QALAAI ZANIST JOURNAL
A Scientific Quarterly Refereed Journal Issued by Lebanese French University – Erbil – Kurdistan – Iraq
Vol. (2), No. (2), April 2017
Speical Issue : The 1st International Conference on Information Technology (ICoIT'17)
ISSN 2518-6566 (Online) - ISSN 2518-6558 (Print)

Internet of Things Based Cloud Smart Monitoring for Asthma Patient

Tabarek G. AL-Jaf
Networks Engineering Department, College of Information Engineering, Al-Nahrain University – Baghdad - Iraq
tabarekaljaaf@yahoo.com
Emad H. Al-Hemiary
Networks Engineering Department, College of Information Engineering, Al-Nahrain University – Baghdad - Iraq
emad@coie-nahrain.edu.iq

ARTICLE INFO

Article History:

Received: 20 March 2017

Accepted: 1 April 2017

Published: 10 April 2017

DOI:

10.25212/lfu.qzj.2.2.36

Keywords: *Internet of Things, IoT, Asthma monitoring system, IoT-Cloud-HTTP*

ABSTRACT

The Internet of Things (IoT) is becoming the sinew of today and future technology. It can be exploited to make life much easier for human beings by taking the advantage that they have their own smart devices connected to the Internet. From this perspective, many society related issues like chronic diseases can be solved. In this paper, an IoT based remote monitoring for Asthma patients is designed and implemented. The work is initiated with a survey on Asthma chronic disease by asking specialists in this field then discussing how to monitor and control it using IoT technology. The prototype IoT Asthma monitoring system consists of a heart pulse sensor controlled by ESP8266. The data collected from the sensor is passed wirelessly to the ESP8266 in real time which in turn is send to the cloud using HTTP protocol. In the cloud, a MySQL database is used to store the received readings. The monitoring facility; hospital, doctor or person can browse the webpage written in PHP to monitor live update of patient condition. The work includes simulation of the network using packet tracer to verify its operation.

1. INTRODUCTION

IoT connects everything together via Internet using sensors, network devices, communication, and software. Internet of things includes many applications cover whole life fields offer a cloud storage which is used to expand the availability of data transferring. It aims to create smart vision of living. With smart network among devices in lower cost, power with highest security and scalability, the core of this technology is to connect the virtual reality with physical world this technology represents the revolution of information technology to have infinite opportunities of impacts and all these benefits help to build smart planet [1]. IoT can be embedded in all aspects of life like 'Smart Home', it includes the ways that controls the environment of the place of living like the lighting,

QALAAI ZANIST JOURNAL
A Scientific Quarterly Refereed Journal Issued by Lebanese French University – Erbil – Kurdistan – Iraq
Vol. (2), No. (2), April 2017
Speical Issue : The 1st International Conference on Information Technology (ICoIT'17)
ISSN 2518-6566 (Online) - ISSN 2518-6558 (Print)

temperature, home privacy and security this technology can also go wider to the large environment like cities including sensors for water and gas management, smart garages, roads, traffics and street lighting as well as mobility these controlled sensors all embedded in 'Smart City' that manage the quality of life (QoL) [2] and for healthcare field there's also sensors works to evaluate the health of bodies like pulse sensor, blood sensor which is represented by wearable devices or in other way as tablets. IoT uses real time transmitting protocols which is the main challenge to enable real-time transferring information to create smart system connect a huge network of devices through internet along with the security feature [3]. There are many protocols that work with the IoT such as MQTT (Message Queuing Telemetry Transport), CoAP (Constrained Application Protocol), XMPP (Extensible Messaging and Presence Protocol), AMQP (Advanced Message Queuing Protocol) and HTTP (Hyper Text Transmission Protocol) and knowing the right type of protocol is the first design requirements. Today the cloud also become in the top of requirements to build IoT systems for hosting the data and remotely managing the device everywhere, it is working as database that contains millions of members to deal with daily. IoT applications gain data from enormous resources sensors connecting between different materials and upload them to the cloud. The cloud computing deals with the application layer as an important layer because it's working to process and analyze the data. IoT devices are rapidly increasing and this will lead to the 'Big Data' concept where huge amount of data need to be processed and analyzed [4,5,6]. In this work, IoT is used to monitor Asmtha patients by sensing their heart beat behaviour and send the recorded pulse counts to the Cloud. The hospital, doctor, or patient relatives can continuously monitor his state and a feedback can be send to the sensor to increase recording rate. The rest of the paper is organized as follows: section 2 gives related researches, section 3 presents the system model, section 4 and 5 discuss problems and challenges accompany system implementation while section 6 state the related references.

2. LITERATURE REVIEW

In [7], the authors present a Module based on ArduinoUNO with GSM shield to connect to the Internet and send an SMS remotely over the GSM network to the user Mobile phone by using GSM library to have a connection with the shield without using cloud database to save the reports of the patient in order to review and diagnosis the patient case. The work in [8] proposed healthcare system based on IoT and using Arduino UNO platform to read sensor data and send it to PC platform then processed with an application to display the graph of heartbeats without mention the Wi-Fi shield or other shields that it used with the Arduino to transfer collected data to the cloud also the authors did not explain how the remote user could access and monitor the information from the cloud but display the heartbeats senses on the local machine. In this paper [9] the authors use architecture of local server to detect arrhythmia via ECG signal without describing how will be notified the medical experts in emergent case, so in this paper the data will be send through the Internet to remote server and there is a website to allow access by authentication person or medical experts to monitor the patient case as well as the notification send via SMS in abnormal case. Finally, this paper [10] describes machine-to-machine M2M connection on local cloud platform to transfer data to and from local environment while M2M connection can be accrued through WAN environment.

QALAAI ZANIST JOURNAL
A Scientific Quarterly Refereed Journal Issued by Lebanese French University – Erbil – Kurdistan – Iraq
Vol. (2), No. (2), April 2017
Speical Issue : The 1st International Conference on Information Technology (ICoIT'17)
ISSN 2518-6566 (Online) - ISSN 2518-6558 (Print)

3. SYSTEM MODEL

According to physicians and references related to Asthma patients, heart rate beats increases rapidly when the patient suffers from symptoms of breathing difficulties. Therefore, the decision to use heart beat sensor to monitor heart beat rate. The proposed network design is devided into three layers: Embedded, gateway, and cloud layers and they are explained in the following sections with the aid of figure 1:

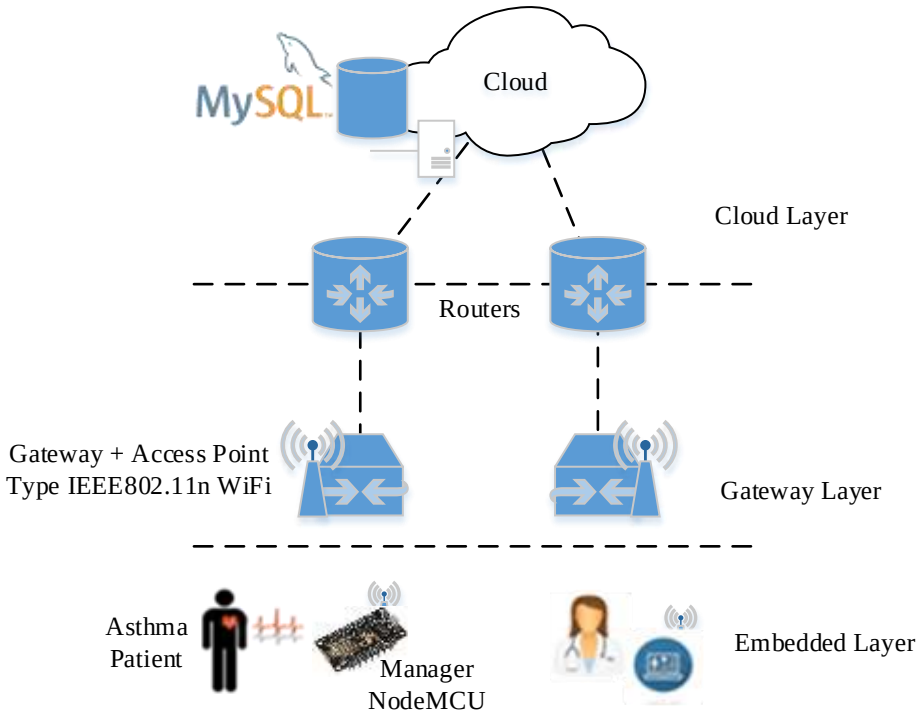

FIGURE 1. IoT based Cloud layering model

3.1 EMBEDDED LAYER

This layer includes the end-users (patient and doctor) the first one has wearable device including pulse sensor used to read the heartbeat rate and send them through the other layers to the destination (Doctor) for monitering the patient status to make decisions. As stated before, the pulse reads the patient heart beat rate continuously and periodically each *t* seconds configured in the microcontroller software of NodeMCU 'esp8266'. The NodeMCU 'esp8266' microcontroller board equipped with a low cost Wi-Fi module to enable wireless connection to a nearby access point type IEEE802.11n WiFi. The interface and programming languages used are the Arduino language and Lua language [11]. As shown in figure 1, the manager (PC based software) is used to display the collected data from the sensor and send them via HTTP protocol to the Cloud to be permanently save for any future analysis. The core language used in this phase is C++.

QALAAI ZANIST JOURNAL
A Scientific Quarterly Refereed Journal Issued by Lebanese French University – Erbil – Kurdistan – Iraq
Vol. (2), No. (2), April 2017
Speical Issue : The 1st International Conference on Information Technology (ICoIT'17)
ISSN 2518-6566 (Online) - ISSN 2518-6558 (Print)

3.2 GATEWAY LAYER:

The gateway layer is a router based network which routes the traffic coming from the microcontroller to the required Cloud. It is evident that when public Cloud is used then this layer might contain single or multiple hops, and in the proposed model it is fixed to a single router.

3.3 CLOUD LAYER:

The Cloud layer is used for storing the sensor data using PHP-MySQL and allow users 'doctor or patient' to access remotely or even to mentoring the patient state from any available device. The basic step is to insert the sensor data into the database after making a successful connection using HTTP. Since the readings become old with time, an averaging process is performed to optimize the storage and prevent large amount of data in the database especially when many sensors use the same database. The monitoring person or even an auto programmed device receive heart rate values when HTTP connecting is established with the cloud and this is follow an authentication process. A live graph is displayed on the monitoring device to highlight the Asthma patient condition in real time.

The verification of IoT-Cloud network is performed using Cisco Packet Tracer as shown in figure 2. In this simulation, a sensor IoE (Internet of Everything) is used to collect sensed data and send them to the Cloud denoted by Server0 through Gateway-Router-Router1. The monitoring is done using a smartphone connected wirelessly to the cloud using wireless router.

4. PROBLEMS, CHALLENGES, AND RESULTS

Throughout this work, some problems and challenges rises and described as follows. The first challenge was the type of the sensor used to detect abnormal breathing for asthma patient. The first idea was to use a breathing sensor named MQ-9 for but then the problem was that the sensor is designed to measure the rate of gases in the air beside the position of the sensor which should be placed near the patient mouth. Therefore, the decision was to use the heartbeat pulse sensor instead which can be easily installed around the arm of the patient, as an example. The second challenge was the type of protocol to connect to the Cloud. Different protocols exists and each one has its own features. Therefore, to verify the proposed architecture, the HTTP protocol is used although other protocols gives better performance. As shown in figure 3(a), the connection to the cloud is prepared by HTTP protocol and the data is sent using HTTP GET method. The readings is continuous as long as the microcontroller is operational this is shown in figure 3(b) and (c).

QALAAI ZANIST JOURNAL
A Scientific Quarterly Refereed Journal Issued by Lebanese French University – Erbil – Kurdistan – Iraq
Vol. (2), No. (2), April 2017
Speical Issue : The 1st International Conference on Information Technology (ICoIT'17)
ISSN 2518-6566 (Online) - ISSN 2518-6558 (Print)

FIGURE 2. Network verification using Cisco Packet Tracer.

(a) (b) (c)

FIGURE 3. Sample result of sensor data store in cloud. (a) HTTP connection with GET method. (b) Sample readings of heart beat rate and (c) MySQL data insertion

5. CONCLUSION

In this paper, a proposal for healthcare system based IoT-Cloud is explained. The system monitors the Asthma patients through sensing their heartbeat rate and store them for future analysis. The use of heartbeat sensor is not optimistic but closely reflects the patient condition since the one of the main asthma symptoms is fast breathing and rapid increase in heartbeat rate. Therefore, using the heartbeat sensor is a contribution to this field as far as test results show. For future work, the system could be extended to include multiple type sensors and include another types of protocols.

QALAAI ZANIST JOURNAL
A Scientific Quarterly Refereed Journal Issued by Lebanese French University – Erbil – Kurdistan – Iraq
Vol. (2), No. (2), April 2017
Speical Issue : The 1st International Conference on Information Technology (ICoIT'17)
ISSN 2518-6566 (Online) - ISSN 2518-6558 (Print)

6. REFERENCES

[1] A. Ngu, M. Gutierrez, V. Metsis, S. Nepal, and M. Sheng, "IoT Middleware: A Survey on Issues and Enabling technologies," IEEE Internet of Things Journal, Vol. 4, Issue 4, Feb. 2017, pp. 1-20.

[2] D. Minoli, K. Sohraby, and B. Occhiogrosso, "IoT Considerations, Requirements, and Architectures for Smart Buildings – Energy Optimization and Next Generation Building Management Systems," IEEE Internet of Things Journal, Vol.4, Issue 1, Feb. 2017, pp. 269-283.

[3] D. Chen, N. Zhang, Z. Qin, X. Mao, Z. Qin, X. Shen, and X. Li. "S2M: A Lightweight Acoustic Fingerprints based Wireless Device Authentication Protocol." IEEE Access, Vol.4, Feb. 2016, pp. 766-773.

[4] Y. Sun, H. Song, A. Jara, and R. Bie, "Internet of Things and Big Data Analytics for Smart and Connected Communities" IEEE Internet of Things Journal, Vol.4, Issue 1, Feb. 2017, pp. 88-100.

[5] H. Cai, B. Xu, L. Jiang, and A. Vasilakos, "IoT-Based Big Data Storage Systems in Cloud Computing: Perspectives and Challenges," IEEE Internet of Things Journal, Vol.4, Issue 1, Feb. 2017, pp. 75-87.

[6] "Oracle: Big Data for the Enterprise - White Paper." Jun. 2013.

[7] U. S.U, O C. O and U. M. E, "Heartbeat Monitoring and Alert System Using GSM Technology," International Journal of Engineering Research and General Science, Volume 3, Issue 4, 2015, pp. 26-34.

[8] D. Singh and R. Gour, "An IoT Framework for Healthcare Monitoring Systems," Int. Journal of Computer Science and Information Security (IJCSIS), Vol. 14, No. 5, May 2016.

[9] M. Hassanalieragh, A. Page, T. Soyata, G. Sharma, M. Aktas, G. Mateos, B. Kantarci, and S. Andreescu." Health Monitoring and Management Using Internet-of-Things (IoT) Sensing with Cloud-Based Processing: Opportunities and Challenges.", *IEEE Int. Conf. on Service Computing*, July 2015.

[10] B. Anggorojati, N. Prasad, and R. Prasad, "Evaluation of secure capability-based access control in the M2M local cloud platform," *10th Int. Conf. on Telecommunication Systems Services and Applications (TSSA)*, Oct. 2016.

[11] "ESP8266 WiFi Module Quick Start Guide", [online] http://rancidbacon.com/files/kiwicon8/ESP8266_WiFi_Module_Quick_Start_Guide_v_1.0.4.pdf, (Accessed: 19 Mar. 2017).