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Neural Network Based Heart Disease Detection System Using Facial Video and image

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Abstract: Heartbeat Rate is an important physiological parameter that provides information about the condition of human body's cardiovascular system in applications like medical diagnosis, fitness assessments etc. Heartbeat Rate is usually measured by an Electrocardiogram (ECG) though placing sensors on the body .A recent study was driven by the fact that blood circulation causes periodic subtle changes to facial skin color. The heartbeat Rate causes the facial color to change slightly by pumping blood into the skin. This fact gave a birth to an idea for Heartbeat Rate estimation. If the videos are recorded under more challenging condition then illumination variation and subject's motion are the factors considered. In this paper, a framework for heart disease detection system by using the initial important variable as Heartbeat Rate extracted from facial video or image is proposed. In this proposed method, the first part is the Heartbeat Rate estimation using facial video or image using the super pixel model-local pixel averaging, PPG peak detection algorithm and in the second part, heart disease detection framework is constructed using neural network classifier. Systems based on neural network have been used since from past years in medical diagnosis applications because of their ability to learn human expertise and to utilize this knowledge for separation. This proposed system results in detecting the type of heart diseases, make a judgment similar to an expert system and reasoning based on expertise suggestions

Keywords: Photoplethysmography (PPG), Superpixel model-local pixel averaging, Gradient Decent optimization, Wavelet, Independent component analysis (ICA), Neural Network.

I. INTRODUCTION

Person's health condition can be revealed using the Heartbeat Rate(HR).As it is an important physiological parameter that provides information about the condition of the person's health for example the person heartbeat rate in cycling is more than in resting pose, as whether that exercise of cycling is safe for him/her to be continued. Heartbeat rate can be calculated by the following two ways, contact monitoring and contactless monitoring. The example for contact monitoring is Electrocardiogram (ECG) to measure heartbeat rate through placing sensors on the body. In conventional ECG ten electrodes are placed in a patients limbs and surface of the chest, then electrocardiograph is generated.

The contactless monitoring found to be very comfortable for the measurement of heartbeat rate .Contactless monitoring can be divided into three categories they are microwave Doppler radar, thermal imaging and video based imaging methods. Among these methods video based monitoring are considered as cheaper and easier to adopt. It uses webcams, surveillance cameras and cellphone camera which are available nowadays.

It has been reported that skin color changes caused by cardiac pulse can be captured by this ordinary camera for heartbeat rate measurement. There are a huge ways to estimate the heartbeat Rate. Nowadays the heart related diseases are faced by many peoples, the people are curious to know their status of heart disease and cure it as early as possible so that it may not lead to future disease related to heart (Heart Attack). Neural network is the one that is used to extract patterns.it act as an expert in the category of information and it learns adaptively.

The model of cardiovascular system is built and compared with real time psychological parameter taken from patients. This helps in early detection of heart diseases and cures it early. The proposed works provides the smart system for heart diseases detection using neural network classifier, where the heartbeat rate is the parameter taken and recommend the nutrition to the respective diseases for a patient.

II. LITERATURE SURVEY

J Allen et al [1] gave a potential method for calculation of Heartbeat rate measurements, by the smartphone consists of HD camera which uses Photoplethysmography (PPG) methodology to detect Heartbeat rate variability. This method is low-cost and noninvasive

means of sensing the cardio blood volume pulse variations .The basic principle is to illuminate the skin with a light emitting diode or ambient light and measure the reflected, transmitted and absorbed light by blood vessels in the skin. The amount of light absorption increases the blood volume ,they change all over the body together with cardiac pulse so the blood volume pulse measured at peripheral body tissue (palm and fingertip) is usually used as an indicator of cardiac cycle measurement. But still this requires a special lighting sources and sensors for detecting the blood volume.

Poh et al[2] approach can be applied to color video recordings of the human face and is based on automatic face tracking along with blind source separation of the color channels into independent components. Using Bland-Altman and correlation analysis, the cardiac pulse rate extracted from videos recorded is compared to a basic webcam to an FDA-approved finger blood volume pulse (BVP) sensor and achieved high accuracy and correlation even in the presence of movement artifacts Poh et al. gave a new potential method to measure the cardiac pulse remotely using video imaging and blind source separation .The source taken for measuring heartbeat rate is face .The facial expression or the face is recorded using built-in webcam of laptop only with sunlight as illumination. They extracted the cardiac pulse signal using independent component analysis and measure heartbeat rate from frequency analysis.

K.Anil Jain et al [3] introduced clearly as human have a remarkable capability to learn and perform a wide variety of physical and mental task. Neural network tries to act as human's expertise.

Anchana Khemphila et al[4] introduced a classification approach using Multi-Layer Perceptron (MLP) with Back Propagation learning in neural network to diagnose heart disease. Clinical diagnosis is done preferably by doctor's expertise and their experience. But still cases are reported of some wrong diagnosis and treatment. Patients are asked to take number of tests for heart diagnosis. Sometimes, not all the tests contribute towards effective diagnosis of a disease.

Marwa Obayya[5] gave a paper for classification of the heart diseases using the heart rate variability signals in order to discriminate between normal subjects and patients with low heart rate variability such as patients suffering from congestive heart failure (CHF) and myocardial infarction diseases. A multilayer feed forward neural network was used in this paper.

Jayshril S Sonawane et al[6] gave a neural network system that accepts 13 clinical features as input and it is trained using back-propagation algorithm to predict that there is a heart disease, or not in the patient with highest accuracy of 98% comparative to other systems. The accuracy thus obtained with this system shows that it is better and efficient than other system

III. METHODOLOGY

In this system for heart disease detection, the neural network classifier is used. This system consists of two scenarios

A. The first scenario

It deals with input as video, the data fetched from MIT source. The video is pre-processed from RGB to HSV form and converted two dimensional to one dimensional matrix using Superpixel model ,the ouput of Heartbeat rate is extracted and sent to decision algorithm where the neural network classifier is trained.

B. The second scenario

It deals with input as image, the data fetched can be real time from IP webcam. IP-webcam is connected to system with IP address and the same process is carried as shown in scenario one.

Neural network classifiers are used to train the system.. Data is separated into training and testing sets involving classification task. Each instance in the training set contains several attributes (i.e. the features or observed variables or the features) and one \target value" (i.e. the class labels). In neural networks learning technique, the patterns that are to be recognized are known in advance and the input values of the training set are classified with desired output.

In turn the perceptron is provided with each training set. The desired output is obtained by comparing the output from the perceptron to input set as Heartbeat rate. In neural network, each layer that is been divided into input layer, the hidden layer and the output layer gives the input to the next. The methodology used here is as shown in Fig.1.

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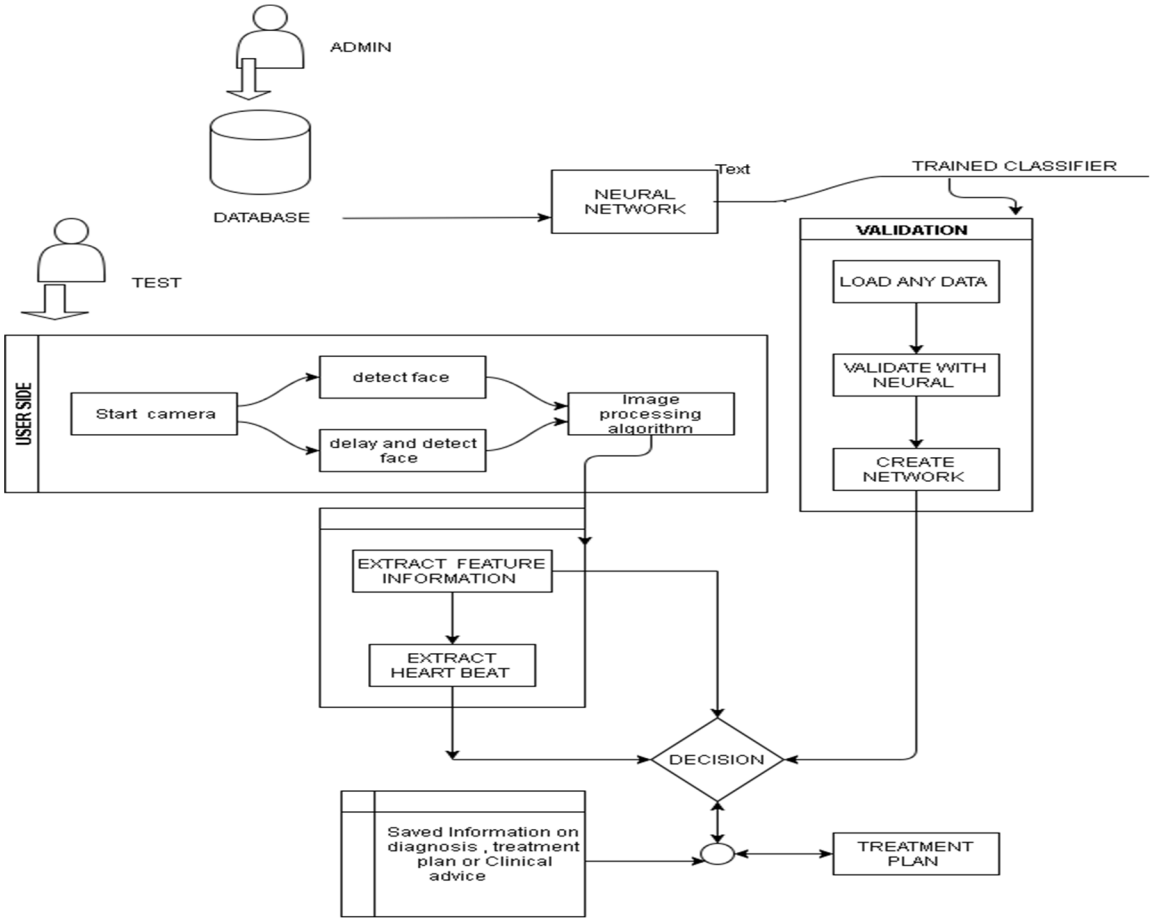

Fig.1 System Architecture

A. Pre-Processing

In this module, the video composed of images from MIT databases are obtained. The video is segregated in to frames. RGB is extracted to every frame and converted to HSV (Hue saturation value) is performed in order to get clear flow of blood count. The Reason of interest (ROI) is selected as forehead. In the second scenario, the image is taken from IP webcam.

B. Classification

In this module, the feature set is obtained and the classifier is trained for classification by neural network classifier. The neural network classifier is used as an advanced classifier. Classification divides the spectral or spatial feature space into several classes based on a decision rule to be used for training the classifier .The neural network classifier is trained, validated and tested .The neural network is validated for 9 hidden layers and 10 hidden layers and the performance is validated for 51 training data's.

In the validation phase the neural network works well with 10 hidden layers by providing 98.1 percent confusion matrix for the 51 training data's provided to this classifier.

C. Testing

In this module, the test dataset is selected with test images or real time images or video, and the validation set is tested on the final classifier to obtain the results.

IV. EXPERIMENTAL RESULTS

The system is made to learn from the training data, the test data is fed to the system, then the test data generates the result for test data to measure accuracy of prediction and then with outcome as whether the person is suffering from the disease or normal. The heart disease taken here are bradycardia and tachycardia and normal

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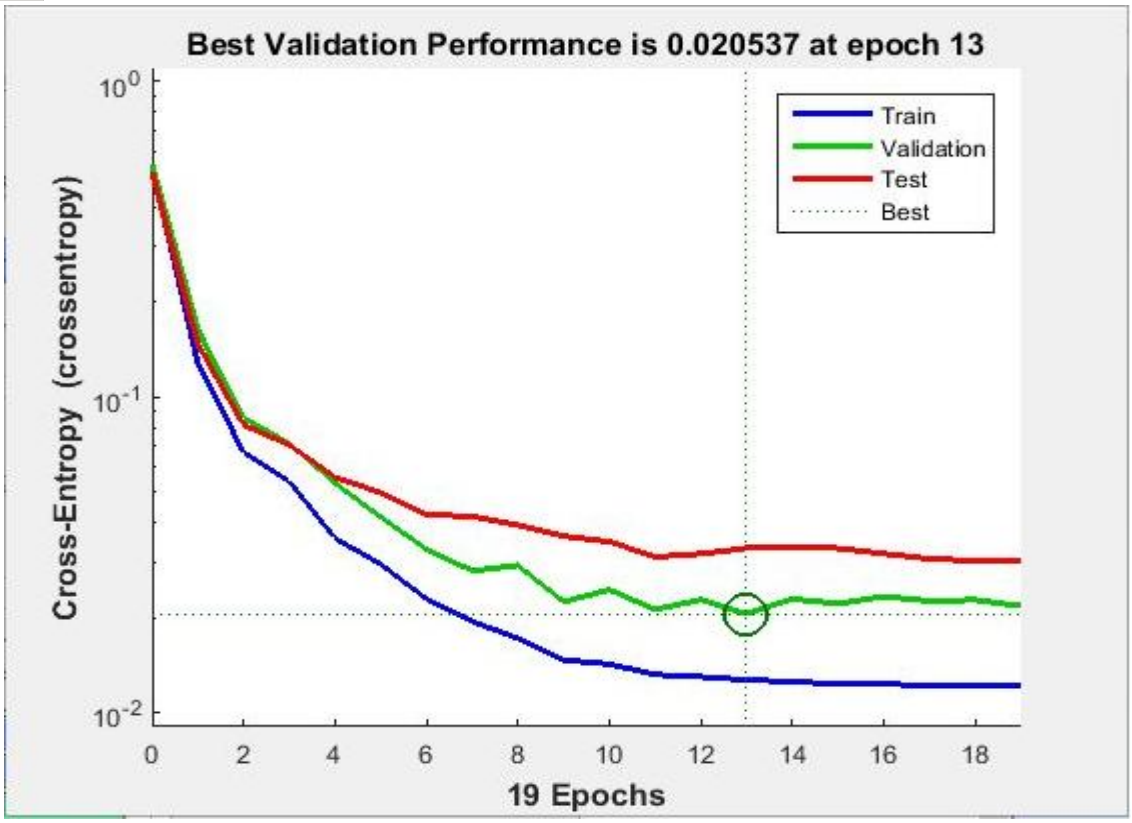

Fig.2 The performance graph of neural classifier

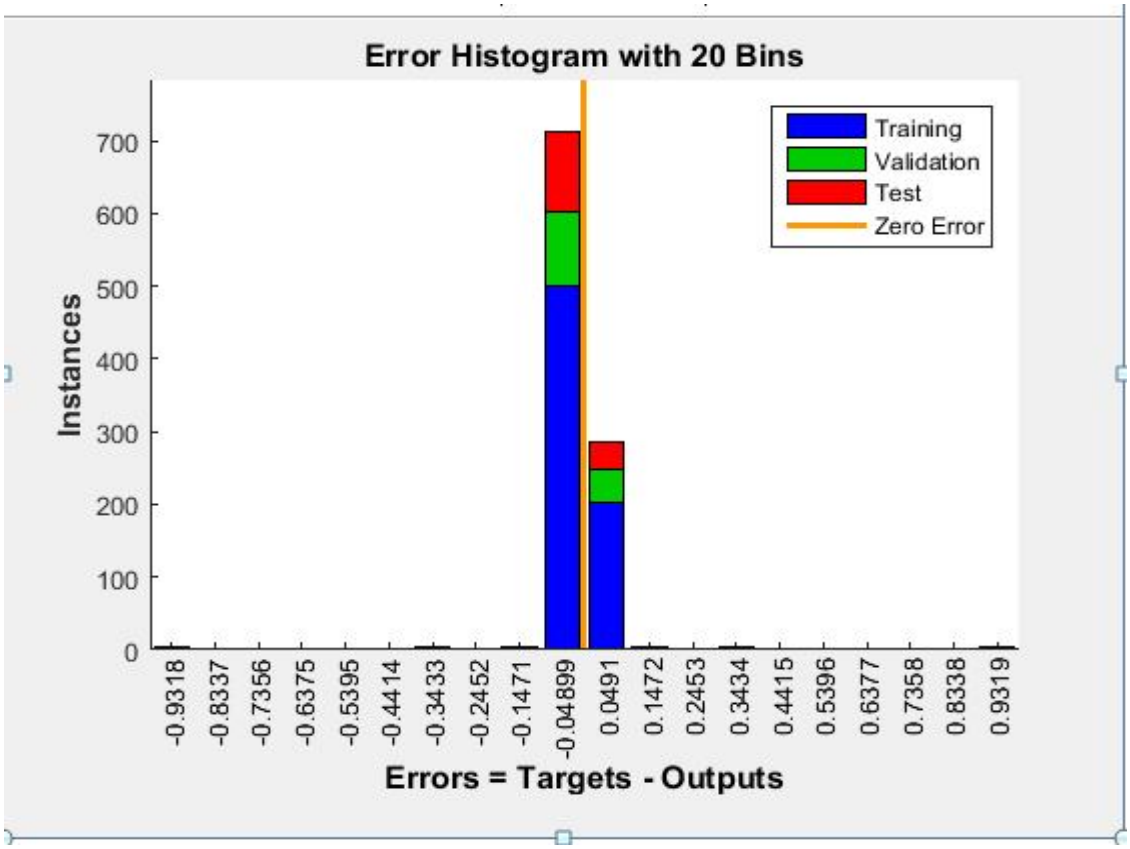

Fig 3 System performance Error histogram

V. CONCLUSION

In this study, automatic disease screening software is developed for detecting the Heart diseases, the system is made to learn from the training data and is tried with another set of data of testing phase with neural network classifiers for guaranteeing the systems legitimate working. This continuity work of estimation of heartbeat rate along with heart disease prediction is carried out. As a future work, this system can be advanced and adopted to MRI scanners so that it can take the video of the patient and predict the disease. This can be used as an alternative in the absence of an expert doctor around.

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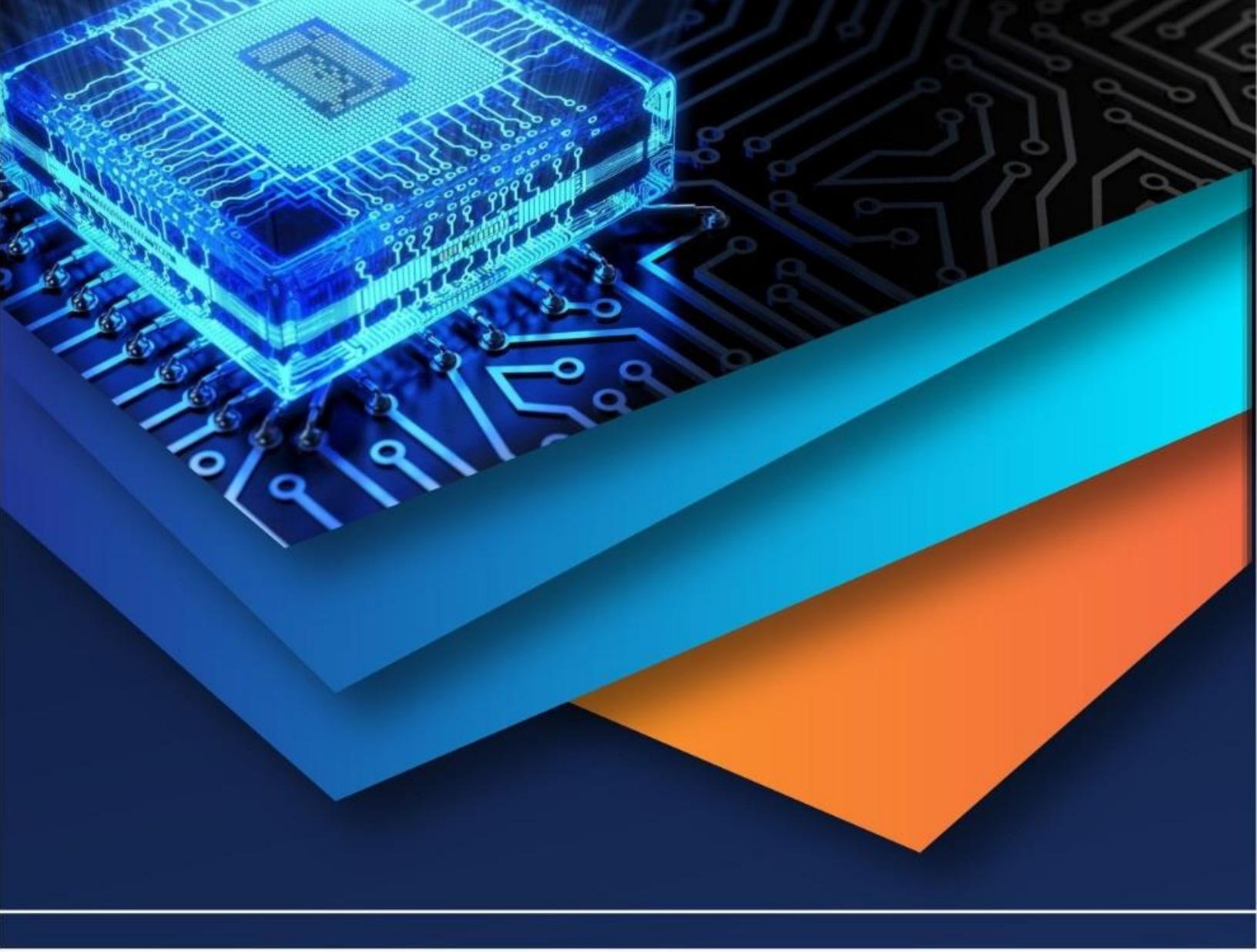

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