BME3161 BIOSIGNAL PROCESSING HOMEWORK

QRS Detection Find Peaks Alghorithme

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1. ECG SIGNAL

The most readily available bioelectric signal that gives clinicians somewhat accurate information about a patient's heart status is the electrocardiogram. On the ECG, many heart issues can be seen as distortions (ECG). Analyzing each heartbeat and connecting the aberrations with different heart disorders is a key component of identifying a heart ailment. The ECG signal, which is typically analyzed in the time domain, reflects the electrical activity brought on by muscle contraction. A single heartbeat is represented by one ECG cycle in normal conditions.[1]

The action potentials produced simultaneously by all of the conducting cells in the heart make up the ECG. Heart waves that are normal or healthy usually have a predictable size and timing. Problems with the heart's conduction system, which could be anything heart-related, can be suggested by abnormalities in the size and timing of the waves. We can now easily analyze the heart rate automatically by analyzing the electrical events that are captured on the ECG graph thanks to this approach. The cardiac cycle starts after each heartbeat.[2] The heart pumps blood out of the body during both the relaxation phase of the cardiac cycle (diastole) and the time of contraction (systole). P wave, QRS complex, and T wave are all seen in one cardiac cycle. P-R interval (conduction through AV node AV bundle) has a 100 msec delay at the AV node when the P wave (atrial depolarization) stimulus extends across the atrial surface. beginning of atrial contraction The AV bundle's interventricular septum is where Q-wave impulses, the first signs of ventricular depolarization, travel before passing through the Purkinje fibers and papillary muscles of the right ventricle via the moderator band. Purkinje fibers transmit the QRS complex impulse—the culmination of the ventricular depolarization—across the ventricular myocardium. Upon the completion of atrial contraction, ventricular contraction starts.[3]

- The P-R interval is the time from the beginning of the P wave to the start of the QRS complex.
- The QRS interval or duration or width is the time from the beginning to the end of the QRS complex.
- The QT interval is the time from the beginning of the QRS complex to the end of the T wave.
- The RR interval is the time from the peak of one R wave to that of the following R wave.[4]

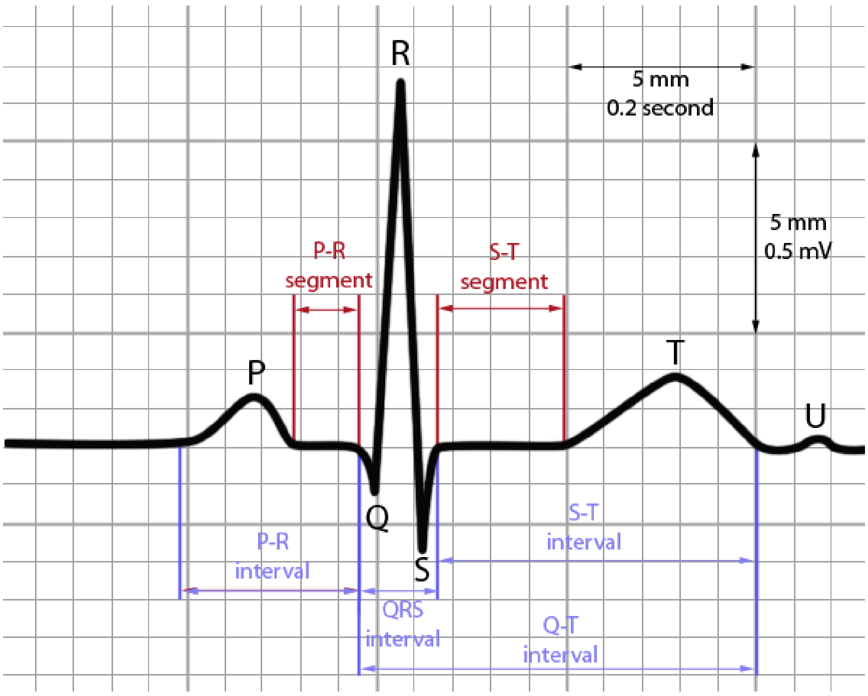
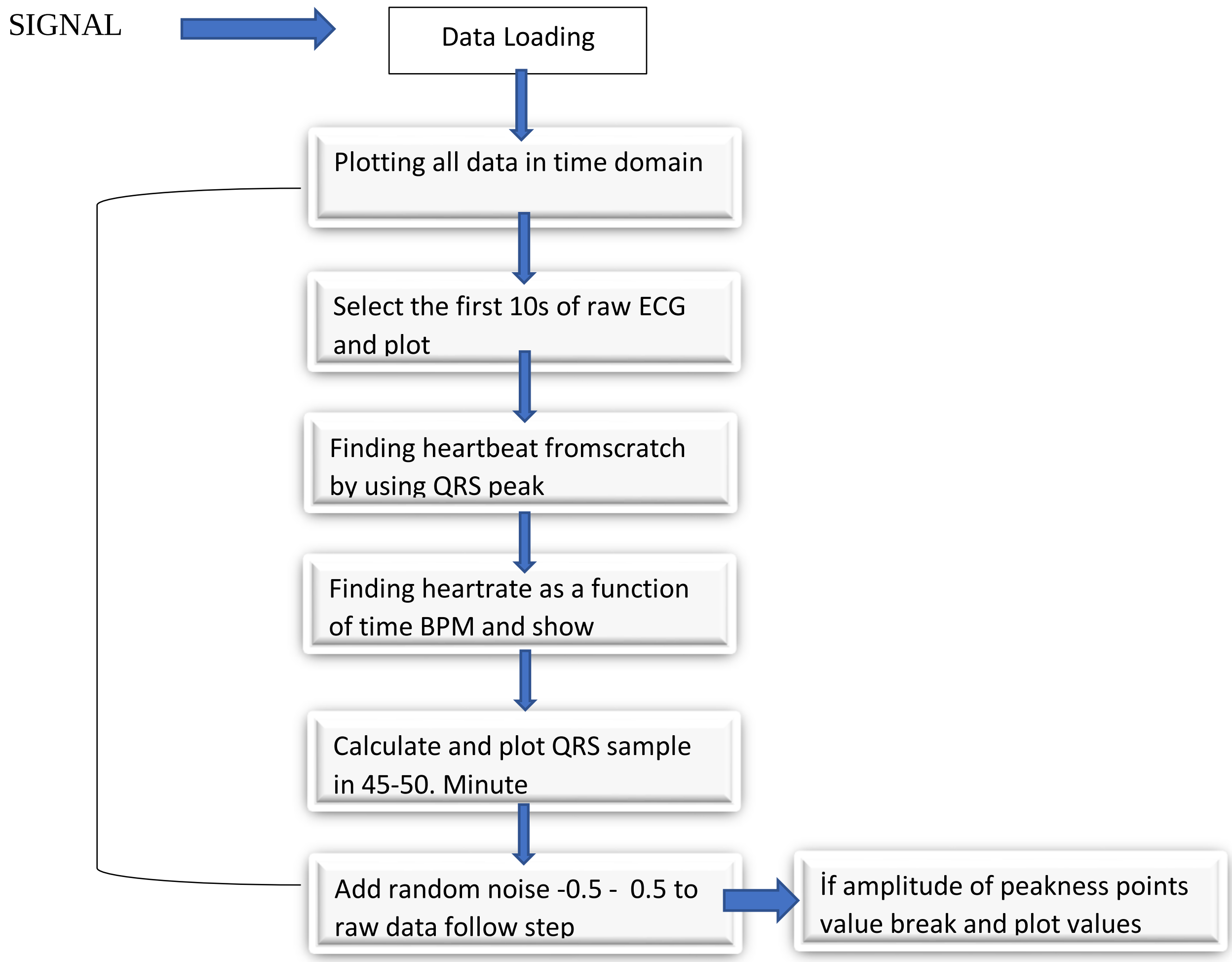


Figure 1: Critical Points at ECG Signal

FLOWCHART FOR ALGORITHM



1.1 Detailed explanation for algorithm:

After preparing our working environment, we introduce our data to our program.

Then we define the information in our data and the required domain information.

This way we graph to see our entire signal.

Then we create a random noise with the rand function and add it to our signal and duplicate a signal with random noises.

We graph this signal to see it as well.

We capture and graph the first 10 seconds as a specific portion of our signal.

Then we do the same to our noise signal and we examine the first 10 seconds of our noise signal.

The next step is to find the peak values in our ecg signal.

we have a certain ecg peak here and we are trying to eliminate it by determining a treshold value. With the for loop and if functions, we perform a treshold finding operation that captures the values that our signal increases.

We record the locations of the signals that pass the treshold we have determined in the memory.

We mark these places and plot our entire signal.

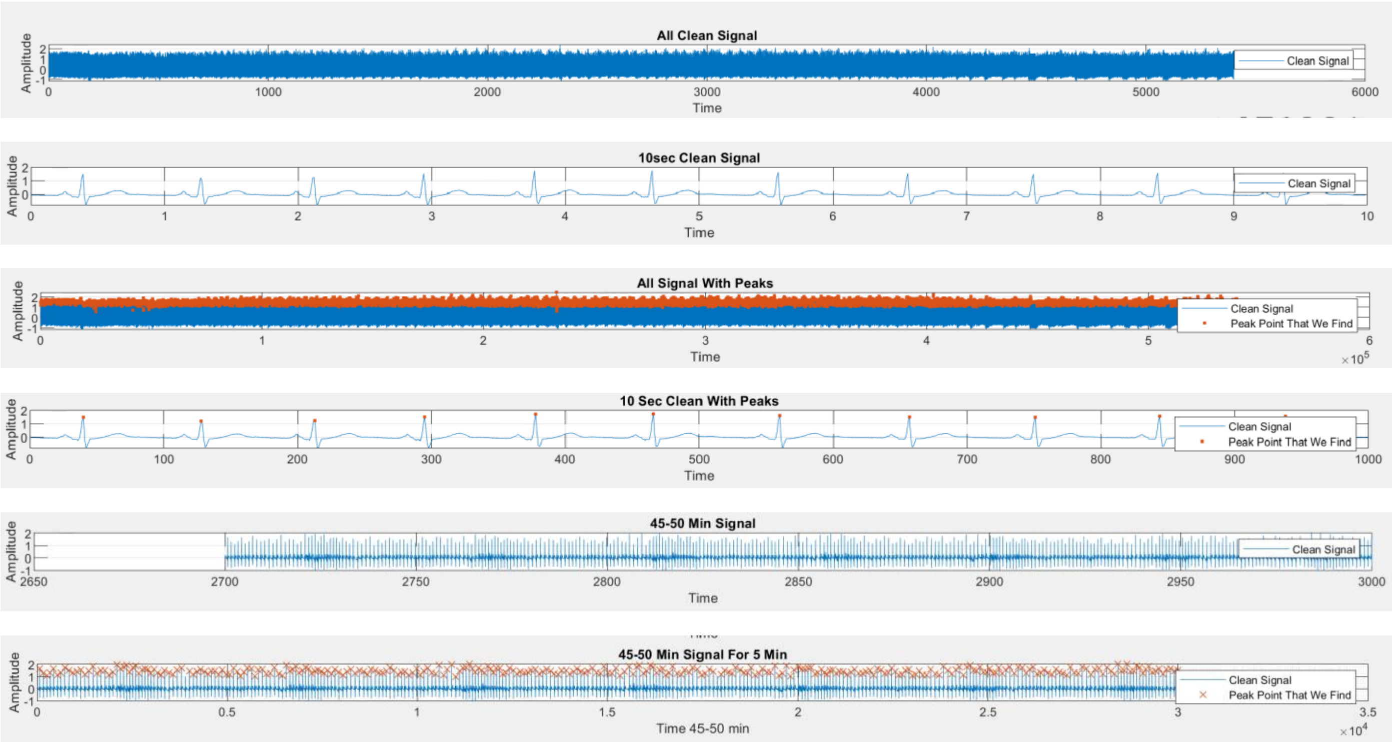
Afterwards, we show these peaks on the 10-second chart. and by counting these peaks in this 10-second slice, we get the number of QRS passed with the for loop.

then we separate a section between 45 and 50 minutes. In this section, we show our peaks both with noise and as normal, and then we count our peaks.

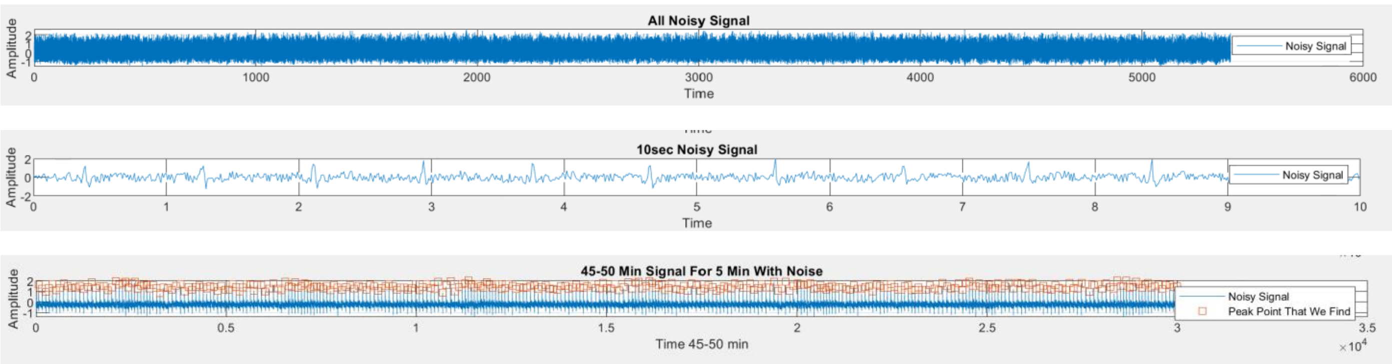
Finally, we take the average of the number of QRS per minute we received in the last time, make the BPM calculation and print it out.[5]

2. RESULTS

Clean Signals



Noisy Signals



2.1 Code Result:

Number of QRS in all signal 5757

Number of QRS in 10 sec 11

Number of QRS between 45. and 50. minute 313

BPM =

62.5979

3. DISCUSSION

The most common limitation encountered when processing body signals is not being able to receive our signal cleanly and make it workable. This becomes an even greater problem, especially in those who require continuity in function, such as the brain and heart.[6] ECG, as we know, is very important for the patient or the procedure to make an inference about the signals coming from the heart and their processing. signals coming from different organs (respiration) signals coming from outside, electrical signals that are already present (signals emitted by the device itself) make it difficult to process such a small signal. These noises need to be removed from the signal for better results.[7] In this study, we had a clean ECG signal, and we added noise to this signal to create such a situation. and we examined the various values we wanted to obtain first in the clean signal and then in the noise-added version. When we consider our results separately, the values calculated by our algorithm differ due to the noise occurring between the R-R values in our QRS waves between our data with added noise and those without. If the places with noise exceed the treshold we have determined, unfortunately, these values can be evaluated as heart rhythm and thus, wrong results can be diagnosed and redirected. Since the probability of encountering such noises in daily life is quite high, we need to pay attention to the cleanliness of the signal we receive in such studies.

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