

“Review on Design and Development of Remote cardiac analysis”

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Abstract— Cardiovascular diseases are growing faster as compare to other disease in India. Growing roots of cardio diseases are lack of knowledge and symptoms of disease which brings this issue to more research. Device should be made to identify cardio diseases and increase the awareness among the people to restrict the growth of sudden death due to cardio disease. To regular use of any device, mobile phones are the best option to combine which can be maintain remotely as Mobiles are become a integral part of people lives which makes easier to handle seamlessly. Device can be useful to give cardio disease indication and it should inform nearby people in emergencies to catch help as early as possible. This device may operate remotely and for long term monitoring of cardio patients.

Keywords— Back propagation, ECG (electrocardiogram), Electrodes, Filtering, Impedance, placement of Electrodes.

I. INTRODUCTION

Heart diseases are increasing day by day. As per research, heart diseases are growing faster than other disease in India. Most common diseases are cardiovascular diseases, Cancer, Obesity, Asthma, Diabetes etc. but comparing those, cardiovascular diseases are growing faster. Cardiovascular Diseases are growing 9.2 % annually, shown in fig. 1.

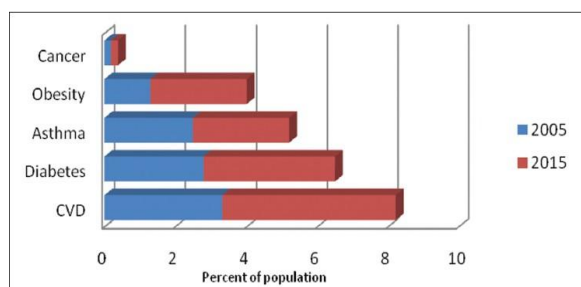


Fig. 1 different diseases variation in recent years

Cardiovascular diseases are the major reason to sudden death, 23.3 % of death are only due to heart disease as compare to other diseases, shown in fig. 2.

So, it becomes more concern for researcher to control growth of cardio disease. Therefore an intelligent device which monitors the personal health of the person and her/his cardiovascular activities is to be made.

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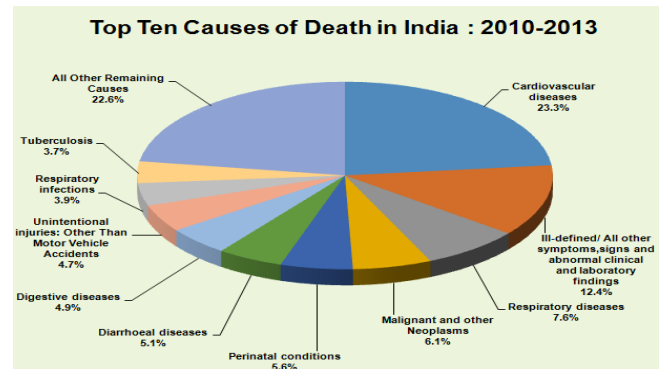


Fig. 2 categorization of causes of sudden death

Mobile device are used by every common people who makes it easier to club with cardio devices to operate regularly. Cardio device used is generally used for obtaining an ECG. In hospitals 12 leads 10 electrodes device are used to do the ECG of patients having some symptoms of cardio disease. Instead of using 12 lead, 3-lead electrodes can be used to give the ECG as it can operate remotely and regularly. As this device becomes remotely operates then it can also used for continuous monitoring. Device can able to give information to user if there is any need or any emergency which help to go through more concern in hospitals which reduces the time and cost of user and health care will be taken care on regular basis without any much cost.

Electrodes used are also one of the major factors for getting quality signals. ECG Device become handier as it used only 3 electrodes and would be operates like mobile phones. Data of user can be transfer to mobile phones and can be share it to the doctors and concern in case of emergencies. Data will be save to the device as well as on mobile memory that can be useful for rechecking as well as for record of patients health as par heart disease are concern which may be also useful in future.

II. RELATED WORK

Biometrics is used as a faithful security tool due to its effectiveness to identify the signal more accurately and secretly. Therefore it is used in many intelligence systems as in smart phones and mobile payable nowadays. Authentication can be done by using finger print, iris detection, and face identification and also by voice recognition. With the help of stated biometrics can keep device information more safe and user ability to use applicable devices more accurate, specific, secure and faithful. From the research, finger print, iris detection, face recognition, voice detection can be result with error and can be misused by another person. So, to avoid misuse of such

biometrics and more precise and faithful authentication ECG can be used as one of the Biometric which is more reliable than other stated biometrics. However, ECG is having comparatively more noise and that because of using dry electrodes in wearable device which is influences by skin impedance and movement of device. Fast signal detection is also one of the important needs of the device with low noise. Proposed algorithm is implemented in a wearable device i.e. watch, which gives fast processing with low error rate and noise created during ECG collection can be removed by using band pass filter or wavelet de-noising and smoothing. Correlation is one of the important factor is used to match the previous and recent pulse to operate the device smoothly. Correlation plays a vital role for operation of device more accurately. For making unit energy signals for having identical signals matching, right and left peak of the sample is resample using quantization and made such that every ECG beat should have same length and it should align at the peak of QRS complex. So that result ECG signals having unit energy signal, this is helpful to more accurate authentication with less error. So, by using ECG as a biometric for authentication device information operate more secretly and by reducing error rate.

Research paper gives the knowledge as how to reduce the noise of ECG signals by using band pass filter and give algorithms as ECG Beat Selection for Registration algorithm and ECG Beat Selection for Authentication algorithm to detect ECG signals more accurately and faster by reducing the noise which gives 5.2% FAR (false acceptance rate) with 1.9% FRR (false rejection rate) on average, with approx. 3 s for the authentication. [1]

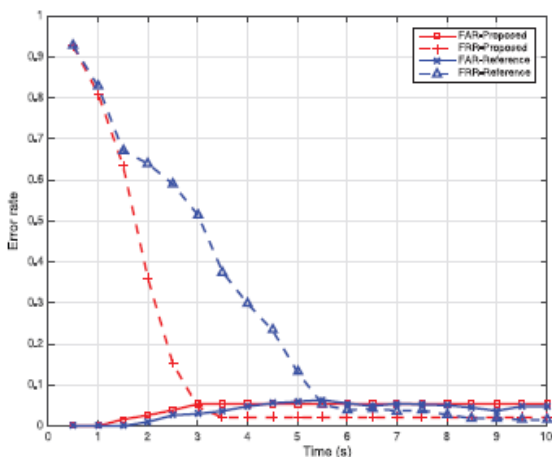


Fig. 3 FAR and FRR performance with authentication speed

FAR and FRR performance with authentication speed is shown in fig. 3. Many PLI (power line interference) methods are studied but adaptive technique is more reliable technique among all. Adaptive PLI filtering technique is robust and as well as used for light weighted online processing. Adaptive filtering is uses analog filter to remove PLI which is also one of the major barriers for getting quality signals. APF RLS means adaptive PLI filter recursive least square algorithm examine the PLI parameters. APF RLS has the best performance in terms of output SNR and it best preserves the frequency characteristics of the targeted signals, while having minimal computational cost. [2]

Power consumption reduction three types of ways are used as it can be carried by using interrupt service routine, sending only detected signals to master flip flop when slave should be sleep mode instead of using wireless transmission but embedded device to reduce the power consumption which is affected when uses a wireless sensor network and for the same reason such algorithm selected which is compatible with the hardware i.e. microcontroller. Four factors which are affected the ECG power consumption during use are hardware module, data communication methods, data processing and detection algorithm, and environmental factors. Among these hardware module and data communication consumes more power. Hardware module can be selected purposefully to reduce the power consumption. So the main focus is on data communication and data processing.

Table1. Energy Consumption of algorithms

SUMMARY OF ENERGY CONSUMPTION FOR DETECTION ALGORITHMS ($T = 508 \text{ ms}$, $W_S = 4 \text{ s}$, $F_{ADC} = 62.5 \text{ Hz}$)

Algorithm	Experiment $E_T (mJ)$	Relative Value	Experiment $E_{saved} (mJ)$	Relative Value
TCI	4.06	1.02	73.08	1.000
VFF	3.97	1.00	73.11	1.000
TOMP	4.24	1.07	72.96	0.998
TD	4.88	1.23	72.43	0.991
TCSC	4.37	1.10	72.715	0.995

Energy consumption with respect to used algorithm is stated in table 1. Five light-weighted algorithm are studied and from them VFF is the most effective low power consumption algorithm.

VFF algorithm is the overall best method in term of energy consumption and computational efficiency but having very low accuracy. Result indicates that data to be send back to mobile or system in real time consume 6.5 times more energy than processing and detecting data via hardware and by sending only detected events back using VD algorithm.

Thus VD algorithm is effectively used to reduce the power consumption. Proposed energy consumption model can accurately estimate the energy consumption for experimental designs within minimum average error of 4.3 %. [4]

ECG is studied mostly for wearable remote health monitoring system. For signal acquisition it is very necessary to choice one of the best electrodes to capture a strong ECG signals. In hospitals disposable wet electrodes are used as gives good performance in short period of time but wet electrodes are uncomfortable if it is used for long time duration, because wet electrodes cause skin irritation, conduction reduces with a period of time. Therefore, wet electrodes term but for long period dry electrodes are faithful than wet electrodes. Structure of Wet and Dry Electrodes are given in fig. 4.

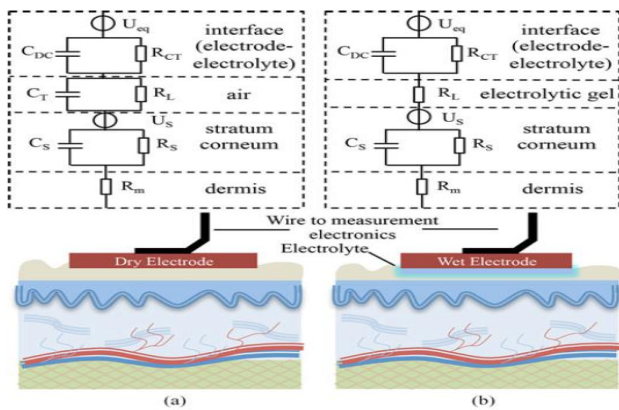


Fig. 4 (a) Dry Electrode and (b) Wet Electrode.

The impedance created during signal acquisition should be low. As discussed, printed fabric dry electrodes are created to catch the ECG signals. Printed area of ECG signals is inversely proportional to its impedance value. Impedance is also affected due to lack of conductive medium between skin surface and electrodes in case of dry electrodes. To reduce the impedance biocompatible hydro-gel is to be used to increase the conductivity of dry electrodes, which shows the lower impedance than disposable wet electrodes. The impedance of dry electrodes can be change with the change in printed area, skin electrode intermediate material and applied pressure on electrodes. As observed, 20 mm printed area having less SNR (signal to noise ratio) ratio than 30 mm printed area, therefore electrodes having 30 mm printed area is preferred. One of important factor which affect the ECG signals is distance between the electrodes while placement on the body.

As distance of electrodes changes from 2 mm, 4 mm, 6 mm, 8 mm, 10 mm, 12 mm during placement on body R peak value in ECG is increases till 8 mm distances and then decreases to 12 mm. SNR is high during 8 mm distance of dry electrodes. Therefore distance of placement between two electrodes 8 mm is preferred. Movement of body is also affected ECG signal strength. During setting position body gives slight difference in SNR but moving wet electrodes gives high SNR. Due to long term requirement and skin issues fabric based dry electrodes are preferred.[5]

III. PROPOSED WORK

Research Work gives the idea about elements which are more suitable for the system.

System will comprises of data acquisition system which takes the data of user and transmit it to the signal processing unit through wired medium..Signal processing filter low frequency ECG signals and passes to the transmitter section of the hardware. Receiver section of classifier receives the data wirelessly and classifies the same data and gives the representation and identification on the screen. This information of individuals can be share to the authorize person for more verification and thus regular health care can be taken daily.

IV. ARCHITECTURE OF PROPOSED WORK

Block diagram of system is shown in Fig.5, which gives overview of whole system.

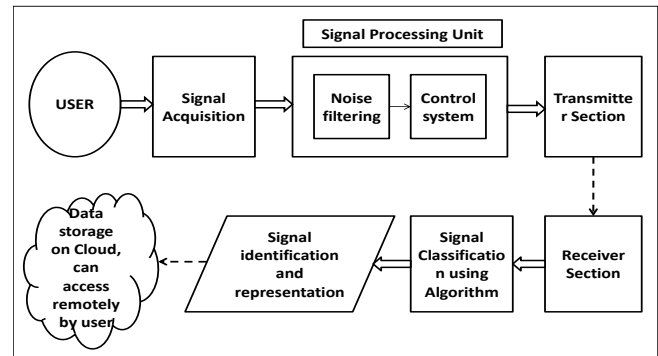


Fig. 5 Block Diagram of system

Any user can used this system. Signal acquisition can be done by using three Wet Electrode only. Electrodes can be place to right hand wrist, left hand wrist and left leg foot where pulse can be easily detected. Acquired ECG signals are pass to the signal processing unit IC AD8232 will have inbuilt filter which filter the high frequency noise and signals can be controlled by using Microcontroller ATMEGA16.

Further signals are passes to the transmitter side of the receiver which is Bluetooth and via Bluetooth signals can be send to the other hardware Bluetooth wirelessly on the another presenting device.

Signals receives by the Bluetooth are further process for classification of possibilities of diseases and ECG can be shown on the screen continuously. Classification of ECG signals is carried out by using Back propagation method. This information of ECG can be shared with the authorized person via Wi-Fi and can operate on Google drive.

V. CONCLUSION

System can be made for daily use of a heart patient, as well as for continuous monitoring, and more effective for regular health check up with low cost, instead of spending much in hospitals for just routine checkup. System can be undergoes using three electrodes only.

VI. REFERENCES

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