

# VOICE-CONTROLLED MANAGEMENT OF ELECTRICAL AND SOLAR APPLIANCES

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**Abstract:-** IoT technology, a cutting-edge innovation, enhances daily life interactions with objects. The Internet connects the world, forming a global community. Our project focuses on an Android app utilizing IoT, enabling voice-controlled household utilities. This improves comfort, allowing easy smartphone commands for lights and fans. The app, with Google's speech recognition, sends commands to an Arduino Uno for execution via Bluetooth or Wi-Fi. Solar power is also integrated for energy efficiency and emergencies.

**Key Words:-** Aurdino, Relay, HC 05 Bluetooth Module, Solar Panel, Voice Control

## **1.INTRODUCTION:-**

### **1.1.Objective:-**

An embedded system is a purpose-specific computer system commonly found in various products like air conditioners, DVD players, printers, mobile phones, etc. It consists of a CPU, specialized hardware, and embedded software (firmware) to carry out specific tasks.

One innovative application is a voice-activated home automation system using an Android app and an Arduino Mega board. The system aims to replace manual appliance control to reduce stress and the risk of accidents at home. The project follows the Waterfall methodology and uses Android, C, Bluetooth module (HC-05), microcontroller (Arduino), and relays to achieve its objective.

The system's output design comprises relays, Arduino, and Bluetooth module, enabling the voice commands received by the Android app to be processed by the Arduino, which then triggers the appropriate relay to control the appliances. The Arduino technology proves to be more efficient for voice control than the HC-05 module used for remote control.

Overall, this voice-activated home automation system offers a safer and more convenient approach to controlling appliances through voice commands, potentially enhancing the quality of life and reducing accidents in the home.

### **1.2.Description:-**

A speech control automation framework using an Arduino board and an Android app allows for hands-free control of appliances. Home automation aims to reduce daily stress and risks by automating tasks. Wireless technologies, such as Bluetooth, GSM, and the internet, have greatly impacted human life and accelerated growth. Bluetooth-based home

automation systems have advantages like extended range (10 to 100 meters) and open access to the 2.4 GHz band. This has led to the rapid development of Bluetooth-based home automation. Automation is a method or system that uses electronic technology to manage processes with minimal human involvement.

### **1.3.Focus Of The Project:-**

The project aims to create a voice-based platform for automating and controlling household electrical equipment. The objectives include designing a Bluetooth interface for the microcontroller board, establishing wireless connectivity between an Android device and the microcontroller via Bluetooth, identifying and transmitting voice data to the microcontroller, creating computer programs for controlling the equipment, and enabling Bluetooth data transfer and speech data collection on the Android device.

The project scope involves implementing a voice recognition system and utilizing the Bluetooth capabilities of an Android handset to control domestic power points wirelessly through an Arduino microcontroller board. This includes writing the necessary code for the microcontroller and enabling Bluetooth capabilities using Bluetooth hardware.

In summary, the project aims to achieve voice-controlled automation of household electrical equipment by integrating Bluetooth and voice recognition technology with an Arduino microcontroller board.

## **2.AURDINO:-**

Engineers, designers, artists, amateurs, and anybody else who tinkers with technology now have access to low-cost, easy-to-use technologies to build their creative, interactive creations, etc. Now it is possible to create an entirely new category of computer-managed projects. Built on modular, user-friendly

hardware and software, Arduino is an open-source platform for electronic prototyping. Everyone who has an interest in creating interactive products or environments, such as artists, designers, hobbyists, etc., should read it. It consists of a development environment for writing software for the board and is an open-source physical computing platform built on a microcontroller board. An Arduino, to put it simply, is a little microcontroller board with a USB connector for connecting to your computer and a number of connection ports for connecting to other devices, such as motors, relays, light sensors, laser diodes, loudspeakers, microphones, etc. Both a 9V battery and a USB port on a computer can be used to power them. They can be connected to a computer, programmed, or controlled, and then set up to operate independently. Since the entire project is open source, anyone can create and market Arduino-compatible goods. In order for the Arduino project to be financially successful, branding is essential.

### 3.COMPONENTS:-

#### 3.1.Relay:-

Relay driver ICs are essential when using a low-voltage circuit to control a high-voltage device, like turning on and off a 220V light bulb. Integrated circuits like Op-Amp cannot provide the required current to drive the relay coil. Relays are preferred over solid-state switches due to their high current capacity, endurance, and ability to isolate the drive circuit.

To drive a relay using a transistor, a small amount of power is sufficient. When the base lead of the transistor receives enough current, it amplifies and allows current to flow from the emitter to the collector, turning on the relay. The transistor's emitter-to-collector channel remains open even without input current, and it closes when enough current or voltage is applied to the base lead, allowing current to pass through the relay's coil.

Relays act as electromagnetic components, enabling low-power circuits to control high-current switching devices through an armature moved by an electromagnet. This provides a safe and efficient method to control high-voltage devices using low-voltage circuits.

#### 3.2.HC 05 Bluetooth Module:-

The HC-05 Bluetooth module is designed for wireless communication and supports both master and slave settings. It has six pins: Key/EN, VCC (3.3V or 5V), GND, TXD, RXD, and State.

- Key/EN: Used to enable AT commands mode when set high. By default, it is in data mode.
- Data mode: Used for data transmission between devices.
- Command mode: Used to change HC-05 settings using AT commands transmitted through the serial port (USART).

The module's red LED indicates Bluetooth activity and connection status. It blinks periodically when not connected and blinks every two seconds when connected to another Bluetooth device. The HC-05 module requires 3.3V, but it can also work with a 5V supply voltage due to its integrated 5 to 3.3V regulator. The microcontroller can directly connect to the HC-05 module's 3.3V level for RX/TX without the need for level alteration. However, the microcontroller's transmit voltage level to the HC-05's RX needs adjustment.

The HC-05 module supports a data transfer rate of up to 1Mbps over a distance of 10 meters. To communicate with the HC-05 Bluetooth module, smartphones require Bluetooth terminal applications for sending and receiving data. These apps are available in app stores for Android and Windows.

To initiate a Bluetooth conversation between two devices, the HC-05 module must first be paired with a smartphone. Then, the PC's terminal program should be launched, selecting the connected USB to serial module's port and the default baud rate of 9600bps. By using the smartphone's Bluetooth terminal application, users can easily communicate with the HC-05 module. Typed characters will be wirelessly transmitted to the module, which will send the data to the PC's terminal for display.

In summary, the HC-05 Bluetooth module allows for wireless communication between devices, and proper setup and pairing enable seamless data transfer and communication.

### **3.3.Bread Board:-**

A protoboard or breadboard is a solderless platform used for creating semi-permanent electronic circuit prototypes. It allows easy insertion and removal of wires and component legs into plastic holes to create electrical connections. Breadboards are essential tools for learning circuit design, enabling designers to test ideas and build prototypes without soldering. They are versatile and accommodate circuits of various complexities. Metal strips and sockets on the breadboard have a standard spacing of 0.1" (2.54mm) and allow connectivity. Each row has tiny clips with color-matching plastic holes for connecting wires and components. However, there are limitations to the number of components that can be connected to a single area of the breadboard, typically five clips per row. The central ravine in the breadboard divides each horizontal row, ensuring no electrical connection between the two sides of a particular row. For larger circuits, multiple breadboards can be connected to support the complexity.

### **3.4.Solar Panel:-**

Photovoltaic solar panels are composed of solar cells organized in patterns of 32, 36, 48, 60, 72, or 96 cells. The voltage produced by the cells depends on their configuration. For instance, a 32-cell panel may output 14.72 volts (0.46 volts per cell). The power generated by a solar panel is determined by the equation  $P \text{ (power)} = V \text{ (voltage)} \times I \text{ (current)}$ . Solar panels come in various sizes for commercial and residential installations.

Solar panels absorb energy from the sun's rays, and the energy is transferred to the semiconductor, creating an electric field that generates voltage and current. The voltage remains relatively constant, but the current can vary based on the amount of light. To increase solar power capacity, multiple solar panels can be connected in series, raising the system's voltage. Series connections are used when a grid-connected inverter or charge controller requires 24 volts or more. To wire panels in series, connect the positive terminal of one panel to the negative terminal of the next panel. In conclusion, using solar energy for homes is a sustainable and efficient way to harness the sun's power and increase our reliance on renewable energy sources.

#### **3.4.1.Series Characteristics Of Solar Panels:-**

In this system, all solar panels have the same kind and power rating. When three 6-volt, 3.0 amp panels are connected in series, they produce an output voltage of 18 volts and 3.0 amperes, resulting in 54 watts of power at full sun. Parallel connections, on the other hand, are used to increase the overall system current. In parallel connections, the positive terminals of the panels are linked together, as well as the negative terminals.

### 3.4.2.Parallel Characteristics Of Solar Panels:-

In this system, all solar panels are of the same kind and power rating. Using the same three 6-volt, 3.0 amp panels as before, the total output increases to 9.0 amperes ( $3 + 3 + 3$ ), resulting in 54 watts of power in full sunlight. The output voltage of each panel remains at 6 volts.

### 3.5.Battery:-

A lithium-ion battery (Li-ion) is a rechargeable battery that stores energy by reducing lithium ions reversibly. It typically consists of a graphite anode and a metal oxide cathode, with a lithium salt electrolyte in an organic solvent. Li-ion batteries vary in chemistry, performance, cost, and safety features. Designing a Li-ion battery pack involves meeting voltage and runtime specifications, considering loading, environmental factors, size, and weight limits. Prismatic or pouch cells are used for compact consumer items, while cylindrical cells like 18650 are common for electric bicycles, power tools, medical devices, and electric cars (EVs).

The majority of Li-ion batteries comprise a separator, copper current collector (anode), aluminum current collector (cathode), and electrolyte with lithium salt. During discharge, lithium ions move between the anode and cathode through the separator, generating an electric current. Battery packs for finished items like electric cars include battery cells, a battery management system, and sometimes cooling/heating systems. Large battery packs utilize modules of stacked battery cells to form functional units. Overall, Li-ion batteries are widely used due to their versatility and convenience for various applications.

### 3.6.DC Fan:-

Brushless DC fans are available in three nominal voltages: 12V, 24V, and 48V. By controlling the power supply, a

precise performance can be achieved, making them versatile for various applications. Changing the supply voltage allows adjusting the fan's speed and airflow to meet specific requirements. Operation at 24V may lead to excessive flow, but the supply voltage can be reduced to achieve the desired airflow. The voltage range for satisfactory operation depends on the fan's design and can be as small as 10-14V for 12V units.

### 3.7.DC Light 12V:-

12V DC systems are commonly used in various electrical applications, such as vehicle batteries in boats and RVs. Opting for a 12V LED system for these applications is advantageous since no additional converters or power supplies are required, simplifying the setup. LED goods are considered safer due to lower voltage, reducing risks related to shock and fire hazards. The natural impedance of objects like human skin makes it harder for electrical current to flow at 12V compared to higher line voltages (120/240V). Line voltage LED products, however, require complex electronics like capacitors to convert AC line voltage to DC for LED operation.

### 3.8.AC Lamps:-

Electric lamps are energy converters that turn electrical energy into light, with LED bulbs being advantageous for their efficiency, longer lifespan, and low power consumption. LED lighting is steadily competing with traditional bulbs, and technology advancements are rapidly improving LED luminance. LED lamps use an LED driver circuit to function with dimmers used for incandescent bulbs. Some LED lights can replace incandescent or fluorescent bulbs, utilizing multiple LED packages to enhance heat dissipation and light diffusion. Retail LED lamp packages typically include a transcript listing light output in lumens, power consumption in watts, and color temperature in Kelvin. LED lamps are

becoming the go-to choice for home and workplace lighting, outlasting incandescent bulbs and offering a comparable output in lumens.

#### 4.VOICE CONTROL:-

- A voice-controlled gadget for household appliances, enabling remote operation in any room.
- Project focuses on voice-controlled management of appliances, prioritizing accessibility for disabilities.
- Google's speech recognition used for speech input, running on an Android phone.
- Application software converts voice instructions to text.

The principles of voice control systems are highlighted in

- i. Speech Signal.
- ii. Feature Selection.
- iii. Feature Extraction.
- iv. Acoustic Models.

#### 5.SYSTEM ANALYSIS AND DESIGN:-

- A voice-controlled gadget for household appliances enables operation from any room.
- Project focuses on voice-controlled management of appliances, prioritizing accessibility for disabilities.
- Google's speech recognition used for speech input, running on an Android phone.
- Application software transforms voice instructions into text.

Voice recognition technology is used for home automation using an Arduino board, V3 voice recognition module, and relay modules. The module needs to be taught by uploading code to recognize voice commands. Each command is assigned a unique ID during training. The microcontroller receives the ID and controls the relay to switch devices on or

off. However, the technology has limitations, including a limited control range and difficulty understanding commands in noisy environments.

#### 6.ARCHITECTURE OF PROJECT:-

The system comprises six building blocks: Relay board for switching, Arduino for control and processing, Bluetooth for wireless commands, open-air block for radio wave channel, Bluetooth-enabled Android phone for communication, and spoken commands transformed by the phone's microphone. Together, these components form the structure of the suggested system.

##### 6.1.Input Design Of The Proposed System:-

The input design involves transmitting a speech command, like "switch to inverter," expressed as a sound wave. Android phones convert the sound wave to electrical waves, transmitted via Bluetooth using air as the medium. The Bluetooth module decrypts the information and sends it back to the Android phone. The microcontroller (Arduino UNO) serves as the main processing device. It processes the received command from Bluetooth and triggers specific relay switching actions based on the command received.

##### 6.2.Output Design Of The Proposed System:-

The Android phone with the installed control application uses a password restriction system. Users must gain access to the application to communicate with the Bluetooth module and send speech commands to the microcontroller for execution.

#### 7.FUTURE SCOPE:-

- Home automation is now in demand among luxury homeowners, simplifying their tasks and becoming a status symbol.



- It can be pre-installed in new constructions and added to existing apartments and communities, attracting tech enthusiasts and convenience seekers.
- The potential for turning home automation into a business functionality system exists, requiring installation and maintenance services.
- A gadget was created for voice-controlled household appliances, utilizing home electrical control systems for seamless operation.
- The project focuses on managing appliances like lights and fans using voice recognition technology, with a priority on accommodating disabilities.
- Google's speech recognition feature will handle speech input through an Android phone running the application software.
- The application software will efficiently convert voice instructions into text.

## 8.CONCLUCION:-

A gadget was created for voice-controlled household appliances, utilizing home electrical control systems. This project focuses on managing household appliances like lights and fans using voice recognition technology, with priority on accommodating disabilities. Google's speech recognition feature will handle speech input through an Android phone running the application software, transforming voice instructions into text. The device aims to control appliances in any part of the house, benefiting from home electrical control systems.

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