Multi-Parameter Patient Monitoring Platform with Wireless Transmission

Santosh N Vasist1 K Vijaylakshmi2
1,2Department of Computer Engineering
1,2B.M.S. College of Engineering

Abstract—This project measures pulse rate, temperature and records ECG signal of a patient. It predicts the risk of a disorder related to the heart using Artificial Neural Networks (ANN) in the absence of a doctor. This project uses an ECG sensor to measure the electrical activity of the heart using a three electrode system, a heartbeat sensor to measure the heart rate by analyzing the blood flow in index finger, and a temperature sensor to measure the body temperature. Additional parameters such as age, gender, height, weight along with the QRS interval from the recorded ECG is used to predict the risk of a disorder using Artificial Neural Networks (ANN).

Key words: Wireless Transmission, Multi-Parameter Patient Monitoring Platform

I. INTRODUCTION

Human heart generates small electrical signals which travel through the muscles of the heart and result in the contraction and relaxation of the heart thus in turn resulting in the pumping action. These electrical impulses can be detected by Electrocardiography. An Electrocardiograph is the record of the electrical activities occurring in the heart.

Electrodes set on distinctive parts of the body distinguish electrical signs originating from diverse regions inside of the heart. Effectively almost all the diseases related to the heart can be detected by the ECG. An ECG is a quick and easy method for the doctor to determine the condition of the heart. The ECG readings are almost immediate and reliable, which means the findings of the test can be used to guide emergency treatment.

For patients in resource constrained locales normal screening and observing of ECG is rare on the grounds that supply channels are restricted and relative expenses are high. Likewise lack of specialists and professionals is another reason.

Restorative science is a standout amongst the most quickly developing and changing fields of science. Hence like numerous different attempts of cutting edge endeavor, today learning based innovation is in effect progressively occupied with the field of medicinal conclusion. Artificial Neural Networks are models based on neural structure of the human brain, discovering numerous applications in the field of therapeutic determination. ANN can assume a key part in medicinal field in taking care of different wellbeing related issues like anticipating and/or arranging intense illnesses and other gentle infections. Utilizing innovation, for example, ANN could prompt lessening in medical errors and reliance on human aptitude. The back propagation is one of the few methods that is utilized for foreseeing the yield with more exactness and is effectively connected to medical field.

In this project, ECG signal is recorded through three lead Ag/AgCl electrode system along with pulse rate and temperature measures by their respective sensors and transferred to the arm microcontroller. The measured data along with additional parameters such as age, gender, height, weight and the QRS interval computed from the recorded ECG are entered manually as inputs to the ANN to predict the risk of a disorder related to the heart. The heart rate measured can be used to detect the risk of two diseases as TDHB and PSVT based on low (<60bpm) and high (>100bpm) heart rates respectively.

II. OBJECTIVE

The objective of this project is to

- Record ECG signal, measure pulse rate, body temperature and also to calculate the QRS interval from the recorded ECG signal.
- Provide GUI to enter additional parameters such as age, gender, height and weight to determine the risk of a disorder related to the heart using artificial neural networks.
- Classify two diseases PSVT and TDHB based on the pulse rate of the person.

III. SYSTEM DESIGN

The block representation of this project is as shown in Figure 1. Three sensors are used to record the ECG signal, measure body temperature, and heartbeat.

Three lead Silver/Silver-Chloride electrodes are utilized to change over the physical signs into electrical voltage by detecting the particle current at the surface of human tissues. These three anodes are set on the midsection which frame an Einthoven's triangle. The three voltage values from the leads are sent to AD8232 (ECG sensor) which is a coordinated signal conditioning block, the sign is high pass filtered to dispose of movement antiquities and the anode half-cell potential and it is low pass filtered to evacuate the extra noise. The instrumentation amplifier in AD8232 enhances the ECG flag enough to drive ADC without the assistance of an extra support. AD8232 works more than a temperature running from −40°C to +85°C. The yield from the ECG sensor is sent to ADC of LPC2148 microcontroller to acquire the advanced estimations of ECG signal. The advanced estimations of ECG sign are sent to PC through Zigbee correspondence. The ECG signal is plotted and the chose components of ECG signal i.e., Q peaks, R peaks and S peaks are identified, and QRS duration are computed.

Body temperature is measured by holding the LM35 (temperature sensor). LM35 operates without calibration at precision of ±0.25°C at room temperature and ±0.75°C more than a full −55°C to +150°C temperature range.

Temperature sensor's yield voltage is directly relative to the centigrade temperature. This voltage is sent to
ADC of LPC2148 microcontroller to acquire the advanced estimation of the body temperature.

Fig. 1: Block representation of the project

Heart rate is the number of heartbeats per unit time and is expressed in beats per minute (BPM) which is measured by inserting the finger into TCRT1000 (heart rate sensor) which generates the pulse for 4 seconds. This time duration is specified by the program. Pulses are generated by sensing the blood flow in finger through transmittance photoplethysmographic principle. This signal is RC high pass filtered to get rid of the DC component (cut-off frequency is 0.7Hz) and then low pass filtered to remove high frequency noise (gain is 101 and cut-off frequency is 2.34Hz). This is sent to the external interrupt of LPC2148 microcontroller and the total pulses for four seconds (f) are counted. Heart rate value is computed as f x 15 to total the number of pulses for 60 seconds. This digital value is manually entered in the GUI in the computer. The diseases are classified into two, namely, TDHB (< 60 BPM) and PSVT (> 100 BPM), based on the heart rate and indicated on GUI.

ANN is utilized to group if a man has a danger of abnormality related to the heart or not. The parameters i.e., age, height, weight, gender, the QRS duration from the ECG and the heart beats from the heart beat sensor are inputs to the ANN. A three layer feed forward back propagation ANN is composed, where the info layer is fed with six inputs, one concealed layer with ten neurons and one yield layer with one neuron to group. The ANN is prepared, tried and approved according to the predefined dataset. The back propagation calculation is connected to feed forward neural system as it utilizes directed realizing, where the inputs are given with separate target qualities and the weights are balanced by figuring the mistake between sought yields and genuine yields which thus enhances the execution of the system.

The ANN is prepared under Levenberg-Marquardt calculation (trainlm) which is fastest and has better execution contrasted with the calculations, for example, quick propagation, genetic algorithm and so on. Levenberg-Marquardt calculation was intended to approach second-request preparing pace without needing to figure the Hessian grid. It utilizes Jacobian for computations as the Jacobian lattice can be registered through a standard back propagation strategy that is a great deal less unpredictable than processing the Hessian lattice. At whatever point the inputs are given to ANN it takes some experiments and gives an accepted result. Risk of ailment is determined based on the output neuron. These results are indicated on GUI for respective inputs.

Fig. 2: Flow Diagram of Training, Validation and Testing of ANN

Three layer feed forward, back-propagation ANN is produced. Presently, this created back-propagation structural planning is the most well-known, compelling model for complex, multi-layered systems. This structural planning has produced a huge class of system sorts with a wide range of topologies and preparing strategies. Its most prominent quality is in non-direct answers for poorly characterized issues. The average back-propagation system has an info layer with nine inputs, one hidden layer with ten neurons and one output layer with a neuron.

A. Input Layer:
   - Age
   - Height
   - Weight
   - Gender Male (0) Female (1)
   - QRS duration

B. Hidden Layer:
   - 10 neurons to compute the result

C. Output Layer:
   - 1 neuron − 0 → Risk of abnormality
   - 1 neuron − 1 → Normal

The output obtained from the heartbeat sensor is verified through simple if-else statement in MATLAB. If the heartbeat is less than 60 an indicator ashes in front of TDHB i.e. Third Degree Heart Block and if the heartbeat is greater than 100 an indicator ashes in front of PSVT i.e. Paroxysmal Supraventricular Tachycardia.

D. ECG Feature Extraction:

Figure 5.2 portrays the ECG signal of a sound individual.

ECG interpretation depends intensely on the “QRS complex”. It indicates that the ventricles are depolarizing from...
and the auricles are repolarizing. Three peaks namely Q, R and S peaks represented here is of normal case. The peaks mimic contours of ventricular depolarization. It begins from left and moves opposite to the cathode. This is the reason for the tiny downward detection which is Q wave. Normal Q peak amplitude is 0.1 mV. The positive detection after Q wave is the R wave. Normal R peak amplitude is 1 mV. The negative detection after R wave is S wave. A typical S wave value is 0.3 mV. ECG signal is recorded from the equipment and the specimens are put away in a text file. An algorithm is developed to find the Q, R and S peaks. Subsequent to stacking the ECG signal, if the specimens are

|  ≥ 0.7 mV the examples are recognized as R tops and the list estimations of these are put away. In the event that the specimens are ≤ 0.07 mV the examples are recognized as Q tops and the list estimations of these are put away. In the event that the specimens are between the extents -0.2 mV to -0.325 mV the examples are recognized as S tops and the file estimations of these are put away. QRS term is processed with the distinction in list estimations of S and Q crests.

IV. RESULTS

A. Results Classified based on ANN

1) Case 1: A Person having Risk of Abnormality

- Age=75
- Gender=0
- Weight=80 kgs

Fig. 4: A person having risk of abnormality

B. Case 2: A person having Normal Health

- Age=49
- Gender=1
- Weight=54 kgs
- Height=162 cms
- QRS duration= 78 ms

Fig. 5: A person having Normal Health

V. CONCLUSION

This system accepts ECG and heartbeat as inputs from the hardware along with additional parameters such as age, height, weight, gender and the QRS duration computed from the ECG signal as inputs to the ANN and detects/predicts the presence of an abnormality related to the heart. The system also classifies two diseases based on heartbeat, i.e., Third Degree Heart Block and Paroxysmal Supraventricular Tachycardia.

This project can be extended further by feeding an improvised ECG signal to ANN.

REFERENCES


