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Program: Embedded Systems Intro

Week 11: RFID Access Control System

Objective:

To design and build an end-to-end access control system by interfacing a Raspberry Pi Pico with an MFRC522 RFID reader and an electromechanical relay to control a high-power door lock.

Introduction:

Access control systems are fundamental examples of embedded system automation. They require reading user input securely (RFID), validating it against a database of authorized users, and actuating physical hardware safely (a magnetic or electric strike lock) using a relay.

1. Theoretical Concepts

Relay Interfacing: Microcontrollers operate at logic levels (3.3V) and cannot supply the current required to drive an electric door lock (typically 12V or 24V). A relay acts as an electrically operated switch. The Pico sends a 3.3V signal to the relay module's transistor, which energizes the internal coil, physically closing the high-power circuit to unlock the door.

Fail-Safe vs. Fail-Secure Locks: Understanding the lock type is crucial. A fail-safe magnetic lock requires constant power to remain locked, meaning the relay should normally be closed (NC). A fail-secure electric strike remains locked when unpowered, meaning the relay should normally be open (NO).

2. Source Code - RFID Access Control

sketch.ino ●

diagram.json ●

Library Manager ▼

```

1 // Week 11: RFID Access Control System
2 // RPi Pico code to read an RFID tag and activate a Relay for an Electric Door Lock
3 // Note: This requires the MFRC522 library.
4
5 #include <SPI.h>
6 #include <MFRC522.h>
7
8 // -----
9 // PIN DEFINITIONS (Raspberry Pi Pico)
10 // -----
11
12 // SPI Pins for MFRC522 (Pico SPI0)
13 #define RST_PIN 20 // GP20
14 #define SS_PIN 17 // GP17 (CSn)
15 // SCK = GP18
16 // MOSI = GP19
17 // MISO = GP16
18
19 // Relay & Indicator Pins
20 #define RELAY_PIN 15 // GP15 - Triggers the electric door lock
21 #define BUZZER_PIN 14 // GP14 - Audio feedback
22 #define GREEN_LED 13 // GP13 - Access Granted
23 #define RED_LED 12 // GP12 - Access Denied
24
25 // -----
26 // PERIPHERAL INSTANCES
27 // -----
28 MFRC522 rfid(SS_PIN, RST_PIN);
29
30 // -----

```

3. Hardware Integration (Relay & RFID)

