IoT Based Home Automation Using Adafruit and Google Assistant

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Abstract— In this age of digitization and automation, human life is getting simpler because almost everything is getting automated, replacing the old manual systems. For developing nations like India, the consumption of electricity is higher. Also, many people forget to switch off the lights when not in use, this led to wastage of electricity in huge amounts. This paper describes a low cost and scalable framework for home control and monitoring the environment. It employs an inbuilt micro-web server in the NODE MCU(ESP8266), with remote access to and control of devices and appliances via IP address connectivity. These devices can be operated through a web application or an Adafruit app based on Wi-Fi or via voice control (like Google assistance). So it will become easy and comfortable for humans to control the appliances from wherever in the world and switch off the lights if they forget to do so and saves electricity.

Keywords: NodeMCU, Adafruit, IFTTT, MQTT, 16 channel Multiplexer, DHT11 Sensor

I. INTRODUCTION

Internet of Things is a term where each device is assigned to an IP address and everybody makes that device visible on the internet via that IP address. This essentially began as the "Internet of Computers." Research reports have projected an exponential rise in the number of "things" or devices linked to the Internet. The network that results is called the "Internet of Things".

The IoT devices track and manage the electronic electrical and mechanical systems used in various fields. A single administrator controls the devices connected to the cloud server which facilitates a number of users to whom a number of sensors and control nodes are linked. The admin can access and manage all nodes that are connected to each user but only the nodes to which the user is connected can be managed by a single user. This whole system using the Internet of Things (IoT) would allow mobile devices and computers to remotely control all the functions and features of home appliances from anywhere in the world using the internet connection.

The built system is economical and can be extended, as it enables a variety of different devices to be connected and managed.

Fig. 1

II. COMPONENTS REQUIREMENT

A. *Node MCU (ESP8266):-*

NodeMCU is an open-source platform and development kit that use to build IoT projects. It includes firmware that running on 'Espressif Systems' ESP8266 Wi-Fi SoC, and hardware-based on theESP-12 board. The firmware uses the Lua scripting language. It is based on the eLua project, which is based on the ESP8266 Espressif Non-OS SDK. Node MCU (esp8266) is selected as the controller for this project due to its compact size, low cost, reliability, easy interfacing over several other types of controllers including the Programmable Integrated Circuit (PIC), the Programmable Logic Controller (PLC) and others. It allows controlling inputs and outputs as you would do with an Arduino, but it comes with a Wi-Fi Module chip that can be configured to connect to the internet. So, it is great for IoT base home automation and other IoT application. It operates at 5V, it have 128kb of memory and 4mb of storage. It has 1 ADC input with a 1024 step resolution.

Fig. 2

B. *16 Channel Analog Multiplexer:-*

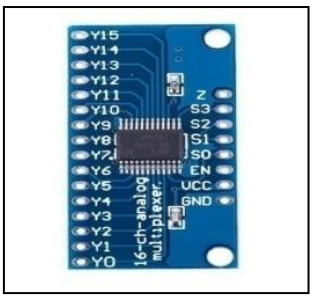

Fig. 3

Node MCU has only one ADC pin so it is difficult to connect several analog sensors to it, but with help of 16 channel analog multiplexers, it is possible to expand i/o analog pin of Node MCU. This multiplexer is a breakout board that mounts a 74HC4067. It can handle analog signals such as a signal from analog sensors or it can handle digital signals such as signal digital sensors or even serial communications. The Operating range of 74HC4067 is 2V to 6V DC; hence it is compatible with both 3.3V and 5V microcontroller and board such as Node MCU. It uses binary addressing, so channel 0 is address 0000, address 1111 is channel 15. When a channel is ON it has resistance around 70 ohms which allows the signal to flow in both the ways.

C. Relay Module:-

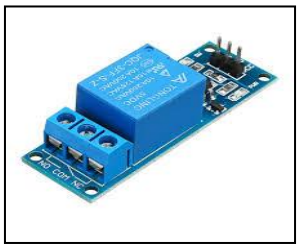

Fig. 4

The relay module is a separate hardware module used for remote electrical load control. The relay module allows one electrical circuit to switch another electrical circuit while they are separated. Relay is used when we want to turn on and off the device using a low voltage circuit. For example, a 5V relay is sufficient to operate the load which is operating on 230V AC supply. Relay consisting of three contactors namely normally closed (NO), normally open (NC), and common (COM). With the proper connection of all contactors, electrical load may turn ON and OFF.

D. DHT11 Sensor:-

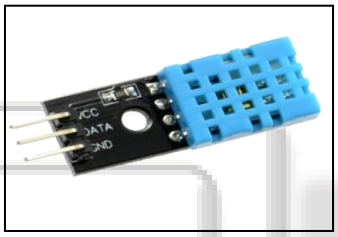

Fig. 5

DHT 11 detects the surrounding environment of the humidity and temperature. With a precision of ±1 ° C and ±1%, the sensor can calculate the temperature from 0 ° C to 50 ° C and humidity from 20% to 90%.

E. MQ135 Sensor:-

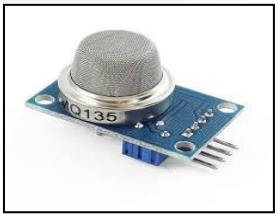

Fig. 6

MQ135 is an air quality sensor module for detecting wide ranges of gases such as NH3, alcohol, smoke, and CO2. It can measure their amount accurately. This is particularly suitable for Air Quality Monitoring applications at a low cost.

F. Light Sensor (LM393):-

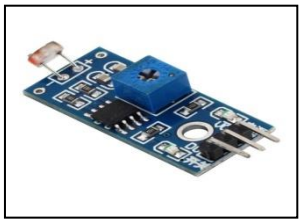

Fig. 7

Light sensor module based on a GL5528 photodetector to measure the ambient light intensity. The sensor's resistance varies depending on the amount of light, to which it is exposed, the output voltage changes with the luminous intensity. This module able to sends digital and analog signals. The potentiometer can also be used to adjust the sensitivity of the digital signal. The output of the digital signal is high when light intensity reaches the value set by the potentiometer and vice versa. The analog terminal outputs increase with the luminous intensity.

III. SOFTWARE REQUIRED

A. Adafruit IO:-

Adafruit IO is a platform designed to display, respond, and interact with another machine through the internet. It collects, saves, and secures the data. It works on the MQTT (Message Queue Telemetry Transport) protocol. It is designed for lightweight machine to machine communication. The two important features of Adafruit IO are dashboard and feeds.

The dashboard is a feature of Adafruit IO, which allows visualizing the data in the chart, graph, gauge, and log. It can be viewed from anywhere from the world through the internet.

Feeds are the core of Adafruit IO, they collect the data from the sensor and saves the data. The data can be shared for any analysis.

B. IFTTT:-

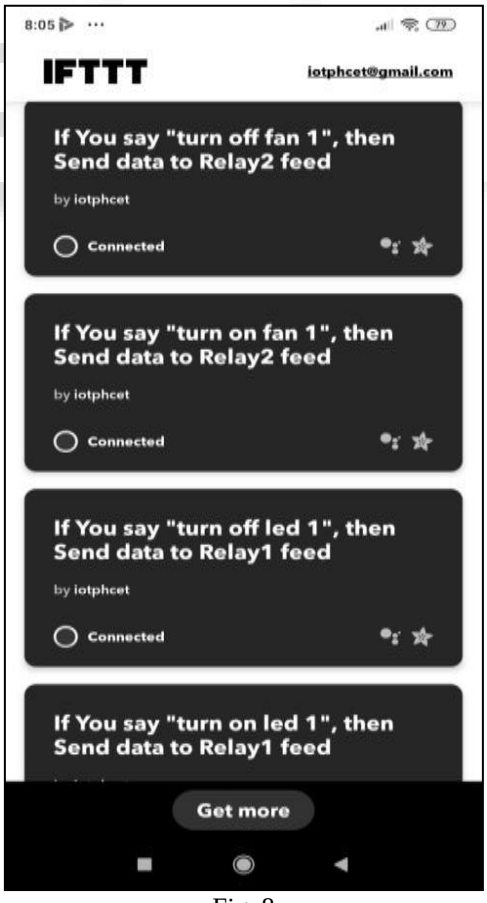

Fig. 8

IFTTT stands for If This Then That. It is a free web-based service that can connect two services together for the machine to machine communication. It creates a chain of

conditional statements called applets. It is used to trigger changes that occur within other web services. Using these services Google assistants and Adafruit IO are connected with each other.

C. Arduino IDE:-

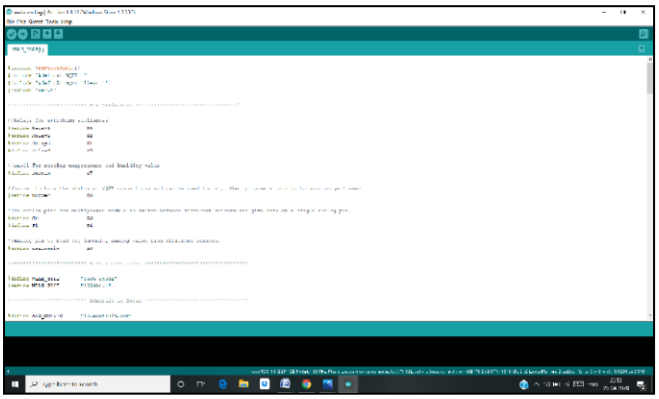

Fig. 9

Arduino IDE is an application used for writing C and C++ programs to the Arduino compatible board but also helps for 3rd party core and other vendor's development. The Arduino IDE supplies a software library for wiring projects. This provides multiple inputs and output procedures. It supports many other boards for programming and compiling. The programs which are written in the Arduino IDE is called a sketch.

IV. WORKING OF THE SYSTEM

The working of home automation is divided into two parts

A. Using Adafruit IO:-

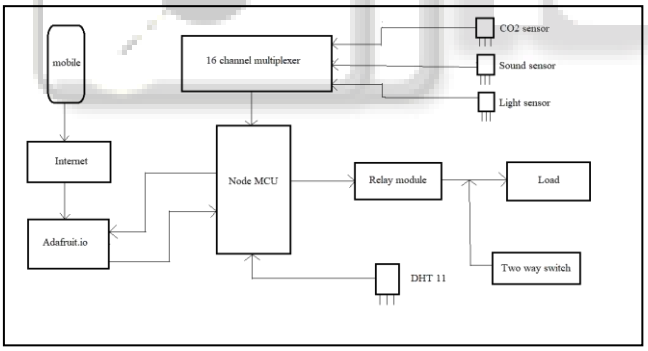

Fig. 10

Adafruit IO is the MQTT (Message Queue Telemetry Transport) server which consists of toggle switches and gauge in the dashboard. Adafruit IO provides the IO username and IO authentication key for connecting NodeMCU to the Adafruit IO. When the toggle switch of a particular load is switched. A signal is sent to Node MCU. The Node MCU will operate the relay module of that particular load. The sensors connected to the Node MCU through 16 channels multiplexer are continuously feeding the parameters of the surrounding atmosphere. This can be monitored on the dashboard. The below shown figure 11 is a dashboard of Adafruit IO.

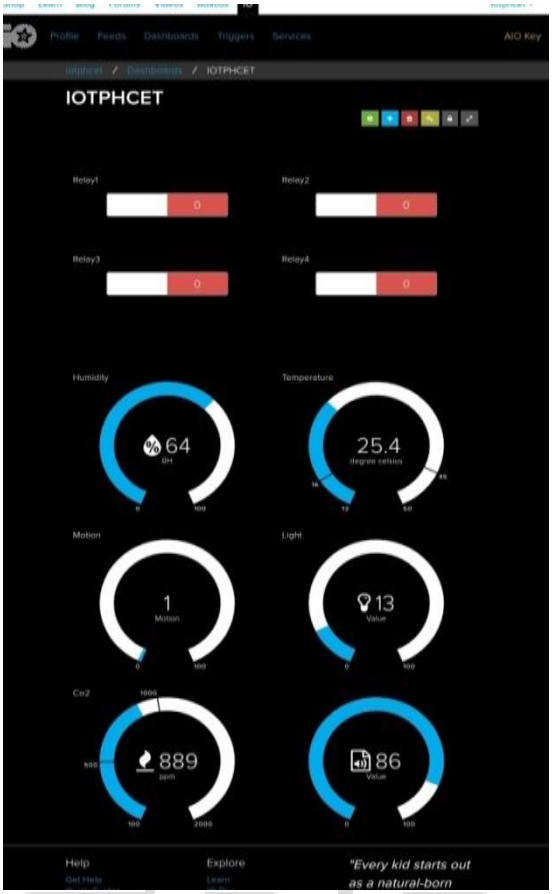

Fig. 11

B. Using Google assistant:-

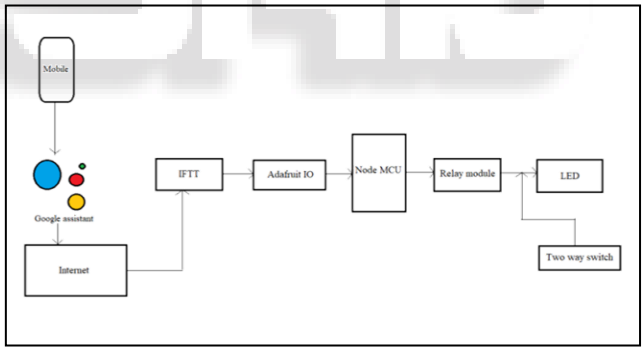

Fig. 12

To operate a load by using Google assistant. It requires IFTTT (If This Then That) to interconnect Google assistant and Adafruit IO. IFTTT takes a condition and performs an action. For e.g. When a command of “Turn ON LED” is given to the Google assistant. The IFTT checks the command if the condition satisfied. IFTT sends a data of ‘1’ to the Adafruit IO; further, the Adafruit IO will send the signal to the Node MCU to operate a relay module of “LED”.

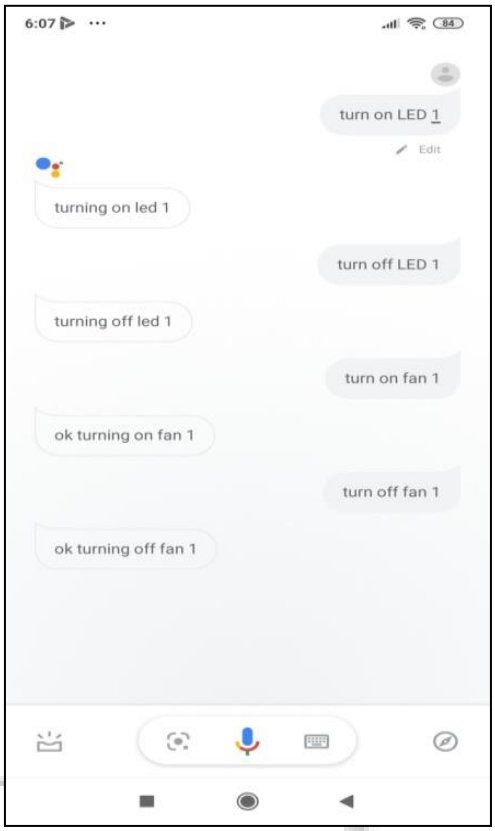

Fig. 13

C. Flowchart:-

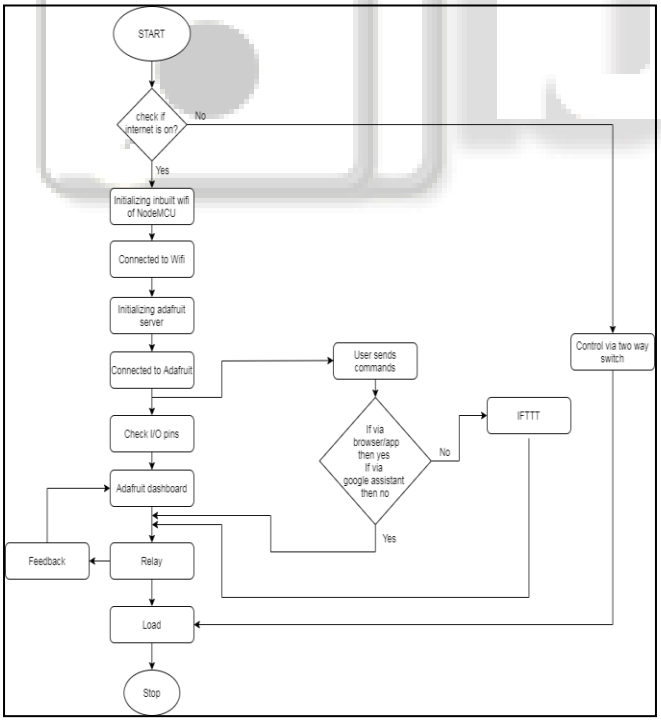

Fig. 14

V. RESULT

The IoT based home automation system of using internet or Voice commands through the mobile to control household appliances was successfully developed. After installation of the experimental setup, the user requires to install the software to his/her laptop or android phone. The application is connected to the same IP as the NodeMCU so that it can be controlled using any device that is connected to a network. No unwanted traffic can enter as the application is protected with the password on your phone and your Wi-Fi. The invented system helps us in realizing our goal of home automation since it was successful in controlling the home appliances using either the application on your smart device or through voice commands. The output of the IoT based home automation system is as shown in the figure below.

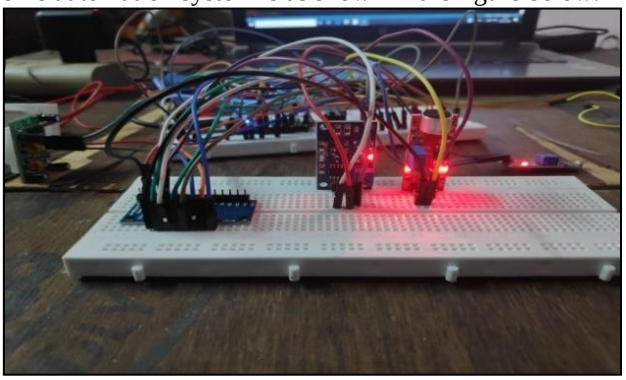

Fig. 15

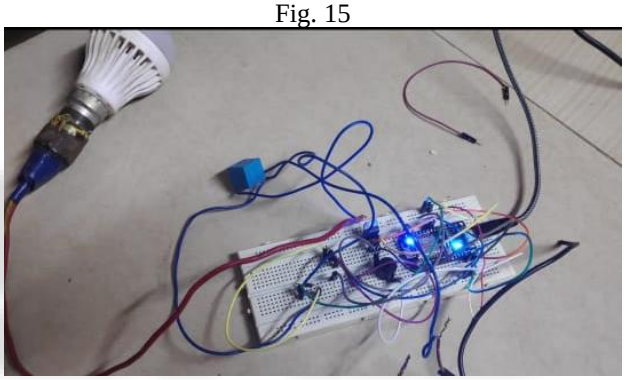

Fig. 16

VI. CONCLUSIONS

The IoT based home automation has been exploring proven to work with adequate by connecting simple appliances to it like fans, CFL's and the appliances were successfully controlled remotely through the internet. The designed system not only monitors the sensor data, like temperature, humidity, Co2 gas, sounds, motion sensors but also stores the sensor parameters in the cloud in a timely manner. It will assist the user to examine the condition of various parameters in the home anytime anywhere. The home automation system is also provided by a two-way switch for the manual operation in case of failure of internet connectivity it means that the system could runs on two modes one is online mode and the other is offline mode. It is also obvious from this project work that individual control of the home automation system can be inexpensively made from low-cost locally available components.

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