Rechargeable Air Mouse

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Introduction

This project features a rechargeable air mouse, a handheld device that allows users to navigate a screen from a distance. It functions similarly to a standard mouse, featuring left and right-click buttons. However, the cursor is controlled by adjusting the device's angle and position. This creates a user experience similar to using a TV remote or a laser pointer.

The primary purpose of this device is to assist users during presentations. Beyond this, it serves a variety of other applications, such as interacting with digital whiteboards or operating a computer from across the room.

The inspiration for this project came while observing a professor using a laser pointer to highlight information on a projector. I realized I could develop a device that not only highlights but also allows the user to select text, draw, and navigate through slides.

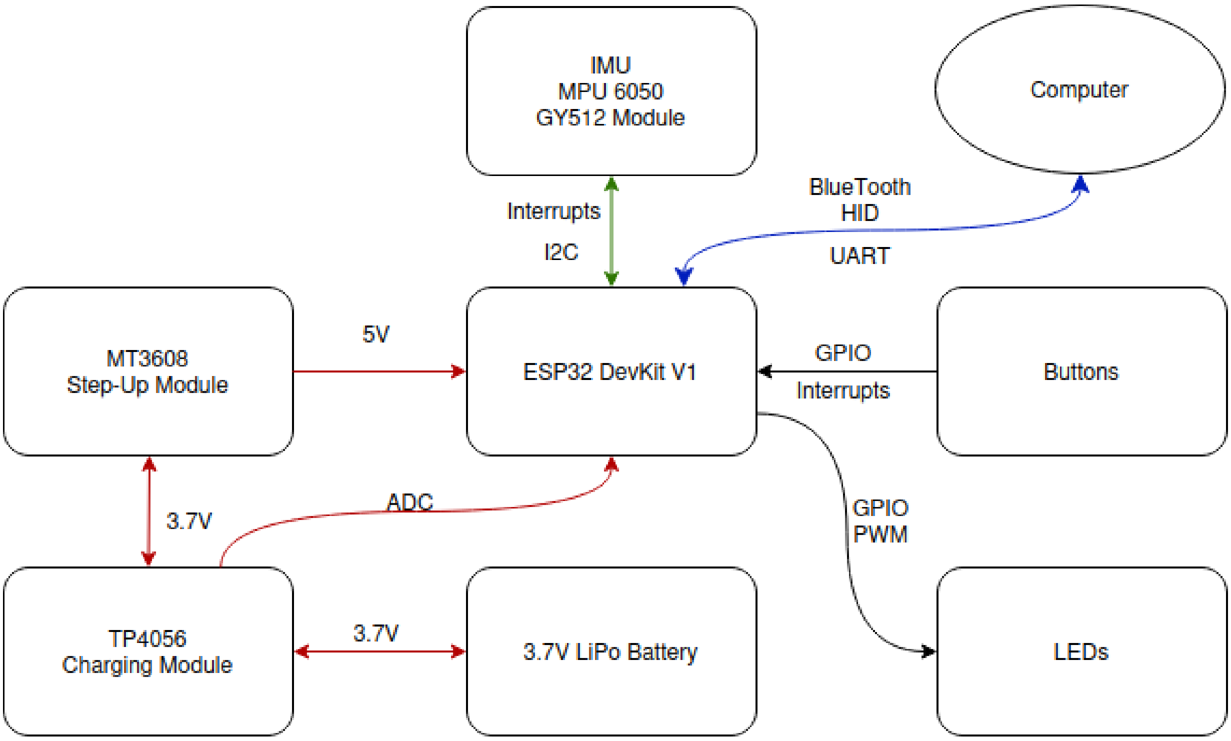
These capabilities make the device ideal for professional presentations, creative tasks, and even free time activities.

General Description

The core of this project is the ESP32 DevKit V1 (WROOM-32D), featuring an integrated antenna for wireless communication. It interfaces with a computer via Bluetooth using the HID (Human Interface Device) protocol. For motion tracking, the microcontroller is connected to an MPU6050 (GY-521 module) using the I2C protocol.

The power system consists of a 3.7V LiPo battery connected to a TP4056 charging module. To meet the power requirements, an MT3608 step-up converter boosts the battery voltage to the 5V necessary for the ESP32 and the IMU. Additionally, the microcontroller is wired to monitor the battery's voltage levels in real-time.

User feedback and interaction are handled through LEDs, which display the battery status and operating mode, while buttons provide the main interface for computer interaction and power control.

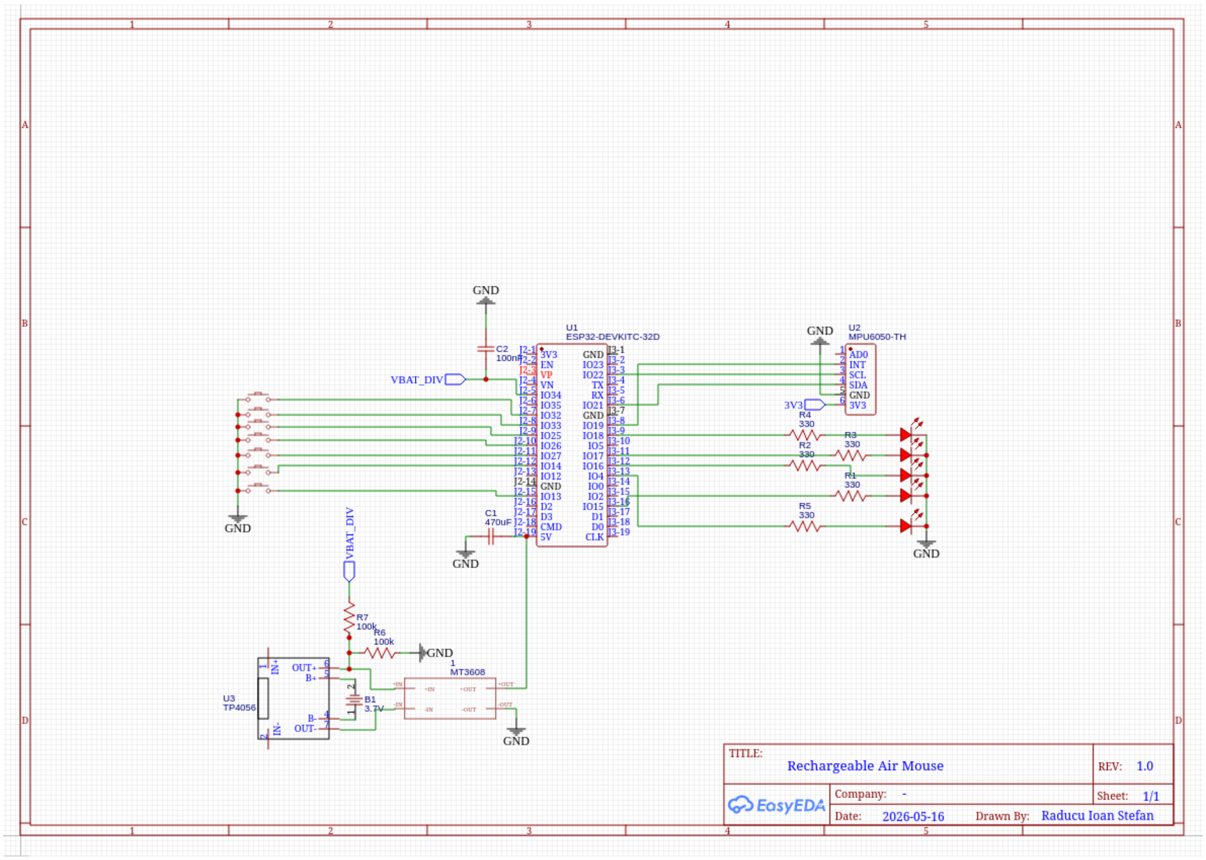


Hardware Design

List of Components

- ESP32 DevKit V1 (WROOM-32D)
- MPU-6050 (GY-521 Module)
- 3.7V Li-ion Battery
- TP4056 Charging Module
- MT3608 Step-Up Module
- Perforated Boards
- 470uF and 100nF Capacitor
- 2x 100kOhm Resistors
- 5x 330Ohm Resistors
- 5x Colored LED's
- Wires

Schematic



The circuit has a power assembly which has four power lines:

- **GND**
- **VBAT** Current battery voltage, after going trough the TP4056 Charger Module.
- **5V** Stable 5V voltage after the TP4056 Charger Module is stepped up to 5V using the MT3608 Step-Up Module.
- **VBAT_DIV** The battery voltage divided using a 100k/100k voltage divider (to read safely using ADC).

The rest of the circuit is buttons and LEDs for GPIO (using PWM and Interrupts), MPU-6050 (GY-521 Module) IMU for inertial measurement (using I2C). For power stability a 420uF bulk capacitor is used. A 100nF capacitor is present for filtering the ADC battery voltage reading.

ESP32 Pinout Configuration

ESP32 Pin	Connected To	Function Type	Description
GPIO 34	VBAT_DIV	Analog Input (ADC)	Battery monitoring via 100k/100k voltage divider.
GPIO 33	Wake Button	Digital Input (RTC)	System wake-up button; triggers wake from Deep Sleep.
GPIO 13	Button 2	Digital Input	General purpose tactile switch.
GPIO 14	Button 3	Digital Input	General purpose tactile switch.
GPIO 25	Button 4	Digital Input	General purpose tactile switch.
GPIO 26	Button 5	Digital Input	General purpose tactile switch.
GPIO 27	Button 6	Digital Input	General purpose tactile switch.
GPIO 32	Button 7	Digital Input	General purpose tactile switch.

GPIO 22	MPU-6050 SCL	I2C Clock	Clock line for I2C communication.
GPIO 21	MPU-6050 SDA	I2C Data	Data line for I2C communication.
GPIO 19	MPU-6050 INT	Digital Input	Hardware interrupt signal from MPU-6050.
GPIO 15	LED 1	Digital Output	Status LED (330Ω resistor).
GPIO 16	LED 2	Digital Output	Status LED (330Ω resistor).
GPIO 17	LED 3	Digital Output	Status LED (330Ω resistor).
GPIO 18	LED 4	Digital Output	Status LED (330Ω resistor).
GPIO 4	LED 5 (PWM)	PWM Output	Intensity-controlled LED (330Ω resistor).
5V (Vin)	MT3608 OUT+	Power Input	Stabilized 5V from the step-up converter.
3V3	MPU-6050 VCC	Power Output	3.3V supply for IMU and sensors.
GND	Common Ground	Ground	Common reference ground for the whole circuit.

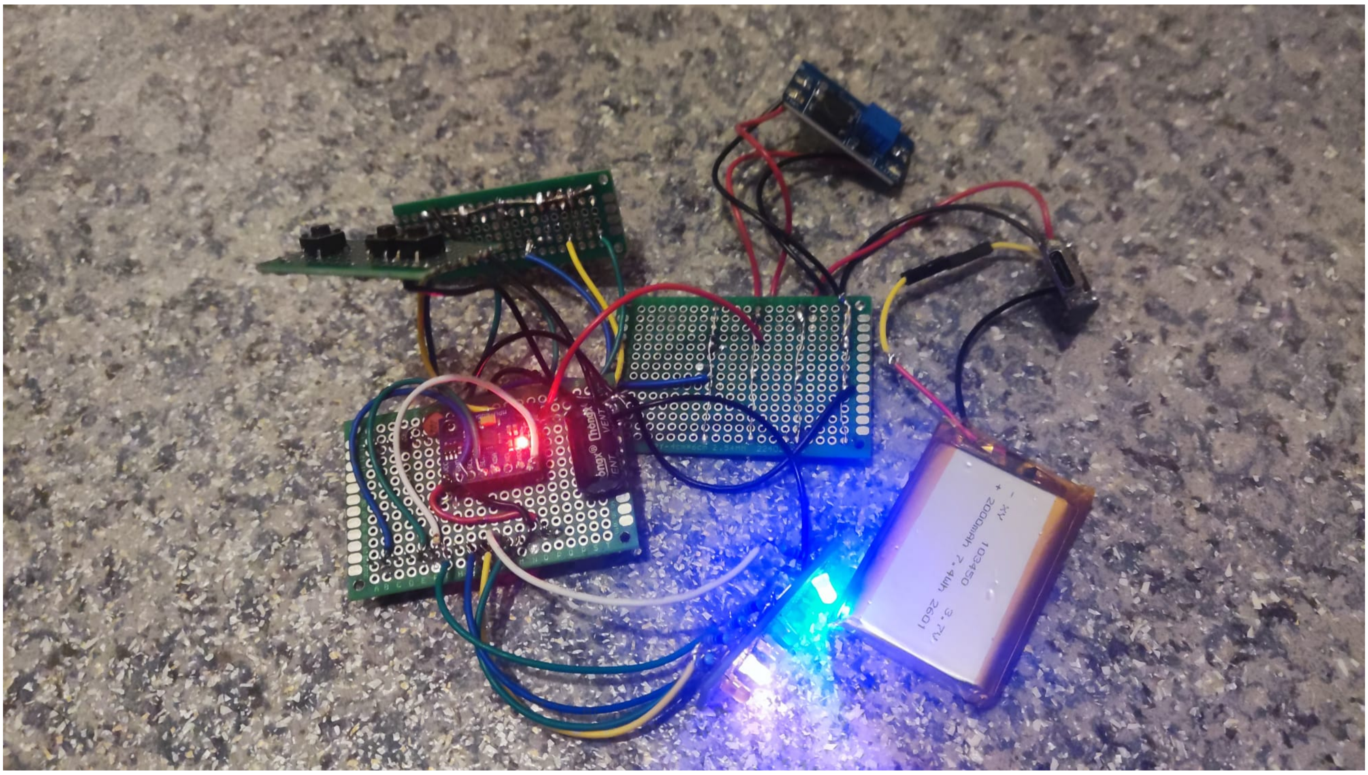
Hardware Notes

- **Input Protection:** All buttons are connected to Ground, utilizing the ESP32's internal pull-up resistors.
- **Power Filtering:** C1 (470µF) acts as a bulk capacitor for the 5V rail, while C2 (100nF) provides high-frequency decoupling for the 3.3V rail.
- **ADC Usage:** GPIO 34 is part of ADC1, ensuring it remains operational while Bluetooth connectivity is active.
- **Battery Voltage Measurement**: The battery voltage is measured using an ADC pin, trough a voltage divider. Even if the battery is rated 3.7V, it can reach up to 4.2V, which would burn the 3.3V rated pin.

Hardware Tests

The first hardware test used is LED illumination on battery power. It checks the power assembly, ESP32 and LED integrity and wiring.

LED illumination on battery power



The second test was testing the buttons, displaying which button was pressed using UART (while the battery is disconnected). The wake button works accordingly.

The third test was ADC reading trough the voltage divider. The test requires the battery being connected while the power assembly does not feed power to the ESP32. The wire connecting them was removed temporarily for this test. As we plug and unplug the battery, I could observe that the voltage rises to the expected voltage in one reading, slowly decreasing to zero after the battery is unplug. This test requires a hardware modification (one wire to disconnect) in order to work without risking burning either the project or the computer motherboard.

Software Design

Coming Soon

Results

Coming Soon

Conclusions

Coming Soon

Download

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Journal

- 09.05.2026: The initial version of this page is available, posted the introduction, general description and the block schema.
- 11-12.05.2026: Finished soldering the power assembly part and the rest of the circuit separately. Tested the power assembly part using a multimeter successfully. Tested the LED's, buttons', IMU's and ADC voltage measurement connections using a simple script.
- 14-16.05.2026: Managed to connect the capacitors and finished soldering the power assembly to the ESP32. LED test ran using battery power. Strengthened weak wiring. The battery can now be disconnected using jumper wires (for debugging).
- 16.05.2026: Updated the hardware chapter of this page. The hardware is now complete and passes the basic tests.

Bibliografie/Resurse

- [1] **Espressif Systems** - Datasheet ESP32 (WROOM-32D)
- [2] **InvenSense** - Datasheet MPU-6050
- [3] **PowerCore** - Datasheet TP4056 (Charger)
- [4] **Aerosemi** - Datasheet MT3608 (Step-up)

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