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Development of Electronic Stethoscope Systems against Beat Value per Minute (BPM)

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Sumber

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Abstract: Heart disease is a disease that is widely experienced by people in the world. Heart disease is one of the most common causes of death. The more sufferers of heart disease, it is necessary to deal with the problem. Handling these problems, namely the need for treatment management and often check the conditions suffered by the patient before it will become a chronic disease. One of the management of heart disease is the use of an electronic stethoscope. An electronic stethoscope is made by placing a condenser microphone in the hollow pipe of an acoustic stethoscope to convert the sound captured by the chestpiece into an electrical signal. Then the signal will be amplified, then passed to the heart filter to clarify the sound that you want to hear more. Module measurement as one method to determine the truth value of the research Development of Electronic Stethoscope System against Beat per Minute Value (BPM) by taking data 10 times. The result of data retrieval shows the maximum error value is 11.67% and the smallest error value is 1.29%

Keywords: Stethoscope, Beat Per Minute.

INTRODUCTION

Heart disease is a disease that is experienced by many people in the world. Heart disease is one of the most common causes of death. The more people with heart disease increase; the handling is needed to overcome the problem. Handling these problems, namely the need for treatment management and frequent checks related to the conditions suffered by patients before it will become a chronic disease. One of the management of heart disease is the use of an electronic stethoscope.

The microcontroller also calculates the value of BPM (Beat per Minute) based on the results of segmentation, and concludes whether the BPM value is normal or not. The result is a standalone electronic stethoscope that is capable of listening to and clarifying heart sounds. At the time of measurement, the chestpiece is affixed to the subject's chest or neck, and is maintained for no change in position for about 15 seconds. This electronic stethoscope can also display BPM values. Today, daily activities cannot be separated from smartphones and music. This paper presents a unique approach to increasing heart rate. Simple applications are the basis of development so it's easy to use. Increased heart rate can be a support in maximizing daily activities. The aim of this study was to detect heart sounds with normal subjects, to find out how large BPM was in normal subjects.

METHODS

The research design used was to use pre experimental method with the type of after-study design because the final result of measurement tool compared with the control group. In this study the researchers use development of electronic stethoscope system against beat per minute value by taking data 10 times

RESULTS AND DISCUSSION

Condenser Mic

Condensor mic is an electronic component that is a sound sensor, condenser mic itself consists of capasitive plates which are sealed at a density of several microns. Meanwhile the working principle of a condenser mic is the process of filling and discharging capacitance caused by a condenser plate that vibrates due to the frequency of the sound it receives, resulting in a changing frequency of capacitance when there is sound received. Microphone (abbreviated as mic) is a transducer that detects sound signals and produces electrical signals in the form of voltage or current proportional to sound signals. Microphone provides analog signal output that is proportional to changes in acoustic pressure depending on the flexibility of the diaphragm. The electrical signal is then used for sending, recording or measuring the characteristics of the acoustic signal.

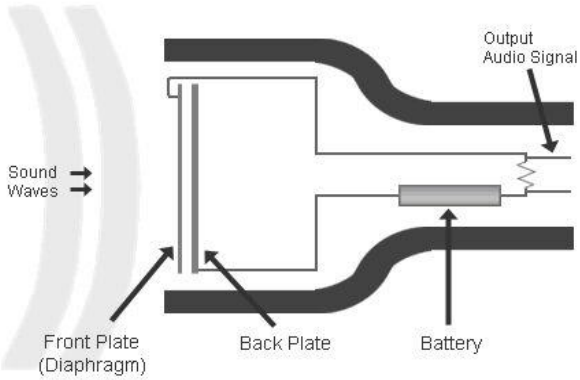

Fig-1: Construction and Mic condenser section

Stethoscope

Stethoscope (Greek: stethos, chest and skopeein, checking) is an acoustic medical device for examining sounds in the body. He is widely used to hear heart and breathing sounds, although he is also used to hear intestine and blood flow in the arteries and "vein". The stethoscope is currently used based on Laennec's original work, which consists of 2 main parts: Sungkup (bell) to collect sounds from the area to be examined. The hood may be open or covered by a thin membrane. The second part is earpieces.

Fig-2: Acoustic Stethoscope

Heart

The heart is one of the important organs in our body. The general function of the heart is to work as a pump. The function of this pump is related to the circulatory system of the body so that when the heart works for and in order to pump blood throughout our tissues. The frequency of heart sounds is in the frequency range of 20 - 150 Hz. actually occurs when closing the heart valve. This event can lead to a false assumption that the heart sound is caused by the closure of the valve leaf, but is actually caused by the effect of the navel flow in the blood due to the closing of the valve. The heartbeat produces two different sounds that can be heard on a stethoscope, which are often stated by lub-dub. Lub sound is caused by the closure of the triscupid and mitral (atrioventricular) valves which allow blood flow from the atria (heart chambers) to the ventricle and prevent backflow. Generally this is called the first heart sound (S1), which occurs almost simultaneously with the emergence of the QRS complex from the electrocardiogram and occurs before the systole (the period of the heart contracting). Dub sound is called the second heart sound (S2) and is caused by the closure of the semilunar valve (aortic and pulmonary) which frees blood to the pulmonary and systemic circulation system. This valve is closed at the end of the systole and before the trioventricular valve reopens. This S2 sound occurs almost simultaneously with the end of the T wave from the electrocardiogram. The third heart sound (S3) corresponds to the cessation of atrioventricular filling, while the fourth heart sound (S4) has a correlation with atrial contraction. This S4 sound has very low Amplitude and low frequency components [1].

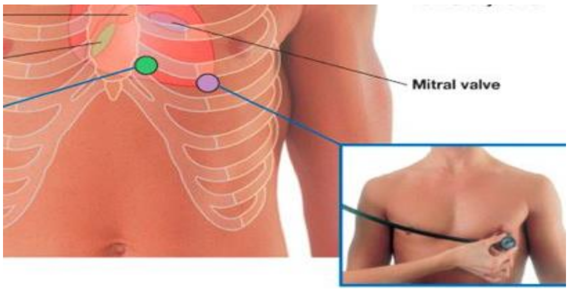

Fig-3. Sound Capture Layout Heart

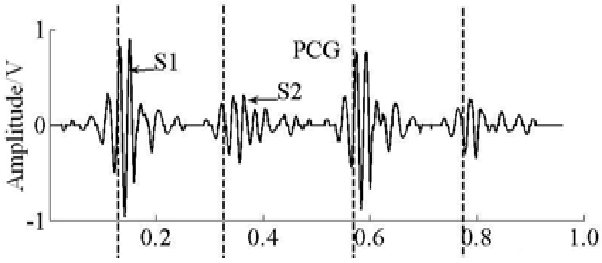

Fig-4: Heart Sound Wave

The four locations are most often used to listen to the sound of the heart, which is named according to the position where the valve can be heard properly: [2].

- The aortic region: centered on the second right intercostal space.
- Pulmonic region: in the second intercostal space along the left sternal border.
- Tricuspid area: in the fourth intercostal space along the left sternal edge.
- Mitral area: at the cardiac peak, in the fifth intercostal space on the vertical line (midclavicular line).

Pre-Amp circuit

Preamplifiers, often called preamp or control amplifiers, are electronic amps that process or process electronic signals before entering the amp.

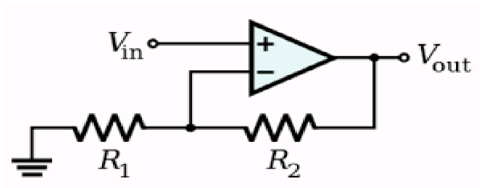

Fig-5: Non Inverting series Amplifier

Filter Series (Band Pass Filter)

Band pass filter (BPF) is a filter that will pass a signal in the frequency range above the lower limit frequency (fL) and below the upper limit frequency (fH). In the band pass filter (BPF) there are 2 types of band pass filter (BPF) known, namely band pass filter (BPF) wide field and narrow band pass filter (BPF).

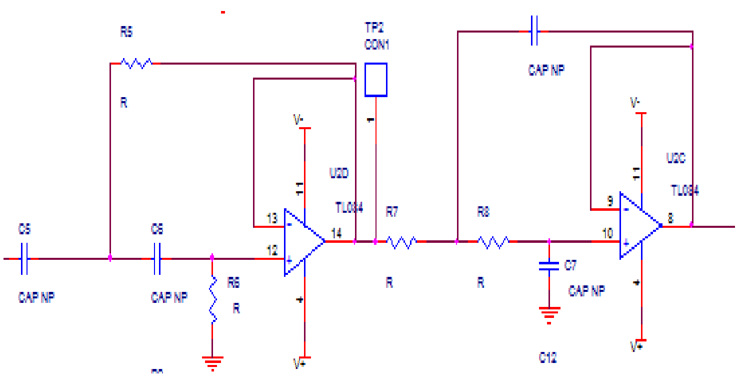

Fig-6: Band Pass Filter series

The circuit used can be like the picture above but there is a special circuit for narrow field BPF. Even this special circuit can also be used for wide field BPFs, but specialists for narrow fields. This circuit is often called a multiple feedback filter because a series produces 2 limits of Lf and Hf. Series images and examples of bandwidth in a narrow field are given as follows. The equation of the equation is different and different. The passive component used is the same as the passive component of the LPF and HPF.

Flow Chart

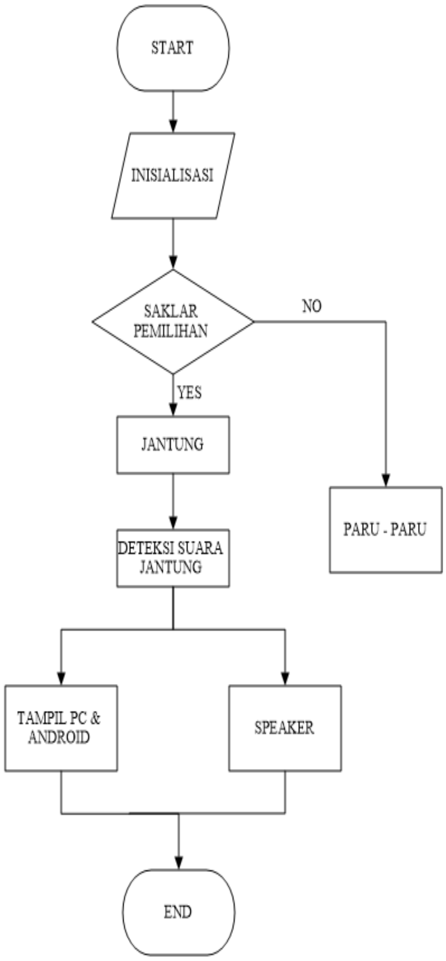

Fig-7: Flow Chart

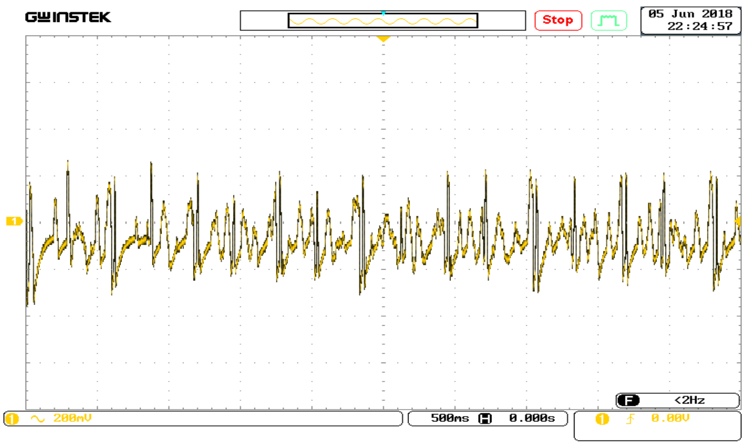

Fig-8: Pre-Amp Output

The picture above is the output of the Pre-Amp circuit. At the output of the Pre-Amp circuit there is still a lot of noise because this series is the first series of leads on an electronic stethoscope. The output results above are taken using a stethoscope which is the result of the sound obtained through the input that comes from the condenser mic.

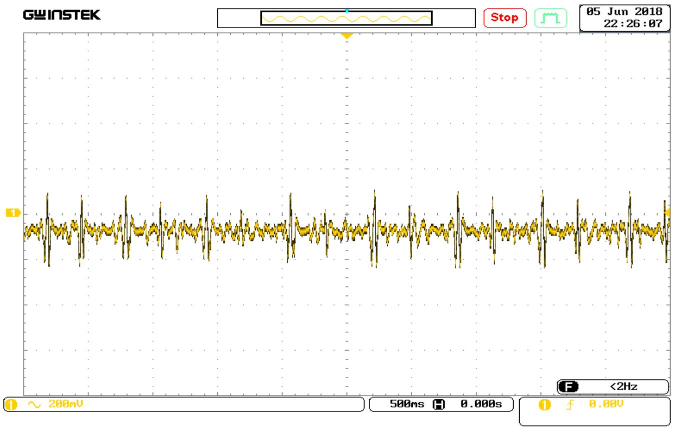

Fig-9: HPF output

The picture above is the output of a high pass filter filter circuit on an electronic stethoscope circuit. This HPF filter circuit is the first range of filters used to capture heart signals with a cut-off frequency of 20 Hz. So the stethoscope only taps signals with frequencies worth more than 20 Hz to get a signal that really comes from the heart. At the output of this circuit the signal is obtained with noise which is less than the output of the Pre-Amp circuit.

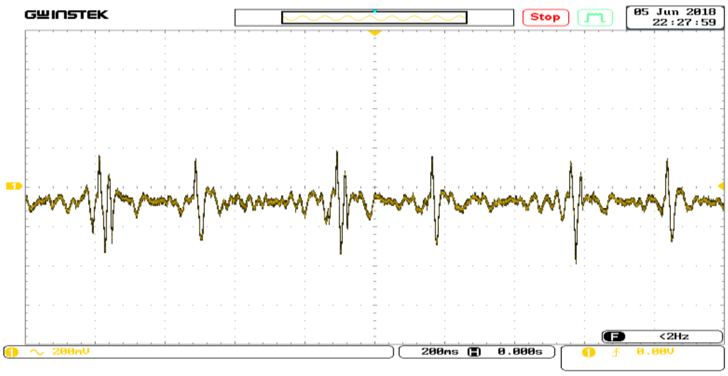

Fig-10: LPF output

The picture above is the output from the LPF circuit. The LPF circuit is used to obtain heart signals with a cut-off frequency of 50 Hz, so that the signal tapped by an electronic stethoscope is no less than 50 Hz. In this LPF circuit, a signal with less noise is obtained because the signal that is the input of the LPF circuit is the output signal from the HPF circuit.

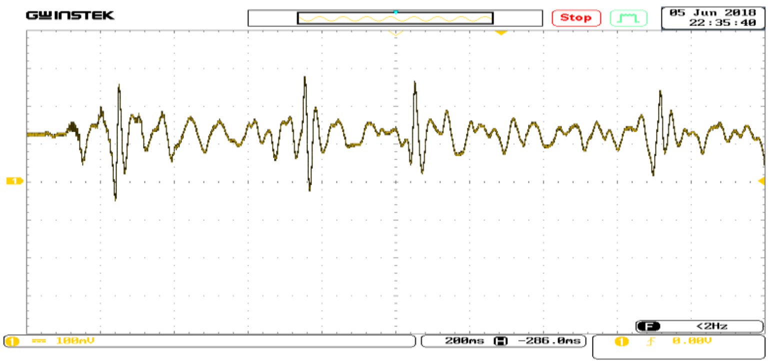

Fig-11: Output Adder circuit

The picture above is the output from the adder circuit. Rangakian adder is used to increase the reference. The purpose of increasing the signal reference is so that it can be read by the microcontroller. It can be seen from the picture above that the signal from the adder circuit has raised the reference compared to the result of the previous circuit signal without changing the amplitude and frequency of the previous signal.

CONCLUSIONS

The result of data retrieval electronic stethoscope systems heart beat per minute shows the maximum error value is 11.67% and the smallest error value is 1.29%

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