International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 05 Issue: 05 | May-2018 www.irjet.net p-ISSN: 2395-0072

Home Automation System Using WeMos D1 Mini

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Abstract - *The Internet of Things (IoT) based home automation system, aims to control all the devices of the smart homes through Internet protocols and an MQTT server. The concept of home automation to bring the control of operating your everyday home appliances, and making them automatic, thus giving better energy conservation, with optimum use of energy. This system consists of a MQTT server, light, motion, touch sensors and a mobile application. Information collected from the mobile application will be sent to the MQTT server periodically. Necessary action will be taken on the basis of the data collected. A user can have multiple houses and the application has the option to have remote connectivity for multiple houses. The system aims to design a smart home with which the user can control home appliances remotely.*

Key Words: **Home Automation, Internet of Things, WeMos D1 Mini, MQTT, Android Application**

1. INTRODUCTION

In today's world, Broadband Internet is widely available, and so is Wi-Fi. More and more devices are getting Internet connectivity built into them, along with the use of sensors. Also, the cost of connectivity is decreasing. All these factors merge into providing a better platform for IoT i.e. Internet of Things. Internet of Things basically refers to the ability of network devices to sense and collect data from the surroundings, send it to the Internet, where it gets processed and hence put to use for various purposes. It allows a plethora of devices to be connected to each other like smart phones, tablets, computers, sensors, etc. which can be used to create a smart system that service our basic needs such as environment and health.

Home automation is a method to seamlessly control various home appliances like lights, fans, etc. using a device like a smartphone which is extremely handy. Moreover, they can also be controlled from a remote location, a feat which cannot be achieved by ordinary remote controls.

This is beneficial for end users, especially the disabled and elderly.

Another key factor we are including is the integration of a cloud server from services such as Amazon, which enables the user to store an ample amount of data for processing and subsequent utilization. The cloud based approach provides lots of services (Infrastructure, Platform and Software) for a secure and real time approach to monitor systems from a remote location, and without the need for a large amount of memory to store data. This paper aims at proposing and therefore using an IoT cloud architecture based on two protocols, the MQTT (Message Queue Telemetry Transport) and the IFTTT (If This Then That). The publish-subscribe method and the fact that it is lightweight both work as an advantage and make MQTT highly reliable. Also, IFTTT leverages the use of the Internet to automate powerful actions.

In this paper we propose a system which enables user comfort and utility, and will subsequently create an efficient network, with security systems, which provides convenience at our fingertips.

1.1 RELATED WORK

Ayad Ghany Ismaeel and Mohammed Qasim Kamal (2017) designed system in 2 categories Hardware via device named Worldwide Auto-mobi and software to automate favourite used devices such as TV, SAT to any other devices that can control IR signal from anywhere through mobile application [1].

Lu Hou, Shaohang Zhao, Xiong Xiong, Kan Zheng, Periklis Chatzimisios, M. Shamim Hossain, and Wei Xiang (2016) provides Home Automation system using Intel Galileo that employs the integration of cloud networking, wireless communication, to provide the user with remote control within their home and store data on cloud[2].

Rutuja D. Ekatpure and Devendra Ingale (2016) designed a low cost Arduino/Android-based energy-efficient Home Automation System with smart task scheduling [3].

T. A. Abdulrahman, O. H. Isiwekpeni, N. T. Surajudeen-Bakinde, A. O. Otuoze provide simplified design protocols for developing a robust home automation system to deal with the problems of complexity and multiple incompatible standards[4].

Mohamed Abd El-Latif Mowad, Ahmed Fathy, Ahmed Hafez (2014) provides design of Smart Home automation System that is SHS includes home automation and remote monitoring, environmental monitoring, including humidity, temperature, fault tracking and management and health monitoring[5].

Ayad Ghany Ismaeel and Mohammed Qasim Kamal The limitation of the system is provision of manual control through remote device only, no automated working of system is provided.

Lu Hou, Shaohang Zhao, Xiong Xiong, Kan Zheng, Periklis Chatzimisios, M. Shamim Hossain, and Wei Xiang system becomes expensive with the use of Intel Galileo.

Mohamed Abd El-Latif Mowad, Ahmed Fathy, Ahmed Hafez has drawback of limited range since the system is constructed using Bluetooth.

This paper proposes Home Automation system using cost effective hardware and software components along with the provision of manual and automated working of the system.

2. PROPOSED SYSTEM

The architecture makes use of LDR and PIR sensors for sensing light and motion respectively. Also, a touch sensor will be deployed for the main gate. The system aims at reducing the complexity by introducing the NodeMCU (ESP8266). Along with that, it intends to achieve low cost estimation for the system, as opposed to higher costs by previous models. Also, the control of room lights from a remote location ensures minimum loss and wastage of electricity.

The application used to achieve this can be used, controlled and monitored by people of all ages. This works perfectly for the physically challenged and the elderly. This system is designed in such a way that multiple users can access the home through multiple applications. It focuses on being a lifestyle product, which aims at improving convenience. It has features like accessibility and portability which will meaningfully integrate into people's lifestyle.

The installation and subsequent usage of this system eliminates the complex rewiring, and also the overhead wiring on the wall. The application is designed in Android 5.0, a low API so that devices with higher versions will be compatible with it. The overall system aims at designing a cost-friendly smart home for the use of the general public, and will provide a comfortable lifestyle of the 21st century.

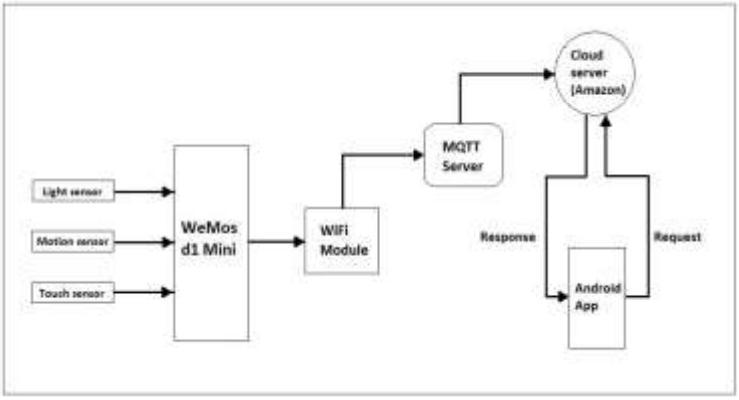

Fig -1: Proposed System Architecture

2.1 PROTOCOLS USED

A. MQTT

It stands for Message Queue Telemetry Transport. This is a lightweight publish/subscribe messaging transport, normally used where a small code footprint is required. Also, this protocol may be used where network bandwidth is at a premium. This usually happens when small devices are used, for example, in home automation. In MQTT protocol, the sender publishes a message on a particular topic, without knowledge of subscribers (receivers) and the subscribers receive messages on the topics which they have been subscribed to. Another great feature is the use of an MQTT broker, which enables one-to-many communication. It receives the messages, filters the messages, and publishes the messages to all subscribed clients. This protocol is chosen over HTTP because it promises a high delivery rate (it provides three different quality of services). Also, MQTT is 93 times faster than HTTP.

B. IFTTT

"If This Then That" protocol is a free web based service used to create chains of simple conditional statements.
This protocol is based on the changes that occur within the other web services.

For example an applet may send a notification when a user is tagged on his Facebook profile or if the user tweets using a hashtag (#).

It employs the following concepts:

1. Services
2. Triggers
3. Actions
4. Applets
5. Ingredients

2.2 IMPLEMENTATION

2.2.1 TOOLS AND TECHNOLOGIES USED

- Software
  1. Android Studio 3.1.2
  2. Arduino IDE
  3. Cloud MQTT
- Hardware
  1. WeMos D1 Mini
  2. ESP8266 (for Wifi connectivity)
  3. PIR Motion Sensor
  4. LDR Light Sensor

2.2.2 METHODOLOGIES

Libraries used within Arduino IDE

- esp8266 by ESP8266 community version: 2.3.0 (for working of WeMos d1 mini board with ESP8266)
- WifiManager by tzapu version: 0.12.0 (to establish Wifi connectivity with fallback web configuration portal)
- PubSubClient by Nick OLeary version: 2.6.0 (a client library for MQTT messaging)

2.2.3 ALGORITHM

- Android Application for Remote access

1. User clicks on Login/Sign Up/About
2. User selects/add the residence/house
3. User selects Light/Gate/Edit profile
4. User chooses to switch On/Off light or Open/close gate
5. User exits

- Hardware Working

1. It collects the data from user application of physical switch
2. Provides internet connectivity through ESP8266
3. Sends the data (user input) to the cloud
4. Switches Light On/Off accordingly

Some screeshots of Android Application given in Fig. 2

Fig -2: SCREENSHOTS OF ANDROID APPLICATION

Constructed hardware system is as shown below in Fig 3.

Fig -3: HARDWARE SYSTEM

The pseudocode used for Android Application functions to switch the lights on and off is:

```
public void onClick(View arg0) {
// TODO Auto-generated method stub
if(flag==0)
{
ib1.setImageResource(R.drawable.bulborange);
//toast and command given through MQTT
flag=1;
}
else
{
ib1.setImageResource(R.drawable.imageedit_2_7007621597
);
//toast and command given through MQTT
flag=0;
}
}
});
```

For automated gate timings Android Services are used.

2.2.4 RESULT

We have successfully done implementation of Automating Room Light. Also we are providing remote access to the user to control the Light and Gate through Android Application. Toast will appear as confirmation (Fig. 2).

For the automated result of the system output of the serial monitor (Fig. 4).

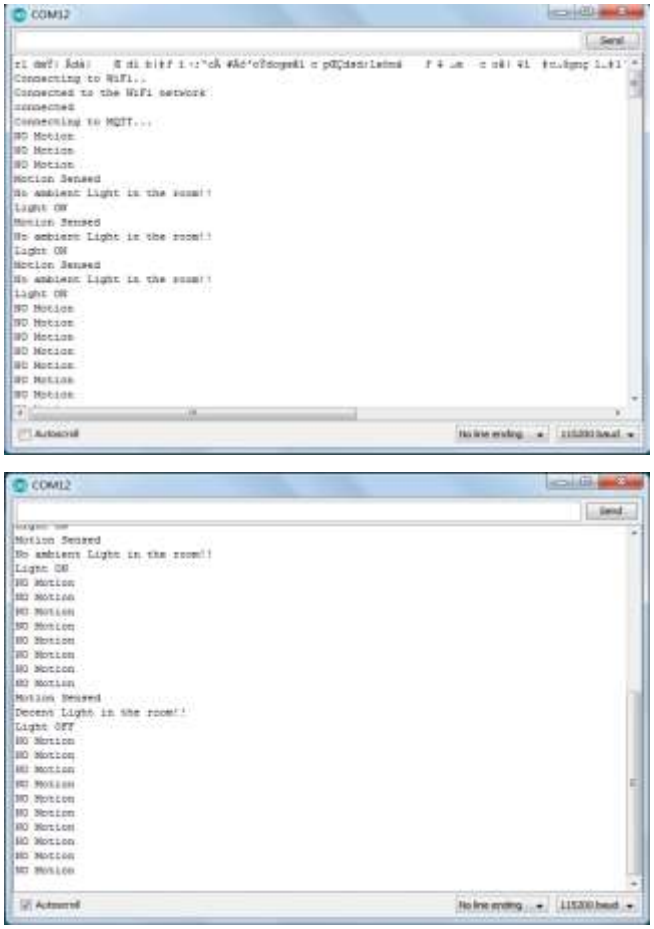

Fig -4: OUTPUT RESULT ON SERIAL MONITOR

3. CONCLUSION AND FUTURE SCOPE

IoT is the most emerging technology in today's world which simplifies Lifestyle to a greater extent. Giving priority to the ease of use, this system is budget friendly and simple to use. Starting from a small house to a huge corporate organization, this system can be easily deployed. This system will help the elderly group of the society, where they need least physical movement for operating lights and gates. Thus, this system can be used by any age group in a very easy and efficient manner. This system can help make your home a smart home. As remote access to the system is given through an Android application, this system encourages people to use smart applications. Also, by making use of cloud, it upgrades the overall performance of the application. This system is also energy efficient. Here, we have used the MQTT cloud server but for future scope, specialized server for the system can be used.

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