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Diagnosis of Diseases using Heartbeat Sound

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Abstract : The world become very busy. People in the world don't want to waste their precious time for waiting something. In this project we proposed the paper on the basis for time consumption and pre-analysis of diseases by themselves without consulting doctor. This project is used for all the type of aged people. It is not possible to monitor the health of the people regularly. Their energy level may go up and down. They may cause different diseases like fever, cough, etc. The predictions of all diseases are not possible, for that this project diagnosis of diseases using heartbeat sound is designed. Using this project the diseases can be detected using the heartbeat sound. The project contains the database of different diseases sound, which has been stored and compare with the heartbeat sound taken from the sample person. If the sample heartbeat sounds taken from person is match with stored database sound, pre analysis diseases is display. This project is designed for the pre-analysis of this body condition without consulting doctor. It spends lot of money for consulting doctor and spends the precious time. So this project designs software to save the money and also help us to know about the body condition when abnormal. This is simple software with valuable cost which saves the health and also money.
Keywords : GUI Window; MATLAB software: Pan Tompkins Algorithm.

Introduction

Our project is the diagnosis of diseases using heartbeat sound using heartbeat sound using MATLAB software. In the proposed diagnoized system, the heartbeat activities, heartbeat variations, mechanical activies of heartbeat workings are noted. The pre-analyzing of the heartbeat data from the sample is then given to the software. Here the data from the database can be compared with the database. The database consists of all the diseases data to predict the diseases. The disease is predicted from the sample data which is compared with the predefined database. The flow in which the disease is predicted from the sampled heartbeat. Finally, the predicted disease is displayed in GUI Window. This system reduces human effort and it is also easy to implement this project in the busy environment.

Biomedical

Biomedical is also defined as the bioengineering. This is one of the applications of engineering principles to the fields of biology and health care. The Bioengineers work with doctors, therapists and researchers on the biomedical applications. It is to develop systems, equipment and devices in order to solve clinical problems. This field builds a bridge between engineering and medicine, combining the design and problem solving skills of engineering with medical and biological sciences to advance health care treatment. Biomedical engineering has only recently emerged as its own study, compared to many other engineering fields. Such an evolution is common as a new field transitions from being an interdisciplinary specialization among

already-established fields, to being considered a field in itself. Much of the work in biomedical engineering consists of research and development, spanning a broad array of subfields. Prominent biomedical engineering applications include the development of biocompatible prostheses, various diagnostic and therapeutic medical devices ranging from clinical equipment to micro-implants, common imaging equipment such as MRIs and EEGs, regenerative tissue growth, pharmaceutical drugs and therapeutic biological.

Heartbeat

A person heartbeat is the sound of the valves in heart contracting or expanding as they force blood from one region to another. The number of times the heart beats per minute (BPM), is the heart beat rate and the beat of the heart that can be felt in any artery that lies close to the skin is the pulse.

An electrocardiogram (ECG) is a time-varying signal that represents the activity of the heart. Each event has a distinctive waveform, the study of which can lead to greater insight into a patient's cardiac pathophysiology. An ECG can also be defined as a time varying signal reflecting the ionic current flow which causes the cardiac fibers to contract and subsequently relax. An Electrocardiogram signal can be used for detection of coronary artery disease, cardiomyopathies and left ventricular hypertrophy. It can also provide information for evaluation rhythm disorders. The ECG can be obtained by recording the potential difference between various electrodes placed on the surface of the skin, at specific locations. A single normal cycle of the ECG occurs with every heart beat.

MATLAB Software

MATLAB is abbreviate as a matrix laboratory. This is a multi-paradigm numerical computing environment and fourth-generation programming language. This programming language is developed by Math Works. MATLAB allows matrix manipulations, plotting of functions and data, implementation of algorithms, creation of user interfaces, and interfacing with programs written in other languages. The other language including C, C++, C#, Java, Fortran and Python. Although MATLAB is intended primarily for numerical computing allowing access to symbolic computing abilities. This also has an additional package, Simulink, adds graphical multi-domain simulation and model-based design for dynamic and embedded systems. MATLAB is used by one million users across industry and academia. MATLAB users come from various backgrounds of engineering, science, and economics. MATLAB is a high-performance language for technical computing. It integrates computation, visualization, and programming in an easy-to-use environment where problems and solutions are expressed in familiar mathematical notation. The use of MATLAB includes Math and computation, Algorithm development. The functions used in the MATLAB like MFCC, RASTA, and PROLCP. The algorithm used in this project is Pan Tompkins algorithm.

Pan Tompkins Algorithm

The Pan Tompkins (PT) algorithm is used for the QRS detection algorithms. This is become a benchmark for QRS wave performance detector. The process in the PT algorithm are band-pass filtered, differentiated, and squared, then moving window integration.The above said process are performed, and two sets of adaptive thresholds are applied to both the filtered signal and the integrated signal.The adaptive threshold are applied for QRS detection. The PT algorithm is implements in order to compare the performance of the proposed UNSW algorithm. This is one of the well established QRS algorithm. Some differences exist between the implementation of the algorithm used here and the original literature: The band-pass filter here is a 6th order zero-phase forward-backward digital IIR filter – this differs from the original implementation which adhered to design constraints that do not apply here; Furthermore initialization of the signal thresholds for the filtered and integrated signal is not described in the literature. Here the signal threshold is initialized as 0.25 of the maximum signal amplitude over the first 2 seconds of the signal. The noise threshold for the filtered and integrated signal is initialized as half of the signal threshold.

Methodology

In the proposed diagnoized system, the heartbeat activities, heartbeat variations, mechanical activities of heartbeat workings are noted. The pre-analyzing of the heartbeat data from the sensor is then given to the software. Here the data from the sensor can be compared with the database. The database consists of all the diseases data to predict the diseases. The disease is predicted from the data of the sensor which is compared

with the predefined database. Fig 1 shows the flow in which the disease is predicted from the sampled heartbeat. Finally, the predicted diseases id displayed in GUI Window. This system reduces human effort and it is also easy to implement this project in the busy environment.

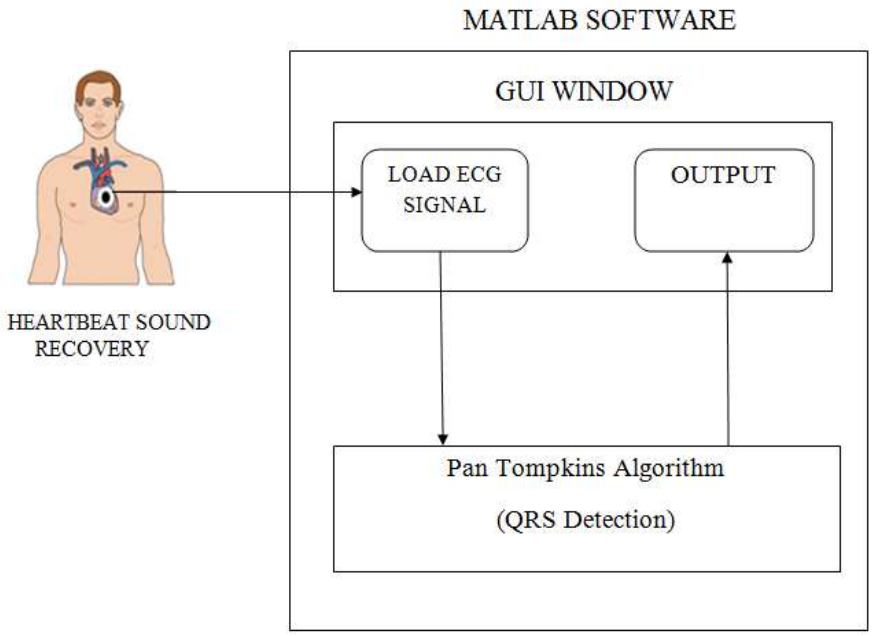

Fig. 1. Block diagram of Diagnosis of diseases using heartbeat sound.

Block Diagram Explanation

The above shown Fig 3.1 consists of various modules like human sample, software. The heartbeat is used to detect the heartbeat activities, heartbeat variations, mechanical activities of heartbeat workings are noted. The pre-analyzing of the heartbeat data is then given to the software. The MALAB software has the duty to analyze thegiven heartbeat and gather the minute details of the heartbeat signal. This analysis is done with the help of the Pan Tompkins algorithm. Here the data from the algorithm can be compared with the database. The database consists of all the data of diseases to predict. The disease is predicted from the data of the sensor which is compared with the predefined database. Fig 3.2 shows the flow in which the disease is predicted from the sampled heartbeat. Finally, the predicted diseases id displayed in GUI Window.

Common Heart Diseases

From the QRS measurement of the ECG signal, the status of the heart can be analyzed. There are various diseases which is occur in the heart. The following are the some of the diseases which is diagnoized in this project.

***(*i)Sinus Bradycardia:**

Sinus Bradycardia is the diseases of the heart beating more slowly than normal. This heart diseases is occur in well conditioned athletes and during sleep relaxation. In the case of athletes, the heart muscle is operate more efficient at pumping blood, therefore, less contraction needed. During deep relaxation, the body is at rest and requires less oxygenconsumption than during normal activity which allows the heart rate to slow.

(ii) Sinus Tachycardia:

Sinus Tachycardia is the excessive heart rate above 100 beats per minute (BPM). It is originates from the SA node. The cause of this diseases are fright, stress, illness and exercise. It is of efficient in identify one P for each QRS.

(iii) Atrial Flutter:

Atrial flutter is a one of the most common heart diseases in which there are multiple atrial contractions for every ventricular contraction. A single large electrical signal that propagates around the atria causes the atrial flutter.This result as in the occurance of P-waves for every QRST complex in the ECG signal. The rate of atrial contraction can be between 200 and 350 beats per minutes. The amount of blood being pumped by the atria can be very small as a result of one side of the atria being contracted while the other being relaxed. The electrical signals enter the AV node at a rate that is too rapid to create a ventricular contraction for every atrial contraction.

(iv) Ventricular flutter:

Ventricular flutter is the heart diseases in which the cardiac arrhythmia, the verticals can be paced at more than 200 beats per second. An extra systole or ectopic pacemaker that occurs in the ventricles tiggers the flutter. This leads an extremely insufficient blood pumping. The P wave is not visible in the ECG recording and the QRS complex and T wave are merged in regularly occurring waves with a frequency between 180 to 250 beats per minute.

Flow Chart:

The flow chart of the project which clearly shows the continuous flow of the project. In which the heart beat is diagnoized using Pan Tompkins algorithm and finally compare the measured sample value with the data base and the diseases is display in the GUI window.

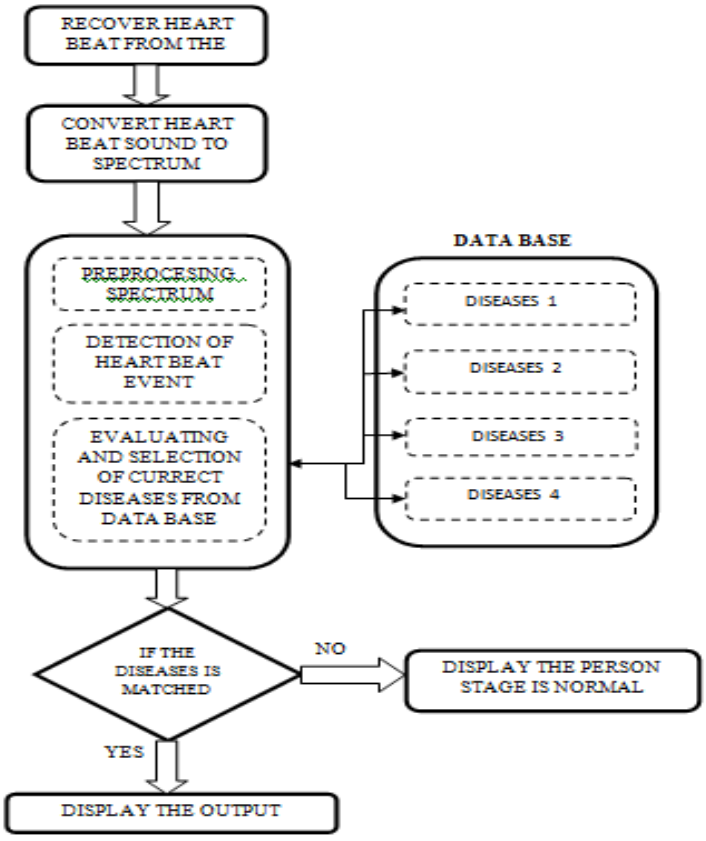

Fig. 2. Flow chart of design flow.

Software Analysis

Here the MATLAB software plays the major role in identifying the heartbeat signal, processing the signal and display the output of the signal. The PAN TOMPKINS ALGORITHM is use in the detection of the ECG signals. The following gives the details about the algorithm.

Pan Tompkins Algorithm:

The works of Pan Tompkins greatly influence the QRS detection as compared to others. A survey of literatures signifies this approach as one of important algorithm in detecting QRS peak. Wherever the accuracy of any Electrocardiogram (ECG) waveform extraction plays a vital role in helping a better diagnosis on any heart related illnesses. Normal ECG should consists of several parts include P wave, QRS complex and T wave. These waves reflect the heart's activity such as P wave produced by muscle contraction of Atria and its duration indicates the Atrial enlargement. Q wave gives the first negative value and typically supposed to be 25% less than the R wave value. The "Pan and Tompkins" QRS detection algorithm identifies the QRS complexes based upon digital analysis of slope, amplitude, and width of the ECG data. The algorithm implements a special digital band pass filter. It can reduce false detection caused by the various types of interference present in the ECG signal. The algorithm automatically adjusts the thresholds and parameters periodically to adapt the changes in QRS morphology and heart rate. It consists of the following processing steps

- Band-pass filtering.
- Differentiation.
- Squaring.
- Moving window integration.
- Thresholds adjustment.

Result and Discussion:

The output of the diseases analysis is display on the GUI window. The GUI window act as an intermediate between the user and the MATLAB software. The process in the MATLAB software is based on the Pan Tompkins algorithm. The Pan Tompkins algorithm is the efficient method plays an important role in the detection of the QRS peak detection of the human heartbeat sample. Hence this algorithm implement in the project to determine the diseases. The process in this algorithm includes Band pass filtering, Derivative, Squaring, Integration. These are the process which is involves in the QRS peak detection in the heartbeat. Upto this step, the heartbeat signal measurement is over.

The next step is to compare the analyzed input signal with the database. In this the database contains the diseases like Sinus Bradycardia, Sinus tachycardia, Ventricular flutter and Atrial flutter. If any of these diseases is matched with the input signal, the disease is display in the GUI Window. Otherwise, the normal status is display in the Window. Fig 3 shows the output display in the GUI Window. Fig 4 gives the clear output of the Pan Tompkins algorithm. This figure shows the process of the Pan Tompkins algorithm such as Band pass filtering, derivative, squaring and integration. Fig 5 gives the analysis of the QRS wave details. Every details of the occurrence of the QRS wave has clearly display in this figure. Fig 6 is the detrended ECG signal output which is the ECG signal at the detrend level. Fig 7 gives the output of the R-Wave and the S-Wave at the noisy level. This graph is used to show the occurrence of the R- Wave and S-Wave in the ECG signal when the person is affect by diseases. Fig 8 is the filtering of the noisy ECG signal. This process is held for the clear calculation of PQRST wave calculation. Fig 9 is the thresholding graph. There is the threshold level which is used for the easy identification of the diseases. The threshold level is the level which is the square value of the heart beat per second of the ECG signal. This graph clearly show the occurrence of the QRS Wave based on the input ECG signal. Thus these graphs are very useful for the identification of the diseases using heartbeat sound.

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