

International Journal of Control Theory and Applications

ISSN : 0974-5572

© International Science Press

Volume 10 • Number 18 • 2017

IOT Enabled Home Automation through Nodered and MQTT

Archit Agarwal¹, Rajesh Singh¹, Anita Gehlot¹, Gautam Gupta¹ and Mohit Choudhary¹

¹ Department of Electronics Engineering, UPES, DEHRADUN, UTTARAKHAND, INDIA,
Emails: agarwal.archit14@stu.upes.ac.in, RSINGH@ddn.upes.ac.in

Abstract: In today's world the word automation seems to be very common but not practically applied to our country to an extent till yet. This breakthrough prospective can be a major part of the smart city. Most of the home automation system available in market lacks certain important features and they are object dependent and expensive. In this paper an internet of thing enabled, cost-effective home automation is developed. Unlike the conventional approach, this system make use NodeRed which is a open source tool for building internet of thing and uses visual programming through nodes to perform certain task. This system can control the outlets, various things inside the home from anywhere in the world. Every part of the home will be equipped with wireless sensor technology that will log the data to the webserver. These WSN technology will be interconnected through MQTT (Telemetry Transport) protocol which is a publish and subscribe tool to establish the communication between different devices. The third feature can revolutionize everything that is notification. User of the home will get notified through email or twitter if any uncertainty is happen. Webserver will access the home automation system through Ngrok which is a secure introspectable webhook development tool. This whole concept make it advance home automation through internet of things.

Keywords: NodeRed, MQTT, control, Data-Logging, Notification, WSN, Ngrok

1. INTRODUCTION

Home automation is the next big technological revolution that needs to be seen in the world. With the ever increasing demands of such devices, internet of things enabled homes will be grown significantly in the next five years. As this whole concept provides user home comfort and efficient home management system [1]. Due to the advances in home automation for last few years, a novel internet of things enabled home automation is developed. It aim at providing cost-effective and intelligent living environment for residents with control, data-logging and notification features [2].

The whole concept of the proposed system uses a central unit which is connected to the Wi-Fi of the home. It involves wireless sensor technology every part of the home will be treated as a node in which different sensors will be embedded according to that particular part of the home. Internet of things with machine to machine communication can visualize the physical world as a virtual one. If we want the internet of things in 50 billion network that is predicted to became in the next upcoming years then we cannot use same communication protocol [3]. In this paper MQTT (Telemetry Transport) protocol That central unit will communicate with other subsystem

consist of wireless sensor networks through MQTT protocol. Traditional Wireless Sensor Networks (WSNs) pose some limitation. To answer such limitation a new communication protocol, data-centric communication, is emerging that is MQTT [4]. It is the publish/subscribe messaging system. It makes it really easy to establish a communication between multiple devices than conventional methods. So now all subsystems that will place in various places across home that can be kitchen, bed-room, dining-room will equipped with WSN that will communicate to central unit wirelessly through Wi-Fi network.

Central unit will consist of raspberry pi which is a credit card-sized single-board computer. It will act as main processing unit which will connect to the home Wi-Fi. This central unit will communicate through ESP which is a Wi-Fi enabled microcontroller. Every part of the house will equipped with subsystem consists of ESP8266 connected through WI-FI. These subsystems will communicate with raspberry-pi through MQTT protocol wirelessly through Wi-Fi [6].

Our subsystem is subdivided into three concepts that is control, data-logging and notification. In control all the electrical appliances of the home will be connected to their respective subsystem [5]. These subsystem is equipped with ESP is controlled through ESP. Here ESP is connected to the raspberry through Wi-Fi. So that any electrical appliance can be controlled through web server. Web server equipped with Ngrok which secure introspectable tunnels to localhost webhook development tool and debugging tool. It can access raspberry pi from anywhere in the world. Second feature sensor data logging in this feature various sensor like temperature, light, humidity, LPG gas and motion sensor data is logged to the webserver [7]. The webserver will deploy all the sensor readings through ESP to the raspberry pi then uploaded to the webserver. So that these reading help in visualization of the home from anywhere in the world. Third feature but note the least is notification which is very important feature to establish a home automation. Threshold will be set for the sensors and electrical appliances with respective condition. So that if any reading goes beyond this threshold notification will be sent to the user through email or twitter [8].

API and Graphical user interface is developed by NodeRed which is a powerful open source tool for building Internet of Things (IoT) applications [9]. Here NodeRed is use to design graphical dashboard for various home automation subsystem that can be kitchen, room, garden and garage on a single dashboard so that user can access their home from anywhere in the world.

The rest of the paper is organized as follows. Proposed embedding internal subsystem are explained in section II. Software development and Rresults are presented in section III. Concluding remarks are given in section IV.

2. INTERNAL SYSTEM HARDWARE DEVELOPMENT

2.1. Six Box Approach

Any embedded system can be correlates to this 6 box model approach. Our system too fits in this generic model. Given below how

1. Microprocessor : Raspberry Pie 3
2. Microcontroller : ESP8266
3. Communication and network : Wife booster
4. I/P devices : Sensors i.e. DHT11-Temperature sensor, PIR motion sensor, MQ-2 gas sensor, Light Dependent Resistor (LDR)
5. O/P devices: Electrical appliances i.e. lamps, outlets, buzzer
6. HOST : Internet server
7. Power supply : Buck and boost power supply

2.2. Block Diagram of Entire System

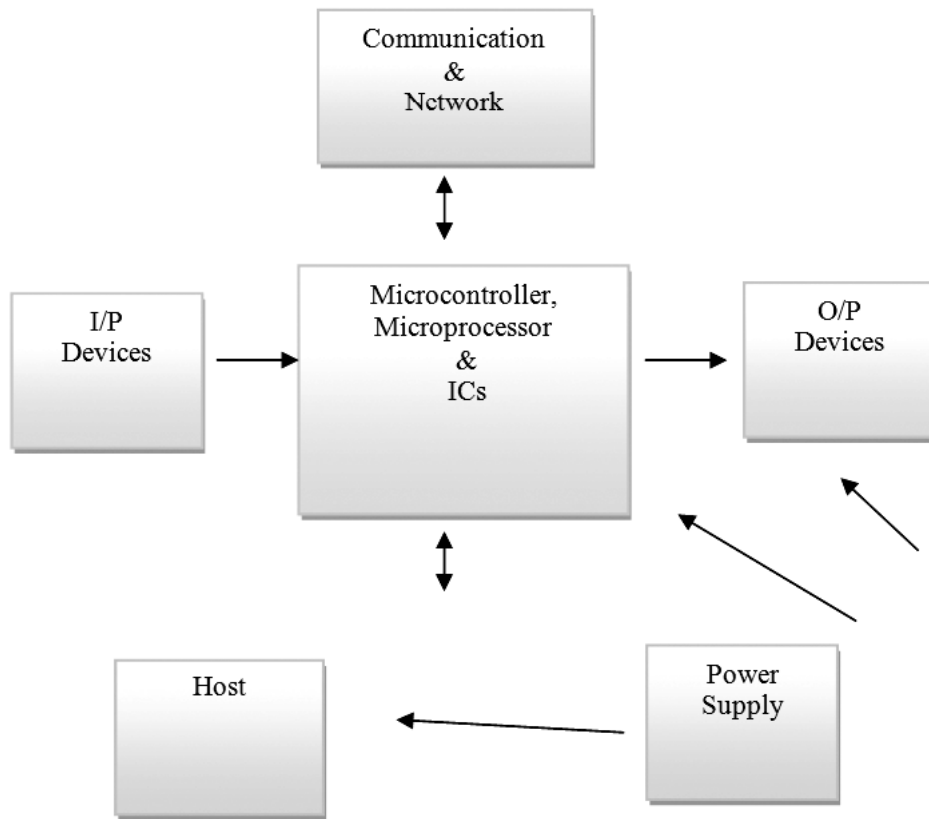
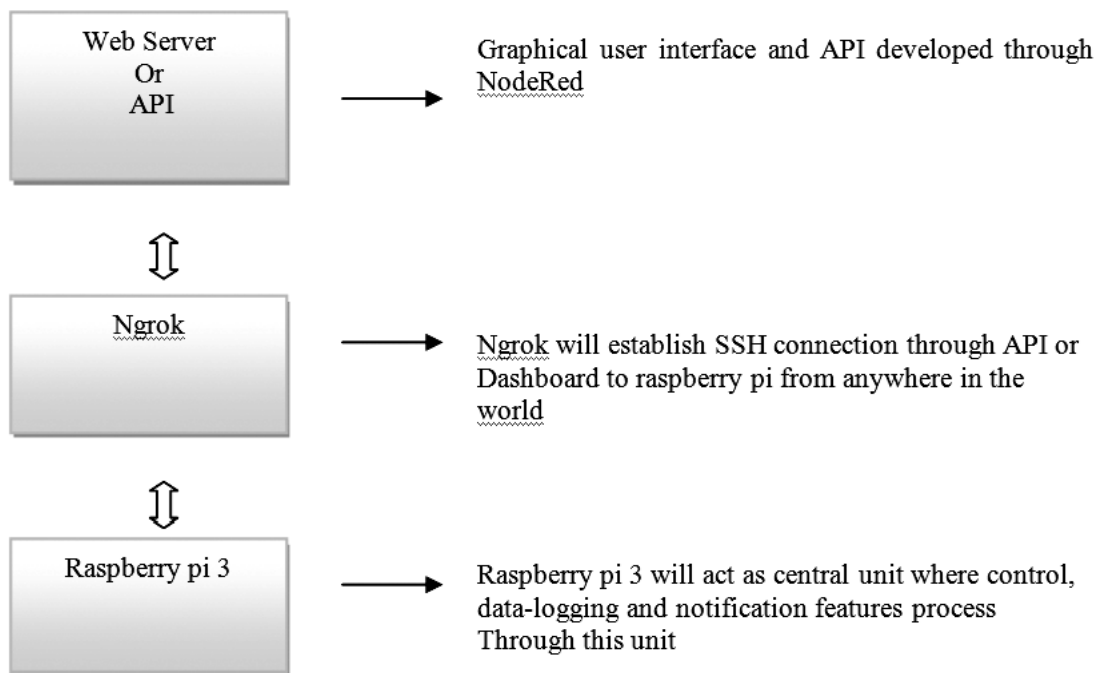


Figure 1: Six box approach model



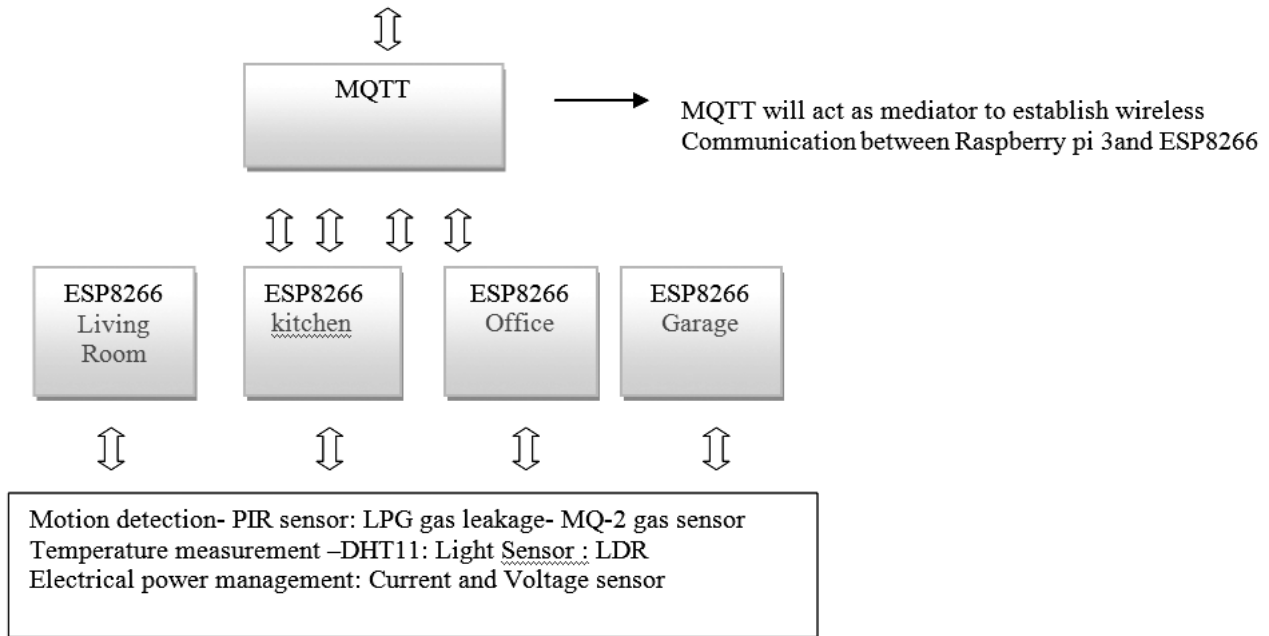


Figure 2: Block Diagram of the concept

Above depicted Fig:1 and Fig:2 clears the whole concept of the proposed system. Any IOT based system can be designed through this concept. Here raspberry pi is acting as central unit where all the sensor data is processes. This respective sensor according to their task is interfaced with ESPs which through MQTT protocol communicate to raspberry pi wirelessly through Wi-Fi. All three concept of control, data-logging and notification can be access through API or graphical user interface or dashboard from anywhere in the world. Ngrok is establishing communication to raspberry pi through SSH from anywhere in the world after authenticating the user.

3. SOFTWARE DEVELOPMENT AND RESULTS

To make use node-red first it should be installed in the Raspberry pi. Raspberry pi firmware can Rasbian Jessie with pixel or lite. Below are the commands to download node-red:

```
pi@raspberrypi:~$ sudo apt-get update && sudo apt-get upgrade
pi@raspberrypi:~$ sudo apt-get install nodered
pi@raspberrypi:~$ sudo systemctl enable nodered.service
pi@raspberrypi:~$ sudo reboot
```

Now node-red is install in raspberry then open the browser enter this `http://YOUR_RPi_IP_ADDRESS:1880` it will open the application where we can design graphical user interface and dashboard according to our system requirement.

To make MQTT enable in the raspberry pi it should be install before proceeding further Below are the steps to download and enable MQTT communication.

```
pi@raspberrypi:~$ wget http://repo.mosquitto.org/debian/mosquitto-repo.gpg.key
pi@raspberrypi:~$ sudo apt-key add mosquitto-repo.gpg.key
pi@raspberrypi:~/etc/apt/sources.list.d$ sudo wget http://repo.mosquitto.org/debian/mosquitto-jessie.list
```

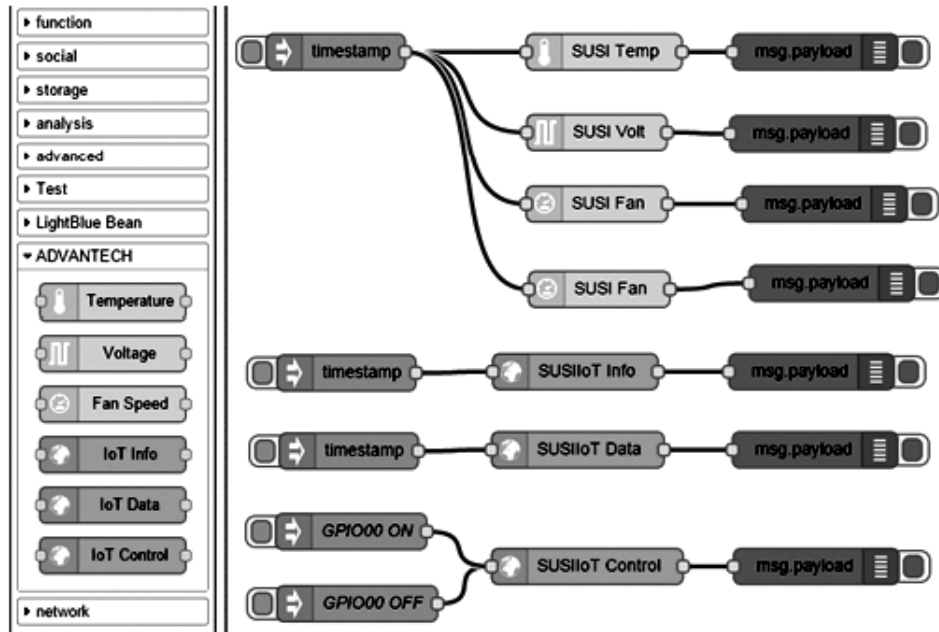


Figure 3: NodeRed application overview

```
pi@raspberrypi:/etc/apt/sources.list.d $ cd
```

```
pi@raspberrypi:~ $ sudo apt-get update
```

```
pi@raspberrypi:~ $ mosquitto -v
```

After installing MQTT in raspberry pi app or dashboard can be designed for the home automation

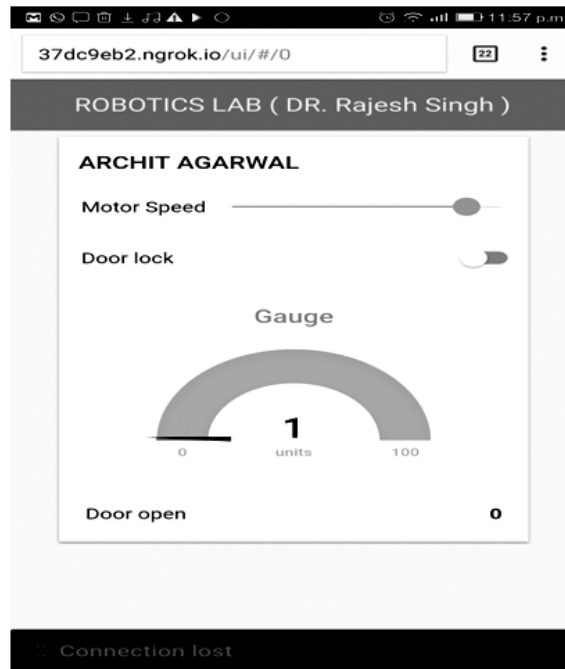


Figure 4: Sample dashboard designed for U.P.E.S robotics Lab can control door lock and Vary the speed of the motor

4. CONCLUSION

A revolutionary system is developed that can change the entire software architecture of current home automation system available in the market. This system is not only uses advance protocol MQTT and visual programming NodeRed but a reliable and efficient internet of things enabled home automation system. It gives the feasibility to change graphical dashboard according to the system requirement. This system can be visualize as overall three system that is controlling the outlets, logging sensor data over web server and notification through email or twitter. All these features can be access through webserver from anywhere in the world. Ngrok help to access raspberrypi remotely and establish SSH communication. So a advance IOT enabled home automation is presented in this paper through NodeRed and MQTT.

REFERENCES

- [1] Kunho Hong, SuKyoung Lee, Kyoungwoo Lee, Performance improvement in ZigBee-based home networks with coexisting WLANs, *Pervasive and Mobile Computing*, v.19 n.C, p.156-166, May 2015
- [2] Shushan Hu, Feng Liu, Cunchen Tang, Xiaojun Wang, A flexible and robust wireless home network structure, *International Journal of Sensor Networks*, v.21 n.2, p.116-126, January 2016
- [3] Collina, Matteo, Giovanni Emanuele Corazza, and Alessandro Vanelli-Coralli. "Introducing the QEST broker: Scaling the IoT by bridging MQTT and REST." 2012 IEEE 23rd International Symposium on Personal, Indoor and Mobile Radio Communications-(PIMRC). IEEE, 2012.
- [4] Hunkeler, Urs, Hong Linh Truong, and Andy Stanford-Clark. "MQTT-S—A publish/subscribe protocol for Wireless Sensor Networks." *Communication systems software and middleware and workshops*, 2008. comsware 2008. 3rd international conference on. IEEE, 2008.
- [5] Gomez, Carles, and Josep Paradells. "Wireless home automation networks: A survey of architectures and technologies." *IEEE Communications Magazine* 48.6 (2010): 92-101.
- [6] Molloy, Derek. "Wireless Communication and Control." *Exploring Raspberry Pi* (2016): 535-575.
- [7] Das, Aditya N., et al. "Data-logging and supervisory control in wireless sensor networks." *International Journal of Sensor Networks* 6.1 (2009): 13-27. Kundur D., Hatzinakos D., Towards robust logo watermarking using multiresolution image fusion, *IEEE Transactions on Multimedia* 6 (2004) 185-197.
- [8] Chowdhury, N., S. Nooman, and Srijon Sarker. "Access Control of Door and Home Security by Raspberry Pi Through Internet." *Int. J. Sci. Eng. Res* 4 (2013): 550-558.
- [9] Olsson, Joel, and Junior Asante. "Using Node-Red to Connect Patient, Staff and Medical Equipment." (2016). P. Tay and J. Havlicek, "Image Watermarking Using Wavelets", in *Proceedings of the 2002 IEEE*, pp. II.258 – II.261, 2002.