GOVERNMENT OF TAMILNADU

DIRECTORATE OF TECHNICAL EDUCATION, CHENNAI

NAAN MUDHALVAN SCHEME (TNSDC) SPONSORED

STUDENTS DEVELOPMENT PROGRAMME

ON

IoT AND ITS APPLICATIONS

HOST INSTITUTION

xxxx

COIMBATORE – 04

TRAINING PARTNER

ENTHU TECHNOLOGY SOLUTIONS INDIA PVT LTD

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ABSTRACT

Device-to-device (D2D) wireless communication using Bluetooth technology enables direct data exchange between devices without the need for intermediary infrastructure like routers or base stations. Bluetooth, a widely adopted short-range wireless communication protocol, supports a variety of applications, including file transfer, audio streaming, and device synchronization. This technology is energy-efficient, operates in the 2.4 GHz ISM band, and can connect multiple devices simultaneously in a piconet. D2D communication via Bluetooth enhances user experience by offering a convenient, low-power solution for connecting a wide range of devices in proximity. This abstract summarizes the fundamental aspects and advantages of Bluetooth-based D2D communication.

INTRODUCTION

Bluetooth is a short-range wireless communication technology that allows devices to exchange data over short distances without the need for cables. It operates in the 2.4 GHz ISM band and uses frequency-hopping spread spectrum to minimize interference. Bluetooth is commonly used for connecting peripherals like headphones, keyboards, and mice to devices such as smartphones, laptops, and tablets. It supports a range of up to 100 meters, depending on the device class, and offers low power consumption, making it ideal for portable devices.

HARDWARE AND SOFTWARE REQUIREMENTS

HARDWARE REQUIREMENT

1.ESP32 Microcontroller

2 .LED

3.Jumper Wires

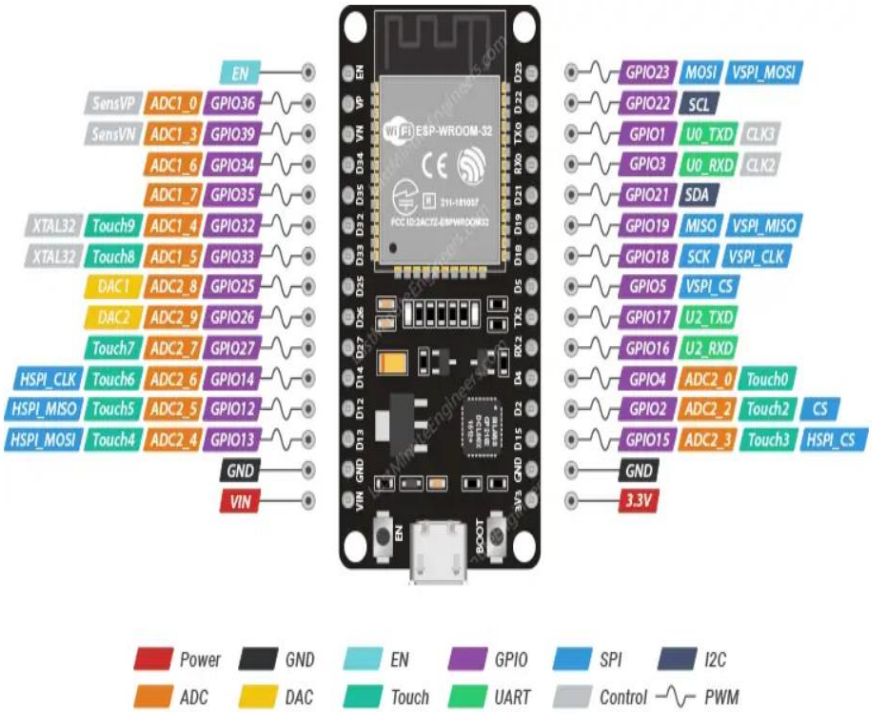
4.USB Cable

SOFTWARE REQUIREMENT

1.Arduino IDE

ESP32 Microcontroller

The ESP32 is a highly versatile microcontroller developed by Espressif Systems, designed for a wide range of applications, particularly in the Internet of Things (IoT) space. It is renowned for its combination of high performance, integrated wireless connectivity, and a rich set of features, all at a low cost. The ESP32 is commonly used in projects that require both Wi-Fi and Bluetooth capabilities, making it suitable for smart home devices, sensor networks, and wearable technology.



LED

An LED (Light Emitting Diode) is a semiconductor light source that emits light when an electric current passes through it. It is one of the most energy-efficient and long-lasting lighting technologies available. LEDs are widely used in various applications, from simple indicators to complex displays, due to their small size, low power consumption, and durability. In the context of an anti-theft security system, the LED serves as a visual indicator to signal the detection of motion. When the PIR sensor detects movement, the ESP32 microcontroller sends a signal to the LED, causing it to light up. This visual alert can help in quickly identifying the presence of an intruder or unauthorized access in the monitored area.The LED's immediate response and visibility make it an effective component for such security systems, providing an instant indication of a security breach.

Jumper Wires

Jumper wires are essential in this project, used to connect the ESP32 microcontroller to the components on the breadboard. These wires provide a flexible and reliable way to link the microcontroller's GPIO pins to the LEDs, resistors, and other circuit elements, enabling proper signal and power flow. Their ease of use allows for quick modifications and testing during the prototyping stage.

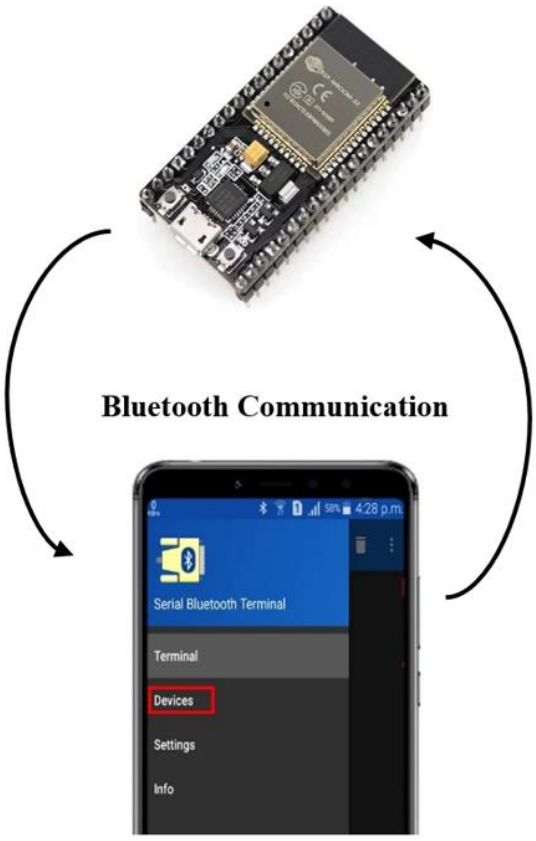
USB Cable

The USB cable is a critical tool in this project, used to connect the ESP32 microcontroller to a computer for power supply, programming, and debugging. It enables the transfer of code and data between the development environment and the microcontroller, facilitating the upload of firmware and real-time communication during the development process. The USB connection also allows for serial monitoring, providing valuable insights into the system's performance and behavior.

Arduino IDE

The Arduino IDE is a user-friendly platform that allows for easy programming and uploading of code to Arduino boards. In a device-to-device communication project, it enables seamless coding and management of serial communication between devices, particularly when using Bluetooth modules. Its integrated development environment simplifies debugging and testing, making it ideal for wireless communication projects.

BLOCK DIAGRAM

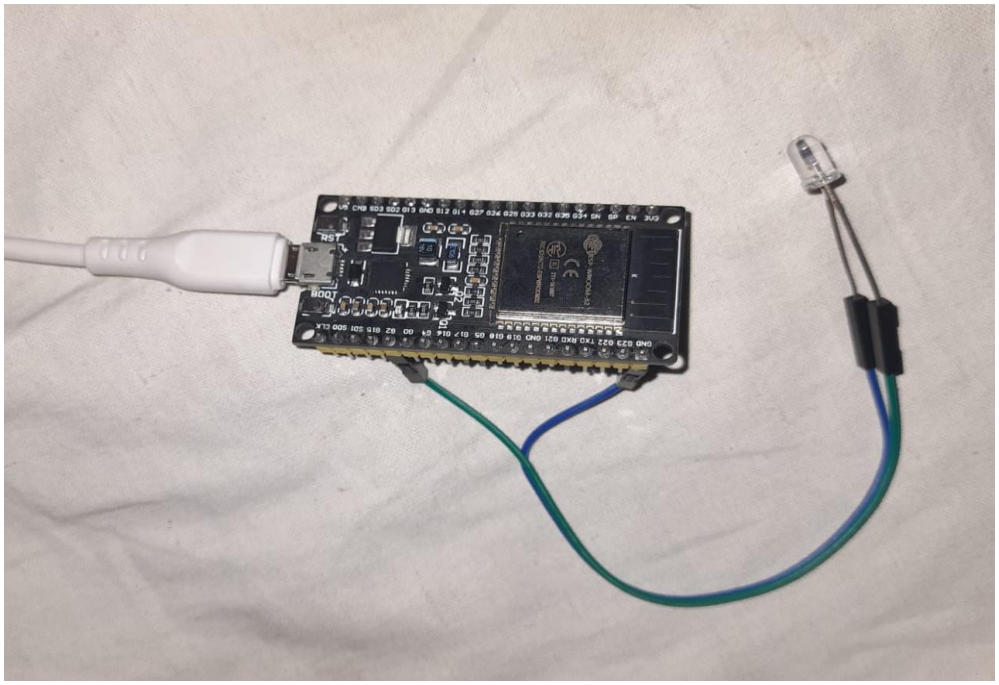


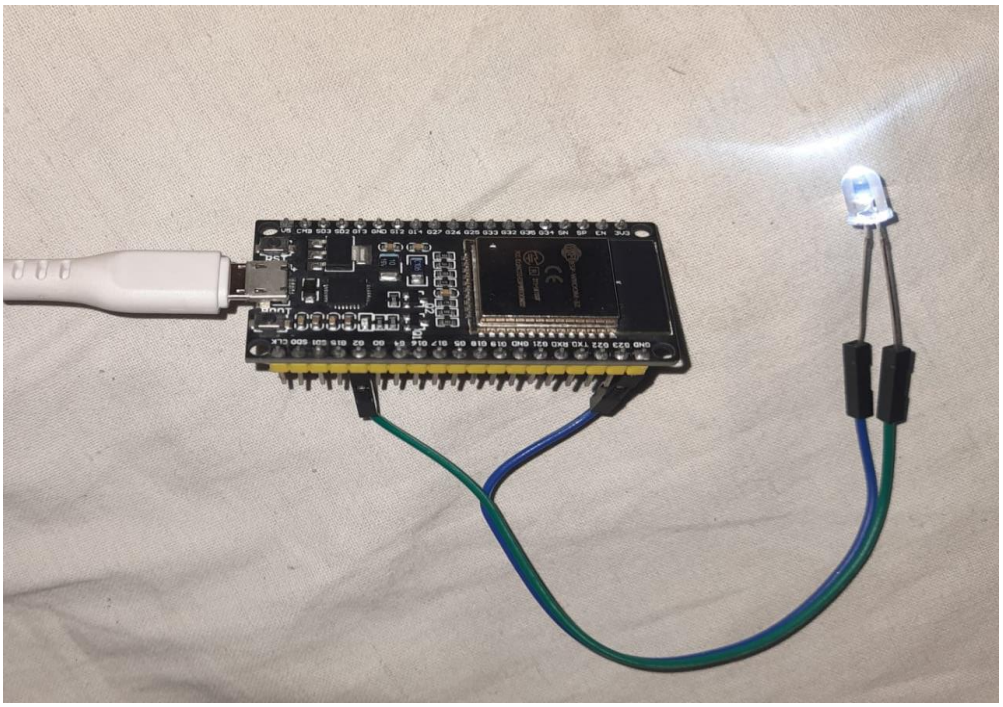
CODE

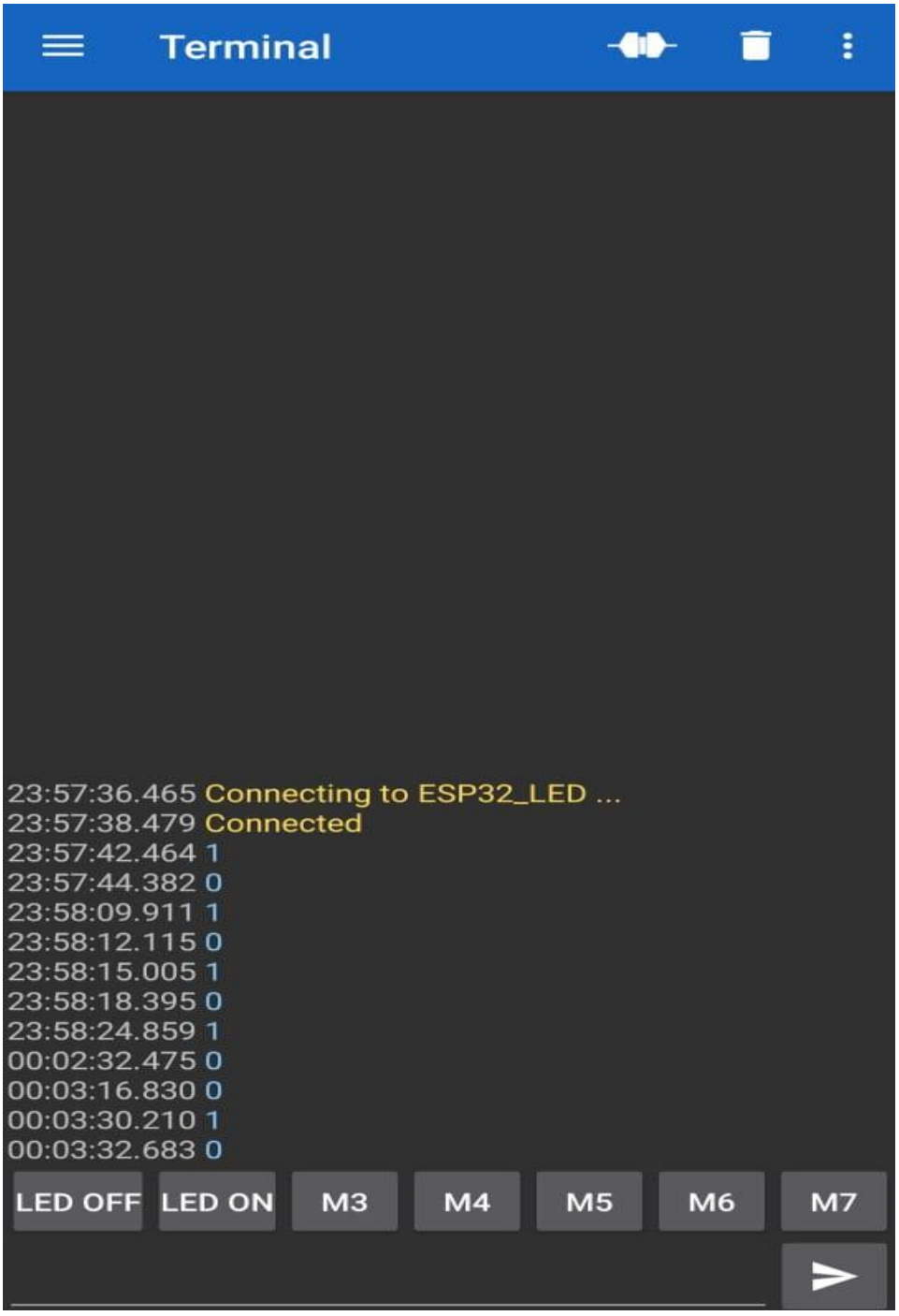
```
#include "BluetoothSerial.h"  // Include the Bluetooth Serial library
BluetoothSerial SerialBT;      // Create a Bluetooth Serial object
const int ledPin = 2;          // Pin where the LED is connected
void setup() {
  pinMode(ledPin, OUTPUT);     // Set the LED pin as an output
  Serial.begin(115200);        // Start the serial communication
  SerialBT.begin("ESP32_LED"); // Start Bluetooth with the name "ESP32_LED"
  Serial.println("Bluetooth device is ready to pair");
}
void loop() {
  if (SerialBT.available()) {  // Check if data is available to read
    char incomingChar = SerialBT.read();  // Read the incoming data
    Serial.print("Received: ");
    Serial.println(incomingChar);
    if (incomingChar == '1') {    // If '1' is received
      digitalWrite(ledPin, HIGH); // Turn the LED on
      Serial.println("LED ON");
    } else if (incomingChar == '0') { // If '0' is received
      digitalWrite(ledPin, LOW);  // Turn the LED off
```

```
  Serial.println("LED OFF");
    }
  }
  delay(1000);  // Small delay to debounce
}
```

OUTPUT RESULTS






Terminal
23:57:36.465 Connecting to ESP32_LED ...
23:57:38.479 Connected
23:57:42.464 1
23:57:44.382 0
23:58:09.911 1
23:58:12.115 0
23:58:15.005 1
23:58:18.395 0
23:58:24.859 1
00:02:32.475 0
00:03:16.830 0
00:03:30.210 1
00:03:32.683 0
LED OFF
LED ON
M3
M4
M5
M6
M7

CONCLUSION

The Bluetooth-controlled LED project using the ESP32 was successfully completed, demonstrating effective wireless control capabilities. The ESP32 was configured as a Bluetooth server to receive on/off commands, reliably toggling the LED's state in response. This project showcased the ESP32's versatility and efficient Bluetooth communication, providing a solid foundation for more advanced applications and further exploration into IoT solutions.