بسم الله الرحمن الرحيم

College of Information Technology and Computer Engineering

Information Technology Department

Eye color-based computer aided diagnosis system

Project Team

Anwar Abu-Rayyan RemahSweiti

Nour Abu-Rayyan

Project supervisors

Dr. MousaAlrefayah

2014

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Chapter One: Introduction

Abstract:

A new method to detect the disease in the human body is proposed in this project. Medical studies show that many diseases have indicators in the eye. Based on image processing technology, the application can recognize objects in a given image of the eye, and discover the features that we need to detect the disease, and excludes features that are not needed. Two diseases will be discovered using this application.

1.1 Problem statement:

Current medical systems detect disease using screening devices which are expensive and time-consuming for diagnosing. Where the time is very important in this area diagnosis for many diseases play a significant role in the success of the treatment. Recently, computer-aided diagnosis system received a considerable attention from researchers. In this study, we aim to propose and develop an eye based computer prediction system for diagnosis diseases in early stage.

1.2 Project importance

The system importance can be summarized in the following aspects:

- Facilitate the processes of predicting and diagnosis of human diseases.
- Low Cost and quick access to identify the disease because the application is available in the hands of anyone.
- Early diagnosis for some diseases based on eyes images

1.3 Project Objectives

We seek to develop a computerized system that determines whether a certain person is infected with some diseases or not at an early stage recognize the disease identity. This can be performed by capturing an image of a certain eye, then extracting a predefined feature from the captured image and analyzing these features. Based on image processing techniques we can know the type of the disease, where we will reveal two diseases: hepatitis and Myasthenia.

1.4 The project targeted group

This project is applicable to all people who suspect that they have hepatitis and Myasthenia disease.

1.5 Methodology

This system is based on the process of determining the symptoms of the disease on the eye. Type of the disease (hepatitis and Myasthenia) is determined based on features that extracted by the system of the eye image such as: the color, intensity, quantity, shape, and other symptoms that appear on the eye. These characteristics vary from one disease to another.

1.6 Expected Results

The expected results of the project are:

1. A computer based method that is able to read a digital image of human eyes and give a statement and numbers that describes disease from the image with minimum user intervention.
2. The project can read a human eye and classify them as infected of a disease or not and show the type of the infection.

Chapter Two: Background

Introduction

The system processes digital images using digital computer. The purpose of creating an enhanced image that is more useful to satisfy human observer, or to perform some of the interpretation and recognition tasks usually performed by computer. Image processing has shown remarkable progress in the past decade in both terms of theoretical development and applications. It is used in many areas, including astronomy, medicine, industrial robotics and many other fields.

There are many theories for image processing, but in this section, the theories that are needed to develop this project are to be introduced.

2.1 Image Processing

The field of digital image processing refers to processing digital images by means of a digital computer.

The image passes through several stages:

- Image acquisition: the image can be captured using a digital camera or a scanner.
- Pre-processing: such as filtering noise or converting the image to binary.
- Segmentation: isolating an object in the image from the background.
- Features extraction: to decide whether there is a disease or not Through certain features.
- Result: the system he can take a decision that a person is infected or not.

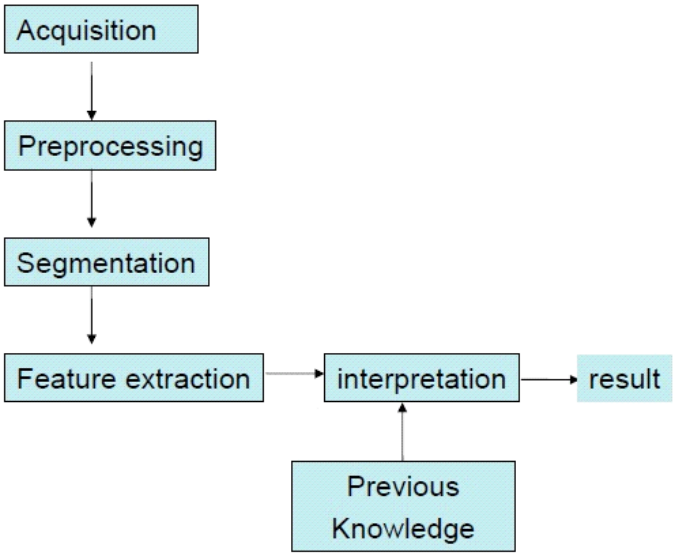


Figure (2,1): Image processing Hierarchy.(Cheng,2008)

Digital Image

An image may be defined as a two-dimensional function f(x, y), where x and y are spatial coordinates, and the amplitude of at any pair of coordinates (x, y) is called the intensity of the level of the image at that point. When x, y, and f are all finite, discrete quantities, we call an image a digital image. Digital image quality depends on the number of pixels in the image. The greater number of pixels the better the quality. If the digital image was enlarged to a certain limit, the image becomes distorted.

Digital image is divided into:

- Binary image: that contains black and white colors and each pixel can be either black or white.
- Grayscale image: contains black, white and grayscale. The intensity of the image can be represented by numbers from 0 to 255. When representing an image in the computer the pixels arranged in rows and columns.

- Color image: the image supports colors by allocating three matrices in each pixel to determine the intensity of the three key colors (Red, Green, and Blue).

2.2 Color model

A color model is an abstract mathematical model describing the way colors can be represented as tuples of numbers, typically as two or four values or color components. When this model is associated with a precise description of how the components are to be interpreted (viewing conditions, etc.), the resulting set of colors is called color space. This section describes three types of the color models.

- **RGB color model:**

RGB color model: an RGB color image is an M X N X 3 array of color pixels, where each color pixel is a triplet corresponding to the red, green and blue components of an RGB image at specific spatial location .All the colors can lie in a cube extending from the origin (black) as illustrates in figure 2.2.

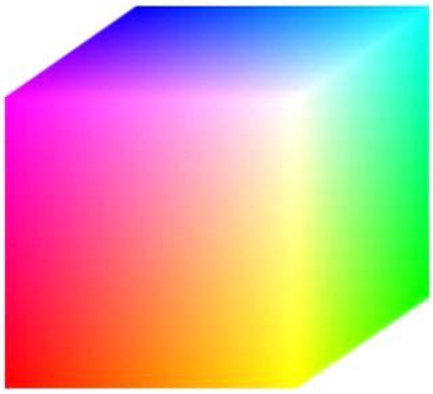


Figure (2,2): RGB color space .

- **HSV color model:**

HSV color model: HSV is one of several color systems used by people to select colors from a color wheel or palette .Hue is expressed as a number from 0 to 360 degrees representing hues of red (starts at 0), yellow (starts at 60), green (starts at 120), cyan (starts at 180), blue (starts at 240), and magenta (starts at 300). Saturation is the amount of gray (0% to 100%) in the color. Value (or Brightness) works in conjunction with saturation and describes the brightness or intensity of the color from 0% to 100%. All the colors can lie in a cone as illustrates in figure 2.3.

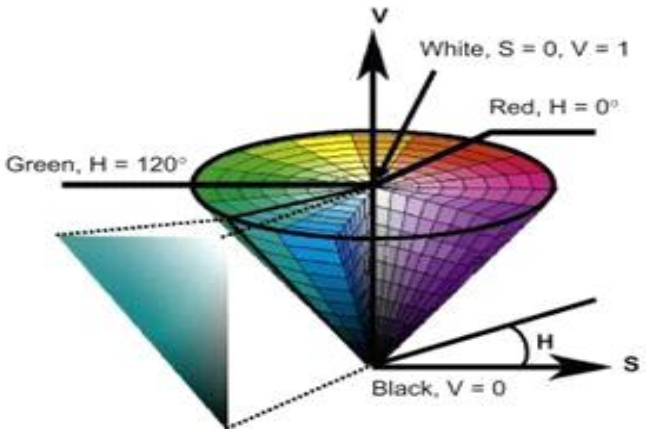


Figure (2.3): HSV color cone .

Converting the color of the image from RGB to HSV

We need to convert the color of the image from RGB to HSV. Color vision can be processed using RGB color space or HSV color space. RGB color space describes color in terms of the amount of red, green, and blue present. HSV color space describes colors in terms of the Hue, Saturation, and Value.

2.3 Image Segmentation

In computer vision, image segmentation is the process of partitioning a digital image into multiple segments (sets of pixels, also known as superpixels). The goal of segmentation is to simplify and/or change the representation of an image into something that is more meaningful and easier to analyze. More precisely, image segmentation is the process of assigning a label to every pixel in an image such that pixels with the same label share certain visual characteristics.

The result of image segmentation is a set of segments that collectively cover the entire image, or a set of contours extracted from the image. Each of the pixels in a region are similar with respect to some characteristic or computed property, such as color, intensity, or texture. Adjacent regions are significantly different with respect to the same characteristic(s).

How the system do segmentation:

Segmentation categories:

The following categories are used to do the segmentation:

- Threshold based segmentation. Histogram thresholding and slicing techniques are used to segment the image. They may be applied directly to an image, but can also be combined with pre- and post-processing techniques.
- Edge based segmentation. With this technique, detected edges in an image are assumed to represent object boundaries, and used to identify these objects.
- Region based segmentation. Where an edge based technique may attempt to find the object boundaries and then locate the object itself by filling them in, a region based technique takes the opposite approach, by (e.g.) starting in the middle of an object and then "growing" outward until it meets the object boundaries.
- Clustering techniques. Although clustering is sometimes used as a synonym for (agglomerative) segmentation techniques, we use it here to denote techniques that are

primarily used in exploratory data analysis of high-dimensional measurement patterns. In this context, clustering methods attempt to group together patterns that are similar in some sense. This goal is very similar to what we are attempting to do when we segment an image, and indeed some clustering techniques can readily be applied for image segmentation.

- Matching. When we know what an object we wish to identify in an image (approximately) looks like, we can use this knowledge to locate the object in an image. This approach to segmentation is called matching.

2.4 The diseases

2.4.1 Disease myasthenia:

Neuromuscular disease leads to fluctuating muscle weakness and debility. It is an autoimmune disease, where there is a weakness because of the prevalence of antibodies which block acetylcholine receptors back - in synaptic neuromuscular junction, thus preventing the stimulant effect of acetylcholine. The estimated incidence of the disease is between 200 and 400 cases per million populations.

Early symptoms of the disease:

Symptoms of the disease may begin abruptly, and in many cases, the symptoms come on intermittently, leading to delayed diagnosis of myasthenia gravis, especially if the symptoms are subtle or variable. The first symptom in most cases muscle weakness affects one eye then the other eye gets affected.

Symptoms of the disease:

Symptoms vary from person to another, but they include the following things permanently:

- Extreme weakness in the muscle when used for a long time.

- Sagging eyelids and blurred vision.
- Change in facial expressions.
- Acute and severe fatigue in the muscles of the pharynx during chewing and talking.
- Fatigue accumulated in the muscles of the legs, hands, fingers, neck.
- Breathing difficulties.

Eyelids sagging are sometimes full and in other cases it can be partially.

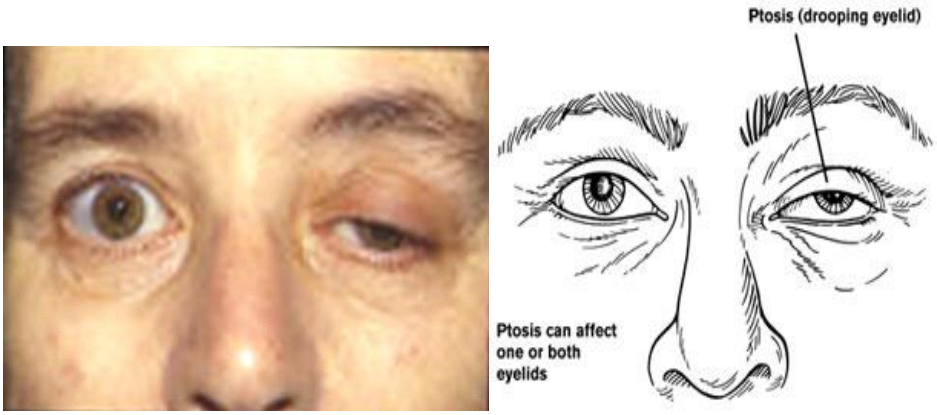


Figure (2,6): a- The effect of Myasthenia on one eye.

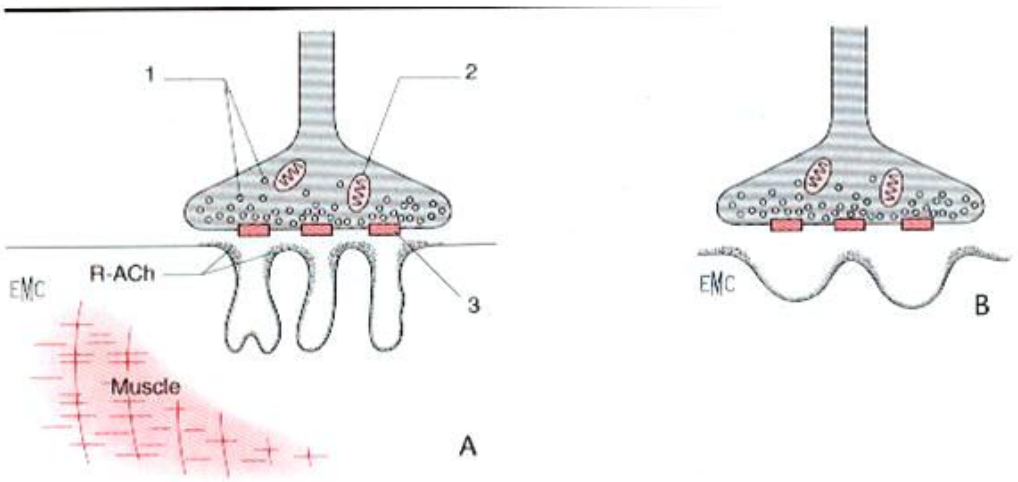
Figure (2,٦): b- Sagging partially

Figure (2,٦): c- Sagging fully

General evolution of the disease:

Fickle in general, and especially during the first five years, it may take the form of a chronic evolution. It can be a generalized weakness and becomes partially controlled weakness sometimes on some muscle and it is associated with atrophy explicit. Exacerbations may occur in the form of a spontaneous attack or induce muscle fatigue, trauma, surgery, or illness or emergency factors adenocarcinoma (hyperthyroidism, pregnancy, especially in the first months or after birth).

- **mechanism of pathogenicity They gravis :**



1 *Plaque motrice. 1. Vésicules (ACh) ; 2. mitochondries ; 3. sites de libération.*
A. Sujet normal.
B. Sujet myasthénique.

Figure (2.6) : A- a natural person B- a patient a myasthenia

- **Complications of the disease**

One of the most important complications of the disease myasthenia sudden seizure, which is considered a medical emergency where the breathing muscles are affected severely, which leads to a sharp decline in Breathing that may lead to the death of the patient.

As well as the factors that lead to increased incidence of complications includes:

- Respiratory diseases viral.
- A surgical procedure.
- Pregnancy.
- Psychiatric disorders.

2.4.2 Hepatitis

"Hepatitis" means inflammation of the liver. Toxins, certain drugs, some diseases, heavy alcohol use, and bacterial and viral infections can all cause hepatitis. Hepatitis is also the name of a family of viral infections that affect the liver; the most common types are Hepatitis A, Hepatitis B, and Hepatitis C.

Hepatitis means inflammation of the liver. Many illnesses and conditions can cause inflammation of the liver, for example, drugs, alcohol, chemicals, and autoimmune diseases. Many viruses, for example, the virus of mononucleosis and the cytomegalovirus can inflame the liver. Most viruses, however, do not attack primarily the liver; the liver is just one of several organs that the viruses affect. When doctors speak of viral hepatitis, they are using the definition that means hepatitis caused by a few specific viruses that primarily attack the liver and are responsible for about half of all human hepatitis. There are several hepatitis viruses; they have been named types A, B, C, D, E, F (not confirmed), and G. The most common hepatitis viruses are types A, B, and C. Reference to the hepatitis viruses often occurs in an abbreviated form. (For example, HAV, HBV, HCV represent hepatitis viruses A, B, and C, respectively.).

The difference between Hepatitis A, Hepatitis B, and Hepatitis C:

Hepatitis A, Hepatitis B, and Hepatitis C are diseases caused by three different viruses. Although each can cause similar symptoms, they have different modes of transmission and can affect the liver differently. Hepatitis A appears only as an acute or newly occurring infection and does not become chronic. People with Hepatitis A usually improve without treatment. Hepatitis B and Hepatitis C can also begin as acute infections, but in some people, the virus remains in the body, resulting in chronic disease and long-term liver problems. There are vaccines to prevent Hepatitis A and B; however, there is not one for Hepatitis C. If a person has had one type of viral hepatitis in the past, it is still possible to get the other types.

Signs and Symptoms

The period of time between exposure to hepatitis and the onset of the illness is called the incubation period. The incubation period varies depending on the specific hepatitis virus. Hepatitis A virus has an incubation period of about 15 to 45 days; Hepatitis B virus from 45 to 160 days, and Hepatitis C virus from about 2 weeks to 6 months.

Many patients infected with HAV, HBV, and HCV have few or no symptoms of illness. For those who do develop symptoms of viral hepatitis, the most common are flu- like symptoms including:

- loss of appetite
- nausea
- vomiting
- fever
- weakness
- tiredness
- aching in the abdomen
- dark urine
- light-colored stools
- fever
- jaundice (a yellow appearance to the skin and white portion of the eyes)

Statistics:

Approximately 500 million people worldwide are living with either hepatitis B or hepatitis C.[1] If left untreated and unmanaged, hepatitis B or C can lead to advanced liver scarring (cirrhosis) and other complications, including liver cancer or liver failure. While many people worry more about contracting AIDS than hepatitis, the reality is that every year 1.5 million people worldwide die from either hepatitis B or C faster than they would from HIV/AIDS.

Prevention techniques and vaccinations have markedly reduced the current incidence of common viral hepatitis infections; however, there remains a population of about 800,000 to 1.4 million people in the U.S. with chronic HBV, and about 2.9 to 3.7 million with chronic HCV according to the U.S. Centers for Disease Control (CDC).

Disease Burden from Viral Hepatitis A, B, and C in the United States:

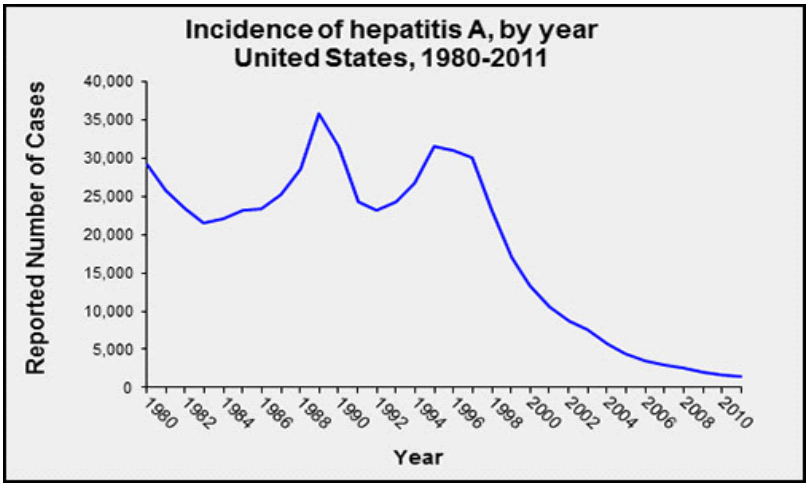
Hepatitis A

Reported Acute (New) Cases of Hepatitis A Virus (HAV)							Estimated Actual New Cases of HAV (range) in 2011*
2005	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2011 (estimated)***
4,488	3,579	2,979	2,585	1,987	1,670	1,398	2,700 (1,650- 4,370)

* Actual acute cases estimated to be 2.0 times the number of reported cases in any year

Est. No. of Chronic Cases In the United States	No. of Death Certificates listing HAV as a Cause of Death, 2010*
No chronic infections	95

* Underlying or contributing cause of death in most recent year available (2010)



Figure(2,8) : incidence of hepatitits A,by year United States, 1980-2011

Hepatitis B

Reported Acute (New) Cases of Hepatitis B Virus (HBV)							Estimated Actual New Cases of HBV (range) in 2011*
2005	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2011 (estimated)***
5,494	4,758	4,519	4,033	3,374	3,350	2,890	18,800(7,400- 86,200)

* Actual acute cases estimated to be 6.5 times the number of reported cases in any year

Est. No. of Chronic Cases In the United States	No. of Death Certificates listing HBV as a Cause of Death, 2010*
800,000- 1.4 million	1,792

* Underlying or contributing cause of death in most recent year available (2010)

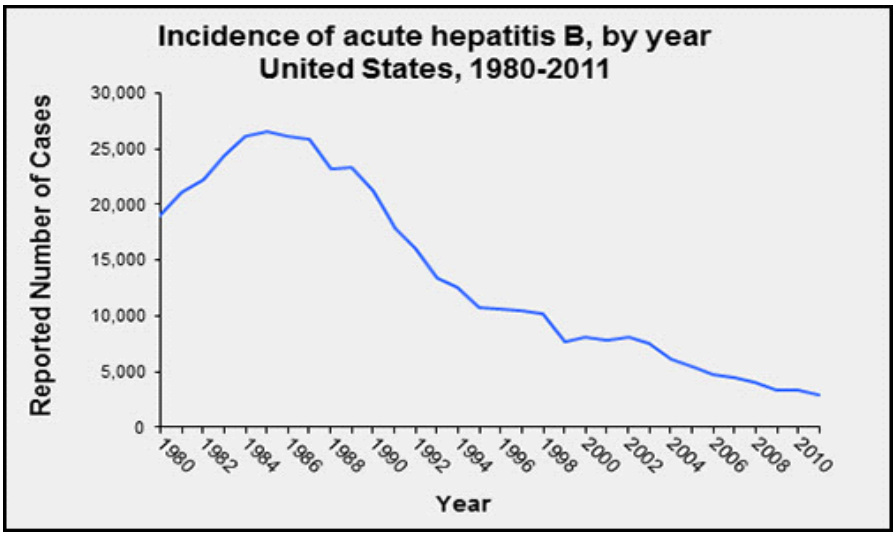


Figure (2,9) : Incidence of acute hepatitis B, by year United States, 1980-2011

Hepatitis C

Reported Acute (New) Cases of Hepatitis C Virus (HCV)							Estimated Actual New Cases of HCV (range) in 2011*
2005	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2011 (estimated)***
694	802	849	878	781	853	1,229	16,500 (7,200- 43,400)

* Actual acute cases estimated to be 13.4 times the number of reported cases in any year

Est. No. of Chronic Cases In the United States	No. of Death Certificates listing HCV as a Cause of Death, 2010*
2.7- 3.9 million	16,627†

* Underlying or contributing cause of death in most recent year available (2010)

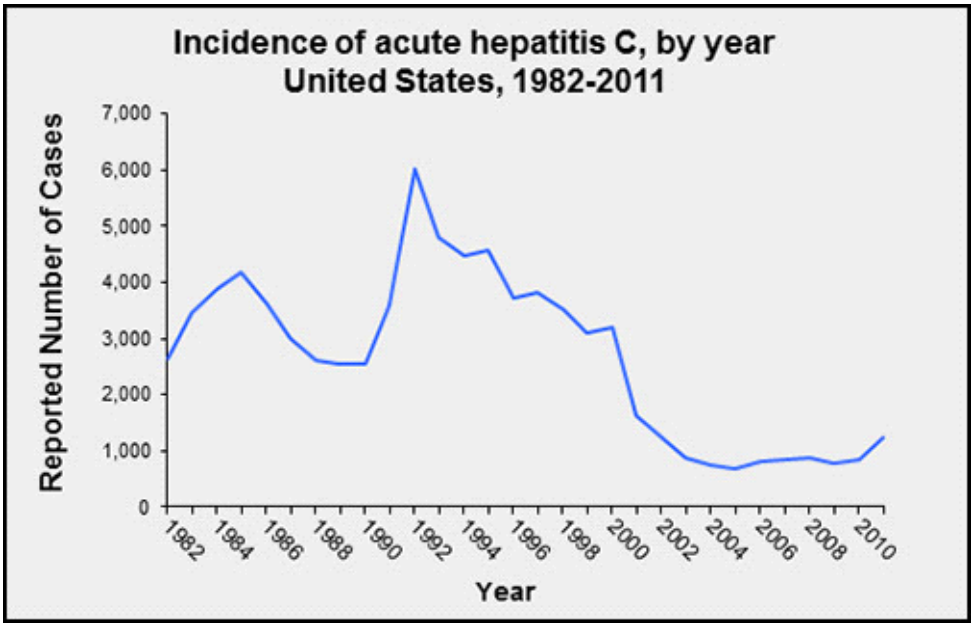


Figure (2,10) : indicates of acute hepatitis C, by year United State, 1982-2011

In our system, we will focus on the symptom which is important for our project, Is a yellowing of the whites of the eyes .As shown in Figure (2,١١):

Figure (2,11) : Yellowing of the eyes in hepatitis diseases

Chapter Three: Literature review

Introduction

This chapter reviews the previous and related works in the field of detecting eyes diseases. In addition, explaining what do we mean by image processing.

3.1 Literature review

3.1.1 Eye color linked to skin diseases:

“The eyes are the window to the soul." But a new study suggests that point of view also offers a peek at risk of serious skin problems on the road. The results showed that people with blue eyes were less likely to develop vitiligo. At the same time, people with brown eyes are more prone to develop this disease, skin and white spots characteristic of the skin and hair.

Researchers say that: results suggest that it may be the eye color that is an important implication for the risk of skin cancer because of the two diseases are linked genetically.

“Genetically , in some ways vitiligo and melanoma polar opposites ," says researcher Richard sprits , " some of the same genetic variations that make one more susceptible to vitiligo make one less prone to skin cancer , and vice versa . "

Vitiligo is an autoimmune disease in which the immune system attacks the person's normal pigment cells , causing irregular white patches of skin and hair. People with vitiligo are also prone to the development of other autoimmune diseases such as autoimmune diseases of the thyroid gland , diabetes , rheumatoid arthritis , and lupus .

Eye Color Tied to Skin Risk

In the study, published in *Nature Genetics*, researchers looked at the genes associated with vitiligo in 450 people with the skin disease and at a comparison group of nearly 3,200 Americans of non-Hispanic European ancestry. The analysis identified 13 new genes that predispose people to vitiligo. The results also showed that a lower percentage of people with blue or gray eyes and a higher percentage of people with brown eyes had vitiligo than would be expected with the normal distribution of eye colors.

For example, among the people with vitiligo:

- 27% had blue or gray eyes, compared with 52% of Americans of European descent without the condition.
- 43% had tan or brown eyes vs. 27%.
- 30% had green or hazel eyes vs. 22%.

Researchers say abnormal immune response associated with vitiligo may have implications in reducing the risk of skin cancer.

"We believe that vitiligo represents over-activity of a normal process that the immune system of a person searches and destroys cancer cells in the skin cancer early,"

The researchers say learning more about the genes associated with vitiligo, they may learn more about the genes responsible for other autoimmune diseases, as well as skin cancer.

3.1.2 In your eyes: what they reveal about your health

Ophthalmologist David Ingvoldstad, sees so much more about the health of his patients' than just their eyes. Thanks to the clues provide eyes, he warns patients regularly for autoimmune diseases such as rheumatoid arthritis as possible and lupus, and monitor the development of diabetes, and once even suspected correctly, as it turned out, that the patient has a brain tumor on the basis of the pattern of changes seen, Because the organs

of the body are interrelated, can reflect changes in the eye that found in the blood vessels, the nervous system and the immune system, among others. Eyes provide a unique glimpse into the body. Blood vessels, nerves and tissues can be seen all directly through the eye with specialized equipment.

"There's no question the eye has always been the window to the body," says Emily Chew, deputy director of the epidemiology division at the National Eye Institute. She adds, "Anybody with any visual changes…should be seeing someone right away."

Scientists working for the advancement of knowledge of what the eye can reveal diseases. For example, researchers are studying how dark spots on the back of the eye known as the CHRPE, or inflation congenital pigment epithelium retina, and are associated with certain forms of colon cancer, and how it is pointed out changes associated with dementia in the eye, such as how it reacts to the eye to light . Other scientists, such as Dr. Chiu, studying how to maintain eye health for a longer period, which can be good for the health of the eye as well as the rest of the body.

The function of the eye is to provide vision by converting the information contained in the light of the messages that the brain can understand. But vision problems can indicate a problem outside of the eye itself, One crucial structure in the eye is the retina, which allows us to experience the vision. It is made from the tissues of the brain and contains many blood vessels. The changes are reflected in the blood in other parts of the body in the retina of the eye, as well as, and sometimes more or significantly less than anywhere else in the body.

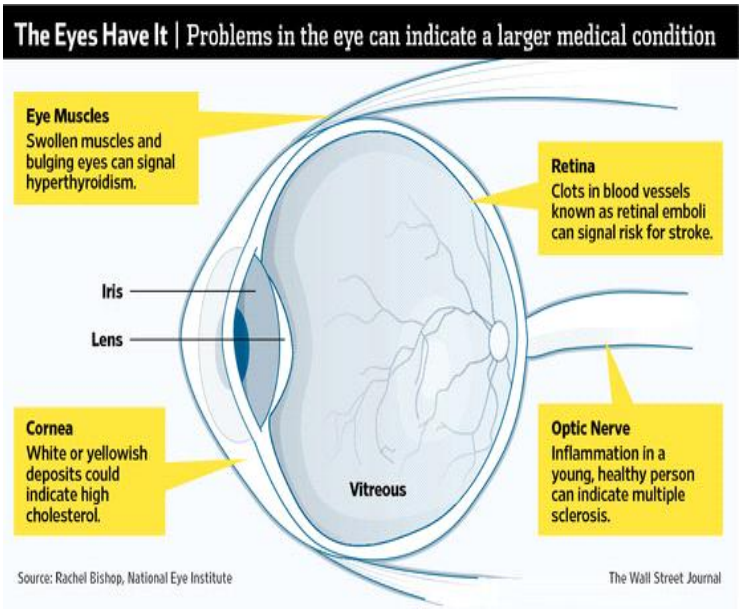


Figure (3,1) :problem in the eye can indicate a larger medical condition

Eyes can help to predict the risk of stroke, especially important for people who suffer from heart disease and stroke risk factors other. This is because the blood clots in the arteries of the neck and head, which could lead to stroke and are often visible as retinal emboli, or blood clots in the small blood vessels in the eye, according to the National Eye Institute. Interaction with the immune system's point of view we could say, well, resulting in information about autoimmune diseases or infections in the rest of the body. Sometimes it may show symptoms of the eye by others, such as joint pain. For example, it can be an inflammation of the optic nerve signal problems in young people. Along with low vision and sometimes pain, can indicate multiple sclerosis. If the optical disk, and a portion of the optic nerve, is swelling, and the patient has symmetrical decreased field of vision, such as the right visual field in both eyes dropped, they may need to make an assessment of a rare brain tumor circumstance.

If seen as immune cells such as white blood cells floating in the vitreous body of the eye, and can refer to the local eye infection or those that spread throughout the body.

" Diabetes is one disease that can cause major changes in the eye. In diabetic retinopathy, a common cause of blindness, blood vessels hemorrhage and leak blood and fluid. When

blood vessels don't function properly, they can potentially cause eye tissue to be deprived of oxygen and to die, leaving permanent vision damage. Also, in diabetic patients additional blood vessels may grow in the eye, anchoring themselves into the sticky gel known as the vitreous, which fills a cavity near the retina. This condition can cause further problems if the retina tears when it tries to separate from the vitreous—a common occurrence as people age—but is tangled by growth of new blood vessels. Usually diabetic patients who come in for eye exams already know they have the disease, and the primary purpose of an eye exam is to make sure they don't have diabetic retinopathy or, if they did have it, that the condition hasn't progressed, say eye doctors like Dr. Ingvoldstad, a private practitioner at Midwest Eye Care in Omaha, Neb. But once in a while there is a patient who has noticed vision changes but didn't realize he or she had diabetes until alerted during an eye exam that there were signs of the eye disease that is consistent with the condition, he says."

3.1.3 Four ways the eyes reflect liver problems

As the old English proverb says: "The eyes are the window to the soul," and this means that looking deeply into the eyes of the person reveals who they really are on the inside. In another perspective of this well-known adage, various medical traditions prove that control a person's eyes also predict the health of the liver.

Nicole says, is recognized as a strong correlation between the liver and eyes across four different types of associations:

- **Scleral Icterus:**

White usually white and opaque, solid is the white part of the human eye. When the solid yellow, and jaundice is the most common culprit. Yellowing of the eyes, and are often a sign of liver damage or liver disease, Jaundice is caused by the accumulation of bilirubin. While most people associate with jaundice, a yellowing of the skin and whites of the eyes are usually the first tissue affected by the infected liver is unable to remove bilirubin from the blood.

Scleral icterus is different from pinguecula, light-yellow colored bumps on the sclera. Although pinguecula usually appear in the corner of the eye near the nose, they can appear anywhere on the sclera. Believed to be a fatty deposit, pinguecula are usually a result of irritation from the elements, such as dust, wind and sun exposure.

- **Xanthelasma Palpebra**

Yellow eyelid plaque is a small yellow bumps on the eyelids. Sometimes referred to as "bumps cholesterol," plaque Yellow eyelid is usually a warning that a person has high cholesterol. These bumps are frequently mistaken for a stye, but consists plaque Yellow eyelid usually multiple, very small bumps. Because high cholesterol is often accompanied by the accumulation of fat in the liver, and yellow plaque can be a warning of the eyelid easily missed, very common, and the case of potentially dangerous known as fatty liver disease.

- **Dry Eyes**

While dry eye can have many different causes, dry eye, accompanied by paleness, fatigue, blurry vision, and thirst, and the absence of menstruation, muscle cramps, and floats in the eye, and poor night vision are all common in traditional Chinese medicine (TCM). In traditional Chinese medicine, can this syndrome refers to a lack of blood in the liver, which is a bug that has the potential to impede optimal liver function. Please note that the TCM detects imbalances in the body before they appear on the disease, as such, the diagnosis of liver blood deficiency in traditional Chinese medicine does not necessarily mean liver disease.

- **Irregularity Between the Eyebrows**

One of the hallmark diagnostic measures in TCM is observation. The Chinese see the body as a whole, where each organ is related to the rest of the body. As such, looking closely at certain areas of the body can offer big clues to its associated organ system. This connection has many applications, one of which is useful when an anomaly is seen between the eyebrows – an area that relates to the condition of the liver.

"A vertical line between the eyebrows may indicate liver problems that encompass impaired liver health due to alcohol, poor dietary choices or high stress levels. Evidenced by a crease in the forehead's center, excessive fat in the diet or food intolerances can negatively impact the liver. In TCM, the liver is the organ that holds anger – and it can be injured from rage. A precursor to congestion in the liver, a deep frown line is frequently found on those who either suppress their anger or get angry quickly; both contributing to potentially harmful liver congestion. "

Chapter Four: The System Description

The system based on image processing, and detection of the disease through the eye image, requires passage the image in several steps until reaching a result.

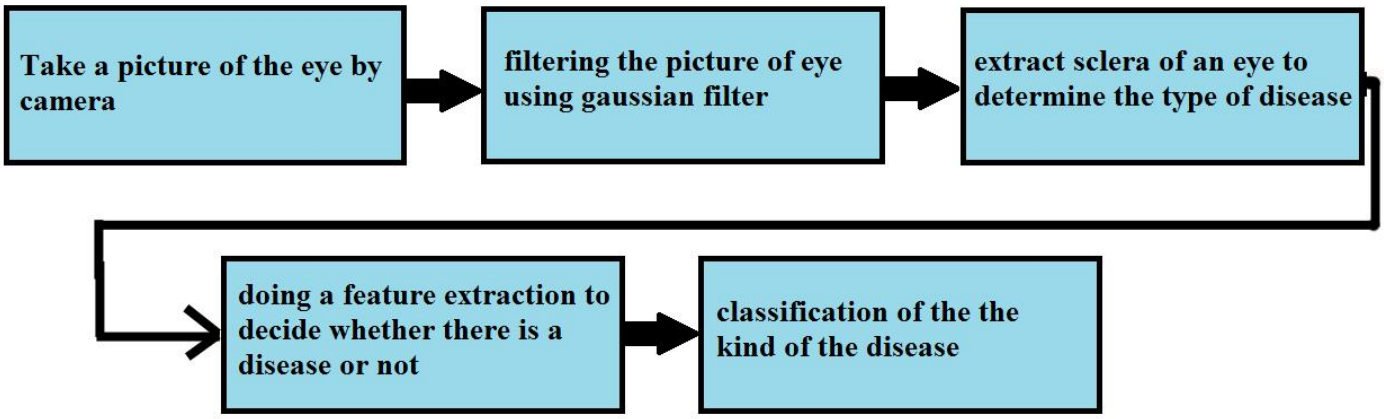


Figure (4.1) : Describe the system in general

Image processing steps

4.1 Acquisition

A picture is taken of the eye using a mobile phone camera or any other camera, the image transmitted to the computer, to be processed according to the following steps.

4.2 Preprocessing

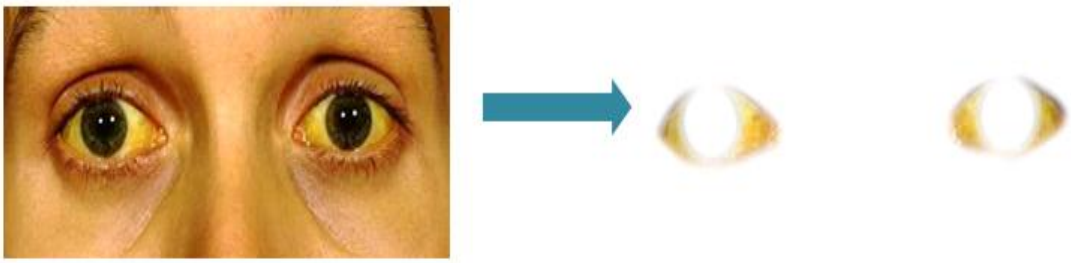
1. Resizing: the system resize image to 600x400, which used in all operation of simulation to produce thresholds.
2. Segmentation: Usually the input image on the system that has not only on the eye. So we need to image segmentation to separate the eye around it. We are interested in our system

with the white part of the eye (sclera). Separation of pixels depends on the color of pixels that have a ratio of yellow color, which indicates the presence of disease, hepatitis, or white color in the absence of disease, but for disease myasthenia depends on the size of sclera, if it is smaller than normal, it indicates the disease. Separated from the rest of the image pixels. And just take it to intervene in other operations.

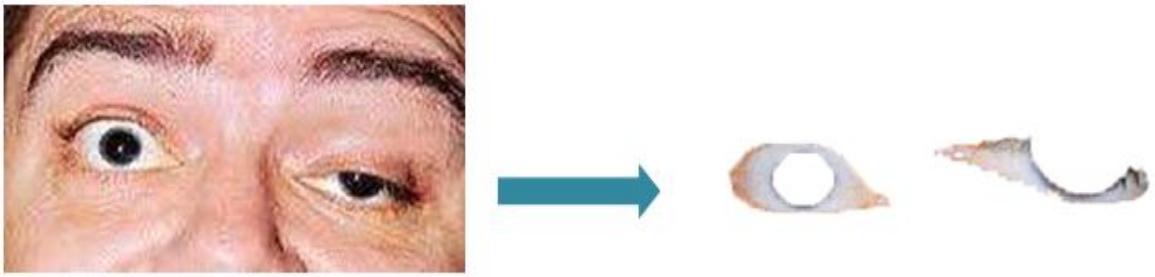
We chose the "color based segmentation" method for many advantages, the important one is that the clearest symptom for the diseases is color of eye.

Final result of implementing color based segmentation method:

- For diseases hepatitis:



- For disease myasthenia.



A- normal eye b- Infected eye

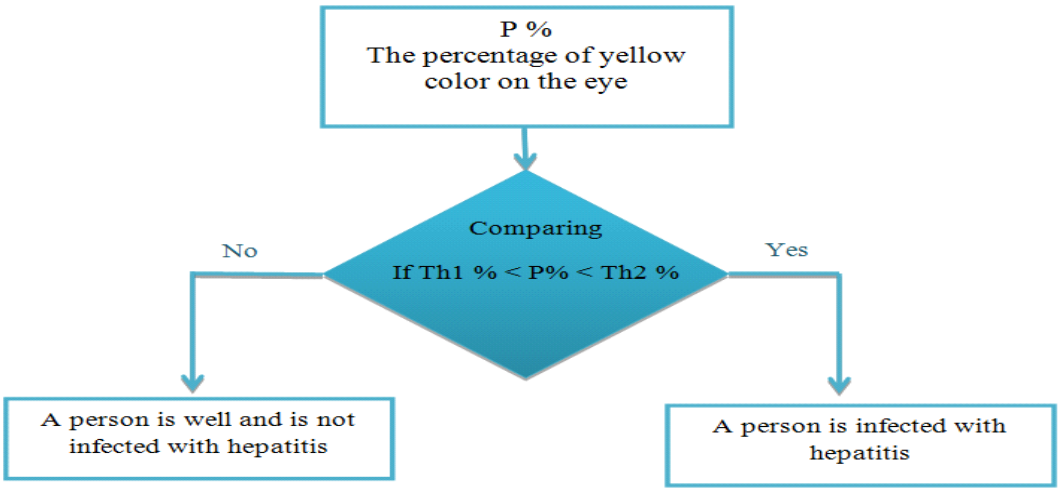
4.3 Feature Extraction and classification

When the input data to an algorithm is too large to be processed and it is suspected to be notoriously redundant (e.g. the same measurement in both feet and meters) then the input data will be transformed into a reduced representation set of features (also named features vector). Transforming the input data into the set of features is called *feature extraction*. If the features extracted are carefully chosen it is expected that the features set will extract the relevant information from the input data in order to perform the desired task using this reduced representation instead of the full size input.

In our system, after we obtained the part of the eye image that contains yellow/white color, the system calculates the number of pixels that hold yellow color to calculate the percentage of color. Then, the system compares the result with predefined range of percentage (threshold1, threshold2).

The threshold values determined based on medical studies, which provide us with information that proves the existence of the disease through a specific percentage of yellow color in the eye.

The system uses algorithm to implement comparing. This algorithm depends on existence of the percentage within the range of predefined thresholds. If yellow color percentage on eye image greater than threshold 1 and less than threshold 2 (within the range), the system take decision: there is a high probability that a person is infected with hepatitis, and a person must go to hospital for treatment, but, if the percentage is not within thresholds range, the system take decision that a person is well and is not infected with hepatitis.

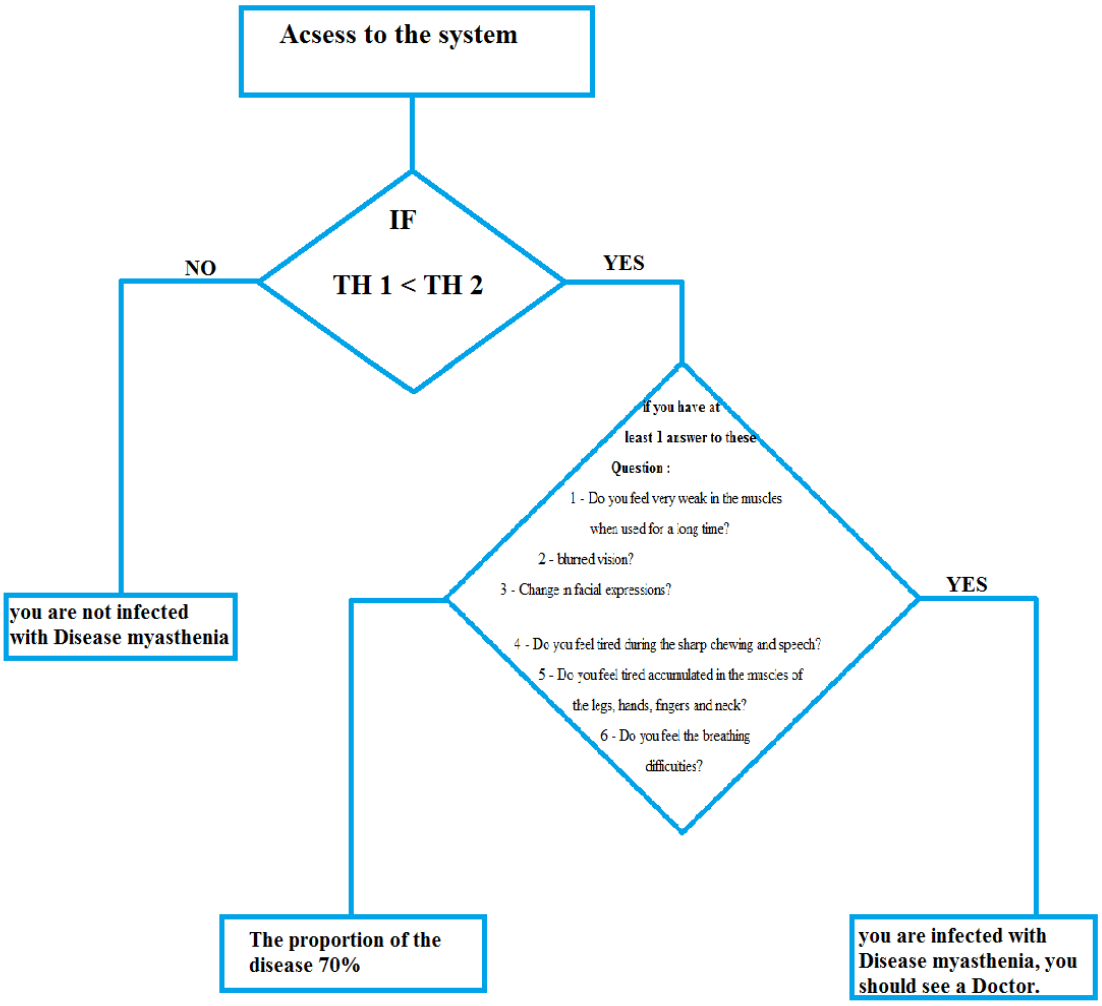


1- Do you feel loss of appetite?
2- Do you feel nausea?
3- Do you vomit?
4- Do you have fever?
5- Do you feel weakness?
6- Do you feel tiredness?
7- Do you feel aching in the abdomen?

As for the disease myasthenia, after that we have to eradicate sclera of the eye , the system compares the affected eye for an eye natural by comparing the threshold for the eyes , so that if the threshold 1 is greater than the threshold 2 , Our system also directed questions to the user system to support result in determining the outcome of the disease , such as:

1- Do you feel very weak in the muscles when used for a long time?
2- Blurred vision?
3- Change in facial expressions?
4- Do you feel tired during the sharp chewing and speech?
5- Do you feel the breathing difficulties?

So that, if a person has at least one answer to these question , he is infected with myasthenia But if he answer was no to all questions is infected with 70% .



Chapter Five: Requirements and Specifications

Overview

This chapter covers the preparation steps that must be followed before starting implementation, the tools that were used to implement this project and the methodology that is used in this project to detect human diseases.

5.1 Data Collection

The preparation steps include collecting images of human eyes and studying them and then defining some constrains on these images to achieve successful result.

Collecting images of a hepatitis and myasthenia disease

We started building this system even reveals two diseases (hepatitis, myasthenia) we have collected image of normal eyes and non-normal eyes of a patient through research via the Internet and through taking pictures of natural persons and people suffering from diseases in Hebron, using a camera with a good accuracy. Figure (5.1) and Figure (5.2) show eye for a person infected with hepatitis and the disease myasthenia.

Figure(5.2) : samples of person infected with hepatitis .

Figure (5.3) : samples of person infected with myasthenia.

Determining the constraints on the data

Human diseases detector system has some constraints; in this section we will list some of them.

1. The images of eyes are digitized using a digital camera with very high resolution at least (600 * 240).
2. The image must be taken to one eye for hepatitis diseases but both eyes for myasthenia disease.
3. The image must be a full image of the eye and is not part of it.

5.2 User Interface

In this part we display and explain the interfaces, there is different interface for each disease.

New Test interface: The user clicks on browse button to upload image from computer to the system in order to be tested. The user answers the questions in the myasthenia disease system and hepatitis disease system. When the user clicks on check button, show him the testing result on the interface. By using this interface the user can see the results of the system as shown in figure 5.3 and Figure 5.4.

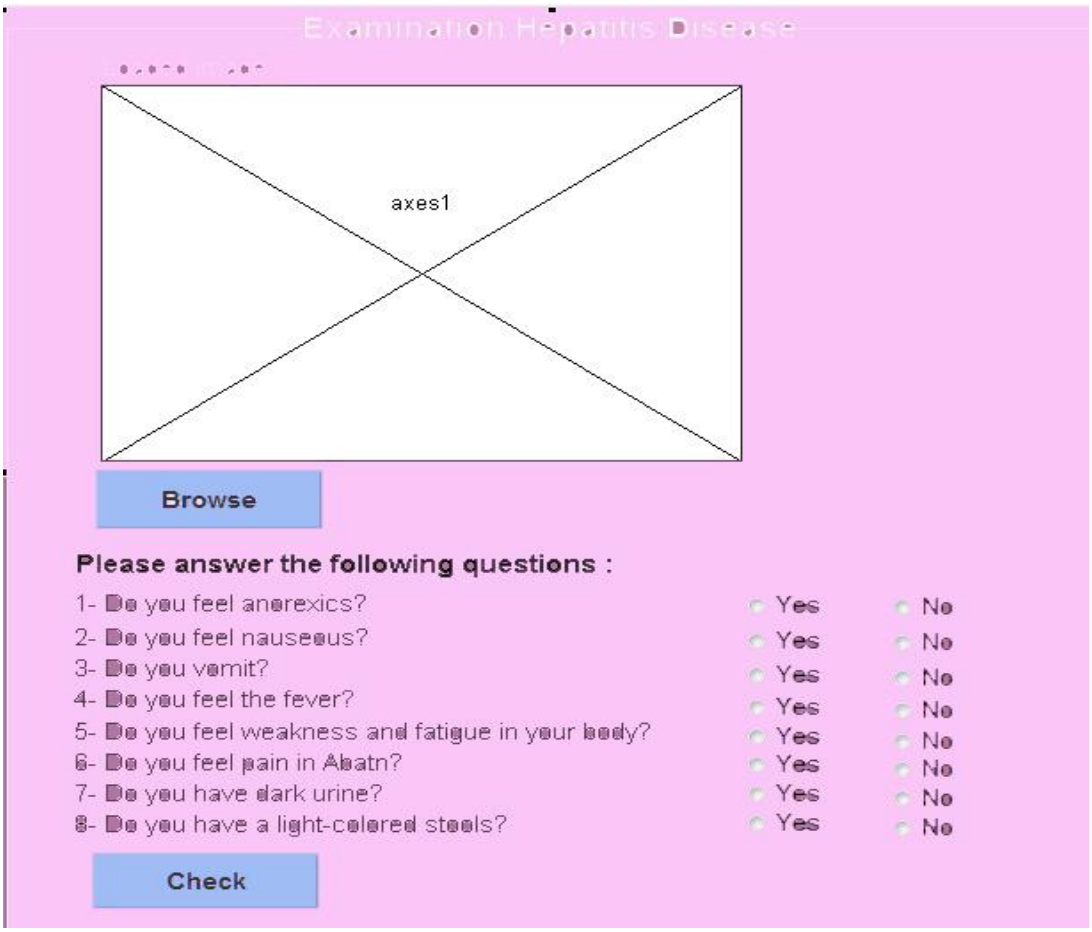


Figure (5.4) : Interface for Hepatitis Disease

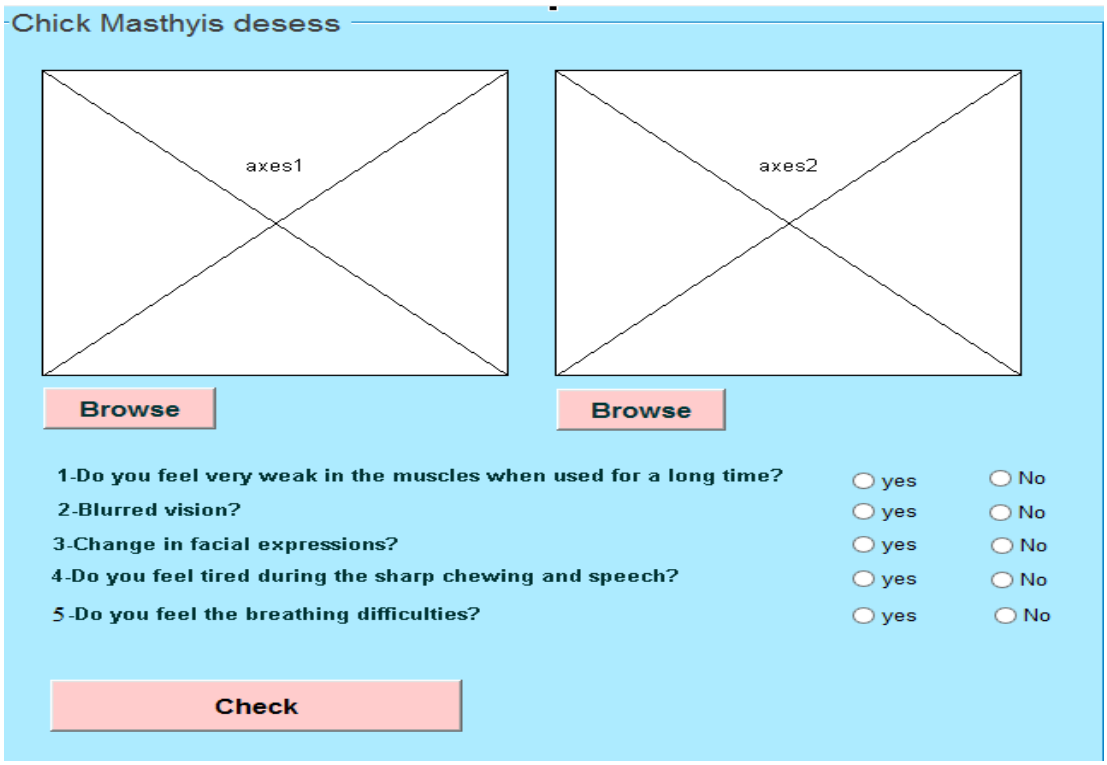


Figure (5.5) : Interface for myasthenia Disease

5.3 System Environment

The system requires special instruments, in order to maintain good detection quality. The project environment must contain the following instruments:

1. A good resolution digital camera at least (600 * 240), The camera takes picture of the human eyes.
2. The camera is connected by a cable to the Computer to upload the image, or by Bluetooth to send the image.
3. Each disease has its own system, in hepatitis disease system; the user enters an image of one eye, and then answers some questions to show him the test result. In myasthenia disease system; the user enters the images for both eyes, and answers some questions to show him the test result.

5.4 System requirements

Hardware

Different hardware tools were used during the development of the project:

1. Digital camera to capture images of eyes.
2. A computer where the system is installed.
3. Cable to connect camera with computer.

5.5 Software Specifications

The software that we worked on to develop the project is:

1- Matlab

We used Matlab for simulation process because of the following reasons:

a. Matlab is an easy environment for simulation.

b. It includes many image processing ready functions in the image processing toolbox.

c. The programming language of Matlab is similar to C language which can help in the code translation.

d. We used matlab to make GUI.

Software design

The human disease detection works as following: first, a digital camera will capture images of eyes. The system will enhance the image using a filter in order to remove unwanted pixels (noise) from the eye image. The system will then apply segmentation on the image for to isolate the Sclera from the eye image. In order to extract infected regions from the eye image we apply another segmentation based on the color of these regions, where the values of pixels that comprise the infected regions are located within specific range. If the system finds pixels that hold a value located within the specified range and the region was of a given size, then the person will be classified as Infected with one of the diseases (Hepatitis, myasthenia), otherwise the person will be classified as not infected. Figure 5.5 shows these steps for two system.

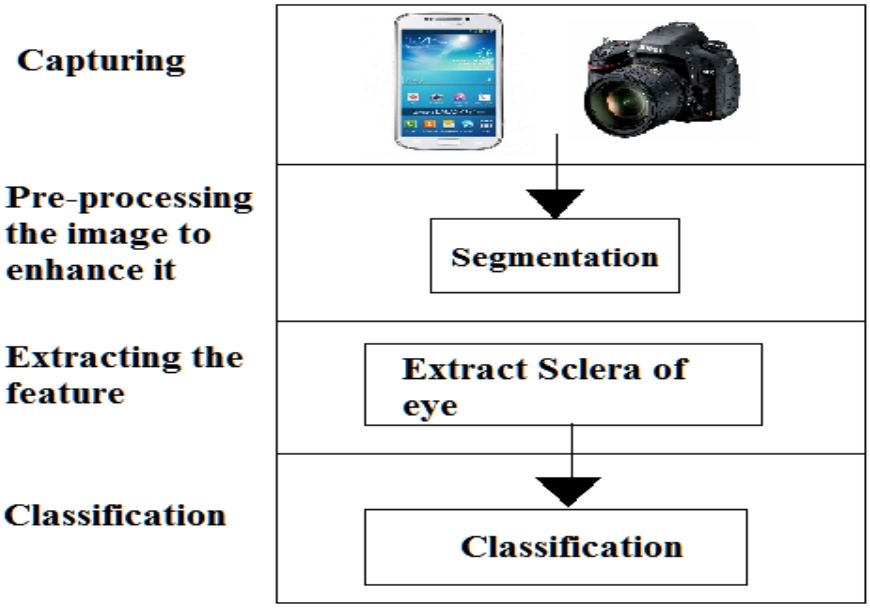


Figure (5.6) : Steps for Two System

Processing the image

Before being able to detect infections, some processing is needed on the image. These processes include:

1. Reading the eye image (RGB model): the model should be entered into the system in RGB model.
2. Using filtering to reduce the noise: As mentioned in chapter two there is many types of filters such as mean and median filters. Image filtering allows you to apply various effects on photos, which will be useful in enhancing images to be clearer to apply segmentation algorithms.
3. Applying segmentation on enhanced images: As mentioned in chapter two, segmentation is determining the boundaries of a region in an image, here the sclera of the eye should be isolated from eye image, this done using segmentation algorithms.
4. Clustering: We have a dataset of normal and abnormal eyes, when we applied a cluster develop code, the images in dataset separated to two clusters; normal eyes in cluster and abnormal eyes in another cluster. This separate depends on the features of the eyes, (color: yellow or white), and questions answered by users. The result of the test depends on the weight of each feature. Where we gives eye color feature 50% of the weight of the result, and we gives all questions 50% of the weight of the result.

Chapter Six: Implementation

Overview

This chapter talks about implementation phase which is divided into two sub phases simulation and real time programming in order improve accuracy and efficiency.

This chapter covers important phases of system development phases which are system programming, installation and testing, where the software tools and equipment that are used in developing the system will be identified, this will be done by analyzing the following:

- Software tools that are required to develop the system.
- System programming.
- System installation.

In this chapter, a set of algorithms were developed to apply them in the project, these algorithms are converted into implementation code. Some of these algorithms will be discussed in this chapter.

6.1 System Simulation

Simulation part was an important step in system development process. We used MATLAB program to simulate the system, which was a great choice because Matlab provides a comprehensive and flexible environment for image acquisition, analysis, processing, visualization, and algorithm development. We applied simulation to test the system using large number of samples and after we were sure of the results we then move to real time programming.

First, we used imread function to read normal and abnormal Hepatitis images from dataset, we read normal eyes images to extract range of white color from eye sclera, and we read abnormal eyes images to extract yellow color range from eye sclera. We need to use this ranges on the segmentation step.

To extract the range of thresholds from images, we apply specific code on image by image entered. Where we tack random sample of yellow pixels and store the RGB values for each pixel on R array,G array and B array. And apply this operation on each normal and abnormal image. Then store the values of normal images on normal RGB arrays, and store the values of abnormal images on abnormal RGB arrays. We use MAX function to determine the maximum value on R array, and we use MIN function to determine the minimum value on R array. And so on for all RGB arrays for normal and abnormal images. The result is normal R threshold [Min Th, Max Th], G threshold [Min Th, Max Th] and B threshold [Min Th, Max Th], and abnormal R threshold [Min Th, Max Th], G threshold [Min Th, Max Th] and B threshold [Min Th, Max Th].

We use this result to apply segmentation code. On segmentation code we use color-based segmentation algorithm.

To develop clustering code, we need to calculate some values previously that resulting from Hepatitis images. After read images, we calculate summation for each RGB values, the result is Rsum, Gsum and Bsum for entered image. Then calculate average of Rsum, Gsum and Bsum and store three average values on three arrays, we calculate another average for each array of three arrays. The result is R mean, G mean and B mean, where R average represent the average of all red pixels averages in all images entered to code.

In the Myasthenia, we develop program to calculate threshold for normal and abnormal eyes from dataset in the same time. First, two images entered into code (normal and abnormal), we convert RGB image to Black-White image, then we count the number of white pixels in each image, and divide count result by image unified size to extract the percentage of white pixel to total image pixels, we calculate the difference between normal count percentage and abnormal count percentage. The result of difference stores on array. Then calculate the average percentages of both normal and abnormal arrays. We use this results to extract the final result of the system.

All needed values to develop real programming are prepared.

6.2 Real time implementation

This is the second phase of implementation process in which the project was programmed using MATLAB GUI program.

Steps of program implementation

1. Read image from Graphical User Interface.
2. Apply segmentation code on image: segmentation depend on color-based segmentation; segmentation code segments white area of normal eye (sclera), and white area of the affected eye by myasthenia disease, and it segment the yellow area of affected eye by hepatitis disease. We used RGB thresholds that have been previously calculated to segment images.
3. Clustering: In the hepatitis case, we calculate R average, G average and B average of segmented image pixels, then calculate the distance between each average of entered image andrelated normal and abnormalmean , such as distance between R average and R mean for normal eye, and distance between R average and R mean for abnormal eye.
4. Result: In the hepatitis case, the result of clustering used to know if the image is closer to normal cluster or to abnormal cluster, where smaller distance in the closer cluster. This result represents of 50% from final result weight. In myasthenia disease code, 60% of the result comes from comparing the percentage of white color on first entered image, with percentage of white color on secondentered image, after compare each percentage with threshold previously calculated. The rest of the weight of the final result comes from the answers to questions relating to the disease on both diseases.

6.3 System Testing

In this phase system modules will be tested, where testing process is done through making sure that the system achieves its desired requirements and needs and works as expected.

Testing is the process of isolating the sclera of eye image from the eye image. This process is done by using segmentation method. (Figure 6.4 and figure 6.5 shows an image before and after isolation for two diseases).

For Myasthenia disease

Figure (6.4) : a- image before isolation b- image after isolation

For hepatitis disease

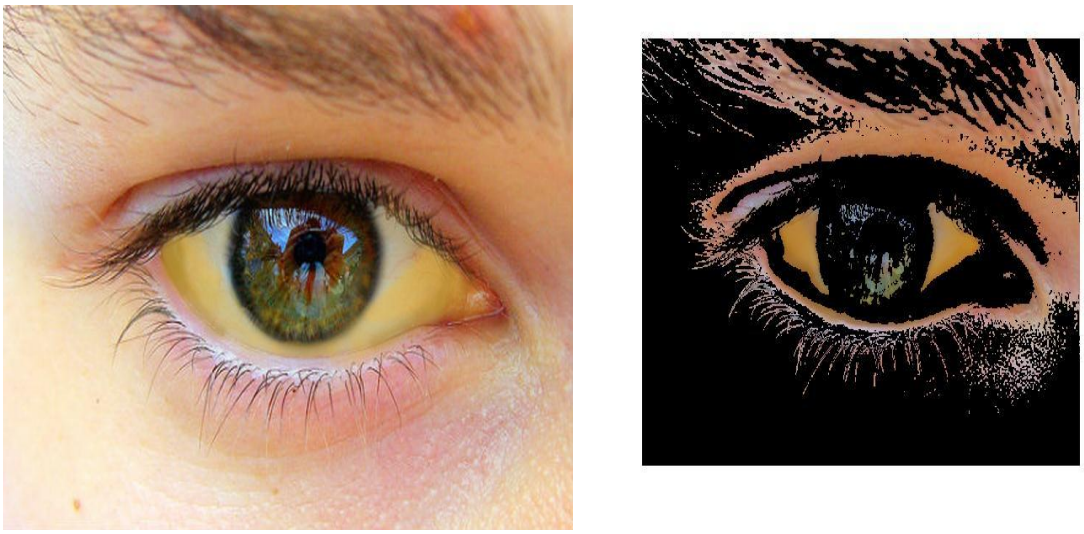


Figure (6.5) : a- image before isolation b- image after isolation

After testing each of system modules separately, we tested the whole system, where all of the system modules are integrated together. Testing process is done through testing the validity of the results. In this approach, the system is tested on 100 samples from which 50 samples normal and abnormal eye image for each system (myasthenia and hepatitis system) are infected with myasthenia and hepatitis disease, 50 samples are not infected for each system. The system gave correct results in almost 82%.

Chapter Seven: Conclusion

Overview

This chapter will illustrate all results that are achieved after finishing development phase, recommendations and references that were used during the development phase.

7.1 Results

After finishing development phase the following results has been achieved:

- The team was able to develop the system, where images were converted to readable data to extract results from it.
- Increasing the accuracy of results if a camera with high resolution were used in capturing images.

7.2 Recommendations

- Using a camera with a very high resolution.
- Adjust lighting properly.

7.3 Future developments

- We will develop the system to mobile application .
- Using another color model.
- Applying the system to detect other human diseases.

7.4 Conclusion

A computer based method that can read a captured image for a human eye and give a statement and numbers that describes infection of this eye from the image with minimum user intervention is innovated. The project can analyze a human eye then decide whether it is infected with Hepatitis and Myasthenia or not in addition to the degree of disease severity.

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