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Smart health monitoring system using internet of things (IoT)

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ABSTRACT
In these days, chronic heart breakdown has grown into a very major problem. This occurs when heart tissue gets blemished, becomes anemic and eventually rattles the instinctive pumping action of heart. This is gently affecting an ever-flourishing portion of population dominant to represent one of the major causes of hospitalization for aged citizens. The modern healthcare exemplary is mostly in-hospital based and includes sporadic visits, that has turned as a endless job for the patients. In this paper, a complete and unified healthcare model is described permissive Chronic Heart Failure (CHF) patients to regularly collect crucial signs at home and sending them using Internet of Things (IoT). This allows specialists to guide patients at a distance and take repeated actions in case of necessity. A set of five parameters has been determined i.e. Electrocardiogram(ECG), Pulse rate, Heart rate, Temperature, Location and Position detection by using wearable sensors. These sensors are connected to an Arduino Nano. The decisive framework can be visualized and supervised on any mobile device including laptops or smartphones which are associated under same network.
Keywords - Arduino, CHF, ECG, pulse sensor, IO

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I. INTRODUCTION

Heart failure is commonly seen in elderly persons because body loses its amnesty gradually with growing. CHF is a leading cause of hospital admittance particularly for older adults embracing a prevalence of 1.3%, 1.5%, and 8.4% in 55–64 years old, 65–74 years, and 75 years or older segments, respectively [1] In medical field continuous patient monitoring is required at hospitals and patient's home also The CHF patients need an intensive care and continuous monitoring to avoid Heart attack and heart related disorders[2]. The objective of this paper is to continuously monitor ECG signal, heart beat and some other vital signs of CHF to avoid re-hospitalization that in turn increase patient satisfaction. It is achieved by a minimum set of vital signs threshold values that are fed in Arduino Nano to monitor the vital signs measured through a pool of wireless, non-invasive biomedical sensors[3]. The Physicians monitor patients at distance and take timely actions in case of emergency. IoT is an ideal emerging technology to influence the internet and communication technologies[4]. IoT connects living and non-living things through internet [5]. Traditionally in the object-oriented paradigm everything in the world is considered an object, but in the IoT paradigm everything in the world is considered as a smart object, and allows them to communicate each other through the internet technologies by physically or virtually [6]. IoT allows people and things to be connected anytime, anyplace, with anything and anyone, by using ideally in any path/ network and any service [7]. Smart Healthcare plays a significant role in healthcare applications through embedding sensors and actuators in patients and their medicines for monitoring and tracking purposes [8]. IoT is used by clinical care to monitor physiological statuses of patients through sensors by collecting and analyzing their information and then sending analyzed patient's data remotely to processing centers to make suitable actions [9]. Health monitoring is the major problem in fast pacing world. Patient suffers from serious health issues due to lack of proper health monitoring. There are lots of IoT devices now days to monitor the health of patient over internet [10]. Health experts are also taking advantage of these smart devices to perceive their patients. With lots of new healthcare technology start-ups, IoT is rapidly revolutionizing the healthcare industry [11].

Here in this project, we will make an IoT based Health Monitoring System which records the

patient heart beat rate and body temperature and also send an email/SMS alert whenever those readings go beyond critical values [12]. Pulse rate and body temperature readings are recorded over Thing Speak, so that patient health can be monitored from anywhere in the world over internet [13].

II. HARDWARE REQUIRED

Arduino Nano
ESP8266 Wi-Fi module
DS18B20 temperature sensor
LM358 Heart rate sensor
Position Sensor
Electro Cardio Gram Sensor
Male-female wires
GSM+GPS module
Working

The system comprises of different wearable sensors which are connected to Arduino Nano(Here two Arduino Nano's are used). Coding of sensors is done in integrated development environment. The values from these sensors are uploaded to cloud or server. By using Wifi module those values can be read from anywhere applications of world as the system is linked to IoT. Here we are using an app to monitor the patient's health the values obtained obtained from the wearable sensors can be seen in our app.Data for threshold values for the values of parameters to distinguish a healthy and unhealthy person is collected from the hospitals and from the internet. Now by comparing the threshold values and real values obtained from the patients a message alert and location of patient is sent to the concerned person.

2.1 Heart Rate Sensor(LM358)

Heart Rate Sensor is a well-designed plug-and-play heart-rate sensor for Arduino. The sensor clips onto a fingertip or earlobe and plugs right into Arduino. It also includes an open-source monitoring app that graphs your pulse in real time.

On the clip which is placed on the finger, you see a small round hole, which is where the LED shines through from the back, and there is also a little square just under the LED. The square is an ambient light sensor, exactly like the one used in cell phones, tablets, and laptops, to adjust the screen brightness in different light conditions. The LED shines light into the fingertip or earlobe, or other capillary tissue, and sensor reads the amount of light that bounces back. That's how it calculates the heart rate. Before we use this sensor, we need to protect the sensor from extreme conditions like temperature and pressure, so that we can get accurate readings and avoid the short circuit due to sweat

2.2 DS18B20 Temperature sensor

The DS18B20 Digital Thermometer provides 9 to 12-bit (configurable) temperature readings which indicate the temperature of the device. The DS18B20 communicates over a 1-Wire bus that by definition requires only one data line (and ground) for communication with a central microprocessor. In addition, the DS18B20 can derive power directly from the data line ("parasite power"), eliminating the need for an external power supply. This sensor has been included in many applications such as Thermostatic Controls, Industrial Systems, Consumer Products, Thermometers, Thermally Sensitive Systems.

2.3 WIFI module (ESP8266)

Most people call ESP8266 as a WIFI module, but it is actually a microcontroller. ESP8266 is the name of the microcontroller developed by Espresso Systems which is a company based out of shanghai. This microcontroller has the ability to perform WIFI related activities hence it is widely used as a WIFI module.

There are two of ways to work with your ESP8266 module .One way is by using the AT commands. The other way is by using the Arduino IDE. Here we will use AT commands to send data from Arduino to ESP.

2.4 ECG sensor

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.

2.5 Position sensor

A position sensor is any device that permits position measurement. It can either be an absolute position sensor or a relative one (displacement sensor). Position sensors can be linear, angular, or multi-axis.

It is a small, thin, low power, complete 3-axis accelerometer with signal conditioned voltage outputs and consumes low power. The power typically ranges from 1.8V to 3.6V, 350 micro Amp. The sensor is a poly silicon surface-micro machined structure built on top of a silicon wafer. Polysilicon springs suspend the structure over the surface of the wafer and provide a resistance against capacitor that consists of independent fixed plates and plates attached to the moving mass. The fixed plates are driven by 180° out-of-phase square waves.

Acceleration deflects the moving mass and unbalances the differential capacitor resulting in a sensor output whose amplitude is proportional to acceleration. Phase-sensitive demodulation techniques are then used to determine the magnitude and direction of the acceleration. on some models, which are also used for loading programs from personal computers. The microcontrollers are typically programmed using a dialect of features from the programming languages C and C++. In addition to using traditional compiler toolchains, the Arduino project provides an integrated development environment (IDE) based on the Processing language project.

2.6 GPS+GSM module (SIM808)

SIM808 module is a GSM and GPS two-in-one function module .It is based on the latest GSM/GPS module SIM808 from SIMCOM, supports GSM/GPRS Quad-band network and combines GPS technology for satellite navigation. It features ultra low power consumption in sleep mode and integrated with charging circuit Li-lon batteries that makes it get a super long standby time and convenient for projects that used rechargeable Li-lon battery. It has high GPS receive sensitivity with 22 tracking and 66 acquisition receiver channels. Besides, it also supports A-GPS that available for indoor localization.

The module is controlled by AT command via UART and supports 3.3V and 5V logical level.

2.7 Arduino nano

The Arduino Nano is a small, complete, and breadboard-friendly board based on the ATmega328P (Arduino Nano 3.x). It has more or less the same functionality of the Arduino Demilune, but in a different package. It lacks only a DC power jack, and works with a Mini-B USB cable instead of a standard one.

Arduino board designs use a variety of microprocessors and controllers. The boards are equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards or breadboards (shields) and other circuits. The boards feature serial communications interfaces, including Universal Serial Bus (USB)

III. CONFIGURING THING SPEAK TO RECORD PATIENT DATA ONLINE

Thing Speak provides very good tool for IoT based projects. By using Thing Speak site, we can monitor our data and control our system over the Internet, using the Channels and webpages provided by Thing Speak. Thing Speak 'Collects' the data from the sensors, 'Analyze and Visualize' the data and 'Acts' by triggering a reaction. Here we are briefly explaining to use Thing Speak for this IoT Patient Monitoring Project. We will use Thing Speak to monitor patient heartbeat and temperature online using internet.

Step 1: - First of all, user needs to Create a Account on ThingSpeak.com, then Sign In and click on Get Started.

Step 2: - Now go to the 'Channels' menu and click on New Channel option on the same page for further process.

Step 3: - Now you will see a form for creating the channel, fill in the Name and Description as per your choice. Then fill 'Pulse Rate', 'Temperature' and 'Panic' in Field 1, Field 2 and Field 3 labels, tick the checkboxes for the Fields. Also tick the check box for 'Make Public' option below in the form and finally Save the Channel. Now your new channel has been created.

Step 4: - You will see three charts as shown below. Note the Write API key, we will use this key in our code.

Step 5:- Now, we will use Thing HTTP app of the server to trigger the IFTTT applet for data entry to Google sheets and send email/sms. Thing HTTP enables communication among devices, websites, and web services without having to implement the protocol on the device level. You can specify actions in Thing HTTP, which you want to trigger using other Thing Speak apps such as React.

IV. RESULTS

Fig -1: This diagram shows the entire smart health monitoring kit along with values of both pulse rate sensor and temperature sensor on the LCD display**.**

Block diagram of smart health monitoring system using IoT

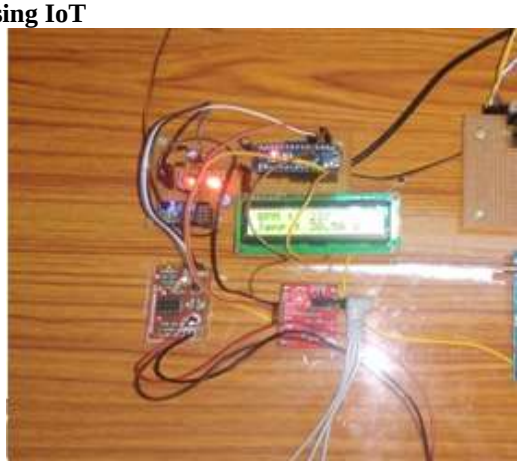

Figure 1

Fig-2: This diagram shows the output results of the temperature sensor from things speak**.**

Figure 2

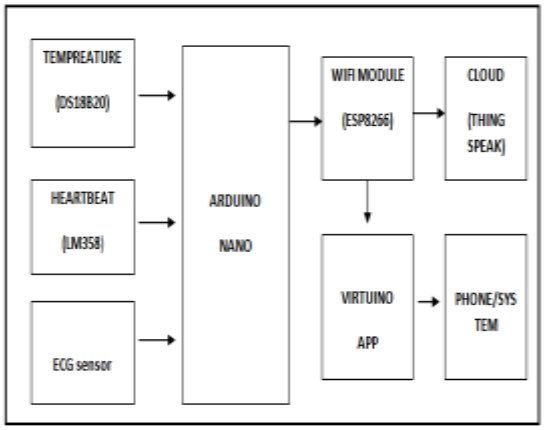

Fig-3 This diagram shows the output results of electrocardiogram from thingspeak.

Figure 3

Fig-4 This diagram shows the output graph of patient's electrocardiogram**.**

Figure 4

V. CONCLUSIONS

A prototype of home smart monitoring system has been achieved, presenting a system in which data is collected from any health sensors, and able to collect data from any health sensors and send that data to doctor or care taker. It does not require any technical intervention, As it offers auto setup to be used easily by the users. Extensions can be done easily and by adding essential hardware any parameter can be measured easily.

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