MQTT BASED HEALTHCARE ANALYTICS

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Abstract - In this paper I have explained about "Health Care Analytics using MQTT Protocol", application is very useful to monitoring patient health condition. In this system we have used high performance PI which is continuously updating to server by using MQTT (Message Queue Telemetry Transfer) protocol [1] where we can see high speed data transfer with best M2M connection. To design a system which enables continuous health monitoring of patient and frequent updating to hospital server, this notifies the care taker and doctor to take necessary action. It also provides enormous sensor record to compare current and previous health condition.

Keywords - *Anomaly detection; M-health; IoT; Health monitoring; Analytics, MQTT protocol.*

I. INTRODUCTION

From the past few decades, at some remote areas the peoples die, with the lack of regular treatment, lack of availability of health monitoring devices and doctors lack of resources. Due to environmental changes made by man, who causes some chronic diseases like heart stroke, cancer, diabetes is introduced to world. Even we have enough devices in some areas due to some reasons like cost and patient data security people do not believe those electronic devices. To avoid this type of existing problem, the proposed system MQTT based health analytics devices with low cost with continuously monitoring patient parameters. The motivation to take up this project is the society is characterized by high costs for its health system and a shrinking work force due to health reasons and an aging population.

In this system we have used high performance PI which is continuously updating to server by using MQTT (Message Queue Telemetry Transfer) protocol [1] where we can see high speed data transfer with best M2M connection. To design a system which enables continuous health monitoring of patient and frequent updating to hospital server, this notifies the care taker and doctor to take necessary action. It also provides enormous sensor record to compare current and previous health condition.

II. LITERATURE SURVEY

[1]Ashrafi Akram and Kazi Masudul Alam: They have reported that how the MQTT (Message Queue Telemetry Transport) protocol is used in IOT (Internet Of Things). It is an open and heart weight publish/subscribe messing protocol, which is used for small devices and sensor constraints. The main reason for opting this protocol can be differentiated easily for its speed and less weight packet. The core elements of MQTT are clients (publisher/subscriber), servers (brokers), sessions, subscriptions and topics.

[2]David Niewolny[4], suggested a report regarding In the Internet of Things (IoT), devices gather and share information directly with each other and the cloud, making it possible to collect, record and analyse new data streams faster and more accurately.

[3]Sunil L.Rahane and Prof. Ramesh pawase [5]: This paper presents the system Architecture for smart Healthcare using Wireless Sensor Network (WSN) with GSM Module and Microcontroller. All the data sensors are attached on body of patients for collecting the analog data from wireless sensors.. The wireless sensors send this signal to base station or control room of physician.

III. IMPLEMENTATION

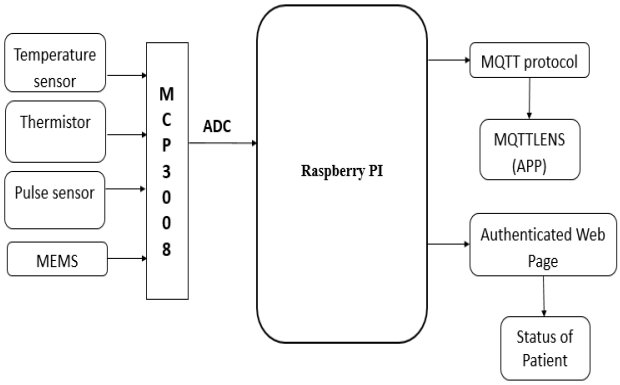


Figure 3.1 block diagram

The Figure shown above The block diagram of Human Monitoring system to Measure Body Parameters like Pulse counting sensor, Body Temperature, motion of body, Room temperature.

The above block diagram explains the hardware with input and output of the total project, Raspberry pi 3 is used which has a processing speed of 1.2 GHZ with ARMv8 BCM2837 SoC processor including in built Wi-Fi and BLE (Bluetooth Low Energy) with 1GB of RAM is used to which all the sensor i.e. Temperature sensor (LM35), Thermistor (LM370), Pulse sensor and MEMS sensor connected to MCP3008 IC to convert analog to digital value and those sensor are connected to patient for monitoring his health condition. This all data will be sent to the server through

which it will be sent to the client using the MQTT protocol at the same time it is updated in a local authenticated web page.

This paper demonstrates on an approach to design a cheap, accurate and reliable device which can easily measure the heart rate of a human body health monitoring system. These devices are mostly used in hospitals and clinics but are gradually finding their way into domestic use.

As per above illustrated figure 3.1which consists some important blocks such as sensors at input stage, raspberry pi for monitoring input section and server at output stage. In first stage all sensors are connected to analog to digital convertor which gives digital data as input to raspberry pi. In monitoring section Pi has built-in SoC which plays vital role using ARM programming.

At output stage, this Pi is configured to server using MQTT protocol and the output is visualized in laptop/smart phone by accessing to that particular host name. The connection establishment has very difficult task which is explained in brief software implementation.

IV. RELATED WORK

The brief introduction of different modules used in this project is discussed below:

Raspberry Pi (ARM-11) processor:

The third generation Raspberry Pi 3 model B board is a single board powerful credit card sized computer used in several applications. By maintaining the board format, the Raspberry Pi 3 Model B has a more powerful processor which is ten times faster than that of first-generation Raspberry Pi. Additionally, it has inbuilt wireless LAN & Bluetooth connectivity making it as the best solution for most of the applications It is a low cost; credit card sized computer that can be easily connected to a computers monitor or TV and uses a regular keyboard and mouse. It is a little device that allows people of all ages to explore computing and to find out the simplest way to program in languages like Scratch and Python. It's capable of doing everything you'd expect a computer to do, from browsing the web and enjoying the high-definition video, to making spreadsheets, word-processing, and enjoying games. Moreover, the Pi has been used in a big range of digital projects. Raspberry Pi being used by most of the youngstars everywhere and every day along the globe to learn how to program and understand how computers work.

It has a power jack which feeds power supply to entire PI board through 5V adapter, here consumes 700mA of current at the rate of 3W power consumption.

The Raspberry Pi 3 has four inbuilt USB ports which provide enough connectivity for a mouse, keyboard, or anything that you feel the Raspberry Pi needs to be connected. However, if you want to add more components, you can still use a USB hub. Keep in mind that it is suggested that you use a power-driven center therefore not to overtax the onboard voltage regulator. Powering the Raspberry Pi 3 is simple, just plug any USB power supply into the micro-USB port. There's no power button that the Pi can begin to boot as soon as power is applied, to turn it off just take away power supply. The four integral USB ports can even output up to 1.2A enabling you to attach plenty of power hungry USB devices. These ports are used to interface external peripherals like mouse, keyboard etc. For Pi-1 it has only one USB port, later it became increased as two, four for Pi-2&3 respectively.

Apart from all that, the low-level peripherals on the Pi made it pleasant for hardware hacking. The 40-pin GPIO header on the Pi provides you access to 27 GPIO, UART, I2C, SPI also as 3.3 and 5V sources. The Raspberry Pi 3 Model B is the latest single-board computer from the Raspberry Pi Foundation. In this version, they've upgraded to a 1.2 GHz 64-bit quad-core ARM processor and added 802.11n Wireless LAN, Bluetooth 4.1 and Bluetooth Low Energy.

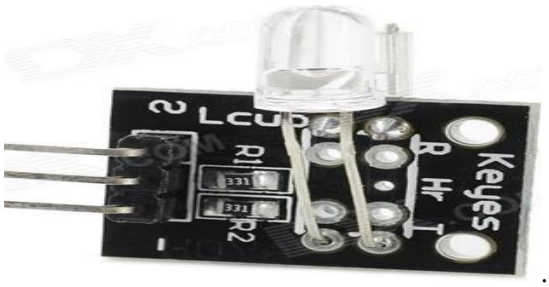
Like the previous version (the Pi 2) it has 1 GB of RAM, 4 USB ports, and full HDMI support. The Raspberry Pi 3 also has the same form factor as the Pi 2 (and Pi 1 Model B+).

The Raspberry Pi runs Raspbian and/or NOOBS (both Linux-based operating systems) which boot from the removable SD card. A host of third-party operating systems are also supported, including Ubuntu Mate, Windows 10 IoT Core, and OSMC.

The Raspberry Pi 3 is a credit-card sized computer capable of doing just about anything a desktop PC does. From web surfing and word processing, to playing Mine craft or acting as a media player, the Raspberry Pi's capabilities are extensive. With plenty of graphics processing power, the Raspberry Pi 3 is capable of streaming BluRay-quality video. If you're looking to incorporate the Pi into your next embedded design, the 0.1" spaced 40-pin GPIO header gives you access to 27 GPIO, UART, I2C, SPI as well as both 3.3V and 5V power sources.

PULSE-COUNTING SENSOR

A heartrate monitor is personal monitoring device which allows one to measure his or her heart rate in real time or record the heart rate for later study. In my project we used pulse counting sensor, as shown below



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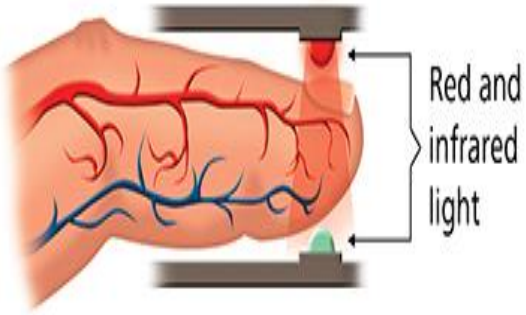
In pulse counting sensor consists of two sensors named IR and LDR. The principle of pulse counting sensor is based on the red and infrared heart absorption characteristics of oxygenated and deoxygenated hemoglobin. Oxygenated hemoglobin absorbs more infrared heart and allows more red heart to pass through. Deoxygenated (or reduced) hemoglobin absorbs more red heart and allows more infrared heart to pass through. Red heart is in the 600-750 nm wavelength heart bands. Infrared heart is in the 850-1000 nm wavelength heart band.



MOTION SENSOR (PIR):

Micro electro-mechanical system, which converts mechanical energy to electrical energy.it consists of three directions (i.e. X, Y, Z) and depends direction of movement. Mainly used in gaming with the help acceleration in it.

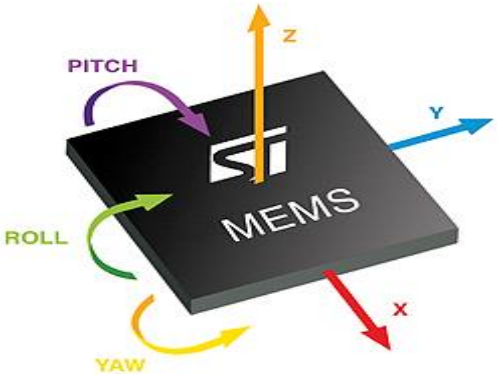


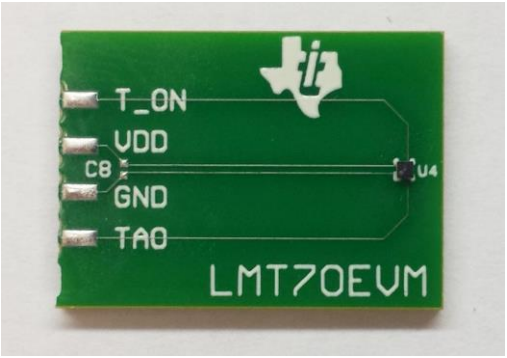
Figure: MEMS

PIR sensor detects a human being moving around within approximately 10m from the sensor. This is an average value, as the actual detection range is between 5m and 12m.PIR are fundamentally made of a pyro electric sensor, which can detect levels of infrared radiation. PIR sensors are incredible, they are flat control and minimal effort, have a wide lens range, and are simple to interface with. Most PIR sensors have a 3-pin connection at the side or bottom. One pin will be ground, another will be signal and the last pin will be power. Power is usually up to 5V.

TEMPERATURE SENSOR (LM35):

In this project, in order to monitor the temperature continuously and compare this with the set temperature pre-programmed in the microcontroller, initially this temperature value has to be read and fed to the microcontroller. This temperature value has to be sensed. Thus the sensor used in this project is LM35. It converts temperature value into electrical signals.LM35 series sensors are precision integrated-circuit temperature sensors whose output voltage is linearly proportional to the Celsius temperature. The LM35 requires no external calibration since it is internally calibrated. . The LM35 does not require any external calibration or trimming to provide typical accuracies of ±1⁄4°C at room temperature and ±3⁄4°Cover a full −55 to +150°C temperature range.

THERMISTOR SENSOR (LMT70):



Thermistors are thermally sensitive resistors whose prime function is to exhibit a large, predictable and precise change

in electrical resistance when subjected to a corresponding change in body temperature. Negative Temperature Coefficient (NTC) thermistors exhibit a decrease in electrical resistance when subjected to an increase in body temperature and Positive Temperature Coefficient (PTC) thermistors exhibit an increase in electrical resistance when subjected to an increase in body temperature. Thermistors capable of operating over the temperature range of -100° to over +600° Fahrenheit.

A/D CONVERTOR (MCP3202/4):

Analog-to-digital converters are among the most widely used devices for data acquisition. Digital systems use binary values, but in the physical world everything is continuous i.e., analog values. Temperature, pressure (wind or liquid), humidity and velocity are the physical analog quantities. These physical quantities are to be converted into digital values for further processing. In our project we used mcp3202.

CONFIGURE RASPBERRYPI

Figure Pi Configuration

When Raspberry Pi boots interestingly you'll have to design a couple of things. You'll know it's prepared for you when you see a Raspi-config window with a really enormous rundown of settings. You can upset the others in the event that you feel so slanted, yet the main thing you truly need to do is extend the record framework so you can go through all the space on your SD card. To do as such, take after these means

1. Select expand_rootfs (the second choice) and press enter
2. Confirm that you need to grow the record framework and let Raspbian do its thing.
3. When you're come back to the arrangement list, go the distance to the base and select the Finish alternative.
4. It'll inquire as to whether you need to reboot. Pick yes. Your Raspberry Pi will reboot and take a little longer this time since it needs to extend the record framework.

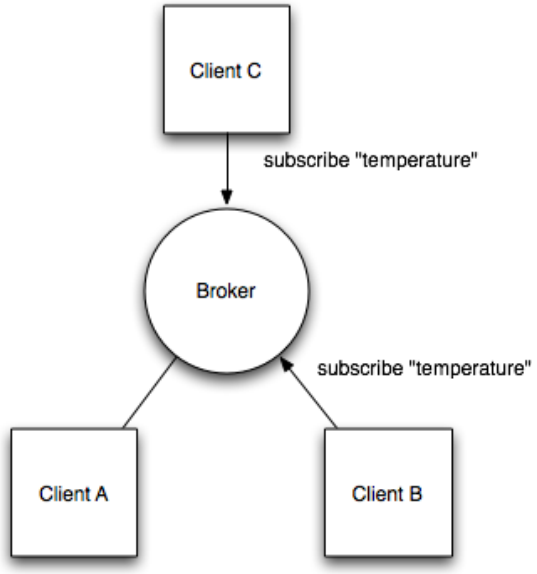
Following an about a moment you'll be made a request to sign in. You'll have to utilize the default username and secret word:

Username: pi

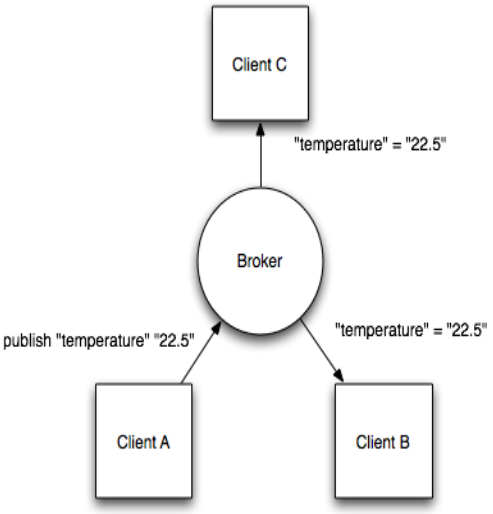
Password: raspberry

ARCHITECTURE OF MQTT:

MQTT has a client/server model, where every sensor is a client and connects to a server, known as a broker, over TCP.MQTT is message oriented. Every message is a discrete chunk of data, opaque to the broker. Every message is published to an address, known as a topic. Clients may subscribe to multiple topics. Every client subscribed to a topic receives every message published to the topic.

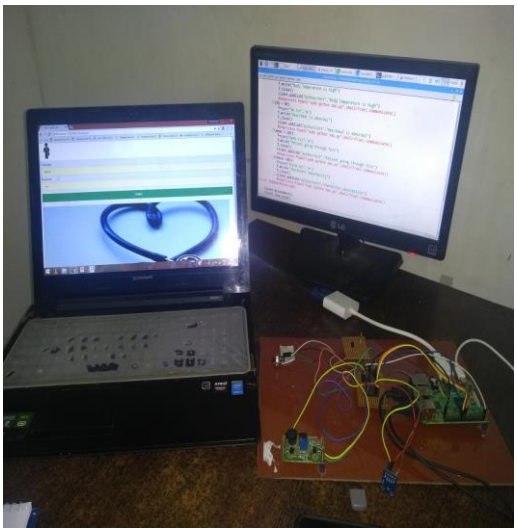


At a later time, Client A publishes a value of 22.5 for topic temperature. The broker forwards the message to all subscribed clients.

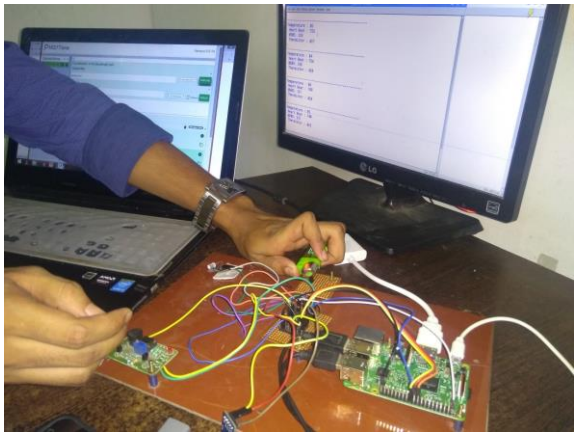


The publisher subscriber model allows MQTT clients to communicate one-to-one, one-to-many and many-to-one.

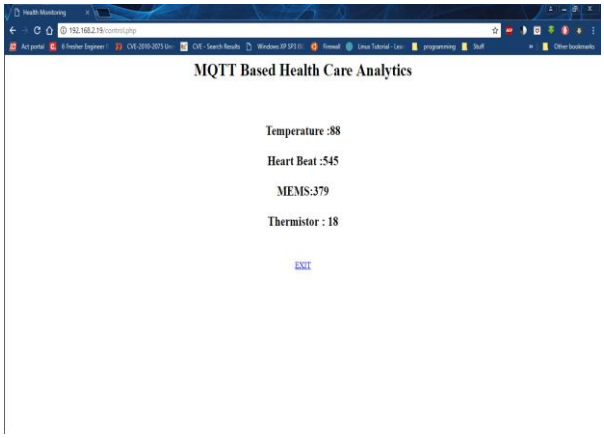
V. RESULTS AND DISCUSSION:



The above figure illustrates about overview of hardware setup and login page of patient with mqtt server.



In the above figure as all sensors are connected to patient.



The above figure explains about patient health status on MQTT server page.

VI. CONCLUSION:

The existing model presents an Integrating feature of all the hardware components which has been used and developed in it with Arm-11 Raspberry pi processor. The Presence of each and every module has been reasoned out and placed very carefully.Using highly advanced IC's like Broadcom BCM2387 chips.et, 1.2GHz Quad-core ARM cortex-A53 (64Bit) processor, Linux OS technology with the help of growing technology. Thus the project has been successfully designed and tested.

VII. FUTURESCOPE:

In future we will implement this system by reducing complexity in circuitry design and manufacturing all sensors on one board.

ACKNOWLEDGEMENT

We would like to thank all the authors of different research papers referred during writing this paper. It was very knowledge gaining and helpful for the further research to be done in future.

VIII. REFERENCES

[1]. Ala Al-Fuqaha, Senior Member, IEEE, Mohsen Guizani, Fellow, IEEE, "Internet of Things: A Survey on Enabling Technologies, Protocols, and Applications. IEEE Wireless Commun, 2015, Vol. 17, No. 4,pp-2347-2375 .

[2]. Liu Y, "The Design and Implementation of a Virtual Medical Centre for Patient Home Care", 20th IEEE Annual International Conference of Engineering in Medicine and Biology Society, Vol. 3, pp. 1163-1165, Hong Kong, 1998.

[3]. Ashrafi Akram and Kazi Masudul Alam, "A Survey on MQTT Protocol for the Internet of Things",Case study, Dept. of Computer Science and Engineering (CSE) , Khulna University, 9208, Bangladesh.

[4]. David Niewolny, Healthcare Segment Manager, Freescale Semiconductor, How the Internet of Things Is Revolutionizing Healthcare, freescale.com/healthcare, https://www.nxp.com/docs/en/white-paper/IOTREVHEALCARWP.pdf

[5]. Sunil L. Rahane , Prof. Ramesh S. "A Healthcare Monitoring System Using Wireless Sensor Network with GSM", International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, ISSN : 2278 – 8875, Vol. 4, Issue 7, July 2015.

[6]. Kaleem Ullah, MunamAli,"Effective Ways to Use Internet of Things in the Field of Medical and Smart Health Care", 2015 International Conference on Identification, Information, and Knowledge in the Internet of Things, 978-1-4673-8753-8/16/ ,2016 IEEE.

[7]. Sneha N. Malokar and Samadhan D. Mali, "A IoT Based Health Care Monitoring System", International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, ISSN: 2278 – 8875 Vol. 6, Issue 6, June 2017.