

# Smart Circuit for Home Automation with Integrated Machine Learning

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## Abstract

This paper tells us the importance of Machine learning based home automation that will analyze the user behavior or pattern and predict the timings of the devices being used by the user, the data obtained by the Machine learning will be used to turn on and off the modules automatically without the user interference. By this system it avoids manual on and off procedures and can be controlled by using mobile phone. In our paper we are developing a hardware which is going to make the existing traditional circuit with non-smart devices (like Bulbs, Fans, Tube Lights, Air conditioner etc.) work as a smart device. Also it consists of various sensors which will give real-time picture of particular room.

## Article History

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## 1. Introduction

In this day to day aspects of life, Home Automation technology has made a huge impact in life and widely used everywhere. It is a technology which is used daily anywhere in the home environment related to Music, Led lights, and you can even apply in TV which can be turned on just by your voice these technologies provide comfort, security, convenience, and save energy efficiency by allotting a time for an specific appliance to turn (On/OFF) after a particular time and this can be done by just an application installed in an user phone or by speech [5].

It is a technology which involves real time analyzing of data and processing it in real time with no delay and take control of it by just an application and monitoring of the complete surrounding environment. IOT is an inter-connected networking environment that has been allocated a Unique IP to every product and is capable of simultaneously processing various types of data. It is capable of transferring huge giga bytes of data information and processing it parallelly. An IoT ecosystem receiver data from the sensors and the information is passed on to the cloud by network medium in cloud the obtained data is processed to find the required output and the Output obtained is passed on to the user mobile by SMS or by app notifications [3]. IoT has the required ability to obtain information from anywhere irrespective of time and location. By this technology it provides more comfort and convenience to the user. Most companies gain beneficial by this technology as the tasks are automated and these it leads to less work.

By applying Machine learning in IoT it makes the devices smarter and it can predict next decision taken by the user. The trained data obtained from various devices can be analysed and it will be used in predicting user behavioural pattern. The IoT mainly relies on the network medium for connecting between many devices. In addition to providing smart devices for home automation, IoT provides businesses framework with a real-time look at how their systems performance, providing in depth insights into everything from system performance to supply chain and logistics operations. By IoT technology companies can automate processes for more efficiency and greater reliability. IoT provides beneficial to all the important sectors, including healthcare, finance, retail and production. Smart cities assist people in day to day aspects of life and giving suggestion whenever required.

As such, IoT is one of everyday life's most significant technologies and will continue to pick up steam as more companies recognize the potential of connected devices to keep them competitive [1].

Machine learning is an application of artificial intelligence (AI) that provides systems the ability to automatically learn and improve from experience without being explicitly programmed. Machine learning focuses on the development of computer programs that can access data and use it learn for

themselves [12]. The application of machine learning for IoT enables users to obtain deep analytics and develop efficient intelligent IoT applications [12]. The application of machine learning for IoT enables users to obtain deep analytics and develop efficient intelligent IoT applications; this is because machine learning can provide feasible solutions to mine the information and features hidden in IoT data.[12]

In the next section related work is discussed. In section III methodology is presented. Section IV shows the Results and discussion. In the V<sup>th</sup> section Conclusion and Future scope is discussed.

## 2. Related Work

In 2019, "Smart Energy Efficient Home Automation System Using IoT" [1] is published by Satyendra K. Vishwakarma et.al. In this paper they have shown the major concern while doing the project was the power consumption. The main idea is to make smart home friendlier to the user, which will be convenient and efficient to the user. The proposed system has advantage of using in multimodal which means in the presence of noise in the surrounding the performance of the google assistance gradually decreases, in such cases web-based application is helpful in controlling the system.

In [2] by Brundha S.M et.al. Client-Server interaction are shown which are provided with internet based on SSID (Service Set Identifier) & password once these requests are matched, they are activated and can be operated, By the presence of PIR sensor in which brightness of bulb varies based on external environment brightness. Host server is created with hosting official site. PIR sensor contains web-cam which captures the image of person entered then compares with the trained images in database if it is not matched alarm triggers and notification is sent to the user by using server in which user can get the image of intruder by accessing Node MCU. The major concern of this paper was security.

In 2017, "Collection and Analysis of System Usage Data in Smart Home Automation Systems"[3] by Sandra Ivanović et.al a paper is presented, here they have tried to implement a basic solution for collection and retrieval of usage of data within the existing home automation system. Data collection modules are implemented, which run on the home automation gateway and within the home automation cloud, and allow us to connect to the already existing big data middleware platform. By storing and analyzing device consumption and sensor data in the smart home environment, the system learns about user's daily habits. In all the paper mentioned above they all have shown concern about some specific domain. Satyendra K. Vishwakarma have tried to solve the problem of energy consumption and make the smart home interaction friendly. Brundha S.M have shown how to operate home automation secure by providing PIR sensors. And Sandra Ivanović has tried to analyze the data of home automation to get the pattern of

usage and what the analyzed data they suggest actions and setting for the home automation system.

In [4] published by IshanKrishnaet.al. points out about Home Automation system using voice commands, and they used LEDs and server shields which helps in transmitting user commands through the use of TCP and UDP protocol. A voice controlling software, BitVoicer is also used which interacts with the Arduino board. Through BitVoicer, user can give commands to Arduino board, and it is highly useful for the elderly and physically disabled people. Also, the range of voice commands can be increased using artificial intelligence.

In [5] by Surajet.al. In this they have shown a vision based machine intelligence system to sense the ON/OFF state of commonly used appliances and they have bimodal approach of providing the user with a website which allows to control the states of appliances along with monitoring the home using camera images. The proposed technology for home automation is very much limited to detecting the states of devices of a given color which acts as a major constraint to generalize the model to work on any set of Television, Fan, and Tube light, and a generalized database of images of ON/OFF states of these appliances of various brands which come in different colors can be collected. Once a variety of textual and color scenarios of appliances are being fed as training examples to the machine learning model.

In [6] by Harsh Kumar Singh Et.al, the User can control switches using a web application after authentication. In this a real-time home automation system has been successfully implemented which is quite effective in terms of performance and technology. The log file been generated as a result of changing state of appliances, through which the system will learn how the user operates the appliances, the system can automatically change the state of the appliances based on the behavior of the user.

### 3. Methodology

#### Proposed Model

The proposed system is a hardware setup which automated to work by the input of user. The input can be the user voice or

Message typed in the google assistance. The proposed system consists of many sensors which provide real time picture of the house on the google assistance when user want to see it.

One of the sensors is DHT11 sensor which sense the temperature and saves the value into the variable. When requested by the user or the machine learning algorithm the value is return back to them. Also, there is a PIR sensor which check any motion and turn the lights on or off accordingly.

#### Motion Detection

Our proposed model includes motion sensor which will sense the motion and turn the lights on or off accordingly. The PIR sensor which is installed at the entrance of the room and when it senses some motion it will trigger the lights to turn it on. This service can be overridden by giving command to stop the motion detection.

The positive pin of the sensor is connected 5V output of the ESP8622 and the negative pin is connected to the ground the third pin which is the output pin of the sensor is connected to the one of the input pin of the ESP8266.

#### Voice Operation

One of the most important function of the project is the voice operation. The proposed model takes input in the form of voice command. Here the voice command is processed with very effective method called IF THIS THEN THAT (IFTTT). IFTTT is the method of passing command through the Google Assistance to the "adafruit" server which then send the command back to the hardware.

The table 1 shows some of the sample command which can be called by the user in the google assistance to handle the hardware. Response is the sentence which we will get to know that the command was understood by the google assistance and has been forwarded to the IFTTT for the further processing. And finally after the processing is completed which takes a fraction of second the result can be seen.

Table 1: Command and output

Command	Response	Result
Hey google	Hello, how can I help you?	Trigger the Google Assistance
Turn on the light	Ok, turning on the light	Turns the light on
Turn off the light	Ok, turning the light off	Turns the light off
Turn on the fan	Ok, turning on the fan	Turns on the fan
Turn of the fan	Ok, turning off the fan	Turns off the fan
What's the temperature of the room	The temperature of the room is	Tells the temperature of the room

#### Temperature Sensing

In our proposed system we are using DHT11 sensor to sense the temperature of the room. The data is collected from the sensor and sent back to the ESP8266.

The connection of this sensor is same as the motion sensor as they both used to retrieve the data. The positive pin of the sensor is connected 5V output of the ESP8622 and the negative pin is connected to the

ground the third pin which is the output pin of the sensor is connected to the one of the input pin of the ESP8266.

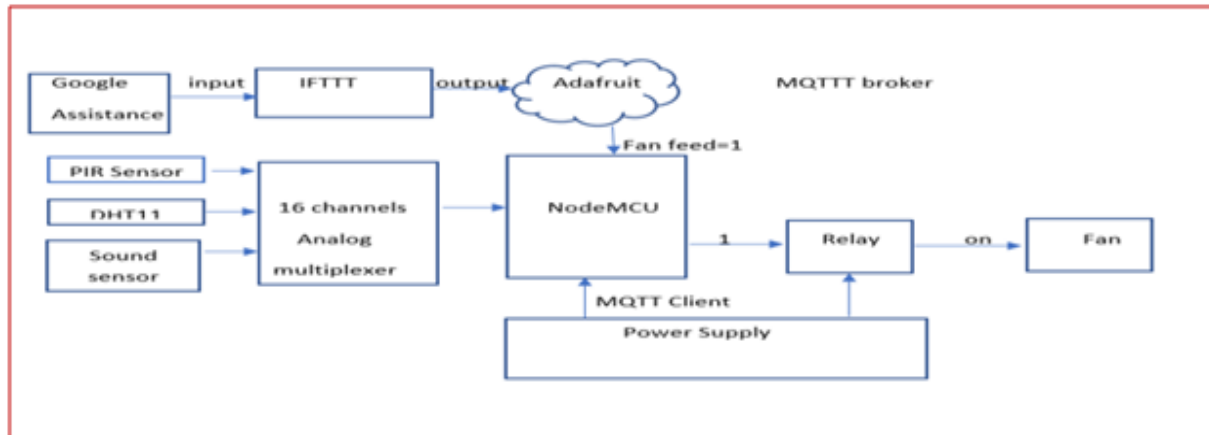


Figure 1: System Architecture

### Voice Control

When the user gives a voice command like turn on or turn off which doesn't required an sensor then the command is forwarded to the IFTTT by the google assistance and the IFTTT will further forward it to the adafruit server which will send request to the hardware for the changes of the state of the device.

If the command given by the user include the interaction with the sensor then the process become little longer to explain. First the command is taken by the user and forwarded to the IFTTT and the IFTTT will send it to the adafruit server, the server further send it to the hardware requesting the data from the sensor. Now the sensor will save the data to a variable which will be retrieve by the adafruit server and sent back to the user google assistance screen and the

voice of google assistance will read it for the user if requested in that way.

### Log File Creation

When some changes happen to the hardware, the separate embed C program will identify this and make a note if it in the log file, which is shown in the Fig 3. This log file include five column first is the Name of the device which is being used, second column is the time which is nothing but the time at which the device is been used or changed the state of the device. Third is the date and which is the date of the event has happen. Fourth column include the initial state of the device before the command is given by the user. The last and the fifth column has the final state of the device after the command is executed.

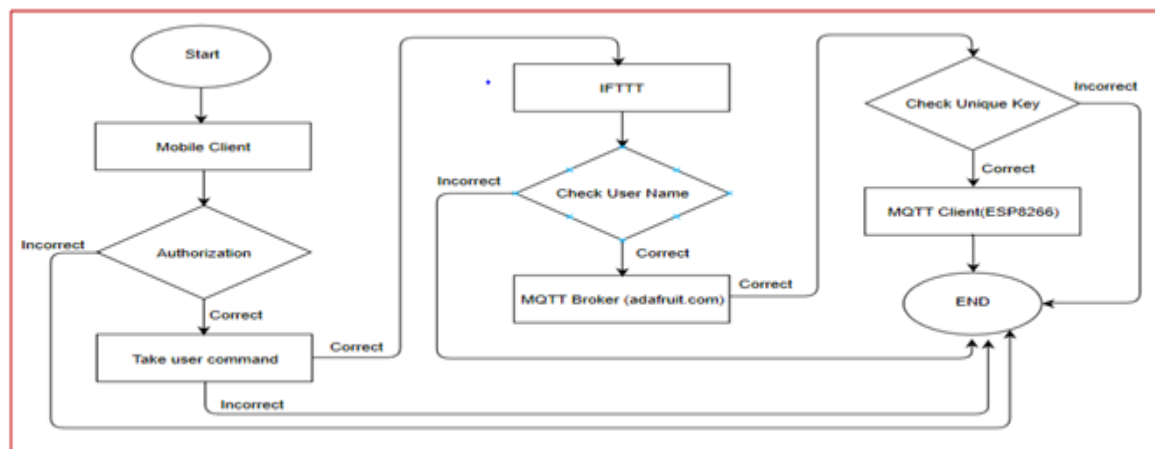


Figure 2: Work Flow Diagram



Fan	16:37:10	03-03-2020	OFF	ON
Bulb	18:45:19	03-03-2020	OFF	ON
Tube Light	20:42:33	03-03-2020	OFF	ON
Bulb	20:42:25	03-03-2020	ON	OFF
Tube Light	22:15:40	03-03-2020	ON	OFF
Bulb	22:15:59	03-03-2020	OFF	ON
Bulb	22:33:42	03-03-2020	OFF	ON
AC	22:30:55	03-03-2020	OFF	ON

Figure 3: Sample Log File generated by the system

### Log File Analysis

The log file created are now being used to analyze by “Log File Analyzer”, and predicting the way of the usage of the devices. These prediction is being used to automate the devices and recommending user when to turn on or turn off the devices.

## 4. Results and Discussion

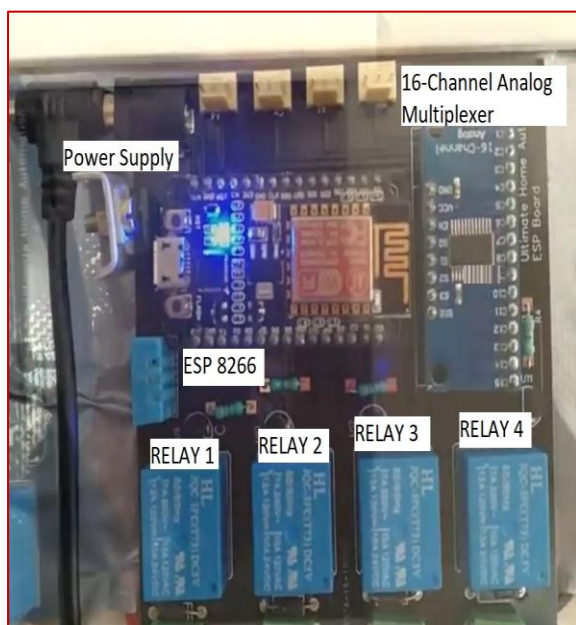


Figure 4: Hardware

The Hardware shown in the Fig 4 consists of four relays which is responsible for turning on and off of the devices like Lights Fans etc. there is one 16 channel Analog Multiplexer which is used to make connections between our hardware board and the different sensors used which is shown in the Fig.5. These sensors are responsible to give the real-time data of the environment. The main component of the hardware is the ESP8266 which is the 16 Bit micro controller, in the microcontroller the code for all the process is coded.

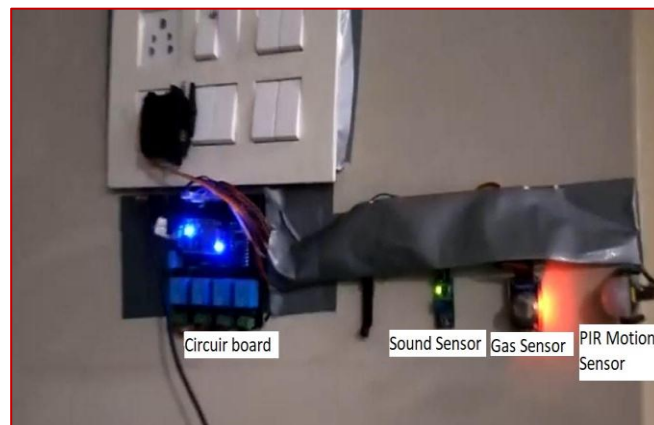


Figure 5: Hardware with sensors

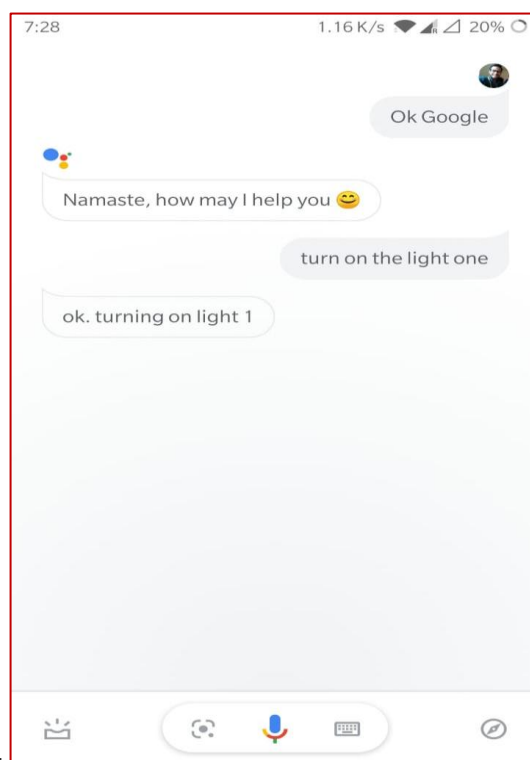


Figure 6: Screenshot

Fig 6 shows the screenshot of the interaction between the user and the system. In the screenshot we can see that the first command is the command used to trigger the google assistance, the second statement is the reply from the google assistance to the user confirming that is working and ready to take command from the user.

The third statement is the command given by the user to the google assistance to perform operation. Here user asked to “switch on the light one”, in return google assistance replies “Ok, turning on the light1” confirming that command is being process and the light is going to turn on.

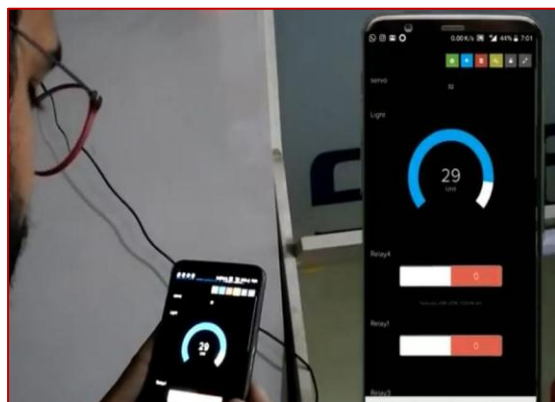


Figure 6: Reading from the sensor

On the successful compilation of the project we will be able to control non-smart appliances as a smart device. By the use of weather update our device notify us about when the appliances should be used and moreover we are able to get notification if any appliances is left turned on more than prescribed limit, as a result we can reduce the usage of electricity and will have save and secure environment to access our devices efficiently. Moreover, by the uses of sensors are able to get the real time condition of the environment where the sensors are installed, and accordingly we can change the status of the appliances remotely. And the because of integrated machine learning, user can allow the system to control the device automatically.

## 5. Conclusion and Future Scope

By this developed project we are going to predict at what particular time the devices are going to switch on and off by using Machine learning technique after one week of training it is going to take decisions automatically based on training database.

This module can be further improved by using 3D-Infrared camera, so that it is going to recognized at night time with accuracy up to 95% to open the doors automatically within a fraction of seconds and two factor authentications like inbuilt security system can be added to improve the security of the user and the hardware from being hacked by someone.

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