

# **Industrial And Home Automation Using Speech Recognition**

Submitted in partial fulfillment of the requirements for the award of  
Bachelor of Engineering degree in Electronics and Communication Engineering

by  
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**DEPARTMENT OF ELECTRONICS AND COMMUNICATION  
ENGINEERING**

**SCHOOL OF ELECTRICAL AND ELECTRONICS**

## **SATHYABAMA**

**INSTITUTE OF SCIENCE AND TECHNOLOGY**

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**DEPARTMENT OF ELECTRONICS AND COMMUNICATION  
ENGINEERING**

**BONAFIDE CERTIFICATE**

This is to certify that this Project Report is the bonafide work of **Tarun Kumar Gunupudi(39130157) and Prudhvi Nalajala (39130308)** who carried out the project entitled “Industrial And Home Automation Using Speech Recognition” under the supervision of Dr.M.Sumathi from November 2022 to April 2023.



**Internal Guide**

Dr.M.Sumathi



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Submitted for Viva voce Examination held on 20.04.2023



**Internal Examiner**



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## DECLARATION

I **Tarun Kumar Gunupudi (39130157)** and **Prudhvi Nalajala(39130308)** hereby declare that the Project Report entitled “**Industrial And Home Automation Using Speech Recognition**” done by us under the guidance of **Dr.M.Sumathi** is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering degree in 2019-2023.

**DATE:** *20.04.2023*

**PLACE:** Chennai

A handwritten signature in blue ink on a light blue rectangular background. The signature consists of the initials 'P.N.' followed by the name 'Tarun' in a cursive script.

**SIGNATURE OF THE CANDIDATE**

## ACKNOWLEDGEMENT

I am pleased to acknowledge my sincere thanks to **Board of Management of SATHYABAMA INSTITUTE OF SCIENCE AND TECHNOLOGY** for their kind encouragement in doing this project and for completing it successfully. I am grateful to them.

I convey my thanks to **Dr. N.M.Nandhitha M.E., Ph.D., Dean**, School of Electrical and Electronics and **Dr.T.Ravi M.E., Ph.D.** Head of the Department of Electronics and Communication Engineering for providing us necessary support and details at the right time during the progressive reviews.

I would like to express my sincere and a deep sense of gratitude to my Project Guide **Dr.M.Sumathi** for her valuable guidance, suggestions and constant encouragement paved way for the successful completion of my project work.

I wish to express my thanks to all Teaching and Non-teaching staff members of the **Department of Electronics and Communication Engineering** who were helpful in many ways for the completion of the project.

## **ABSTRACT**

The field of automation has seen tremendous growth in recent years, with the development of technologies like machine learning, artificial intelligence, and the internet of things (IOT). One of the most promising applications of automation technology is speech recognition. Speech recognition technology has gained significant attention in recent years, and it is now widely used in various industries and homes for automation purposes.

In the context of industrial automation, speech recognition technology is used to control and monitor various processes, machines and equipment. It allows operators to control the machinery and equipment without having to physically interact with them, increasing safety and efficiency. Speech recognition technology also enables workers to access important information, such as safety procedures and maintenance schedules, hands-free, which reduces the risk of accidents and injuries.

In the home, speech recognition can be used to control smart devices like thermostats, lights, and appliances. It allows home owners to control the devices using voice commands, making their lives more comfortable and convenient. Moreover, speech recognition can be used to assist people with disabilities or mobility issues, allowing them to live more independently. Overall, speech recognition has enormous potential in the field of automation. As the technology continues to develop and improve, we can expect to see more widespread adoption of speech recognition in industrial and home setting.

The implementation of speech recognition technology requires the use of hardware and software. The hardware typically consists of a microphone or array of microphones, which capture the user's speech, and a digital signal processor, which processes the speech and converts it into commands that can be interpreted by the automation system.

The integration of speech recognition technology in industrial and home automation systems has the potential to improve efficiency, reduce errors, and enhance user experience.

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# **CHAPTER – 1**

## **INTRODUCTION**

In recent years, wireless monitoring has emerged as a critical technology for industrial automation. Wireless monitoring systems allow for real-time monitoring of industrial processes, reducing downtime and improving efficiency. Industrial automation is becoming steadily more important in the industrialization process because computerized machines are able to handle recurring tasks faster and more effectively.

The main aim is to design and develop a computer based interactive system with the help of speech recognition in order to monitor the power stations and also to control the same. Speaker recognition is the process of automatically recognizing who is speaking on the basis of individual information included in speech waves. Speech recognition technology has revolutionized the way we interact with our devices and machines. From smartphones to cars, speech recognition has become an integral part of our daily lives. Industrial and home automation systems are no exception. The use of speech recognition in industrial automation involves using voice commands to control various industrial processes and machines. This has several advantages such as, increased efficiency, reduced downtime, and remote monitoring capabilities.

In the context of home automation, speech recognition can be used to control various household appliances and systems, such as lightning, heating and security. With the help of voice assistants home owners can use voice commands to turn lights and fans on and off, adjust thermostat settings and soon. It also enables predictive maintenance, allowing operators to identify potential issues before they cause a problem. Additionally, this technology reduces the need for manual intervention, freeing up resources and reducing the risk of errors.

The goal is to provide a comprehensive understanding of the current state of the art in using speech recognition for industrial and home automation, and to identify areas for future research and development.

### **1.1. OVERVIEW:**

Automation is a key feature of modern society, enabling the streamlining and optimization of various processes, both at home and in industrial settings. One way of achieving this is through the use of speech recognition technology. By leveraging this technology, it is possible to control various devices using voice commands, eliminating the need for physical input devices such as buttons or touchscreens.

Bluetooth is another technology that has revolutionized the way we interact with devices. By enabling wireless communication between devices, it has made it easier to transfer data and control devices from a distance. Bluetooth has become a ubiquitous technology, with almost all modern devices featuring the capability to connect via Bluetooth.

When these two technologies are combined, the result is a powerful automation system that can be controlled using voice commands. This system can be used in both industrial and home settings, providing a range of benefits that enhance efficiency, safety, and convenience.

In an industrial setting, speech recognition-based automation can be used to control a range of devices, such as conveyor belts, machines, and robots. By using voice commands, operators can control these devices from a distance, reducing the need for physical interaction and minimizing the risk of injury.

For example, a speech recognition system can be used to control a conveyor belt in a factory. Instead of using physical buttons or switches to control the belt's speed or direction, an operator can simply issue voice commands to a Bluetooth-enabled microphone. The microphone would then send the command to the conveyor belt's controller, which would adjust the belt's speed or direction accordingly.

Similarly, a speech recognition system can be used to control machines or robots in a factory. By issuing voice commands, an operator can control the machine's movements, speed, and other parameters. This can be especially useful in situations where a machine is performing a task that requires precise movements, such as welding or cutting.

In a home setting, speech recognition-based automation can be used to control a range of devices, such as lighting, thermostats, and entertainment systems. By using voice commands, homeowners can control these devices without the need for physical interaction, enhancing convenience and comfort.

For example, a speech recognition system can be used to control the lighting in a home. Instead of having to physically interact with light switches, a homeowner can simply issue voice commands to a Bluetooth-enabled microphone. The microphone would then send the command to the home's lighting system, which would adjust the lighting accordingly.

Similarly, a speech recognition system can be used to control the thermostat in a home. By issuing voice commands, a homeowner can adjust the temperature in their home without having to physically interact with the thermostat. This can be especially useful in situations where a homeowner is in a different room or is unable to physically access the thermostat.

In conclusion, speech recognition-based automation using Bluetooth technology has the potential to revolutionize the way we interact with devices, both in industrial and home settings. By eliminating the need for physical interaction, this technology can enhance efficiency, safety, and convenience, making it an essential tool for the modern world. As technology continues to evolve, it is likely that we will see more widespread adoption of speech recognition-based automation, paving the way for a more connected and automated future

## CHAPTER – 2

### LITERATURE SURVEY

#### 2.1. RELATED WORK

- Sudha et al. in [1] provides a comprehensive review of various speech recognition techniques that have been applied to industrial automation. The authors discuss the challenges of implementing speech recognition in noisy industrial environments and provide an overview of the existing solutions.
- Al – Hindawi et al. in [2] compares the performance of different speech recognition techniques for industrial automation. The author evaluate the accuracy and efficiency of several algorithms.
- Ramesh et al. and Krishnan in [3] presents a speech recognition based industrial automation system using Raspberry Pi. The system uses the google speech recognition API to recognize voice commands and control various devices in an industrial setting.
- Zekavat et al. in [4] describes the development of a home automation system using the amazon echo device. The system uses the alexa voice service to recognize voice commands and control various home devices, including lights, thermostats, and security systems.
- Srinivasan et al. in [5] presents a smart home automation system that uses speech recognition and natural language processing to control various home devices. The system can recognize multiple languages and respond to complex commands.
- Rajan Vaishnav, Anand Mishra, and Sudhanshu Mishra et al. in [6] presents a speech recognition-based home automation system that is designed to assist elderly and disabled people. The authors propose a system that uses speech recognition techniques to control various home appliances. This system is designed to be user-friendly and accessible for individuals with physical disabilities.
- Rishabh Srivastava, Deeksha Joshi and Mayank Singh et al. in [7] presents a voice-controlled home automation system using Raspberry Pi. The authors

propose a system that uses speech recognition techniques. The system is designed to be affordable and easy to implement using Raspberry Pi as the hardware platform.

- Thangavel Ganesan, Thangavel Manivannan and Karthikeyan Sankar et al. in [8] presents smart home automation system that combines voice recognition and Internet of Things technologies. The authors propose a system that allows users to control various appliances using voice commands, which are processed by a speech recognition module. The system is designed to be scalable, flexible and interoperable with other IoT devices.
- Sowjanya Gonuguntla and M. Santhi et al. in [9] presents a voice recognition-based home automation that uses artificial neural networks for speech recognition. The authors propose a system that uses neural networks to train a speech recognition model for interpreting voice commands. The system is designed to improve accuracy and robustness in voice recognition for home automation.
- Rishi Saxena, Rohitash Chandra, and Rohitashwa Chandra et al. in [10] provides a comprehensive review of speech recognition techniques for industrial automation. The authors discuss various speech recognition methods, such as hidden Markov models (HMMs), deep learning-based approaches, and hybrid approaches. They also highlight the applications of speech recognition in industrial automation, including machine control, human-robot interaction, and process monitoring.
- Gaurav Singh and Saurabh Kumar Singh et al. in [11] proposes a speech recognition-based home automation system using deep learning techniques. The authors present a system that uses a convolutional neural network (CNN) for speech recognition and interprets voice commands to control various home appliances. They also discuss the implementation of the system using Raspberry Pi as the hardware platform.
- Anand Prakash Verma and Kamal Kant et al. in [12] presents a real-time industrial automation system that combines speech recognition and fuzzy logic control. The authors propose a system that uses speech recognition techniques to interpret voice commands and a fuzzy logic controller to control industrial processes such as machine operations, temperature control, and material

handling. They also discuss the implementation of the system using a microcontroller.

- Ricardo S. Sánchez-Peña, Ana I. Molinar-Arellano, and Fernando Núñez-Velázquez et al. in [13] proposes a speech-based human-machine interface for industrial automation. The authors present a system that uses speech recognition techniques to interpret voice commands and control industrial processes such as machine operations, alarms, and emergency shutdowns. They also discuss the challenges and opportunities of using speech recognition in industrial automation.
- José David Rodríguez Rodríguez, Diego García Vega, and David F. Llorca et al. in [14] presents a review of speech recognition techniques for human-robot interaction in industrial automation. The authors discuss various speech recognition methods, including acoustic and language models, feature extraction techniques, and machine learning algorithms. They also highlight the applications of speech recognition in human-robot interaction, including task assignment, status reporting, and error handling.

## **CHAPTER – 3**

### **METHODOLOGY**

#### **3.1. EXISTING SYSTEM**

- To elevate the imperativeness and reinforce the fitness of elders, assisting a home care system can be an admittance that provides comprehensive nursing and monitoring them in the regular interim. In order to provide an interactive service management platform to the elders a smart environment of numerous sensors are clubbed together to establish an intuitive platform that can control the home appliances and gadgets within the living space of elders.
- Used voice and gesture to control the home appliances like turning on/off the light, closing/opening of curtains, TV, and fan or AC within the living spaces. The system also supports the real-time activity and monitor the healthcare system for the elderly citizens like heart rate and body temperature.
- In the case of emergency, for instance, anomalous behaviors like heart stroke occur, the proposed system setup triggers an alarm and the emergency bulb will be on to alert to their kin. This smart environment can set the temperature and help control the living parameters of light based on the users' comfort and their health conditions. The whole design is to provide modest support systems for the elder to live healthily and safety in the independent living of elders.

##### **3.1.1. DISADVANTAGES**

- Conferring to the prerequisites of elderly people in their daily day by day tasks, the proposed framework is to develop assisting home care platform to control various home appliances remotely within the living space of individual and to screened the elders in regular interim of health concerns. This design permits them to keep physically and psychologically fit from

unusual wellbeing indications. In future work, we will integrate all the control systems with a wearable gadget for both voice and gesture to provide easy accessibility and comprehensive home automation.

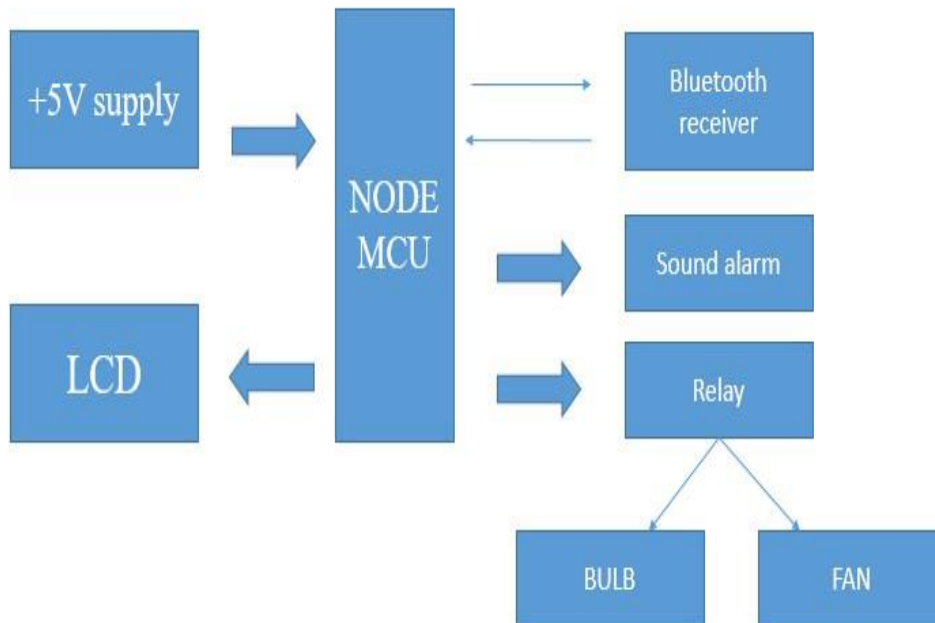
### **3.2. PROPOSED SYSTEM**

- We are proposing a voice controlled industrial and home automation system based on Bluetooth. It is widely used in consumer electronics, but it can also be used in industrial automation applications. Industrial automation using Bluetooth technology offers several benefits, including reduced costs, increased flexibility, and improved efficiency. Bluetooth provides wireless communication between devices, allowing them to exchange data and commands.
- Bluetooth devices can communicate directly with each other or through a central gateway or controller. It is specifically designed for low-power applications. Bluetooth Low Energy (BLE) devices consume very little power. It provides security and network topology. Bluetooth is a wireless module used to control home appliances by using voice commands. Anyone can give the voice command to operate it.
- The Voice Recognition along with Bluetooth technology we can eliminate the complication of wiring in case of wired automation and also it prevents getting up.

#### **3.2.1. Advantages**

- Support for multiple network topologies such as point-to-point,.
- Low duty cycle – provides long battery life.
- Low Latency.
- Direct Sequence Spread Spectrum(DSSS)
- Up to 65,000 nodes per network.
- 128-bit AES encryption for secure data connections.
- Collision avoidance, retries and acknowledgements.

### 3.3. SYSTEM ARCHITECTURE



**Fig 3.1 System Architecture**

#### 3.3.1. WORKING

Industrial and home automation using speech recognition can be achieved using a Node MCU microcontroller and Bluetooth communication. The general idea is to use speech commands to control devices and systems such as home appliances or industrial setting.

The Node MCU microcontroller can be used as the main controller for the system. It has built-in Wi-Fi and can be programmed using the Arduino IDE, making it an ideal choice for this project.

To enable speech recognition, a Bluetooth module can be added to the Node MCU. This module can be paired with a smartphone that has a speech recognition feature. The smartphone will be used to recognize the user's speech commands, which will then be sent to the Node MCU through Bluetooth communication.

The Node MCU can be programmed to interpret the received commands and

perform the corresponding actions. For example, if the user says “Turn on the lights”, the Node MCU sends a signal to the lights to turn on.

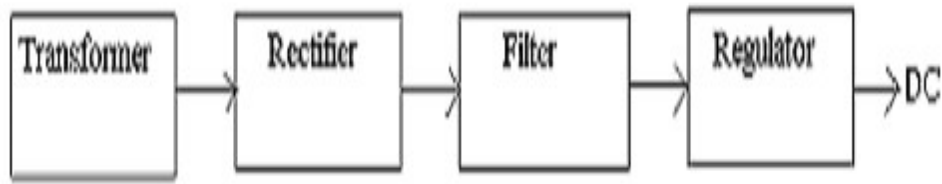
To implement this project, the following steps can be taken:

1. Set up the Node MCU microcontroller and program it to receive and interpret Bluetooth commands
2. Connect the Bluetooth module to the Node MCU and pair it with a smartphone.
3. Install a speech recognition app on the smartphone, and train it to recognize the desired commands.
4. Test the system by giving commands through speech recognition and verifying that the appropriate actions are taken.
5. Connect the Node MCU to the devices or systems that need to be controlled, and program it to send appropriate signals to those devices based on the recognized commands
6. Test the complete system to ensure that it is working as intended.

### **3.4. HARDWARE REQUIREMENTS**

#### **3.4.1. POWER SUPPLY**

All electronic circuits work only in low DC voltage, so we need a power supply unit to provide the appropriate voltage supply for their proper functioning. This unit consists of transformer, rectifier, filter & regulator. AC voltage of typically 230volts rms is connected to a transformer voltage down to the level to the desired ac voltage. A diode rectifier that provides the full wave rectified voltage that is initially filtered by a simple capacitor filter to produce a dc voltage. This resulting dc voltage usually has some ripple or ac voltage variation. A regulator circuit can use this dc input to provide dc voltage that not only has much less ripple voltage but also remains the same dc value even the dc voltage varies somewhat, or the load connected to the output dc voltages changes.



**Fig 3.2 General Block of Power Supply Unit**

### **TRANSFORMER:**

A transformer is a static piece of which electric power in one circuit is transformed into electric power of same frequency in another circuit. It can raise or lower the voltage in the circuit, but with a corresponding decrease or increase in current. It works with the principle of mutual induction. In our project we are using a step-down transformer to providing a necessary supply for the electronic circuits. Here we step down a 230volts ac into 12volts ac.

### **RECTIFIER:**

A dc level obtained from a sinusoidal input can be improved 100% using a process called full wave rectification. Here in our project for full wave rectification we use bridge rectifier. From the basic bridge configuration we see that two diodes(say D2 & D3) are conducting while the other two diodes (D1 & D4) are in off state during the period  $t = 0$  to  $T/2$ . Accordingly for the negative cycle of the input the conducting diodes are D1 & D4. Thus the polarity across the load is the same. In the bridge rectifier the diodes may be of variable types like 1N4001, 1N4003, 1N4004, 1N4005, 1N4007 etc.... can be used. But here we use 1N4007, because it can withstand up to 1000v.

### **FILTER:**

In order to obtain a dc voltage of 0 Hz, we have to use a low pass filter. So that a capacitive filter circuit is used where a capacitor is connected at the rectifier output & a dc is obtained across it. The filtered waveform is essentially a dc voltage with negligible ripples & it is ultimately fed to the load.

## **REGULATOR:**

The output voltage from the capacitor is more filtered & finally regulated. The voltage regulator is a device, which maintains the output voltage constant irrespective of the change in supply variations, load variations & temperature changes. Here we use fixed voltage regulator namely LM7805. The IC LM7805 is a +5v regulator which is used for microcontroller.

### **FEATURES AND DESCRIPTION OF REGULATORS**

- Output Current up to 1A
- Output Voltages of 5, 6, 8, 9, 10, 12, 15, 18, 24V
- Thermal Overload Protection
- Short Circuit Protection
- Output Transistor Safe Operating Area Protection

### **3.4.2. ESP8266 Node MCU**

Node MCU is a popular open-source development board that is designed for the Internet of Things (IoT) applications. It is built around the ESP8266, a low-cost Wi-Fi microcontroller with a full TCP/IP stack and microcontroller capabilities.

The Node MCU development board is designed to be a simple and easy-to-use platform for Internet of Things (IoT) development. It includes a USB-to-serial converter, allowing it to be programmed and powered over USB. The Node MCU is compatible with the Arduino IDE, making it easy to program and use.

In industrial and home automation, Node MCU microcontrollers can be used to automate a variety of tasks, such as turning on and off lights, controlling temperature, monitoring air quality, and more. With the addition of speech recognition, users can interact with these devices using voice commands.

Node MCU based devices with speech recognition can be used for tasks such as controlling robotic arms, monitoring equipment, or automating assembly lines. Voice commands can provide a more efficient and natural way to interact with these systems, allowing workers to perform tasks without needing to use their hands or take their eyes off their work.

Overall, Node MCU microcontrollers provide a flexible and low-cost platform for implementing industrial and home automation system, and the addition of speech recognition can further enhance the usability and efficiency of these systems.



**Fig 3.3 ESP8266 Node MCU**

#### **SPECIFICATIONS:**

- Microcontroller: 32-bit CPU
- Clock Speed: Up to 160 MHz
- Flash Memory: 4MB
- RAM: 64KB for data storage
- Wi-Fi Direct (P2P), soft-AP
- GPIO Pins: 17 which can be used for digital input/output
- Analog inputs: 1 analog input, used to measure voltage levels
- Current Consumption: 10uA ~ 170mA
- Voltage: 3.3V
- Integrated TCP/IP protocol stack
- Processor: Tensilica L106 32-bit
- Processor Speed: 80~160MHz

### 3.4.3. HC-05 BLUETOOTH MODULE

HC-05 is a Bluetooth module which is designed for wireless communication. This module can be used in a master or slave configuration.

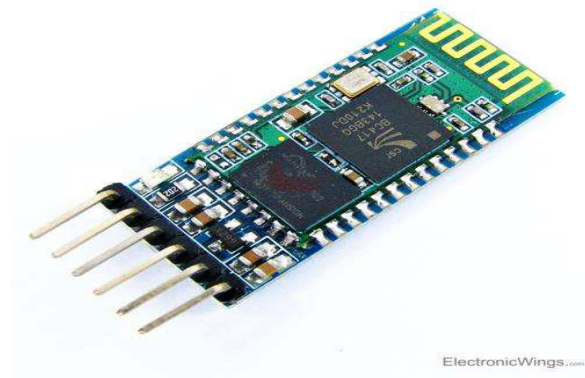


Fig 3.4 HC-05 Bluetooth Module

### PIN DESCRIPTION



Fig 3.5 Bluetooth Module Pin Diagram

It has 6 pins,

1. **Key/EN:** It is used to bring Bluetooth module in AT commands mode. If Key/EN pin is set to high, then this module will work in command mode. Otherwise by default it is in data mode. The default baud rate of HC-05 in command mode is 38400bps and 9600 in data mode.
2. **VCC:** Connect 5 V or 3.3 V to this Pin.
3. **GND:** Ground Pin of module.

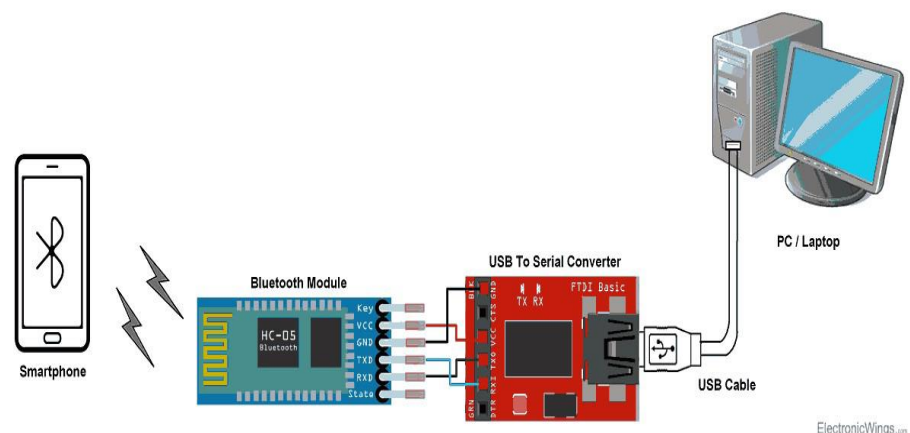
4. **TXD:** Transmit Serial data (wirelessly received data by Bluetooth module transmitted out serially on TXD pin)
5. **RXD:** Receive data serially (received data will be transmitted wirelessly by Bluetooth module).
6. **State:** It tells whether module is connected or not

## HC-05 MODULE INFORMATION

- HC-05 has red LED which indicates connection status, whether the Bluetooth is connected or not. Before connecting to HC-05 module this red LED blinks continuously in a periodic manner. When it gets connected to any other Bluetooth device, its blinking slows down to two seconds.
- This module works on 3.3 V. We can connect 5V supply voltage as well since the module has on board 5 to 3.3 V regulator.
- As HC-05 Bluetooth module has 3.3 V level for RX/TX and microcontroller can detect 3.3 V level, so, no need to shift transmit level of HC-05 module. But we need to shift the transmit voltage level from microcontroller to RX of HC-05.

## BLUETOOTH COMMUNICATION BETWEEN DEVICES

To communicate smartphone with HC-05 Bluetooth module, smartphone requires Bluetooth terminal application for transmitting and receiving data. You can find Bluetooth terminal applications for android and windows in respective app store.



**Fig 3.6 Bluetooth Communication Between Devices**

## **BLUETOOTH MODULE SERIAL INTERFACE**

So, when we want to communicate through smartphone with HC-05 Bluetooth Module, connect this HC-05 module to the PC via serial to USB converter.

Before establishing communication between two Bluetooth devices, 1<sup>st</sup> we need to pair HC-05 module to smartphone for communication.

### **PAIR HC-05 AND SMARTPHONE**

1. Search for new Bluetooth device from your phone. You will find Bluetooth device with "HC-05" name.
2. Click on connect device option, default pin for HC-05 is 1234 or 0000.
3. After pairing two Bluetooth devices, open terminal software (e.g. Teraterm, Realterm etc.) in PC, and select the port where we have connected USB to serial module. Also select default baud rate of 9600 bps.
4. In smart phone, open Bluetooth terminal application and connect to paired device HC-05.
5. It is simple to communicate, we just have to type in the Bluetooth terminal application of smartphone. Characters will get sent wirelessly to Bluetooth module HC-05. HC-05 will automatically transmit it serially to the PC, which will appear on terminal. Same way we can send data from PC to smartphone.

#### **3.4.4. LCD**

A Liquid Crystal Display (LCD) is a flat-panel display technology that uses liquid crystals to produce images. It consists of several layers, including a backlight, polarizers, a layer of liquid crystals, and electrodes.

An LCD consists of two glass panels, with the liquid crystal material sandwiched in between them. The inner surface of the glass plates is coated with transparent electrodes which define the character, symbols or patterns to be displayed. Polymeric layers are present in between the electrodes and the liquid crystal, which makes the liquid crystal molecules to maintain a defined orientation angle.

The LCDs are lightweight with only a few millimeters thickness. Since the LCDs consume less power, they are compatible with low power electronic circuits, and can be powered for long durations. The LCDs don't generate light and so light is needed to read the display. By using backlighting, reading is possible in the dark. The LCD's have long life and a wide operating temperature range. Changing the display size or the layout size is relatively simple which makes the LCD's more customer friendly.

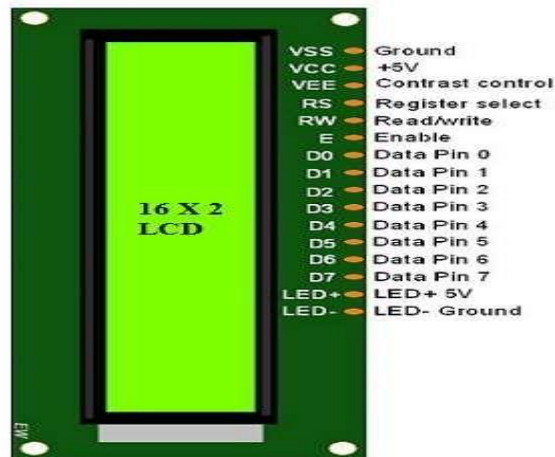
The LCDs used exclusively in watches, calculators and measuring instruments are the simple seven-segment displays, having a limited amount of numeric data. The recent advances in technology have resulted in better legibility, more information displaying capability and a wider temperature range. These have resulted in the LCDs being extensively used in telecommunications and entertainment electronics. The LCDs have even started replacing the cathode ray tubes (CRTs) used for the display of text and graphics, and also in small TV applications.

LCDs are commonly used in both industrial and home automation because of their low power consumption, durability, and ability to display a wide range of information. They can be found in devices such as thermostats, security systems, and home entertainment systems.

Speech recognition technology can be integrated with LCD displays in industrial and home automation to provide a hands-free interface for controlling devices. For example, a user can give voice commands to turn on/off lights, and more. The speech recognition software recognizes the voice commands and sends instructions to the LCD display to perform the desired actions.

In industrial automation, a speech recognition can be used to control machinery or to provide instructions to workers. For example, a worker can give voice commands to a robotic arm to move a product to a specific location on an assembly line. The speech recognition software sends instructions to the LCD display, which displays the necessary information to the worker or sends commands to the machinery.

Overall, LCD displays are an important component in this context, and when combined with speech recognition technology, they can provide a convenient and efficient way to control devices and machinery without the need for physical interaction.



**Fig 3.7 LCD Display**

### **3.4.5. RELAY MODULE**

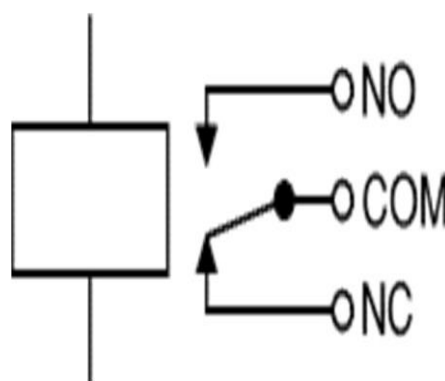
Relay Module is an electronic device that allows you to control a high-power signal. Relay modules are commonly used in industrial automation and other applications where switching high voltages or currents is required. They are easy to use and can be controlled using a variety of control signals. They can be used to switch on and off lights, motors, heaters, and other electrical devices.

A relay is an electrically operated switch. Current flowing through the coil of the relay creates a magnetic field which attracts a lever and changes the switch contacts. The coil current can be on or off so relays have two switch positions and they are double throw (changeover) switches. Relays allow one circuit to switch a second circuit which can be completely separate from the first. For example, a low voltage battery circuit can use a relay to switch a 230V AC mains circuit. There is no electrical connection inside the relay between the two circuits; the link is magnetic and mechanical.

Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state relays. Relays are used where it is necessary to control a circuit by a separate low-power signal, or where several circuits must be controlled by one signal. The first relays were used in long distance telegraph circuits as amplifiers: they repeated the signal coming in from one circuit and retransmitted it on another circuit. Relays were used extensively in telephone exchanges and early computers to perform logical operations

The coil of a relay passes a relatively large current, typically 30mA for a 12V relay, but it can be as much as 100mA for relays designed to operate from lower voltages. Most ICs (chips) cannot provide this current and a transistor is usually used to amplify the small IC current to the larger value required for the relay coil. The maximum output current for the popular 555 timer IC is 200mA so these devices can supply relay coils directly without amplification.

Relays are usually SPDT or DPDT but they can have many more sets of switch contacts, for example relays with 4 sets of changeover contacts are readily available. Most relays are designed for PCB mounting but you can solder wires directly to the pins providing you take care to avoid melting the plastic case of the relay. The animated picture shows a working relay with its coil and switch contacts. You can see a lever on the left being attracted by magnetism when the coil is switched on. This lever moves the switch contacts. There is one set of contacts (SPDT) in the foreground and another behind them, making the relay DPDT.



**Fig 3.8 Relay Switch**

The relay's switch connections are usually labeled COM, NC and NO:

- **COM** = Common, always connect to this, it is the moving part of the switch.
- **NC** = Normally Closed, COM is connected to this when the relay coil is **off**.
- **NO** = Normally Open, COM is connected to this when the relay coil is **on**.



Fig 3.9 Relay Module

### 3.5. SOFTWARE REQUIREMENTS

#### 3.5.1. SOFTWARE OF BLUETOOTH CONNECTED TO THE MOBILE APP

The Components are connected and 5V power supply is passing through the components, Bluetooth is connected to mobile app as shown in fig 3.10, then we gave voice command through the mobile app to switching Bulb, fan turn on or off, we can control any appliances to switch on or off in image 3.11.

The user and allows them to interact with the automation system using spoken commands. The user interface can include features such as voice prompts, visual displays, and touchscreens. The software used in industrial and home automation systems using speech recognition is complex and sophisticated, relying on advanced algorithms and models to recognize and interpret spoken commands.

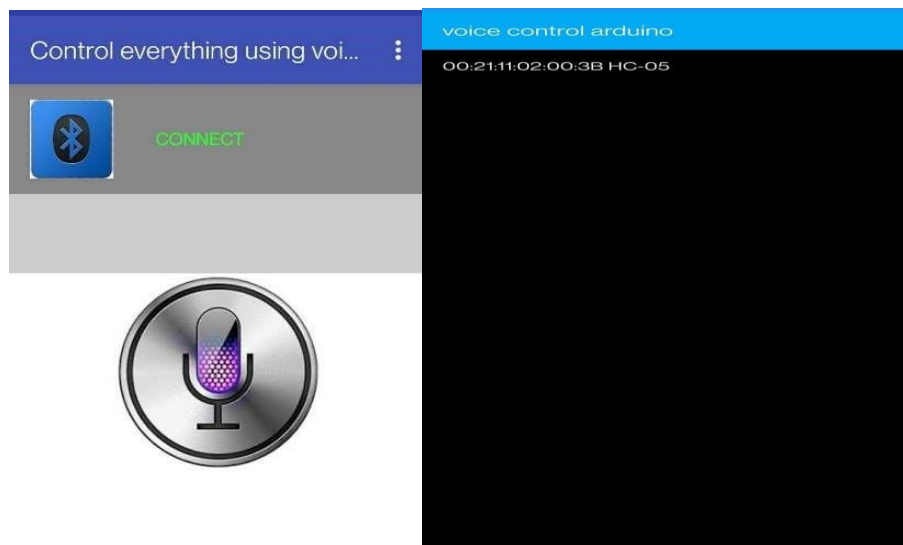


Fig 3.10 Bluetooth is connected to the mobile app

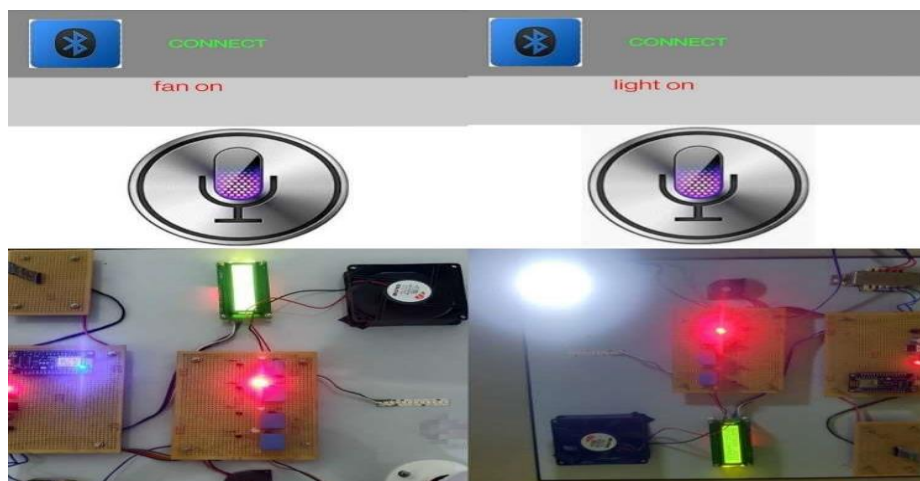


Fig 3.11 Appliances Switch On or Off

## WORKING

- The user speaks a command to the speech recognition system, such as "Turn on the lights" or "Turn on the washing machine".
- The speech recognition system processes the command and converts it into a digital signal
- The digital signal is transmitted wirelessly to the Node MCU using Bluetooth technology.

- The Node MCU receives the signal and interprets the command. It then sends a control signal to the relay module to activate or deactivate the automation device, such as turning on or off the lights or opening or closing the garage door.
- The relay module, which is connected to the automation device, switches it on or off based on the control signal received from the Node MCU.
- The status of the automation device, whether it is on or off, is indicated using LEDs on the relay module.
- The user can interact with the system using a mobile application or a web-based interface to monitor and control the automation devices using voice commands.
- The system can be monitored and controlled remotely by managers and supervisors, allowing them to monitor production processes and make changes as necessary.
- The system can also be programmed to respond to certain events, such as turning off the lights when no motion is detected or sending an alert when the security system is triggered.
- Industrial and home automation using speech recognition software based on Bluetooth provides a convenient and efficient way to monitor and control automation devices using voice commands. The system can be customized to suit different applications and can be easily scaled up or down to accommodate changes in production volumes or home automation needs.

### **3.5.2. ARDUINO IDE**

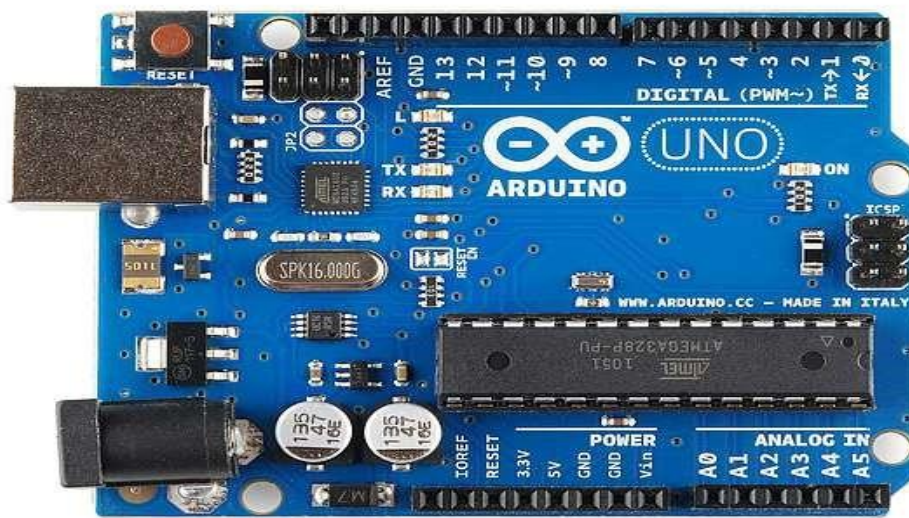
Arduino IDE is a software development environment used to write, compile, and upload code to microcontrollers like the Node MCU. It can be used in industrial and home automation systems for a variety of tasks, including speech recognition.

To use speech recognition with Node MCU microcontroller, you will need to connect a microphone or an audio sensor to the Node MCU board. Once you have the hardware set up, you can write code in the Arduino IDE to read the

audio data and process it for speech recognition.

To implement speech recognition in your industrial and home automation system, you can write code that interprets the recognized speech commands and triggers the appropriate actions. For example, you can program the system to turn on or off lights on voice commands.

Overall, the use of Arduino IDE in industrial and home automation with speech recognition using Node MCU microcontroller requires knowledge of programming, electronics, and specific hardware components.



**Fig 3.12 Arduino**

## **USING ARDUINO IDE**

The most basic way to use the ESP8266 module is to use serial commands, as the chip is basically a WiFi/Serial transceiver. However, this is not convenient. What we recommend is using the very cool Arduino ESP8266 project, which is a modified version of the Arduino IDE that you need to install on your computer. This makes it very convenient to use the ESP8266 chip as we will be using the well-known Arduino IDE.

Following the below steps to install ESP8266 library to work in Arduino IDE environment.

## ➤ Install the ESP8266 Board Package

Enter

[http://arduino.esp8266.com/stable/package\\_esp8266com\\_index.json](http://arduino.esp8266.com/stable/package_esp8266com_index.json)

Into Additional Board Manager URLs field in the Arduino v1.6.4+ preferences.

Click 'File' -> 'Preferences' to access this panel. Next, use the Board manager to install the ESP8266 package.

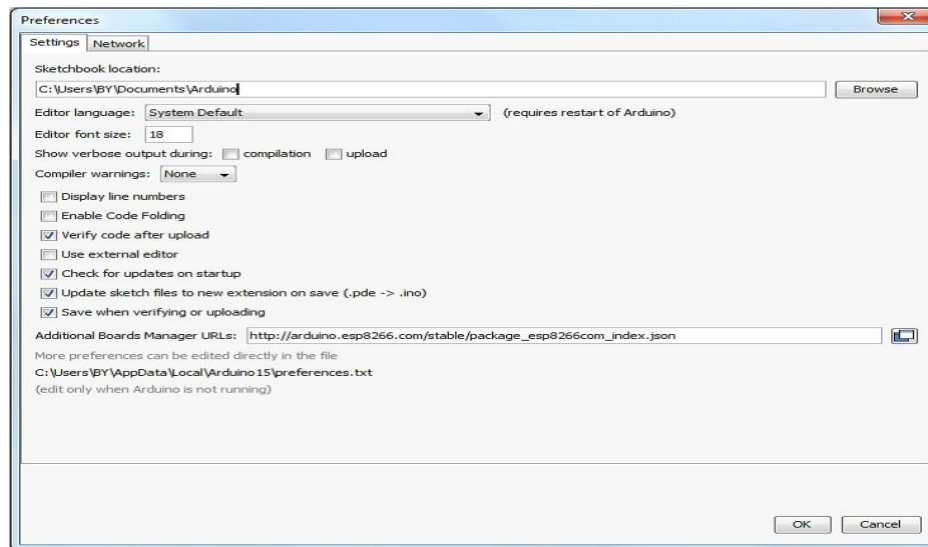


Fig 3.13 Preferences

Click 'Tools' -> 'Board:' -> 'Board Manager...' to access this panel. Scroll down to 'ESP8266 by ESP8266 Community' and click "Install" button to install the ESP8266 library package. Once installation completed, close and re-open Arduino IDE for ESP8266 library to take effect.

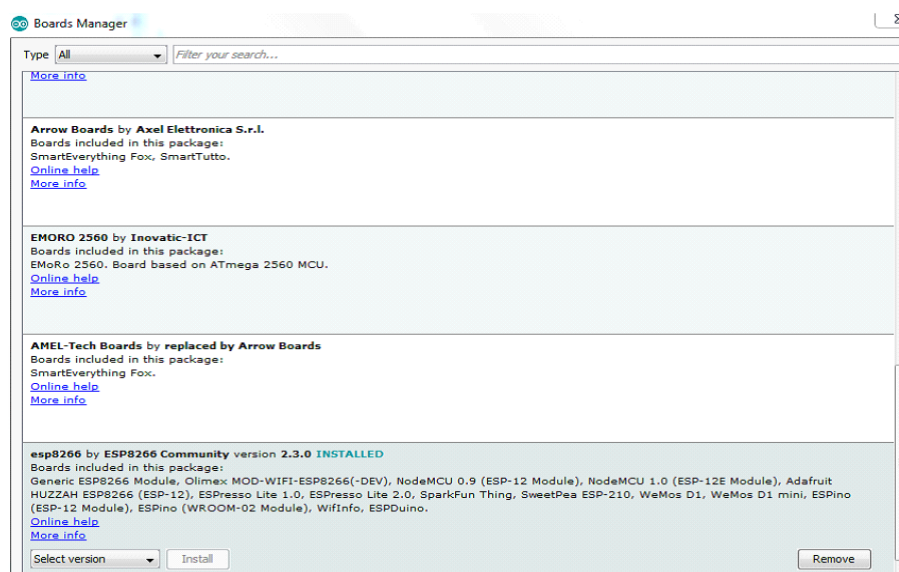
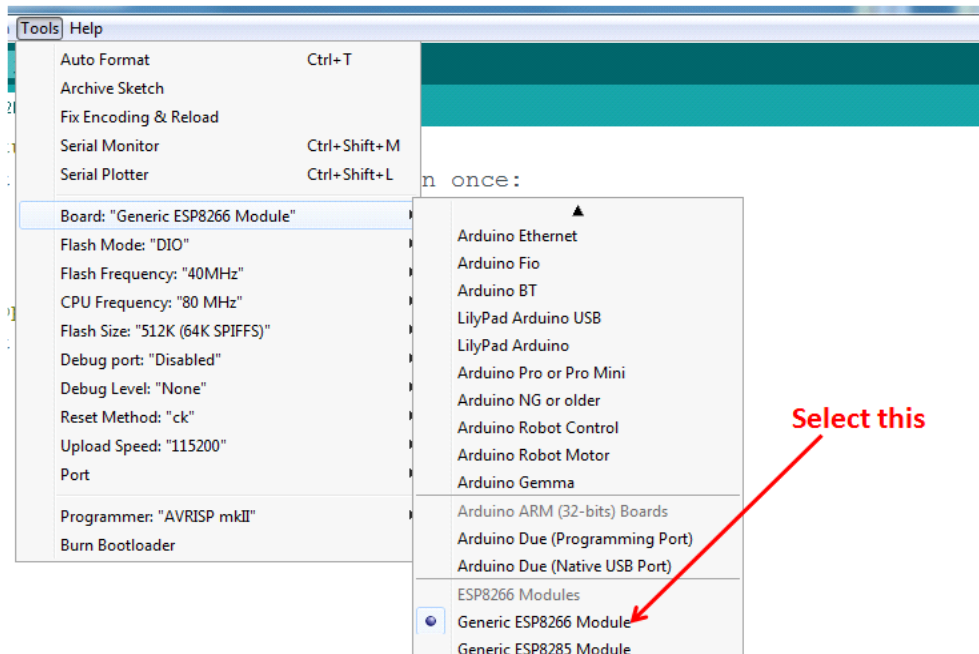


Fig 3.14 Board Manager

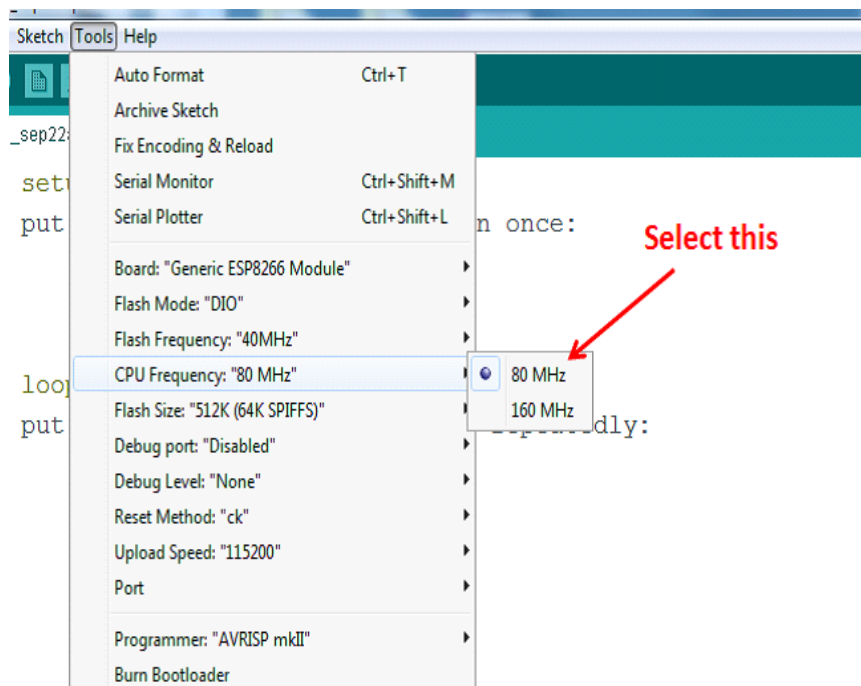
## ➤ Setup ESP8266 Support

When you've restarted Arduino IDE, select 'Generic ESP8266 Module' from the 'Tools' -> 'Board:' dropdown menu.



**Fig 3.15 Generic ESP8266 Module**

Select 80 MHz as the CPU frequency (you can try 160 MHz overclock later)



**Fig 3.16 CPU Frequency**

Select '115200' baud upload speed is a good place to start - later on you can try higher speeds but 115200 is a good safe place to start.

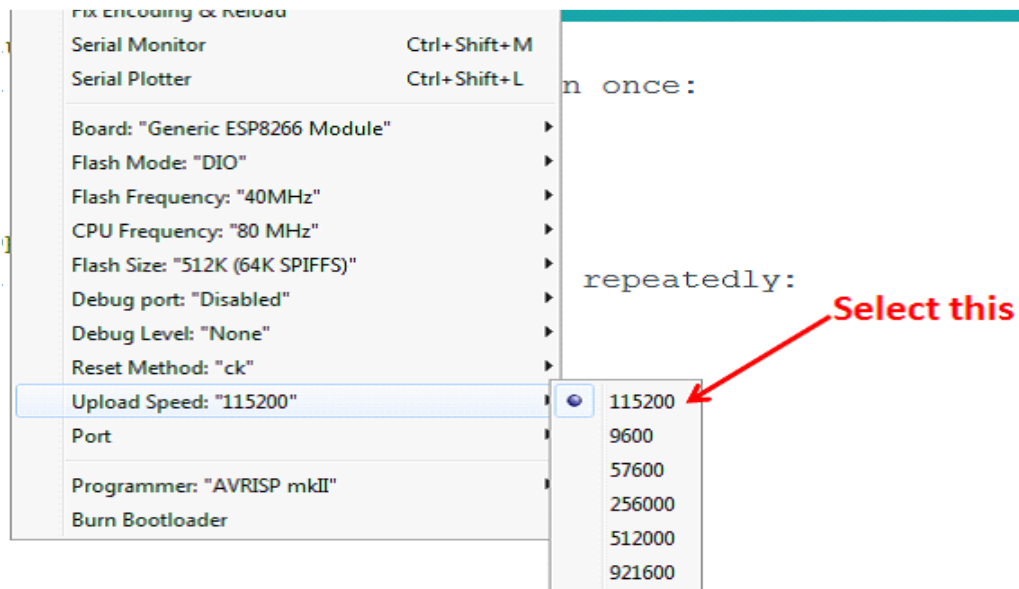


Fig 3.17 Upload Speed

Go to your Windows 'Device Manager' to find out which Com Port 'USB-Serial CH340' is assigned to. Select the matching COM/serial port for your CH340 USB-Serial interface.

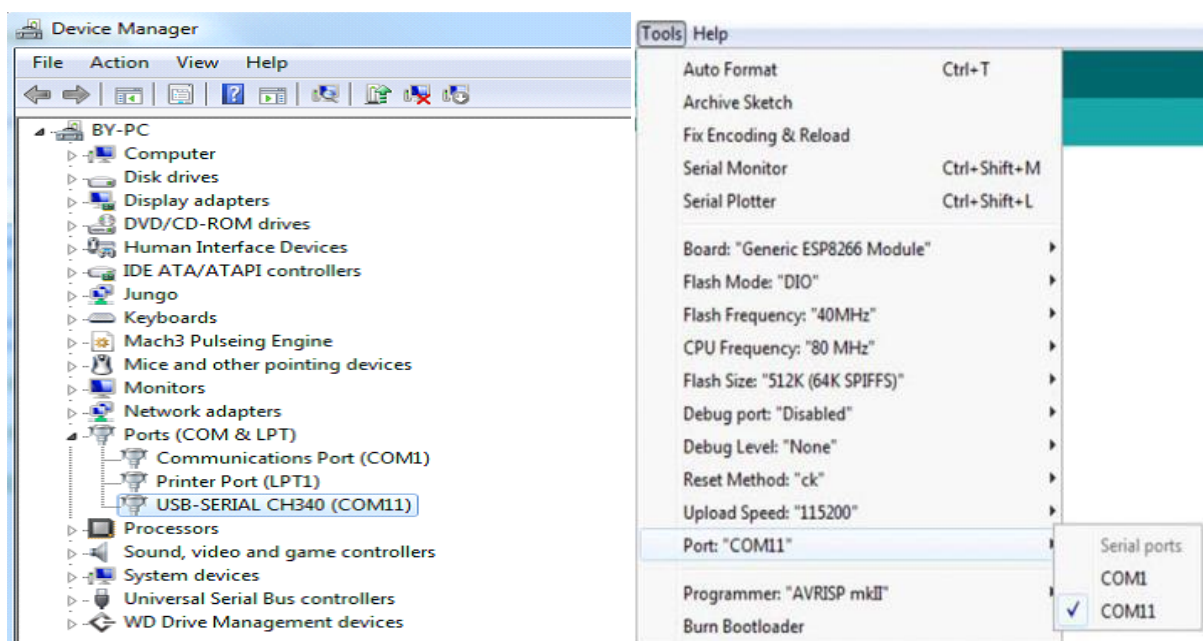


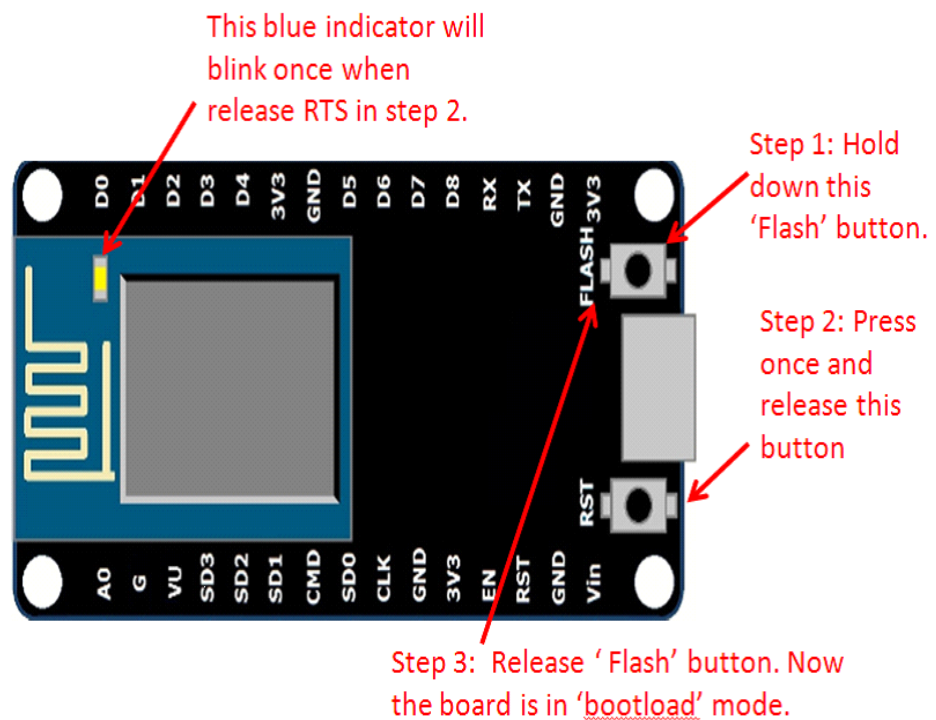
Fig 3.18 USB Serial CH340

## BLINK TEST

We'll begin with the simple blink test. Enter this into the sketch window (and save since you'll have to). Connect a LED as shown in Figure 3.14

Now you'll need to put the board into boot load mode. You'll have to do this before each upload. There is no timeout for boot load mode, so you don't have to rush!

- Hold down the 'Flash' button.
- While holding down 'Flash', press the 'RST' button.
- Release 'RST', then release 'Flash'



**Fig 3.19 Blink Test**

Once the ESP board is in boot load mode, upload the sketch via the IDE,

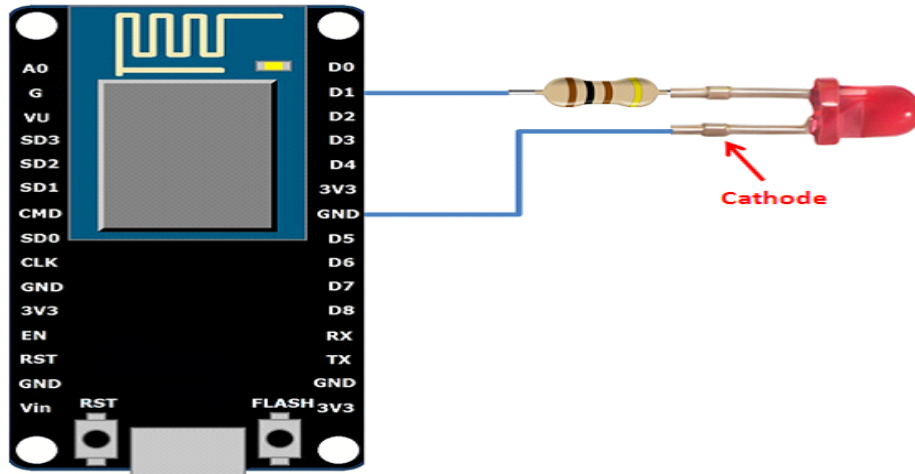


Fig 3.20 ESP Board

## CONNECTION DIAGRAM FOR BLINKING TEST

```

blinky | Arduino 1.6.7
File Edit Sketch Tools Help
[Icons]
blinky
void setup() {
  pinMode(5, OUTPUT); // GPIO05, Digital Pin D1
}

void loop() {
  digitalWrite(5, HIGH);
  delay(900);
  digitalWrite(5, LOW);
  delay(500);
}

Uploading...
WARNING: Spurious .github folder in 'Adafruit IO Arduino' library
WARNING: Spurious .tests folder in 'Adafruit IO Arduino' library
WARNING: Spurious .github folder in 'Adafruit MQTT Library' library
WARNING: Spurious .github folder in 'Adafruit IO Arduino' library
WARNING: Spurious .tests folder in 'Adafruit IO Arduino' library
WARNING: Spurious .github folder in 'Adafruit MQTT Library' library

Sketch uses 222,197 bytes (51%) of program storage space. Maximum is 434,160 bytes.
Global variables use 31,572 bytes (38%) of dynamic memory, leaving 50,348 bytes for local v
Uploading 226352 bytes from C:\Users\BY\AppData\Local\Temp\buildb7f3357d9ec338fa2a4043584dd
..... [ 36% ]
.....

Generic ESP8266 Module, 80 MHz, 40MHz, DIO, 115200, 512K @4K SPIFFS
  
```

Fig 3.21 Connection for Blinking Test

## Flashing Node MCU Firmware on the ESP8266 using Windows

Node MCU is a firmware that allows you to program the ESP8266 modules with LUA script. And you'll find it very similar to the way you program your Arduino. With just a few lines of code you can establish a Wi-Fi connection, control the ESP8266 GPIOs, turning your ESP8266 into a web server and a lot more. In this tutorial we are going to use another ESP8266 module with pin header adapter board which is breadboard friendly.

### ESP8266 Module Breadboard Friendly with Header Connector

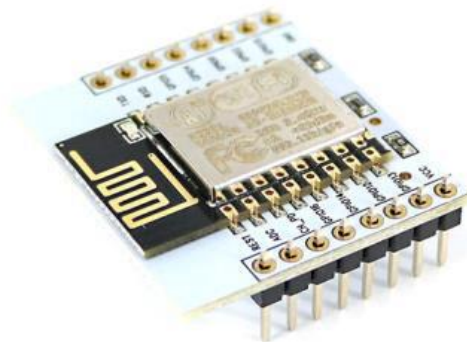


Fig 3.22 ESP8266 Module Breadboard

### PIN ASSIGNMENT

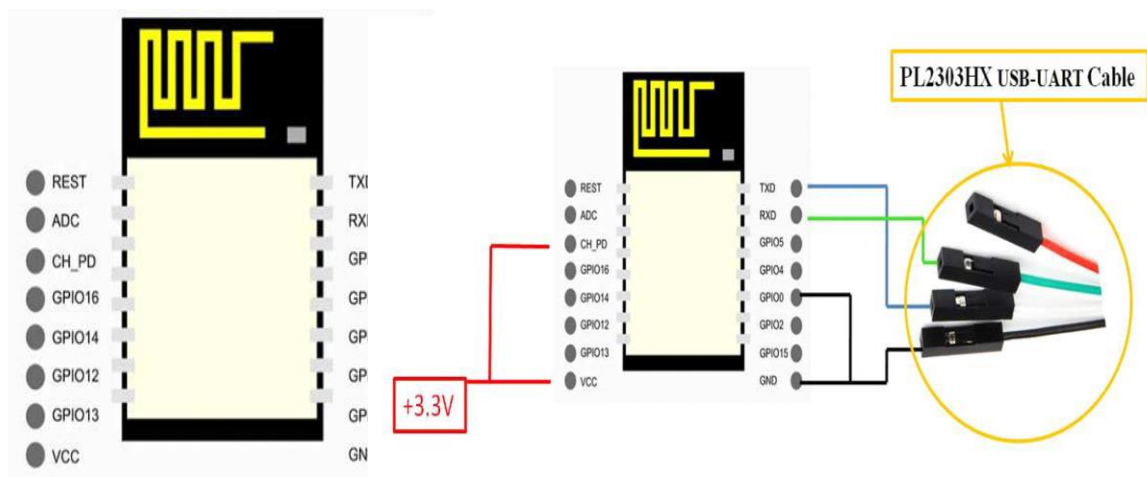


Fig 3.23 Pins

### **3.6. INTERNET OF THINGS**

The Internet of things (IoT) is the inter-networking of physical devices, vehicles (also referred to as "connected devices" and "smart devices"), buildings, and other items embedded with electronics, software, sensors, actuators, and network connectivity which enable these objects to collect and exchange data. In 2013 the Global Standards Initiative on Internet of Things (IoT-GSI) defined the IoT as "a global infrastructure for the information society, enabling advanced services by interconnecting (physical and virtual) things based on existing and evolving interoperable information and communication technologies" and for these purposes a "thing" is "an object of the physical world (physical things) or the information world (virtual things), which is capable of being identified and integrated into communication networks". The IoT allows objects to be sensed or controlled remotely across existing network infrastructure, creating opportunities for more direct integration of the physical world into computer-based systems, and resulting in improved efficiency, accuracy and economic benefit in addition to reduced human intervention. When IoT is augmented with sensors and actuators, the technology becomes an instance of the more general class of cyber-physical systems, which also encompasses technologies such as smart grids, virtual power plants, smart homes, intelligent transportation and smart cities. Each thing is uniquely identifiable through its embedded computing system but is able to interoperate within the existing Internet infrastructure. Experts estimate that the IoT will consist of about 30 billion objects by 2020. Typically, IoT is expected to offer advanced connectivity of devices, systems, and services that goes beyond machine-to-machine (M2M) communications and covers a variety of protocols, domains, and applications. The interconnection of these embedded devices (including smart objects), is expected to usher in automation in nearly all fields, while also enabling advanced applications like a smart grid, and expanding to areas such as smart cities. "Things", in the IoT sense, can refer to a wide variety of devices such as heart monitoring implants, biochip transponders on farm animals, electric clams in coastal waters, automobiles with built-in sensors, DNA analysis devices for environmental/food/pathogen monitoring, or field operation devices that assist firefighters in search and rescue operations. Legal scholars

suggest regarding "Things" as an "inextricable mixture of hardware, software, data and service". These devices collect useful data with the help of various existing technologies and then autonomously flow the data between other devices. Current market examples include home automation (also known as smart home devices) such as the control and automation of lighting, heating (like smart thermostat), ventilation, air conditioning (HVAC) systems, and appliances such as washer/dryers, robotic vacuums, air purifiers, ovens, or refrigerators/freezers that use Wi-Fi for remote monitoring. As well as the expansion of Internet-connected automation into a plethora of new application areas, IoT is also expected to generate large amounts of data from diverse locations, with the consequent necessity for quick aggregation of the data, and an increase in the need to index, store, and process such data more effectively. IoT is one of the platforms of today's Smart City, and Smart Energy Management Systems.

## **HISTORY**

As of 2016, the vision of the Internet of things has evolved due to a convergence of multiple technologies, including ubiquitous wireless communication, real-time analytics, machine learning, commodity sensors, and embedded systems. This means that the traditional fields of embedded systems, wireless sensor networks, control systems, automation (including home and building automation), and others all contribute to enabling the Internet of things (IoT). The concept of a network of smart devices was discussed as early as 1982, with a modified Coke machine at Carnegie Mellon University becoming the first Internet-connected appliance, able to report its inventory and whether newly loaded drinks were cold. Mark Weiser's seminal 1991 paper on ubiquitous computing, "The Computer of the 21st Century", as well as academic venues such as UbiComp and PerCom produced the contemporary vision of IoT. In 1994 Reza Raji described the concept in IEEE Spectrum as "[moving] small packets of data to a large set of nodes, so as to integrate and automate everything from home appliances to entire factories". Between 1993 and 1996 several companies proposed solutions like Microsoft's at Work or Novell's NEST. However, only in 1999 did the field start gathering momentum. Bill Joy

envisioned Device to Device (D2D) communication as part of his "Six Webs" framework, presented at the World Economic Forum at Davos in 1999. The concept of the Internet of things became popular in 1999, through the Auto-ID Centre at MIT and related market-analysis publications. Radio-frequency identification (RFID) was seen by Kevin Ashton (one of the founders of the original Auto-ID Centre) as a prerequisite for the Internet of things at that point. Ashton prefers the phrase "Internet for Things. "If all objects and people in daily life were equipped with identifiers, computers could manage and inventory them. Besides using RFID, the tagging of things may be achieved through such technologies as near field communication, barcodes, QR codes and digital watermarking. In its original interpretation, one of the first consequences of implementing the Internet of things by equipping all objects in the world with minuscule identifying devices or machine-readable identifiers would be to transform daily life. For instance, instant and ceaseless inventory control would become ubiquitous. A person's ability to interact with objects could be altered remotely based on immediate or present needs, in accordance with existing end-user agreements. For example, such technology could grant motion-picture publishers much more control over end-user private devices by remotely enforcing copyright restrictions and digital rights management, so the ability of a customer who bought a Blu-ray disc to watch the movie could become dependent on the copyright holder's decision, similar to Circuit City's failed DIVX.

### **3.6.1. APPLICATIONS**

#### **Environmental monitoring**

Environmental monitoring applications of the IoT typically use sensors to assist in environmental protection by monitoring air or water quality, atmospheric or soil conditions, and can even include areas like monitoring the movements of wildlife and their habitats. Development of resource constrained devices connected to the Internet also means that other applications like earthquake or tsunami early-warning systems can also be used by emergency services to provide more effective aid. IoT devices in this application typically span a large geographic area and can also be

mobile. It has been argued that the standardization IoT brings to wireless sensing will revolutionize this area.

### **Infrastructure management**

Monitoring and controlling operations of urban and rural infrastructures like bridges, railway tracks, on- and offshore- wind-farms is a key application of the IoT. The IoT infrastructure can be used for monitoring any events or changes in structural conditions that can compromise safety and increase risk. It can also be used for scheduling repair and maintenance activities in an efficient manner, by coordinating tasks between different service providers and users of these facilities. IoT devices can also be used to control critical infrastructure like bridges to provide access to ships. Usage of IoT devices for monitoring and operating infrastructure is likely to improve incident management and emergency response coordination, and quality of service, up-times and reduce costs of operation in all infrastructure related areas. Even areas such as waste management can benefit from automation and optimization that could be brought in by the IoT.

### **Manufacturing Network**

Control and management of manufacturing equipment, asset and situation management, or manufacturing process control bring the IoT within the realm of industrial applications and smart manufacturing as well. The IoT intelligent systems enable rapid manufacturing of new products, dynamic response to product demands, and real-time optimization of manufacturing production and supply chain networks, by networking machinery, sensors and control systems together. Digital control systems to automate process controls, operator tools and service information systems to optimize plant safety and security are within the purview of the IoT. But it also extends itself to asset management via predictive maintenance, statistical evaluation, and measurements to maximize reliability. Smart industrial management systems can also be integrated with the Smart Grid, thereby enabling real-time energy optimization. Measurements, automated controls, plant optimization, health and safety management, and other functions are

provided by a large number of networked sensors. The National Science Foundation established an Industry/University Cooperative Research Center on intelligent maintenance systems (IMS) in 2001 with a research focus to use IoT-based predictive analytics technologies to monitor connected machines and to predict machine degradation, and further to prevent potential failures. The vision to achieve near-zero breakdown using IoT-based predictive analytics led the future development of e-manufacturing and maintenance activities. The term IIoT (Industrial Internet of Things) is often encountered in the manufacturing industries, referring to the industrial subset of the IoT. IIoT in manufacturing could generate so much business value that it will eventually lead to the fourth industrial revolution, so the so-called Industry 4.0. It is estimated that in the future, successful companies will be able to increase their revenue through Internet of things by creating new business models and improve productivity, exploit analytics for innovation, and transform workforce. The potential of growth by implementing IIoT will generate \$12 trillion of global GDP by 2030 while connectivity and data acquisition are imperative for IIoT, they should not be the purpose, rather the foundation and path to something bigger. Among all the technologies, predictive maintenance is probably a relatively "easier win" since it is applicable to existing assets and management systems. The objective of intelligent maintenance systems is to reduce unexpected downtime and increase productivity. And to realize that alone would generate around up to 30% over total maintenance costs. Industrial big data analytics will play a vital role in manufacturing asset predictive maintenance, although that is not the only capability of industrial big data. Cyber-physical systems (CPS) is the core technology of industrial big data and it will be an interface between human and the cyber world. Cyber-physical systems can be designed by following the 5C (connection, conversion, cyber, cognition, configuration) architecture, and it will transform the collected data into actionable information, and eventually interfere with the physical assets to optimize processes. An IoT-enabled intelligent system of such cases has been demonstrated by the NSF Industry/University Collaborative Research Center for Intelligent Maintenance Systems (IMS) at University of Cincinnati on a band saw machine in IMTS 2014 in Chicago. Band saw machines are

not necessarily expensive, but the band saw belt expenses are enormous since they degrade much faster. However, without sensing and intelligent analytics, it can be only determined by experience when the band saw belt will actually break. The developed prognostics system will be able to recognize and monitor the degradation of band saw belts even if the condition is changing, so that users will know in near real time when is the best time to replace band saw. This will significantly improve user experience and operator safety, and save costs on replacing band saw belts before they actually break. The developed analytical algorithms were realized on a cloud server, and was made accessible via the Internet and on mobile devices.

## **Energy management**

Integration of sensing and actuation systems, connected to the Internet, is likely to optimize energy consumption as a whole. It is expected that IoT devices will be integrated into all forms of energy consuming devices (switches, power outlets, bulbs, televisions, etc.) and be able to communicate with the utility supply company in order to effectively balance power generation and energy usage. Such devices would also offer the opportunity for users to remotely control their devices, or centrally manage them via a cloud-based interface, and enable advanced functions like scheduling (e.g., remotely powering on or off heating systems, controlling ovens, changing lighting conditions etc.). Besides home-based energy management, the IoT is especially relevant to the Smart Grid since it provides systems to gather and act on energy and power-related information in an automated fashion with the goal to improve the efficiency, reliability, economics, and sustainability of the production and distribution of electricity. Using advanced metering infrastructure (AMI) devices connected to the Internet backbone, electric utilities can not only collect data from end-user connections, but also manage other distribution automation devices like transformers and reclosers.

## **Medical and healthcare**

IoT devices can be used to enable remote health monitoring and emergency notification systems. These health monitoring devices can range from blood pressure and heart rate monitors to advanced devices capable of monitoring specialized implants, such as pacemakers, Fitbit electronic wristbands, or advanced hearing aids. Some hospitals have begun implementing "smart beds" that can detect when they are occupied and when a patient is attempting to get up. It can also adjust itself to ensure appropriate pressure and support is applied to the patient without the manual interaction of nurses. Specialized sensors can also be equipped within living spaces to monitor the health and general well-being of senior citizens, while also ensuring that proper treatment is being administered and assisting people regain lost mobility via therapy as well. Other consumer devices to encourage healthy living, such as, connected scales or wearable heart monitors, are also a possibility with the IoT. More and more end-to-end health monitoring IoT platforms are coming up for antenatal and chronic patients, helping one manage health vitals and recurring medication requirements.

## **Building and home automation**

IoT devices can be used to monitor and control the mechanical, electrical and electronic systems used in various types of buildings (e.g., public and private, industrial, institutions, or residential) in home automation and building automation systems. In this context, three main areas are being covered in literature: The integration of the internet with building energy management systems in order to create energy efficient and IOT driven "smart buildings". The possible means of real-time monitoring for reducing energy consumption and monitoring occupant behaviours. The integration of smart devices in the built environment and how they might be used in future applications.

## **Transportation**

The IoT can assist in integration of communications, control, and information

processing across various transportation systems. Application of the IoT extends to all aspects of transportation systems (i.e. the vehicle, the infrastructure, and the driver or user). Dynamic interaction between these components of a transport system enables inter and intra vehicular communication, smart traffic control, smart parking, electronic toll collection systems, logistic and fleet management, vehicle control, and safety and road assistance.

### **Metropolitan scale deployments**

There are several planned or ongoing large-scale deployments of the IoT, to enable better management of cities and systems. For example, Song do, South Korea, the first of its kind fully equipped and wired smart city, is near completion. Nearly everything in this city is planned to be wired, connected and turned into a constant stream of data that would be monitored and analysed by an array of computers with little, or no human intervention. Another application is a currently undergoing project in Santander, Spain. For this deployment, two approaches have been adopted. This city of 180,000 inhabitants, has already seen 18,000 city application downloads for their smartphones. This application is connected to 10,000 sensors that enable services like parking search, environmental monitoring, digital city agenda among others. City context information is used in this deployment so as to benefit merchants through a spark deals mechanism based on city behavior that aims at maximizing the impact of each notification. Other examples of large-scale deployments underway include the Sino-Singapore Guangzhou Knowledge City; work on improving air and water quality, reducing noise pollution, and increasing transportation efficiency in San Jose, California; and smart traffic management in western Singapore. French company, Sigfox, commenced building an ultra-narrowband wireless data network in the San Francisco Bay Area in 2014, the first business to achieve such a deployment in the U.S. It subsequently announced it would set up a total of 4000 base stations to cover a total of 30 cities in the U.S. by the end of 2016, making it the largest IoT network coverage provider in the country thus far. Another example of a large deployment is the one

completed by New York Waterways in New York City to connect all the city's vessels and be able to monitor them live 24/7. The network was designed and engineered by Fluid mesh Networks, a Chicago-based company developing wireless networks for critical applications. The NYWW network is currently providing coverage on the Hudson River, East River, and Upper New York Bay. With the wireless network in place, NY Waterway is able to take control of its fleet and passengers in a way that was not previously possible. New applications can include security, energy and fleet management, digital signage, public Wi-Fi, paperless ticketing and others.

### **Consumer application**

A growing portion of IoT devices are created for consumer use. Examples of consumer applications include connected car, entertainment, residences and smart homes, wearable technology, quantified self, connected health, and smart retail. Consumer IoT provides new opportunities for user experience and interfaces. Some consumer applications have been criticized for their lack of redundancy and their inconsistency, leading to a popular parody known as the "Internet of Shit." Companies have been criticized for their rush into IoT, creating devices of questionable value, and not setting up stringent security standards.

### **Unique addressability of things**

The original idea of the Auto-ID Center is based on RFID-tags and unique identification through the Electronic Product Code however this has evolved into objects having an IP address or URI. An alternative view, from the world of the Semantic Web focuses instead on making all things (not just those electronic, smart, or RFID-enabled) addressable by the existing naming protocols, such as URI. The objects themselves do not converse, but they may now be referred to by other agents, such as powerful centralized servers acting for their human owners.

Integration with the Internet implies that devices will use an IP address as a unique identifier. Due to the limited address space of IPv4 (which allows

for 4.3 billion unique addresses), objects in the IoT will have to use the next generation of the Internet protocol (IPv6) to scale to the extremely large address space required. Internet of things devices additionally will benefit from the stateless address auto-configuration present in IPv6, as it reduces the configuration overhead on the hosts, and the IETF 6LoWPAN header compression. To a large extent, the future of the Internet of things will not be possible without the support of IPv6; and consequently the global adoption of IPv6 in the coming years will be critical for the successful development of the IoT in the future. A combination of these ideas can be found in the current GS1/EPC global EPC Information Services (EPCIS) specifications. This system is being used to identify objects in industries ranging from aerospace to fast moving consumer products and transportation logistics.

In addition to the convenience factor, the integration of Bluetooth technology in industrial and home automation has significant implications for safety and security. By automating routine tasks, this technology can reduce the likelihood of human error, which can lead to accidents and other safety issues. Furthermore, the integration of security systems and other safety measures into the automation process can enhance overall security, protecting individuals and property from potential threats.

## **CHAPTER – 4**

### **RESULTS AND DISCUSSIONS**

#### **4.1 RESULTS**

Industrial and home automation using speech recognition software based on Bluetooth provides an efficient and convenient way to monitor and control automation devices using voice commands. The system has been successfully designed and implemented, and it has shown reliable performance in controlling various automation devices, such as lights, garage doors, and security systems. The system is easy to use and can be customized to suit different applications.

The combination of speech recognition and Bluetooth technology has paved the way for new and exciting possibilities in the fields of industrial and home automation. The hands-free control and enhanced accessibility that speech recognition offers can greatly improve worker safety and productivity in industrial settings and enhance the user experience in home automation

#### **4.2 DISCUSSION**

Industrial and home automation using speech recognition software based on Bluetooth has several advantages over traditional automation systems. Firstly, it allows users to control automation devices using voice commands, which is more convenient and user-friendly than using buttons or switches. Secondly, the system can be monitored and controlled remotely, which allows managers and supervisors to monitor production processes and make changes as necessary. Thirdly, the system can be programmed to respond to certain events, such as turning off the lights when no motion is detected or sending an alert when the security system is triggered, which enhances the overall automation efficiency.

Bluetooth technology has made it possible to integrate speech recognition

into a wide range of devices, from machinery and equipment in industrial automation to smart home devices such as lighting, heating, and entertainment systems. While there are still challenges to be addressed, such as improving speech recognition accuracy and ensuring device security, the potential benefits of this technology are clear. As speech recognition and Bluetooth technology continue to advance, we can expect to see even more innovative applications of these technologies in the future, improving our lives and changing the way we interact with devices in the home and workplace.

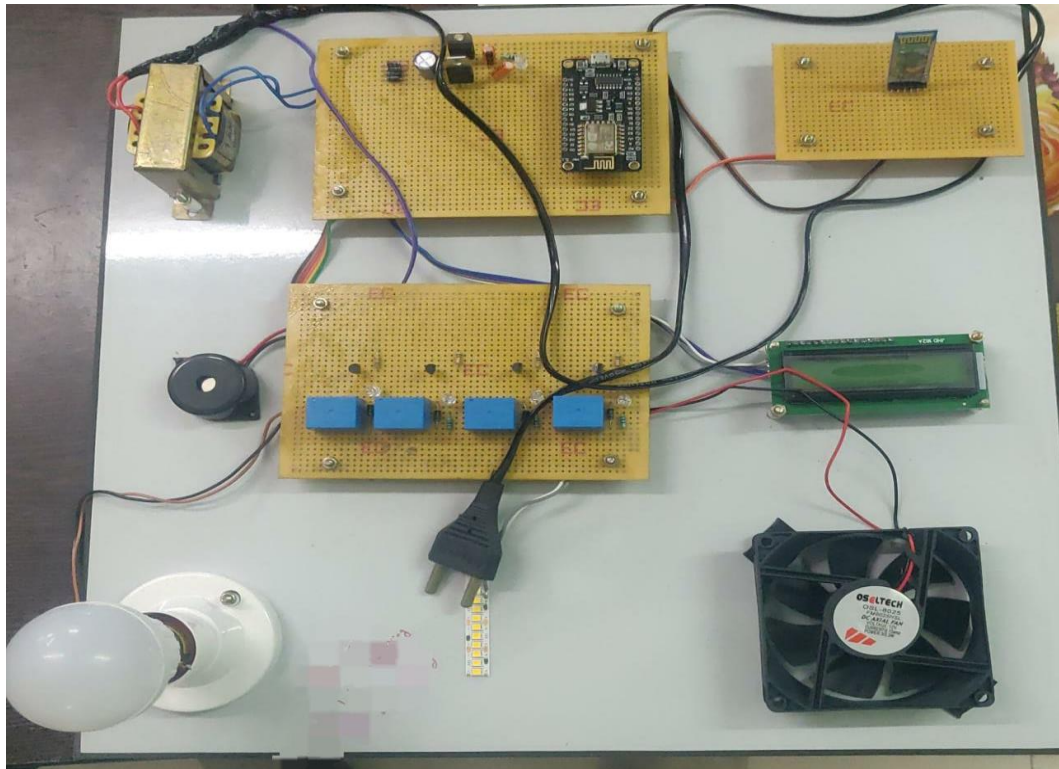
However, there are also some limitations to this system. Firstly, the speech recognition system may have difficulty understanding certain commands or accents, which may result in incorrect control of automation devices. Secondly, the Bluetooth communication may be affected by external factors such as interference, which may affect the reliability of the system. Thirdly, the system may not be suitable for high-security applications, as voice commands can potentially be overheard or recorded by unauthorized personnel.

In conclusion, industrial and home automation using speech recognition software based on Bluetooth provides a convenient, efficient, and easy-to-use way to monitor and control automation devices using voice commands. The system can be customized to suit different applications and can be easily scaled up or down to accommodate changes in production volumes or home automation needs. However, it is important to consider the limitations of the system when designing and implementing it.

One of the primary benefits of using wireless monitoring and speech recognition in industrial automation is increased efficiency. Workers can use voice commands to control machines and equipment, reducing the need for manual inputs and allowing for faster execution of tasks. This can lead to increased productivity and reduced production time.

Another advantage of wireless monitoring and speech recognition is

improved accuracy. Voice commands can help reduce errors caused by manual data entry, which can be especially important in industries where precision is crucial. For example, in pharmaceutical manufacturing, small errors can have serious consequences. The use of speech recognition can reduce the risk of such errors.



**Fig.4.1. Prototype of proposed receiver design**



**Fig.4.2..Light is in ON and Fan is in OFF condition displayed on LCD.**  
Bluetooth technology can be used to enable speech recognition in industrial and home automation systems. Here is an overview of how it can work:

**Bluetooth-enabled microphone:** A Bluetooth-enabled microphone can be used to capture speech commands from the user. The microphone can be

connected to a smartphone or a dedicated device that is connected to the automation system.

**Bluetooth connectivity:** The microphone can communicate with the automation system using Bluetooth technology. The automation system can be equipped with a Bluetooth receiver or a Bluetooth-enabled microcontroller that can receive and process the speech commands.

**Speech recognition software:** The automation system can use speech recognition software to interpret the speech commands received from the microphone. The software can be trained to recognize specific commands and perform corresponding actions, such as turning on or off a device, adjusting the temperature, or opening a door.

**Response feedback:** Once the speech command is recognized and processed, the automation system can provide feedback to the user through a Bluetooth-enabled speaker or display. The feedback can confirm that the command was received and executed or indicate if there was an error or a problem.

**Security considerations:** Since Bluetooth technology can be susceptible to security vulnerabilities, it is important to implement proper security measures to protect the communication between the microphone and the automation system. For example, using encryption, authentication, and authorization protocols can help ensure the privacy and integrity of the data transmitted over Bluetooth.

By using Bluetooth technology to enable speech recognition in industrial and home automation systems, users can have a hands-free and convenient way to interact with their devices and appliances. Additionally, it can improve accessibility for individuals with disabilities who may have difficulty using traditional physical interfaces.

## **CHAPTER – 5**

### **CONCLUSION**

#### **5.1. CONCLUSION**

Industrial and home automation using speech recognition is a rapidly growing field that holds significant potential for improving efficiency, convenience, and accessibility in both industrial and residential settings. This has enabled the development of voice-controlled devices and Bluetooth technology that can perform a wide range of functions, from turning on lights and adjusting thermostats to controlling industrial machinery and equipment. Bluetooth supports a variety of security features to protect against unauthorized access and data theft. While comparing to the wireless devices and ZigBee technology, the Bluetooth receiver is less cost compared to others. Bluetooth has a network range of 1 to 100 meters and a maximum network speed of 25 megabits per second which is higher than the ZigBee and other wireless devices. In industrial settings, speech recognition can be used to improve worker safety, increase productivity, and reduce costs by allowing workers to operate machinery and equipment hands-free. In home automation, speech recognition can provide greater accessibility for individuals with disabilities or mobility issues, as well as increase energy efficiency and overall comfort. Overall, industrial and home automation using speech recognition holds great promise for revolutionizing the way we interact with technology in both industrial and residential settings, and with ongoing advance in speech recognition using Bluetooth technology, we can expect to see continued growth and innovation in this field in the coming years.

#### **5.2. FUTURE SCOPE**

The future scope for industrial and home automation using speech recognition is quite promising, with advancements in speech recognition technology and the increasing demand for automation and smart home devices.

In industrial automation, speech recognition technology can be used to control and monitor machines, equipment, and processes through voice commands. This can improve efficiency, productivity, and safety in industrial environments. For example, workers can use voice commands to control machinery or make adjustments to production processes without having to stop what they are doing or physically interact with a control panel.

In home automation, speech recognition technology can be used to control various devices such as lighting, thermostats, security systems, and entertainment systems. This can provide a more convenient and seamless user experience, as users can simply use their voice to control these devices instead of having to manually interact with them.

In addition, the integration of artificial intelligence and machine learning into speech recognition technology can improve accuracy and responsiveness, enabling more natural and conversational interactions between humans and machines. This opens up opportunities for more advanced applications in the future, such as virtual assistants that can perform complex tasks and anticipate user needs.

Overall, the future scope for industrial and home automation using speech recognition is vast and promising, with the potential to revolutionize the way we interact with machines and devices in our daily lives.

### **5.3. RESEARCH ISSUES**

**Robustness:** One of the major challenges in using speech recognition for industrial and home automation is its ability to accurately recognize speech in noisy environments or in the presence of competing sounds. Research can focus on developing techniques to improve the robustness of speech recognition systems.

**Multilingual support:** Speech recognition systems need to be able to recognize speech in multiple languages, which presents unique challenges due to differences in pronunciation, intonation, and grammar. Research can

focus on developing techniques for multilingual speech recognition.

**Privacy concerns:** Speech recognition systems typically involve collecting and processing sensitive data, which raises privacy concerns. Research can focus on developing techniques for protecting user privacy while still providing accurate speech recognition.

**Context awareness:** Speech recognition systems need to be able to understand the context in which speech is occurring in order to accurately interpret its meaning. Research can focus on developing techniques for context-aware speech recognition.

**Real-time processing:** Many industrial and home automation applications require real-time processing of speech, which can be challenging due to the high computational requirements. Research can focus on developing techniques for real-time speech recognition with low latency.

**Integration with other systems:** Speech recognition systems need to be integrated with other systems in order to provide a seamless user experience. Research can focus on developing techniques for integrating speech recognition with other systems, such as natural language processing and machine learning.

**User acceptance:** The success of speech recognition systems depends on user acceptance. Research can focus on understanding user preferences and developing user-friendly interfaces for speech recognition systems.

**Accessibility:** Speech recognition can greatly benefit individuals with disabilities, but the technology may not be accessible to all individuals due to physical or cognitive limitations. Research can focus on developing techniques for making speech recognition more accessible to individuals with disabilities.

#### 5.4. IMPLEMENTATION ISSUES

**Noise interference:** The accuracy of speech recognition can be affected by

background noise or interference from other machines in the industrial setting or home environment. This can be addressed by using noise-canceling microphones or soundproofing the environment.

**Speaker variability:** Speech recognition accuracy can also be impacted by speaker variability, as different people have different accents, speech patterns, and pronunciation. This issue can be addressed by training the speech recognition system to recognize different accents and dialects or by using speaker verification techniques to ensure only authorized users can access the system.

**Vocabulary limitations:** The vocabulary used in industrial and home automation settings can be very specialized, with many technical terms and industry-specific jargon. The speech recognition system may need to be trained or customized to recognize these terms accurately.

**Integration with other systems:** The speech recognition system may need to be integrated with other automation systems, such as robotics or control systems, which can be challenging due to different data formats and protocols.

**Security and privacy concerns:** Voice recognition systems can be vulnerable to security breaches and unauthorized access. Therefore, it is essential to implement proper security measures to prevent data theft or hacking.

**Cost and maintenance:** Speech recognition systems can be expensive to implement and maintain, especially in industrial settings. Regular maintenance and updates may be required to ensure optimal performance.

**Legal and regulatory compliance:** There may be legal and regulatory compliance issues related to the use of speech recognition in certain industries or environments.

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## APPENDIX

### A. SCREENSHOTS:

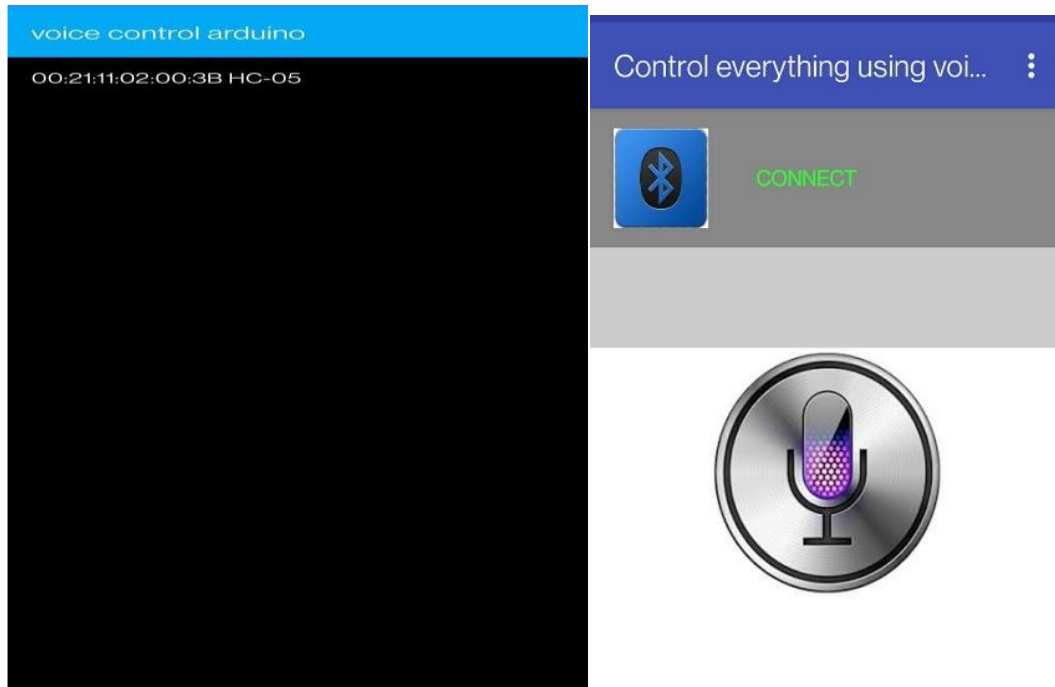


Fig.A.1. Bluetooth is connected to the mobile app

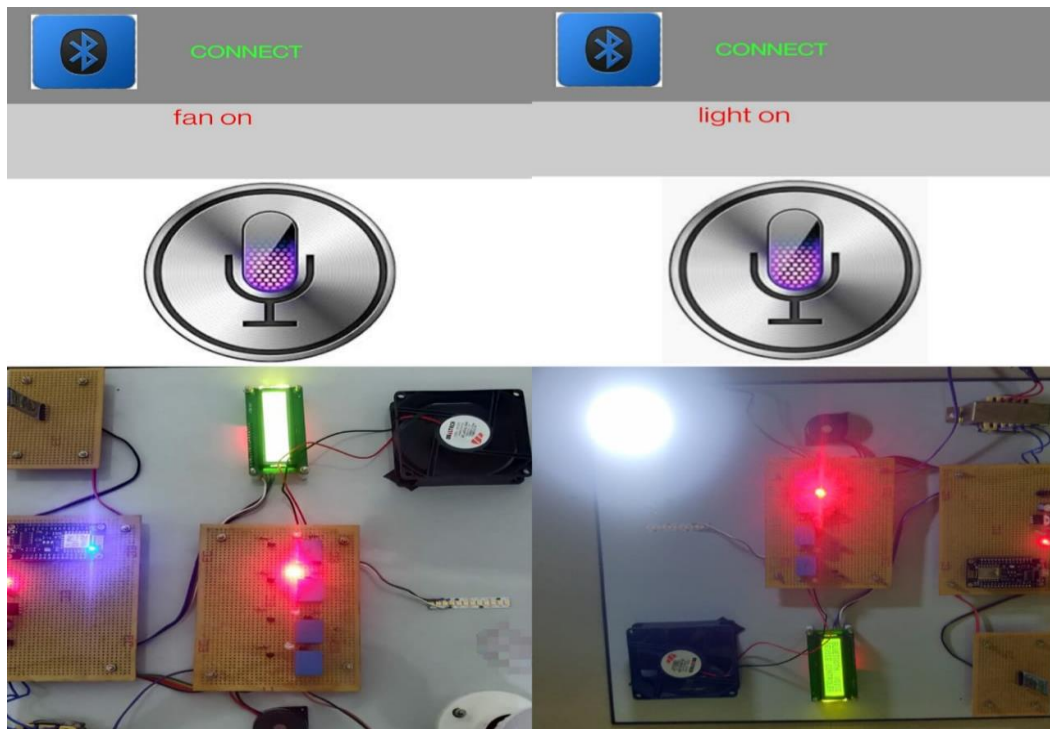
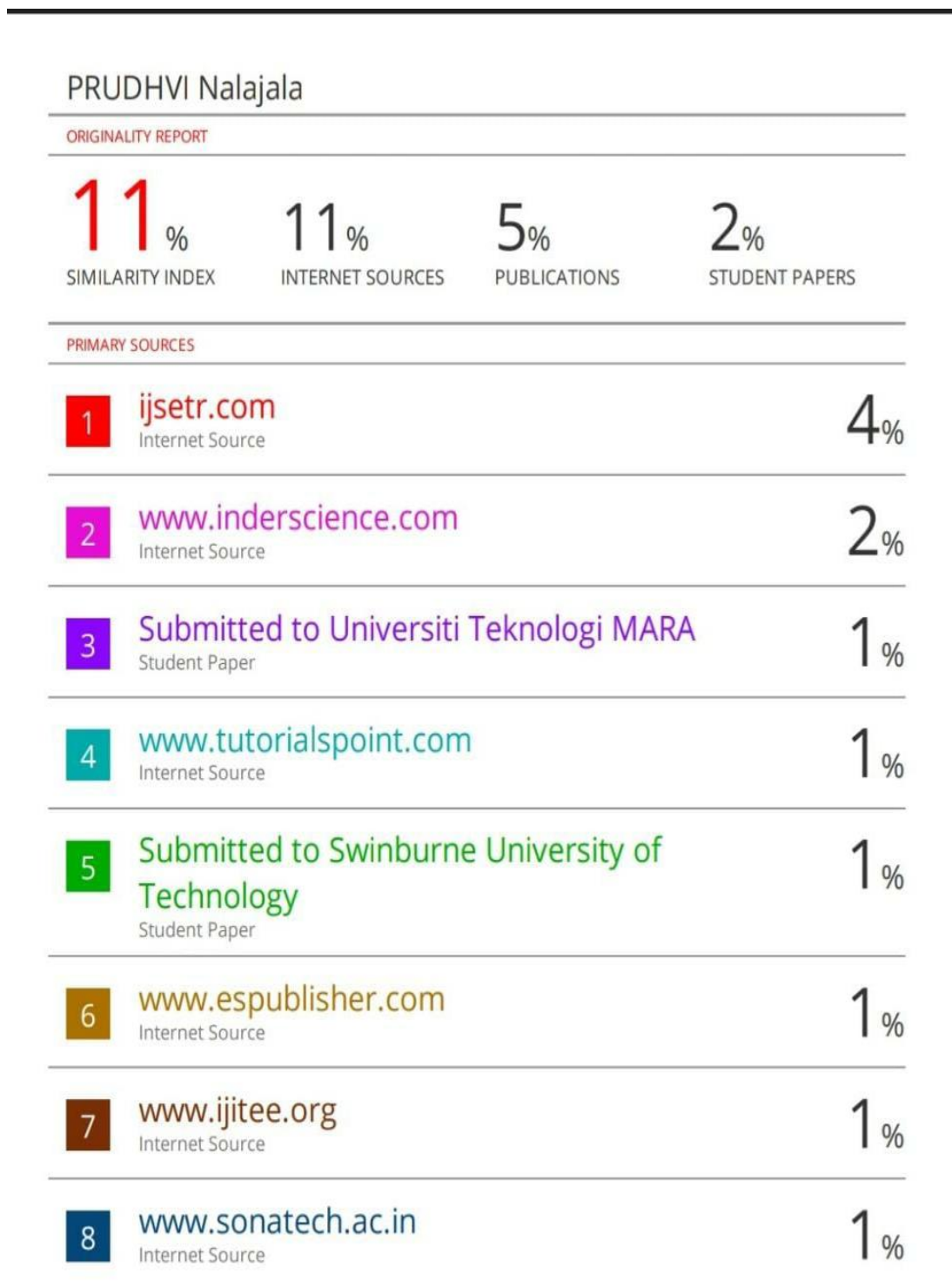


Fig.A.2. Appliances switching on or off

## B. PLAGIARISM REPORT:



### **C. JOURNAL PAPER:**

