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Voice-Activated Home Automation using NodeMCU

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Abstract - *Home automation is a modern technology that helps to enjoy comfortable living conditions inside the home. With home automation, data can be instantly collected and passed between devices and analyzed simultaneously. By connecting the home appliances with the internet, they can be easily accessed from anywhere. In the home automation system, settings are feasible through smartphones or other remote-control devices. This paper gives the design and implementation of a new voice- controlled home automation system that uses Google Assistant for giving user's voice commands as input. It is a low cost and flexible home automation and monitoring system. It enables the user to use a home automation system based on the Internet of Things (IoT). Home appliances like fans and lights can be controlled. The fundamental purpose of this project is to control electronic appliances based on the situational demands of the user.*

Key Words: **Home automation, NodeMCU, Arduino IDE, IFTTT, MQTT Adafruit, DHT11 Sensor, MQ2 Sensor**

1. INTRODUCTION

Internet of things (IoT) is the developing technology that deals with the connection of the hardware devices and the software applications over the network. The important application of IoT is Home Automation [1]. The home automation system gives immediate access to control all the home appliances. The physically challenged and elderly people find it difficult to reach the switchboard to turn on and off the appliances. So, a voice-controlled home automation system can be useful for them to access the appliances by sitting in one place [5]. This paper employs a smartphone for giving user commands by using the Google assistant and NodeMCU microcontroller, with Wi-Fi (ESP8266) connectivity to gain access and control the devices and appliances. It uses the Arduino IDE to write and upload programs and Adafruit IO- a cloud service to handle multiple feeds of data. MQ2 Sensor is used to detect the presence of combustible gases and DHT11 Sensor detects the room temperature and humidity.

2. METHODOLOGY

This paper aims to control the various home appliances by receiving the voice command from the user through Google Assistant. The command is interpreted by the mobile and sent to the IFTTT if it's an appropriate command. The IFTTT acts as a central means through which the user communicates with the appliances. It sends the signals to the NodeMCU which in turn sends the appropriate command to the Relay through which the appliances are controlled, thus it demonstrates the concept i.e. IoT. The ESP8266 is programmed to send controls to relay which in turn controls the appliances. The DHT11 sensor is used to measure the temperature and humidity and the MQ2 sensor senses the gases. With the help of this project, we'll be able to automate every appliance by sitting at one place.

3. HARDWARE CONFIGURATION

3.1 NODE MCU (ESP8266)

The Node MicroController Unit also called the NodeMCU is an open-source hardware development board. It contains the chip called ESP8266 which is the wifi module used to connect the devices with the network [4]. NodeMCU is inexpensive hardware that is suitable for the construction of home automation systems.

3.2 GOOGLE ASSISTANT

Google Assistant is Google's voice assistant software that is used to give voice commands. The keyword "Hey Google/ Ok Google" is used to engage with the Google Assistant [6]. Google Assistant is available in all kinds of android smartphones. The users can give the voice commands through Google Assistant to access smart devices and applications. It's a convenient method for users to automate their devices.

3.3 IFTTT

IFTTT is a website that is used to create simple conditional statements called applets. To set up the IFTTT application, it must be logged in and the applets can be created. The commands given in the Google Assistant triggers the IFTTT application [4]. IFTTT connects various applications and devices. Creating applets, users can link devices and applications by signing up for a free account.

3.4 4- CHANNEL RELAY MODULE

The relay module is the series or array of switches. It is used to turn on and turn off the electrical circuit [2]. The relay works depending upon the input signals. The 4 channel relay

module which contains 4 relays, handles the voltage and power much better than the microcontroller.

3.5 ANALOG MULTIPLEXER

The analog multiplexer is shortly known as AMux is a component that can be used to select one input signal is from multiple input signals [8]. Multiple signals can share a single line at different times. It also handles analog applications. Analog signals from the sensor passes through the multiplexer and thus converted into digital form by connecting it with Analog to Digital Converter (ADC) input pin in the NodeMCU board.

3.6 DHT11 SENSOR

DHT11 is the sensor that is used to sense the temperature and humidity. It is the digital sensor that uses the thermistor to measure the surrounding air and capacitor to measure the humidity [9]. DHT11 is a low-cost sensor that uses the negative temperature coefficient to measure the temperature. It detects the changes in the temperature.

3.7 MQ2 SENSOR

MQ2 sensor is used to detect the presence of gases like hydrogen, propane, methane, alcohol, and LPG. It contains both digital and analog pins [10]. MQ2 gas sensor is the type of gas sensor that detects the presence of combustible gases. Analog values from the sensor can be converted into digital values by using the ADC input pin in the microcontroller.

4. SOFTWARE CONFIGURATION

4.1 ARDUINO IDE

The circuit board is controlled by Arduino IDE until the board is either turned off or reset. It consists of two functions such as Setup () and loop () [3]. Arduino Integrated Development Environment (IDE) is a software used to write programs and connect with the microcontroller. It supports a simplified version of the C and C++ programming languages.

4.2 MQTT ADAFRUIT IO

Message Queue Telemetry Transport shortly known as MQTT is used for device communication. It's supported by the Adafruit IO. Feed data can be sent or received by publishing and subscribing to the feed by using the MQTT library or client [7]. Adafruit IO is a cloud service that allows users to store multiple feeds of data. It can be connected over the internet and the Adafruit dashboard is visible from anywhere in the world.

5. SYSTEM DESIGN

5.1 BLOCK DIAGRAM

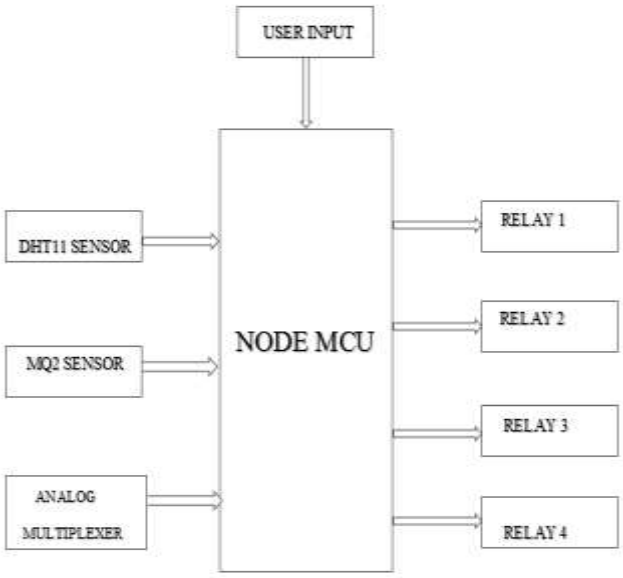

Fig -1: Represents the arrangements of components.

5.2 FLOW DIAGRAM

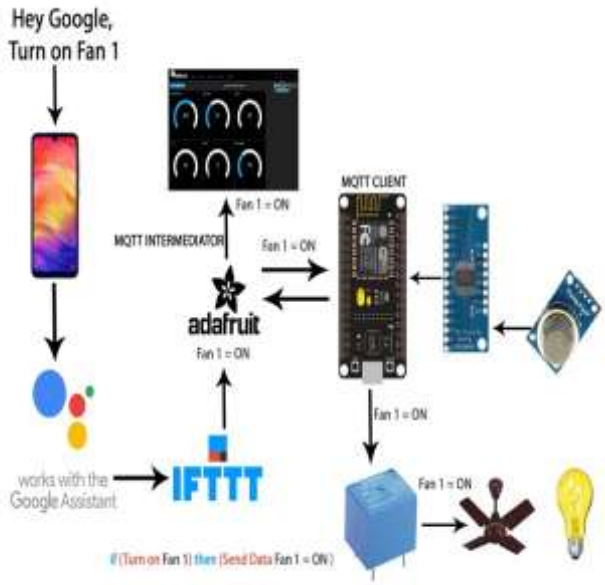

Fig -2: Flow diagram of voice-activated home automation.

5.3 CIRCUIT DIAGRAM

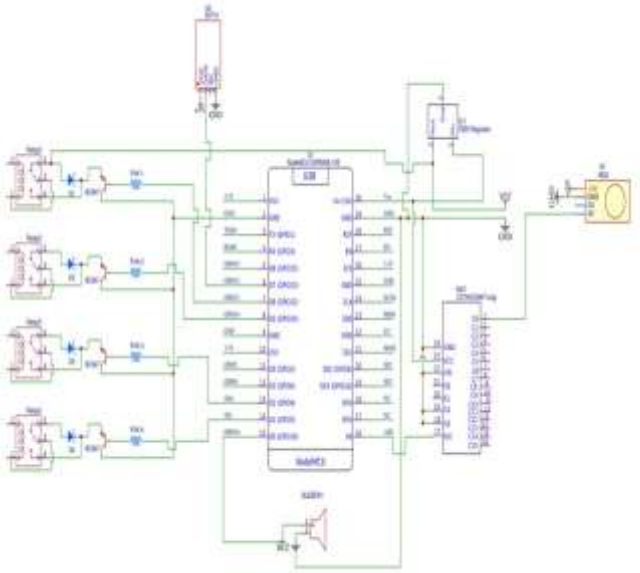

Fig -3: Circuit connections of hardware components.

6. PROCEDURE

6.1 Circuit connections

1. All the four relays are connected to the General Input Output Pins in the NodeMCU.
2. DHT11 Sensor is directly connected to the microcontroller whereas the MQ2 Sensor is connected to the microcontroller through the Analog Multiplexer.
3. The VCC is connected to the microcontroller through the regulator.

6.2 Adafruit dashboard setup

1. Sign up for a free account using Gmail Id in the Adafruit website
2. Create the dashboard and add the buttons to it and name the buttons as Light1, Fan1, Light2, and Fan2.
3. Add the gauge blocks to view the numeric values of temperature, humidity, and gases.

6.3 Creating applets using IFTTT

1. Sign up with Gmail Id.
2. To create new applets click on 'If This' option and connect it with the Google Assistant using the Gmail Id.
3. Create simple commands like 'Turn on light 1'.
4. Click on 'that' button and connect with Adafruit
5. Choose the feed names and finally click the Finish button to create the applet. Create applets for all the other relays.

6.4 Connecting Arduino IDE with NodeMCU

1. Open the Arduino software and enter the board manager URL of the NodeMCU ESP8266 in the preferences
2. Search for the ESP8266 community and Install it to the software.
3. Choose the NodeMCU 1.0 (ESP-12E Module) and finally upload the source code.

7. WORKING

Using the hot keyword "Hey Google/Ok Google" we command Google assistant. Google assistance receives the voice command and interprets it to data. Interpreted data is analyzed and checked whether the command is for IFTTT or some other application. If the data is meant for IFTTT then IFTTT receives the Interpreted data. For eg, we command "Hey Google Turn on Fan 1". Google assistant interprets it as FAN 1=ON and the data is for IFTTT. Then IFTTT receives FAN 1 = ON. IFTTT interprets the data like, If Fan 1 = ON then Relay2 = ON. The interpreted data from IFTTT is then sent to the Adafruit MQTT Server. From there the data is displayed on the dashboard as well as the data is sent to Node MCU like Relay 2 = ON. After Node MCU receiving data Relay 2 = ON, Node MCU looks for the appliance connected to the relay. If the fan is connected, then it is turned on automatically. DHT11 Sensor is used for monitoring the temperature and humidity. Air quality can also be monitored using the MQ Sensor. The temperature and humidity values are displayed in the Adafruit dashboard.

8. RESULT AND DISCUSSION

The result of this paper provides the smart home automation system using voice commands. By giving voice command using Google Assistant the lights and fans are turned on and turned off. The voice commands "turn on light 1" and "turn on fan 1" is given by the user and the Google assistant responds to those commands as shown in the Fig -4. The Adafruit dashboard displays the value 1 if the light/fan is on and 0 if the light/fan is off as shown in the Fig -5. The temperature and the humidity values of the room are collected by the DHT11 Sensor and displayed on the Adafruit dashboard as shown in the Fig -6. Similarly, the gas sensed by the MQ2 Sensor is also displayed as shown in the Fig -7.

Fig -4: User's voice commands in Google Assistant.

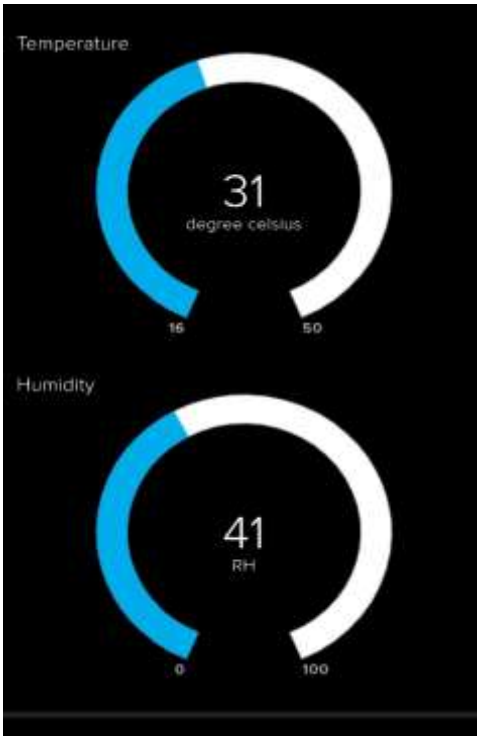

Fig -6: Temperature and humidity values displayed on Adafruit dashboard.

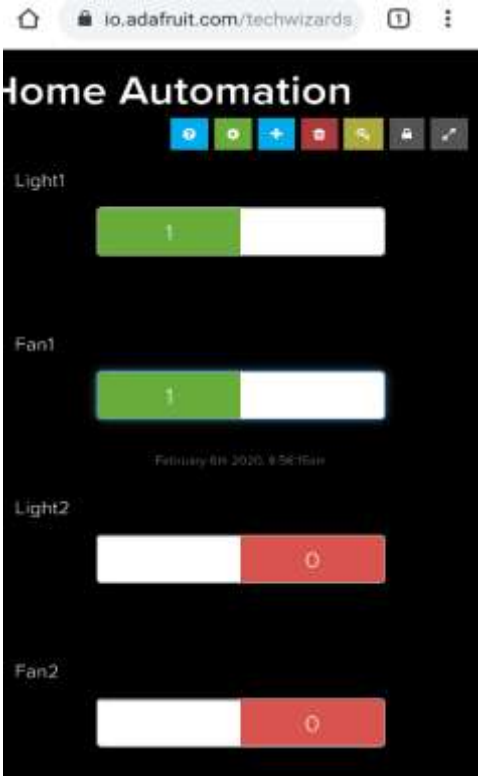

Fig -5: Adafruit dashboard shows light1 and fan1 are turned on.

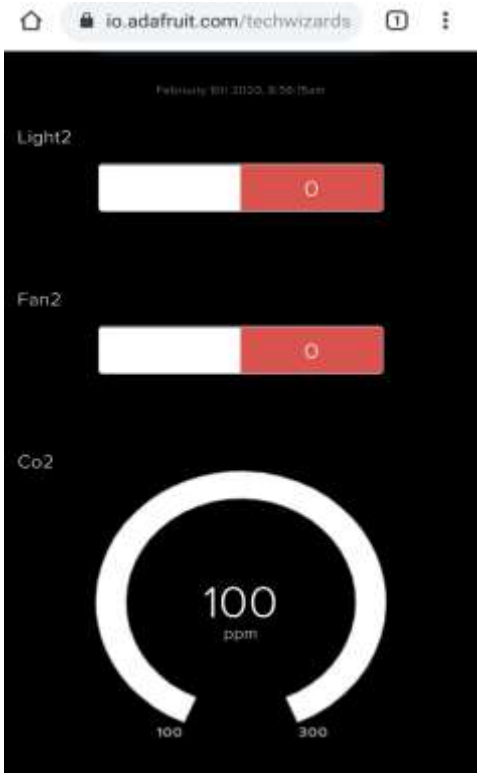

Fig -7: Value of Co2 gas displayed in Adafruit dashboard.

9. CONCLUSION

IoT Technology will become more efficient and everything can be controlled from one place. The IoT devices will work automatically and there is no need for human intervention. Home automation is flexible to accommodate new devices and appliances. A user can control the home appliances even if he/she is far away from home. In the future, the security system can also be enhanced by adding PIR sensors. It is known that all the homes will be equipped with such IoT devices which will make the daily lives and work of the users easier, faster and more accurate.

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