Patient Medical Checkup using Webapp and IOT

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Abstract

Internet of things is the way in which sensors or things get the power of internet making it to work in coordination. Patient medical checkup is always simply and it demands a physician or nurse to check and report the vitals. There is a bottleneck with increasing population and less doctors in this process.

In this paper, we introduced an efficient way in which patient medical checkup is done and seen by doctors connected remotely. Here, we have used internet of things, playing major role in connecting sensors to internet. The vitals of patient can be taken by volunteers without medical knowledge. Compared to other study on patient medical checkup this project gives complete monitoring of data in that required medical checkup time. The data is connected to cloud making the website admin to retrieve records efficiently.

Objective: *The main objective of this research is to develop a medical checkup environment reaching doctors to help public located remotely using hospital website and Internet of things. IOT (Internet of Things) help in connecting the sensors to cloud service which is then retrieved by hospital website for calibration of records. The doctors can view the records and also comment or write notes based on records. The gross records of remotely connected patients can also be viewed.*

Method and Improvement: *We have implemented technology like thing speak, a cloud service and also user interface part through website which can be connected for android development in future. Also prediction using machine learning algorithms can also be implemented. Processing visualizer is another software which is used to visualize the patient records.*

Keywords — *Internet of Things, Thing speak, Cloud service, Website*

I. INTRODUCTION

Patient medical checkup uses IOT as its backbone to collect vitals of patient from the sensor. The sensor is kept in patient sensitive parts to check for correct value. The values are displayed in monitor technically. The volunteer need not know the medical knowledge to collect such details. It is uploaded direcly to cloud service via Internet of Things connecting to Thing speak which is a cloud analytic platform services by Matlab Simulator. The sensed data is also sent to website where patient and doctor can view their records remotely. User interface is made mobile friendly and readable format.

Three basic modules are taken here for medical checkup they are:

- Heartbeat module,
- Body temperature checkup module and
- Anglometer and gyrometer for angle and position detection module.

The cloud service connection of Thingspeak has separate channel for each patient which can be accessed by channel id and write api keys available in thingspeak. The Arduino is coded in such a way that it connects to server thingspeak. Here the data from sensor pin of Arduino is collected and visualized in graph format for monitoring of patient data during that specific checkup time.

Smart utilization of IOT has led to utilization of things and connecting over internet become easy. The algorithms used in coding of Arduino mostly involve changing of analog to value generation. A brief detail of each separate part needed for this study is described below:

A. Arduino as internet of things

Arduino is a microcontroller chip which controls many sensors or things via code. The coding is included in Arduino software. The C language used gives the sensor instruction of when to retrieve or stop data using other things in control. The sensed data is connected to any of internet service provides acting as server or client. For internet connectivity Ethernet shield is used. Via Ethernet connectivity the data in sensor pin of Arduino are sent as Ethernet client to internet as server. Other IOT devices like raspberry can also be involved to help in these things.

Arduino has 6 analog pins starting from A0 to A5 and 12 digital pins from 3 to 13 . 0 and 1 is used as

transistor and receiver pins. There is three ground pins one near digital which is inbuilt led pin and also two near analog pin. The power supply is of four ways: 1) via USB cable 2) via external power supply 3) via AC to DC converter and 4) via jumper wires.

B. ThingSpeak as cloud service

ThingSpeak is a cloud data service provided by Matlab Simulator for visualizing and calibration of data via graph. ThingSpeak has inbuilt library making it feasible to connect to Arduino. The write API keys, channel id , network name and password are the only fields required for connecting Arduino to thingspeak. Retrieval of data is made simple as API keys are available and also GET statement is used to retrieve the entire field data from Thingspeak. In this project each channel represents a patient which has five fields providing data of each module. diagrammatic view of fields utilized are shown below.

C. Channels in thingspeak:

Thingspeak has recently provided inbuilt libraries for connecting to iot devices. And incase of Arduino there is a separate library for connecting Ethernet or wifi shield or module to thingspeak by knowing the id and api keys.

The channel has setting of private, public and personal view which helps in viewing the details confidentially. Each field is shown via graph which can be aligned through settings.

D. UI or website

A random hospital management website is undertaken to visualize the data via website. The website is made through respective HTML (hypertext markup language), CSS (cascade styles sheet) and javascript to make it user friendly and rich in graphics. Bootstrap is also used for look and feel of dynamic website. PHP code is used for retrieval and fetching of sensed data from thingspeak. The GET statement provided in thingspeak is retrieved and using PUSH statement in PHP it is made to reflect in website UI part. Also the monitored data in graph of thingspeak is retrieved and shown via link in website.

E. Syntax for website retrieving data:

url field will have the required url of the data contents

```
json_decode(file_get_contents($url),true);
```

On echoing the respective json object of list the required details of the field is retrieved. And displayed using POST command in php.

II. PATIENT MEDICAL CHECKUP ARCHITECTURE AND MODULE DESCRIPTION

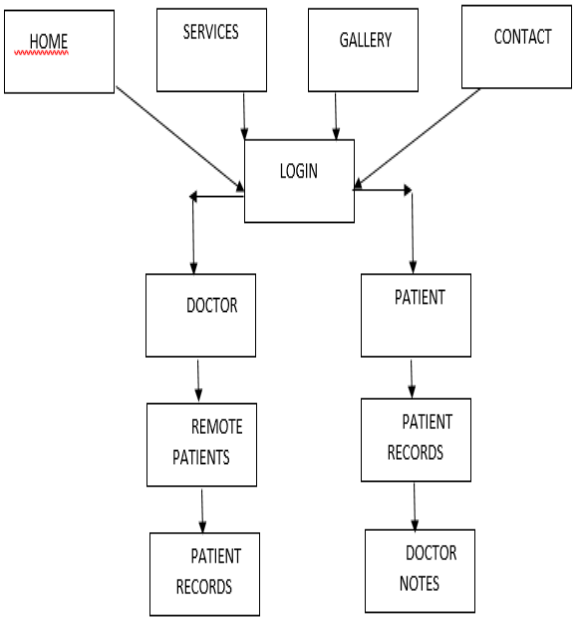

Fig 2. Architecture and workflow of website

Various Modules that comes under Patient Medical Checkup are as follows:

Module 1: Heartbeat checkup module

In this module, the heartbeat of a patient is checked from a sensor pin(here A0 pin is used). The heart beat pulse sensor is used to serve this purpose. + is connected to 5v of Arduino, - is connected to ground of Arduino and S pin is connected to A0(analog pin of Arduino). The below is formula used to find the heartbeat of patient:

If the sensed data is true

Then,

faderate is 255 //led fade

senddataTomonitor (Beat)//A0 pin has hearbeat

senddataTomonitor (index) //600 by default

set sensed data to false at the end.

This loop performs the sensed data and led is faded based on it. A default index is set to processor to calculate the correct heartbeat.

Following is the output of heartbeat checkup module:

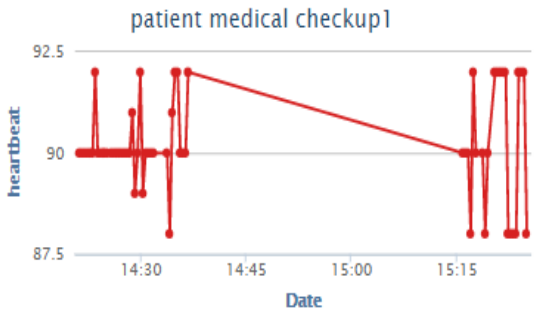

Fig 3. Heartbeat monitoring in thingspeak

Module 2: Body Temperature checkup module

In this module the body temperature of patient is found using a sensor called thermistor. The positive of thermistor is connected to 5v of Arduino and negative is connected to ground. A 100 ohm resistor is added to reduce the power supply by increasing the resistance to Arduino. The positive side is also connected to A1(analog sensor pin) of Arduino.

The following is the formula to detect the body temperature of patient.

```
Vo = analogRead(A0);
R2 = R1 * (1023.0 / (float)Vo - 1.0);
logR2 = log(R2);
T = (1.0 / (c1 + c2*logR2 + c3*logR2*logR2*logR2));
Tc = T - 273.15;
Tf = (Tc * 9.0)/ 5.0 + 32.0;
```

Here Vo is the variable that has sensor value, R2 is used to find the resistance of the sensor . Using the formula T is derived which is static temperature from which celsius and fahrenheit temperature are derived.

Module 3: Angle and Position checkup module

In this module, the angle and position are checked by inertial measurement unit sensor(IMU) which displays the angle in x, y and z axis to which the patient is inclined. And also the degree to which it is inclined is also shown making it easy to interpret a patient correct angle by inserting it to the parts where angle needs to be deducted. The initial angle which it is placed is taken as default correct position. Also the connection of IMU sensor to Arduino involve a interrupt(digital pin2), SDA, SCL are attached to analog pin A4 and A5 and a GRND and Vo pin to ground and 5v of Arduino.

The following is the formula used to find the angle and degree in three axis:

```
Wire.beginTransmission(MPU6050_addr);
Wire.endTransmission(false);
Wire.requestFrom(MPU6050_addr,14,true);
AccX=Wire.read()<<8|Wire.read();
```

MPU6050_addr is the mac address of MPU or IMU sensor. First the write transmission is begined and end transmission of data is kept false. Here angle(anglometer) and degree(gyrometer) both values are figured out. And the respective values are read via the read function of wire.

The readings taken from x,y,z axis can be incalculated to find the correct position and angle of the patient.

The below is the output of Arduino code:

Module 4: Ethernet Arduino connectivity

In this module, the connectivity of Arduino to internet is discussed. Here Ethernet shield is used with act as module to generate the mac address (incase of single microcontroller default mac address can be used). The wifi and Ethernet connectivity are bridged in networks making the Ethernet to connect to internet. Here Arduino along with Ethernet shield will act as client and internet as server and required client server connectivity using C language is used as Arduino code.

The following is the algorithm used for client server connectivity.

ENTIRE WORFLOW :

The below flow diagram visualizes the entire workflow of this project:

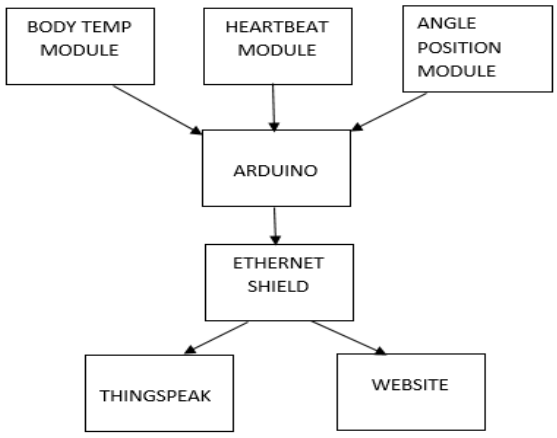

Fig 4. Block Representation

Here all the three modules are connected to the Arduino which is the microcontroller controlling all the sensor. The sensed data are taken from each pin and sent to Ethernet shield which connects the mac address

of the Arduino to internet via bridge connection and client server code.

Thingspeak is connected from Arduino to internet via Ethernet connection making Arduino to access cloud service. From cloud the records are retrieved and displayed in UI format by website making the encapsulation and abstraction of technical aspect from the user.

III. CONCLUSION

In this paper, for patient medical checkup, the accuracy of reading depends on the sensor accuracy that is, the sensor are choosed in such a way to get approximate accuracy to map it with original sensor used in medical field. And moreover the reading is monitored also to show the detailed readings taken during that period of time. Let's take a look at the result projected in UI for better understand of data retrieval

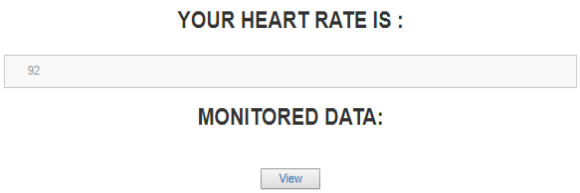

Fig 5. UI representation

Let's take a look over to output of monitored data in thingspeak to understand better about the result of accuracy, precision and recall.

Fig 5. Thing Speak monitoring data

All the fields show the data sensed from the sensor pin of Arduino. Each field belong to any one of the three modules.

Separate channel for each patient makes each patient records to be stored via cloud and no data or details are lost. The privacy of the channel is maintained in private view settings of channel.

In the conclusion paper, we propose the various advancement that can be done to enhance this project. Andriod development can be used for mobile friendly viewing of patient records. And also an email can be triggered on successful patient checkup. An message using GSM module can also be used to check for patient record if the patient is unable to connect to internet.

IV. ACKNOWLEDGMENT

We thank N. JAYANTHI, Assistant Professor, Department of Information Technology, SRM Institute of Science and Technology, for her constant support and guidance throughout the research project.

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