

Voice Control IoT Home Automation using Bluetooth Module

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Abstract - Modern technology is progressing nowadays to develop a system that will benefit humans utilizing current technologies. This paper describes the development of an inexpensive, user-friendly, and secure home automation system based on Android. The home automation system controls all lights and electrical appliances in a home or office using voice commands. This article describes the implementation of Bluetooth technology and an Android application with voice prompts home-automated system using an Arduino microcontroller. The system is aimed at designing an automated appliance control that is user-friendly and convenient to use. The design comprised an Arduino Uno microcontroller board, a Bluetooth module (HC-06), and an Android application (MIT App Inventor 2). The Arduino controls any connected component and was programmed with C++ programming language by using the Integrated Development Environment (IDE). Relays are used for the switching mechanism. Once the system is connected, the user controls the electrical appliances connected to the home-automated system, which can also be controlled using a voice prompt with the help of a Google assistant built with the Android smartphone. The system switches the home appliances ON and OFF using the Android app, Bluetooth module, and voice prompt. It can also be timed to switch off appliances for a pre-time of 12 hours, thus making the application easy and convenient to operate via a smartphone.

Keywords: Home Automation, Smartphone, Arduino UNO Controller, Hc-06 Bluetooth Module, 2 channel Relay Module, Android application (MIT App Inventor 2), Home Appliances.

1. INTRODUCTION

The 21st century is the era of the fastest period of evolution in information technology. Every single day the concept behind the scenes is getting more and more complex to provide humanity with the best level of comfort. Whenever the thinking goes to think of the most prominent technology that has completely altered people's way of interaction with the normal World, then in that stage the clear concept of IoT (Internet of Things) pops up in mind. The Internet of Things (IoT) has become one of the most common things nowadays. This is due to the existence of cloud storage that allows people to access their data and share all kinds of information with whomever they want to, regardless of when or where. This smart thing is the gateway between our physical world and the internet where it enables information to be spread quickly. The Internet of Things makes human life easier, safer, and smarter. There are three main components in an IoT system for home automation namely IoT Gateway, Virtual Assistant, and User Interface. These three components are essential elements to building an IoT system. In the Present day, everybody has a smartphone and wants to control everything from an Android device. Everyone is aware of how to control cell phones so it is simple to utilize and comprehend. Lights, fans, switches, and coolers are

controlled through Bluetooth based far off utilizing Arduino. The planning of home automation will become easier and more famous because the vast majority of individuals utilize Android nowadays. In this gadget, we are utilizing Arduino which is the most ordinarily utilized gadget for computerization. Arduino is equipment that is utilized to interface the PC and the task model with the goal that we can control it by utilizing Arduino code as needed. Arduino is a microcontroller it is much the same as the human mind it measures data and afterward it plays out some Logical and numerical procedures on that data. Arduino is associated with the Bluetooth module which gets the data from the client. Arduino likewise associated relay module, which gets data from Arduino and plays out the activity as a switch. Bluetooth innovation is Wireless radio transmissions in a short separation giving a vital innovation to make insight and controllability. This produces individual zone networks in home conditions, where every one of these machines can be interconnected and checked to utilize a microcontroller with Arduino utilizing a smartphone. Home automation includes a level of mechanized or programmed control of certain

electrical and electronic frameworks in a structure. After the text has been formatted and styled.

Related works

This paper describes the development of an inexpensive, user-friendly, and secure home automation system based on Android. The project is implemented with the help of an Arduino Bluetooth board and the home appliances are connected to 4 channel relay module. A wireless connection is created for communication between the Arduino Bluetooth board and the Android phone. This project is meant to be economical and Control a measurable range of devices with few improvements to its operations. To prevent unauthorized users from accessing the equipment at home, password protection is required. In this paperwork, one advanced feature is added which is the effective usage of EEPROM. EEPROM acts like a flash memory and stores the data received from the Bluetooth module while running when a power interruption occurs EEPROM stores information and stops the execution. It will continue the process after the Interrupt Service Routine is clear it will start the previous process of execution. By using the ISR technique the project is developed. The major objective is to provide older persons and people with physical disabilities the means to perform daily duties and remotely operate household appliances. It is cost-effective to build and simple to install a Bluetooth-based wireless home automation system in an existing house. According to the studies of B. Dilleshwara Rao, he suggests that Bluetooth systems are better than IR-controlled and GSM systems. Depending on the type of Bluetooth device, Bluetooth technology has a physical range of up to 10 meters and a data transmission rate of up to 3 Mbps. An Arduino board, a Bluetooth module, and a smartphone application are the basis of the operational plan. The Arduino board is connected to the Bluetooth module HC-05, and the 4-channel relay module is connected to the home appliances. An application for smartphones is used to facilitate communication between the devices. The smartphones are connected to an Arduino board through Bluetooth. [1].

The basic ideology of the project of Rejwan Bin Sulaiman is to make people more comfortable while they are at home and use basic facilities i.e. light and fan. Instead of going around and finding the power source to use utilities, this project will make them calm staying at the same place and using the smartphone to give the voice order, which will be ultimately processed, and the action will be performed. The same concept goes for people with little mobility or maybe with no mobility, all they

need to have an Android phone with the application installed, give a recognized voice command, and the rest of the process will be taken care of by the IoT technology. Even if this concept is implemented on a larger scale, the hospitals can be truly modified for the patients where they would be able to control the things around in the room just with voice commands, and that voice will be going to cause the action of their requirement. One of the major reasons for choosing the Android phone instead of the iPhone for our project is the difference in the number of people who are mostly using these smartphones. Certain projects in home automation are using the WI-FI technology for their operation. While considering the WI-FI system, the infrastructure is usually divided into three major components –a) Web-based server b) Interface module c)WI-FI connection. According to Rejwan Bin Sulaiman, this system is quite flexible in terms of user interface, as all it requires is to log in to the web server using the interface module i-e Arduino Uno provided with the WI-FI connection. And all the result is the functionality of sensors and actuators which act suddenly in response to the information processed by the web-based server. The user can remotely log in without any geographical restrictions. This login system was developed on the Android-based system, in the form of an application. And the home appliance that has been used for this project is the window shutter. application. And the home appliance that has been used for this project is the window shutter. According to Rejwan Bin Sulaiman another major work could be a WI-FI based using Arduino Uno:- This project was developed using Wi-fi technology, and for that purpose microcontroller is used Arduino Uno. This system has been implemented to control and monitor various appliances, among them, most commonly used are monitoring temperature, detecting fire, the door opened or closed, CCTV monitoring, the brightness of the light, and various others. To give the user access to these monitoring and controlling strategies web-based application was founded, which allows the user to utilise these features after following authentication procedures. The ultimate benefit of using this system is its reduced cost, more authenticated, good accessibility for the remote user, and can be controlled from anywhere without any geographical restrictions. According to Rejwan Bin Sulaiman, there is another IoT technology that is Android-based using Arduino Mega 2560:- which uses the Android application to control and monitor various home utilities including lights, switches, temperature, intrusion detection systems, and smoke sensors. Arduino Mega 2560 and the

Arduino Ethernet shield have been used for this system, which is connected to the microweb server it takes the user command from the Android application and is ultimately processed by the controller to give the output to the appliance according to the input received. This system of controlling and monitoring home appliances is quite feasible and effective in its way of working. The central microcontroller is responsible for connecting the sensors and the actuators, where it directly connects to the Android-based application which is the source of the user input for controlling and managing the appliances. This application provides remote access to the users to carry out any changes in the appliances from anywhere. This system also provides siren and email notifications to the intrusion. [2]

In this proposed application, when the user launches the application, the skill will be checking the authorization of the user. For unregistered users, it will give a message to log in to continue to access the services of the application. In the case of registered users, users will receive a welcome message along with the details of the appliances in their home, and daily updates of the current state of the appliances in the home. According to the studies of Uma S, R. Eswari, Bhuvanaya R., and Gopisetty Sai Kumar, the application input is provided by the user using Google Assistant through his mobile phone. Using this application the users can schedule the devices connected to Arduino and ESP8266. The input given by the users is fed into the Firebase. The Wi-Fi-connected ESP8266 fetches the information from the firebase and turns on or off the devices depending upon the user's requests. Any device can be scheduled independently using this application. The Node-RED Technology is used for the functions of the application which is embedded with IoT devices (Node MCU). This developed application is deployed in the Dialog Flow Account. The Node MCU is connected with regular home appliances. The flow written in the Node-RED is deployed in the Dialog flow that will be integrated with Google Assistant. Whenever commands are given it triggers the API call through the cloud Firebase Real-time database to store the values in the integrated Node MCU.[3]

Arduino is associated with the Bluetooth module which gets the data from the client. Arduino likewise associates a relay module, which gets data from Arduino and plays out the activity as a switch. Bluetooth innovation is Wireless radio transmissions in a short separation giving a vital innovation to make insight and controllability. This produces individual zone networks in home

conditions, where every one of these machines can be interconnected and checked utilizing a microcontroller with Arduino utilizing a smartphone. 2022-2023 8Department of ECE, JSSATEB According to the studies of To achieve this, a Bluetooth module is interfaced to the Arduino board at the receiver end while on the transmitter end, a GUI application on the cell phone sends ON/OFF commands to the receiver where loads are connected. By touching the specified location on the GUI, the loads can be turned ON/OFF remotely through this technology. When the power is turned on, the connection LED on the Bluetooth module starts blinking. We need to start the "Bluetooth Controller" app on our smartphone and get connected to the Bluetooth module. If the pairing is successful, the LED becomes stable. When a key is pressed in the smartphone, the Bluetooth module receives the corresponding data and the intern transmits that data to Arduino. Arduino then compares the received data with the data written in the sketch and accordingly turns on the Load [4]

According to the studies of N. David, A. Chima, A Ugochukwu, and E. Obinna, This paper presents a low-cost and flexible home control and environmental monitoring system. It employs an embedded micro-web server in Arduino Mega 2560 microcontroller, with IP connectivity for accessing and controlling devices and appliances remotely. These devices can be controlled through a web application via Bluetooth Android-based Smartphone app. This system has two main modules: the hardware interface module and the software communication module. At the heart of this system is the Arduino Mega 2560 microcontroller which is also capable of functioning as a micro web server and the interface for all the hardware modules. All communication and controls in this system pass through the microcontroller.

Hardware interfacing: Arduino can sense the surroundings by receiving input signals from a variety of sensors and can affect its environment via actuators. An analog temperature sensor is a chip that tells you what the ambient temperature is. The DHT11 is a basic, ultra-low-cost digital temperature and humidity sensor. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air and spits out a digital signal on the data pin (no analog input pins needed). It is fairly simple to use but requires careful timing to grab data. The only real downside of this sensor is you can only get new data from it once every 2 seconds, so when using our library, sensor readings can be up to 2 seconds old.

Software interfacing: For this web application, which in this text is a website, we used Adobe Dreamweaver as our programming environment and we used Hypertext Pre-Processor (PHP) and also JavaScript (JSON), and Ajax as our programming languages. The website will control the Arduino by passing information to it as codes. In this case, the Arduino micro-controller acts as a client and the PHP will act as a server (Wamp, IIS or Apache servers can be used) because PHP is not a client-based programming language. The design of the web pages was chosen to be in metro style as it gives user friendliness and also a colorful display of the web items. The web page will display all the variables being read from the Arduino microcontroller and also be able to perform the functions as the mobile application.[5]

METHODOLOGY

Home automation describes a system of networked, controllable devices that work together to make your home more comfortable, customized, efficient, and secure. In this device, the 5 key additives are Arduino UNO V2.0, Bluetooth module, Relay drivers, a smartphone, and an Android application. A Proteus 8.13 Professional was used in this project for the implementation of the design. The Arduino is a microcontroller which is a small integrated circuit that governs a certain operation and the Arduino IDE software is a specialized program in the Windows environment for writing programs for the microcontroller Arduino, therefore the C++ code for this project is written and verified(compiled) and the hex file of the compiled code is being copied and pasted in the Proteus software environment where we have made the connections of the components mentioned above. Further to understand the communication agenda, we've first hooked up the Bluetooth app on our smartphone, which is available in the Play Store without any difficulty. The application is free and easy to use. This app first asks us to set up the Bluetooth module from the device of implementation of the circuit to the Android device and then recognizes our Voice command through the Google assistant and sends it to the Bluetooth module wirelessly. The Arduino decodes this command from the Bluetooth module. Then the Arduino sends a command to the Relays to govern the house home equipment such as the LED light and fan used in our project. This project is relatively simple to implement in the real world and it may be controlled by anyone of any age just by uttering the orders

IMPLEMENTATION

A Proteus 8.13 professional software development was used for the implementation of

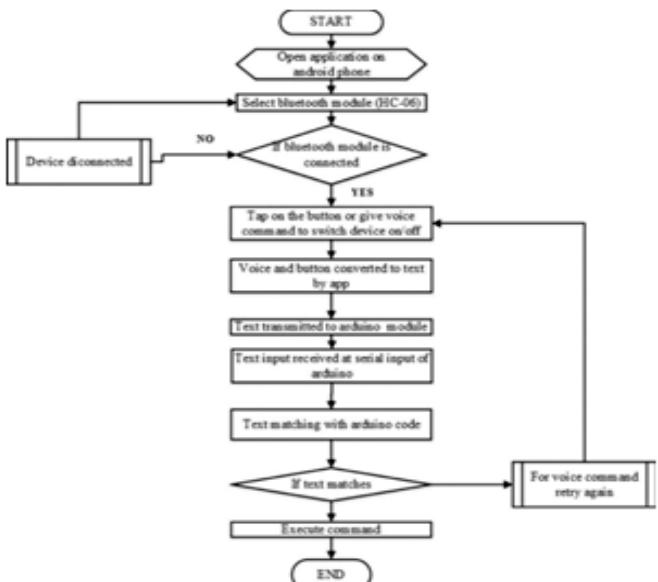
the design of this project. All the components were connected according to the design interpreted and understood. The Arduino UNO v2.0 is available in the Proteus environment. The Bluetooth module used in this project is installed from the Bluetooth libraries available in web browsers. The Bluetooth module compatible with the environment of the project was the HC-06 module. The HC-06 module of Bluetooth is more compatible as it consists of a serial interface and a Bluetooth adapter. The module is user-friendly as it uses the slave mode of operation and does not require a setting to switch between master and slave modes. The transmitter and the receiver pins of the Bluetooth module and the Arduino UNO are connected alternatively to encourage serial communication between the two which means transmitting one bit at a time serially which uses the simple SPP (serial port protocol) module planned for the direct distant consecutive affiliation arrangement.

The client module (Bluetooth HC-06) and the host controller (Arduino UNO) communicate through an enabled Bluetooth in a smartphone. Next, we use the 2-channel 5V relay for the connection to the home equipment devices such as bulbs, fans, motors, etc. which is used typically as a switch to turn on or off the devices when controlled from the Bluetooth-based app. It has a maximum current rating of 10A at 250VAC. It works on the principle of electromagnetism where the electromagnetic switch of the relay is used to defer two circuits electrically and connect it electromagnetically. So when the Arduino transmits the signal then the relay driver receives the signal and starts to work. After all these components are connected in the Proteus software environment it is important to assign the appropriate values to these components and dump the hex file

in the Arduino board which has been compiled in the Arduino IDE environment. The app development is usually done by the MIT app inventor where we create our apps or simply download the Bluetooth-based voice control app from the Play Store. The process of connecting the Bluetooth from the device where the design is being implemented to the Android device to which the app is being controlled is the next major step. Later a properly available WI-FI connection is necessary for the working of the automation without any proxy error problems for the stability of the medium. Now the software implementation from the Proteus is ready to be run and the voice commands are given by the user which is recognized by the Google assistant in the Android app. The commands are then obeyed after a delay of

how much time is being mentioned in the code and the same instructions are given by the user, which is coded in the Arduino IDE and turns on/off the lights.

SOFTWARE IMPLEMENTATION FLOWCHART



PROTEUS 8.13 PROFESSIONAL:-

The Proteus Design Suite is a proprietary software tool suite used primarily for electronic design automation. The microcontroller simulation in Proteus works by applying either a hex file or a debug file to the microcontroller part on the schematic. It is then co-simulated along with any analog and digital electronics connected to it. This enables its use in a broad spectrum of project prototyping in areas such as motor

control, temperature control, and user interface design. It also finds use in the general hobbyist community and, since no hardware is required, it is convenient to use as a training or teaching tool.

The Proteus 8.13 professional has the following features –

1. Push and Shove routing for greater control of manual track placements.
2. Board Constraints as granular as you need them to be.
3. Differential Pair routing and group Length Matching.
4. 15 million library parts are integrated and on demand.
5. Dedicating reporting module for project documentation

Arduino IDE:-

The Arduino Integrated Development Environment [IDE] is an open-source software, which is used to write and upload code to the

Arduino boards. The IDE application is suitable for different operating systems such as Windows, Mac OS X, and Linux. It supports the programming languages C and C++. It includes a code editor with features such as text cutting and pasting, searching and replacing text, automatic indenting, brace matching, and syntax highlighting, and provides simple one-click mechanisms to compile and upload programs to an Arduino board. It also contains a message area, a text console, a toolbar with buttons for common functions, and a hierarchy of operation menus. The source code for the IDE is released under the GNU General Public License, version 2.

The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures. User-written code only requires two basic functions, for starting the sketch and the main program loop, which is compiled and linked with a program stub main() into an executable cyclic executive program with the GNU toolchain, also included with the IDE distribution. The Arduino IDE employs the program to convert the executable code into a text file in “hexadecimal encoding” that is loaded into the Arduino board by a loader program in the board's firmware.

From version 1.8.12, the Arduino IDE Windows compiler supports only Windows 7 or newer OS. sketch is a program written with the Arduino IDE. Sketches are saved on the development computer as text files with the file extension. A minimal Arduino C/C++ program consists of only two functions:

- ◆ **setup():** This function is called once when a sketch starts after power-up or reset. It is used to initialize variables, input and output pin modes, and other libraries needed in the sketch. It is analogous to the function main().
- ◆ **loop() :** After setup() function exits (ends), the loop() function is executed repeatedly in the main program. It controls the board until the board is powered off or is reset. It is analogous to the function while(1).

Bluetooth-Based Voice Control application:-

1. First of all, open the Play Store of your phone and search for “Arduino Voice Control”. Then you will get this app. Now install this app.
2. After completing the installation process, open the app and make sure the circuit is connected to the power supply and the Bluetooth module is switched on in the device from which we have setup software implementation and the Android device and

- to develop a metered WIFI connection between the device of implementation (here it is a laptop) and the Android device.
3. Then when we open the application, we can see 2 options: connect and disconnect. Click on “connect” and we must establish the required Bluetooth module connection of HC-06 and the Bluetooth connection of the Android and the device of implementation.
 4. Soon after the above step, the voice command can be given in “English” by tapping on the microphone-like icon or logo present on the screen which will direct the Google assistant present in the android to accept and obey the voice commands, as per the code instructions mentioned in the Arduino IDE code. For eg:- “Turn on light or Turn off light” / “Turn on the fan or Turn off the fan”

HARDWARE IMPLEMENTATION:-

ARDUINO UNO V2.0:-

Microcontroller: The Arduino Uno V2.0 is based on the ATmega328P microcontroller chip from Microchip Technology. It has 32KB of flash memory for storing your program, 2KB of SRAM for variable storage, and 1KB of EEPROM for data storage.

Clock Speed: The ATmega328P on the Arduino Uno V2.0 runs at a clock speed of 16 MHz.

Digital I/O Pins: It has 14 digital input/output pins, out of which 6 can be used as PWM (Pulse Width Modulation) outputs. **Analog Input Pins:** The board features 6 analog input pins that can also be used as digital I/O pins if needed.

USB Interface: The Arduino Uno V2.0 comes with a built-in USB interface, allowing you to connect it to your computer for programming and communication. It uses the CH340G USB-to-serial converter chip for communication with the computer.

Power Supply: The board can be powered through a USB connection or an external power supply. The recommended input voltage range is 7 to 12 volts.

Power Jack and Vin Pin: The Arduino Uno V2.0 includes a power jack that accepts a DC input, and it also has a Vin pin that can be used to supply power to the board.

Reset Button: It has a reset button that allows you to restart your program or initiate the bootloader.

ICSP Header: The Arduino Uno V2.0 features an ICSP (In-Circuit Serial Programming) header, which enables you to program the microcontroller using an external programmer.

LED Indicators: The board has built-in LEDs that indicate the power status and the status of digital pins 13, 5, 4, and 3.

Compatibility: The Arduino Uno V2.0 is compatible with the Arduino software (IDE) and can be programmed using the Arduino programming language, which is a subset of C/C++.

BLUETOOTH MODULE HC-06:-

Bluetooth era is an excessive velocity low powered wi-fi era hyperlink that is designed to attach telephones or different transportable gadgets. The Bluetooth module has six pins - Enable, VCC, Ground, Transmit Data (Tx), Receive Data (Rx), and State. The Enable and State pins are unused and so now no longer linked within side the circuit. The VCC and Ground pins are linked to the not-unusual place VCC and Ground. The Tx and Rx pins of the module are linked to pins 10 and 11 of the Arduino. For serial communication connect the TXD pin of Bluetooth Module HC-06 with RX (pin 0) of Arduino UNO and RXD pin with TX (pin1) of Arduino UNO. It supports the Serial Port Profile (SPP) that allows transparent serial data transmission between devices.

2 - CHANNEL RELAY:-

A 2-channel relay is a device that allows you to control two separate electrical circuits using a single control signal.

Each channel of the relay consists of a switch that can open or close the circuit it is connected to. Relay is an electromagnetic switch that is used to defer two circuits electrically and connect magnetically. When Arduino transmits the signal the relay driver receives the signal and starts its work. They are frequently used to interface an electronic circuit (working at low voltage) to an electrical circuit which works at extremely high voltage. When the power is transmitted the relay works as a switch due to electromagnetic effect so that we can switch ON or OFF our home appliances.

RESULTS AND DISCUSSION

As indicated by the proposed arrangement the ultimate result of this paper prompts the advancement of home mechanization. Through this undertaking, a computerization framework has been made with the goal that we can undoubtedly control home machines like lights, fans, tube lights, AC, bulbs, and so on. One of the goals of this task is likewise to get us a shrewd robotization and minimal effort venture. In this paper, we have likewise given data about Arduino Uno, Bluetooth regulator, and hand-off module. Also, the data

about their work is given. Alongside the segment of home computerization, its preferred position has likewise been examined. The framework is simple and made sure to access from subterranean insect clients or gate crashers. From the results, it can be deduced that home automation refers to a particular type of device that requires extra effort to operate home appliances such as fans, air conditioners, lights, and televisions. And this paperwork demonstrated how to build a home automation system, and discussed the operation and its application in a better way. In this work, the advantages are latency of the controller is improved and while executing the process if the power interruption occurs, the controller will stop execution and when the power interruption clears then the controller will continue the execution process where it will stop earlier.

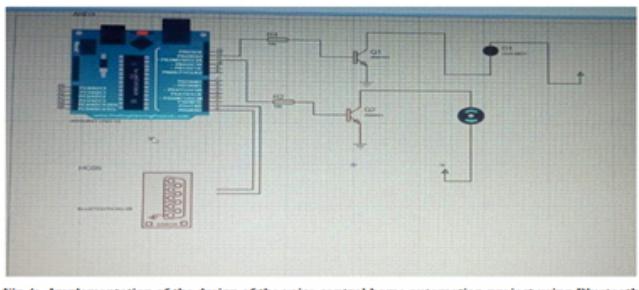


Fig 4:- Implementation of the design of the voice control home automation project using Bluetooth module.

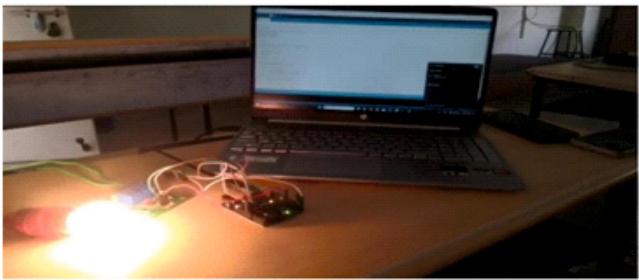


Fig 5:- Voice Command given to Turn on Light.

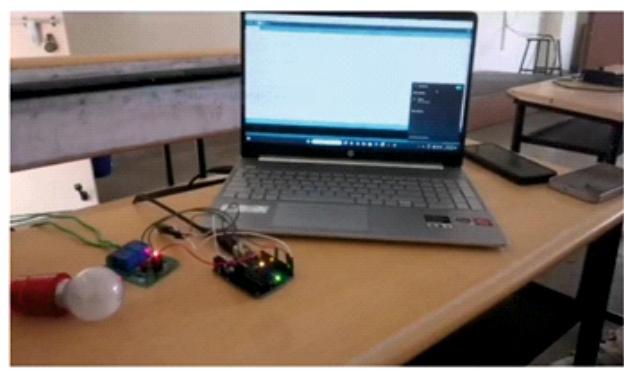


Fig 6:- Voice Command given to Turn off Light.

CONCLUSION AND FUTURE SCOPE

Controlling the home utilities via voice is just an amazing step forward toward the development in the IoT sector, as this involves a wireless medium to create the connection. Many Android-based applications have been developed to initiate the working on this technology which also includes voice-controlled wheelchairs etc. In all the

previous experiments and trials which are done before, we have utilized the same concept to implement it efficiently, so that more people can benefit which involves just a say of the word to make things work i.e. home utilities. Without a doubt, this technology will bring revolution in people's lives if that is implemented on a larger scale. After performing deep research and study, we have introduced a platform, in which more efforts can result in a better format in the future. But according to all the existing technology, this is something new in several aspects and it is worth being accepted by a wide number of people because of its advantages towards the elderly and special people. It is the century where everyone is focussing on bringing comfort into people's lives. This is just one step leap

toward the future goal, many other things are coming ahead with more challenges. We must make sure while introducing any project, that it keeps the legal, ethical, social, and environmental concerns to its best because these are the basic pillars for the success of any work that is done for the people's welfare.

ACKNOWLEDGMENT

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