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# SIGNAL PROCESSING COURSE PROJECT

## ECG BASED HEART RATE CALCULATOR

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### Problem Statement:

To analyze and display the ECG from a data file provided, and also provide the average heart rate of the same data.

### Conceptual Knowledge Required:

Basic operations in MATLAB such as file operations and plotting.

### Proposed Methodology:

Obtain ECG data from a reputed source.

Detect number of peaks of R- wave (R-peaks) in signal, and use it to calculate heart rate.

Also display ECG visualized to user

### Experimentation:

Import ECG samples in text format from Physionet.org.

Scale the given ECG signal so that peaks lie under 1.5 mV.

Detect R-peaks, which are higher than both their neighboring peaks AND also above threshold value (0.6 in our case).

Count the number of R-peaks and divide by the duration of the signal to obtain the number of R-peaks (beats) in one minute.

Also using MATLAB, read and plot the data into a graph and display for the user.

## Results:

For regular heart rates, the program works as expected:

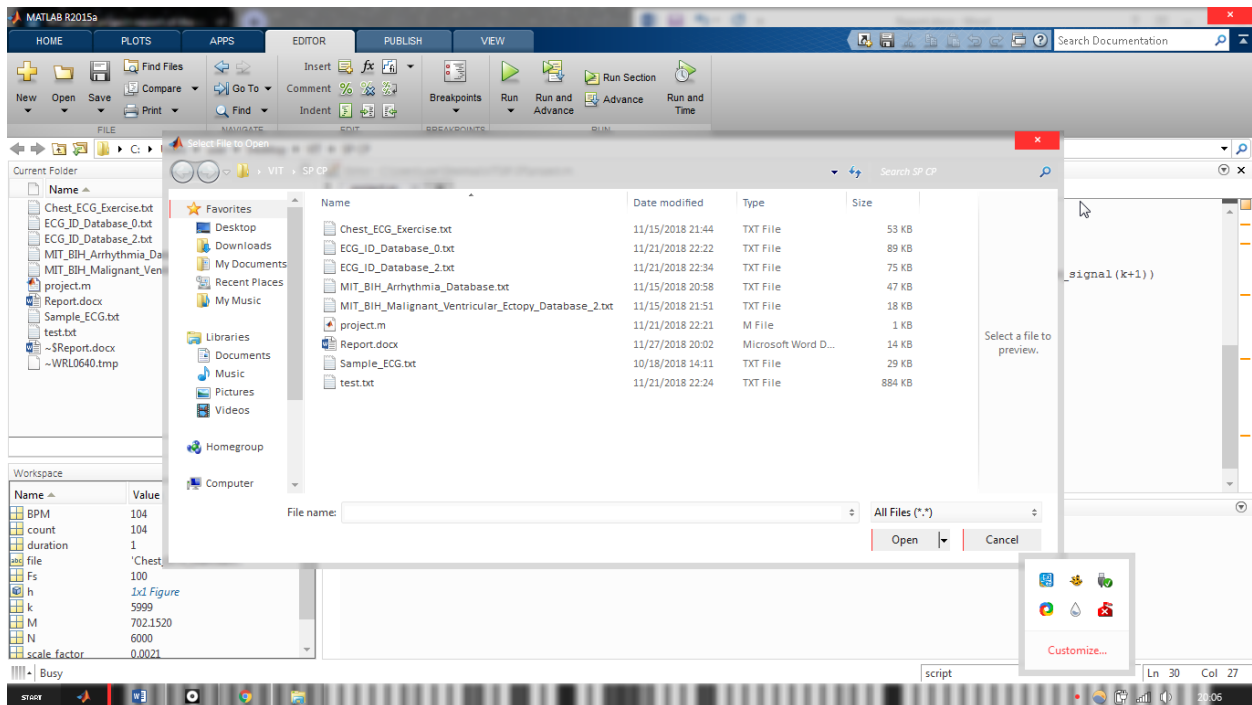


Fig. 1: File selector GUI

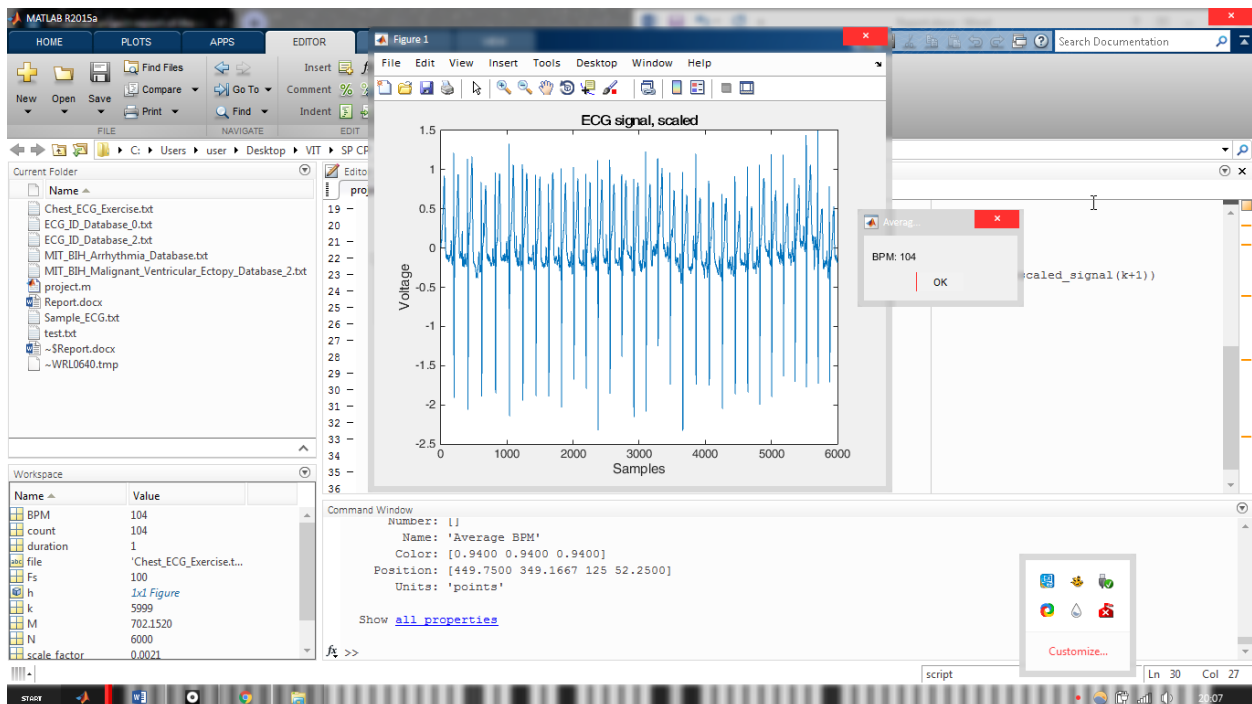


Fig. 2: Heart rate report of test subject during exercise

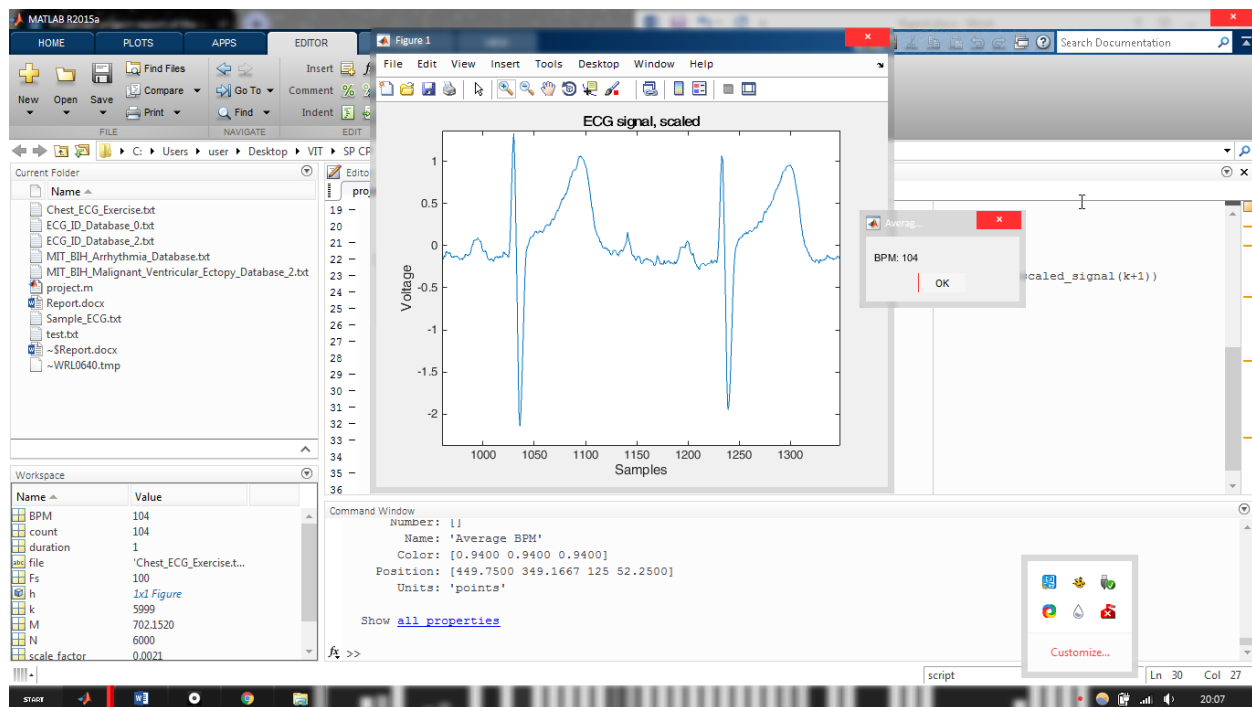


Fig. 3: Zoomed view showing ECG in greater detail

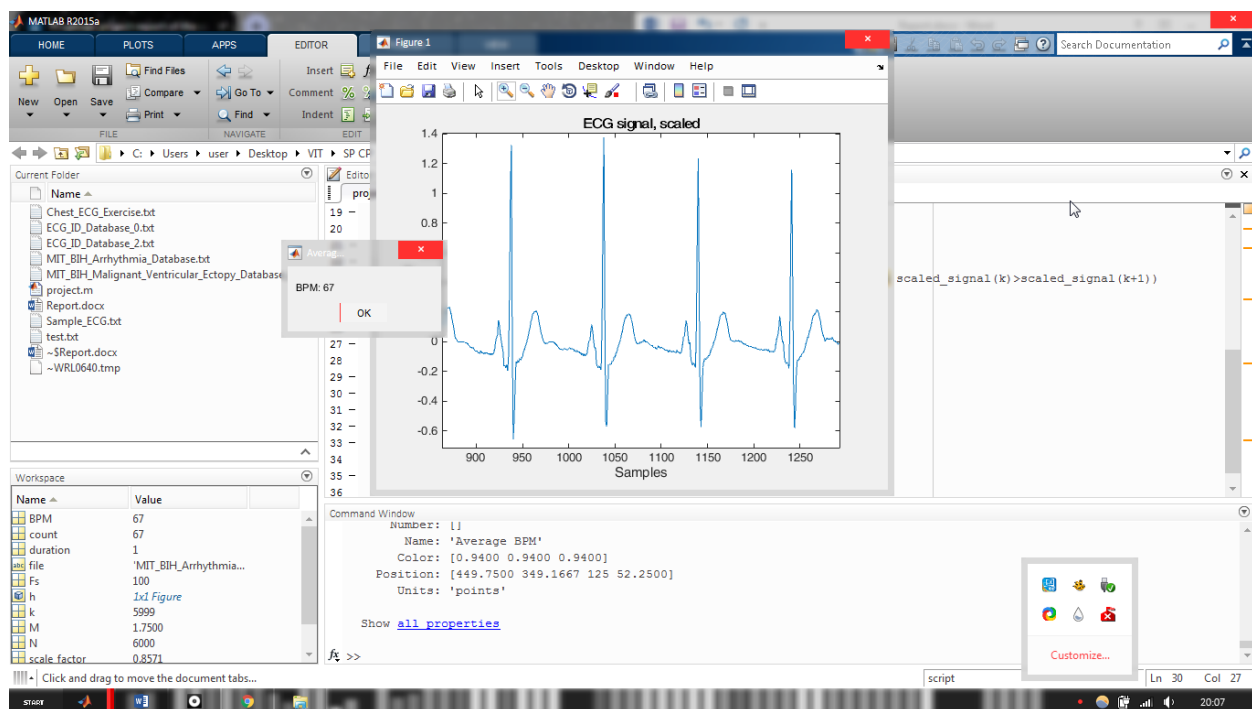


Fig. 4: Zoomed ECG of patient with resting heart rate

However, the program does not work for patients with irregular heart rate such as those exhibited by patients of various heart diseases such as Malignant Ventricular Ectopy as shown below:

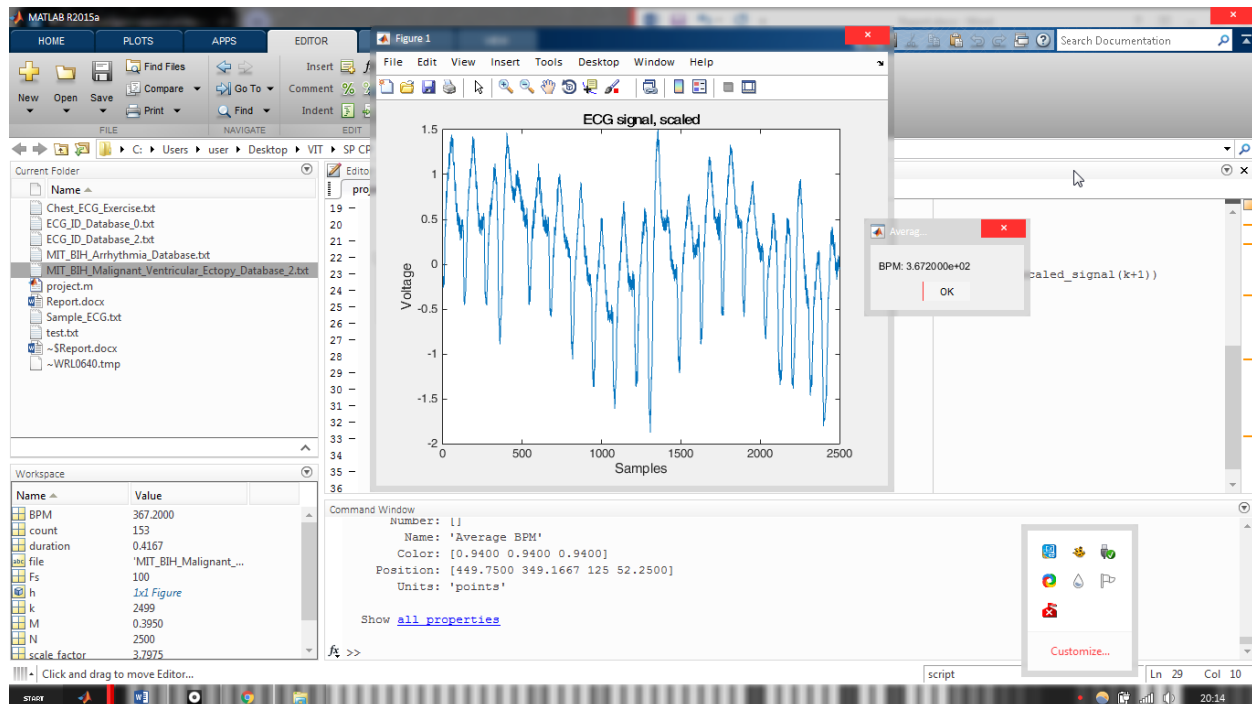


Fig. 5: Malignant Ventricular Ectopy ECG

This is caused due to checking for a peak above a set threshold value (0.6 mV) which normally rules out other smaller peaks for regular heartbeats, but results in this error for irregular heartbeats.

## Conclusion:

This program provides us with a basic analysis of heart rate in test subjects with regular heartbeats, but not in those with irregular heart rates. This problem might be mitigated by using filtering techniques with downsample the signal and then count the R-peaks, we may avoid the usage of threshold values in code, making it effective for irregular heartbeats.

The irregularities caused by certain heart diseases, while giving wildly inaccurate readings, present a further research area on detection of these anomalies based on ECG alone.

This program also plots an accurate graph of the ECG signal, which can aid people in the medical field with analysis of ECG signals.