Thesis Literature Review

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Contents

1 B. V. P Prasad and Parthasarathy (2018)

Summary

- signal processing and data analysis are widely used methods
- detecting cardiovascular abnormalities with an ECG is possible
- a fuzzy-based multi-objective algorithm using a fast fourier transform is used to extract rough features like PQRST amplitude
- then apply an algorithm to classify the abnormality
- ECG behavior depends on many different factors
- accuracy is achieved by taking into account these factors
- maintaining a database of previous results makes prediction better
- this provides 98.7% efficiency in abnormality detection
- accurate ECGs are necessary to classify cardiac abnormalities
- ECGs are noisy and thus an algorithm needs to de-noise the signal
- after noise removal, ECG signals must be extracted – FFT
- fuzzy–based scheme should classify how sick a patient is
- de-noising can be done using a wavelet transform
- contour wavelet transform CTW – Daubechies algorithm for de-nosing
- goal is to remove all noise
- discrete wavelet transform is not accurate enough, adaptive wavelet decomposition is proposed
- then FFT is used to extract the features
- ANN for classification
- FFT to discretize the signal
- radix–2 FFT, is the simplest way to evaluate the DFT
- heartbeat is calculated as the interval between two R peaks – heartbeat is the number of R peaks in a particular minute
- RR interval can be useful for fining symptoms that include heart–rate variation
- QRS is the main thing that a heart's conditions is measured by
- QRS duration is the time interval between the two peak Q and S signals
- multi-objective genetic algorithm is exactly what it sounds like
- uses MIT–BIH arrhythmia database
- finds good results for their approach
- methods is more efficient than previous results
- IFR: analysing and modelling the sequence of heartbeats using advanced machine learning

methods can be implemented to achieve better performance

2 A. K. M Fazlul Haque et al. (2009)

A. K. M Fazlul Haque et al. "Automatic Feature Extraction of ECG Signal Using Fast Fourier Transform". In: (2009). Retrieved from https://www.researchgate.net/publication/295813369_Automatic_Feature_Extraction_of_ECG_Signal_Using_Fast_Fourier_Transform

Summary

- using FFT to find abnormalities in ECGs
- ischemia or infarct can be seen in the ST–segment of the ECG
- ischemia can also cause low–amplitude notches and slurs in the ECG
- Holter monitors are ECGs over > 24h, you need programs to analyze that much data
- major problem is the feature extraction
- mentions a bunch of other peoples attempts at feature extraction
- FFT breaks down a signal into its sinusoidal components
- nothing that interesting

3 Parak and Havlik (2011)

Jakub Parak and Jan Havlik. "ECG SIGNAL PROCESSING AND HEART RATE FREQUENCY DETECTION METHODS". in: (2011). Retrieved from https://www.researchgate.net/publication/266281892_ECG_Signal_Processing_and_Heart_Rate_Frequency_Detection_Methods

Summary

- digital signal filtering methods for ECGs
- remove 50Hz network and breathing muscle artifacts
- 3 heart rate detection algorithms
- main problems with ECGs are interfering 50Hz supply signals and muscle artifacts
- for real–time applications, these things should be very efficient
- heart rate is important and can be computed from ECGs among other things
- often, heart rate is detected by measuring the distance between QRS complexes
- neural networks, genetic algorithms, wavelet transforms, filter banks, adaptive threshold, signal spectral analysis, short–term autocorrelation can be used to find it
- the methods here are simpler and real–time suited
- Butterworth filter is used in professional ECG applications
- they remove all the noise from the signal first, using the described methods
- Butterworth filters are used to also detect the R peaks
- with the highlighted R peaks one can detect heart rate

- for heart rate detection, the autocorrelation method can be use because R peaks are quasi–periodical
- other methods find the difference between R peaks, by either using thresholds, or peak detector
- the three algorithms find completely different results

References

[1] A. K. M Fazlul Haque et al. "Automatic Feature Extraction of ECG Signal Using Fast Fourier Transform". In: (2009). Retrieved from https://www.researchgate.net/publication/295813369_Automatic_Feature_Extraction_of_ECG_Signal_Using_Fast_Fourier_Transform.

[2] B. V. P Prasad and Velusamy Parthasarathy. "Detection and classification of cardiovascular abnormalities using FFT based multi-objective genetic algorithm". In: *Biotechnology & Biotechnological Equipment* 32.1 (2018). Retrieved from https://www.tandfonline.com/doi/full/10.1080/13102818.2017.1389303#, pp. 183–193. DOI: 10.1080/13102818.2017.1389303.

[3] Jakub Parak and Jan Havlik. "ECG SIGNAL PROCESSING AND HEART RATE FREQUENCY DETECTION METHODS". In: (2011). Retrieved from https://www.researchgate.net/publication/266281892_ECG_Signal_Processing_and_Heart_Rate_Frequency_Detection_Methods.