**Literacy Review**

**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