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An Internet of Things (IoT) Based Cardiac Monitoring System Using the RFID and Mobile-Based Application

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Abstract: *In this paper, some IoT device will help user to maintain a proper diet chart during they taking their meal. There is a device, which can measure human heart rate and after measuring this user can send heart rate data to a server, after they can read those data and get more information from server by an application. This application is developed for android devices. This whole thing is based on IoT architecture. Using IoT architecture, we will ensure this service to our end user.*

Keywords: IOT, Cardiac Monitoring, Mobile Application, Microcontroller, Pulse Sensor.

I. Introduction

The "Internet of things" (IOT) is becoming an increasingly growing topic of conversation both in the workplace and outside of it. It is a concept that not only has the potential to affect how we live but also how we work. However, what exactly is the "Internet of things" and what impact is it going to have on us, if any? There are many complexities around the "Internet of things" but I want to stick to the basics. Lot of technical and policy-related conversations are being had but many people are still just trying to grasp the foundation of what the heck these conversations are about.

We are trying to implement an application for heart patient using IOT Architecture. Our main targeted group of people for this paper is "Heart Patients". Every Heart patient always have to maintain some sort of diet plan for his or her meal. This paper will help them to maintain their diet plan more strictly and properly. That is our main goal of this paper. We developed this application for them. The device and our application will help patient to measure their heart rate easily and after that, their relatives or him/herself will get a suggestion for further instruction or more information about emergency treatment. In addition, you have to use a mobile app to get this suggestion. In addition, we developed this mobile application.

1.1 Objective

To help human to lead a healthy life is the main objective of our Paper.

1. Help human to lead a life with proper guideline.
2. Help heart patients to keep in touch with relatives and doctors.
3. Ensure To keep heart rate in normal state.
4. At last, to help them to maintain a certain meal plan to save them from sudden heart attack.

1.2 Scope

Following are the scope of the developed system:
For User:

1. To use this service user has to complete their registration process. In registration user need to use their phone number as a "username".
2. This username or phone number will configure

the device.

3. User need to use Wi-Fi Network to run this device, and for the limitation user need to use specific SSID and Password, which has also configured in the device.
4. User also needs to use username and password for login process.
5. After successful login, they will get some information about what should they do for maintaining a diet plan.

For Management:

1. Only **Management** has the control, so he can configure that device by using username or phone number.

1.3 Benefits for user and medical science view

The Followings are the benefits of the user and admin
User View: This service will help a heart patient to maintain a diet chart before taking meal or medicine. By using this service patient will be monitored by their relatives and doctors also.
Medical Science View: This may help medical science to provide better service to their heart patient.

II. Floorplan and Material

Due to internet of things, hospitals are shifting to remote self-monitoring for patients. Due self-monitoring it gives the patient greater freedom and independence for their health and free the equipment for emergency propose for patients. Internet of Things (IoT) is a new revolution of the Internet. Internet of Things (IoT) is can be said the expansion of internet services. It provides a platform for communication between objects where objects can organize and manage themselves. It makes objects themselves recognizable. The internet of things allows everyone to be connected anytime and anywhere. Objects can be communicated between each other by using radio frequency identification (RFID), wireless sensor network (WSN), Zigbee, etc. Radio Frequency identification assigns a unique identification to the objects. RFID technology is used as more secure identification and for tracking/locating objects, things, vehicles.

Build IoT paper is a process that could involve the step of finding free platforms. As we know, Internet of things is a set of physical objects that use network support to exchange data. These objects can be sensors, software, boards and so on. This is an interesting ecosystem where the software can be connected directly to real hardware or devices. The most known board for building internet of things paper are Arduino (with its several versions) and Raspberry. Integrating these devices with cloud platforms is possible to collect and analyze data, create "smart" object that can be controlled remotely. One way to control such devices is using smartphones like Android and iOS devices. Dev Boards like Arduino or Raspberry are cheap and everyone can experiment IoT papers. Cloud IoT platforms help developers and maker to build IoT paper and test them fast and easily.

In our paper, we did not use any specific framework or any platform. We just wanted to keep it simple. However, we might follow a basic architecture.

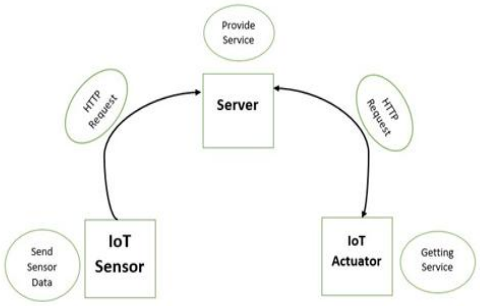

Figure 1: Project Architecture

There is a sensor in our Paper, which can detect human heart rate, and then it will send heart rate data to a server. Those data will be saved in a database. Here we are using http get request to send data from the sensor. There is also a mobile application in our paper, where user can see their heart rate related information. For that they need to login by using their username and password. Heart rate related information is provided by the server, for that WE need to send http get and post request to that server. Based on those request servers will provide some service to user, and user will get that service by using that mobile application. Therefore, this is the architecture, which we are following to develop our IoT based paper, where WE did not use any framework or any specific platform. Anyone can develop any kind of IoT based paper following this architecture and this is the advantage of our paper.

In this research, they propose an intelligent healthcare service model that can enable personal health device to recognize the relationship between mutual diseases and risk factors and provide intellectualized feedback to the patient. In addition, suggestion is made for the assessment algorithm of intellectualized processing essential during the modeling procedure and

collaboration application protocol between personal health devices. Furthermore, it is presented the effectiveness of the proposed model through experiments.

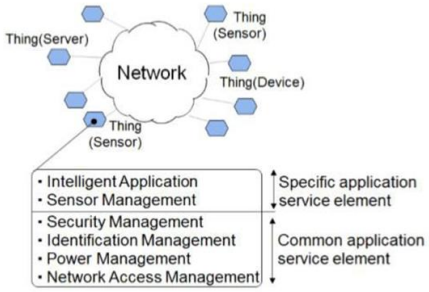

Figure 2: Conceptual Model for IOT and its functionalities

We did not use any framework or specific platform to develop our paper but for the purpose of communication, we need to follow a protocol. Which is quite similar to XMPP. In our paper user send data from device to server and to get those data from server it will be using a phone.

For successful communication, it requires sending and receiving data operation managed by HTTP GET and POST request. Usually XMPP used for person-to-person communication. However, in IOT we know two or many things/devices is connected with each other through the internet. They need to communicate with each other. Therefore, for successful communication they need to follow a protocol and to make this happen we are using XMPP. Where our device can send data to the server and other device, which is phone, can read data from server

III. Implementation

3.1 Knowing the Each Part of the Paper

We have divided our paper in three parts to follow that architecture, those are:

- Hardware
- Manage Data in Server site
- Develop Application for Smart Phone

3.2 Hardware

Here we have developed a device for detecting human heart rate. For that, we need a sensor, which can detect human heart rate. To support that sensor, we need to connect it with Arduino, and we need an ESP8266 Wi-Fi module to connect our device with internet

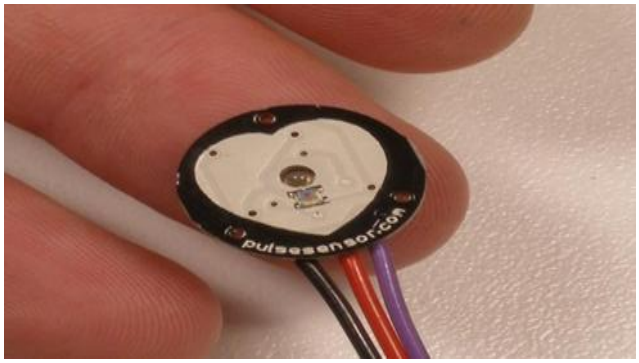

Figure 3: Pulse Sensor

Pulse Sensor is a well-designed plug-and-play heart-rate sensor for Arduino. Students, artists, athletes, makers, and game & mobile developers who want to easily incorporate live heart rate data into their papers can use it. The sensor clips onto a fingertip or earlobe and plugs right into Arduino.

3.3 How the Pulse Sensor Works

The front of the sensor is the pretty side with the Heart logo. This side makes contact with the skin. On the front, we see a small round hole, which is where the LED shines through from the back, and there is a little square just under the LED. The square is an ambient light sensor, exactly as the one used in cellphones, 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. The other side of the sensor is where the rest of the parts are mounted. We put them there so they would not get in the way of the sensor on the front. Even the LED we are using is a reverse mount LED.

The cable is a 24” flat color-coded ribbon cable with 3 male header connectors.

RED wire = +3V to +5V
BLACK wire = GND
PURPLE wire = Signal;

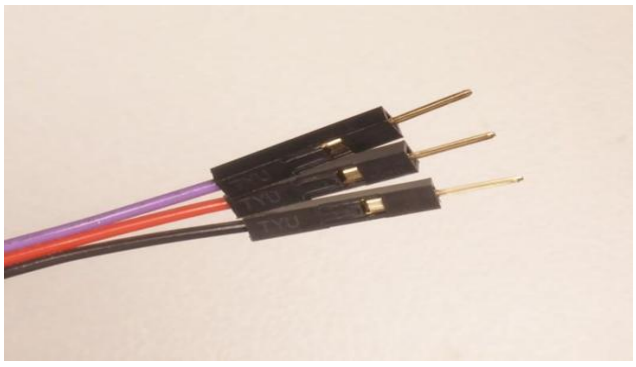

Figure 4: Pulse Sensor Pin Out

The Pulse Sensor can be connected to Arduino, or plugged into a breadboard. Before we get it up and running, we need to protect the exposed circuitry so you can get a reliable heartbeat signal.

3.4 Arduino

We are using Arduino Mega to connect our pulse sensor and Esp8266 Wi-Fi module. The Mega 2560 is a microcontroller board based on the ATmega2560. It has 54 digital input/output pins (of which 15 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to- DC adapter or battery to get started. The Mega 2560 board is compatible with most shields designed for the Uno and the former boards Duemilanove or Diecimila.

Figure 5: Arduino Mega

3.5 ESP8266 Wi-Fi Module

ESP8266 Wi-Fi module is used to connect our device with internet. This is very important part in our paper. Because without this thing we could not able to send our data to server.

Figure 6: ESP8266 Wi-Fi Module

ESP8266 is an impressive, low cost Wi-Fi module suitable for adding Wi-Fi functionality to an existing microcontroller paper via a UART serial connection. The module can even be reprogrammed to act as a standalone Wi-Fi connected device just need to add power. The feature list is impressive and includes: 802.11 b/g/n protocol Wi-Fi Direct (P2P), soft-AP Integrated TCP/IP protocol stack.

The hardware connections required to connect to the ESP8266 module are fairly straight-forward but there are a couple of important items to note related to power: The ESP8266 requires 3.3V power–do not power it with 5 volts! The ESP8266 needs to communicate via serial at 3.3V and does not have 5V tolerant inputs, so we need level conversion to communicate with a 5V microcontroller like most Arduinos use.

3.6 Liquid Crystal Display

This will help us to read data from that device that means it will show us heart rate value in its display.

Figure 7: Liquid Crystal Display

Figure 8: Installation of smart health measurement system.

3.7 IOT Platforms analysis for building projects

Cloud IoT platforms provides several kinds of services that can be very useful in building IoT project:

- Cloud data store data
- Event logic
- Platforms integration

Cloud data store enables developers to store data sent from different board (like Arduino or Raspberry); for example, it is possible to store values read from a sensor. This information can be visualized using a graph or analyzed with other tools.

Event logic is web-based programming logic that can be used to trigger some action when an event occurs. Using this kind of platforms is possible to implement some "business logic" using just a web interface without knowing much about the board we are using for the project. Usually, the logic is like IF-THEN, for examples if an event occurs then do this action. An event can be a signal read from a sensor and the action can be an email or a SMS. Platforms integration is a set of "adapters" that implements specific protocol so that it is possible without writing a line of code mix different internet services to make a chain of actions. For example, using Arduino with Ethernet shield is possible to send an alert via SMS when a value read from a sensor is higher than a threshold level

Devices must communicate with each other (D2D). Device data then must be collected and sent to the server infrastructure (D2S). That server infrastructure has to share device data (S2S), possibly providing it back to devices, to analysis programs, or to people. From 30,000 feet, the protocols can be described in this framework as:

3.8 XMPP

XMPP originally called "Jabber." It was developed for instant messaging (IM) to connect people to other people via text messages. XMPP stands for Extensible Messaging and Presence Protocol. Again, the name belies the targeted use: presence, meaning people are intimately involved. XMPP uses the XML text format as its native type, making person-to-person communications natural. Like MQTT, it runs over TCP, or perhaps over HTTP on top of TCP. Its key strength is a name@domain.com-addressing scheme that helps connect the needles in the huge Internet haystack

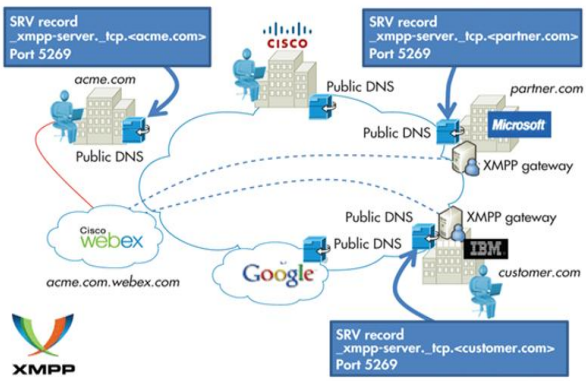

Figure 9: The Extensible Messaging and Presence Protocol (XMPP)

Figure 9 The Extensible Messaging and Presence Protocol (XMPP) provides text communication between points. In the IoT context, XMPP offers an easy way to address a device. This is especially handy if that data is going between distant, mostly unrelated points, just like the person-to-person case. It's not designed to be fast. In fact, most implementations use polling, or checking for updates only on demand. A protocol called BOSH (Bidirectional streams over Synchronous HTTP) lets severs push messages. However, "real time" to XMPP is on human scales, measured in seconds.

XMPP provides a great way, for instance, to connect your home thermostat to a Web server so you can access it from your phone. Its strengths in addressing, security, and scalability make it ideal for consumer-oriented IoT applications.

3.9 Develop Application for Smart Phone

We have developed a mobile application, which can give user a proper suggestion about how to maintain a proper diet chart during their meals. By using this, user can also see their heart rate information. This application can be used by anyone, mainly heart patients, his or her relatives and doctors. By using this, they can monitor their relatives and patients. At first user need to complete registration process where they need to provide their personal information. To configure that device for user, we need their username. Based on their username data will be stored in the database table.

By this application, WE need to provide some service to our user. At first user will send their heart rate data to a server. Therefore, WE need those data to make a meaningful suggestion. For that, WE need to fetch all heart rate data from database for a specific user to show him/her some suggestion. Data will be processed in our application that means which kind of message WE need to provide to a specific user; this decision will make in this application based on user heart rate data. This application is for android device. User who has an android device only they can download and install it to their phone. Mainly there are four activities in this application.

- Login
- Registration
- Show Heart Rate data for a specific user.
- Show some suggestion based on a specific heart rate.

IV. Testing

If anyone has relatives or family members who are heart patient, they can use this application to monitor their relatives from anywhere they want. They do not need to monitor the device. They just need to fill the login form with their username, so they can get to know about the condition of their relatives or family members. Device only need for a patient who can send his/her hear rate data to the server.

Figure 10: Screen Shot of Android Applications.

In our paper, we need to send our data to a server. To manage those data, we need to use a database where WE can store our data.
When a user hit the server from a device, that means the device is sending get request to the server. By sending this request user stored their heart rate data in database table. From that device this URL request will be sending;
http://localhost:8080/OurHeartRate/PatientPulse.php?beats=100

Phone	Time	PulseRate	id
01818532013	2016-05-03 11:56:49	116	34
01818532013	2016-05-03 11:56:46	116	33
01818532013	2016-05-03 11:44:16	116	32
01818532013	2016-05-03 11:40:44	116	31
01818532013	2016-05-03 11:34:01	116	30
01823105205	2016-05-03 11:29:43	116	29
01823105205	2016-05-03 11:25:54	115	28

Figure 11: Patient Pulse info table

So, if we see that URL, we can see we are sending GET request to a server, when we send this request a PHP file, which called PatientPulse.php is hit. In this file, there is some PHP code, which will help the device to store data in database table. After storing heart rate, data in database table user need to see those data to get more information about their heart rate. We are trying to give them a suggestion how to maintain a proper diet chart during their meal. Therefore, when they need that information, they need to use our application, which can give them that information. To manage this service a user, need to complete a registration process by which they can store their personal information in database table. For registration process user will send post to "http://localhost:8080/OurHeartRate/registration.php" this is the post request where user can store their personal information in database table. Here we can see a registration.php, in that file there is some php code which will help to store user personal information.

Name	Email	Phone	Age	Password	Id
Asadujjaman	asadujjamandm@gmail.com	01823105205	21	dm123456	1
shohan	as a Dunham and me gmail.com	01925137880	23	dm123456	2
asad	asa@gmail.com	+8801881532013	23	dm123456	3
asad	asad@gmail.com	+8801818532013	23	dm123456	4
asad	asad@gmai.com	+880818532013	23	dm123456	5

Figure 12: Patient Info Table

Previously we told that user need to see their heart rate information, for this firstly they need to login by using their username and password. For login, we also send post request in server. If username and password is valid user then can see their heart rate information.

"http://localhost:8080/OurHeartRate/login.php" this is the post request; when user try to login in our application this request URL is send by them. Here we can see a login.php file which can help user to login in our application, if he/she gives valid username or password.

V. Conclusion and Future Work

Nowadays Internet became more popular thing. Without this we cannot live a single day. Internet is continuously changing our life style. Internet now crossed its boundary and changed the concept, nowadays internet is not only connecting people it also connecting things/devices. Where devices can communicate with each other through internet.

This new concept of internet of things covers a wide area, where anyone can take part by making different kind of paper. For communication, devices need sensors. Various kinds of sensors can help people to make different kind of paper in IoT.

Therefore, we were trying to implement this new concept in our paper. We tried making this simple by using IoT concept. In our country, the total number of Internet subscribers has reached 61.288 million at the end of March 2016. That means smartphone user is also increasing day by day in our country. Therefore, this is the best time to change the idea about using internet in our country. Bangladesh is a developing country; most of the people in our country are not so rich. Therefore, they are not able to pay high amount

for any kind of technology, which will help them to lead a healthy life style. Therefore, our intension was clear; we were trying to develop a device for them, which is not so expensive. By using this device, We hope they will get some benefit. People became more and more dependent on technology. This technology can able to change human thought and life style. In our daily life, we are attached with technology. IoT will change human life style in near future. Because this new concept has a wide area. People in Bangladesh are not so health conscious. Therefore, we tried to provide them an online service based on IoT. In our paper, we will provide a service to our user by a mobile application; we know this is not enough to serve our user. If we want to guide them in proper way, we need to help form hospital. Initially there is no sector for hospitals or medicals to control our service. Where they can serve their patients directly. To create more opportunity for patients and hospitals, we need to involve the hospital's helps. Where they can monitor their patient more effectively.

In our paper, there are some limitations for user. We did not give them any option to change their Wi-Fi SSID or Password. They have to use default SSID and password, which will be configured, in that device, and before using that device, they need to ensure that they are in same SSID network, or they can open hotspot from their mobile or any other device by using the default SSID and Password. The device then connects with internet if matching SSID and password is found. To give them proper suggestion we need more time to make decision. Initially we could not be able to give them a best service. To ensure a good service we need to analyze their data more and more.

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