

HEARTBEAT RATE MONITORING SYSTEM USING GSM TECHNOLOGY

GUIDE – DR. GHANASHYAM ROUT

STUDENTS –

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ABSTRACT

- At present time in contrast with the past, the work load has increased significantly for people. They have to work more and more which diverts their attention from their personal health care. As people get older the risk of contracting heart disease increases. The heart diseases being one of the leading factors in deaths, so neglecting your health care from earlier stage could cause severe consequences in future. Since the medieval times humans have strived to improve in the field of medicine, as health related issues and parameters are one of the most salient part. With the passage of time, technology evolved and with it came new innovative technology which can monitor a patient's health parameters regardless of time and place. Any delay in communication can cause severe consequences. Heart beat rate is one of the major factor for detecting irregularities in health condition of a person. This work provides a system which is capable of monitoring of the heartbeat remotely and has the capability for alarm systems and SMS alerts using GSM in cases of any emergency.

INTRODUCTION

- Heart is one of the most important muscular organ in humans and most animals, it is responsible for pumping blood through the blood vessels of the circulatory system [1]. Blood plays the vital role providing oxygen and nutrients to the body and also responsible for metabolic waste removal [2]. While pumping the blood the heart beats with a rhythm which is recognized because of the pace making cells present in the sinoatrial node. The average heart beat rate of resting person is close to 72 beats per minute [3]. The heart beat rate increases while people exercise but in long term the resting heart rate lowers which in turn improves the health of the heart [4].
- The range of conditions which affect your heart is described by heart disease. The most well-known heart diseases includes coronary artery disease, arrhythmias (heart rhythm problem), congenital heart defects (diseases by birth) and many more [5].

INTRODUCTION (CONT.)

- In the current decades cardiovascular diseases is at number one position for causing death of people all around the world. 31% of all global deaths as of 2016 is estimated 17.9 million deaths due to CVDs. Financial problems are the major cause of death of people globally due to CVD [6].
- In older times life style of people was very simple, it included abundant physical labor, stress was very little and their diet was not toxic compared to present times which as a result not many people didn't suffer from heart diseases as they do today.
- In modern time the work environment of people is unhealthy, their life is very complex, fast and hard. The stress is high, toxicity in food has increases, as a result of which we find increase in heart diseases which is linked with other diseases such as diabetes, blood pressure, hyper-tension, etc. which are basically known as life style diseases [6].

INTRODUCTION (CONT.)

- The symptoms of underlying heart diseases is very subtle and if ignored for longer period of time could cause severe consequences. But if these abnormalities are detected in early stages then the problems can be taken care of [6].
- As we move forward in life new technologies are introduces, which can be cheaper, faster with a higher level of accuracy. With this people who are financially stable are able to monitor their health remotely, without going to hospitals. But this causes problem for people who live in remote areas, older people who are unable to visit hospitals frequently which can cause problems in case of emergencies.

OBJECTIVE OF OUR PROJECT

- The main objective of our project is to reduce the communication gap between the medical personnel and the patients. we designed a system which uses minimum hardware to reduce the expenses, this system is integrated with GSM technology with an alert system so that hospital visits can be reduced and make response time quicker for emergency services.
- To achieve our goals we used MATLAB. MATLAB is a high-performance language which incorporate computation, visualization, and programming for technical computing.
- In our proposed model most of the work is done in software and the only major hardware used are camera and GSM module. Like every system our input is in form of 10 second video and output is the resulting heart beat rate.

LITERATURE SURVEY

- Rupa Chandra et.al [8] in this project is combined wireless communication with medical application to bring changes in personal health care. The main objective is to build a wireless heart beat monitoring system combined with GSM technology, which would play a big role in personal health care appliances for a large scale in patient monitoring system. This is a Health monitoring system. In the event of emergency this system will send an SMS to doctor and patient's relative about their complete heart details. Continuously monitoring the human's body is a difficult task. The Health monitoring parameters include temperature, pulse rate of a human body. In the present time the systems can be used only when the patient is [resent in the ICU on the bed and those system has a large number of wiring complexities. Monitoring the patient's body becomes more difficult when the distance between the patient and system increases. The present available system is more expensive and difficult to operate because of its large size. To decrease the hard work done by the doctor to monitor patient body we are introducing a system which can monitor patient using GSM. In this system The heartbeat and temperature are amplified and given as a input to the microcontroller. After the processing of the input the out is displayed on the LCD screen and with the help of GSM module the output is send as a SMS to the doctor and patients relative.

LITERATURE SURVEY (CONT.)

- S. Vinodhini et.al [9] proposed a system that uses GSM technology and Arduino to help the patient monitor its health condition without even going to the hospital. The most important organ in a human's body after brain is human heart. It is responsible for pumping blood to all the body parts such as brain, kidney etc. The average human heart beats around 60-100 times per minute. If the person has a higher heart rate than the normal range then the efficiency of the heart is decreased. The person may be suffering from cardiovascular diseases. To prevent people from such cases, a heartbeat sensor named pulse oximeter is combined with the GSM module to send the heart rate to the system for every heartbeat. The sensor senses the blood circulation per rate. The Arduino is used to provide a warning signal when the heart rate is not within the predefined limit. The total calculated value is compared with a given set of values. The final data set is sent to the concerned person through an SMS. This system can be used to measure heart rate from child to elder person.

LITERATURE SURVEY (CONT.)

- N. Kaleeswari et.al [10] presents a systematic solution for continuous and cost effective heart beat monitoring system using Raspberry Pi3 model B with IOT. IOT helps to transfer data over internet without human intervention which helps in conveying patient's condition every 60 seconds and if the patients heartbeat is abnormal during this period, then it sends condition of patient to doctors, family members by email and SMS. This paper proposed preventive and individual method of monitoring heart beat using IOT which enables smart devices to communicate with each other. The heartbeat sensor collects data every 60 seconds and gives it to ADC convertor (ADS1015) and then it gets to Raspberry Pi kit where the patient details are stored and passes information (warning) to doctor, family members if heartbeat is less than the safe level.

LITERATURE SURVEY (CONT.)

- Sufiya S Kazi et.al [11] proposes a health monitoring system that can detect many of our body's parameters such as blood pressure, temperature, heart rate. An ongoing record of body health parameters can be used to diagnose the disease more effectively. Nowadays, people are paying close attention to the prevention and early detection of disease. In addition to it, new technologies for new generations. Satisfactory work was done on health monitoring using raspberry pi and IoT, but this paper offers an embedded concept for both platforms. By using a combination of these, the proposed structure will work better. In this paper, we investigated recent papers related to IoT health monitoring systems. IoT is nothing without the developed concept of ICT (Information Communication Technology). IoT is to connect devices and services that minimize human intervention for a better life.

LITERATURE SURVEY (CONT.)

- (cont..) This paper that illustrates advances in healthcare management technology, would save patients future health problems that may arise and that will help doctors take the right dosage at the right time in relation to the patient's health. In this paper, we analyzed a health assessment system based on Raspberry-Pi using IoT. Any discomfort in health conditions can be directly identified. The proposed system is simple, powerful and easy to understand. It acts as a link between the patient and the doctor. The hardware is generated and the validation results are successfully verified. In this paper the introduction of a real low-risk cardiovascular system is introduced. If the system detects any of these defects it will notify the doctor and the hospital by sending an e-mail and SMS message. The app also uses an Android-based app for doctors and patients. This program provides some kind of freedom for both doctor and patient as the results displayed in real time.

LITERATURE SURVEY (CONT.)

- Rohit Kumar Dubey et.al [12] purposes this project with various sensors that are used to know the real state of health of patients such as heat sensors, pulse sensors, etc. In order to feel we have serious health problems with patients, so that effective health services can be provided to the patient at the most painful time. In a patient monitoring system, it requires equipment, devices and resources, which records the recording of a patient monitoring patient monitoring system including data retrieval and performance data from the patient and this health-related data is sent to the medical staff via the Internet of Things (IoT) through the Raspberry Pi kit. There are many applications of this method in the biomedical field leading to better accuracy, design safety, productivity, speed and flexibility and flexibility. Over the last decades humans have come to realize that they are using different technologies for this system such that the patient monitoring system uses GSM, RFID, Arduino, and ZigBee. Accelerometer etc. but in this project IoT is used.

LITERATURE SURVEY (CONT.)

- (cont..) By using IoT data can be transferred to the network without needing anyone to communicate with anyone or anyone to interact with the computer. Raspberry pi kit is used here. This is a small unit that is sized and performs a variety of functions .In this system four types of sensors are used. These sensors are the Blood Pressure Sensor, ECG sensor, heart rate sensor, temperature sensor and humidity sensor. Using this study the patient or smart phone of their caregiver can check their health status. In response to these types of requirements, health monitoring systems are recommended as a low cost solution.

METHODOLOGY

Step-1: The name, ID number, age/date of birth, mobile number, types of diseases and area of the patient are to be fetched and stored in the doctor's database.

Step-2: Then different parameters of the patient are to be taken that are initial blood pressure, weight of the patient and the timing.

Step-3: Next step is for the patient to take a 10-second video of his finger (left/right) in front of a light source as the input. It is required that the video is to be taken in a dark environment.

- Fig. 1 shows a snapshot of a frame of the video input given to the system.



Fig. 1

Step-4: The next step is to process the input and get the required data. The light passing through the finger flickers. This flickering is because when blood pumps through the veins the light passing through the finger dims down. This dipping of light represents the heartbeats.

Step-5: Now, the video's number of frames and the number of samples are calculated and the video is converted from RGB to grey. Each frame of the video when greyscaled is stored in the form of a 2-D matrix and the number of rows and columns is with respect to the resolution of the video. So, the values stored in the matrix denotes the white value. Hence the lower white values represent each heartbeat, whose is then stored in an array of the size of the total number of frames of the video.

- After that the video is converted to greyscale using `rgb2gray()` method in matlab, Fig.2 shows a snapshot after the change.

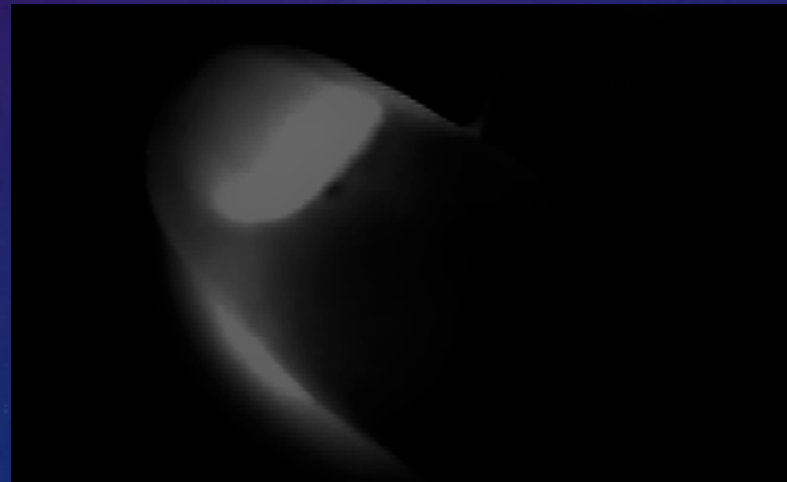


Fig. 2

Step-6: Then in the next step all the column values are added and stored in a single column. This results in an $N \times 1$ matrix which has the white values of each frame.

Step-7: Now with the matrix, the signal is plotted. Since the lower values signifies the heartbeats. So, when plotted the lower points represents the heartbeats.

- After the conversion the data is stored in 2-D matrix, as shown in Fig. 3 the lower values represents the heartbeats.

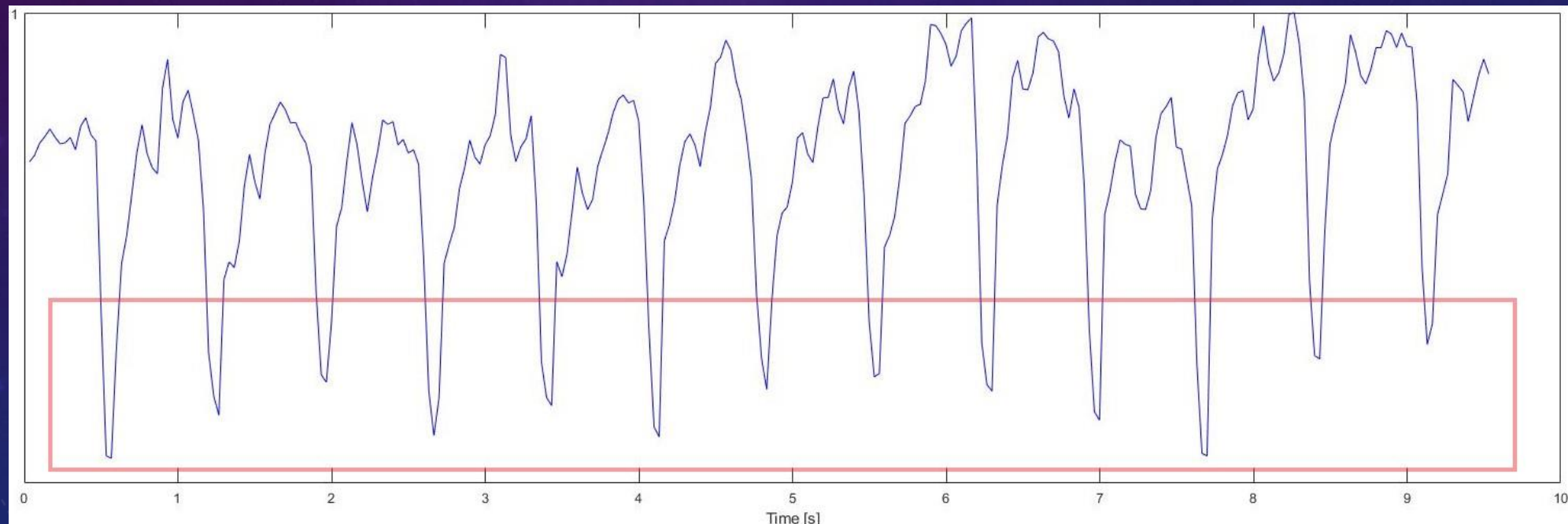


Fig. 3

Step-8: Now that we have the signal we need to filter it as in the higher white light parts noise is very high and it could interfere with heart rate calculation.

Step-9: A threshold is calculated which will be required to filter and rectify the signal. For filtering, the parts of the signal which are above the calculated threshold are filtered.

In pseudo code – 1 the signal is filtered with respect to the threshold to remove the unwanted noise.

```
-While counter is less than number of  
frames  
-If signal value at counter is greater  
than threshold  
-Filter the signal  
-End if  
-End of loop
```

Pseudo Code 1

Step-10: For this, the signal is filtered using the 1-D median filter. Here, the noise is reduced by taking mean values.

Step-11: Since we now have the filtered signal, the next step is to rectify the signal. Here, by using the threshold value the signal is converted to square wave.

- The threshold is used here to rectify the signal. The signal is converted to square wave signal using pseudo code – 2. The resulting signal is shown in Fig. 4.

```
-While counter is less than number of  
frames  
-If signal value at counter is less than  
or equal to threshold  
-Make the value of signal 1  
-Else  
-Make the value of signal 0  
-End if  
-End of loop
```

Pseudo Code 2

Step-12: To get the heartbeat rate the square wave is converted to impulses and total impulses are counted to get the heartbeat rate.

Step-13: After the diagnosis of the report by the doctor, a text message will go to the respective patient regarding the continuation of the medications.

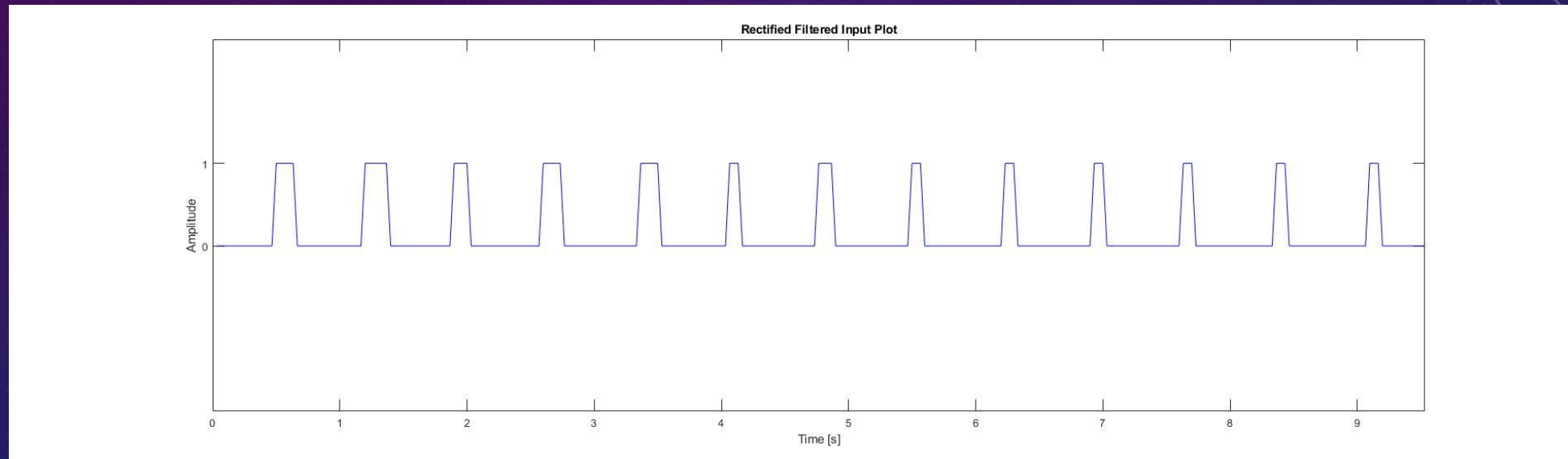


Fig. 4

- Finally to get the heartbeat rate the signal is converted into impulses with each high impulse representing each heartbeat and is shown in Fig – 5.

- While counter is less than number of frames
- If signal value at counter is not equal to previous value
- Create an impulse at alternate counter
- Increment alternate counter
- Make previous value to current value
- Else
- Make previous value to current value
- End if
- End of loop

Pseudo Code 3

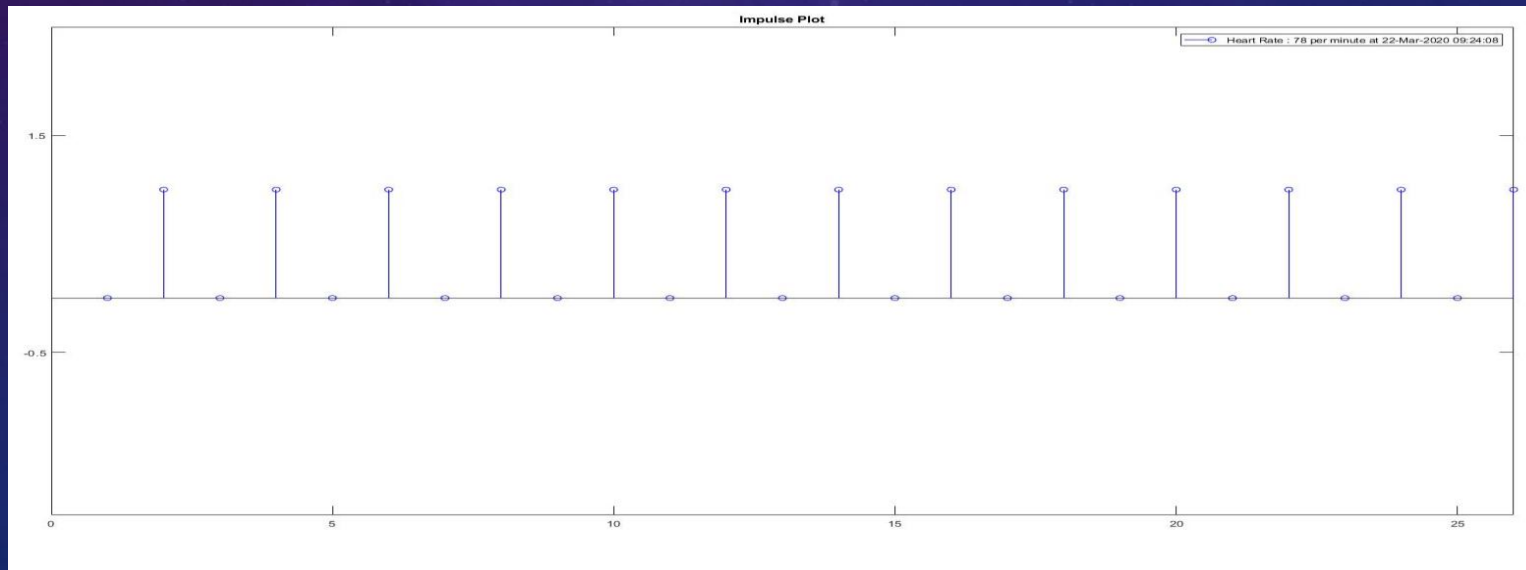


Fig. 5

- Here the impulses represents the heart beats in the span of 10 seconds. The heart rate is calculated by counting the impulses which in case of our system is done by taking half of the alternate counter as in the pseudo code - 3. Then the count is multiplied by 6 for beats per minute.
- Then the next step is to store the data in a database, from where the medical personnel can look into the data and give their expertise. For this JDBC (Java Database Connectivity) is used, which is a standard Java API for database-independent connectivity between the Java programming language and a wide range of databases.
- JDBC is a specification that provides a complete set of interfaces that allows for portable access to an underlying database.
- The algorithm for the database entry is given in the next slide in pseudo code 4.

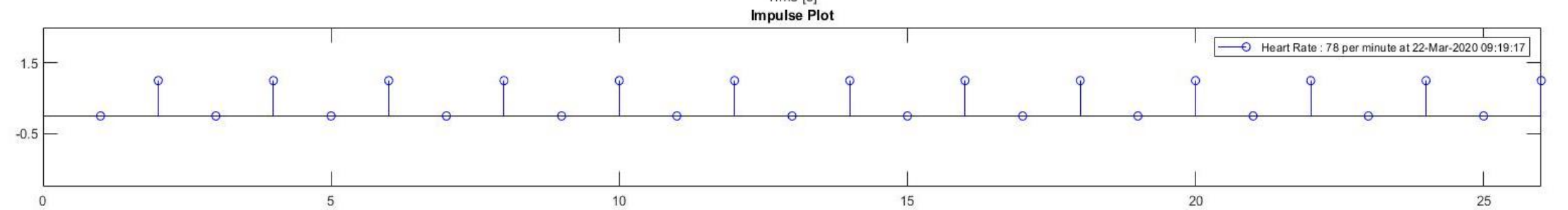
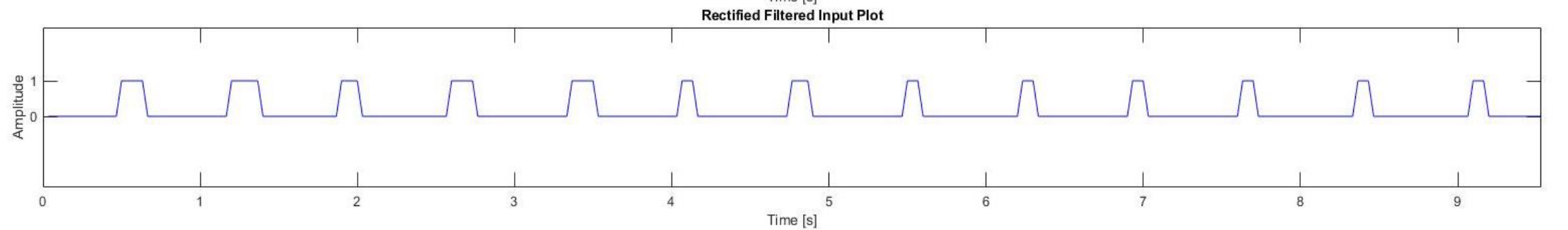
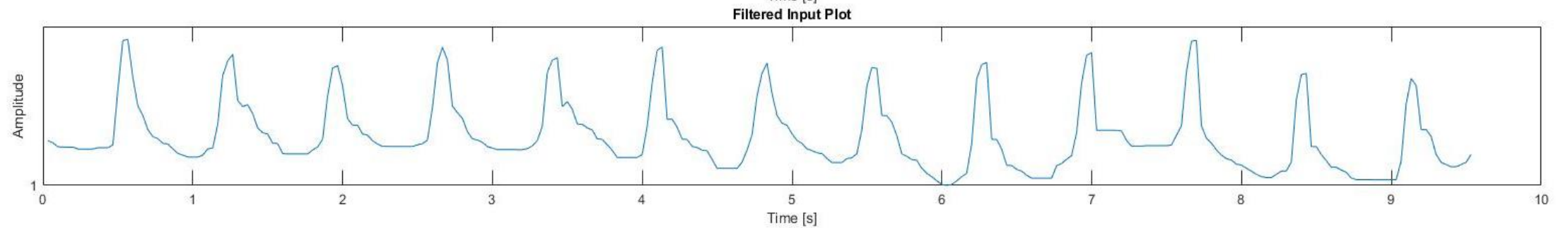
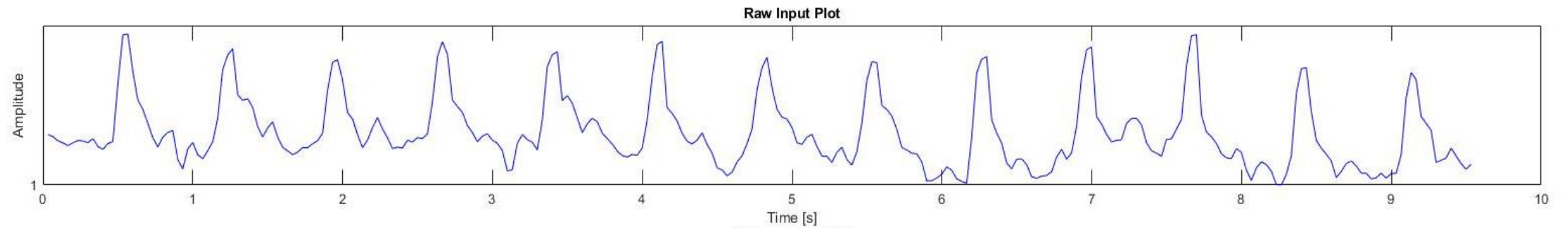
```
For allList:  
PreparedStatement preparedStatement = connection.prepareStatement(sql_query);  
preparedStatement.setInt(1,patientDetails.getDate());  
preparedStatement.setInt(2,patientDetails.getHeartbeat_Rate_Morning());  
preparedStatement.setString(3,patientDetails.getCondition_Morning());  
preparedStatement.setInt(4,patientDetails.getHeartbeat_Rate_Evening());  
preparedStatement.setString(5,patientDetails.getCondition_Evening());  
preparedStatement.execute();  
End of loop
```

Pseudo Code 4

- The next step is to check for abnormalities in the calculated heart beat rate. If the heart beat rate is found to be less than or greater than the range of a normal person, an alert is sent using GSM module to the family and the medical personnel to attend the patient.

RESULT AND ANALYSIS

- After giving the required input the model successfully calculated the heartbeat rate which is displayed with the graphs along with the time.
- The program then swiftly processes the first 10 seconds of the video input, analyzing heartbeat for faster processing. It then processes the dipping of light and plots a graph. To reduce noise from the previously generated signal it filters (filtering parts of the signal that are above threshold) and rectifies the graph to generate an impulse signal. This helps in counting BPM and finally, a signal is generated with the measured heart rate with date and time when the report is generated. We have further taken heartrate data for consecutive 5 days during morning and evening hours for comparing and detecting any significant abnormal changes. This also indicates the patient's resting heart rate and heart rate after any activity carried out by the patient. From the above tabulation, we get a perspective of the varying heart rate for both morning and evening hours with the state of the patient during the measurement of heart rate.



- This data collected in table – 1 is of a person in his early 20's. Different conditions state different details of the person's state when he took the fingertip video. Resting conditions states that the person was on resting condition and have not moved from his place for at least past 10 mins. Moderate activity states that the person has been doing some mild activity which includes walking or standing. Strenuous activity states that the person was doing some rigorous work which may include jogging, running etc. The average maximum heartrate of a person in his early 20's is 200 and resting heart rate ranges from 60 to 100 bpm for a normal healthy person. So the above data shows that the person is normal and will lead a healthy life.

Days	Morning		Evening	
	Heartbeat Rate	Condition	Heartbeat Rate	Condition
Day 1	78	Resting	84	Moderate activity
Day 2	78	Resting	90	Moderate Activity
Day 3	84	Moderate Activity	102	After Strenuous Activity
Day 4	72	Resting	84	Moderate Activity
Day 5	78	Resting	96	After Strenuous Activity

CONCLUSION AND FUTURE SCOPE

- Taking care of your health should be of the utmost importance and with the work habits nowadays it is easily neglected. Taking care of yourself and your loved ones while still working is a laborious task. Having to go to the doctors now and then could be tedious but also in the contrary could reduce the risk of critical cases. Another difficulty could be for the people living in the rural areas as the medical establishment could be far away. But as technology is developing, almost everything can be done from home. So this model is made to eliminate the communication gap between patients and medical personnel. If any abnormalities are found beforehand critical situations could be avoided. Our purposed model intends to reduce the cost of monitoring patients regardless of location. This model is capable of using
- GSM module which in cases of emergency will send alert to family members and medical personnel. In future, more parameters of a patient's body could be taken into consideration to further improve the result of our model.

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THANK YOU