LOCATION BASED REMOTE ECG MONITORING

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ABSTRACT

The objective of the work was to make a simple wireless one channel limited (3-lead) home electrocardiogram (ECG) transmission system for home and ambulance use. Electrocardiographic signal (ECG) is the graphical representation of electrical heart activity and is the most precise tool for heart activity monitoring by the medical practitioners and cardiologists. The wireless ECG monitoring system significantly improves the quality of life of the cardiac patients, reflected primarily in the permanent monitoring. In case of an emergency, an immediate message or notification is being sent to the physician. This module includes monitoring systems such as electrodes, ECG Sensor, data acquisition systems, signal analysing, and wireless technology, as well as some heart monitors with built-in global positioning systems. These features give the doctor and patient's family the ability to remotely monitor and determine the patient's location when a heart attack happens.

Keyword: - *Electrocardiogram (ECG), cardiologists, ECG Sensor, wireless technology, global positioning system.*

1. INTRODUCTION

Heart is a crucial organ and its of very cardinal importance to the functioning of human life. Heart pumps the blood to the body with oxygen and nutrients. Cardiovascular illnesses are very fatal and described as one of the biggest diseases responsible for mortality of people in the world by the WHO, and predominantly in case of elderly people. The treatment of such ceaseless illness requires constant and long haul observing to have legitimate control on it.

Indoor ECG Monitoring system has been designed by some designers to use this system for non-technical users in this system bio signal can be taken from the patient body after processing it. Moreover, to provide analytics of the heart rate variability on real time, a temporary windowing process should also be evaluated to discover which type of algorithms offers reliable results through the implementation of a system that integrates acquisition and analysis. Therefore, our main objective is to implement and evaluate a real-time monitoring system based on a low cost ECG sensor. Developments in wireless heart monitors (WHM) have closed the gaps of old designs and have improved the performance. These enhancements have given the WHM the best performance with good results and have facilitated remote monitoring of the patient by the doctor.

For a 12-lead ECG, ten electrodes are placed on the patient's limbs and on the surface of the chest. The overall magnitude of the heart's electrical potential is then measured from twelve different angles and is recorded over a period of time. The anomaly persisting in this is that it is not feasible and will put a dent on user’s wallet for home usage. Our projects aim is for much more portable and a better device to provide more accuracy and at low cost.

Modern approach for reducing mortality rate is thought to be performing non-invasive ECG signal monitoring at home or a non-clinical environment. This requires persons to measure their ECG signal periodically or sometimes monitoring. In addition, a basic analysis of physiological data, such as, ECG data, is required to provide in education for understanding the heart function-based ECG signal.

In this era Internet of Things (IoT) had been proven a lot more helpful and smart in various applications and still continues to be useful. The most promising application of IoT is in the field of health care sector. The physical distance between patient and clinic is one of the foremost reasons. This paper studies the application of IoT in health care domain and a system is proposed to monitor the ECG of the distant patient. Whilst recording the ECG of a person we also intend to send the live location of person using the device so that the doctors and close contacts are notified about the condition and action can be taken instantly. We shall discuss this more in detail ahead.

2. SYSTEM DESIGN

2.1 AD 8232

The AD8232 is an integrated signal conditioning block for ECG and other bio potential measurement applications. It is designed to extract, amplify, and filter small bio potential signals in the presence of noisy conditions, such as those created by motion or remote electrode placement. This design allows for an ultra low power analog-to-digital converter (ADC) or an embedded microcontroller to acquire the output signal easily. It also comes along with 3 probe electrical wire which directly catches pulse signal generated by pumping of heart for conversion of analog signals.

Figure 1: AD 8232

2.2 GPS Module

This is a complete GPS module that is based on the Ublox NEO-6M. This unit uses the latest technology from Ublox to give the best possible positioning information and includes a larger built-in 25 x 25mm active GPS antenna with a UART TTL socket. A battery is also included so that you can obtain a GPS lock faster.

It is an updated GPS module that can be used with ardupilot mega v2. The GPS module gives the best possible position information, allowing for better performance with your Ardupilot or other Multirotor control platform.

Figure 2: Ublox NEO-6M

2.3 ESP 32

ESP32 is an open source IOT platform, comes with 2.4 GHz WiFi and dual mode bluetooth. It is highly integrated with built-in antenna switches, RF balun, power amplifier, low-noise receive amplifier, filters, and power management modules. Engineered for mobile devices, wearable electronics, and IoT applications, ESP32 achieves ultra-low power consumption through power saving features including fine resolution clock gating, multiple power modes, and dynamic power scaling.

Figure 3 – ESP 32

2.4 Arduino Uno

Arduino Uno is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino.cc. The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits. The board has 14 digital I/O pins (six capable of PWM output), 6 analog I/O pins, and is programmable with the Arduino IDE (Integrated Development Environment), via a type B USB cable. It can be powered by the USB cable or by an external 9-volt battery, though it accepts voltages between 7 and 20 volts.

Figure 4 – Arduino Uno

3. METHODOLOGY

This is the model we have proposed and the following diagram elucidates in a quick manner of how things are done.

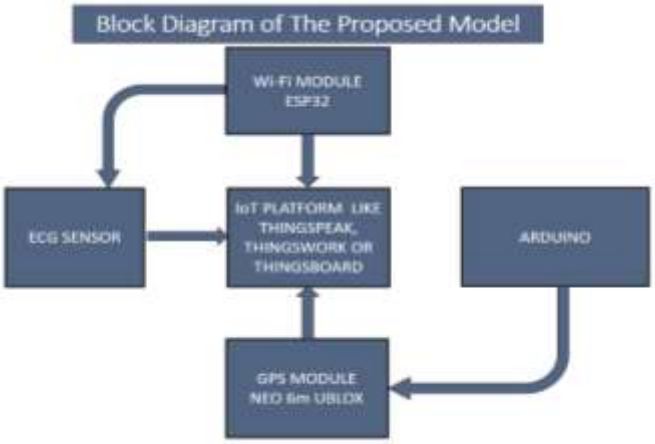

Figure 5 – Block Diagram of The Proposed Model

We have divided our project in to two main parts:

3.1 Hardware Development:

To get our system running the first thing which is required is, acquisition of raw signals from 3 probes of the ECG sensor which converts our raw analog signals to digital with the help of AD 8232. The raw data acquired is directly sent by microcontroller which has an inbuilt Wi-Fi Module connected to internet network. This data is then posted on IoT platform using a MQTT (Message Queue Telemetry Transport) Client which is accessible to doctor and relatives of the concerned person and can have real time updates regarding it. Simultaneously, we are also having a GPS Module connected to another microcontroller device, Arduino Uno to get current GPS location of the patient.

3.2 Software Development:

Our justification of first part is done here in the second, where, while using a MQTT protocol hosted on Ubidots, an IoT Platform which allows one to have an User ID and a Password, and have libraries named by wifi.h and PubSubClient.h in Arduino. Ubidots platform provide point-and-click application development tools that actually help creating real time dashboards for analysis of data and control devices remotely. It has a very handy interface to visualise data with stock graphs, charts, tables, control widgets and etc. Ubidots gives decision makers the upper hand by providing exact information in where critical decisions are needed to be taken regardless of the users are.

We added libraries like TinyGps++.h and softwareserial.h to get NMEA (National Marine Electronics Association.) Statements. NMEA existed well before GPS was invented. In the world of GPS, NMEA is a standard data format supported by all GPS manufacturers. The purpose of NMEA is to give equipment users the ability to mix and match hardware and software. NMEA-formatted GPS data also makes life easier for software developers to write software for a wide variety of GPS receivers instead of having to write a custom interface for each GPS receiver. NMEA data can be transmitted via different types of communications interfaces such as RS-232, USB, Bluetooth, Wi-Fi, UHF, and many others. The NMEA sentences generated by GPS Module are sent in a particular format which are required to get latitude and longitude. An example of NMEA Statement is, this particular message was output from an RTK GPS receiver:

$GPGGA,181908.00,3404.7041778,N,07044.3966270,
W,4,13,1.00,495.144,M,29.200,M,0.10,0000*40

All NMEA messages start with the $ character, and each data field is separated by a comma. **GP** represent that it is a GPS position (GL would denote GLONASS).**181908.00** is the time stamp: UTC time in hours, minutes and seconds.**3404.7041778** is the latitude in the DDMM.MMMMM format. Decimal places are variable. **N** denotes north latitude.**07044.3966270** is the longitude in the DDDMM.MMMMM format. Decimal places are variable.

W denotes west longitude. **4** denotes the Quality Indicator:[1 = Uncorrected coordinate;2 = Differentially correct coordinate (e.g., WAAS, DGPS);4 = RTK Fix coordinate (centimeter precision);5 = RTK Float (decimeter precision)]. **13** denotes number of satellites used in the coordinate. **1.0** denotes the HDOP (horizontal dilution of precision). **495.144** denotes altitude of the antenna. **M** denotes units of altitude (eg. Meters or Feet) **29.200** denotes the geoidal separation (subtract this from the altitude of the antenna to arrive at the Height Above Ellipsoid (HAE). **M** denotes the units used by the geoidal separation. **1.0** denotes the age of the correction (if any). **0000** denotes the correction station ID (if any). ***40** denotes the checksum. The $GPGGA is a basic GPS NMEA message. There are alternative and companion NMEA messages that provide similar or additional information.

After the location essentials are acquired then we used a website named, "maps.ie" to get current location of concerned person by putting the latitude and longitude.

4. RESULT & CONCLUSION

The following graphic is demonstration carried out by us on person which shows the continuous signals received on the IoT platform.

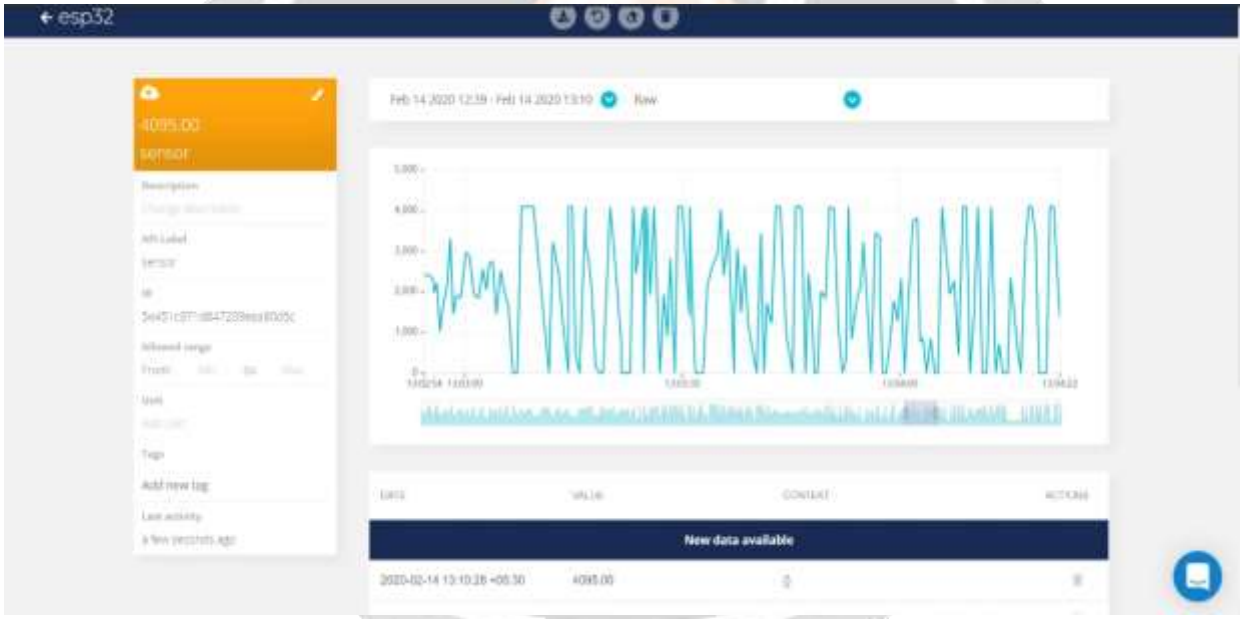

Figure 6 – Result obtained on the IoT Platform (Ubidots)

All in all, we are here with our prototype which was already tested on human with the aforesaid hardware and software working properly. So, this hardware can be readily used by the people who are at risk or might have a potential threat of cardiovascular illness, so that their respective families and concerned doctors are notified continuously. This could help to save life of person in case of emergency in scenarios like a person is isolated from people for work or any purpose, this immediately can update others as patient might not be able to call or contact someone nearby to seek help, and get access to health care services in immediate response.

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