**Chapter 1**

**Introduction**

**Patient’s Monitoring System**

* 1. **Real Time Patient Monitoring**
  2. **Motivation**

Heart Diseases have become one of the leading cause of death and World Health Organization states that cardiovascular diseases are the world’s largest killers causing death for 17.1 million people per year. In the recent years, world is experiencing high rate of

Heart diseases [].

The number of elderly people in the world's population is increasing significantly. The number of people 60 years of age and over has been projected to reach approximately 700 million by 2009 and 2 billion by 2050 [1].

In a 2005 survey, most respondents—92%—recognized chest pain as a symptom of a heart attack. Only 27% were aware of all major symptoms and knew to call 9-1-1 when someone was having a heart attack [5].

About 47% of sudden cardiac deaths occur outside a hospital. This suggests that many people with heart disease don’t act on early warning signs [6].

The number of death can be decreased if the patient is monitored constantly for minimizing response time during an attack. As country like Bangladesh not every people are capable of visit to a doctor constantly and it’s really costly and time consuming for general people. Using our system, a patient need to be present to a doctor physically. In our system a patient can be monitored from home as patient’s vital information’s are processed through the system automatically. Doctor and relatives are notified by the system if patient suffers from a critical situation.

* 1. **Problem Statement**

In an aging society, heart attacks have huge consequences since they tend to cause tremendous concerns as related to deterioration in the quality of life and an increase in the cost of healthcare. Although there has been a great deal of research on automatic heart attack detection, the area of risk of heart attack prediction is still lacking in study and investigation. The need to identify all the possible patterns that can lead to a heart attack is very challenging.

Historically, seniors living all around the world have been known to be late adapters to the world of technology compared to their younger neighbors, but their movement into digital life is continuing to expand. Today, 59% of seniors report that they go online, and 47% say they have a high-speed broadband connection at home. In addition, 77% of them have a phone and among that number, 18% are using smartphone devices [3, 17]. With recent developments, smartphones have increased processing capabilities and are equipped with several built-in multimodal sensors, including accelerometers, gyroscopes, and GPS interfaces.

People who is aged can’t move from places to places frequently. There are many people live in rural areas don’t get much opportunity to visit doctor’s frequently. As everyone got at least a smart phone , so this system is possible to build for monitoring critical heart disease patient’s.

* 1. **Objective**
* To introduce a system for real time monitoring heart disease patient’s that can minimize the response time in emergency situation.
* To develop a wireless body area network for monitoring heart rate of critical patient’s.
  1. **Thesis Organization**

The structure of rest of this report are described below:

Chapter 2 describes the literature review and existing techniques of Real time Heart disease patient monitoring.

Chapter 3 represents the methodology, Diagrams and algorithms describing how this project is developed.

Chapter 4 represents the real time implementation, results and decisions of this project.

Chapter 5 describes the overall conclusion of this work precisely and future scope of work with this project.

**Literacy Review**

Chapter 3

**Design and Methodology**

**3.1 IoT Healthcare Applications**

In addition to IoT services, IoT applications deserve closer attention. It can be noted that services are used to develop applications, whereas applications are directly used by users and patients. Therefore, services are developer-centric, whereas applications, user-centric. In addition to applications covered in this section, various gadgets, wearables, and other healthcare devices currently available in the market are discussed. These products can be viewed as IoT innovations that can lead to various healthcare solutions. The next subsections address various IoT-based healthcare applications, including both single- and clustered-condition applications.

3.1.2Heart Rate Monitoring:

Heart rate data can be really useful whether you’re designing an exercise routine, studying your activity or anxiety levels or just want your shirt to blink with your heart beat. The problem is that heart rate can be difficult to measure.

The Pulse Sensor Amped is a plug-and-play heart-rate sensor for Arduino. It can be used by students, artists, athletes, makers, and game & mobile developers who want to easily incorporate live heart-rate data into their projects.It essentially combines a simple optical heart rate sensor with amplification and noise cancellation circuitry making it fast and easy to get reliable pulse readings. Also, it sips power with just 4mA current draw at 5V so it’s great for mobile applications.

Simply clip the Pulse Sensor to your earlobe or finger tip and plug it into your 3 or 5 Volt Arduino and you’re ready to read heart rate! The 24" cable on the Pulse Sensor is terminated with standard male headers so there’s no soldering required. Of course Arduino example code is available as well as a Processing sketch for visualizing heart rate data.

3.2 Design Specification and Hardware:

Following diagram shows the complete transmitter and receiver flow.

Here four sensors are connected to Arduino Uno,

* Biomedical Sensor pad which collects Electric Signal from human’s Body.
* Sensor Cable - Electrode Pads (3 connector) carries the Electrical signal of human body to AD8232 Serial Monitor.
* Single Lead Heart Rate Monitor - AD8232 measures the Electric activity of the Heart.

These sensors are connected to Arduino Uno where all that information is processed before sending. Then it is sent to Smartphone for data processing via HC-05 Bluetooth Module communication. Then the data is processed for detecting any anomalies present on patient Heart Beats.

Block Diagram of the System

**3.3 Hardware Connection**

Here we will discuss how the sensors and equipment’s are integrated to this system.

3.3.1 Single Lead Heart Rate Monitor - AD8232

The AD8232 is an integrated front end for signal conditioning of cardiac biopotentials for heart rate monitoring. It consists of a specialized instrumentation amplifier (IA), an operational amplifier (A1), a right leg drive amplifier (A2), and a midsupply reference buffer (A3). In addition, the AD8232 includes leads off detection circuitry and an automatic fast restore circuit that brings back the signal shortly after leads are reconnected. The AD8232 contains a specialized instrumentation amplifier that amplifies the ECG signal while rejecting the electrode half-cell potential on the same stage. This is possible with an indirect current feedback architecture, which reduces size and power compared with traditional implementations.

Fig: AD8232 with Arduino

The AD8232 is an integrated signal conditioning block for ECG and other biopotential measurement applications. It is designed to extract, amplify, and filter small biopotential signals in the presence of noisy conditions, such as those created by motion or remote electrode placement. This design allows for an ultralow power analog-to-digital converter (ADC) or an embedded microcontroller to acquire the output signal easily.

The AD8232 can implement a two-pole high-pass filter for eliminating motion artifacts and the electrode half-cell potential. This filter is tightly coupled with the instrumentation architec-ture of the amplifier to allow both large gain and high-pass filtering in a single stage, thereby saving space and cost.

An uncommitted operational amplifier enables the AD8232 to create a three-pole low-pass filter to remove additional noise. The user can select the frequency

3.3.2 Sensor Cable - Electrode Pads (3 connector)

This is your simple three conductor sensor cable with electrode pad leads. These cables are 24" long and feature a 3.5mm audio jack connector on one end with snap style receptacles for biomedical sensor pads. Each cable comes in a red/blue/black set.

Fig: Sensor Cable with AD8232

3.3.3 Biomedical Sensor Pads

Biomedical Sensor Pads, disposable electrodes that can be used to measure EEG, ECG and EMG levels. these little pads are perfect for short-term monitoring of Neurofeedback and Biofeedback purposes. They are to be used once and are very handy because of integrated, latex-free gel. Each pad adheres very well to the skin and the snap connector can be pushed on or removed from the electrode lead with no issue.

Fig: Biomedical Sensor Pad with Sensor Cable

3.3.4 HC-05 Bluetooth Module

HC-05 Bluetooth Module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. Its communication is via serial communication which makes an easy way to interface with controller or PC. HC-05 Bluetooth module provides switching mode between master and slave mode which means it able to use neither receiving nor transmitting data.

Software features

* Default Baud rate: 38400, Data bits:8, Stop bit:1,Parity:No parity, Data control: has.
* Supported baud rate: 9600,19200,38400,57600,115200,230400,460800.
* Given a rising pulse in PIO0, device will be disconnected.
* Status instruction port PIO1: low-disconnected, high-connected;
* PIO10 and PIO11 can be connected to red and blue led separately. When master and slave are paired, red and blue led blinks 1time/2s in interval, while disconnected only blue led blinks 2times/s.
* Auto-connect to the last device on power as default.
* Permit pairing device to connect as default.
* Auto-pairing PINCODE:”0000” as default
* Auto-reconnect in 30 min when disconnected as a result of beyond the range of connection.

Fig: HC-05 Bluetooth Module with Ardiuno

3.4 Circuit Diagram

This circuit Diagram describes how this device will look like after integrating all the components.

Fig: Circuit Diagram

3.5 Project Flow Diagram

Fig: Flow Diagram of Data Send

Fig: Flow Diagram of Data Process

**Chapter 4**

**Real Time implementations, Results and Decisions**

**4.1 Circuit Connections**

Fig: Embedded device Actual Picture

To develop the system, we used Single Lead Heart Rate Monitor (AD8232), Sensor Cable - Electrode Pads (3 connector), Biomedical Sensor Pad (10 pack), HC-05 Bluetooth Module and Arduino Uno R3. Biomedical Sensor Pads are connected to Sensor Cable. These pads are responsible for collecting electrical signals from human heart and pass through the Sensor Cable. The Sensor Cable carries the electric signals to Single Lead Heart Rate Monitor. Single Lead Heart Rate Monitor filters the signal using High pass filtering and low pass filtering techniques. These filtering techniques are very much effective for cancelation of noise of the signal.

The AD8232 Heart Rate Monitor breaks out nine connections from the IC that you can solder pins, wires, or other connectors to. SDN, LO+, LO-, OUTPUT, 3.3V, GND provide essential pins for operating this monitor with an Arduino or other development board. Also provided on this board are RA (Right Arm), LA (Left Arm), and RL (Right Leg) pins to attach and use your own custom sensors. Additionally, there is an LED indicator light that will pulsate to the rhythm of a heartbeat. Biomedical Sensor Pads and Sensor Cable are required to use the heart monitor.

The 3.3V pin of Heart Rate Monitor is connected to 3.3V pin of arduino.

**4.2 Real Time Monitoring**

Fig: Sample Data Monitor Interface for Doctor

This Project includes a system (web app) so that the doctor can monitor a patient’s Electrocardiography (ECG) using the system. If a patient got critical condition the will notify the patient’s relative as well as doctor. Then the doctor can immediately login to the system and monitor the patient’s Electrocardiography. If he finds anything suspicious, he can suggests some treatment immediately before visiting any doctor.

Fig: Mobile Interface

This figure is showing the mobile application of the system. The mobile application is responsible for receiving Electrocardiography signal from embedded device and process the signal to analyze the condition of patient. After analyzing if any anomalies found in the Electrocardiography of the patient, the system immediately notify the patient’s relative as well as the doctor appointed to him.

**4.3 Results and Decision**

**4.4 Comparative Study**

**4.5 Summary**

**Chapter 5**

**Conclusion**

**5.1 Overall Conclusion**

In this process, the system can be developed for monitoring real time heart disease patients. The information of Electrocardiography goes to the cloud server so that a doctor can observe it without the patient. Our system will be life saver as it minimizes the response time by providing early warning at critical situation. Using the proposed algorithm the system can successfully detect any anomalies of patient’s heart beats and ask for emergency help. To analyze the Electrocardiography, the patient need not to be present before doctor. Using the smart algorithm, the system will analyze the data and tell the user’s what to do. If the system is developed in future under proper guidance and funding by heart institute like “National Heart Foundation” a massive number of critical heart patient will be benefited.

**5.2 Future Work**

Future work in this system can be use of more Electro pads for better Electrocardiography (ECG) signal. The system can be developed is such a way that the doctor can suggest some treatment through the system in case of life threatening situation. Machine learning technique like classification can be used to improve more accuracy to detect anomalies in Electrocardiography. Here is the list of work that can be done to improve the system.

* Develop a system for doctor to suggest patient in case of life threatening situation of patient.
* Maintain a cloud server to store the record patient’s information and Electrocardiography.
* Use of more Electro pads for more improved ECG signal.

**References**