

## Project Set 3: Bluetooth + RFID Access Control - Learning Roadmap

### Stage 1: Understand the Building Blocks

- Learn ESP32 architecture, GPIOs, SPI, UART, and ESP-IDF setup.
- Understand MF RC522 (RFID reader) and SPI communication.
- Study Bluetooth SPP (Serial Port Profile).
- Optional: HC-SR501 motion sensor basics.
- Review C programming concepts (structs, pointers, buffers).

### Stage 2: Set Up the Environment

- Install ESP-IDF and configure with VS Code.
- Flash 'hello world' on ESP32 and confirm serial output.
- Connect MF RC522 via SPI and test communication.
- Ensure proper wiring and power supply setup.

### Stage 3: Get RFID Working

- Integrate RFID driver or use existing libraries.
- Read UID from cards and print via serial.
- Implement basic matching against authorized UIDs.

### Stage 4: Bluetooth Communication

- Enable Bluetooth Classic and configure SPP in ESP-IDF.
- Pair phone using Serial Bluetooth Terminal app.
- Send 'ACCESS GRANTED' message upon valid RFID scan.

### Stage 5: Add Motion Sensor (Optional)

- Connect HC-SR501 to ESP32 GPIO.
- Use interrupts or polling for motion detection.
- Only enable RFID scanning after motion detected.

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### Stage 6: Full Integration and Debugging

- Combine RFID and Bluetooth logic with FreeRTOS tasks.
- Add logging and error handling.
- Structure code using modular files (e.g., rfid.c, bluetooth.c).

### Final Stretch Goals

- Store UUIDs in flash memory using NVS.
- Implement method to add/remove UUIDs.
- Add buzzer/LED feedback and battery support.