Smart Home Automation System with Voice Control

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***Abstract*— Home automation is the new era in the field of technology where we all can control our regular electrical home appliances. It is very useful and it's used in today's tech world. Everything can be controlled from anywhere in the world because the distance is not a boundary anymore. Although now in the current market we all can see that there are some smart devices which are very costly. Nowadays smart led light are dominant over normal lights. So, for that reason, we need a middle system that can convert our regular home to a smart home. By using voice command, you can be able to turn on and off that device easily from anywhere in the world. This research paper presents a very useful low-cost IoT work that is very flexible with our current non-smart electrical devices which has the potential to convert our traditional electric devices to an IoT-enabled devices. It can simply connect to the internet by using home Wi-Fi or any hotspot.**

Keywords*— *Electrical Devices, IoT, Internet, Voice command.

I. INTRODUCTION

Most of the people in our society work in some private company, for their jobs, they have to leave their homes to attend the office early in the morning and they will return back to their houses in late night. In that stated scenario, it is very obvious that time & money is a very important thing for everyone. Let's consider a person who lives alone has no other choice to return home if he/she forgets to turn off any electrical device before leaving the house for office, it is a very bad thing for him because, there is no one in the home to turn off that electric device & this is the big reason for electricity wastage & maybe some kind of electrical hazard.

In today's world the concept of smart appliances which can be connected with the internet and accessed by their users anywhere in the world is becoming a necessity. Suppose in the time of summer you are returning to your home from your office and you have to wait a few minutes after turning on your Air conditioner to cool your room, in this situation if you have the option to turn on your air conditioner five or ten minutes before you reach your home then it will be the more peaceful situation. So, for solving that issue we are introducing a new idea by using the IoT in our homes. The person needs a middle device that can allow him to turn on or off that regular air conditioner or any regular electrical appliances from anywhere through the internet and it is possible when he/she will use our concept.

II. LITERATURE SURVEY

In the Year 2011 R. Piyare and M. Tazil published a paper named "Bluetooth based home automation system using a cell phone" in the "2011 IEEE 15th International Symposium on Consumer Electronics" in Singapore [1], they proposed the method which was very useful although there concept is very useful and secure there is a limitation of distance, as Bluetooth signal is not capable enough to connect a device above 5 - 10 meters, and Bluetooth is not capable enough to communicate or establish a connection with a home Wi-Fi router so the range is becoming a big concern because although their concept is implemented in a particular area globally the connectivity will not be possible this concept is useful in intranet domain but not fully useful in the actual internet domain. Previously In the Year 2015 Sonali Sen, Shamik Chakrabarty, Raghav Toshniwal, Ankita Bhaumik published a paper named "Design of an Intelligent Voice Controlled Home Automation System" [2] in the International Journal of Computer Applications, they proposed the method of voice recognition based home automation concept which was amazing and future-ready but the main problem was that it was using Bluetooth for communicating with the Arduino module. So, in that case, the Arduino module is not accessible via the internet and it limits its usability. Earlier in the year 2017 M. Abivandhana, K.Divya, D. Gayathri, R. Ruhin Kouser published a paper named "Smart Home Automation Based on IoT and Android Technology" in IJESC [3]. In their research paper they explained home automation through Bluetooth and GSM communication technology which is actually used locally by using Bluetooth signals and global by using traditional GSM signal. A paper published by J. Vijaya Kumari & Pavithra Neelam in the year 2021 named "IoT Based Smart Home Automation System" in JETIR [4] also demonstrates the IoT by using NodeMCU, but speech recognition technology was not embedded with that. Previously in the year 2019 K. Lova Raju, V. Chandrani, SK. Shahina Begum, M. Pravallika Devi published a paper named "Home Automation and Security System with Node MCU using Internet of Things" [5] in the International Conference on Vision Towards Emerging Trends in Communication and Networking (ViTECoN), the study on the overall IoT based system using nodemcu and the system security was discussed by them. In the year 2020 a paper on "Wireless Home Automation with Security System" was published in the International Journal of Electrical Engineering and Technology (IJEET) [6] by Jolan

Baccay Sy, Shegaw Melak Akele & Edward B. Panganiban briefly researched an RFID based authentication system with home automation.In the year of 2017 Menal Dahiya was also published a paper named "Bluetooth Remote Home Automation System using Internet of Things" [7] in the International Journal of Innovative Research in Computer and Communication Engineering, discussing about the home automation using Bluetooth technology. A paper was also published in the year of 2019 by A. Senthil Kumar & Easwaran Iyer named "An Industrial IoT in Engineering and Manufacturing Industries – Benefits and Challenges" [8] on International Journal of Mechanical and Production Engineering Research and Development (IJMPERD) discussed about the industrial benefits & challenges & implementation of the IoT & IIoT in industry level.

III. RESEARCH METHODOLOGY

A. Hardware Requirements

- NodeMCU ESP 8266 Board (Fig 1, Fig 2):- A NodeMCU is a 32bit microcontroller used in IoT projects. It is an open-source microcontroller. It has a total of 11 I/O Digital Pins and 1 Analog Input Pin. It has an ESP 8266 Wi-Fi module on-chip for communication and internet connectivity. It has 4MB of flash storage and the clock frequency is 80MHz. The NodeMCU is a very low-cost IoT platform and it has an initial firmware that runs on esp8266 SoC. The firmware of NodeMCU uses Lua-based firmware. It has also a memory of 128Kb. It has a total of 30 pin headers. It can be easily programmed with Arduino

Fig. 1. NodeMCU ESP 8266 Board

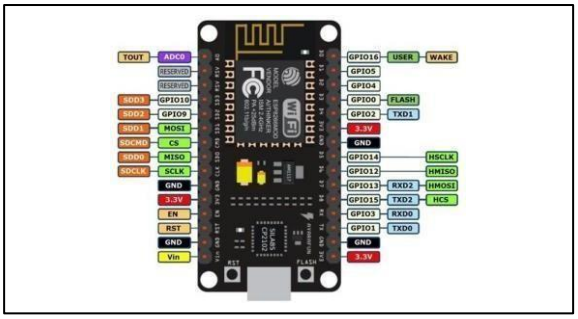

Fig. 2. NodeMCU ESP 8266 Board Pin Diagram

- 4 Channel Relay Module (Fig 3): - The 4-channel relay module is used as an interconnector between the low voltage and high voltage devices. The module contains 4 relays which are used as a switch. The relay module has one +5V Vcc & one Ground Connector pin and four input pins through which the microcontroller sends the needed digital input in terms of HIGH & LOW (0 or 1) for controlling the relays.

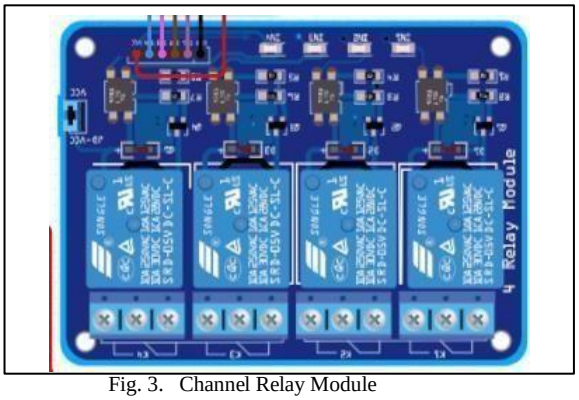

Fig. 3. Channel Relay Module

- LDR Module (Fig 4):- LDR sensor module is an analogue sensor module that can measure and dig out light intensity. This sensor has a Light Dependent Resistor that helps to detect light. This module has 4 terminals. There is a "DO" pin which is a digital output pin. The "AO" pin is an analogue output pin. When light is absent the output of the module is high and when there is a presence of light then the output becomes low. Also, there is a potentiometer knob that is required for the adjustment of the sensitivity of the sensor. This sensor is also known as the Photoresistor sensor. This sensor consists mainly of the LM393, Comparators, Variable Resistor(Trim Pot), Output LED, Power LED. The LDR works on the principle of "Photo Conductivity". The resistance of the LDR changes according to the light intensity that falls on the LDR. When the intensity is high then the resistance will decrease and vice-versa. When intensity is high on the surface of the LDR then LDR resistance decreases. After that, the maximum voltage will pass across the resistor's a minimal voltage from the LDR is put to the inverting input of the IC. In this scenario, the voltage taken as input is less than the threshold voltage. Due to this sensor output goes to LOW. And the opposite goes for HIGH". The microcontroller takes that input value through the analogue input pin.

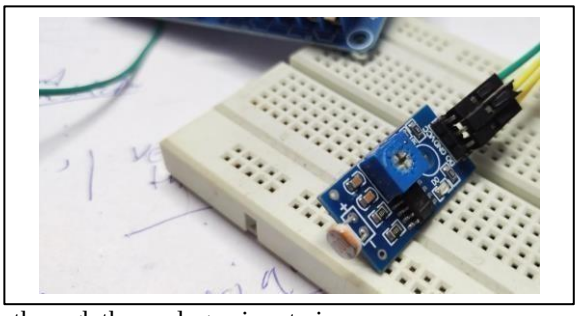

Fig. 4. LDR Module

- PIR Motion Sensor Module (Fig 5):- PIR or passive infrared sensor is a motion sensor that senses the motion by taking and analysing the infrared light

radiating by the moving object. The PIR Motion sensor detects the motion by analysing the infrared radiation or radiant heat reflected from any moving thing. It has 3 pins one is for 3.3V DC Vcc and the Other one is for GND and the middle one is a Data or Digital Pin for the output if motion detects it provides "High" as an output otherwise it gives "LOW" as output in binaries 1's and 0's where 1 is for High and 0 is for Low. As the PIR sensor provides the output in digital like 0's and 1's its output/data pin is normally connected with the digital pins of the NodeMCU board. The PIR module has 2 types of modes one is the single trigger and the second one is the Repeat trigger. This PIR sensor it has two potentiometers one is for detection range and another one is for delay setting.

Fig. 5. PIR Motion Sensor Module

B. Workflow diagram (Fig 6):-

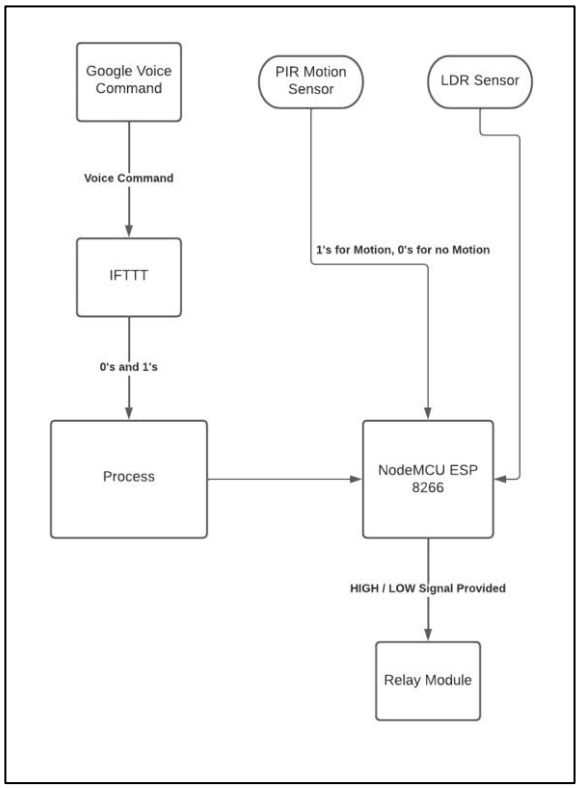

Fig. 6. Workflow Diagram

C. Circuit Diagram (Fig 7):-

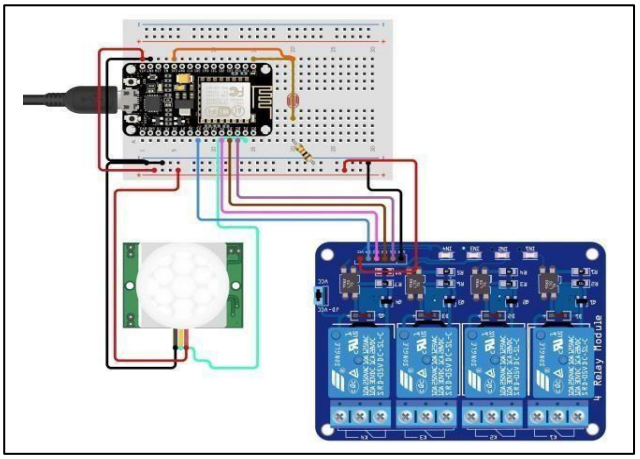

Fig. 7. Circuit Diagram

IV. WORKING PRINCIPLE

Our research paper is based on home automation by using some hardware like NodeMCU which is our main microcontroller and 4 channel relay module which acts as the smart switch which operates on traditional electric appliances. We are also using a PIR motion sensor which will sense the motion and LDR which we use to sense the environment's light intensity. The motion sensor provides the digital input to the microcontroller LDR sensor provides an analogue signal to the microcontroller. The software like Google Assistance, Blynk, and IFTTT are used in our research. At first according to the circuit diagram all the connections will be made electrically then we have to install the Blynk app to our smartphone and configure each relay. Now we have to configure the google assistant with Blynk and IFTTT. Now everything is done, thus the whole system is ready to be used through the Blynk app & Google assistant. The microcontroller sense the data from LDR and PIR motion Sensor, when the environment light and motion are detected, then it selects a specific relay to active state.

Fig. 8. Application Working model

V. RESULT AND DISCUSSION

When any person provides the voice comment to activate or deactivate any electrical appliances the system will do so. Several observations on the research model are done to verify its working in a practical scenario. Total 5 types of observations are taken on the research model, the 1st one is the voice assistance working or functioning in terms of command given as "Turn on & Turn off Light" 2nd observation is based on the voice command given as "Turn on & off Fan", 3rd observation is based on controlling water Pump by providing command as "Turn On and Turn Off- Pump" and 4th one is the observation on Chimani by proving some voice command to Turning on and off that Chinami by using voice, all though we get total 98% accuracy for above 4 observation, the fifth observation was automated by the system, the system will turn a light on when motion is detected by the sensor and there is no light in the environment, The LDR sensor is responsible to sense the light intensity and the PIR module is responsible to detect motion by using passive infrared the model get 97% accuracy on the 5th observation. By getting all observations the average accuracy of our model is 97.5%. Most of the time our system behaves perfectly which is should be.

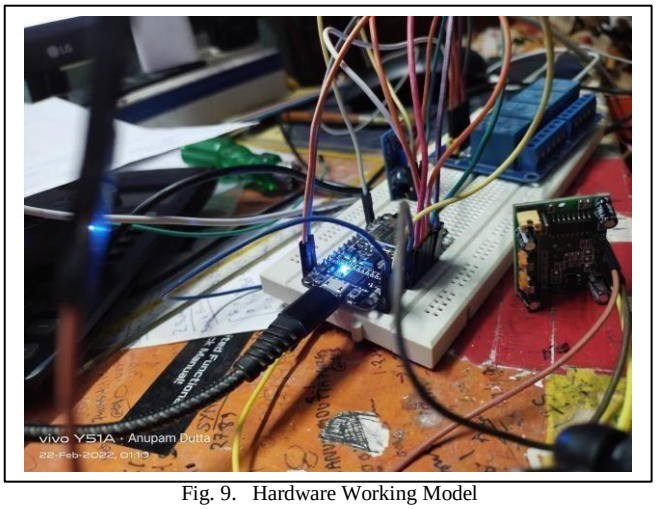

Fig. 9. Hardware Working Model

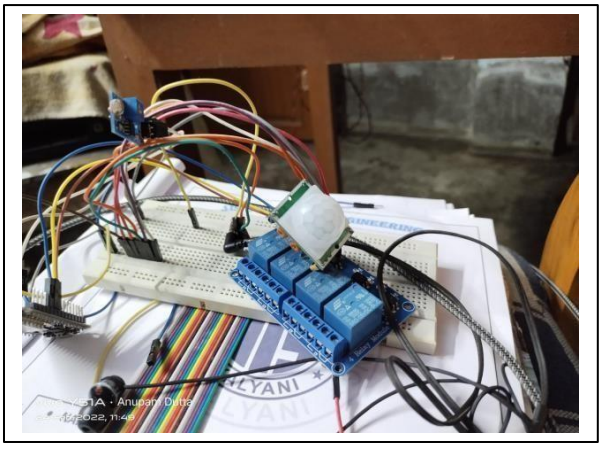

Fig. 10. Hardware Working Model

TABLE I. EXPERIMENTAL DATA ANALYSIS FOR THE VOICE COMMAND TO CONTROL THE LIGHTS.

Sl. No.	Sample	Instruction Given	Result	Performance State (%)
Command Given When Light Current State is Off				
1	1	Turn On Light	Light Turned On	100
2	2	Turn On Light	Light Turned On	100
3	3	Turn On Light	Light Turned On	100
4	4	Turn On Light	Light Turned On	100
5	5	Turn On Light	Light Turned On	100
6	6	Turn On Light	Light Turned On	100
7	7	Turn On Light	Light Turned On	100
8	8	Turn On Light	Light Turned On	100
9	9	Turn On Light	Light Turned On	100
10	10	Turn On Light	Light Turned On	100
Command Given When Light Current State is On				
11	1	Turn Off Light	Light Turned Off	100
12	2	Turn Off Light	Light Turned Off	100
13	3	Turn Off Light	Light Turned Off	100
14	4	Turn Off Light	Light Turned Off	100
15	5	Turn Off Light	Light Turned Off	100
16	6	Turn Off Light	Light Turned Off	100
17	7	Turn Off Light	Light Turned Off	100
18	8	Turn Off Light	Light Turned Off	100
19	9	Turn Off Light	Light Turned Off	100
20	10	Turn Off Light	Light Stays On	0

TABLE II. EXPERIMENTAL DATA ANALYSIS FOR THE VOICE COMMAND TO CONTROL THE FAN

Sl. No.	Sample	Instruction Given	Result	Performance State (%)
Command Given When Fan Current State is Off				
1	1	Turn On Fan	Fan Turned On	100
2	2	Turn On Fan	Fan Turned On	100
3	3	Turn On Fan	Fan Turned On	100
4	4	Turn On Fan	Fan Turned On	100
5	5	Turn On Fan	Fan Turned On	100
6	6	Turn On Fan	Fan Turned On	100
7	7	Turn On Fan	Fan Turned On	100
8	8	Turn On Fan	Fan Turned On	100
9	9	Turn On Fan	Fan Turned On	100
10	10	Turn On Fan	Fan Turned On	100
Command Given When Fan Current State is On				
11	1	Turn Off Fan	Fan Turned On	100
12	2	Turn Off Fan	Fan Turned Off	100
13	3	Turn Off Fan	Fan Turned Off	100
14	4	Turn Off Fan	Fan Turned Off	100
15	5	Turn Off Fan	Fan Turned Off	100
16	6	Turn Off Fan	Fan Stays On	0
17	7	Turn Off Fan	Fan Turned Off	100
18	8	Turn Off Fan	Fan Turned Off	100
19	9	Turn Off Fan	Fan Turned Off	100
20	10	Turn Off Fan	Fan Turned Off	100

TABLE III. EXPERIMENTAL DATA ANALYSIS FOR THE VOICE COMMAND TO CONTROL THE WATER PUMP.

Sl. No.	Sample	Instruction Given	Result	Performance State (%)
Command Given When Pump Current State is Off				
1	1	Turn On Pump	Pump Turned On	100
2	2	Turn On Pump	Pump Turned On	100
3	3	Turn On Pump	Pump Turned On	100
4	4	Turn On Pump	Pump Turned On	100
5	5	Turn On Pump	Pump Turned On	100
6	6	Turn On Pump	Pump Turned On	100
7	7	Turn On Pump	Pump Turned On	100
8	8	Turn On Pump	Pump Turned On	100
9	9	Turn On Pump	Pump Turned On	100
10	10	Turn On Pump	Pump Turned On	100
Command Given When Pump Current State is On				
11	1	Turn Off Pump	Pump Turned Off	100

12	2	Turn Off Pump	Pump Turned Off	100
13	3	Turn Off Pump	Pump Turned Off	100
14	4	Turn Off Pump	Pump Turned Off	100
15	5	Turn Off Pump	Pump Stays On	0
16	6	Turn Off Pump	Pump Turned Off	100
17	7	Turn Off Pump	Pump Turned Off	100
18	8	Turn Off Pump	Pump Turned Off	100
19	9	Turn Off Pump	Pump Turned Off	100
20	10	Turn Off Pump	Pump Turned Off	100

TABLE IV. EXPERIMENTAL DATA ANALYSIS FOR THE VOICE COMMAND TO CONTROL THE CHIMNEY

Sl. No.	Sample	Instruction Given	Result	Performance State (%)
Command Given When Chimney Current State is Off				
1	1	Turn On Chimney	Chimney Turned On	100
2	2	Turn On Chimney	Chimney Turned On	100
3	3	Turn On Chimney	Chimney Turned On	100
4	4	Turn On Chimney	Chimney Turned On	100
5	5	Turn On Chimney	Chimney Turned On	100
6	6	Turn On Chimney	Chimney Turned On	100
7	7	Turn On Chimney	Chimney Turned On	100
8	8	Turn On Chimney	Chimney Turned On	100
9	9	Turn On Chimney	Chimney Turned On	100
10	10	Turn On Chimney	Chimney Turned On	100
Command Given When Chimney Current State is On				
11	1	Turn Off Chimney	Chimney Turned Off	100
12	2	Turn Off Chimney	Chimney Turned Off	100
13	3	Turn Off Chimney	Chimney Turned Off	100
14	4	Turn Off Chimney	Chimney Turned Off	100
15	5	Turn Off Chimney	Chimney Stays On	0
16	6	Turn Off Chimney	Chimney Turned Off	100
17	7	Turn Off Chimney	Chimney Turned Off	100
18	8	Turn Off Chimney	Chimney Turned Off	100

TABLE V. EXPERIMENTAL DATA ANALYSIS FOR THE MOTION AND ENVIRONMENT LIGHT DETECTION.

Sl. No	Sample	Real Condition		System Output		Relay O/P	Performance State (%)
		Motion	Light	Motion	Light		
1	1	YES	YES	YES	NO	HIGH	100
2	2	YES	YES	YES	YES	LOW	100
3	3	YES	YES	NO	YES	LOW	100
4	4	YES	YES	YES	YES	LOW	100
5	5	YES	YES	YES	YES	LOW	100
6	1	NO	YES	NO	NO	LOW	100
7	2	NO	YES	YES	NO	HIGH	0
8	3	NO	YES	YES	YES	LOW	100
9	4	NO	YES	NO	YES	LOW	100
10	5	NO	YES	NO	YES	LOW	100
11	1	YES	NO	YES	NO	HIGH	100
12	2	YES	NO	NO	NO	LOW	100
13	3	YES	NO	YES	NO	HIGH	100
14	4	YES	NO	YES	NO	HIGH	100
15	5	YES	NO	YES	NO	HIGH	100
16	1	NO	NO	NO	NO	LOW	100
17	2	NO	NO	NO	NO	LOW	100
18	3	NO	NO	YES	NO	HIGH	100
19	4	NO	NO	NO	NO	LOW	100
20	5	NO	NO	NO	NO	LOW	100

VI. CONCLUSION & FUTURE SCOPE

In this paper, we have developed and given a concept about how the IoT can change regular home appliances and provide more flexibility to us in our daily life. As the technology is upgrading day by day, we also have to take some measures to modify our regular devices with smart ones, but for reducing the cost we have proposed our concepton those aspects.

As our research paper is based on IoT it has a lot of scope for future expansion and upgradation. Firstly, our research should be incorporated with other sensors like humidity and temperature sensor so that our operations will be more useful and relevant. Secondly, in our research, we didn't use any camera module for video or image processing purposes, but nowadays it is very important to use Machine Learning algorithms for getting more accurate results and data, in future we add a camera and by using a video processing

algorithm the System will accurately take a needed decision. If the System detects that the person at the home is sleeping but forgot to turn off the light then the system will automatically be able to turn them off. Thirdly, our provided concept has a drawback because in case of Wi-Fi router failure the system will not work, so, we are planning to make some changes in the future and add the GSM and Bluetooth module for solving that issue. Otherwise, lots of up-gradation is possible in the future in this IoT domain.

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