Journal of Theoretical and Applied Information Technology
28th February 2023. Vol.101. No 4

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

CARDIOVASCULAR ABNORMALITIES DETECTION THROUGH IRIS USING THRESHOLDING ALGORITHM

NILAM UPASANI[1], ASMITA MANNA[2], SHATABDI PINGALE[3], YASHASHREE SHINDE[4], SAKSHI RATHI[5], SONALI SURPATNE [6]

[1]Associate Professor, Balaji Institute of Technology & Management, Sri Balaji Unibversity, Pune, India.
[2]Assistant Professor, Pimpri Chinchwad College of Engineering, Department of Computer Engineering, India
[3]Student, Pimpri Chinchwad College of Engineering, Department of Computer Engineering, India
[4]Student, Pimpri Chinchwad College of Engineering, Department of Computer Engineering, India
[5]Student, Pimpri Chinchwad College of Engineering, Department of Computer Engineering, India
[6]Student, Pimpri Chinchwad College of Engineering, Department of Computer Engineering, India

E-mail: [1]nilamupasani@gmail.com, [2]asmita.nag@gmail.com,[3]shatabdi.pingale19@pccoepune.org, [4]yashashree.shinde19@pccoepune.org, [5]sakshi.rathi19@pccoepune.org, [6]sonali.surpatne19@pccoepune.org

ABSTRACT

Cardiovascular diseases have proven to be the leading reason of death worldwide. To identify cardiovascular diseases at an early stage, often very expensive pathological tests are required. A less costly alternative method for determining the conditions of the organs is highly appreciated, and Iridology is one such popular method. Many researchers have proposed cardiovascular disease identification systems by combining Iridology with computation system. In this study, a novel model for detecting heart abnormalities using Iridology is proposed. The entire process includes several stages such as target capture, pre-processing, auto-cropping based on histogram analysis, heart area extraction, and classification using a thresholding algorithm. The cropping method and classification process are both affected by the iris photography procedure. The iridology expert at Clinic in Indonesia labelled the data as abnormal and normal. The precision produced by the system ranges from 80-83%. Some errors occur due to ineffective cropping. The failed outcome may affect the segmentation process resulting in erroneous segmentation in the heart area eventually.

Keywords: *Iridology, Pre- processing, Classification, Thresholding Algorithm, Binarization.*

1. INTRODUCTION

The heart is a musculature that percolates blood via blood vessels. It serves as one of the most essential body parts. Any abnormalities that occur in its functioning will lead to many serious diseases like heart failure, cardiomyopathies, cardiac arrhythmias, and many more. Consequently, it is necessary to maintain the good condition of the heart. In accordance with the WHO, cardiovascular disease was indeed the most frequent cause of death globally in 2008. Each year, the disease claims the lives of 596.577 people. Most people believe that heart disease only impacts the elderly, but owing to sedentary lifestyles, stress, and genetics, heart disease can now affect people of all ages. Usually, it can be diagnosed only when the situation is severe. If the early detection of diseases is not done, then this situation will make the patient's condition worse and the healing process will be delayed. Normally, radiology techniques like ultrasonography and CT scans are used for monitoring a person's health via heart images. Detection through these devices is quite expensive and not everyone can afford it. So, taking into consideration the above factors, alternative medical treatments have been introduced in many parts of the world.

One of the most effective approaches is iridology. Iridology, also known as Iridodiagnosis, is the study of the iris, one of the human body's most intricate and captivating tissue structures. The iris can disclose a person's current health status, as well as the strengths and weaknesses of various organ systems, as well as personality features. The condition of nerves, adequate circulation, condition of blood and lymph nodes and nutrition, rest quality, breathing, and state of mind are the factors responsible for the health of the iris. Iridology is used to detect reduced organ functions caused by environmental pollutants, inadequate nutrition, and weariness, rather than to diagnose illness. According to iridologists, the color variation in the iris carries some significance and may also indicate that the suspected condition is severe/invasive, prolonged/inflammatory, or allergic. Organ system failure is also differentiated by iris color. It has been practiced in Europe since the 17th centenary, however it was only in the latter half of the twentieth century that it became popular in the United States. The iris is segmented using trimming algorithms, and the ocular region is located using the Gaussian Mixture Model. Masked R-CNN, along with Alex Net, VGGNet, ResNet, and others, is employed to perform classification and segmentation [4]. Deep Learning algorithms encompass CNN, RNN, and Long Short-term Memory Systems etc. while Naive Bayes, SVM, Random Forest, K-Nearest Neighbor's, and Logistic Regression all seem to be Machine Learning algorithms. Even while there are a great number of individual analyses of various algorithms, there is not yet any research that takes a holistic approach to looking at all of them together for iridology-based heart disease detection.

1.1 Research objective

To Detect the health issues through iris which is one of the reliable and accessible methods in the health.

To identify the abnormality in heart in an early stage. If primary detection of disease is done in the early stage, then we can save lives many.

Implementing the suggested system on a local level hospital where it would entail taking iris photographs of the patients and then using the proposed system to recognize the disease in the minimum cost. The rural people will be benefited most from this.

To put forth a system that will be easy to understand and implement by a non-medical practitioner by applying easy techniques and acquire the maximum accuracy.

1.2 Contribution of the paper

The Paper Contains:

A comprehensive examination of algorithms (Naive Bayes, Support Vector Machine, Random Forest, K-Nearest Neighbors, Logistic Regression, Convolutional Neural Networks, Recurrent Neural Networks, Long Short-Term Memory Networks) used in the tracking of heart abnormalities using iridology.

A detailed description of all the datasets studied and a comparative analysis of these datasets. A comprehensive survey of techniques used in iridology-based heart abnormality detection with its advantages, limitations and datasets used. This study proposes an efficient and cost-effective model for detecting heart abnormalities using iridology.

1.3 Organization of the paper

The section 1 comprises the paper's introduction, which states that the heart is a critical component of the human body and that the iridology is process of diagnosing disease by inspecting the iris of the eye. The section 2 contains a literature review, which does include a deep study of various deep learning and machine learning research articles available, as well as an overview of datasets related to iris. The section 3 incorporates the proposed work, which includes the development of the Iridology programme. Finally, in section 4, the results are presented, and section 5 concludes the paper by highlighting future scopes.

2. LITERATURE SURVEY

This section provides an overview of a number of studies on iridology and its application to heart disease diagnosis. The research was conducted in a wide range, around the world. These papers are further classified by the various approaches used throughout the research process. These papers span the years 2000 to the present.

2.1 Overview of Methodologies

The literature survey is based on emerging technologies used for iridology-based heart disease detection. The comparison is determined by the following criteria: the problems addressed, the preprocessing techniques used, the algorithms provided and their performance, and the limitations/future scope. This portion is divided into two sections based on the literature review: machine learning and deep learning.

2.1.1 Deep Learning based methods

Investigation on the use of deep features obtained from VGG-Net for the purpose of iris recognition is found in [2]. The method was put into practice on two iris databases, and the findings were very encouraging, with an accuracy rate of 99.4% being the greatest possible score. Despite the fact that the initial convolutional network adopted in this research was developed for a completely different goal (object detection), it is demonstrated that the characteristics may be translated effectively to biometric identification. J. Jayanthi, E. L. Lydia, N. Krishnaraj, T. Jayasankar, R. L. Babu, and R. A. Suji [4] produced a powerful deep learning-based effective framework for precise iris detection, segmentation, and recognition. The proposed model consists of various steps, including preprocessing, detection, segmentation, and recognition. For improving the image quality during preprocessing, Black Hat, Median, and Gamma Corrections are used. Hough Circle Transform model localizes the region of interest.

Many iris segmentation approaches struggle with noisy images from non-cooperative environments [8]. This approach proposes effective iris segmentation-based deep learning to solve this challenge. This system's Random Implication Image Classifier Technique (RIICT) can accurately identify images in diverse color spaces. Accuracy result is 96.7%.

According to the experimental results, the deep learning-based classifier supports the rest in terms of accuracy and runtime (GPUs version) and should be used whenever possible.[9] Young-Woo Lim, Young-Bae Park, and Young-Jae Park [10] introduce an innovative algorithm for iris boundaries identification. The suggested algorithm divides the division of the iris into two distinct processes: identifying the eye and segmenting the iris region. Kumar, Kadamati,, Vankala, Kamalakararao, and Pandurangu, Terlapu emphasized on deep learning-based convolutional neural network architecture paired with support vector machine for identification of cardiac irregularity in human body using iris of human[14].

Omar M.M introduced a novel iris recognition model to make it easy for anybody to use, especially since any image may be included in the model and the system filter itself and select only the pictures that meet the model filters [29]. Iris recognition from eye detection to picture recognition is shown here.

IrisConvNet, a trained deep learning system, uses a CNN and softmax classifier to extract discriminative features from the input image, which represents the localised iris region,

then class it into one of N classes without domain expertise [33]. Iridology examines the iris to assess organ health [35]. Iris localisation, segmentation, region of interest extraction, histogram equalisation, and convolutional neural network classification determines heart condition. Precision, recall, f-score, and accuracy evaluate findings.

2.1.2 Machine Learning based methods

Liu Jin, Fu Xiao, and Wang H.[12] propose a K-means clustering-based iris segmentation approach. K-Means clustering-based limbic border localization is proposed for pupil detection.

The input image locates the pupil and iris centers. Two iris boundary image strips are extracted. Shrunk image Hough transform localizes iris outer boundary.

Basic processing of images, extracting features using Principal Component Analysis (PCA), and classification using Backpropagation Neural Network are used to recognize cardiac function [16]. The researcher examined 90 normal and abnormal heart patients. 50 training and 40 test data will be used. PCA score result variations of 600, 500, 400, 300, and 200 yielded recognition rate percentages. The research created an iris-based heart issue detection system [24]. The system will feature extract using Principal Component Analysis (PCA) and Gray Level Co-occurrence Matrix (GLCM) to determine how feature extraction affects Backpropagation Neural Network classification success rate. PCA yielded 90% and GLCM 77.5%. Awan, Shahid, Riaz, Muhammad, and Khan, Abdul discusses artificial neural network techniques (ANN). ANN accuracy is 94.7%, yet PCA accuracy is 97.7%.

Considering the above literature survey there are many intelligent approaches through which the problem statement can be fulfilled. Some technique suggests a hybrid model using CNN and SVM the other suggested to apply HOG, GLCM and LBP. Back propagation Neural Network is also considered in many of the reputed papers. The accuracy ranges from 80-97 %, the individual algorithm provides less accuracy than the combined models but requires lot of knowledge in the field of deep learning and machine learning. So, after considering all these machine learning and deep learning algorithms, we finalized the below system model which is easy to implement those other techniques stated. The thresholding algorithm is the basic and easy to interpret algorithm which does not require to understand the methods and pre-trained models in deep learning, a simple non-medical practitioner can also make use of this model.

2.2 Overview of Datasets

Below is the overview of the popular datasets used world-wide for iridology-based heart disease detection.

Table 1: Overview of Datasets

Sr. No	Dataset	Description
1	CASIA-Iris V1	756 iris images from 108 eyes are part of the CASIA Iris Image Database Version 1.0 (CASIA-IrisV1). With their self-developed CASIA close-up iris camera, 7 photographs of each eye are taken in two sessions, with three samples being gathered in the first session and four in the second. All pictures are kept in BMP format and have a 320x280 resolution.
2	IIIT-Delhi Contact Lens Iris	Each folder in the obtained database contains 224 subjects, making a total of 224 folders. The left eye provided most of the images, with the right eye providing the remainder. Now the left or right eye is indicated by the labels "L" or "R" in the database. There are 1288 photographs from 224 people that are taken with the left eye, and the remaining images are taken with the right eye for 211 subjects.
3	CASIA-IrisV3 Interval	2655 photos from 249 subjects make up the dataset for CASIA Iris Image Database. Iris images of CASIA – IrisV3-Interval were captured with their self-developed iris camera. All pictures have a 320x280 resolution.
4	MobBIO fake	In order to examine the live identification in iris pictures taken from mobile devices in uncontrolled conditions, the MobBIOfake database was developed. The MobBIO database's subset of 800 photos was used to create the 1600 false iris images in this database, each measuring 250 by 200 pixels.
5	BERC Mobile-iris Database	The iris recognizer installed on a mobile phone accumulated the BERC mobile-iris database, which consists of 500 images from 100 irises.
6	Iris Image Dataset	The database includes iris photos in jpg format obtained from 704 people, comprising 392 females and 312 males. More than 6 pictures of each student's left and right eyes were taken. 3 photographs from the left eye and 3 photographs from the right eye were chosen as the most suitable images and added to the database after the images were examined.
7	Mugi Barokah Dataset	Mugi Barokah Clinic's iridology expert worked on the system design that was proposed for the development of this concept. The results are excellent due to its high-resolution camera as well as supports macro technology
8	UCI Dataset	This includes databases, domain theories, and information generators for being used by researchers to empirically test machine learning algorithms.472 patients' ECG data were gained from the Machine Learning Repository of UCI.
9	UBIRIS database	1877 photos from 241 subjects make up the dataset for Ubiris, which has two sessions. Because session 2 contains more photographs than session 1, an unbalanced dataset would result, hence only session 1 which comprises 1214 images—was used in this paper. A Nikon E5700 camera was used to capture the photographs, with a focal length of 71mm and an image resolution of 800 by 600 pixels.
10	MMU-Iris-Database	The iris database from Multimedia University (MMU), which contributed 450 photos in total, including 5 photographs per iris and 2 irises per person. With the LG Iris Access 2200, all pictures were shot between 7 and 25 centimeters.

Journal of Theoretical and Applied Information Technology
28th February 2023. Vol.101. No 4

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

3. PROPOSED WORK

Pre-processing, heart area feature extraction, along with classification are the three main components of the proposed system.

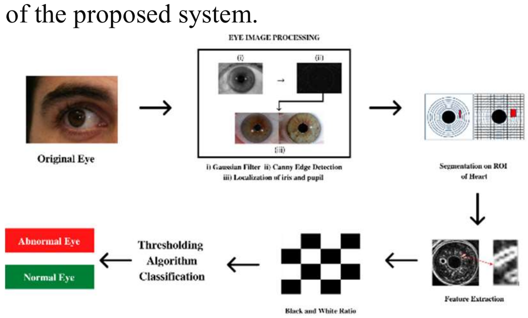

Figure 1: Proposed Architecture for Detection of Cardiovascular Abnormalities Through Iris

The training and testing phases are included in the system classification. Considering the 40 images from Indonesian eye dataset which were already labelled by the clinical experts. The image was pre-processed after it was taken. This procedure is helpful for obtaining the iris picture and improving the image quality. The result will be filtered in the heart's regions using feature extraction. The training phase is beneficial in learning the variations between typical and abnormal iris image qualities.

3.1 Iris data collection

For the following study the data is taken from Indonesian clinic. The data is taken from people's eye who have abnormal and normal heart conditions. These images are further used as learning data and testing data. It is following are the important points to be aware of the methods utilized to capture the iris in order to get a good image and make the appropriate classification. As a result of the examination using an Iridology chart, the image was taken from the left eye. Also, the amount of light should be adequate in order to obtain good quality of images. The images can also be taken from the existing databases which are used for iris recognition. CASIA, UBIRIS, IIT database are some of them which can be used for improvising the implementation

3.2 Data pre-processing

Pre-processing is a technique for transforming raw data into a useful and efficient format. To obtain the iris of the eye, the eye picture should undergo the series of transformation to recognize the iris and then should be first converted to grayscale. To improve edge detection, the grey image is smoothed with a Gaussian filter. It is used to reduce noise in images. Canny edge detection is an approach for discovering valuable structural data from diverse vision objects. Canny edge assisted in determining the boundary of the eye and attempting to reduce noise to some extent.

3.2.1 ROI of Heart Region

The preceding procedure's results will be sectioned to evaluate the Heart ROI (Region of Interest). The goal of this method is to extract the heart-related portions of the iris image. The heart area is mapped to the left eye between 02.20 and 03.10 on the Iris Chart.

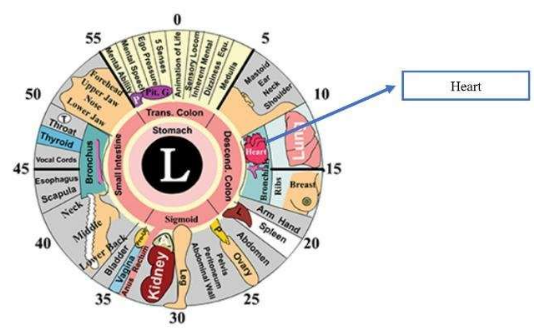

Figure 2: Iridology Chart

3.3 Heart Area's Feature Extraction

Feature extraction is used to get the crucial knowledge about the ROI area of the heart. To obtain the data, the ROI image of the heart had to be converted to a binary image. The process used to transform was the same as the previous Binarization process. The ratio will then be determined by calculating the number of black and white pixels on the image. These results will be divided by the image pixel depicted below.

$$\textit{Ratio of Black} = \frac{\textit{Total of Black Pixels}}{\textit{Total of All Pixels}}$$

$$\textit{Ratio of White} = \frac{\textit{Total of White Pixels}}{\textit{Total of All Pixels}}$$

This method is used to compute the black and white ROI of the heart. The averaged ratio value results of

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

all normal and abnormal types are used as a classification threshold.

3.4 Classification

The threshold value is unquestionably required as a classification parameter. As described in the feature extraction process, this value was calculated using the black and white heart ROI average ratio. The white ratio is 0.275, while the black ratio is 0.725. The training process concluded that the normal individual's ratio range had less than 0.275 white ratio and more than 0.725 black ratio. It is considered an abnormal condition if it is outside of the range. Improper cropping of the image may result in incorrect classification results.

4. RESULT

The accuracy of the proposed method is calculated using the Equation 1 and 2.

Accuracy = (True Data Total / Data Total) x 100% (1)

Error = (False Data Total / Data Total) x 100% (2)

The results of proposed method are compared with other existing methods based on the recognition accuracy and the results are shown in Table 2.

Table 2: Performance comparison based on accuracy

Algorithm	Accuracy (%)
SVM	95.45
BNN	87.5
CNN	80
Random Forest	78.9
ANN	94.7
Proposed Method	**93**

The proposed method is compared with all the algorithms as shown in the Figure 3.

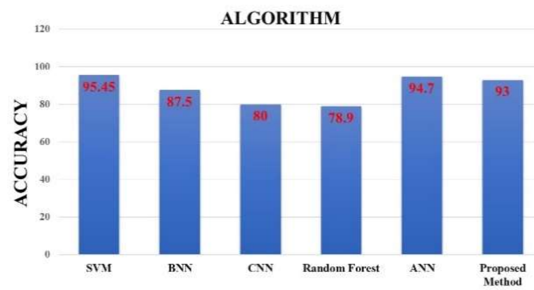

Figure 3: Comparison based on accuracy of algorithms

Considering the above data, the accuracy calculated of this methodology ranges about 93 % giving the error of 7%. The proposed method is found better than the BNN, CNN and Random Forest algorithms. Its performance ANN and SVM is found slightly better than the proposed method. Though, it is simple to understand and easy to implement as compared to the SVM and ANN.

Because of its improved efficiency and ease of implementation, the proposed method is useful for aiding in the detection of cardiac problems prior to surgery. In terms of accuracy, our proposed approach experimental results demonstrate previous methodologies.

5. CONCLUSION AND FUTURE SCOPE

5.1 Conclusion

In this paper, we have proposed a method to detect the heart abnormalities through iris using thresholding algorithm which proves to be the basic algorithm through which the heart abnormalities can be addressed. A successful iris cropping and the correct region of interest of the heart area are required for proper classification. However, if the ROI of the heart is misplaced, the classification may be incorrect. The threshold of classification getting from the experiment performs on Indonesian dataset. Based on the results of that experiment, it was determined that the average person had a white ratio of less than 0.275 and a black ratio of greater than 0.725. Aside from that range, abnormal classification is included. Some errors occur as a result of the unsuccessful cropping result. As this following proposed method can be implemented on the mobile devices also the patients in the rural parts will also will be able to keep regular check on their heart as it requires no money. Thus, we tried to fulfil the research objectives which were stated at the beginning of the paper and come to the conclusion that this method will be convenient and practically the best suited method for the problem statement suggested.

5.2 Future Scope

The provided methods can reach high performance, however there are several obstacles that still prevent higher performance, such as database type and picture quality in these databases. Additionally, the methods employed throughout the pre-processing, segmentation, and normalization phases. However, a number of recommendations are made below to enhance the functionality of the suggested system, including:

Applying the suggested system to various datasets, such as the CASIA database, and contrasting the outcomes with the conclusions in this thesis.

Comparing the outcomes with the outcomes from this paper, utilizing different feature extraction algorithms like Principal Component Analysis (PCA) and different classifiers like Artificial Neural Networks (ANN) and many more deep learning techniques as the data available on this methodology of detecting diseases is minimum

Propose a mobile application for checking heart conditions that everyone can use on a regular basis. Users can perform all computing tasks from their mobile devices at any time and from any location.

REFERENCES:

[1] E. M. Kusumaningtyas, A. Barakbah and A. Salsabil, “Auto Cropping for Application of Pancreas Abnormality Detection in Order to Recognize Diabetes Mellitus Through Iris Based on Mobile Devices”, 2018 International Electronics Symposium on Knowledge Creation and Intelligent Computing (IES-KCIC), 2018, pp. 287-291, doi: 10.1109/KCIC.2018.8628585.

[2] S. Minaee, A. Abdolrashidiy and Y. Wang, “An experimental study of deep convolutional features for iris recognition”, 2016 IEEE Signal Processing in Medicine and Biology Symposium (SPMB), 2016, pp. 1-6, doi: 10.1109/SPMB.2016.7846859.

[3] Kirti Panchal, Riddhi Surve, Kaustubh Thanekar, Vidya Pujari, “Iris Analysis for Health Diagnosis”, International Journal of Innovative Science and Research Technology, Volume 4, Issue 4, April – 2019

[4] J. Jayanthi, E. L. Lydia, N. Krishnaraj, T. Jayasankar, R. L. Babu, and R. A. Suji, “An effective deep learning features based integrated framework for Iris Detection and Recognition” Journal of Ambient Intelligence and humanized computing, SpringerLink, 08- Jun-2020.

[5] P. Shimpi, S. Shah, M. Shroff and A. Godbole, “A machine learning approach for the classification of cardiac arrhythmia,” 2017 International Conference on Computing Methodologies and Communication (ICCMC), 2017, pp. 603-607, doi: 10.1109/ICCMC.2017.8282537.

[6] A. Šećkanović et al., “Review of Artificial Intelligence Application in Cardiology,” 2020 9th Mediterranean Conference on Embedded Computing (MECO), 2020, pp. 1-5, doi: 10.1109/MECO49872.2020.9134333.

[7] R. A. Halim and A. Wahju Rahardjo Emanuel, “A Review of Iris Recognition System ROI and Accuracy,” 2020 International Conference on Smart Technology and Applications (ICoSTA), 2020, pp. 1-6, doi: 10.1109/ICoSTA48221.2020.1570615087.

[8] Y. Wang and S. Shan, “Accurate disease detection quantification of Iris based retinal images using random implication image classifier technique,” Microprocessors and Microsystems, 22-Oct-2020.

[9] E. Severo et al., “A Benchmark for Iris Location and a Deep Learning Detector Evaluation”, 2018 International Joint Conference on Neural Networks (IJCNN), 2018, pp. 1-7, doi: 10.1109/IJCNN.2018.8489638.

[10] Y.-H. Li, P.-J. Huang, and Y. Juan, “An efficient and robust iris segmentation algorithm using Deep Learning,” Mobile Information Systems, 02-Jan-2019.

[11] Young-Woo Lim, Young-Bae Park, Young-Jae Park, “Experimental study of reliable iris parameters and their relationships with temperament, character, and heart rate variability,” European Journal of Integrative Medicine, Volume 6, Issue 5, October 2014, Pages 524-531

[12] Liu Jin, Fu Xiao and Wang Haopeng, "Iris image segmentation based on K-means cluster," 2010 IEEE International Conference on Intelligent Computing and Intelligent Systems, 2010, pp. 194-198, doi: 10.1109/ICICISYS.2010.5658566.

[13] A. A. Jarjes, Kuanquan Wang and G. J. Mohammed, "Iris localization: Detecting accurate pupil contour and localizing limbus boundary," 2010 2nd International Asia Conference on Informatics in Control, Automation and Robotics (CAR 2010), 2010, pp. 349-352, doi: 10.1109/CAR.2010.5456828.

[14] Kumar, Kadamati & Professor, Asstant & Vankala, Kamalakararao & Terlapu, Panduranga. (2020). An Efficient Method for Detection of Dysfunctionality in Heart through Iris Using Hybrid Method.

[15] F. D. Kusuma, E. M. Kusumaningtyas, A. R. Barakbah and A. A. Hermawan, "Heart Abnormalities Detection Through Iris Based on Mobile", 2018 International Electronics Symposium on Knowledge Creation and Intelligent Computing (IES-KCIC), 2018, pp. 152-157, doi: 10.1109/KCIC.2018.8628515.

[16] Putra, Leonardus & Isnanto, Rizal & Triwiyatno, Aris & Gunawan, Vincentius. (2018). Heart Disease Detection using Iridology with Principal Component Analysis (PCA) and Backpropagation Neural Network. 251-258. 10.5220/0009009402510258.

[17] Nguchu, Benedictor & Li, Li. (2017). Iris features-based heart disease diagnosis by computer vision. 104203X. 10.1117/12.2281954.

[18] Yohannes, C & Nurtanio, Ingrid & Halim, K. (2020). Potential of Heart Disease Detection Based on Iridology. IOP Conference Series: Materials Science and Engineering. 875. 012034. 10.1088/1757-899X/875/1/012034.

[19] K. E. Martiana, A. R. Barakbah, S. S. Akmilis and A. A. Hermawan, "Application for heart abnormalities detection through Iris", 2016 International Electronics Symposium (IES), 2016, pp. 315-322, doi: 10.1109/ELECSYM.2016.7861024.

[20] C. Banowati, A. Novianty and C. Setianingsih, "Cholesterol Level Detection Based on Iris Recognition Using Convolutional Neural Network Method", 2019 IEEE Conference on Sustainable Utilization and Development in Engineering and Technologies (CSUDET), 2019, pp. 116-121, doi: 10.1109/CSUDET47057.2019.9214690.

[21] Rachman, L & Basari, Basari. (2020). Detection of Cholesterol Levels by Analyzing Iris Patterns using Backpropagation Neural Network. IOP Conference Series: Materials Science and Engineering. 852. 012157. 10.1088/1757-899X/852/1/012157.

[22] F. Hernandez, R. Vega, F. Tapia, D. Morocho and W. Fuertes, "Early detection of Alzheimer's using digital image processing through iridology, an alternative method", 2018 13th Iberian Conference on Information Systems and Technologies (CISTI), 2018, pp. 1-7, doi: 10.23919/CISTI.2018.8399151.

[23] Martiana, Entin & Barakbah, Ali & Hermawan, Aditya. (2018). Feature Extraction for Application of Heart Abnormalities Detection Through Iris Based on Mobile Devices. EMITTER International Journal of Engineering Technology. 5. 312. 10.24003/emitter. v5i2.202.

[24] L. S. Ade Putra, R. Rizal Isnanto, A. Triwiyatno and V. A. Gunawan, "Identification of Heart Disease with Iridology Using Backpropagation Neural Network", 2018 2nd Borneo International Conference on Applied Mathematics and Engineering (BICAME), 2018, pp. 138-142, doi: 10.1109/BICAME45512.2018.1570509882.

[25] P A, Reshma & Divya, K. & Subair, T. (2019). Detection of Heart Abnormalities and High-Level Cholesterol Through Iris. 10.1007/978-3-030-00665-5_35.

[26] Awan, Shahid & Riaz, Muhammad & Khan, Abdul. (2018). Prediction of Heart Disease using Artificial Neural Network. 13. 102-112.

[27] A. K. Dewi, A. Novianty and T. W. Purboyo, "Stomach disorder detection through the Iris Image using Backpropagation Neural Network", 2016 International Conference on Informatics and Computing (ICIC), 2016, pp. 192-197, doi: 10.1109/IAC.2016.7905714.

[28] Abiyev RH, Altunkaya K. Personal Iris Recognition Using Neural Network. International Journal of Security and its Applications, Vol.2, Issue.2, pp. 41-50, 2008.

[29] Omar Medhat Moslhi, "New full Iris Recognition System and Iris Segmentation Technique Using Image Processing and Deep Convolutional Neural Network," International Journal of Scientific Research in Multidisciplinary Studies,, March (2020), Vol.6, Issue.3, pp.20-27

[30] Tobji, Rachida & DI, Wu & Ayoub, Naeem & Samia, Haouassi. (2018)." Efficient Iris Pattern Recognition Method by using Adaptive Hamming Distance and 1D Log-Gabor Filter". International Journal of Advanced Computer Science and Applications. Vol.9, Issue.11, pp.662-669,

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

2018.

[31] Proenca, Hugo & Neves, Joao., A Reminiscence of" Mastermind": Iris/Periocular Biometrics by" In-Set" CNN Iterative Analysis. IEEE Transactions on Information Forensics and Security, Vol.14, pp.1702-1712, 2019

[32] Nguyen, K., Fookes, C., Ross, A. and Sridharan, S., Iris Recognition with Off-the-Shelf CNN Features: A Deep Learning Perspective. IEEE Access, vol. 6, pp.18848-18855, 2018.

[33] Al-Waisy, Alaa & Qahwaji, Rami & Ipson, Stanley & Al-Fahdawi, Shumoos & Nagem, Tarek. (2017). A multi-biometric iris recognition system based on a deep learning approach. Pattern Analysis and Applications. 21. 10.1007/s10044-017-0656-1.

[34] Khourdifi, Youness & Bahaj, Mohamed. (2019). Heart Disease Prediction and Classification Using Machine Learning Algorithms Optimized by Particle Swarm Optimization and Ant Colony Optimization. International Journal of Intelligent Engineering and Systems. 12. 10.22266/ijies2019.0228.24.

[35] Tadiparthi, Pavan & Bheemavarapu, Pradeep. (2020). Automated Heart Dysfunctionality Identification Based on Iris using Deep Learning. International Journal of Innovative Technology and Exploring Engineering. 9. 2278-3075. 10.35940/ijitee.E2526.039520.

[36] Azam, Md & Raihan, Md & Rana, Humayan. (2020). An Experimental Study of Various Machine Learning Approaches in Heart Disease Prediction. International Journal of Computer Applications. 175. 16-21. 10.5120/ijca2020920741.