Meteorology Based Home Automation Using Internet of Things (IoT)

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Abstract- *IOT is an ever-growing field that connects various smart devices over the internet and can be controlled by a push of a button.This paper proposes the study of Internet of Things(IOT) based home automation system (HAS)that can be controlled by end users through their mobile devices from anywhere around the world through WIFI. This system can perform various functions which are performed at home on daily basis. The primary focus of this project is to minimize the use of electricity, human efforts and cost. In this project we are monitoring elements like temperature, carbon monoxide, air-quality, and rain, and then can control a door using IOT. This paper integrates various technologies like wireless networking, communication over cloud and storage of data in cloud. This paper shows the real-time 24-hour care using the IoT on Thing Speak cloud.*

Keywords- Home Automation System (HAS), Internet of Things (IOT), Sensor, Thing Speak.

I. INTRODUCTION

Home automation by IOT is the drive to a wiser home and luxurious lifestyle.IOT is a system of integrated computing devices which has exclusive identifiers so that these devices can transfer and store data over a network. The main purpose for rise in home automation by IOT is to minimize human efforts by analysing the information retrieved from the sensors and performs suitable activities thereby saving human time and cost.

IOT is an expansive field that connects various smart devices over the internet. This paper proposes the study of a smart home automation system (HAS)by IOT that can be controlled by end users through their mobile devices from anywhere around the world. In this project we are monitoring elements like temperature, carbon monoxide, air-quality, and rain, and in which any of these parameters exceeds their threshold values, the user gets alerted by a buzzer and can control the motor attached to the door or window through an application on their mobiles by using IOT.

This model includes numerous technologies like wireless networking, communication over cloud and storage of information in cloud. IOT analyses the knowledge extracted from the sensors and performs specific actions automatically when certain situations arise. This assured individuals about their home activities and securities which led to the path of advancement of Home Automation System. The system will ceaselessly update the system information as well as the user. The information collected by the various sensors are displayed in a graph form on the Thing Speak application.

The progressive development of the computational electronics infrastructure has led to the development of servers with competence for intensive data accumulation and management, known as big data, opening doors to the concept of IoT, which transforms simple objects into intelligent devices. In the scope of wireless communication, specifications were developed for sending information between electronic devices with the objective to increase safety, signal range and many other aspects. Some of the existing protocols are Z-Wave; Bluetooth; Zigbee; Wi-Fi. Communication protocols have also evolved to meet like the need for low response time; new security standards in data transfer and; real-time communication. Hypertext Transfer Protocol Version 2 was designed to provide more efficient use of network, data compression with the addition of the SSL / TLS security layer results in the HTTPS protocol, which encrypts the client-server connection, making it difficult to view the data transferred by third parties.

The demand for automated systems has widely increased in India over the last few years. Due to easy accessibility of the internet, IOT is a quickly emerging domain.

II. LITERATURE SURVEY

1.A Low-Cost Home Automation System Using Wi-Fi Based Wireless Sensor Network Incorporating Internet of Things (IoT)

The authors for this paper are N. Vikram,K. S. Harish, M. S. Nihaal, R. Umesh, A. Shetty and A. Kumar. The paper has been published in2017 IEEE 7th International Advance Computing Conference**.** This paper provides a plan

to model a low-cost Home Automation System (HAS) using Wi-Fi. Smart appliances like lights, fan speed, and other devices regarding humidity and water tank level are regulated by an android app. It also provides security features like fire alarms and gas leakage detection. The technology used here is ZigBee. The hardware components are ESP8266 WIFI module, ATMEGA microcontroller, sensors and relays. The drawbacks are that it has only limited control over devices as they are connected to existing electrical power lines.

2.Home automation in client-server approach with user notification along with efficient security alerting system

The authors are S. M. Brundha, P. Lakshmi and S. Santhanalakshmi. This paper has been published in 2017 International Conference on Smart Technologies for Smart Nation (SmartTechCon).This paper proposes a Client-Server service and device friendly approach for Home automation. The main purpose is to offer security. Suppose an intruder enters, the user is warned by a notification immediately and an image at that instant is captured. The technology used here is Bluetooth. The methodology consists of four steps. First, the environment is sensed and understood. Second, the events are reported to a centralized entity. Third, the centralized entity analyses the information and triggers the work flow. Fourth, the work flow will update the user.

3.Intelligent interface-based speech recognition for home automation using android application

The authors of this paper are M.Tharaniyasoundhari and S. Brilly Sangeetha. It has been published in 2015 International Conference on Innovations in Information, Embedded and Communication Systems (ICIIECS).This paper suggests a method to operate electrical appliances in home through an android application by appliances by using voice commands.The user's voice commands control over electrical appliances like lights, fans, etc with a microcontroller.The speech recognition is done by Support Vector Machine. The home automation system is done by using General packet radio service (GPRS) technology. Several drawbacks are there is no battery backup provided and Bluetooth technology is used but only valid for shorter distance.

4.Smart home for elderly care, based on Wireless Sensor Network

The authors of this paper are R. S. Ransingand M. Rajput. This paper has been published in 2015 International Conference on Nascent Technologies in the Engineering Field (ICNTE**).** In this, they recommend that numerous devices ought to be integrated to createsmart home,so that those devices can sense the required parameters and manage the characteristics of the home. The graphical user interface (GUI) utilized is LabView.This system uses ZigBee because of its low price and low power.No rectification is given for its transmission delay, and energy efficiency.

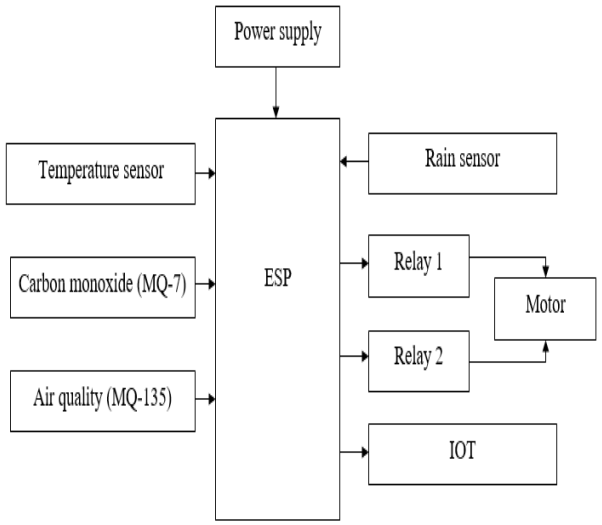
5.Android based smart home system with control via Bluetooth and internet connectivity

The authors for this paper are S. Kumar and S. R. Lee. This paper has been published in the 18th IEEE International Symposium on Consumer Electronics (ISCE 2014).This paper presents an inexpensive Smart Living System where the home appliances are controlled byan Android based User Interface. The technology used here isBluetooth and also internet. The connection is through a designed app via Bluetooth which only provides for a short distance. Home security is also provided along with an alert system.

III. PROPOSED SYSTEM

In our proposed model of home automation system, door and windows can be operated by a motor that can be switched ON and OFF accordingly to the user's desire by IOT. Various sensors like temperature sensor, carbon monoxide sensor, air quality sensor and rain sensor are connected to read their respective data. This data is sent to the cloud in which they can be stored and processed there. The data is continuously updated. This data is displayed in ThingSpeak application in the form of graph and this page is linked to the mobile application where it is also shown and also the control of motor can be controlled here. The threshold level for each sensor is set in the program of the microcontroller used. In case, if the present value is greater than the threshold value, the connected buzzer buzzes and the user can control the motor from the mobile application.

IV. BLOCK DIAGRAM



In this system, the hardware components are power supply, ESP32 microcontroller with WIFI module, temperature sensor LM35, carbon monoxide sensor MQ7, air quality sensor MQ135, rain sensor, relays, buzzer and dc motor. The software components are Arduino-IDE and embedded C.

The advantages of this system are reduction of installation costs, system scalability and integration of mobile devices.

A. ESP32microcontroller

ESP32 is an affordable low-power system on-chip microcontroller with integrated Wi-Fi and dual-mode Bluetooth module.The ESP32 employs a Tensilica Xtensa LX6 silicon chip in each dual-core and single-core variations and includes inbuilt antenna switches, RF balun, power amplifier, low-noise receive amplifier, filters, and power-management modules that can operate at 160 or 240 MHz and carrying out at upto 600 DMIPS.

B. Temperature Sensor-LM35

The LM35 sensor is a precision integrated-circuit temperature device with an output voltage linearly-proportional to the Centigrade temperature. LM35 device makes interfacing to readout or manage circuitry easily because it has low output impedance, linear output and precise inherent calibration.

C. Carbon Monoxide Sensor-MQ7

The MQ7 is appropriate for sensing CO concentrations within the air. It can detect CO-gas concentrations anyplace from 20 to 2000ppm. MQ7 is highly sensitive to carbon monoxide gas therefore it is stable for a long-life span.

D. Air Quality Sensor-MQ135

The air quality sensor is employed to detect venomous gases that are existing in the air in the surrounding environment. The air quality device detects ammonia, nitrogen oxide, smoke,CO2, and other injurious gases. A layer of the sensor unit is made of tin dioxide. The power supply is 5V. It has a wide detecting scope.

E. Rain Sensor

As the name suggests, this device senses rain fall and is acceptable for outdoor use. This sensor consists of a probe in which the sensing is an etched area which consists of three carbon electrodes separated by a waterproof resin. The water droplets run effortlessly on the sensing area. A slower and longer beep is created by increasing the 1 uF capacitor. The 10k resistor may be increased for a longer beep time without decreasing the beep rate but at some point, the circuit will terminate to function properly.

F. Direct Current (DC) Motor

A DC motor converts direct current electrical power into mechanical power on the principal of a current carrying conductor being placed in a magnetic field, it acknowledges a torque force and has a tendency to move from the original position.

G. ThingSpeak

ThingSpeak is an Internet of Things (IoT) application and API to store and retrieve information from devices using the HTTP and MQTT protocol over the Internet or via a Local Area Network. In simpler terms, this is an IoT platform that accumulates and stores the data in the cloud and develops the IoT applications. Sensor data can be sent to ThingSpeak from ESP32 Wi-Fi module. Cloud system is considered to be the stock house of all information and can be shared by some devices with specific privileges. Generally, the user gets an application programming interface (API) key, password and the registered device purpose. Using these API keys and the password that has been set up by the user by taking the Wi-Fi hotspot, they could access the data retrieved from the devices.

H. Arduino IDE

Arduino integrated development environment (IDE) is the platform used for coding the program and uploaded to the ESP32 microcontroller. Arduino application supports many languages like C and C++ and this program is written in the language of extension of C which is known as embedded C.

V. EXPERIMENTATION

First, the hardware components are tested separately and then are connected to each other accordingly. A program written on Arduino IDE is uploaded to the ESP32 so that the module can transmit and receive data about the sensors from/to the cloud. The Wi-Fi module is initialized and configured properly. The program includes reading the data from the sensors and allocating a threshold value for each parameter.

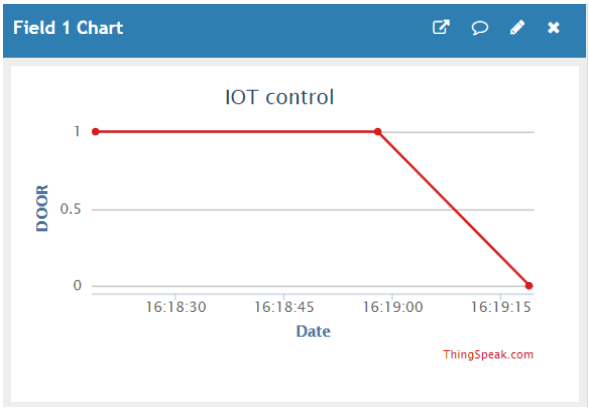
After switching on the power supply, the ESP32 transmits the sensor data to the cloud. After the data is uploaded to the cloud, we use the ThingSpeak application to aggregate, visualize and analyze live data. The Wi-Fi module sends data to the cloud through its assigned IP address. Once connected to ThingSpeak, an API key is assigned to monitor the readings. After every device is connected, we can see the login page where the user has to login with particular API key and the token which is given by the cloud so that the privacy is maintained by the server. The values are updated in a periodic manner and are plotted on the graph accordingly.

Also, a second webpage has been created to monitor the control of the door. The door can be controlled from the mobile through IOT MQTT Dashboard and the status is shown in the graph.

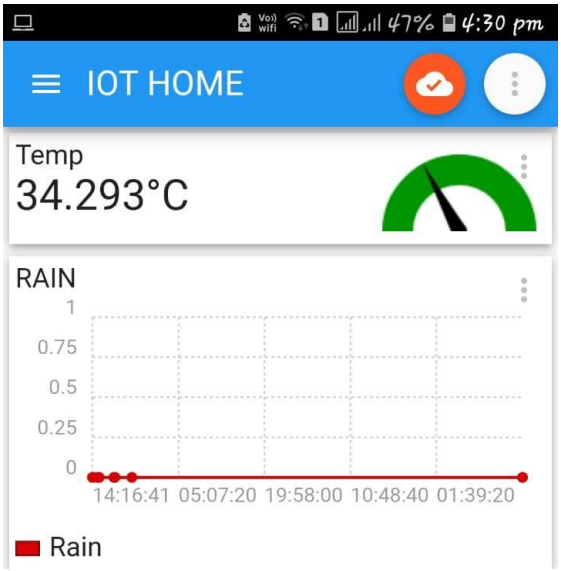
VI. RESULT

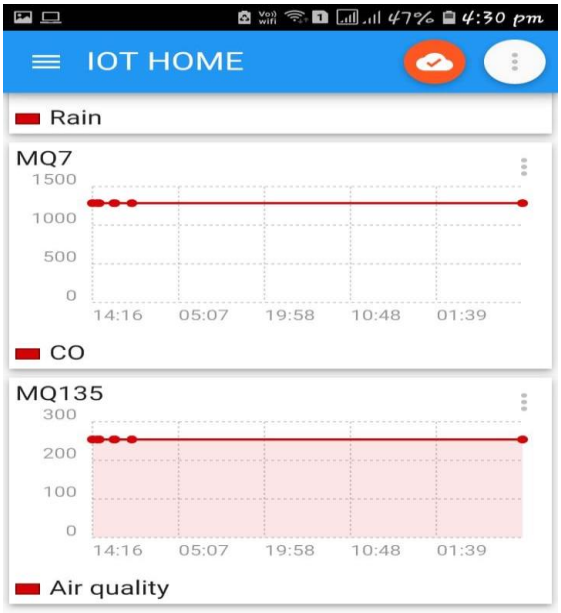
The results are stored and can be displayed in ThingSpeak application where two separate web pages are created. One for different environmental conditions such as temperature, carbon monoxide, air quality, rain and the other one for control of door.

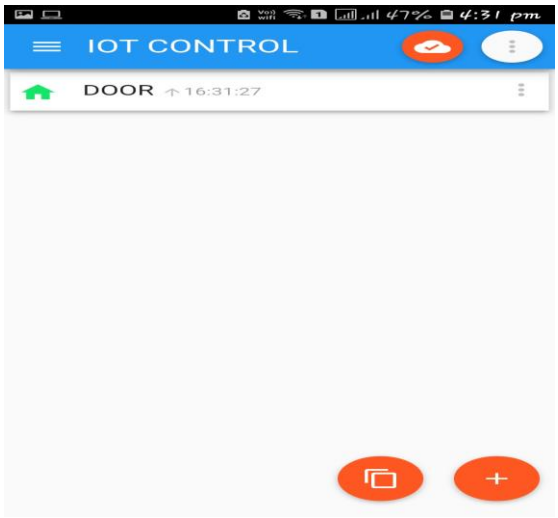
In total, there are four graphs in the first web page where the x-axis is measured by time and y-axis by the graph's respective parameter. The interval between each value is 10 seconds for the sensor graph and 15 seconds for the control graph.

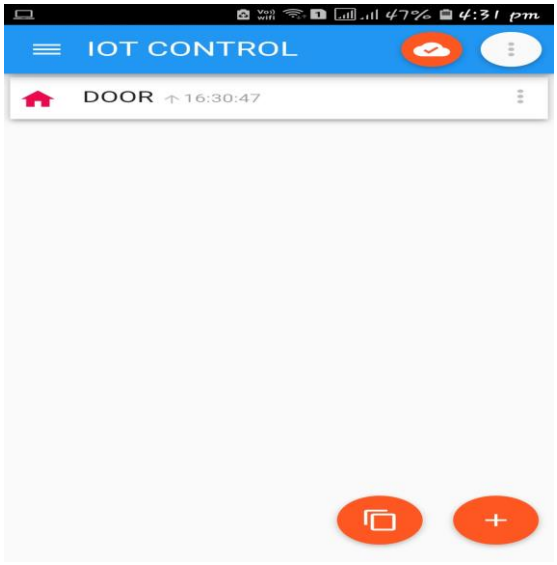


Also, the mobile application can be done by IOT MQTT Dashboard where the graphs from ThingSpeak are shown and the status of the door can be viewed. The operation of the door can be controlled from the mobile.









VII. CONCLUSION& FUTURE SCOPE

A real-time home automation system has been successfully implemented which is quite effective in terms of performance and technology. Despite Home automation systems beingan unpopular choice in the present, there is a very large likelihood that it will be the trend in future.

The log file can be generated as a result of changing state of appliances. It can be used to track the user's behaviour,for an example, the time of controlling the appliances. Using this log file, we can apply Machine Learning to the system, through which the system will learn how the user operates the appliances in his house. According to the results provided by the machine learning, the system can automatically change the state of the appliances based on the behaviour of the user.

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