



MQTT with ESP8266: The Smart Way to Automate Your Home

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Abstract: Home Automation refers to the automatic control of the electronic home appliances remotely through the devices like smartphone, tablet or PC through which we can access our appliances throughout the globe. More over it also provides home security other than these applications; It can also control emergency system like fire alarm and camera. The home automation system differs from other automatic systems because it provides the control over different devices without the dependency of wireless remote inside any home or industry. Today we are entering into that era where mobile devices are handling daily tasks which were handled by desktop or laptop once. The mobile devices are leading over laptops and desktops. Since mobile devices are playing a vital role in the automation system hence we proposed this project which is controlled by android mobile. This study focused to automate the home appliances by integrating different technologies like android device, wireless communication and power line communication to provide the users remote control over many appliances. Since android ADK is more flexible and reliable than web portal hence it is facile to use. Android mobile communicates to the appliances through IOT (Internet of Things). This project is more efficient and cost effective. The authentication is also provided to give the secured access to the system as only authorized users can access it by login with their username and password. The appliances are connected to one wifi module and the requests to this module are sent with an android application.

Keywords: Home Automation System; Android; Microcontroller; Wifi; Mobile Phone; Appliance; ESP8266; Adafruit

I. Introduction

Automation is adopted in today's life for the daily routine to utilize the time and make the appliances energy efficient [1,2]. When the control of the appliances is completely taken over by the automatic system, the monitoring and the controlling becomes more facile. This system is not only for the homes, it can be applied in any industrial area where there is a need to decrease the man power. The industrial application is also migrated towards the automatic system. There are many issues which require automated system to decrease the manpower and time to complete these issues. These issues are like fire incidents or gas leakage. Sensor units are used to recognize the fire and gas-related explosion. The safety mechanism of the house will enable the safety system so that it can monitor any unwanted activity [12,13]. More safety can also be provided to link the camera with our automated system so that anytime anyone can see the footage of once house. This system is also helpful for the disable persons who are not able to control home appliances manually [9].



Fig.1: HOME AUTOMATION

According to [3], Home automation system is helpful to those who are in need to access home appliances while away from the home. Home automation can be divided into two categories –locally controlled system and remotely controlled system. The locally controlled system is used from inside the home through mobile device while the remotely controlled system are controlled through mobile application from anywhere in the globe[5]. Our project is based on second type of system in which anyone can access the appliances from anywhere because we operate the devices by integrating them with the web.

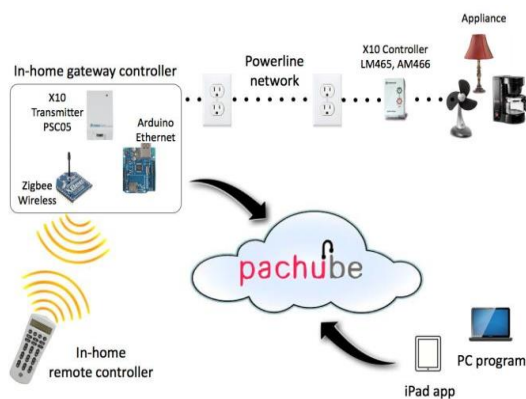


Fig. 1(a): in-home automation system

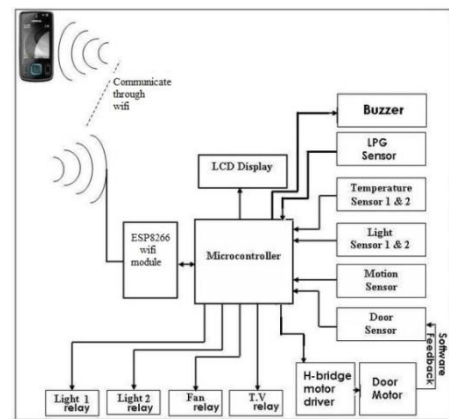


Fig. 1(b): Home automation using android application and wifi module

According to Piyare and Tazil [4] the system should be reliable. It means that the system is able to integrate the new devices and appliances. The interface of home automation application should be user-friendly so that the devices can be easily controlled and monitored by easy access. In the architecture of our project the home appliances are connected with the wifi module (ESP8266) through electromechanical relays and the android device is connected to the internet. The wifi module is also connected to the web through a router. The mobile device sends the request over internet and triggers the appliances through adafruit API [14,15]. This api works on the backend of this project and sends commands to the esp module. This module gets the requests and triggers the appliances according to the given command. In this project we can also prepare a server to work on backend but the better option is to take the adafruit api because it provides already developed api's by which one can make many types of requests like GET, POST and PATCH etc.

II. Components used

- a) ESP8266 module
- b) Relay
- c) Arduino 1.8
- d) Adafruit
- e) Android

ESP8266

In the project we use a low-cost wifi chip with full TCP/IP stack and an MCU (Micro Controller Unit). The Micro controller is used to connect to a wifi network and makes a connection using AT commands. This module contains 64KB instruction RAM and 96 KB of data RAM which makes it much more cost effective module[18]. Since there are many other wifi modules available but they are not so much cost efficient and they also have no micro controller unit hence we have to use some other devices which are used as the micro controller unit which led to the more cost. The ESP8266 is like a mini Arduino with wifi. We only have to give some dedicated power supply to activate this chip[16,17]. To configure the ESP8266 we use the Arduino IDE 1.8. It is a very simple and efficient way to program the chip using the well-known Arduino IDE where we can re-use many existing Arduino libraries. For ESP8266 we firstly select the ESP8266 board and then install the corresponding libraries[19,20].

Relay

In order to trigger the home appliances we use four channel electrical relay as we only want to trigger four appliances otherwise more than four channel relay can also be used. One channel of the relay is used to trigger one appliance[16]. The relay is an electrically operated switch. There are two types of relays used to trigger the appliances. The first one uses electromagnet to mechanically operate a switch while the another type of relay is called the solid state relay. There are many pros and cons of both types of relays. In spite of being inexpensive, easy to use and able to perform on low power circuit, the major disadvantage of electromechanical relay is that it is a mechanical device since it works on moving some physical parts so the speed of electromechanical relay is slow. The more movements in the physical devices tend to wear out the parts and failure and also it is electrically noisy due to the contact noise of two parts[20]. On the other hand if we talk about solid state relay there are no moving parts in these type of relays. It uses power transistors to trigger the appliances. Firstly the solid state relay was used in the project but it has one disadvantage. When the manual working is provided in it in order to operate the switch the current backtracks and the circuit fails hence it does not supports manual working. Therefore in order to overcome this disadvantage electrical relay was used in the project.

Adafruit

Adafruit is an open source hardware company which provides the platform for hardware devices. It provides the backend support to these devices [14]. The adafruit api's are used to give commands to the devices. It provides many requests which can make by users easily by only call the api's provided by adafruit. Adafruit works on MQTT protocol. MQTT, or message queue telemetry transport, is a protocol which is better than HTTP and it is used for communication among devices. Using a MQTT library or client one can publish or subscribe data feeds. It is a Client Server protocol which is published or subscribed by different entities. It is light weight, open, simple, and designed so as to be easy to implement [15]. This can be used in many situations; including constrained environments. This environment includes communication in Machine to Machine (M2M) and Internet of Things (IoT) contexts. Firstly at adafruit we have to create a dashboard at which the feed are created in order to perform different operations. In our case we have created four feeds which are operated through different requests. These requests are handled by MQTT protocol. To call the different feeds we have to only call the api's provided by adafruit. In our application when we trigger the appliances through application interface, actually we are calling the adafruit api. This api sends the request to the esp module and further operation is done by esp module.

Arduino IDE

Arduino IDE is the desktop editor for all Arduino boards both .org and .cc alike. The open source Arduino software makes it easy to upload codes to any board. The Arduino Integrated Development Environment - or Arduino Software (IDE) - has a message area, a text editor for writing code, a text console for showing the output, a toolbar with many tools for coding and a series of menus [19,20]. Firstly we have to select the board on which we want to upload the code and then we have to install the libraries regarding that board. Arduino IDE also provided some basic examples which can also be used fir our purpose. In our project we select esp8266 board and the install the corresponding libraries.



Fig. 2: ESP8266 module

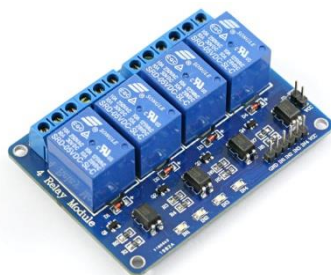


Fig.3: Four channel relay

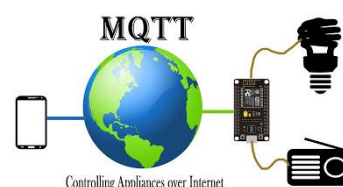


Fig. 4: Communication through MQTT protocol

Andriod

Android is a mobile operating system. It is developed by Andy Rubin around the dawn of this twenty-first century [2]. In 2005, Google acquired android. Initially the android developed is done using eclipse by integrating it with Android Development Tool (ADT) plugin but in 2014 Google launched Android Studio as its primary IDE [1]. In android studio the android application is built over two languages. The static screens are designed in XML code and the backend operations are performed in java language [3].

Home Automation using android application: Since android application is more flexible and reliable than any other means of operations hence we provide the whole control of our project to an android application which makes this project easy to use. We can use Bluetooth technology to access the home appliances but then it will be accessed from inside the home (in-home access) that's why we use a wifi module to provide the accessibility throughout the globe[1,4].



Fig. 6: The application screens

III. Result

The project is completed now and in working state as described in this paper. This system provides user to control their appliances from anywhere in the world through an internet connection. The project was already tested to trigger the appliances like light, fan, AC and music system.



Fig. 7: The whole setup of this project

Fig. shows this project in running state. In this setup we connect the esp module to relay. One channel of relay controls one appliance. Different pins of esp are connected to the relays to trigger the appliances. When we send the command from mobile application to the esp module, the microcontroller receives this signal and further send the signals to the corresponding relay.

IV. Conclusion

The proposed technology can be implemented from anywhere to make automatic systems. The home and offices will be safe from many incidents like fire accidents and gas leakage. The monitoring over many emergency systems can be easily done by this system. To provide more security authentication can also be provided to the users to give them the accessibility when they provide their authorized username and password so that only authorized users can access this system[9]. We can use many sensor devices which will notify us at any unwanted happening. This system can be expanded to provide it other functionalities like voice control system which convert the human voice to different commands. It will reduce the human effort to control the appliances [7]. Energy monitoring can also be applied so that one can control his/her energy consumption. The energy consumption of each and every appliance can also be displayed on the application interface. Further this system may include artificial intelligence to make it more users friendly and increase the automation.

References

- [1] Shewale, Archana N., and Jyoti P. Bari. "Renewable Energy Based Home Automation System Using ZigBee." *Renewable Energy* 5.3 (2015).
- [2] Vidyasagar, K., G. Balaji, and K. Narendra Reddy. "Android Phone Enabled Home Automation." *Journal of Academia and Industrial Research (JAIR)* 4.2 (2015): 65.
- [3] Laur, I., "Microcontroller based home automation system with security," *International Journal of Advanced Computer Science and Applications*, vol. 1, no. 6, pp. 60-65, 2010.
- [4] Piyare, R., Tazil, M., "Bluetooth-based home automation system using cell phone," *IEEE ISCE*, pp. 192-195, 2011
- [5] WALE, DIPTI P., SS PATIL, and DRSV ANEKAR. "Home Automation using Cloud Network and Mobile Devices." (2015).
- [6] PATEL, SYED MUJEEB, and SYED JILANI PASHA. "Home automation system (HAS) using android for mobile phone." (2015).
- [7] Pandya, Bhavik, Mihir Mehta, and Nilesh Jain. "Android-Based Home Automation System Using Bluetooth & Voice command." (2016).
- [8] Ekatpure, Rutuja, and Devendra Ingale. "Android-based Interactive Home Automation System through Internet of Things."
- [9] Javale, Deepali, et al. "Home automation and security system using Android ADK." *International journal of electronics communication and computer technology (IJECCCT)* 3.2 (2013): 382-385.
- [10] Mohana, R., P. G. Scholar, and India R. Murugasami. "Home Automation Based on Android Application." *Journal of Network Communications and Emerging Technologies (JNCET)* www.jncet.org 6.4 (2016).
- [11] ANITHA, T., and T. UPPALAIAH. "Android-Based Home Automation using Raspberry Pi." (2016).
- [12] Chan, M., Campo, E., Esteve, D., Fourniols, J.Y., "Smart homes-current features and future perspectives," *Maturitas*, vol. 64, issue 2, pp. 90-97, 2009.
- [13] Das, S.R., Chita, S., Peterson, N., Shirazi, B.A., Bhadkamkar, M., "Home automation and security for mobile devices," *IEEE PERCOM Workshops*, pp. 141-146, 2011.
- [14] Giles, Jim. "Inside the race to hack the Kinect." (2010): 22-23.
- [15] Riley, Mike. *Programming your home: automate with Arduino, Android, and your computer*. Pragmatic Bookshelf, 2012.
- [16] Kotiyal, Bandanawaz, and Muzamil Muzamil. "Home automation using Arduino WiFi module ESP8266." (2016).
- [17] Di Nisio, A., et al. "Design of a low cost multipurpose wireless sensor network." *Measurements & Networking (M&N)*, 2015 IEEE International Workshop on. IEEE, 2015.
- [18] Kumar, M. Kranthi, and K. Srenivasa Ravi. "Automation of irrigation system based on Wi-Fi technology and IOT." *Indian Journal of Science and Technology* 9.17 (2016).
- [19] Badamasi, Yusuf Abdullahi. "The working principle of an Arduino." *Electronics, Computer and Computation (ICECCO)*, 2014 11th International Conference on. IEEE, 2014.
- [20] Shajahan, Altaf Hamed, and A. Anand. "Data acquisition and control using Arduino-android platform: Smart plug." *Energy Efficient Technologies for Sustainability (ICEETS)*, 2013 International Conference on. IEEE, 2013.