

# Home Automation and Home Security using Arduino and ESP8266(IOT)

J.Selvin Paul Peter, S. Selvakumar, Henum Pandit, Pratul Aggarwal

**Abstract:** The objective of the project is to develop a Home Automation System, that also focuses on home security with the present available environment condition, without any major changes to the already existing infrastructure. The project is developed using Arduino Uno and NodeMCU (ESP8266) as microcontrollers that control two different 4-Channel Relay that are in turn responsible for the operation of the home appliances. The Arduino Uno is programmed using the Arduino IDE and is interfaced with many sensors like Temperature Sensor, PIR sensor, Flame Sensor and Gas Sensor through jumper wires. The sensors provide the Arduino with various types of inputs which upon receiving the Arduino is programmed to perform certain type of operations, it gives user the ability to control the appliances automatically. Node MCU is also a type of microcontroller with the added feature of connecting to the Internet through the Wi-Fi Module that is already soldered on module. The NodeMCU is also programmed using the Arduino IDE, it is connected to the Internet through which it receives signal and perform certain action on the relay for which it has been programmed by the user. This feature gives user the ability to be able to control all of the home appliances manually through a click of a button on the Interface of the mobile application or through simple voice commands. The user was given both the option to either control the appliances manually using the app interface or the voice commands, or automatically based on the input provided by the different sensors that are interfaced with the Arduino board

**Keywords:** Arduino, NodeMCU, Relay, Sensors, IOT, MQ135, ESP8266.

## I. INTRODUCTION

The application's key focus is to be able to easily control household appliances, the user will be provided with better support. An on/off switch is given directly to act as an interface between the application and the NodeMCU which enables the user to manually control the appliance without the use of any automated device. The application has the feature of communicating with the appliances, which allows the user to send signals to the appliances through a secure application.

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**J.Selvin Paul Peter**, Asst Professor, SRM Institute of Science & Technology

**S.Selvakumar**, Asst Professor, SRM Institute of Science & Technology

**Henum Pandit**, Student, SRM Institute of Science & Technology

**Pratul Aggarwal**, Student, SRM Institute of Science & Technology

The application sends the command selected by the user to the Wi-Fi module i.e. the NodeMCU, it is further connected to a 4 Channel relay which acts as a switch for turning the appliances ON and OFF, the appliances can also be controlled using voice commands.

The Arduino is further interfaced with different types of sensors which is used to take input from different types of sensors and perform actions on the 4-CH Relay, the Arduino is also used to give external power to the relay so that it can be operated. Most of the sensors give input to the Arduino in Analog form, the Arduino takes the reading and perform the required action accordingly.

**Arduino Board:** It is an open source micro controller which can be programmed using Arduino IDE to perform various functions. The board is equipped with various digital and Analog Input and Output pins.

**NodeMCU(ESP8266):** It is an open source IOT platform that has the ability to connect to the Wi-Fi and also act as a micro controller to send and receive signal through which the user is able to signal which command needs to be performed by the Relay.

**4-CH Relay:** It is an electrically operated switch which can be used to control the appliances according to the command received by the user, it can be controlled both by Node MCU and Arduino.

**Temperature Sensor:** It is used to measure the temperature of its surrounding and act accordingly. It can be programmed to perform certain actions at certain temperatures.

**PIR Sensor:** It is the type of sensor which detects infrared radiations, which can be used to detect human presence and perform certain actions.

**Fire Sensor:** It is a type of sensor that is used for security purposes as it gets activated during the presence of fire and it usually triggers a buzzer.

**Gas Sensor:** It is a type of sensor that detects if there is a gas leakage, it can also be used to detect smoke and do the needful operations like triggering a buzzer etc.

## II. LITERATURE SURVEY

**H. Singh. et al**, IOT based smart home automation using sensor node.

**Conclusion:** The Arduino is connected to the Bluetooth module, all the appliances can be controlled using the Arduino but it needs to be within a small distance for it to connect to the Bluetooth.

**Disadvantage:** Since Bluetooth module is used, the range at which the home appliances can be controlled is reduced.



**P.J.Rani et al, Voice Controlled home automation system.**

Conclusion: The devices connected to the Arduino board can be controlled by voice commands, eliminating the need to control using the application interface.

Disadvantage: Since a user defined NLP algorithm is used, there can be times when the assistant is not able to recognize your commands properly.

**N. Vikram et al, A low cost Automation System.**

Conclusion: The system can be controlled directly from the Wi-Fi module which eliminates the need of using Arduino board, the command can directly be provided by the user to the module to control the appliances accordingly.

Disadvantage: Since the equipment that is used is low cost, there can be numerous occasions when you are **encountered** with errors or technical difficulties.

**Kushiro et al, Wi-Fi (Light Fidelity).**

Conclusion: This technology if practiced can turn every bulb into a hotspot to transmit wireless data, which can help us in achieving a cleaner future.

**Bhide et al, An intelligent Self Learning System for Home Automation using IOT.**

Conclusion: A smart home was developed that was able to control and monitor the usage of the appliances, it also takes into account the external environment conditions.

Disadvantage: Since a relatively new self-learning system is used the user is sometimes given outcomes that the user doesn't desire.

**Nagendra et al, An IOT Based Home Automation System using Android application.**

Conclusion: Wi-Fi technology was used to control the devices which uses an application on your smart phone, the system can be controlled even remotely.

Disadvantage: Since a Wi-Fi module is used, the application that is used to control the home appliances need to be connected to the internet at all times.

**Baby et al, Home Automation using IOT and chat-bot using NLP.**

Conclusion: A home automation system was developed that can be controlled by either an web application or a Chabot.

Disadvantage: Since a text Chabot is used instead of a voice Chabot the user needs to manually type in commands, which not only consumes more time but is also not convenient to the user.

**III. COMPONENTS**

**A. Hardware Components**



**Fig. 1 Arduino Uno**



**Fig. 2 NodeMCU**



**Fig. 3 Flame Sensor**



**Fig. 4 PIR Sensor**



**Fig. 5 Relay**



**Fig. 6 Smoke Sensor**



**Fig. 7 Temperature Sensor**

## B. Software Requirements

Arduino IDE to develop and upload the code to the board. Android IDE and MIT App Inventor to develop android app.

## IV. EXISTING SYSTEM

Most of the Smart home appliances that exist nowadays only have the provision of turning the machines ON and OFF. There are many systems available that aim to automate using NFC, Bluetooth and Wi-Fi. The existing system consists of a procedure to interact with the appliances, which usually includes pressing a button at some location within the application on your smart device. While some also have the provision to do so with the help of specific command. Many existing systems still uses Bluetooth module instead of the Wi-Fi module so the area of operation is greatly reduced. Many smart home appliances are available nowadays, which includes Amazon Echo, Google Home and Apple Home Kit, this is in order to bring home automation to every household.

## V. PROPOSED SYSTEM

The aim of the project is to give user both the option to either control various appliances through the app interface or through voice commands, which disregards the need to manually click within the application.

The user first needs to authenticate by entering the credentials required, the user is then given the option to either send a voice command or click any of the radio buttons present on app interface, the command is interpreted by the mobile and an appropriate command is sent to the appliance. The application on your smart device acts as a central means through which the user communicates with the appliances. The application sends the signals to the NodeMCU which in turn send the appropriate command to the Relay through which the appliances are controlled, this demonstrates the concept i.e. IOT. The ESP8266 is programmed to send controls to relay which in turns control the appliances. With the help of this project you will be able to automate every appliance, which will greatly help in reducing power consumption.

The user was also given the option to control the devices automatically using the input provided by the different types of sensor that are interfaced with the Arduino. The sensors provide the Arduino readings from the surrounding, the Arduino is in turn connected to the Relay which is in turn connected to the appliances, so the devices were able to be controlled automatically using the input from the sensors.

## VI. DESIGN AND IMPLEMENTATION

In this project the main component are the Arduino Uno and the NodeMCU. The Arduino board is connected to the relay and the sensors through jumper wires. The ground pin on the Arduino is connected to the ground pin on the different Sensors. The temperature sensor, smoke sensor, flame sensor, PIR sensor are connected to the (A0, A1, A2) pins of the Arduino board through which they provide input. The digital pin of the Arduino provides the relay with input and the relay performs the operation accordingly. The power supply is provided to the Arduino as well as the relay

module. The power supply to the sensors is provided directly by the 3.3V pin on the Arduino as well as 5V pin.

On the other hand, the NodeMCU is connected to another relay module which controls different Home Appliances. The NodeMCU is programmed to control different type of appliances through an application. The digital pins on the NodeMCU (D1, D2, D3, D4) are connected to the input pin of the relay. The relay provides the output of certain commands given by the user to turn the appliances ON and OFF.

The application is designed to be connected to the same IP as the Wi-Fi module so that exchange of signals can take place, the user selects an appropriate command through the application which sends signals to the NodeMCU through which the signal is forwarded to the relay, which is programmed to perform certain actions which includes controlling the appliances, when signals are received.

The mobile application is developed using Android IDE and MIT App Inventor that helps us to create an interface between the Node MCU and the mobile device. The application has various options to choose from, the user decides what commands to forward to the NodeMCU. The Wi-Fi module (NodeMCU) receives signal from the application, when the user opens the application he/she is provided with a field to enter IP address so that the user is able to control the appliances from anywhere as long as he/she is connected to the Internet. The application is also integrated with the voice commands. The user can control the appliances through voice commands.

## VII. WORKING

The Arduino Uno is interfaced with all the sensors that we are using in the project, the sensors provide the Arduino with input of specific type, upon receiving which the Arduino is programmed to execute a certain list of commands. The input received from the sensors are usually in analog form and hence are connected to the analog pin on the Arduino, every sensor has a different style of working, the discussed module provides the Arduino with different kind of Input received from different kind of sensor that are integrated with the device. The Arduino is programmed in such a manner that it is supposed to execute a set of commands depending upon the type of Input received from the sensors, the Arduino is connected to the relay through the digital pins, the Input to the relay is provided by the Arduino and based on the Input received the relay is turned ON and OFF. The NodeMCU is also used as it is also a type of microcontroller with the added functionality of connecting to the Internet using the Wi-Fi module, it is interfaced with the relay to give user the option to manually control all the home appliances either from the touch interface present on the mobile application or through voice commands. The digital pins on the NodeMCU are connected to the input pins on the relay, through which the relay receives input from the Arduino and based on the input received, the relay is turned ON and OFF.



The mobile application is designed in such a way that it sends a signal to the Arduino if any of the buttons are pressed through the application interface. There are a set of commands that the Application passes to the Arduino if there are any changes found in the state of the device.

As both the mobile device and the NodeMCU are connected to the Internet, it is very easy for interchanging of commands

### VIII. RESULT

The proposed system of using Voice commands to control household appliances was successfully developed. 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 developed system helps us in achieving our goal of home automation since it was successful in controlling the appliances using either the application on your smart device or through voice commands. The appliances were also be able to be controlled automatically through the different type of input provided by the Sensors.

### IX. CONCLUSION

We were successful in developing a system through which the user was given the ability to either control their household appliances through application or by using voice commands. The user is connected to the same network as the module so exchange of signal takes place frequently. This gives users the ability to automate his home without the need to buy expensive smart appliances, many advancements can be added to this project like adding motor to control window drapes, fire sensor to prevent mishaps etc.

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