Comparison Study Design of Analog Filters Notch Filters Digital on Bio-Amplifier circuit ECG

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Abstract—ECG is a diagnostic tool that is used to detect the electrical pulses generated by the heart, so that the average heart rate - the average can be calculated in beats per minute. The way these aircraft to monitor the patient’s heart condition is to put electrodes placed at specific points on the surface of the patient’s skin. Electrode serves as a catcher heart activity signal, then amplified so that it can be seen on the screen and reading on the record paper.

Based on the results of measurements using a phantom at 30 BPM unfiltered ECG and ECG using an analog filter has an amplitude of 2V and the frequency of 0.49 Hz; ECG using a digital filter has an amplitude of 1.9 V and frequency of 0.49 Hz; 60 BPM unfiltered ECG and ECG using an analog filter has a 2V amplitude and frequency of 0.99 Hz; ECG using a digital filter has an amplitude of an 1.9 V and frequency of 0.99 Hz; 120 BPM unfiltered ECG and ECG using an analog filter has an amplitude of 2V and the frequency of 1.99 Hz; ECG using a digital filter has an amplitude of 1.9V and frequency of 1.98 Hz. ECG without noise filter is still Clearly visible, whereas the ECG using an analog notch filter reduced the noise from the signal even more subtle and no-noise digital filters.

Thus, by using matlab software can make a digital filter that can be used to Eliminate the noise so the signal is more perfect and help finance doctors misdiagnosis.

Keywords—ECG, Notch Filters, Matlab.

I. INTRODUCTION

Living things compose of ions that amount / concentration varies. Charged ions are present in the human body that has called biopotensial electrical potential can be measured between living cells, tissues, and organisms in the body. A tool / device diagnostic use to detect electrical pulses generated by the heart or record bioelectric pulses that resulted by heart, so that the speed of the average heart rate (heart rate per beep) can be calculated in beats per minute is the best Electrocardiograph (ECG). The best way is monitoring the state of a patient’s heart is by placing electrodes – electrodes are placed at a point - to a point on the surface of the patient’s skin. These electrodes serve as the heart activity signal catcher, then amplified so that it can be seen or read on the monitor screen recorder paper (paper records).

The results of the recording physician who later became a reference in analyzing the patient's heart condition. The use of ECG filter has a considerable influence on the results of the ECG recording. Good filter can filter out voltage - the voltage and noise that can interfere with the results of the ECG recording. This can lead to misdiagnosis of the patient's illness. Notch filter or better known as the band stop filter is one of the filters that can be used to reduce noise in the ECG recording.

From the above statement, the researcher would like to compare and test the use of notch filters in the bio-ECG amplifier so that the author took the title "Comparative Study Design of Analog Filters Notch Filters Digital on Bio-Amplifier circuit ECG".

II. METHODS

Types of experimental studies, using the comparative method of designing and testing an analog notch filter with a digital filter.

As the dependent variable is the output of the comparison and testing the use of analog notch filters with digital filters.

Controlled Variables (Control) As the controlled variable in this module is the magnitude of the filter frequency used in analog and digital filters.

![Picture 1. Operational framework](image)
Pre-Ampis used to amplify the signal from the body to the ECG. There are 3 different treatment in this study. The first treatment, the output of the ECG directly shown in the display. Issued ECG signal will be filtered by the NotchFilter. Notch filters are divided into two, namely the analog filters and digital filters. Hardware such as analog filters and the digital filters in the form of digital signal processingin Matlab. The results of both filters will be displayed on the display. The third output will be analyzed and distinguished from the noise that appears, large amplitude and period.

III. DISCUSSION

Cup electrodes via cable delivers ECG heart signal then passes through capacitor C3 and C10 as DC blocking, then stabilized by the stabilizer circuit R7, R9, and C8 and the incoming signal to the Instrument Amplifier circuit in which the signal will be processed to generate signals PQRS, but outputan of instrument amplifier circuit is still very young and is still mixed with the frequency of the grid so the signal can not be in process. For the signal will be filtered by the low pass active filter circuit so that the signal R is already visible but still there is noise then used a passive low pass filter so that the noise that participate in PQRS signal so that the signal will be lost PQRS is clearly visible and the signal is reinforced by the circuit in non-inverting amplifier, with the aim revamp the amplitude of the signal PQRS. To refine PQRS signals then used R13 and C11

The series Low Pass Filter This circuit serves as a high frequency filter and low frequency skip or also called circuit LPF (Low Pass Filter). For the application of this tool is used as a filter circuit so that the frequency of heartbeats are missed. Besides, it is also not to be affected than the frequency of the grid. The series has a Low Pass Filter Cut off frequency or frequency range, when the incoming frequency is higher than the cut off frequency of the amplitude will be suppressed, and vice versa when the incoming frequency is lower than the cut off frequency of the amplitude will miss without experiencing emphasis. To design such as picture 4. has a cut off frequency of 15.915 Hz.

The series Sallen Key Low Pass Filter is designed to have a cut-off frequency as in the design of Low Pass Filter on figure 6.2 is 15.915 Hz. Sallen Key Low Pass Filter actively used as a signal smoothing (reducing noise) of outputan passive Low Pass Filter. Non-inverting amplifier circuitNon-inverting amplifier is used to increase the output voltage of the electrical potential of human measurement results without flipping the input signal. The resulting strengthening of this series at 22.28 times.
The series of Notch Filter

Notch filter or better known as the Band Stop Filter is used to suppress or stop certain frequencies. This module is used in analog filters and digital filters. Filters be set at a frequency of 50 Hz with a bandwidth (bandwidth) 5. Circuit The output frequency of 47.5 Hz Notch Filter and 52.5 Hz.

Amplitude before and after the stop band will be greater than the amplitude at the time of the stop band. Because bandwidth in 5 settings, so when frekuensi47.5 Hz and 52.5 Hz and amplitude decrease when the frequency of 50 Hz amplitude completely - completely suppressed and lost.

Software to read and display image data on the oscilloscope

ai = analoginput ( ‘Winsound ’ , 0 ) ; initialization line in addchannel ( ai , 1:2 ) ; softscope hardware initialization ( ai ) ; oscilloscope displays.

This program is used to initialize the analog input through sound card ( line in) with a sample rate of 8000 data on each channel per second. The hardware used is also needed in the initialization and in settings that can be displayed by using matlab. Oscilloscope on matlab can only be read by the input signal ± 1V.

If the input voltage exceeds the threshold , it is feared that the signal at the show will be truncated .

Software for the digital notch filter wo=50/(120/2); eliminate the signal frequency of 50 Hz to 120Hz (fs) bw=wo/5; bandwidth (bandwidth) 5[b, a]=iirnotch(wo, bw); make a digital filter with iir notch fvtool(b, a); display filters This program is used to create a digital notch filter with a frequency of 50Hz or 0.833π and bandwidth5. So ECG input from the phantom line in that goes into the laptop directly filtered using a digital notch filter. The signal from the filtering process directly on the oscilloscope display contained on the laptop.
IV. CONCLUSION

After making the process of making and planning literature study, experiments, testing and data collection tools, researchers can conclude the following:

1. ECG can be made to display the results of PQRST signal on the oscilloscope and Matlab.
2. Can be made on Matlab software to display the results of the ECG signal.
3. At 30 BPM without filters and ECG by using analog filters have a 2 volt amplitude and frequency of 0.49 Hz, while the ECG by using a digital filter having amplitude of 1.9 volts and a frequency of 0.49 Hz.
4. BPM 60 unfiltered ECG and ECG by using analog filters have a 2 volt amplitude and frequency of 0.99 Hz, while the ECG by using a digital filter having amplitude of 1.9 volts and a frequency of 0.99 Hz.
5. Unfiltered ECG output images and using different filters. In the ECG using the filter, smoother and clearer images and reduced noise.

REFERENCES

[8] www.CardiacBasicPhysiology.com