

ECG Pre-processing and Clustering of Heart Rhythm

¹Spoorthi Rakesh, ²Pruthviraj M A, ³Kruthani B R, ⁴Pavan S, ⁵Sumarani H P

¹Assistant Professor,

^{1,2,3,4,5}School of Computing & Information Technology, REVA University, Bengaluru-560064, India

¹spoorthirakesh@reva.edu.in, ²pruthvigudduraj@gmail.com, ³kruthanibr@gmail.com,

⁴pavan9480051794@gmail.com, ⁵sumaranihp123@gmail.com

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Abstract

ECG is an abbreviation of electro cardio graph and it is measured of electric activity of blood pumping organ which is reproduced on article. The ECG consist of PQRS waveform. QRS is where the complexity or fault in heart is usually identified. Noise is one of the major cause which distortion in ECG. Then to overcome filters are uses to cancel noise from the signal which help for accurately detection of the faulting heart. Our aim is to digitalize and pre-processing of ECG or paper-based ECG. The ECG papers are collected from the patient suffering from Bradycardia, Tachycardia and Normal individuals. The ECG is crop and scanned for further processing. The next stage is Binarization which converts colour image to binary image, which is further pre-processed that involves removal of the noise using the filter like Butterworth SOS and median. Further peaks are calculated to extract QRS, which is stored in csv file and is used for clustering process.

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1. Introduction

ECG is an abbreviation of electro cardio graph. It is measurement of heart electrical activity which is usually paper based these paper-based ECG is viewed by doctor to determine the state of heart. The aim is to convert the paper-based ECG to digital data which can be easily understood by patients also. QRS is where the complexity or fault in heart is usually identified. Noise is one of the major causes which distortion in ECG. Then to overcome filters are uses to cancel noise from the signal which help for accurately detection of the faulting heart. Our aim is to digitalize and pre-processing of ECG or paper-based ECG. The ECG papers are collected from the patient suffering from Bradycardia, Tachycardia and Normal individuals. The ECG is crop and scanned for further processing. The next stage is Binarization which converts color image to binary image, which is further pre-processed that involves removal of the notice using the filter like Butterworth SOS and median. Further peaks are calculated to extract QRS, which is stored in csv file and is used for clustering process.



Figure 1: A pictorial representation of the ECG

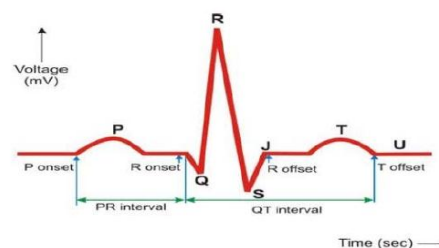


Figure 2: Schematic representation of normal ECG

Noise is the significant reason for mutilation in ECG signal. Pattern meanders, Powerline impedance and movement ancient rarities are the significant sorts of noise in ECG signal.

Baseline Wander: Triggered by air going in and exiting out of lungs or patient movements.

Power line interference: Disconnected electrode and Improper grounding of ECG machine

Motion Artifact: Passing baseline changes triggered by fluctuations in the conductor skin impedance with conductor gesture owing to movement of patient.

2. Literature Survey

Below component gives an outline of varied refining procedures towards the method removing noise from the ECG signal. many filters are bestowed within the last decade, however there were tidy variations in every with relevancy the procured outcome and attributes merit. Here are the prominent researches related to ECG Signals filter procedures.

The method of detecting the QRS advanced using ECG was proposed by Sharma in [11]. This method has potential of being a significant platform in comparison to distinguishing other signal section ahead, beat-fragment, or other structural outlook for Electrocardiogram. In addition, for the popularity of this technique, the technique with minimal pre processing has been conferred. This strategy used 2 staged filtering technique to pre process through the use of Median filtering and SG smoothing filters. This evaluation has been aided through RMS wave's value. Several trials has been made for various datasets mentioned in [11] in order to distinguish internal organ fitness prognosis. Studies shown [12] mentioned regarding the automated identifying and localizing for MI. Also, most important tread in process the EKG signal has to be the way for pre process in the same. Prior to this, the reception and depiction of QRS-advanced is carried out after which the moment ripple remodel has been applied for silencing those signals. Then, this extant or nonbeing for MI was certain by obtaining of different waves variants s mentioned in[12] through twelve leading EKG -signals. At the end, K-Nearest Neighbour classification algorithm has been applied to classify them. These trials were carried out on PTB Db physio bank.

Studies done in [13] shows significance of ventricular-late-potentials also known as VLP classifiers. It also followed the methodology of PCA-algorithm. There was a lesser amplitude and higher frequencies transient observed in HR-ECG in case of VLP's process and also that these are the essential components of causing threat to life for ventricular tachy-arrhythmia. For the observation part, the information about thirty six patients signal had been partitioned within 2 teams particularly eighteen healthy controls and eighteen patients with elicited sustained mono-morphic cavum arrhythmia was thought-about. For classifying using

regression-technique decided by best separating-thresholds among teams to each matrixes done by using Mahalanobis-distance. HR-ECG signals are additionally analyze through several traditional methodologies.

"Adaptive DBSCAN" for distinguishing Groups with variable Bulks by "Md. Rahman Khan", "Md. Abu Bakr Siddique"[17] They have aforesaid that the projected adaptative the "ADBSCAN" beats standard DBSCAN just in instance of groups with variable masses. The projected cluster technique have few limits. The technique adjusts with unplanned values of ϵ , Minpts and Eps that styles it a lesser amount of comprehensive. There aim was analyze and advance the adaptative "DBSCAN" algorithmic rule in an very mode that it can locate the optimal values of Minpts and ϵ for every group. All the preprocessing steps done take away the clamor from chart indicator is completed for standard dataset. No work has been done on Indian dataset.

3. Methodology

The major requirement of this project is ECG paper of patient which belongs to normal, tachycardia and bradycardia.

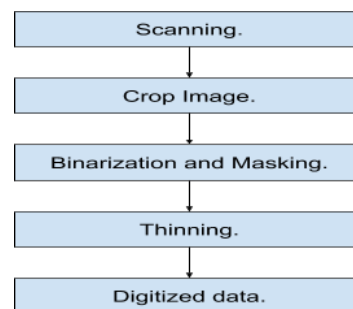


Figure 3: Step involved in Obtaining Digitized data

3.1 Data collection

Which requires collection of ECG papers from patients with normal, Tachycardia (High BP) and Bradycardia (Low BP).



Figure 3.1: Scanned copy ECG from a paper.

3.2 Cropping image

After scanning the desired region should be cropped. Here the region of interest that's to be cropped is any a part of the signal that's gift within the cardiogram paper.

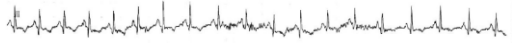


Figure 3.2: Cropped image.

3.3 Binarization and masking

Binarization could be a method of changing color image into binary image. The image must be reborn into binary image for more process. The binary mask defines the region of interest of the first image. Mask is made from grayscale image by classifying every component happiness to region of interest or background. The createmask methodology returns the binary image same size as of the first image. That is background is modified from white to black whereas the image is modified from black to white. it's done to get rid of the unwanted components that aren't needed for more process that area unit gift within the signal. Bwareaopen is that the operate accustomed take away the tiny objects from binary image.

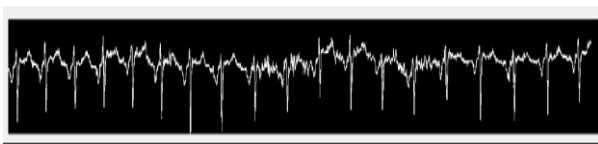


Figure 3.3: Binarized and masked Image

3.4 Thinning

Thinning could be a morphological operation that's accustomed take away hand-picked foreground pixels from binary pictures

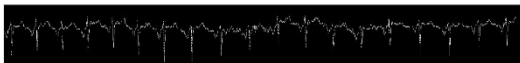


Figure 3.4: Thinned Image

3.5 Digitized Data

After image binarization the result obtained from that step is regenerate into image vector. For higher information retrieving from the image, vectors have double the quantity of columns of pixels analyzed. A standard worth is taken and and also the values that ar matching there to is known. it's hold on in a pair of dimensions as indexes and values. A table of index and values are generated.

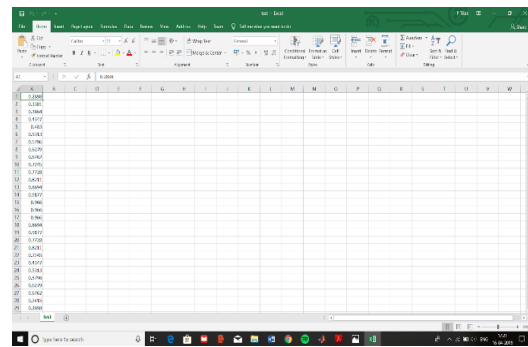


Figure 3.5: Snapshot of digitized values obtained in a csv file.

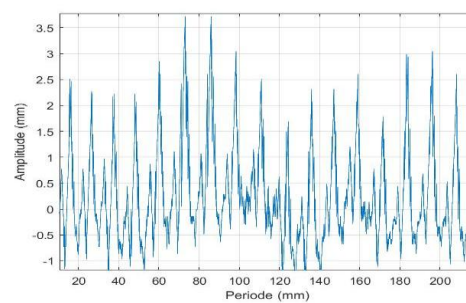


Figure 3.6: Graph plotted to Digitized Values

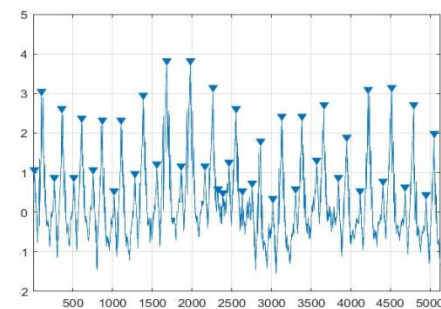


Figure 3.7: Observation of peaks.

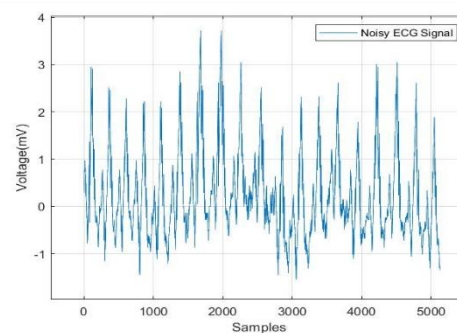


Figure 3.8: Noisy ECG signal.

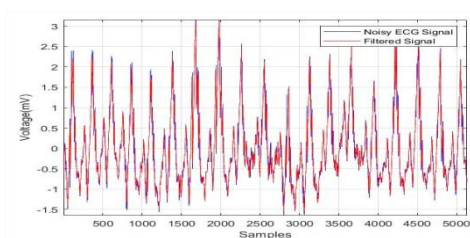


Figure 3.9: Comparison of Filtered and Noisy signal.

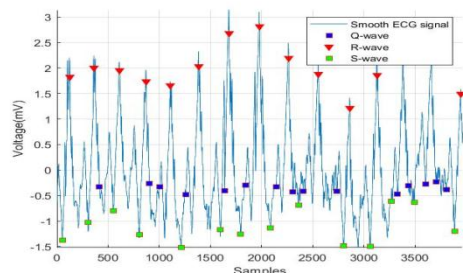


Figure 3.10: Detection of Q,R and S Peaks.

3.6 Preprocessing

It is done after digitalization where noise is removed from signal using filters like Butterworth, Median, SOS.

Butterworth filter: This is a type of filter in which the frequency reaction is highly flat. They are rapid and simple to use. As they're frequency-based, the impact of filtering may be effortlessly understood.

Median filter: is a nonlinear digital filter that's typically used to take away noise from a picture or signal. Median filter processes signal with work every wave entry within the signal with the median of neighboring entries.

Savitzky-golay filter: It is a non analog filter that may be applied to a group of non analog data facts for the aim of smoothing the information, that is, to extend the exactitude of the information while not garbling the signal tendency. It conjointly reduces noise whereas maintaining the form and height of wave peaks. the first advantage of Savitzky-Golay filter is its capability to retain form of the signal, that is usually impractical with a moving average filter.

3.7 Clustering

It is an analysis in the mission of grouping a set of items in such a way that items are more alike to each other than to those in other groups.

The region of intersect is planned and cropped and digitalization which converts the coloring to binary and which notice from the signal is removed which is known as forecasting and clustering involves task of grouping a set of projects.

ADBSKAN: For Identifying Clusters with Varying Densities is a data clustering procedure which has the

high-performance degree for dataset where groups have the constant density of data points. One of the significant qualities of this procedure is clutter annulment. However, DBSCAN determines reduced routines for clusters with unlike densities.

4. Result Analysis

Our Project aim in digitalizing paper - based ECG, removing noise by applying filters. We obtain a result from (D B S C A N) forming clusters on a graph forming clusters on a graph. Cluster of Tachycardia, Bradycardia & Normal.

The red points forms a cluster of Tachycardia, green points forms a cluster of Bradycardia & black points forms a cluster of Normal.

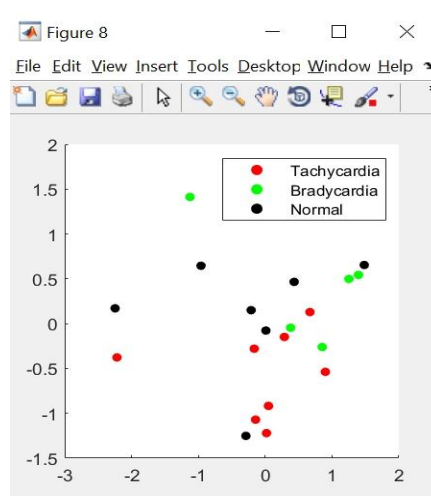


Figure 4: Graph obtained after clustering

5. Conclusion

The main contribution of this project is the collection of new Indian dataset and performing digitization for it. Various signal processing filters like Savitzky-Golay, Median, Butterworth and SOS filters are utilized for eliminating the disturbance from the signal. Filters have been applied for all the variants of the dataset i.e Tachycardia, Bradycardia and Normal ECG. Further all filters are compared. From the obtained results it was found that median filter performs efficiently than other filtering techniques. It has some needed features such as tall peak signal to noise quantitative relation and low root mean square difference.

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