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Detection of Cardiac Stress using Acoustic Heart Signal

[1]Dr. S. M. Rajbhoj, [2]Aditi Mahodaya, [3]Apoorva Anand, [4]Bhor Akanksha Kashinath

[1]Assistant Professor, [2,3,4]UG Student, BE E&TC, [1,2,3,4]BharatiVidyapeeth's college of Engineering for Women, Pune, India.

[1]sushilrajbhoj38@gmail.com, [2]mahodaya10@gmail.com, [3]apoorvaanand14@gmail.com, [4]bhorakanksha@gmail.com

Abstract—Acoustic heart sounds provide important information about cardiac activity. This paper presents a method to provide a framework for the analysis of heart signal for cardiac monitoring. It makes use of biomedical signal processing to extract candidate features. These features change during cardiac stress and the change is more significant for patients with cardiac problem. This system detects cardiac irregularities in real time. This is not possible by ECG monitoring alone.

Keywords — acoustic heart sounds, cardiac monitoring, cardiovascular diseases, biomedical signal processing, feature extraction, irregularities

I. INTRODUCTION

Cardiovascular diseases, such as coronary artery disease, hypertension and cardiomyopathy, may impair the mechanical functionality of the heart, leading to the clinical syndrome of heart failure (HF). These diseases are major public health problems worldwide.

The use of remote monitoring devices significantly improves efficiency of health monitoring services. It improves quality of service and also reduces cost. As prevention is better than cure this system has great benefits .The system developed mainly for early detection of cardiac diseases.

Most devices use ECG for remote cardiac monitoring. However, it does not provide detailed information on the internal activity of heart.

To improve early diagnosis patient monitoring cardiac stress detection system is implemented. This is non-invasive, easy to perform and reliable method. Heart sounds are generated by closer of valves and flow of blood through it. Normal cardiac cycle contains two major audible sounds, S1and S2.

Fig.1 Heart Sounds

Here, different sensors like stethoscope, microphone and heart beat sensor are used for acquiring heart sound. Then, signal processing is used for feature extraction and data analysis. From analyzed data person's cardiac status is determined.

II. PROPOSED METHOD

A. Hardware Design

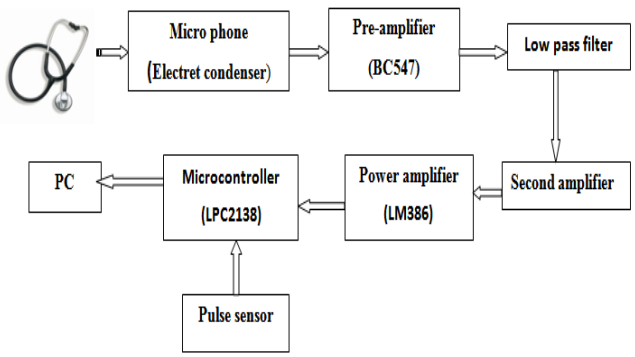

Fig.2 Hardware Block Diagram

Stethoscope: The stethoscope is a medical device for listening to the internal sounds of human body. It typically has a small disc-shaped resonator that is placed against the chest, and two tubes connected to earpieces. It is often used to listen to lung and heart sounds.

Microphone: A microphone is a sensor that converts sound energy into electrical energy. Microphones are the natural

choice of sensor when recording sound. These sensors have a high-frequency response that is quite adequate for body sounds.

Pre-amplifier: The preamplifier BC547 is used to increase the low-signal from the microphone to line level for further amplification. This is accomplished by providing a voltage gain from the microphone to the circuit.

Low pass filter: A low-pass filter is provided to remove high-frequency noise and also to act as an anti-aliasing filter.

Second amplifier: Further amplification is done using second amplifier LM393.

Power Amplifier: The LM386 is a power amplifier designed for use in low voltage audio applications. It has Voltage gains from 20 to 200.

Heart beat sensor: It is used to obtain heart beat of person which will be used for mapping with acoustic heart signal obtained from stethoscope.

Microcontroller: LPC 2138 is used to convert analog signal into digital one. Heart beat sensor is also given to microcontroller.

Serial communication: RS232 & MAX232 is used for serially connecting the o/p of microcontroller to PC.

PC: MATLAB is used for signal processing on input data. From this we will extract the features which will be used for classifying person as normal or abnormal.

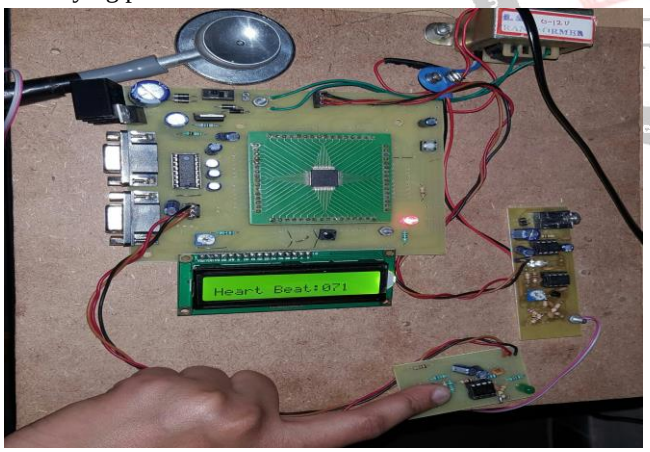

Fig.3 Hardware Model

B. Software Design

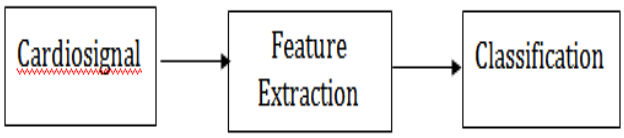

Fig.4 Software Block Diagram

Cardiosignal: The heart sound from the output of microcontroller which is serially connected to PC is recorded using distortion free MIC. This sound is captured in MATLAB. Sample number Vs Amplitude graph is plotted.

Feature extraction: From the recorded heart sound features like power, energy and heart sound are extracted.

Classification: A particular threshold is set for the extracted features to categorize as they are having normal or abnormal characteristics. From this a person's cardiac status as normal or abnormal is determined.

III. RESULT ANALYSIS

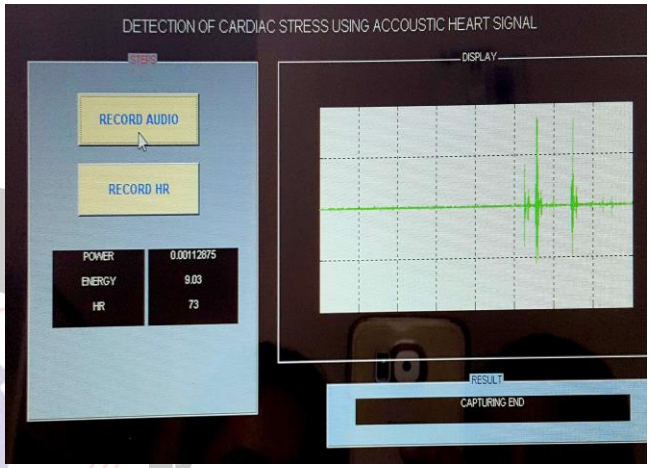

Fig.5 Recorded Sound

Fig.6 Cardiac Status Result

The figures represent the heart signal variations of the person . Fig 5 shows recorded heart sound using Matlab . Fig 6 shows cardiac status result. It shows extracted features like power, energy and heart rate.

IV. CONCLUSION

The hardware model used for acquiring heart sound was able to acquire heart sound accurately. The signal processing performed on acquired heart sound was able to extract candidate features effectively. From these features level of cardiac stress is determined. Hence this proposed method of analyzing heart sounds for monitoring cardiac stress is more efficient and accurate than the conventional method of using ECG. Thus provides a new technology for detection and diagnosis of mechanical disorders caused by cardiovascular diseases.

REFERENCES

[1] Ana Gavrovska, Vesna Bogdanovic, Irini Reljin, Branimir Reljin, " Automatic heart sound detection in pediatric patients without electrocardiogram reference via pseudo-affine Wigner-Ville distribution and Haar wavelet lifting," Elsevier Publication, Computer methods and programs in biomedicine 113 (2014) 515-528.

[2] Herzig, J., Bickel, A., Eitan, A. and Intrator, N., 2015, "Monitoring Cardiac Stress Using Features Extracted From S1 Heart Sounds,", IEEE Transactions on Biomedical Engineering, 62(4), pp.1169-1178.

[3] Eugenijus Kaniusas, elmut Pfutzner, Member, IEEE, and Bernd Saletu," Acoustical Signal Properties for Cardiac/ Respiratory Activity and Apneas," IEEE Transactions on Biomedical Engineering, vol. 52, no.11, November 2005.

[4] Yang Tang, Guitao Cao, Hao Li, Kanjie Zhu, "The design of electronic heart sound stethoscope based on Bluetooth," IEEE 2010.

[5] W.Y. Shi, Jeffrey Mays, and J.-C. Chiao , "Wireless Stethoscope for Recording Heart and Lung Sound" Electrical Engineering Department, The University of Texas at Arlington, TX, USA.

[6] Hemant Kumar, Ashish Harsola Tiwari, "Development of Embedded Stethoscope for Heart Sound", Department of Electronics and Telecommunication, Fr. C. Rodrigues Institute of Technology.

[7] T.K. Hareendran, " Spy Ear" , Electronics for you, April 2010.

