Diabetes and heart disease identification using biomedical iris data

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Abstract. The World Health Organization (WHO) report shows that Heart disease is the major cause of death all over the world i.e. nearly 21.2 million people die every year directly or indirectly from Cardiovascular (Heart) diseases estimated 32% of all deaths worldwide. Whereas, Diabetes is at the ninth position for the death all over the world i.e. nearly 3.7 million people die every year from diabetes estimated 6.61% of all deaths worldwide. The Heart and Pancreas organ play a most important role in human being. The blood flows in all parts of the body through heart. The function of pancreas is to regulate maintain the insulin levels that is responsible for diabetes. The detection of heart disease and diabetes takes too much time and very costly process. In our research, we develop a Heart Disease and Diabetes Identification System based on Iris Healthcare Kiosk. We proposed a desktop system application that detects these diseases through the Iris. The process starts by taking the left Eye photograph of the patient's through Eyeronec (company name) camera and perform intermediates operations of target cropping, pre-processing, auto-cropping (through integral projection and removing sclera), heart regions of interest (ROI) measuring, pancreatic measuring, extracting the feature and finally classify in the result. The classification result shows that 83% tests are successful, 11% tests are scant whereas 6% tests became fail. The operation is performed on 32 different training digital data sets and final result is labelled as normal or abnormal. The result shows that accuracy of our proposed system in heart disease and diabetes are 86.36% and 90.91% respectively.

Keywords: Cardiovascular Diseases (CVD’s), Eyeronec, Sample Registration stem (SRS) Heart Regions of Interest (ROI), Signal to Noise Ratio (SNR).

1. Introduction

Everyone knows that diabetes is a long time chronic disease. The excessive glucose present in the blood that is not absorbed properly by the body cells causes many disorders in the human body e.g. heart disease and diabetes [1]. Diabetes is divided into two categories namely normal or abnormal based on the value of random blood glucose (if values are above normal). The person is a said to be a non-diabetic (normal) if blood glucose level is between 80 to 142 mg/dl.

The person is pre-diabetes if blood glucose level is between 142 to 210 mg/dl. If glucose level in the blood is more than 210 mg/dl than the person is diabetic. If any disease is not treated on time that may cause many serious complications and may be life threaten in the later stage [2]. Uncontrolled blood sugar may cause many serious complications attack in the human body. Vision (Eye) problem may be cause due to uncontrolled blood sugar that results blindness.

The function of heart is to carry blood that pass through different blood vessels size from 9.5 cm to 13.5 cm. The heart lies is in the middle of chest compartment, slightly in the left and behind the human breastbone [3]. The heart is an important giant muscle in the human body while its weigh is only 8 to 13 ounces. The function of every part in the heart is different but every part works equally to run the human body properly. The heart disease may be cause due to heart malfunction, blood vessel disorder, rhythm disorder or blood cells congestion in the heart [4].

In 2021, a survey named sample registration system (SRS) conducted by the ministry of health shows that the second highest cause of death is heart disease is nearly 12.9% after the heart stroke [5]. The result of health ministry survey data shows that diabetes value increase sharply from 5.7% to 6.9% in last 7 years (2014 to 2021).

The Sample Registration System (SRS) survey conducted by the Health ministry in 2014 shows that diabetes is also the higher cause of death with 6.9% than the heart stroke (20.2%) and heart disease (13.1%). The unhealthy food, unmanaged lifestyle, consumption of more sugar, consuming lots of oil and wrong eating habits is another reason of many diseases [6]. Another reason is the lack of sports activities, obesity and consults a doctor rarely or almost never.

In present work scenario, people should not ignore the diabetes and heart disease. Everyone should consult with the doctor for laboratory tests and health check-ups in a regular manner [7]. Presently, health check-up is too much costly in any hospital or health checkup institution. In reality, it is very difficult for low income group people to take the health services [8]. Hence, there is a need to identify diabetes and heart disease through a low cost examination system. The Iris system is an alternative to identify the diabetes and heart disease instead of paying very expensive health check-ups. The process of heart disease and diabetes identification start with the interaction of our health based digital system [9].

In this paper, our purpose is to design a digital health based system that is used to detect the health issues specially heart disease and diabetes of any person based on Iridology (also known by iridiagnosis and iridodiagnosis) [10]. The images of iris will be captured through the iridology using the designed system. The designed system will help in diabetes and heart disease prediction of any human being.

This research will facilitate the normal human being to locate the HealthCare Kiosk System easily that helps to provide the disease information in early stage without performing high cost medical checkups [11]. In the field of medical, this technique will help in minimizing the detection cost of diseases like heart disease and diabetes.

In the human body, most of the organs condition can be access/read/examined through iris/ iridology because every organ in human body has a direct complicated nerve connection to the iris (muscular diaphragm). Our both eyes (left and right) have nearly 60 (sixty) different identification locations that represent certain organs [12]. The organs in the left side of the body are controlled and imagined through the right side iris and organs in the right side of the body are controlled and imagined through left side iris [13].

Initially, Iridology concept was introduced by “Herr Theodor Kriege” through his book “Chromatica Medica” published in year 1664. Herr Theodor Kriege not used the term iridology directly. Later, a European scientist (Bernard Jensen) explained poison detection concept in the human. In 19th century, Hungarian physician “Ignaz von Peczely” was the first person who use "Eye Diagnosis" loosely translated as iridology [14]. Hence “Ignaz von Peczely” is titled as the father of the iridology technique.

The Iridologists described that iris contains eight different topographies those are used to represents the condition of organs in human being [15]. The abnormality in the organ can be detect through the iris if any organ is irregular or damaged. The iridologist is based on the eye blood vessels that may

discover food allergies, environmental allergies and other sensitivity. The nature of the allergy or sensitivity is determined by comparing various markers in the iris based on iridologists [16].

The pancreas has a relationship with mellitus diabetes called a metabolic diseases group where hyperglycemic result is classified in secretion insulin defects, insulin defects in the action) and positioned in third outer circle after the pupillary area at a position 03.50 - 04.20 mm in the left eye. The eyes vasculature and heart has many common characteristic.

The early and timely accessible of the eye vessels are very beneficial [17]. The heart disease can be detected through the blood vessel positioned at 02.20 - 03.10 mm in the left eye. The pancreas, heart and many other organ regions in the iris are shown in Figure 1.

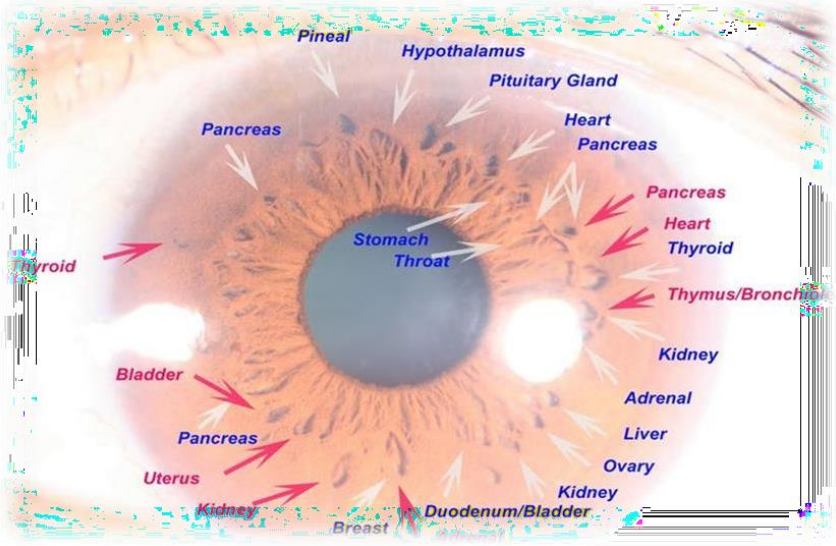

Figure 1. Pancreas and Heart Organ Regions in the Iris.

The detail region representation of all the organs in both the irises (Right & Left Iris) is shown in Figure 2.

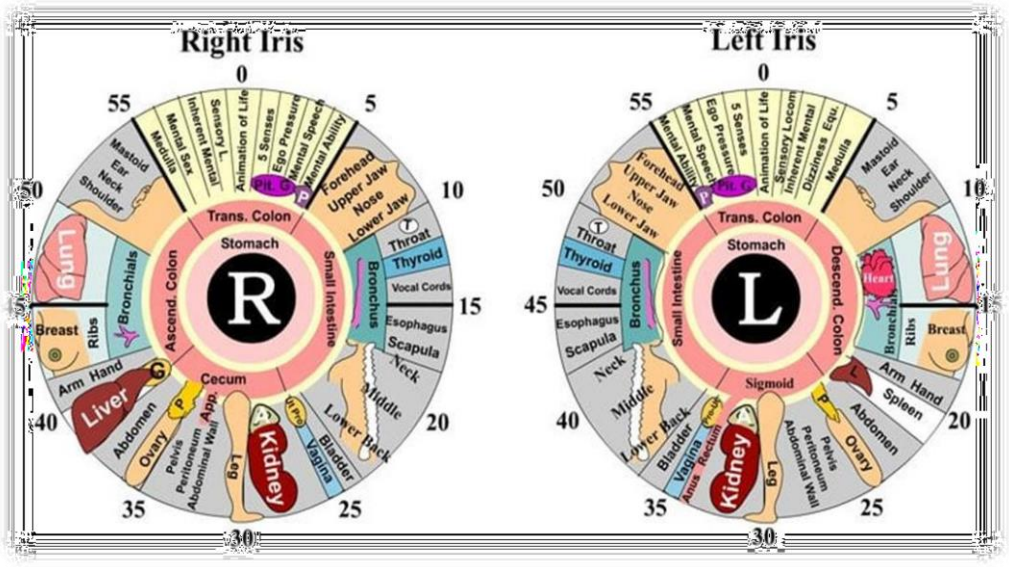

Figure 2. Iris Organs Regions Position Representation in the irises (Right & Left Iris).

2. System design

In our system design, we use five different steps or processes. The complete five steps (processes) of our system design are shown steps by In our system design, we use five different In our system design, we use five different steps or processes. The complete five steps (processes) of our system design are shown steps by step in Figure 3:

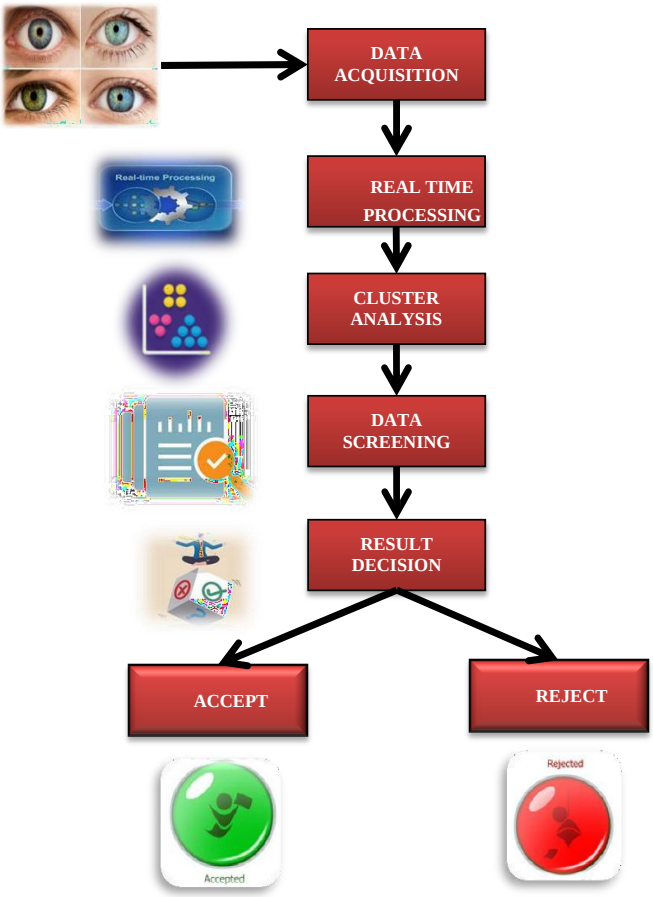

Figure 3. Design of Proposed System.

2.1. Data acquisition

The acquisition of the data is the process to collect the iris photo details in the form of digital record. In image acquisition, our main aim is to selection and collection the digital record of the iris image. In the design of our system application, the acquisition process is implemented and recorded through a high quality Iris Camera also known as Iridology Camera, Digital Iriscope, Eyology and Sclerology Camera. In our research, we select the Iris Camera of EyeRonec Company, USA. EyeRonec Company is specialist in Iris camera manufacture and supply economical high quality products. The recorded Iris images are used as a digital test data. The image of EyeRonec iris camera is shown in Figure 4.

In our research, we use light black color Iris images in the form of digital data. The high definition different images of left iris are captured using high quality camera (EyeRonec company) connected with a special application based desktop. The camera collected digital data is used to represents the pancreas and heart organs. There are some special instructions that should be take care at the time of image capturing as precise as possible for a correct result. The patient should place the iris in the central point of EyeRonec device. The pupil center should be keep along with center coordinates and eye position should be straight to capture the best image.

Figure 4. EyeRonec Iris Camera Image.

2.2. Real time processing

Real time processing is a technique that improves the quality of input digital data of an iris images. Preprocessing is divided in two different process called segmentation and normalization. Segmentation process divides the input data in different categories as well as combines the similar category input data. Segmentation process helps to improve the success rate in the next processing stage. On another hand, normalization process improves the quality (contrast, brightness etc.) of image digital data. The Normalization process performs noise elimination, image transformation and use the image partially as per the requirement to enhance the result accuracy. Preprocessing includes the color detection, median filter and cropping and many more to improve the image quality of digital data.

2.3. Cluster analysis

Cluster analysis is used to extract all the needful features from the iris images data set. The heart disease or diabetes disorder classification is decided based on the iris image extracted features. The main purpose of feature extraction is to measure the quantitative values like magnitude average, standard deviation and coefficient variation as well as signal to noise (SNR) ratio for every pixel of all images. The pixel values ratio is based on the different intensity of image pixel that helps in classification the result for the next stage.

2.4. Data screening

Data screening is the process to separate desired data as per their class values. The correctness of classification result is based on the image intensity calculated by the feature extraction stage. The threshold value is calculated based on image intensity. The threshold value is calculated by the average ration of black and white training data set. The output is classified into different categories based on their intensity values. The result is classified in two categories i.e. normal and abnormal. The classification is *"Normal"* if white ratio is less than the threshold value and *Abnormal"* if white ratio is greater than the threshold value.

2.5. Result decision

Result decision is the final/last stage after classification process. The final result is based on the intermediate result after image acquisition. The final result is classified normal or abnormal (not normal) based on the threshold value. The normal result represents that the patient do not have any disease among diabetes or heart disease. The abnormal result confirms that the patient have diabetes or heart disease.

3. Experiment stage

In the experiment state, we discussed about the analysis of result and test our proposed model. In testing phase, the result of every stage of the model/system e.g. the result of feature extraction, autocropping and finally classification is tested thoroughly. In second stage, the test result/classification is analyzed using different approach. The purpose of our proposed model is to detect abnormal pancreat-

ic those are used to recognize mellitus diabetes as well as diseases like heart disease and diabetes through high definition camera (Eyeronec in our experiment) and verify the system accuracy.

The ratio of black and white pixels in digital training data set is shown in Table 1 and Table 2. We divide each Table in two different diseases i.e. heart disease and diabetes as per our research concept. Table 1 shows the black ratio and white ratio values of 15 different Iris images captured for the "Normal" identification. Whereas, Table 2 shows the black ratio and white ratio values of 15 different Iris image captured for the "Abnormal" identification.

The next step is to assign the predefined threshold value of each disease (diabetes and heart disease) for the Normal or Abnormal classification based on average black ratio and white ration. The threshold values of black and white ratio for normal and abnormal data for Diabetes and Heart Disease are shown in Table 3 and Table 4.

Table 1. Black Ratio and White Ratio in Diabetes and Heart Disease for the Normal Eyes.

S.N.	CAMERA NAME	DIABETES		HEART	
		BLACK PIXEL RATIO	WHITE PIXEL RATIO	BLACK RATIO	WHITE RATIO
1	Mob-cam 313	652	315	732	265
2	Mob-cam 346	764	346	668	213
3	Mob-cam 382	83	22	547	186
4	Mob-cam 407	905	399	173	33
5	Mob-cam 464	835	386	692	264
6	Mob-cam 538	804	365	752	306
7	Mob-cam 574	724	304	786	357
8	Mob-cam 633	578	286	574	234
9	Mob-cam 664	624	308	592	257
10	Mb-almas 1	404	205	704	302
11	Mb-almas 3	386	175	516	216
12	Mb-almas 6	628	214	734	326
13	Mb-almas 8	554	358	612	243
14	Mb-almas 12	625	241	598	218
15	Mb-almas 15	734	258	314	142

Average Pixel Ratios in Diabetes:
Black Pixels Ratio: 620.0
White Pixels Ratio: 278.8

Average Pixel Ratios in Heart Diseases:
Black Pixels Ratio: 599.6
White Pixels Ratio: 237.5

Table 2. Black Ratio and White Ratio in Diabetes and Heart Disease for the Abnormal Eyes.

S.N.	CAMERA NAME	DIABETES		HEART	
		BLACK PIXEL RATIO	WHITE PIXEL RATIO	BLACK PIXEL RATIO	WHITE PIXEL RATIO
1	Mob-cam 313	532	237	614	306
2	Mob-cam 346	654	369	512	282
3	Mob-cam 382	437	232	476	198
4	Mob-cam 407	815	574	241	49
5	Mob-cam 464	424	296	495	275
6	Mob-cam 538	744	368	642	413
7	Mob-cam 574	624	294	186	101
8	Mob-cam 633	438	182	474	287
9	Mob-cam 664	623	310	513	300
10	Mb-almas 1	502	275	684	406
11	Mb-almas 3	86	98	267	187
12	Mb-almas 6	426	115	624	281
13	Mb-almas 8	375	157	423	188
14	Mb-almas 12	478	214	244	99
15	Mb-almas 15	624	351	735	367

Average Pixel Ratios in Diabetes: Average Pixel Ratios in Heart Diseases:
Black Pixels Ratio: 518.8 Black Pixels Ratio: 475.3
White Pixels Ratio: 271.5 White Pixels Ratio: 249.3

Table 3. Threshold Value of Black and White Ratio in Diabetes.

S.N.	RATIO	AVERAGE		THRESHOLD
		NORMAL DATA	ABNORMAL DATA	
1	Black Pixels	620	518.8	623.4
2	White Pixels	278.8	271.5	284.7

Table 4. Threshold Value of Black and White Ratio in Heart Disease.

S.N.	RATIO	AVERAGE		THRESHOLD
		NORMAL DATA	ABNORMAL DATA	
1	Black Pixels	599.6	475.3	613.4
2	White Pixels	237.5	249.3	263.4

Finally, we calculate the identification accuracy Diabetes and Heart disease for our training data set

and comparison of final result with target is shown through Table 5 and Table 6 respectively.

Table 5. The Accuracy Comparison of Final Result with Target in Diabetes.

SN	CAMERA NAME	PREDICTED VALUE	RATIO		CALCULATING VALUE
			BLACK PIXELS	WHITE PIXELS	
1	Mob-cam 313	N	736	317	N
2	Mob-cam 258	N	684	270	N
3	Mob-cam 326	N	335	137	ABS
4	Mob-cam 423	N	716	592	N
5	Mob-cam 458	N	124	193	N
6	Mob-cam 635	N	547	403	N
7	Mob-cam 354	N	626	391	N
8	Mob-cam 276	N	402	283	N
9	Mob-cam 454	N	214	212	N
10	Mob-cam 512	N	178	101	N
11	Mob-cam 623	N	298	118	N
12	Mb-almas 1	ABS	425	215	ABS
13	Mb-almas 2	ABS	97	86	ABS
14	Mb-almas 4	ABS	408	112	ABS
15	Mb-almas 5	ABS	528	251	ABS
16	Mb-almas 7	ABS	312	176	ABS
17	Mb-almas 9	ABS	400	201	ABS
18	Mb-almas 12	ABS	205	96	N
19	Mb-almas 16	ABS	313	209	ABS
20	Mb-almas 17	ABS	220	145	ABS
21	Mb-almas 20	ABS	736	301	ABS
22	Mb-almas 21	ABS	813	356	ABS

Accurate percentage: (19/22) X 100 = 86.36%

Error percentage: (3/22) X 100 = 13.64 %

Table 6. The Accuracy Comparison of Final Result with Target in Heart Disease.

SN	CAMERA NAME	PREDICTED VALUE	RATIO		CALCULATING VALUE
			BLACK PIXELS	WHITE PIXELS	
1	Mob-cam 313	N	736	317	N
2	Mob-cam 258	N	684	270	N
3	Mob-cam 326	N	335	137	N
4	Mob-cam 423	N	716	592	N
5	Mob-cam 458	N	124	193	N

Table 6. (continued).

6	**Mob-cam 635**	**N**	**547**	**403**	**ABS**
7	Mob-cam 354	N	626	391	N
8	Mob-cam 276	N	402	283	N
9	Mob-cam 454	N	214	212	N
10	Mob-cam 512	N	178	101	N
11	Mob-cam 623	N	298	118	N
12	Mb-almas 1	ABS	425	215	ABS
13	Mb-almas 2	ABS	97	86	ABS
14	Mb-almas 4	ABS	408	112	ABS
15	Mb-almas 5	ABS	528	251	ABS
16	Mb-almas 7	ABS	312	176	ABS
17	Mb-almas 9	**ABS**	**400**	**201**	**N**
18	Mb-almas 12	ABS	205	96	ABS
19	Mb-almas 16	ABS	313	209	ABS
20	Mb-almas 17	ABS	220	145	ABS
21	Mb-almas 20	ABS	736	301	ABS
22	Mb-almas 21	**ABS**	**813**	**356**	**N**

Accurate percentage: (20/22) X 100 = 90.91%
Error percentage: (2/22) X 100 = 9.09 %

In both diseases, system accuracy depends on the accuracy percentage and propositional to each other. The result shows that our proposed system accuracy percentages are 86.36% and 90.91% whereas the error percentages are 13.64% and 9.09% in Diabetes and Heart Disease respectively. Hence, our proposed system is as per our predication based on accuracy and error percentage.

4. Conclusion

In this research, we propose a model to detect two diseases (Heart disease and Diabetes) based on iris high definition images through our health based model. Initially, the training set of digital data is created by taking the Iris image through EyeRonec Iris Camera. Finally, the result is classified into two different categories namely Normal and Abnormal category based on the threshold values. The predefined threshold value for the white ratio is 0.681 in case of Diabetes the black is 0.971 in case of Heart disease. The patient is Abnormal if his/her threshold values exceeds than 0.681 and 0.971 in case of white and black ratio respectively. The result shows that proposed system accuracy is 86.36% and 90.91% in Heart Disease and Diabetes respectively. Sometimes, final stage result is not correct or fails due to poor lighting and camera shooting position.

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