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AN USER FRIENDLY ELECTRONIC STETHOSCOPE FOR HEART RATE MONITORING

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Abstract: This paper is a biomedical based related to the heart pulse dealing with the accuracy of acquiring the pulses for determining the heart rate precisely. In addition to this it will be helpful in determining exact heart pulse per minute and diseases associated to it. It is one step forward to improve its present features and try to make a more efficient stethoscope with advanced features.

1. Introduction:

Assumed Heart sound generally takes place as an when the heart contracts and expands. The information of myocardial contractility and also to the blood vessels present in the body is provided by it, which cannot be received by the use of Electro cardiogram (ECG). This is the reason why stethoscopy of heart sound in anesthesiology is a very crucial tool to obtain cardiac information and to prevent medical accidents which are operative within itself which requires a unique system for precise measurement to fulfil the objectives which helps in analysing of heart sound as well as murmur. Thus, the purposed of this study is to develop portable digital electronic stethoscope that can objectify and quantify heart sound as well as murmur. The stethoscope is the basic tools for diagnosing in the present medical world. The heart sounds are being generated by the beating of heart and the flow of blood during the circulation in it. It then collects and analyse the basic information of patient's related to cardio respiratory system. Heart diseases are the reason of untimely death and it has been termed to be the reason behind the high mortality factor that comes second to the stroke that prevailed in the present day's world. A Heart sound stethoscope is the most primary stage to access for a physician. Generally a stethoscope is an acoustic instrument used in medical world for listening to internal sounds that are produced in a human body. Some present day researchers has concluded that a heart-rate profile which is abnormal during the time of exercise may lead to sudden death sometimes. Nowadays the cardiovascular diseases that keep on increasing every year, and it has become worldwide concern that is common and very high prevalent disease. An electronic stethoscope that will work digitally will change the way of auscultating the sounds related to heart.

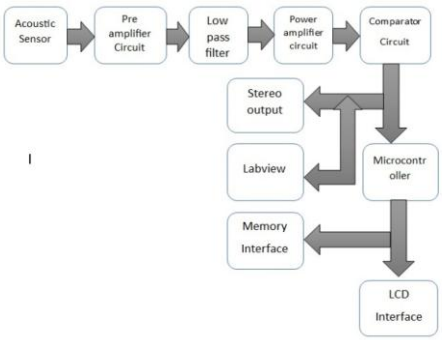

Figure 1: Block diagram.

2. Theoretical review:

At present, the domestic living standard is improving as well as numbers of patients with heart disease are increasing rapidly. Stethoscope is being since time in memorial by the professionals dealing in healthcare. Disadvantage includes that the sound level is very low and becomes hard to listen it clearly, which is important for the diagnoses but cannot been clearly distinguished by doctors amplifiers. Recently, there have been a number of advances in auscultation technology, including the introduction of a number of electronic

stethoscopes, portable Bluetooth visual electrical stethoscope, stethoscope based on Bluetooth and embedded digital stethoscope that uses the adaptive noise cancellation filter and the Type I Chebyshev IIR band pass filter to reduce the noise of the heart sound. Many of these stethoscopes rely on the use of a personal computer to filter record and replay the signal. When the heart sounds are extracted many externally generated body noises that include ambient noise, along with internal body noises such as, speech heavy breathing etc. All the noises are mixed together with heart sound.

3. Literature review:

Some of the previous works done in this field are written below.

Kyle Jamar et all discussed mainly about Basic of Stethoscope, Current and Previous Design, Components, Description, Microphones, Amplifiers and Filters, Wireless design.[1]

Wah W. Myint & Bill Dillard discussed about Acoustic heart Sounds, list of Possible Diagnoses that includes Heart beat extraction, Segmentation of Heart Sound Cycle, Extraction of murmur data, Time frequency analysis of murmurs, Statistical metrics, Diagnoses algorithm and Portable Digital Esophageal Stethoscope System. [2]

J.Y. Shin et all designed a PDES for precise measurement and analysis of heart sound and murmur data. Heart sound information obtained by inserting the sensor of the PDES into the patient's esophagus can be transmitted to a terminal or a PC and displayed on the screen. The hardware was designed so that heart sound data are collected using a microphone connected to the esophageal catheter, and then processed and transmitted wirelessly to a PC. In addition, software Heart Sound ver. 1.0 was developed to display the amplitude and waveform of heart sound and murmur. Also, their aim was to measure body temperature along with the heart sound. [3]

Adrianus J.M. Houtsma et al studied is about the medical emergencies where patient examination with a stethoscope (auscultation) is of critical importance for the patient's survival. In case of Conventional acoustic stethoscopes the maximum noise level in the environment that still allows successful auscultation is between 80 and 85 dB sound pressure level (SPL), dependent on details of stethoscope design and physician's skill. Noise levels in heavy-duty helicopters like the Black Hawk can go as high as 120 dB SPL. Noise levels at indoor sporting events and pop concerts can easily reach 100 dB SPL. To conquer these high noise levels, a totally different technology was added to the stethoscope design.[5]

Kuldeep Singh et al discussed an electronic stethoscope, which is based on embedded processors, is designed to fulfill the shortages from the auscultation. It converts acoustic sound into electrical signal and this signal is amplified and heard on speakers, so there is no need of headphone for listening heart sounds. Heart Beats per Minute (HBM) is displayed on LCD.

4. Working of the stethoscope:

The stethoscope consists of a pre-amplifier followed by a low pass Butterworth filter and an amplifier to amplify the input signals. Here, a microphone is used to attain the input signal by keeping the microphone to near the chest. The sound is converted into electrical signal and so these signals are observed as a voltage. The comparator circuit is used so that a voltage level is set, when the input voltage exceeds the set voltage, a heartbeat is considered. When the heartbeat is observed for a minute duration heartbeat per minute can be determined which is different for each person.

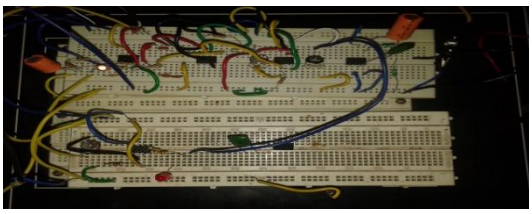

Figure 2: Hardware part of the electronic stethoscope.

5. Results:

We have completed the hardware of the electronic stethoscope and it is showing good results. The heart pulse has been displayed using a cathode ray oscilloscope (CRO). The signal of the heart is observed to be clear and it is ready to be heard using a microphone. Moreover when Labview is used, the heart pulse can be very clearly seen. It has three peaks of different amplitude each varying from one another. Next using a microcontroller possibly Intel 8051 or Atmel based for displaying the heartbeat using an LCD.

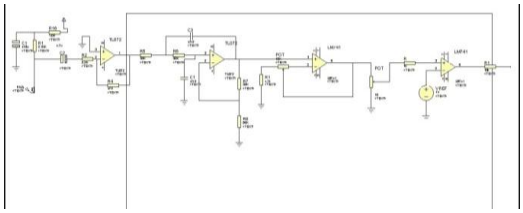

Figure 4: Design of a circuit.

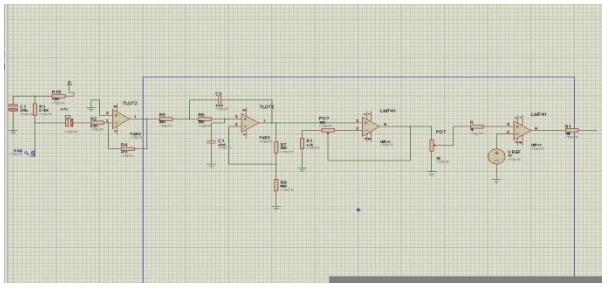

Figure 5: Design of circuit in Proteus.

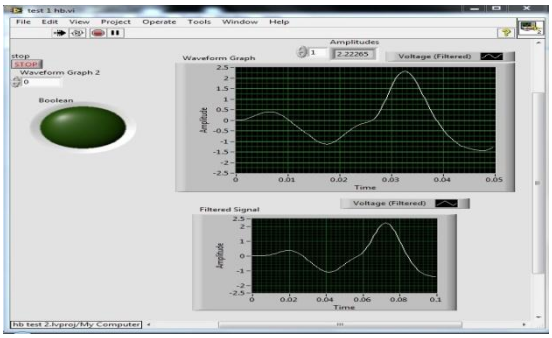

Figure 6: Generation of Heart Pulse in Labview.

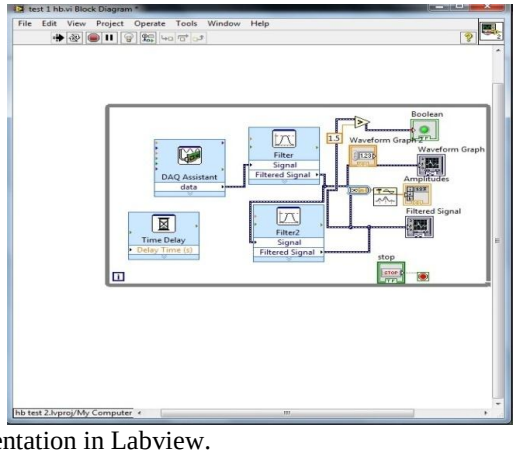

Figure 7: Block diagram representation in Labview.

6. Future work:

The work of this paper will be extended so that the stethoscope could be made more reliable by developing it into a kit which will be able to determine the number of heartbeat correctly and with higher precision which will be displayed in the LCD. The heartbeat will be considered for a minute which will determine the blood pressure as well. Also there will be a thermometer which will measure the temperature simultaneously of the patient.

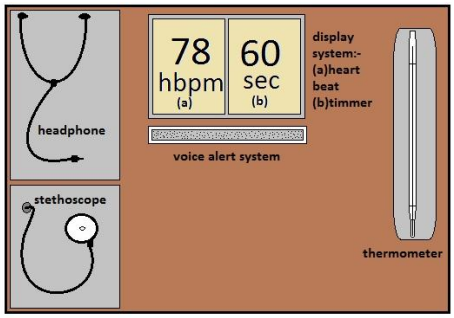

Figure 8: A concept kit consisting of blood pressuring tool and thermometer.

7. Conclusion:

The content of this paper is the design and developing of an electronic stethoscope which have minimum noises and the extracted heartbeat by this device is shown with the help of Labview Software. The previous works which were already being done are improved while doing this paper. In a single kit, a heartbeat measuring tool which comprises of a counter, LCD etc. will be designed to measure the blood pressure. A thermometer will also be installed into the kit. It will be an ideal Stethoscope for use in air and ambulance transport of patients. Also Separate adjustable filter and volume controls will make it user friendly.

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