



# Secure Android-Controlled Phase Line Controller To Enhance The Safety And Efficiency Of Power Line Operators

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**Abstract :** Electrical communication systems are inherently dangerous, and precautions must be taken when dealing with power lines. Traditional grid handling methods are inflexible and pose risks to maintenance personnel. This work proposes a solution using embedded systems and Bluetooth technology to enable secure, remote control of power lines through an Android mobile application. By connecting the Arduino Uno ATMEGA 328 controller to a Bluetooth receiver, users can control power lines by sending commands through a dedicated Android app. Password authentication ensures authorized access, increasing security for maintenance personnel. The system allows individuals to control multiple power lines, making maintenance and repair easier. By leveraging the ubiquitous 2.4 GHz frequency range, this project demonstrates the potential of Bluetooth technology to revolutionize power grid management, delivering cost-effective and scalable solutions for future use. Electrical communication systems are inherently dangerous, and precautions must be taken when dealing with power lines. Traditional grid handling methods are inflexible and pose risks to maintenance personnel. This work proposes a solution using embedded systems and Bluetooth technology to enable secure, remote control of power lines through an Android mobile application. By connecting the Arduino Uno ATMEGA 328 controller to a Bluetooth receiver, users can control power lines by sending commands through a dedicated Android app. Password authentication ensures authorized access, increasing security for maintenance personnel. The system allows individuals to control multiple power lines, making maintenance and repair easier. By leveraging the ubiquitous 2.4 GHz frequency range, this project demonstrates the potential of Bluetooth technology to revolutionize power grid management, delivering cost-effective and scalable solutions for future use.

**IndexTerms -** Solar Energy, HC-05 Bluetooth Modul, Relay Driver IC,Arduino, Keiluvicino IDE, Microcontroller,

## INTRODUCTION

Modern power systems face the challenges of maintaining large power lines and associated electrical equipment, especially if there are faults, breaks, or short circuits, which can cause power system faults it is more difficult, it is necessary to eliminate faults quickly to protect electrical wiring and equipment. The proposed system, Password-Based Circuit Breaker using Android solves these challenges by monitoring lineman security. In this system, the power of the power line is up to the lineman, who can use a password through a Bluetooth app to adjust the power line through a Bluetooth app on an Android device, thus enabling it safe maintenance and repair The system enhances safety by delegating power to linemen only Minimizing risks from communication gaps When the system uses a micro controller, specifically the ATMEGA 328, with a password in compares a reserved password to allow operation. This new system not only prioritizes lineman safety but also simplifies power line management processes. Additionally, it addresses the issue of inconvenient customer disconnection during maintenance by enabling line control options. Leveraging the improved wireless communication technology of Bluetooth, the system offers a cost-effective and scalable solution for the safety and efficiency of power grid management.

## NEED OF THE STUDY.

Password-based circuit breakers are designed to enhance security by requiring specific passwords to control circuits, thus ensuring access only to authorized persons fatal electrical accidents going high for linemen during maintenance of power lines emphasizes the critical importance of improved communication and coordination. To minimize such risks, the circuit breaker system allows access only to authorized personnel with a valid password.systems are designed to enhance security by requiring specific passwords to manage circuits, thereby ensuring access only to authorized personnel Fatal electrical accidents increased costs for linemen during

maintenance of power lines highlights the critical need for improved communication and coordination. To minimize such risks, the circuit breaker system allows access only to authorized personnel with a valid password.

All these systems are controlled by the Arduino Uno micro controller, which is one of the most important components of embedded systems. Embedded systems are electronic devices that integrate a microprocessor in their operation. Developers of embedded systems have extensive knowledge of hardware technologies and use specific programming languages and software to develop and manipulate these systems. Embedded systems generally use slower processors and smaller memory to reduce costs while performing their intended functions. They consist of a specialized system in which a computer is embedded or mounted on the device or controller. Unlike general computers, such as personal computers, embedded systems consist of one or a few predefined functions, and usually have specific requirements Password-based circuit breakers are designed to enhance security by requiring specific passwords to control circuits, thus ensuring access only to authorized persons fatal electrical accidents going high for linemen during maintenance of power lines emphasizes the critical importance of improved communication and coordination. To minimize such risks, the circuit breaker system allows access only to authorized personnel with a valid password.

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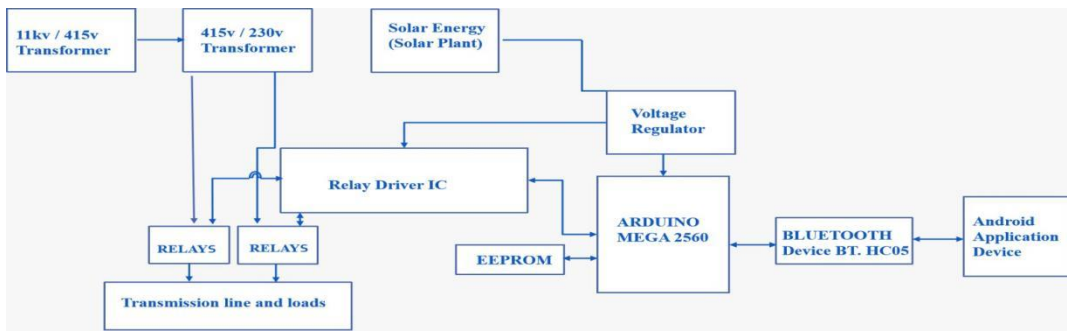
## **PROPOSED SYSTEM**

In order to eliminate the physical connection between the lineman and the circuit, we introduced a project that uses a password-based circuit breaker system controlled by an Android application in which this system allows the lineman to enter a password though for the circuit came to work. Once the operation is complete, the password must be reentered to restore the circuit. Delegating sole control of circuit activation and deactivation to the lineman effectively reduces the risk of accidents In addition, the system incorporates password storage capabilities using EEPROM to provide security measures. Additionally, it allows the password to be changed whenever necessary, further emphasizing the security measure. This curve not only provides protection in the liner but also ensures the integrity and safety of the entire electrical system.

The lack of switches in different locations in the distribution network presents the challenge of isolating a particular load when necessary. Although circuit breakers are a defensive method to isolate downstream networks in the event of faults such as short circuits or overloads, they are not recommended when used for load control Such method this often causes severe power outages, blacking out large sections of distribution lines. Disruption of power for businesses, even temporarily, can wreak havoc on production. It is important to maintain uninterrupted power supply to ensure that industrial areas continue to operate. However, when contractors are tasked with repairing a power line, there is a risk that the circuit breaker will be activated inadvertently or with malicious intent, which could cause the inspector has been involved in a fatal accident

To address these concerns, a more sophisticated approach to load management is needed that minimizes power supply disruptions and ensures the safety of maintenance personnel role. This could include using advanced control systems or using remotely controlled switches that allow low-voltage target loads to be reduced by such means through it, we can increase the performance and security of electricity distribution networks to meet the needs of industrial applications

## BLOCK DIAGRAM



## HARDWARE REQUIREMENTS

### BLUETOOTHMODULE(Bluetooth Module –BTHC05):

Bluetooth wireless technology has truly changed the way we connect with digital devices in our homes and offices. By equipping devices with Bluetooth technology, they can communicate with each other, creating networks that allow for seamless communication. This technology is particularly valuable in long-distance wireless communications where conventional infrastructure may not be available. The project you describe focuses on implementing Bluetooth technology on a robotic vehicle on the Android platform. It consists of two main modules: an Android mobile phone and an Arduino BT board equipped with a Bluetooth module. Android mobile phones have a variety of Bluetooth apps, which allow users to access and control home appliances and send commands to the Arduino BT board.

Android, being open source and widely accepted serves as an ideal platform for this project. It provides a robust software stack, including operating system, middleware, and core applications. Android applications are typically developed in a Java-like language and run on a virtual machine called Dalvik. The Android SDK provides the tools and APIs needed to develop applications on the platform. Accessory mode, a feature introduced in Android OS versions 2.3.4 Gingerbread and 3.1 Honeycomb and later, simplifies communication between Android devices and external hardware accessories such as Arduino BT boards. The main function of the application is to control electrical devices such as lights or bulbs. The status of these devices is displayed on the LCD which is connected to the Arduino board.

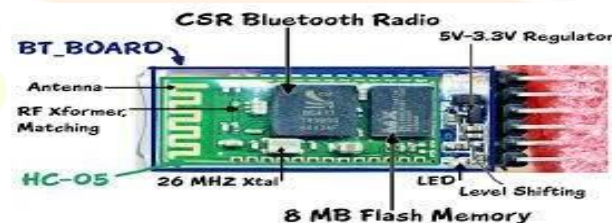


Fig 1: HC-05 Bluetooth module

The Bluetooth module HC-05 used in the project is a Bluetooth SPP (Serial Port Protocol) module that supports both Master and Slave configurations. This Bluetooth V2.0 + EDR (Enhanced).

### ANDROID :

Android is a Linux-based operating system designed primarily for touchscreen mobile devices, whose characteristics are open source characteristics. It has a vast ecosystem of users, many of which are freely available to users. Additionally, developers are free to create customized applications tailored to their specific needs, free or low cost. The Android platform has a complete software package that includes the operating system, middleware layer and core applications. Unlike proprietary platforms like iOS (iPhone OS), Android offers a Software Development Kit (SDK) that provides developers with the tools and features needed to create applications smartphones using as central processing units for various devices have appeared as dynamic research area Android, rooted in the Linux kernel, originated from Android, Inc., which received financial backing from Google and was later acquired by the company in 2005. Android was officially unveiled in 2007 when it was founded Open Handset Alliance, which is a body dedicated to promoting open standards for A mobile devices.

### LIQUID CRYSTAL DISPLAY (LCD):

NLCD displays offer significant advantages over LED displays, particularly in the ability to display letters, numbers, and a variety of special characters, while LED displays, such as seven-segment displays, are limited to showing numbers. These functions for LCD displays is invaluable for facilitating user feedback and interaction. They come in a variety of sizes, the most common being 2 x 16, meaning two rows of 16 alphabetic characters. Other models include 3 x 16, 2 x 40, and 3 x 40, among others. In recent years, LCD displays have become increasingly popular, gradually replacing LEDs, primarily due to their ability to display a wide range of information including numbers, colors and graphics for transmission because of the background indication.

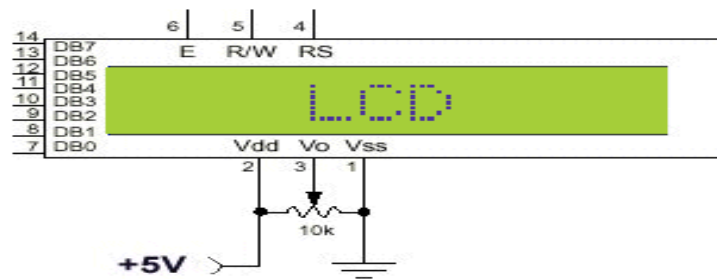


Fig 2: liquid crystal display (lcd)

Typically, LCD modules have an 8-bit interface, with an 8-bit data bus connected to port '0' and additional control lines connected to port '2'. By default, all 8 data lines are used for data transfer between the LCD module and the external device. However, only four of the 8 data lines can be used to communicate with the LCD module. In this function, the R/W (Read/Write) line is grounded, meaning that the processor cannot read any status information from the LCD module but can only write data to a continuous LCD panel used in this work are 14 pins , each serving a specific function.

### RELAY (Relay Driver IC) :

A relay acts as an electrical switch, operated by an electromagnet to open or close one or more contacts under the control of other electrical circuits Basically it acts as an automatic electrical or electronic switch capable of or break a circuit. This ability to control the output circuit with more power than the input circuit makes it widely distributed as a kind of power amplifier. For this project, two relays were used to individually control the cooling fan and DC motor. The relay has a variety of contact types, including normally open (NO), normally closed (NC), or variable contacts: Normally open (NO) contacts: These contacts connect the circuit when the relay is active and disconnect when the relay is inactive. Form A contacts or also known as "make" contacts, are suitable for applications requiring switching from remote devices to high voltage power sources Normally closed (NC) contacts: These contacts close the circuit when the relay is active and connect when the relay is inactive. Also called Form B contacts or "break" contacts, they are ideal for applications where the circuit needs to be closed until the relay operates.



Fig 3: Relay

Switching connections: These connections control two circuits, one normally open connection and one normally closed terminal. Also known as Form C contacts, they offer versatility in circuit switching. The concept of generators dates back to the early days of electrical engineering, and has been used successfully in wiring since 1850. Today, the modern relay stands as simple, flying objects effective, and one of the most reliable available time management systems .

### SOLAR ENERGY :

There are three main methods of using solar energy: photo voltaics, solar heating & cooling, and solar centralization. Photovoltaic electricity electronically generates electricity directly from sunlight and can be used to power everything from small electrical appliances such as calculators and road signs to large homes and commercial projects that connect, or have In the case of CSP-power, a studied compound affects conventional turbines



Fig 4: Solar Energy

### VOLTAGE REGULATOR:

Voltage regulator ICs are available with fixed (mainly 5, 12 and 15V) or variable output voltages. The maximum current they can pass also gives them a number. Negative voltage regulators are available, primarily for use with double supplies.



Fig 5 : A Three Terminal Voltage Regulator

Most regulators include some form of automatic protection against over current ('overload protection') and overheating ('thermal protection'). Many regular voltage regulator ICs have 3 leads and are similar to power transistors, such as the 7805 +5V 1A regulator LM7805 shown on the right is easy to use. You just connect the positive lead of your irregular DC power supply (anything from 9VDC to 24VDC) to the Input pin, connect the negative lead to the Common pin and then when you turn on the power, get a 5 volt supply from the output heat .

### ARDUINO :

The Arduino Uno is a micro controller board built around the ATmega328 chip. It has 14 digital input/output pins, 6 of which are capable of pulse width modulation (PWM). There are also 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header and a reset button. All necessary accessories need to be connected and connected to a computer via USB cable or powered by an AC-to-DC adapter or battery just to start using it Unlike its predecessor, the Uno features the Atmega16U2 (formerly known as the Atmega8U2) programmed as a USB-to-serial converter. Version 3 of the Uno board brings many new features:

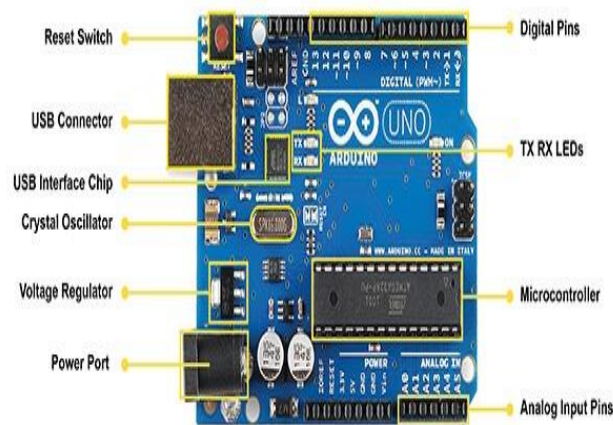


Fig 6: Arduino

Updated pinouts: Added SDA and SCL pins, located near the AREF pin, and two new pins near the RESET pin. These modifications include an IOREF pin, which allows the shield to adjust to the voltage supplied by the board. This upgrade ensures future shield compatibility with 5V-powered AVR-based boards as well as the 3.3V-powered Arduino Due. The new new PINs are still un linked and stored for future use. Improved RESET circuit: The changes include improvements to the RESET circuit, to increase its efficiency and reliability. Replacing the At mega 8U2 with the At mega 16U2: The USB-to-serial converter chip has been upgraded to the At mega 16U2 in Revision 3 for improved performance and performance. The name "Uno," which means "one" in Italian, indicates its status as the main reference model of the Arduino, especially in anticipation of the release of Arduino 1.0. Both the Uno board and version 1.0 of the Arduino software are ready to become standard reference points for the Arduino platform.

### LOAD:

Loads: In this project we are using the loads for indication of power in the lines whether the power is passing or not in this lines

### MICROCONTROLLER :

The ATmega32 is a low-power CMOS 8-bit micro controller with an AVR RISC architecture. The design emphasizes efficiency, allowing powerful instructions to be executed in one hour. This capability allows the ATmega32 to achieve up to 1 million instructions per second (MIPS) per MHz, giving system designers the flexibility to strike a better balance between power consumption and processing speed in the 19th century. Advanced RISC Architecture: The micro controller is built on advanced RISC (Reduced Instruction Set Computing) architecture, which provides better performance and power consumption 131 powerful instructions: The ATmega32 supports 131 instructions, many of which can be executed in one clock, increasing processing speed.

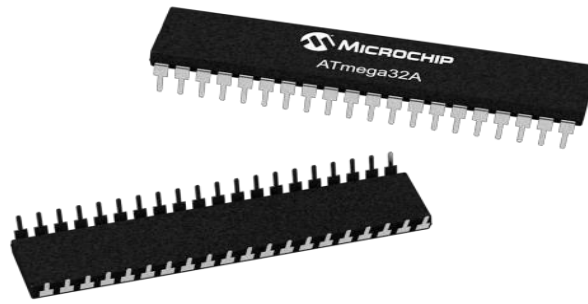


Fig 7: Micro controller

## SOFTWARE REQUIREMENTS

### KEIL $\mu$ VISION IDE :

Keil  $\mu$ Vision is an integrated development environment (IDE) developed by ARM, used primarily for programming and debugging ARM micro controllers. It provides a comprehensive set of tools for embedded software, including code editing, compilation, debugging, and emulation. Code Editor:  $\mu$ Vision provides a powerful code editor with syntax highlighting, code completion, and other productivity-enhancing features to help you write and modify code. Compiler and Debugger: Introduces the ARM Compiler, which allows developers to compile their code for ARM micro controllers. In addition,  $\mu$ Vision includes a debugger for real-time debugging of code, allowing developers to step through code execution, set breakpoints, view variables, and analyze program flow Simulator: Keil  $\mu$ Vision has a built-in simulator that allows developers to test and debug their code without the need for physical hardware. This is especially useful in the early stages of development when hardware may not be readily available. Application configuration: The IDE provides robust management capabilities, allowing developers to organize their rules, objects, and system development. Device support: Keil  $\mu$ Vision supports a wide range of ARM micro controllers and development boards, providing comprehensive device support for a variety of embedded projects Integration: Seamlessly integrates with other Keil software tools and third-party components, facilitating a smooth development workflow.

### MC PROGRAMMING LANGUAGE EMBEDDED C:

Embedded C is a micro controller-based programming language that is an extension of the C language. I/O Hardware Addressing, fixed-point arithmetic operations, accessing address spaces, and other features distinguish the Embedded C language from traditional C programming. Embedded C is a micro controller-based programming language that is an extension of the C language. It is used to make electronic devices, such as mobile phones, washing machines and digital cameras. Embedded C runs on a specific hardware architecture and includes additional header files. It has additional features such as data types and keywords, distinguishing it from traditional C systems with I/O hardware addressing, fixed-point arithmetic operations, and continuous address spaces.

### WORKING

#### OPERATION

The system uses an Android application to monitor the circuit to prevent fatal accidents to linemen due to electrocution. The policy addresses the issue of interactions between maintenance workers and substation power plants, which can create hazardous conditions for line men The circuit is controlled at the central location in the substation, where line men can enter a password to operate the circuit. This allows for safe repairs without the risk of electric shock. Once repaired, the substation can be returned and the password reentered to turn on the circuit. By placing the control directly in the hands of the line men, the system eliminates the possibility of accidents. In addition, the system has a password storage feature using EEPROM, which ensures that passwords are safely stored and accessible when needed. This also allows you to change passwords as needed for improved security. Overall, this system provides a reliable and safe solution to prevent accidents and ensure the safety of electrified linemen The use of mechanical and centralized control fatigue significantly lower the risk of electric shock and enhance safety measures in maintenance work.

### IMPLEMENTATION

Below is the image of implementation of password based controlled substation

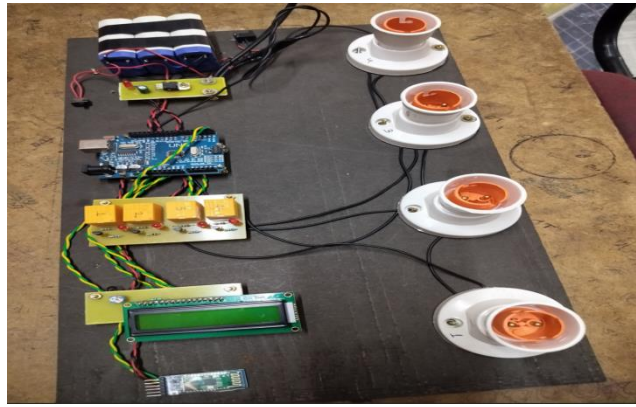


Fig 8 : Implementation of Hardware components

## RESULT

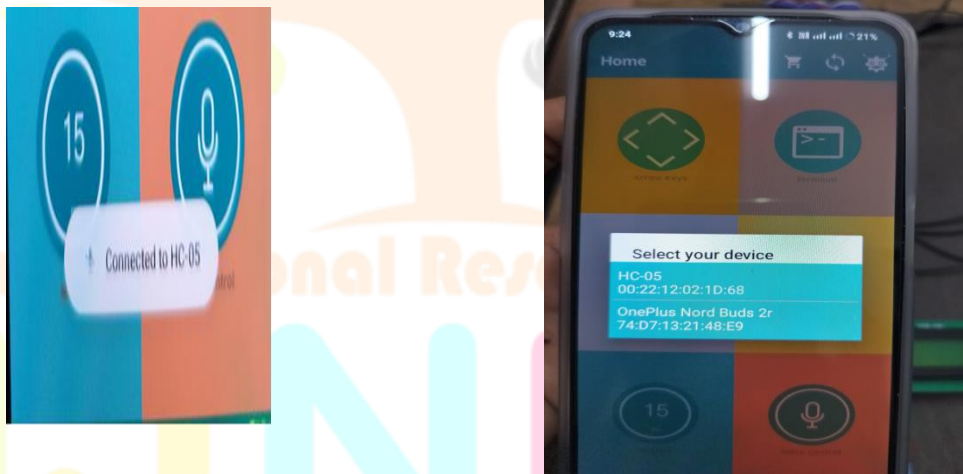


Fig 9: android App connecting to hardware

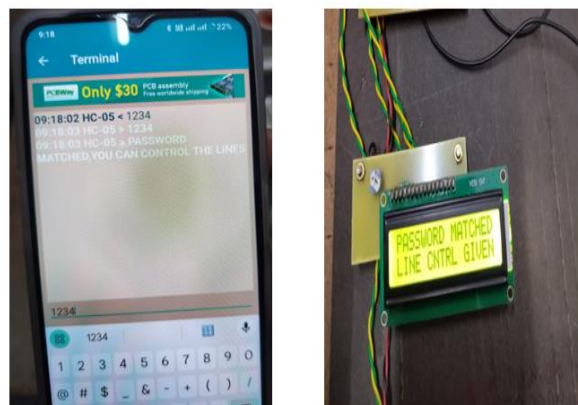


Fig 10: password matched you can control the lines

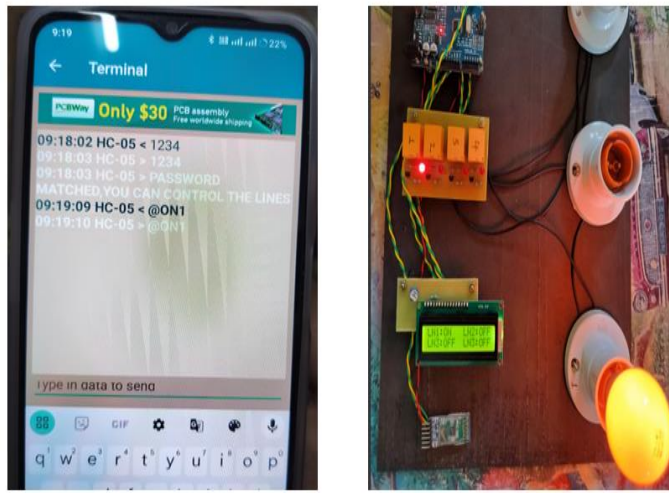


Fig 11: command given to line1 to on line1

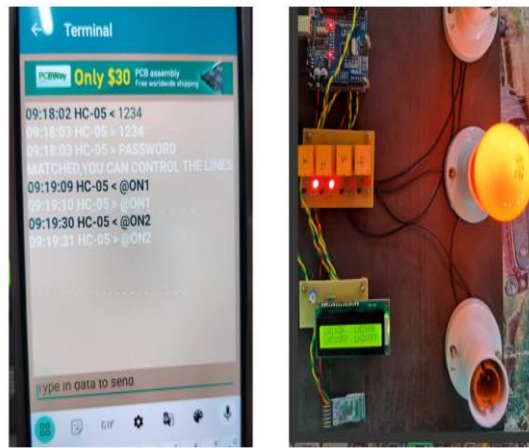


Fig 12: command given to line2 to on line2

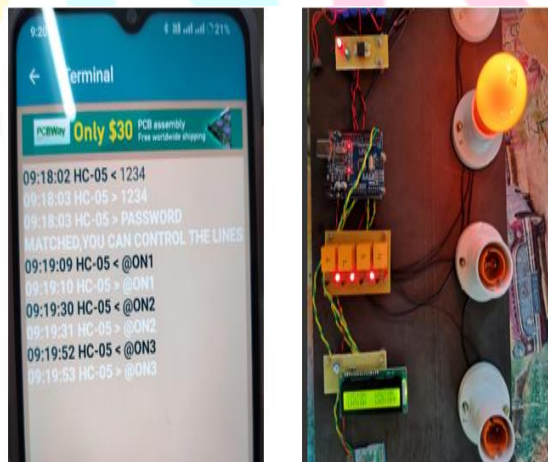


Fig 13: command given to line3 to on line3



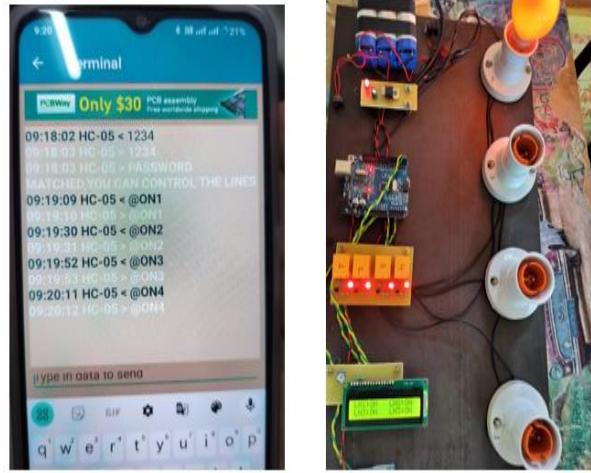


Fig 14: command given to line4 to turn on line4

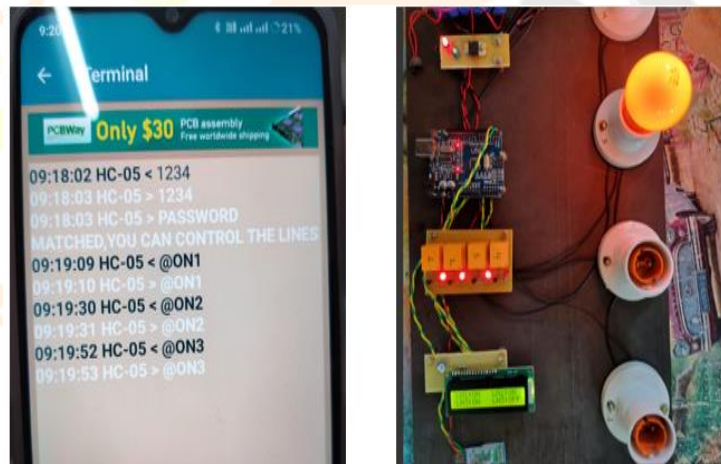


Fig 15: command given to line3 to on line3

## CONCLUSIONS

This document presents a cost-effective, simple, wireless solution for managing power lines, ensuring protection from unauthorized access. Users must have two passwords for Bluetooth modules and their phones, providing additional protection from internet connections of those who enter this system. It acts as a versatile test bed for devices requiring unattended on-off switching applications do not involve yourself.

The performance of the line control system was thoroughly tested, and it showed that there is an effective wireless connection between the mobile phone and the Bluetooth module. The communication distance under practical conditions was found to be less than 50 m in a concrete structure and up to 100 m in the open. In summary, this system provides a solution that enables only linears to control the system, preventing the participation of unauthorized individuals. By centralizing control at the main hub, linemen can handle loads more efficiently without the need for a circuit breaker source. This method proves to be very practical, cost-effective and safe for circuit breaker operation. The project successfully developed a prototype module, which showed satisfactory results. However, software plays an important role in input-based tasks, which emphasizes the importance of well-defined controller code.

While the technology used here achieves the goal of a prototype module, further development is required to transition to a fully functional system and requires continuous refinement and improvement to realize and power as a practical solution for wireless power transmission.

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