

SMART AND EFFICIENT HOME AUTOMATION SYSTEM USING IOT

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Abstract

Nowadays, IoT has become one of the important domains not just as an area of study, but also as a domain of implementation due to its invariable applications. Home Automation has become more of a necessity than a luxury to many households. Due to the increasing usage of mobile devices, providing security features to households through mobile devices makes a lot of sense. We are proposing a project where our main objective is to create a Home Automation System which helps us to save energy and at the same time is cost-effective and flexible. This project presents the methods used for developing Wi-Fi and Bluetooth Home Automation System for monitoring the electrical energy consumption of our houses tracked in real-time using a custom node MCU. There are many sensors that will be interfaced with the node MCU which will give us the real-time status of the surroundings and also assist us in monitoring various appliances like lights, fans, etc. Communication between people and devices will be interfaced through an android application which will help them to control the devices and will provide a real-time feed of various appliances and sensors.

Keywords: Home Automation System, node MCU, Wi-Fi, Bluetooth, Home Automation System, IOT(Internet Of Things), Android, Security.

I. INTRODUCTION

In the 21st century, the entire world is revolutionized by digitalization. People from various backgrounds carry smartphones. A few years ago we found a significant change in how phones were developed and at the present times phones are used not just to make phone calls, but for a plethora of other reasons. Similarly, houses have also made their way from being normal to smart. This transformation came into the picture due to the advancement of IoT. Due to the rapid growth of IoT, smart homes can integrate various sensors, appliances, and robots. Consequently, many applications or use cases have been developed for mankind. Lately, home automation systems have been integrated with cloud services which have helped in real-time status updation and checking. It has unlocked new potential for controlling devices from anywhere across the globe. We can also observe a drastic surge in demand for home automation systems for many reasons. It brings security to the houses, it helps disabled people and most importantly, integration of these systems is available at affordable rates. Currently, the smart home provides the following features: Smart Refrigerator, Smart Washing Machine, Smart TV, Smart coffee maker, Smart clothing, etc. Smart homes usually provide an alert system. It is an absolutely essential part of a home automation system as it brings about security not just to the house, but also for the appliances. It provides monitoring and control for various appliances in the house. For example, we can control the lights/fans of a particular room in the house through an app. It also brings an intelligence aspect. For example, we can set a threshold to a temperature sensor, once the

threshold is crossed, the fans in that respective room can be turned ON/OFF automatically. Providing intelligence also helps in saving energy because tasks can be automated. We are proposing our project with the following features:

- Weather forecast monitoring inside the house.
- Safety measures are being provided using an LPG sensor and a Smoke sensor.
- Controlling appliances like lights and fans using an android application.
- Automating the control of various appliances based on sensor readings that are integrated with the appliances.

Benefits of our Home Automation System

- Cost-effectiveness is being achieved by using a custom-made Node MCU which is cheaper than a Raspberry Pi.
- Cloud services have been integrated using Google Cloud platform (Firebase) which allows us to control and monitor our houses efficiently.
- Integration of mobile app helps the users to check the status and control various appliances.

II. SURVEY STUDY

1) Briefing of the paper presented by the authors P Bhaskar Rao et cetera ^[1]

The main objective of their project was to aid physically challenged people and elderly people in controlling their home appliances. They have used a Raspberry Pi to connect to the devices in order to achieve webcam surveillance, door sensor notification and controlling other devices like fans, lights, etc. They have used OpenShift PASS to run the servlet application. Hardware components communicate with each other through Wi-Fi via the Raspberry Pi. Briefing of the paper presented by the authors Dimitris Kehagias et cetera ^[2]

The goal of their project was to create a dual interface for controlling various appliances which bring about flexibility, cost-effectiveness, and easier access. The main challenge was to obtain a solution in which both the android and web interfaces could interact via a single server in order to provide real-time data. They overcame this hurdle by using the PI4J library in the 'Java Web-Socket' server. They have used JavaScript and HTML5 for the frontend, PHP for the back end, and have used Adobe Dreamweaver CS6 for running the website. They used GlassFish 4.1 server to run the application.

2) Briefing of the paper presented by the authors Vinod Choudhary et cetera ^[3]

The objective of their project was to build a Home Automation system using IoT such that the system was affordable by a common man. They have built a system that could monitor temperature, video, door status, humidity, and motion detection. The commands from the app were sent using different protocols like HTTP, MQTT and the connection was wireless through Wi-Fi or the internet.

3) Briefing of the paper presented by the authors J.Chandramohan et cetera ^[4]

The aim of their project was to create a home control and monitoring system. This was achieved by integration of micro-web server with internet protocol. They integrated a LDR and a temperature sensor to the Arduino controller in order to provide intelligent operation for lamps and fans. LDR was used for controlling lamps and LM 35 temperature sensor used to control fans. They provided the ability of scheduling tasks which could automate the controlling of smart home environment.

4) Briefing of the paper presented by the authors Siddharth Wadwhani et cetera [5]

The author here concentrated majorly on three major aspects i.e., collecting data from the sensor, monitoring the devices and providing control over the devices. The first part consisted of a flex sensor, magnetic sensor, flame sensor, accelerometer, etc. The second part i.e., controlling was done using a cloud platform and the third part was done using an Arduino UNO. Therefore their main effort was to provide a less expensive way of operating the devices/appliances.

5) Briefing of the paper presented by the authors M.L Sharma et cetera [6]

They have created an advanced automation system which was made by considering the uses of Wi-Fi in the present-day world. They have used a smartphone to give instructions to the Wi-Fi module. They have used an ESP8226 Wi-Fi module which is a low-cost Wi-Fi chip. It also has a full TCP/IP stack. Since Wi-Fi technology provides increased battery life of mobile devices, consumes less power, and increases range of security, they have proposed a system that increases mobility and provides easier access to control the home appliances.

6) Briefing of the paper presented by the authors Majid Al-Kuwari et cetera [7]

They have proposed an automation system that had the ability to sense and monitor the house. They have used the EMON CMS platform for various purposes like visualising, controlling and monitoring the data at the same time it could aid the user in controlling number of appliances. They made a hub using Node MCU where all the devices and various sensors were integrated. They used humidity, temperature, LDR, proximity, and CO2 sensors. The sensors data was collected from each node using Node MCU. They were able to upload and store the changes made to the data periodically using the EMON CMS platform. The solar panel was integrated with sensors that could detect the dust, lux, etc. which would be sent to the CMS platform using Node MCU, and based on the result the panels would be covered or dusted off. They had devised a cleaning system which would clear all the dust in case there was too much of it on the panel.

7) Briefing of the paper presented by the authors Vignesh Govindraj et cetera [8]

The main target of their project was to design a smart home automation using IoT. They built a system that could help in controlling electrical appliances using a Wi-Fi module. They made a base station using Arduino mega which could communicate with the satellite station using the RF transceivers. They used sensors like temperature sensor, Gas leakage sensor, Light detector, motion detector sensor, and touch captivating sensor integrated to the satellite station which could monitor the readings of all the sensors integrated to it and it could update the data on thinkspeak cloud services. The devices could be controlled manually or they could be put in an automatic mode where the appliances could be used based on the readings from the sensors.

8) Briefing of the paper presented by the authors Kim Baraka et cetera [9]

The purpose of their project is to build a cost-effective hybrid IoT platform that could save energy and the cost of the setup as much as possible. They are using Zigbee technology and X10 protocols for communication among the devices. They have connected various appliances to an Arduino and have integrated different sensors to monitor the status of the devices. They use the database present in the Arduino to store the data received from the sensors and to store the commands given by the user. They have come up with an algorithm for scheduling the tasks that have to be performed on different appliances considering different factors. They have created an app to check the status of different devices and to control the

devices. They used the HTTP protocol to take the requests from the user and then run an efficient time scheduling algorithm based on the resources available.

III. METHODOLOGY

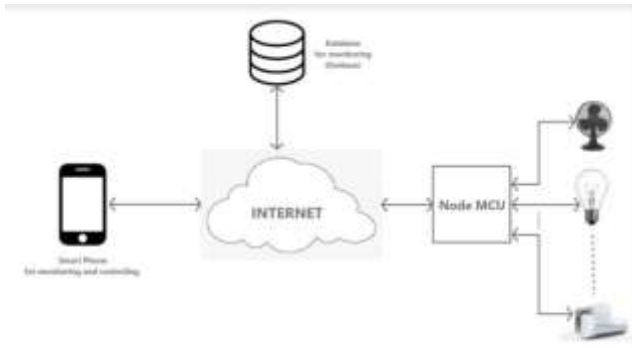


Figure 1: SCHEMATIC OVERVIEW OF IMPLEMENTATION

The main intent of our proposal is to create an energy-efficient smart home automation system. The main component that we are utilizing is the custom-made IoT board that has a Node MCU integrated along with it and it also has an integrated Wi-Fi module. We are using a DHT22 temperature and humidity sensor to detect the weather conditions of our surroundings. Later, the result obtained from the sensor will be stored in the cloud and will be displayed in the android app.

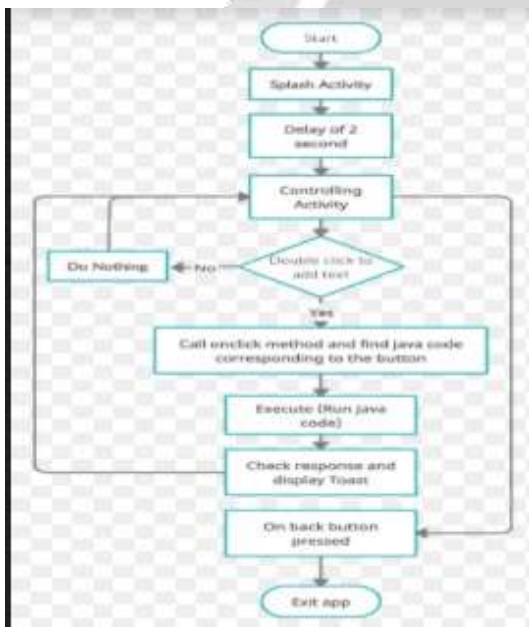


Figure 2: ANDROID ACTIVITY LIFECYCLE

We are also giving the option of automating the regulation of fans and controlling of lights. The readings obtained from the temperature sensor will be continuously monitored. There will be a threshold value set for the temperature readings. Once the temperature spikes above the threshold value, the fans in that particular room will switch on automatically and vice versa. Similarly, an LDR sensor will be used to continuously monitor the luminosity inside a particular room. If the room is dark, the lights in that particular room will be turned on automatically. The readings from these sensors will help us automate various tasks thereby contributing towards saving electrical energy. We are also integrating LPG sensors and smoke sensors to bring about security in the house. The LPG gas sensor helps to detect any kind of gas leakage and if in case a leakage is detected, a notification will be sent to the concerned user which will give an indication of gas leakage in the house. We are also integrating a smoke sensor in order to detect fire/smoke in the house. If the house is on fire then a notification will be sent to the phone of the concerned user. The user will also be able to control these devices through an android app. They can control and monitor the status of each and every smart appliance.

WORKING:

The data from the server will be collected and the data will be stored in the Node MCU. Later the data will be transferred from the Node MCU to the cloud service (FIREBASE). Once the user logs into the app, the data stored in firebase will get displayed in the app. The user can also control the appliances by toggling through various available options. The option that the user selects gets automatically updated in firebase. This data will be collected by the Node MCU and the appropriate action will be performed.

HARDWARE USED:

Custom IoT board, Node MCU, LEDs, LED Screen, Buzzers, Jumper cables, Breadboard, micro USB cable, DHT22 sensor, Bluetooth HC05, LPG sensor, Smoke sensor, Motion detector, OLED Screen.

SOFTWARE USED:

Android Studio, Arduino IDE, Visual Studio Code.

IV. CONCLUSION

We propose a secure and low-cost system that can remotely control smart home appliances through an android application. The methodology we discussed in this paper is novel in achieving the target of controlling home appliances remotely using Wi-Fi technology. The proposed system not only monitors the sensor data but also takes necessary actions according to the circumstances, for example turning ON fans when the temperature crosses a threshold value. The approach we discussed in this paper also stores the sensor data in the database to analyse the various conditions of the user's environment. The application can be enhanced further by adding smart camera functionality to monitor the house and to get notified in case of any intrusion. Smart gardening can also be made part of a smart home where the sprinklers water the plants when they detect low moisture in the soil.

V. REFERENCES

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