
‘c(i,j)==1;count==count+1
... elseif a(i,j)==0 and  a(i-1,j-1)==1 and a(i-1,j)==1
```

```
and a(i-1,j+1)==1 and a(i,j-i)==1 and a(i,j+1)==1
‘c(i,j)=1;count=count+1
... elseif a(i,j)==1 and  a(i-1,j-1)==0 and a(i-1,j)==0
and a(i,j-1)==0 and a(i+1,j-1)==0 and a(i+1,j)==0
‘c(i,j)=0;count=count+1
... elseif a(i,j)==1 and  a(i-1,j)==0 and a(i-1,j+1)==0
and a(i,j+1)==0 and a(i+1,j+1)==0 and a(i+1,j)==0
‘c(i,j)=0;count=count+1
... elseif a(i,j)==1 and  a(i,j-1)==0 and a(i,j+1)==0
and a(i+1,j-1)==0 and a(i+1,j)==0 and a(i+1,j+1)==0
‘c(i,j)=0;count=count+1
... elseif a(i,j)==1 and  a(i-1,j-1)==0 and a(i-1,j)==0
and a(i-1,j+1)==0 and a(i,j-i)==0 and a(i,j+1)==0
‘c(i,j)=0;count=count+1
‘end
end %for j
end  % for i
‘a=c
if count >0
‘(disp(count
‘end

end;%while
‘cp=c
‘(imshow(cp
‘return
‘end
```

5- Split Image

```
if em==1
if there is no image%
'errormessage='please enter your image to perform the spliting function
‘em=1

else
‘(x1=b(15:76,8:122
‘(x2=b(15:76,123:237
‘(x3=b(15:76,238:352
‘(x4=b(15:76,353:467
‘(x5=b(77:136,8:122
‘(x6=b(77:136,123:237
‘(x7=b(77:136,238:352
‘(x8=b(77:136,353:467
‘(x9=b(137:196,8:122
‘(x10=b(137:196,123:237
‘(x11=b(137:196,238:352
‘(x12=b(137:196,353:467
```

```
all previouse commands are used to split the image into 12 charts each %
chart has terminate which were appeared in the commands%
**********************************************************%
*****

(subplot(3,4,1);imshow(x1
(subplot(3,4,2);imshow(x2
(subplot(3,4,3);imshow(x3
(subplot(3,4,4);imshow(x4
(subplot(3,4,5);imshow(x5
(subplot(3,4,6);imshow(x6
(subplot(3,4,7);imshow(x7
(subplot(3,4,8);imshow(x8
(subplot(3,4,9);imshow(x9
(subplot(3,4,10);imshow(x10
(subplot(3,4,11);imshow(x11
(subplot(3,4,12);imshow(x12
these commands are used display the 12-charts in one pakage%
'end
```

6- Convert

```
if em==1
'errormessage='there is no image to make conversion
'em=1
else
'(D=size(x1
(for j=1:D(2
(for i=1:D(1
if x1(i,j)== 0
'r1=100-i
'end
'end
'y1(j)=r1%
'end
(subplot(3,4,1);plot(y1%

'(D=size(x1
(for j=1:D(2
(for i=1:D(1
if x1(i,j)== 0
'r1=100-i
'end
'end
'y1(j)=r1
'end
(subplot(3,4,1);plot(y1

'(D=size(x2
(for j=1:D(2
```

```
(for i=1:D(1
if x2(i,j)== 0
‘r2=100-i
‘end
‘end
‘y2(j)=r2
‘end
(subplot(3,4,2);plot(y2

‘(D=size(x3
(for j=1:D(2
(for i=1:D(1
if x3(i,j)== 0
‘r3=100-i
‘end
‘end
‘y3(j)=r3
‘end
(subplot(3,4,3);plot(y3

‘(D=size(x4
(for j=1:D(2
(for i=1:D(1
if x4(i,j)== 0
‘r4=100-i
‘end
‘end
‘y4(j)=r4
‘end
(subplot(3,4,4);plot(y4

‘(D=size(x5
(for j=1:D(2
(for i=1:D(1
if x5(i,j)== 0
‘r5=100-i
‘end
‘end
‘y5(j)=r5%
‘end
(subplot(3,4,5);plot(y5%

‘(D=size(x6);D=size(x5
(for j=1:D(2
(for i=1:D(1
if x5(i,j)== 0
‘r5=100-i
‘end
‘end
‘y5(j)=r5
```

```
‘end
(subplot(3,4,5);plot(y5
(for j=1:D(2
(for i=1:D(1
if x6(i,j)== 0
‘r6=100-i
‘end
‘end
‘y6(j)=r6
‘end
(subplot(3,4,6);plot(y6

‘(D=size(x7
(for j=1:D(2
(for i=1:D(1
if x7(i,j)== 0
‘r7=100-i
‘end
‘end
‘y7(j)=r7
‘end
(subplot(3,4,7);plot(y7



‘(D=size(x9
(for j=1:D(2
(for i=1:D(1
if x9(i,j)== 0
‘r9=100-i
‘end
‘end
‘y9(j)=r9%
‘end
(subplot(3,4,9);plot(y9%


‘(D=size(x9
(for j=1:D(2
(for i=1:D(1
if x9(i,j)== 0
‘r9=100-i
‘end
‘end
‘y9(j)=r9
‘end
(subplot(3,4,9);plot(y9

‘(D=size(x10
```

```
(for j=1:D(2
(for i=1:D(1
if x10(i,j)== 0
‘r10=100-i
‘end
‘end
‘y10(j)=r10
‘end
(subplot(3,4,10);plot(y10

‘(D=size(x11
(for j=1:D(2
(for i=1:D(1
if x11(i,j)== 0
‘r11=100-i
‘end
‘end
‘y11(j)=r11
‘end
(subplot(3,4,11);plot(y11

‘(D=size(x12
(for j=1:D(2
(for i=1:D(1
if x12(i,j)== 0
‘r12=100-i
‘end
‘end
‘y12(j)=r12
‘end
(subplot(3,4,12);plot(y12
‘end


‘(D=size(x8
‘(D(1
‘(D(2
(for j=1:D(2
(for i=1:D(1
if x8(i,j)== 0
‘r8=D(1)-i
‘end
‘end
y8(j)=r8%
‘end
(subplot(3,4,8);plot(y8%

‘(D=size(x8
‘(D(1
‘(D(2
```

```
(for j=1:D(2
(for i=1:D(1
if x8(i,j)== 0
ǂr8=D(1)-i
ǂend
ǂend
ǂy8(j)=r8
ǂend
(subplot(3,4,8);plot(y8
```

7- wavelet

```
ǂs = y1
ǂ(l_s = length(s
ǂ('cA1,cD1] = dwt(s,'db1]
ǂ(disp(cA1%
ǂ(subplot(3,4,1);plot(cA1

ǂs = y2
ǂ(l_s = length(s
ǂ('cA2,cD2] = dwt(s,'db1]
ǂ(disp(cA2%
ǂ(subplot(3,4,2);plot(cA2

ǂs = y3
ǂ(l_s = length(s
ǂ('cA3,cD3] = dwt(s,'db1]
ǂ(disp(cA2%
ǂ(subplot(3,4,3);plot(cA3

ǂs = y4
ǂ(l_s = length(s
ǂ('cA4,cD4] = dwt(s,'db1]
ǂ(disp(cA4%
ǂ(subplot(3,4,4);plot(cA4

ǂs = y5
ǂ(l_s = length(s
ǂ('cA5,cD5] = dwt(s,'db1]
ǂ(disp(cA5%
ǂ(subplot(3,4,5);plot(cA5

ǂs = y6
ǂ(l_s = length(s
ǂ('cA6,cD6] = dwt(s,'db1]
ǂ(disp(cA2%
ǂ(subplot(3,4,6);plot(cA6

ǂs = y7
```

```
‘(l_s = length(s
‘('cA7,cD7] = dwt(s,'db1]
‘(disp(cA7%
‘(subplot(3,4,7);plot(cA7

‘s = y8
‘(l_s = length(s
‘('cA8,cD8] = dwt(s,'db1]
‘(disp(cA8%
‘(subplot(3,4,8);plot(cA8

‘s = y9
‘(l_s = length(s
‘('cA9,cD9] = dwt(s,'db1]
‘(disp(cA9%
‘(subplot(3,4,9);plot(cA9

‘s = y10
‘(l_s = length(s
‘('cA10,cD10] = dwt(s,'db1]
‘(disp(cA10%
‘(subplot(3,4,10);plot(cA10

‘s = y11
‘(l_s = length(s
‘('cA11,cD11] = dwt(s,'db1]
‘(disp(cA11%
‘(subplot(3,4,11);plot(cA11

‘s = y12
‘(l_s = length(s
‘('cA12,cD12] = dwt(s,'db1]
‘(disp(cA12%
‘(subplot(3,4,12);plot(cA12
```

8- connect

```
(logintimeout(5
(" ‘" ‘'conn = database('final
(ping(conn%
('a = exec(conn, 'select max(chartid) from w1
('setdbprefs('DataReturnFormat','numeric
(a = fetch(a, 1
maxindex = a.Data

(close(a
‘maxindex=maxindex+1
```

```
{'col={'chartid','sid','cid','coefficient
for i=1:58
‘{(data={maxindex,1,i,cA1(i
‘(insert(conn,'w1',col,data
‘end

**********************************%
("‘"‘'conn=da5tabase('final%
{'col={'chartid','sid','cid','coefficient
for i=1:58
{(data={maxindex,2,i,cA2(i
(insert(conn,'w2',col,data
‘end


**********************************%
("‘"‘'conn=database('final%
{'col={'chartid','sid','Cid','coefficient
for i=1:58
{(data={maxindex,3,i,cA3(i
(insert(conn,'w3',col,data
‘end


**********************************%
("‘"‘'conn=database('final%
{'col={'chartid','sid','cid','coefficient
for i=1:58
{(data={maxindex,4,i,cA4(i
(insert(conn,'w4',col,data
‘end


**********************************%
("‘"‘'conn=database('final%
{'col={'chartid','sid','cid','coefficient
for i=1:58
{(data={maxindex,5,i,cA5(i
(insert(conn,'w5',col,data
‘end


**********************************%
("‘"‘'conn=database('final%
{'col={'chartid','sid','cid','coefficient
for i=1:58
{(data={maxindex,6,i,cA6(i
(insert(conn,'w6',col,data
‘end
```

```
**********************************%
("‘"‘'conn=database('final%
{'col={'chartid','sid','cid','coefficient
for i=1:58
{(data={maxindex,7,i,cA7(i
(insert(conn,'w7',col,data
‘end

**********************************%
("‘"‘'conn=database('final%
{'col={'chartid','sid','cid','coefficient
for i=1:58
{(data={maxindex,8,i,cA8(i
(insert(conn,'w8',col,data
‘end

**********************************%
("‘"‘'conn=database('final%
{'col={'chartid','sid','cid','coefficient
for i=1:58
{(data={maxindex,9,i,cA9(i
(insert(conn,'w9',col,data
‘end

**********************************%
("‘"‘'conn=database('final%
{'col={'chartid','sid','cid','coefficient
for i=1:58
{(data={maxindex,10,i,cA10(i
(insert(conn,'w10',col,data
‘end

**********************************%
("‘"‘'conn=database('final%
{'col={'chartid','sid','cid','coefficient
for i=1:58
‘{(data={maxindex,11,i,cA11(i
‘(insert(conn,'w11',col,data
‘end

**********************************%
‘("‘"‘'conn=database('final%
{'col={'chartid','sid','cid','coefficient
for i=1:58
{(data={maxindex,12,i,cA12(i
(insert(conn,'w12',col,data
‘end
```

MATLAB SERVER WORK

1- Read image

```
(function retstr = imageread1(instruct, outfile
ʕ('')retstr = char
ʕ(cd(instruct.mldir




ʕ('img,map]=imread('first.gif]
ʕ(i,j]=size(img]
('IMWRITE(img,map,'displayimage1.gif','bmp
********** *******%
********** **********%


ʕ'outstruct.my_output_variable_1='Your image read
ʕ('templatefile = which('testrounza.htm
(if (nargin == 1
ʕ(retstr = htmlrep(outstruct, templatefile
(elseif (nargin == 2
ʕ(retstr = htmlrep(outstruct, templatefile, outfile
end
```

2- Verify

```
(function retstr = verify(instruct, outfile
ʕ('')retstr = char
ʕ(cd(instruct.mldir




ʕ(i,j]=size(img]%
if i==274%
if (i==274 && j==467)%the size of the read image should be 274*467    %
outstruct.my_output_variable_1 = 'your reading image has extension .gif and it is  %
'size 467*274
ʕimg1=img  %
em=0;%used 0 for reading image%
else%if the size of the image is not 274*467%
'outstruct.my_output_variable_2 ='check image size%
end;%end second if statement%
else%if there is no image to be reading%
' outstruct.my_output_variable_3='please enter the image %
```

```
em=1;%used 1 for un-read image%
end;%end first if statment%
outstruct.my_output_variable_2 ='your reading image has extension .gif and it is
'size 467*274
outstruct.my_output_variable_1='your reading image has extension .gif and it is %
' 'size 467*274



('templatefile = which('testrounza.htm
(if (nargin == 1
(retstr = htmlrep(outstruct, templatefile
(elseif (nargin == 2
(retstr = htmlrep(outstruct, templatefile, outfile
end
```

3- Denoise

```
(function retstr =denoise2(instruct, outfile
('')retstr = char
(cd(instruct.mldir


('img,map]=imread('first.gif]

(i,j]=size(img]

(if(i==274 && j==467%
(b=im2bw(img,map,0.4
(disp(b%
for i=240:274
for j=150:450
(if(b(i,j)==0
b(i,j)=1
end
end
end
for i=19:35
for j=19:35
(if(b(i,j)==0
b(i,j)=1
end
end
end
for i=19:35
for j=60:200
(if(b(i,j)==0
b(i,j)=1
end
```

```
'end
'end
for i=8:27
for j=200:280
(if(b(i,j)==0
'b(i,j)=1
'end
'end
'end
for i=19:35
for j=350:400
(if(b(i,j)==0
'b(i,j)=1
'end
'end
'end
for i=200:220
for j=19:35
(if(b(i,j)==0
'b(i,j)=1
'end
'end
'end
for i=130:150
for j=19:35
(if(b(i,j)==0
'b(i,j)=1
'end
'end
'end
for i=50:90
for j=19:35
(if(b(i,j)==0
'b(i,j)=1
'end
'end
'end
for i=80:100
for j=70:263
(if(b(i,j)==0
'b(i,j)=1
'end
'end
'end
for i=80:100
for j=350:369
(if(b(i,j)==0
'b(i,j)=1
'end
'end
```

```
‘end
for i=120:160
for j=350:369
(if(b(i,j)==0
‘b(i,j)=1
‘end
‘end
‘end
for i=140:155
for j=250:270
(if(b(i,j)==0
‘b(i,j)=1
‘end
‘end
‘end
for i=130:160
for j=100:150
(if(b(i,j)==0
‘b(i,j)=1
‘end
‘end
‘end
(imshow(b
('IMWRITE(b,'denoise image.gif','bmp
‘end

‘'outstruct.my_output_variable_3='pure image
‘('templatefile = which('testrounza.htm
(if (nargin == 1
‘(retstr = htmlrep(outstruct, templatefile
(elseif (nargin == 2
‘(retstr = htmlrep(outstruct, templatefile, outfile
end
```

4- Filter image

```
(function retstr =filterimage(instruct, outfile
‘(")retstr = char
‘(cd(instruct.mldir



if em==1%
'errormessage='there is no image to make smooth function%
‘em=1%
else%
‘cp=img1%
‘count=0%
‘('a=imread('b.bmp%
```

```
‘('img,map]=imread('first.gif]
‘('a=imread('first.gif%
‘a=img%
‘c=a%

‘cp=img
‘count=0
‘('a=imread('first.gif
‘a=img
‘c=a


while count ~=0 loop
‘count=0
‘for i=2:19
‘for j=2:19
... if a(i,j)==0 and  a(i-1,j-1)==1 and a(i-1,j)==1
and a(i,j-1)==1 and a(i+1,j-1)==1 and a(i+1,j)==1
‘c(i,j)=1;count=count+1
... elseif a(i,j)==0 and  a(i-1,j)==1 and a(i-1,j+1)==1
and a(i,j+1)==1 and a(i+1,j+1)==1 and a(i+1,j)==1
‘c(i,j)=1;count=count+1
... elseif a(i,j)==0 and  a(i,j-1)==1 and a(i,j+1)==1
and a(i+1,j-1)==1 and a(i+1,j)==1 and a(i+1,j+1)==1
‘c(i,j)==1;count==count+1
... elseif a(i,j)==0 and  a(i-1,j-1)==1 and a(i-1,j)==1
and a(i-1,j+1)==1 and a(i,j-i)==1 and a(i,j+1)==1
‘c(i,j)=1;count=count+1
8**********************************************%
... elseif a(i,j)==1 and  a(i-1,j-1)==0 and a(i-1,j)==0
and a(i,j-1)==0 and a(i+1,j-1)==0 and a(i+1,j)==0
‘c(i,j)=0;count=count+1
... elseif a(i,j)==1 and  a(i-1,j)==0 and a(i-1,j+1)==0
and a(i,j+1)==0 and a(i+1,j+1)==0 and a(i+1,j)==0
‘c(i,j)=0;count=count+1
... elseif a(i,j)==1 and  a(i,j-1)==0 and a(i,j+1)==0
and a(i+1,j-1)==0 and a(i+1,j)==0 and a(i+1,j+1)==0
‘c(i,j)=0;count=count+1
... elseif a(i,j)==1 and  a(i-1,j-1)==0 and a(i-1,j)==0
and a(i-1,j+1)==0 and a(i,j-i)==0 and a(i,j+1)==0
‘c(i,j)=0;count=count+1
‘end
end %for j
end  % for i
‘a=c
if count >0
‘(disp(count
‘end

end;%while
```

‘cp=c
‘return
‘end

‘'outstruct.my_output_variable_4='Your image filter
‘('templatefile = which('testrounza.htm
(if (nargin == 1
‘(retstr = htmlrep(outstruct, templatefile
(elseif (nargin == 2
‘(retstr = htmlrep(outstruct, templatefile, outfile
end

5- Split image

(function retstr = split(instruct, outfile
‘(")retstr = char
‘(cd(instruct.mldir

‘('img,map]=imread('CustomerId.gif]

‘(i,j]=size(img1] %
(if(i==274 && j==467%
‘(b=im2bw(img,map,0.4
‘(disp(b%
for i=240:274
for j=150:450
(if(b(i,j)==0
‘b(i,j)=1
‘end
‘end
‘end
for i=19:35
for j=19:35
(if(b(i,j)==0
‘b(i,j)=1
‘end
‘end
‘end
for i=19:35
for j=60:200
(if(b(i,j)==0
‘b(i,j)=1
‘end
‘end
‘end
for i=8:27
for j=200:280

```
(if(b(i,j)==0
‘b(i,j)=1
‘end
‘end
‘end
for i=19:35
for j=350:400
(if(b(i,j)==0
‘b(i,j)=1
‘end
‘end
‘end
for i=200:220
for j=19:35
(if(b(i,j)==0
‘b(i,j)=1
‘end
‘end
‘end
for i=130:150
for j=19:35
(if(b(i,j)==0
‘b(i,j)=1
‘end
‘end
‘end
for i=50:90
for j=19:35
(if(b(i,j)==0
‘b(i,j)=1
‘end
‘end
‘end
for i=80:100
for j=70:263
(if(b(i,j)==0
‘b(i,j)=1
‘end
‘end
‘end
for i=80:100
for j=350:369
(if(b(i,j)==0
‘b(i,j)=1
‘end
‘end
‘end
for i=120:160
for j=350:369
(if(b(i,j)==0
```

```
꞉b(i,j)=1
꞉end
꞉end
꞉end
for i=140:155
for j=250:270
(if(b(i,j)==0
꞉b(i,j)=1
꞉end
꞉end
꞉end
for i=130:160
for j=100:150
(if(b(i,j)==0
꞉b(i,j)=1
꞉end
꞉end
꞉end
(imshow(b
('IMWRITE(b,'denoise image.gif','bmp%


꞉end

꞉'outstruct.my_output_variable_3='pure image
꞉('templatefile = which('testrounza.htm
(if (nargin == 1
꞉(retstr = htmlrep(outstruct, templatefile
(elseif (nargin == 2
꞉(retstr = htmlrep(outstruct, templatefile, outfile
end



꞉(x1=b(15:76,8:122
꞉(x2=b(15:76,123:237
꞉(x3=b(15:76,238:352
꞉(x4=b(15:76,353:467
꞉(x5=b(77:136,8:122
꞉(x6=b(77:136,123:237
꞉(x7=b(77:136,238:352
꞉(x8=b(77:136,353:467
꞉(x9=b(137:196,8:122
꞉(x10=b(137:196,123:237
꞉(x11=b(137:196,238:352
꞉(x12=b(137:196,353:467
all previouse commands are used to split the image into 12 charts each %
chart has terminate which were appeared in the commands%
**********************************************************%
*****
```

```
(subplot(3,4,1);imshow(x1
(subplot(3,4,2);imshow(x2
(subplot(3,4,3);imshow(x3
(subplot(3,4,4);imshow(x4
(subplot(3,4,5);imshow(x5
(subplot(3,4,6);imshow(x6
(subplot(3,4,7);imshow(x7
(subplot(3,4,8);imshow(x8
(subplot(3,4,9);imshow(x9
(subplot(3,4,10);imshow(x10
(subplot(3,4,11);imshow(x11
(subplot(3,4,12);imshow(x12
these commands are used display the 12-charts in one pakage%
('IMWRITE(x12,'split1 image.gif','bmp%
('IMWRITE(x1,'image spliting1 .gif','bmp
('IMWRITE(x2,'image spliting2 .gif','bmp
('IMWRITE(x3,'image spliting3 .gif','bmp
('IMWRITE(x4,'image spliting4 .gif','bmp
('IMWRITE(x5,'image spliting5 .gif','bmp
('IMWRITE(x6,'image spliting6 .gif','bmp
('IMWRITE(x7,'image spliting7 .gif','bmp
('IMWRITE(x8,'image spliting8 .gif','bmp
('IMWRITE(x9,'image spliting9 .gif','bmp
('IMWRITE(x10,'image spliting10 .gif','bmp
('IMWRITE(x11,'image spliting11 .gif','bmp
('IMWRITE(x12,'image spliting12 .gif','bmp
```

```
'outstruct.my_output_variable_4='split image
('templatefile = which('testrounza.htm
(if (nargin == 1
(retstr = htmlrep(outstruct, templatefile
(elseif (nargin == 2
(retstr = htmlrep(outstruct, templatefile, outfile
end
```

6- Convert

```
(function retstr = convert(instruct, outfile
('')retstr = char
(cd(instruct.mldir
```

```
if em==1%
'errormessage='there is no image to make conversion   %
ٔem=1 %
else%

ٔ('img,map]=imread('CustomerId.gif]

ٔ(i,j]=size(img1] %
(if(i==274 && j==467%
ٔ(b=im2bw(img,map,0.4%


ٔ(b=im2bw(img,map,0.1
ٔ(disp(b%
ٔ(imshow(b
ٔ(x1=b(85:130,8:122
ٔ(x2=b(85:130,123:237
ٔ(x3=b(85:130,238:352
ٔ(x4=b(85:130,353:467
ٔ(x5=b(125:170,8:122
ٔ(x6=b(125:170,123:237
ٔ(x7=b(125:170,238:352
ٔ(x8=b(125:170,353:467
ٔ(x9=b(165:208,8:122
ٔ(x10=b(165:208,123:237
ٔ(x11=b(165:208,238:352
ٔ(x12=b(165:208,353:467

ٔ(D=size(x1%
(for j=1:D(2%
(for i=1:D(1%
if x1(i,j)== 0%
ٔr1=100-i   %
ٔend%
ٔend%
ٔy1(j)=r1*****************%
ٔend%
(subplot(3,4,1);plot(y1*****************%
*************** start convert%

ٔ(D=size(x1
(for j=1:D(2
(for i=1:D(1
if x1(i,j)== 0
ٔr1=100-i
ٔend
ٔend
ٔy1(j)=r1
```

```
end
(subplot(3,4,1);plot(y1


(D=size(x2
(for j=1:D(2
(for i=1:D(1
if x2(i,j)== 0
r2=100-i
end
end
y2(j)=r2
end
(subplot(3,4,2);plot(y2

(D=size(x3
(for j=1:D(2
(for i=1:D(1
if x3(i,j)== 0
r3=100-i
end
end
y3(j)=r3
end
(subplot(3,4,3);plot(y3

(D=size(x4
(for j=1:D(2
(for i=1:D(1
if x4(i,j)== 0
r4=100-i
end
end
y4(j)=r4
end
(subplot(3,4,4);plot(y4

(D=size(x5
(for j=1:D(2
(for i=1:D(1
if x5(i,j)== 0
r5=100-i
end
end
y5(j)=r5**********%
end
(subplot(3,4,5);plot(y5**********%

(D=size(x6);D=size(x5
(for j=1:D(2
```

```
(for i=1:D(1
if x5(i,j)== 0
‘r5=100-i
‘end
‘end
‘y5(j)=r5
‘end
(subplot(3,4,5);plot(y5
(for j=1:D(2
(for i=1:D(1
if x6(i,j)== 0
‘r6=100-i
‘end
‘end
‘y6(j)=r6
‘end
(subplot(3,4,6);plot(y6

‘(D=size(x7
(for j=1:D(2
(for i=1:D(1
if x7(i,j)== 0
‘r7=100-i
‘end
‘end
‘y7(j)=r7
‘end
(subplot(3,4,7);plot(y7



‘(D=size(x9
(for j=1:D(2
(for i=1:D(1
if x9(i,j)== 0
‘r9=100-i
‘end
‘end
‘y9(j)=r9%
‘end
(subplot(3,4,9);plot(y9%


‘(D=size(x9
(for j=1:D(2
(for i=1:D(1
if x9(i,j)== 0
‘r9=100-i
‘end
```

```
'end
'y9(j)=r9
'end
(subplot(3,4,9);plot(y9

'(D=size(x10
(for j=1:D(2
(for i=1:D(1
if x10(i,j)== 0
'r10=100-i
'end
'end
'y10(j)=r10
'end
(subplot(3,4,10);plot(y10

'(D=size(x11
(for j=1:D(2
(for i=1:D(1
if x11(i,j)== 0
'r11=100-i
'end
'end
'y11(j)=r11
'end
(subplot(3,4,11);plot(y11

'(D=size(x12
(for j=1:D(2
(for i=1:D(1
if x12(i,j)== 0
'r12=100-i
'end
'end
'y12(j)=r12
'end
(subplot(3,4,12);plot(y12
'end


'(D=size(x8
'(D(1
'(D(2
(for j=1:D(2
(for i=1:D(1
if x8(i,j)== 0
'r8=D(1)-i
'end
'end
y8(j)=r8*******************%
```

```
'end
(subplot(3,4,8);plot(y8**********%

'(D=size(x8
'(D(1
'(D(2
(for j=1:D(2
(for i=1:D(1
if x8(i,j)== 0
'r8=D(1)-i
'end
'end
'y8(j)=r8
'end
(subplot(3,4,8);plot(y8
('IMWRITE(y1,'image convert 12 .gif','bmp


'outstruct.my_output_variable_5='convert done
'('templatefile = which('testrounza.htm
(if (nargin == 1
'(retstr = htmlrep(outstruct, templatefile
(elseif (nargin == 2
'(retstr = htmlrep(outstruct, templatefile, outfile
end
```

7- Wavelet

```
(function retstr = wavelet(instruct, outfile
'('')retstr = char
'(cd(instruct.mldir


**********************************************************************%
*******
*********%
'('img,map]=imread('CustomerId.gif]

'(i,j]=size(img1] %
(if(i==274 && j==467%
'(b=im2bw(img,map,0.4%


'(b=im2bw(img,map,0.1
'(disp(b%
'(imshow(b
'(x1=b(85:130,8:122
'(x2=b(85:130,123:237
'(x3=b(85:130,238:352
```

```
‘(x4=b(85:130,353:467
‘(x5=b(125:170,8:122
‘(x6=b(125:170,123:237
‘(x7=b(125:170,238:352
‘(x8=b(125:170,353:467
‘(x9=b(165:208,8:122
‘(x10=b(165:208,123:237
‘(x11=b(165:208,238:352
‘(x12=b(165:208,353:467

‘(D=size(x1%
(for j=1:D(2%
(for i=1:D(1%
if x1(i,j)== 0%
‘r1=100-i  %
‘end%
‘end%
‘y1(j)=r1*****************%
‘end%
(subplot(3,4,1);plot(y1*****************%

‘(D=size(x1
(for j=1:D(2
(for i=1:D(1
if x1(i,j)== 0
‘r1=100-i
‘end
‘end
‘y1(j)=r1
‘end
(subplot(3,4,1);plot(y1


‘(D=size(x2
(for j=1:D(2
(for i=1:D(1
if x2(i,j)== 0
‘r2=100-i
‘end
‘end
‘y2(j)=r2
‘end
(subplot(3,4,2);plot(y2

‘(D=size(x3
(for j=1:D(2
(for i=1:D(1
if x3(i,j)== 0
‘r3=100-i
‘end
```

```
‘end
‘y3(j)=r3
‘end
(subplot(3,4,3);plot(y3

‘(D=size(x4
(for j=1:D(2
(for i=1:D(1
if x4(i,j)== 0
‘r4=100-i
‘end
‘end
‘y4(j)=r4
‘end
(subplot(3,4,4);plot(y4

‘(D=size(x5
(for j=1:D(2
(for i=1:D(1
if x5(i,j)== 0
‘r5=100-i
‘end
‘end
‘y5(j)=r5**************%
‘end
(subplot(3,4,5);plot(y5**************%

‘(D=size(x6);D=size(x5
(for j=1:D(2
(for i=1:D(1
if x5(i,j)== 0
‘r5=100-i
‘end
‘end
‘y5(j)=r5
‘end
(subplot(3,4,5);plot(y5
(for j=1:D(2
(for i=1:D(1
if x6(i,j)== 0
‘r6=100-i
‘end
‘end
‘y6(j)=r6
‘end
(subplot(3,4,6);plot(y6

‘(D=size(x7
(for j=1:D(2
(for i=1:D(1
```

```
if x7(i,j)== 0
‘r7=100-i
‘end
‘end
‘y7(j)=r7
‘end
(subplot(3,4,7);plot(y7



‘(D=size(x9
(for j=1:D(2
(for i=1:D(1
if x9(i,j)== 0
‘r9=100-i
‘end
‘end
‘y9(j)=r9%
‘end
(subplot(3,4,9);plot(y9%


‘(D=size(x9
(for j=1:D(2
(for i=1:D(1
if x9(i,j)== 0
‘r9=100-i
‘end
‘end
‘y9(j)=r9
‘end
(subplot(3,4,9);plot(y9

‘(D=size(x10
(for j=1:D(2
(for i=1:D(1
if x10(i,j)== 0
‘r10=100-i
‘end
‘end
‘y10(j)=r10
‘end
(subplot(3,4,10);plot(y10

‘(D=size(x11
(for j=1:D(2
(for i=1:D(1
if x11(i,j)== 0
‘r11=100-i
```

```
'end
'end
'y11(j)=r11
'end
(subplot(3,4,11);plot(y11

'(D=size(x12
(for j=1:D(2
(for i=1:D(1
if x12(i,j)== 0
'r12=100-i
'end
'end
'y12(j)=r12
'end
(subplot(3,4,12);plot(y12
'end


'(D=size(x8
'(D(1
'(D(2
(for j=1:D(2
(for i=1:D(1
if x8(i,j)== 0
'r8=D(1)-i
'end
'end
y8(j)=r8*******************%
'end
(subplot(3,4,8);plot(y8*****************%

'(D=size(x8
'(D(1
'(D(2
(for j=1:D(2
(for i=1:D(1
if x8(i,j)== 0
'r8=D(1)-i
'end
'end
'y8(j)=r8
'end
(subplot(3,4,8);plot(y8
**********************************************************************%
*******
*****  wavelet start *******%

's = y1
'(l_s = length(s
```

```
ؼ('cA1,cD1] = dwt(s,'db1]
ؼ(disp(cA1%
(subplot(3,4,1);plot(cA1

ؼs = y2
ؼ(l_s = length(s
ؼ('cA2,cD2] = dwt(s,'db1]
ؼ(disp(cA2%
(subplot(3,4,2);plot(cA2

ؼs = y3
ؼ(l_s = length(s
ؼ('cA3,cD3] = dwt(s,'db1]
ؼ(disp(cA2%
(subplot(3,4,3);plot(cA3

ؼs = y4
ؼ(l_s = length(s
ؼ('cA4,cD4] = dwt(s,'db1]
ؼ(disp(cA4%
(subplot(3,4,4);plot(cA4

ؼs = y5
ؼ(l_s = length(s
ؼ('cA5,cD5] = dwt(s,'db1]
ؼ(disp(cA5%
(subplot(3,4,5);plot(cA5

ؼs = y6
ؼ(l_s = length(s
ؼ('cA6,cD6] = dwt(s,'db1]
ؼ(disp(cA2%
(subplot(3,4,6);plot(cA6

ؼs = y7
ؼ(l_s = length(s
ؼ('cA7,cD7] = dwt(s,'db1]
ؼ(disp(cA7%
(subplot(3,4,7);plot(cA7

ؼs = y8
ؼ(l_s = length(s
ؼ('cA8,cD8] = dwt(s,'db1]
ؼ(disp(cA8%
(subplot(3,4,8);plot(cA8

ؼs = y9
ؼ(l_s = length(s
ؼ('cA9,cD9] = dwt(s,'db1]
ؼ(disp(cA9%
```

```
(subplot(3,4,9);plot(cA9

ʕs = y10
ʕ(l_s = length(s
ʕ('cA10,cD10] = dwt(s,'db1]
ʕ(disp(cA10%
(subplot(3,4,10);plot(cA10

ʕs = y11
ʕ(l_s = length(s
ʕ('cA11,cD11] = dwt(s,'db1]
ʕ(disp(cA11%
(subplot(3,4,11);plot(cA11

ʕs = y12
ʕ(l_s = length(s
ʕ('cA12,cD12] = dwt(s,'db1]
ʕ(disp(cA12%
(subplot(3,4,12);plot(cA12



"=x%
for i=1:58%
(x=x + cA1(i   %
ʕend%
'|'&x=x %
for i=1:58%
(x=x+ cA2(i   %
ʕend%
outstruct.my_output_variable_6='Wavelet Coeffoicient Have Been Stored in %
ʕ' Database
(my2=cA1(1
ʕoutstruct.my_output_variable_6=my2
outstruct.z = my2%
ʕ('templatefile = which('testrounza.htm
(if (nargin == 1

ʕ(retstr = htmlrep(outstruct, templatefile
(elseif (nargin == 2
ʕ(retstr = htmlrep(outstruct, templatefile, outfile
end
```

8- Connect

```
(function retstr = connect(instruct, outfile
ʕ('')retstr = char
ʕ(cd(instruct.mldir
```

```
(logintimeout(5
(" ‹" ‹'conn = database('final
(ping(conn%
('a = exec(conn, 'select max(chartid) from w1
('setdbprefs('DataReturnFormat','numeric
(a = fetch(a, 1
maxindex = a.Data

(close(a
꞉maxindex=maxindex+1

{'col={'chartid','sid','cid','coefficient
for i=1:58
꞉{(data={maxindex,1,i,cA1(i
꞉(insert(conn,'w1',col,data
꞉end

**********************************%
("‹"‹'conn=da5tabase('final%
{'col={'chartid','sid','cid','coefficient
for i=1:58
{(data={maxindex,2,i,cA2(i
(insert(conn,'w2',col,data
꞉end


**********************************%
("‹"‹'conn=database('final%
{'col={'chartid','sid','Cid','coefficient
for i=1:58
{(data={maxindex,3,i,cA3(i
(insert(conn,'w3',col,data
꞉end


**********************************%
("‹"‹'conn=database('final%
{'col={'chartid','sid','cid','coefficient
for i=1:58
{(data={maxindex,4,i,cA4(i
(insert(conn,'w4',col,data
꞉end


**********************************%
("‹"‹'conn=database('final%
```

```
{'col={'chartid','sid','cid','coefficient
for i=1:58
{(data={maxindex,5,i,cA5(i
(insert(conn,'w5',col,data
'end


**********************************%
("'"'conn=database('final%
{'col={'chartid','sid','cid','coefficient
for i=1:58
{(data={maxindex,6,i,cA6(i
(insert(conn,'w6',col,data
'end


**********************************%
("'"'conn=database('final%
{'col={'chartid','sid','cid','coefficient
for i=1:58
{(data={maxindex,7,i,cA7(i
(insert(conn,'w7',col,data
'end

**********************************%
("'"'conn=database('final%
{'col={'chartid','sid','cid','coefficient
for i=1:58
{(data={maxindex,8,i,cA8(i
(insert(conn,'w8',col,data
'end

**********************************%
("'"'conn=database('final%
{'col={'chartid','sid','cid','coefficient
for i=1:58
{(data={maxindex,9,i,cA9(i
(insert(conn,'w9',col,data
'end

**********************************%
("'"'conn=database('final%
{'col={'chartid','sid','cid','coefficient
for i=1:58
{(data={maxindex,10,i,cA10(i
(insert(conn,'w10',col,data
'end

**********************************%
("'"'conn=database('final%
```

```
{'col={'chartid','sid','cid','coefficient
for i=1:58
‘{(data={maxindex,11,i,cA11(i
‘(insert(conn,'w11',col,data
‘end

**********************************%
‘("‘"‘'conn=database('final%
{'col={'chartid','sid','cid','coefficient
for i=1:58
{(data={maxindex,12,i,cA12(i
(insert(conn,'w12',col,data
‘end




‘'outstruct.my_output_variable_9='connect done
‘('templatefile = which('testrounza.htm
(if (nargin == 1
‘(retstr = htmlrep(outstruct, templatefile
(elseif (nargin == 2
‘(retstr = htmlrep(outstruct, templatefile, outfile
end
```

References

[1] JohnR.Hampton, the ECG made easy, Churchill Livingstone, 2003.

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[3] TE-Chuan Chou,Electrocardiography in Clinical Practice,Grune & Stratton,2003

[4] Ian Sommerville, Software Engineering, Addison Wesley, 2001.

[5] Microsoft, Developing Microsoft ASP.NET Web Application Using Visual Studio.NET, 2002.

[6] http://www.google.com/diseases/heart_disease

[7] http://www.mamma.com/extract_wavelett.htm

[8] http://www.info.com/ecg_diagnose/str.htm

User Manual

To operate the ECG system, a set of requirements must be done to help the administrator configure and operate the system. These pre-requirements are:

1. Microsoft Windows server family or XP.
2. Microsoft office Family.
3. Internet Information Service (IIS).
4. .NET Framework.
5. SQL Server 2000.
6. MATLAB web server.

The administrator module is programmed by MATLAB. The following steps must be done:

* Install MATLAB and MATLAB server.

* Copy all MATLAB functions in work directory.

* Establish Connection between SQL server and MATLAB using ODBC driver.

* Call MATLAB functions in MATLAB editor to execute it according to the following sequence:

1- Read an ECG image

2- Verify type and size.

3- De-noise Image

4- Filter Image.

5- Split Image.

6- Convert 2D-Array to 1D-Array

7- Extract Wavelet

8- Connect to SQL server.

The user (physician) module is programmed by ASP.NET,the following steps must be done to put the system in production and deal with it:

1. Build the application (BIN directory and DLL file will be created).
2. Copy the following files to the production server (BIN directory, web forms (.aspx), user controls (.ascx), XML files (.asmx), web.config, global.asax and changes of machine.config).
3. Create a virtual directory using IIS.
4. Register your domain name with one of the companies.
5. While site is up and running, you can replace (update) files with new versions.

After completing the environment requirements, the user begins use ECG System. The first screen gives user an overview about the system and allows him to Login, Registration, Send Comment, Contact Us and Help about use the system as shown in figure 1.

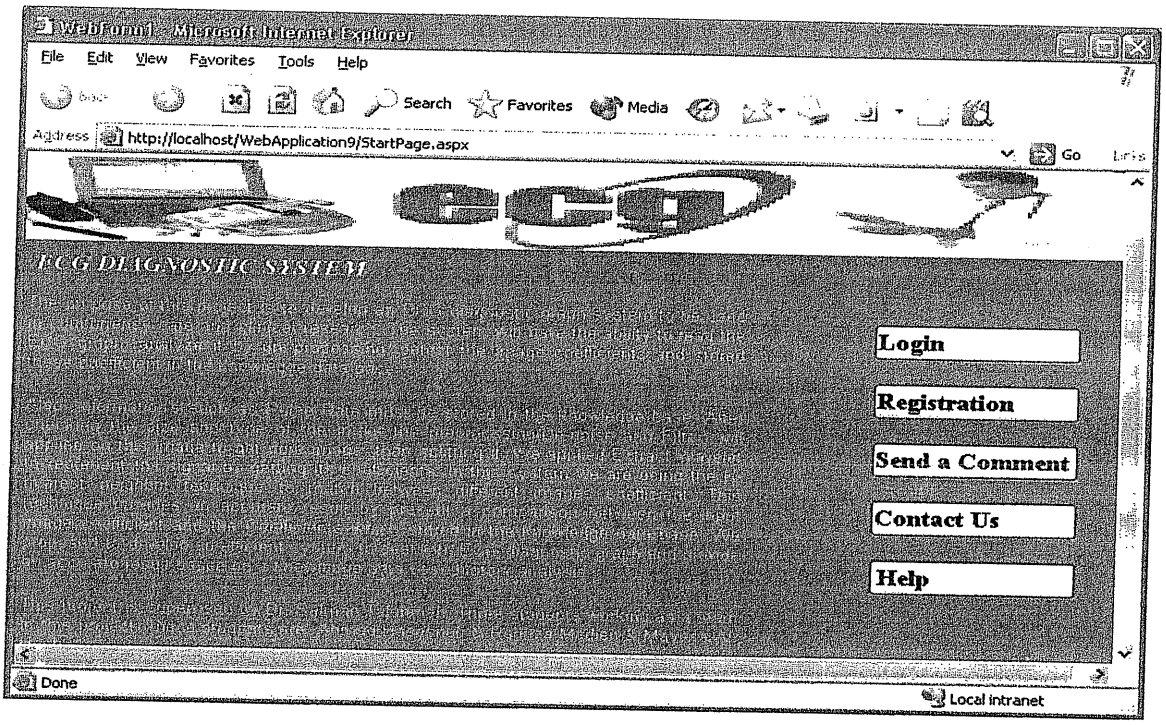

Figure 1: To begin the ECG System

After previous screen the system allow to old user to login and change his password and allow to new user to registration and after old user enter Login ID and Password if it is correct, he will start using the system as shown in figure 2 .

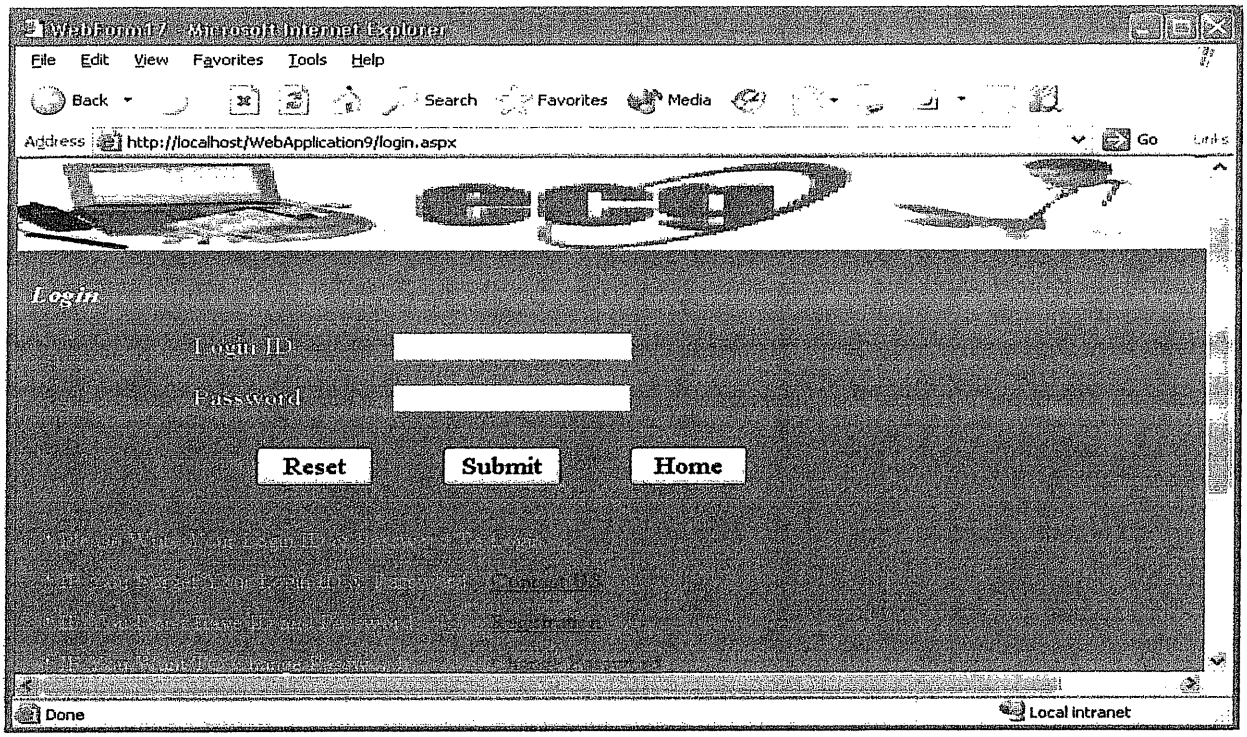

Figure 2: Login Screen

The following screen allows user to change his password by enters Login Id, Old Password, New Password and Confirm new Password, so his password will change as shown in figure 3.

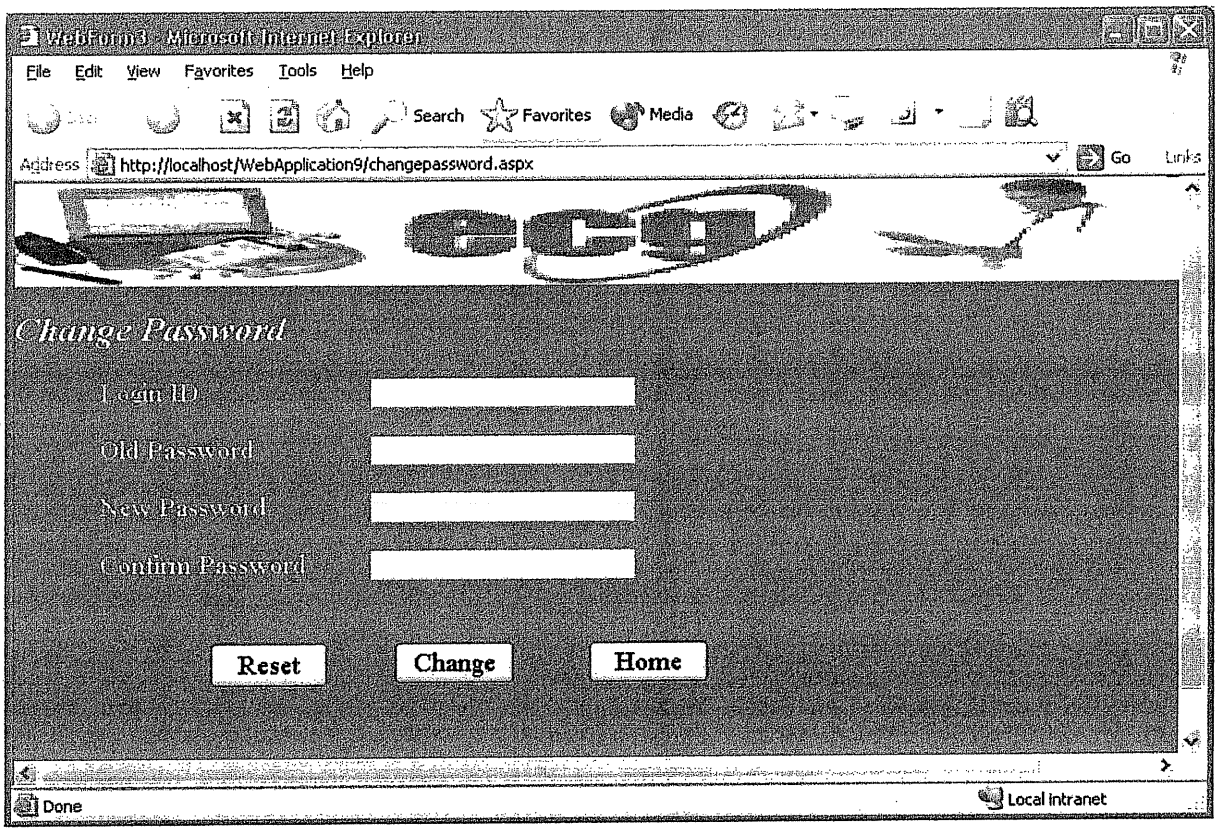

Figure 3: Change Password Screen

If new user enter to the system he must registration and enter the following information: Patient name,Email,Sex,City,Cellphone,Login ID,Password and Confirm Password ,this screen allows user to have account to use the system as shown in figure 4.

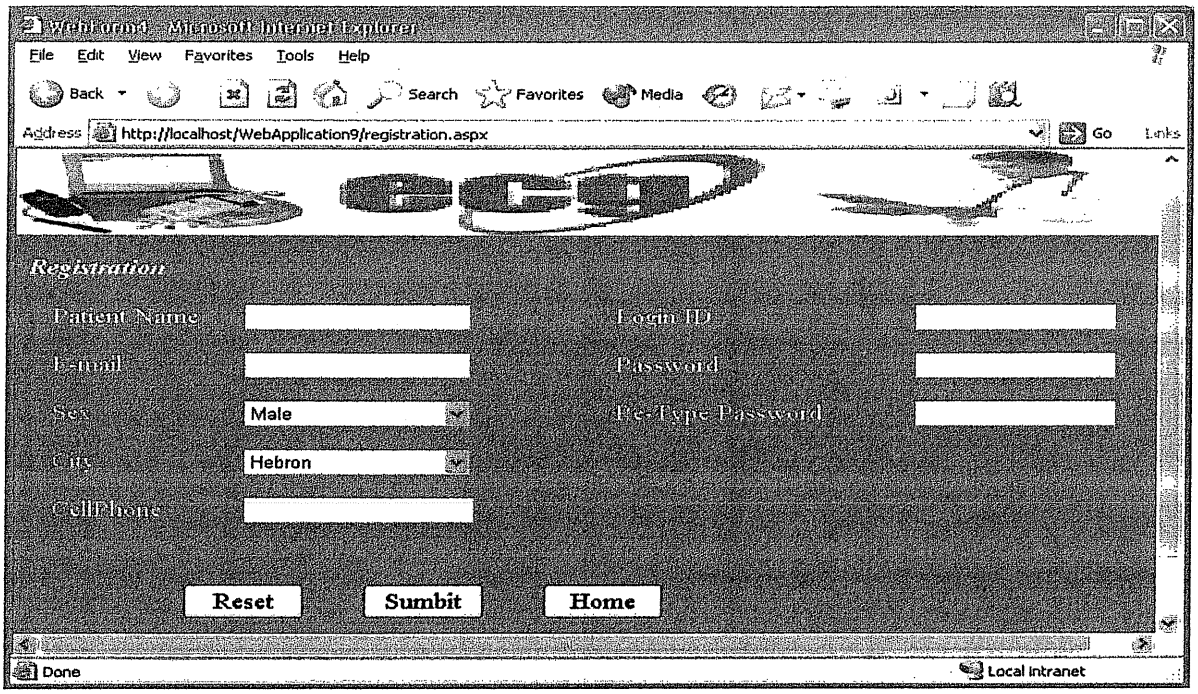

Figure 4: Registration Screen

After enter to the system the following screen explain the main steps to start diagnose and allows user to load an ECG image that want to diagnose it and store it in the work directory in MATLAB on the server as shown in figure 5.

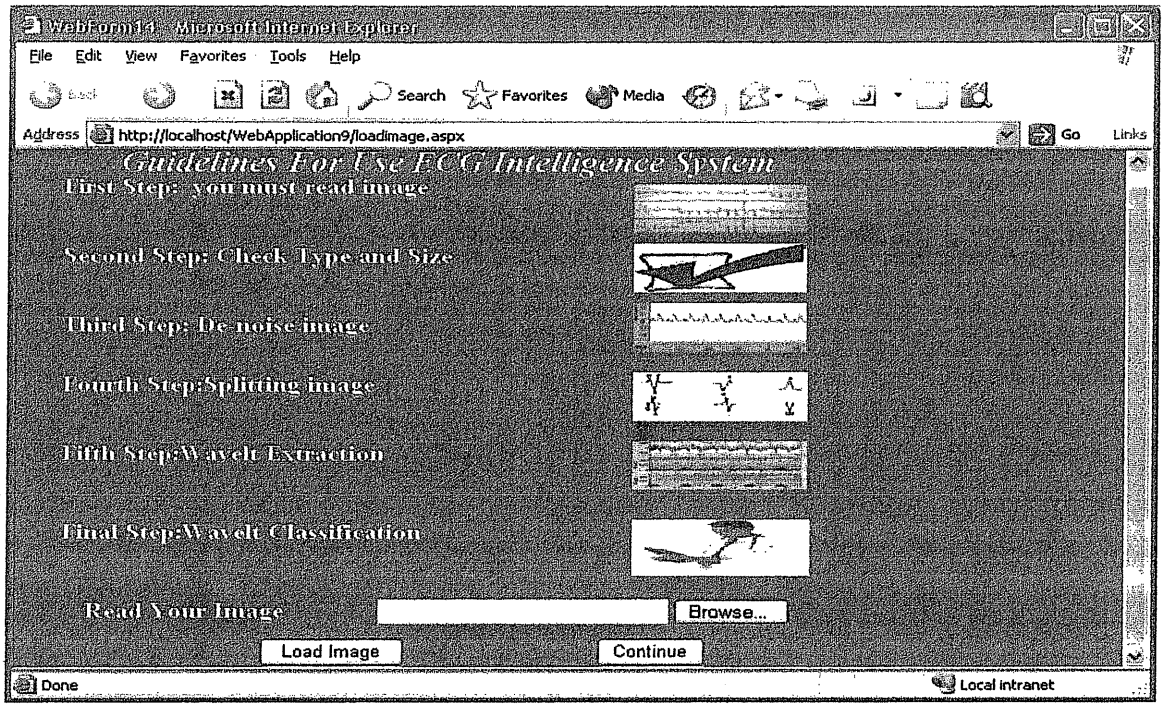

Figure 5: Load Image Screen

To continue diagnose the following screen shows main steps will be done, for example button read image will call MATLAB function (read image) and execute it as shown in figure 6.

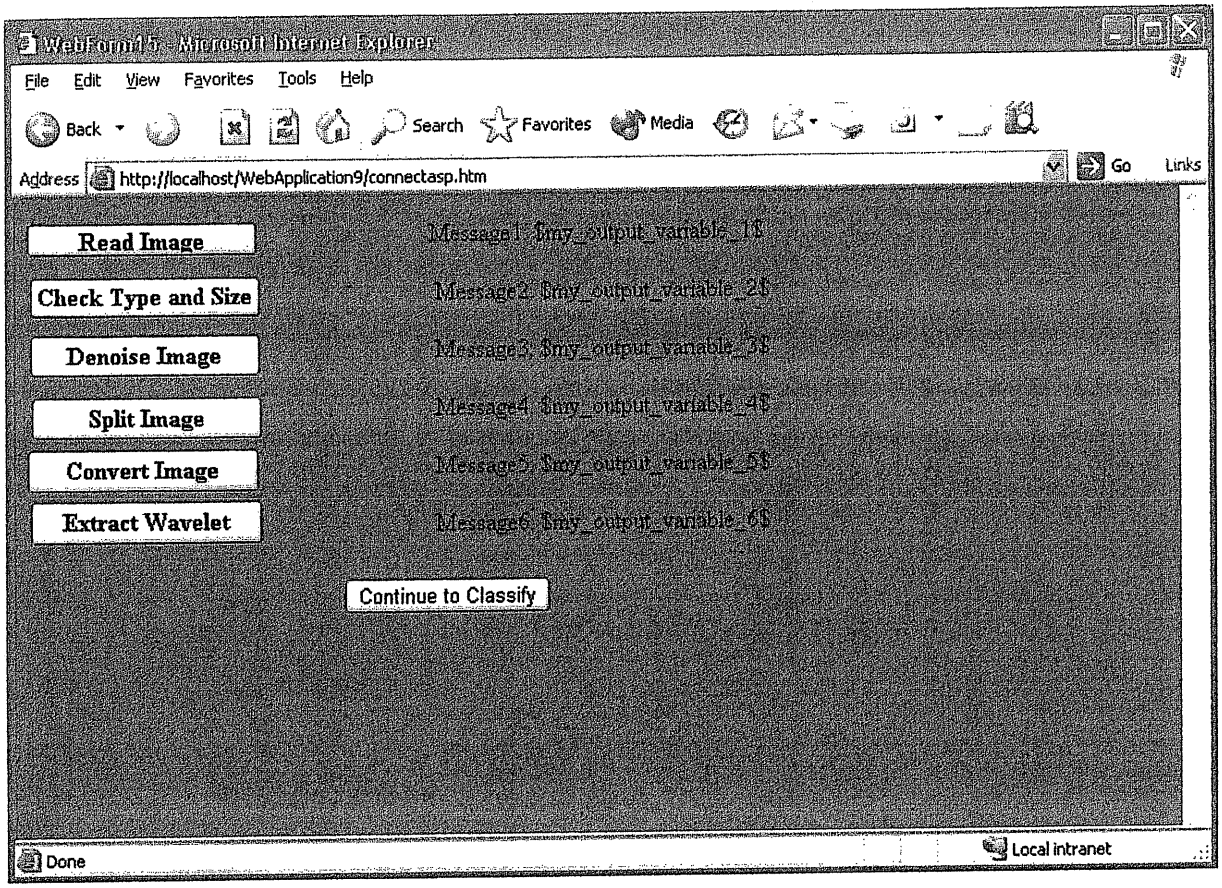

Figure 6: Diagnose Screen

After execute the previous MATLAB function the physician can classification by clicking button classification so that description will appear and then physician enter Patient ID,Patient Name,Age,Sex,Pulse Rate and Illness .

This screen can consider it as report and print it.

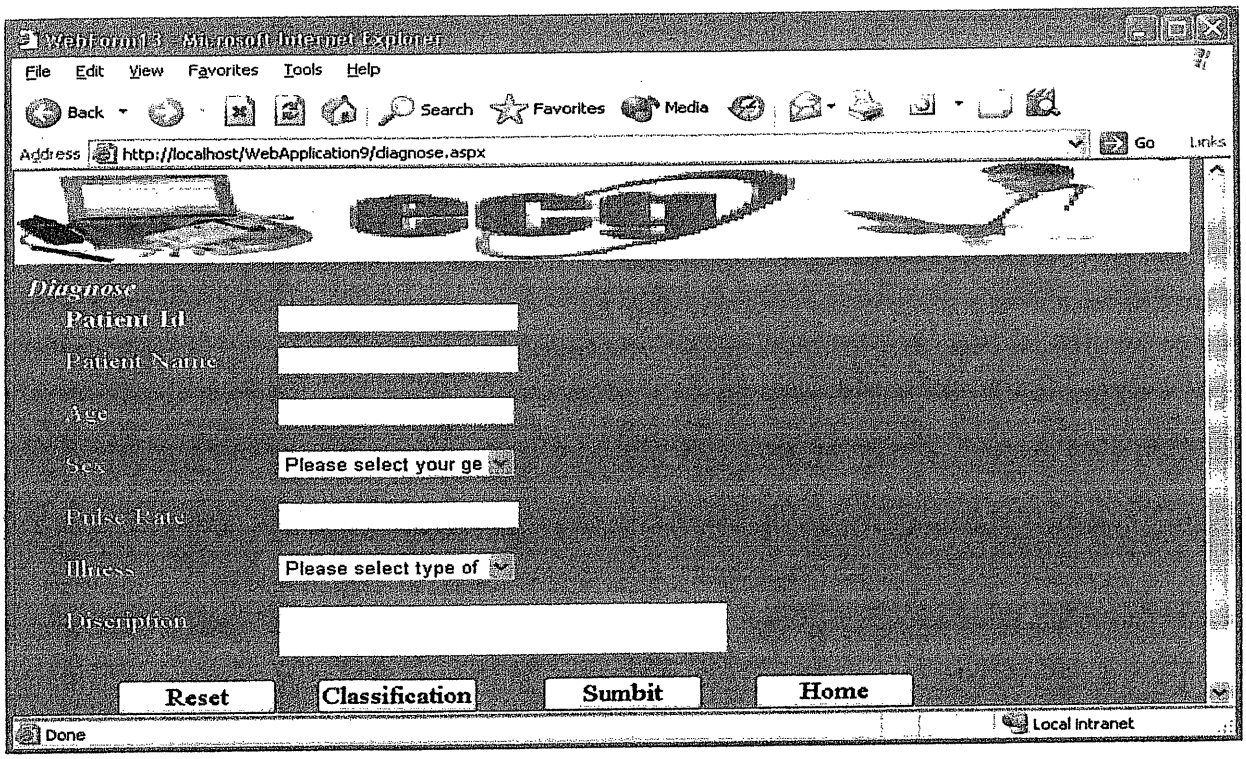

Figure 7: Classification Screen

The user can send any comment such as suggest, call and explain about the system as shown in figure 8.

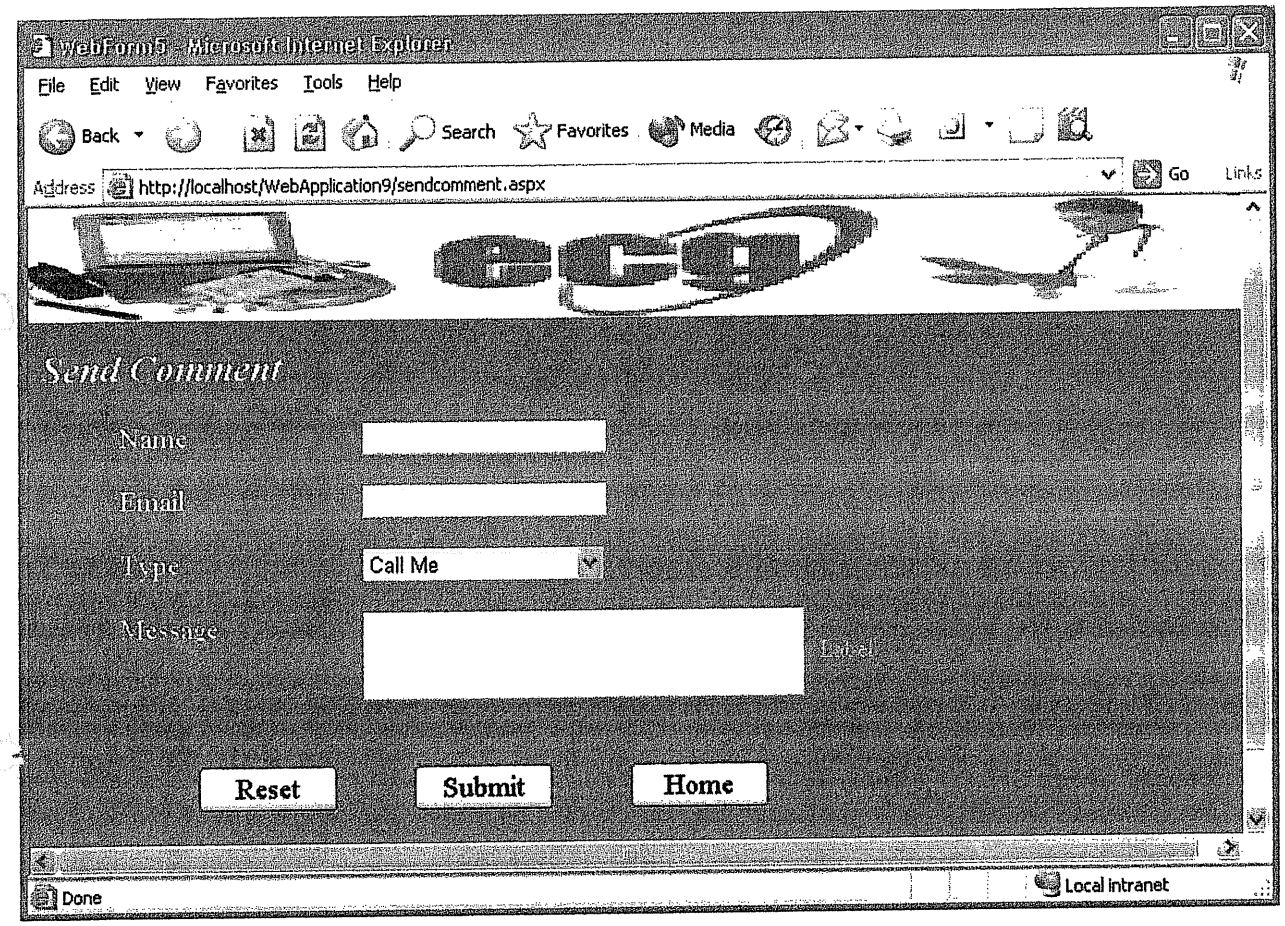

Figure 8: Send Comment Screen

The following screen help user how to read image, image characteristic, registration, classification and output, when click to any button of them the data will display in text area as shown in figure 9.

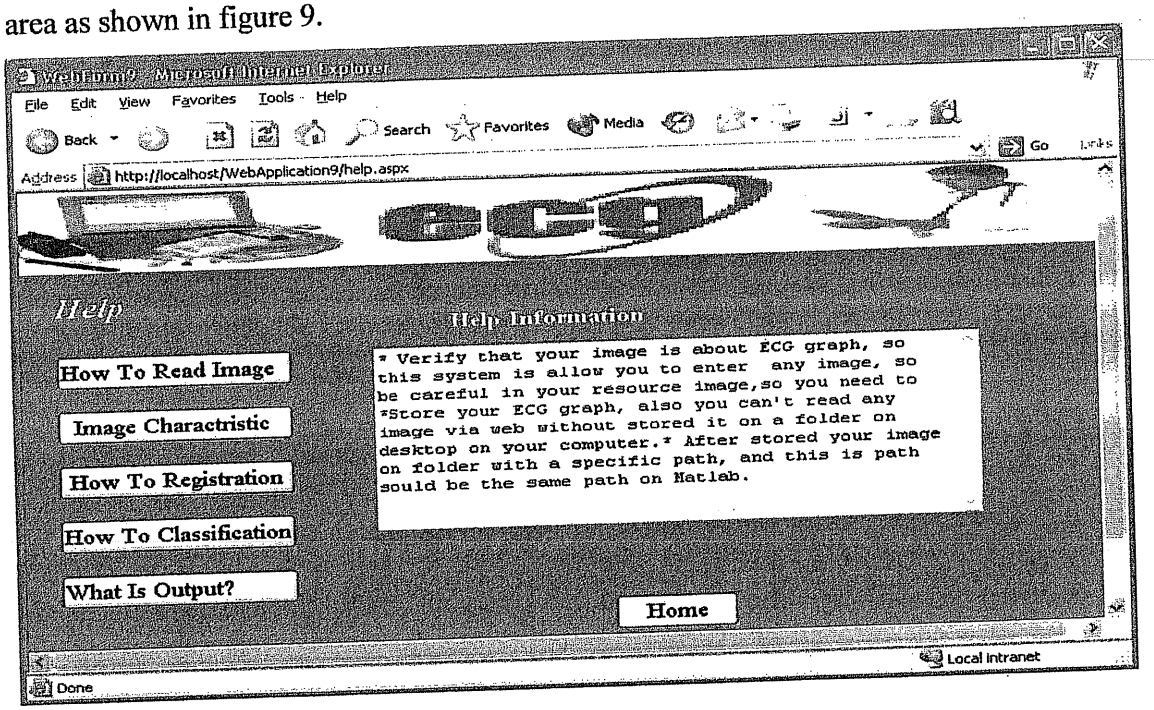

Figure 9: Help Screen