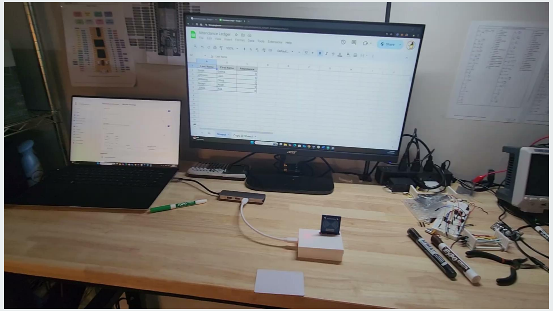
Rapid Prototyping 101: RFID Attendance System



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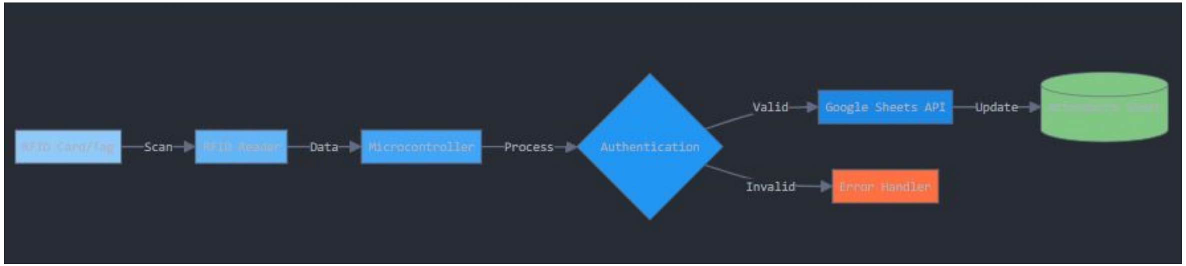
This hands-on course guides you through building an automated attendance system using RFID technology integrated with Google Sheets. Perfect for educators looking to streamline their attendance tracking process.

Bill of Materials (BOM)

Item #	Component	Specifications	Quantity	Est. Price (USD)	Notes
1	ESP32 Development Board	ESP32-WROOM-32D Module Dual-core MCU WiFi + Bluetooth 3.3V Operation	1	$8-12	Any ESP32 DevKit board will work. Common variants include NodeMCU-32S or DOIT ESP32 DEVKIT V1
2	RFID-RC522 Module	Operating Frequency: 13.56MHz Operating Voltage: 3.3V SPI Interface With Card and Key Fob	1	$3-5	Comes with example antenna. Compatible with Mifare cards
3	Breadboard	400 tie points Standard 0.1" spacing ABS plastic construction	1	$3-6	Any standard 400-point solderless breadboard

RFID Attendance System: Architecture Diagram



Initial Scan (RFID Card/Tag → RFID Reader)

- Student/faculty member taps their RFID card or tag
- Reader captures the unique identifier stored on the card

Data Capture (RFID Reader → Microcontroller)

- Reader sends the captured RFID data to the microcontroller
- Data is transmitted through serial communication

Processing (Microcontroller → Authentication)

- Microcontroller processes the raw RFID data
- Formats data for authentication check

Authentication Check (Decision Point)

- System verifies if the RFID tag is registered
- Valid IDs proceed to update the spreadsheet
- Invalid IDs are directed to error handling

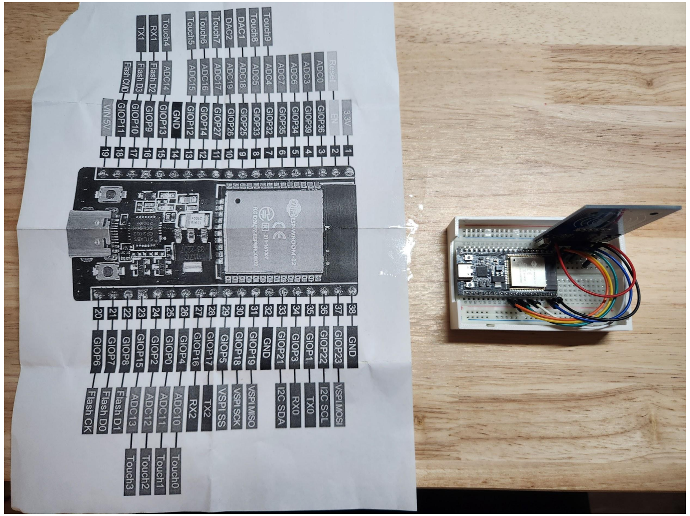
Google Sheets Integration (Google Sheets API → Attendance Sheet)

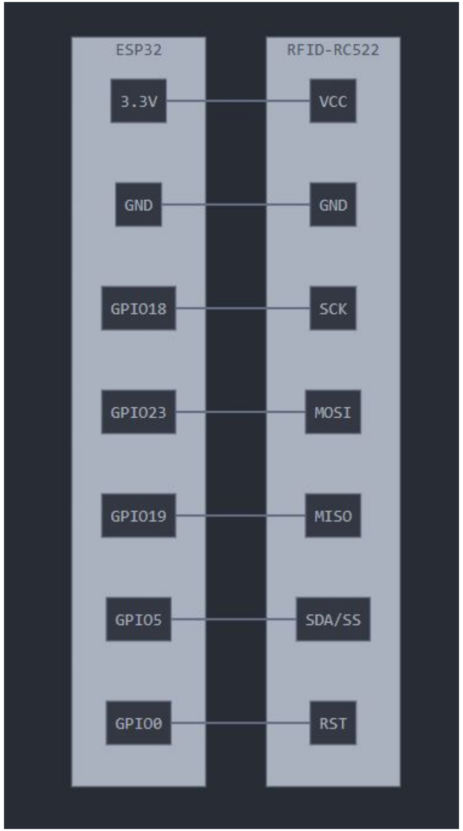
- Valid IDs trigger an API call to Google Sheets
- Attendance record is updated in real-time
- Timestamp and attendance status are recorded

Error Handling

- Manages invalid IDs, failed scans, or connection issues
- Provides feedback for troubleshooting

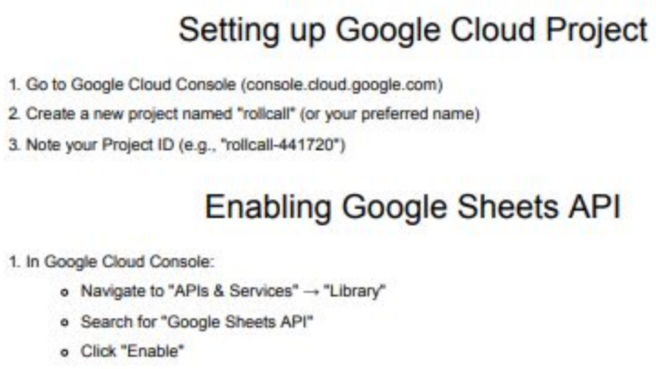
Breading Board Connections





ESP32	RFID-RC522
3.3V	VCC
GND	GND
GPIO18	SCK
GPIO23	MOSI
GPIO19	MISO
GPIO5	SDA/SS
GPIO0	RST

Google Sheets Integration

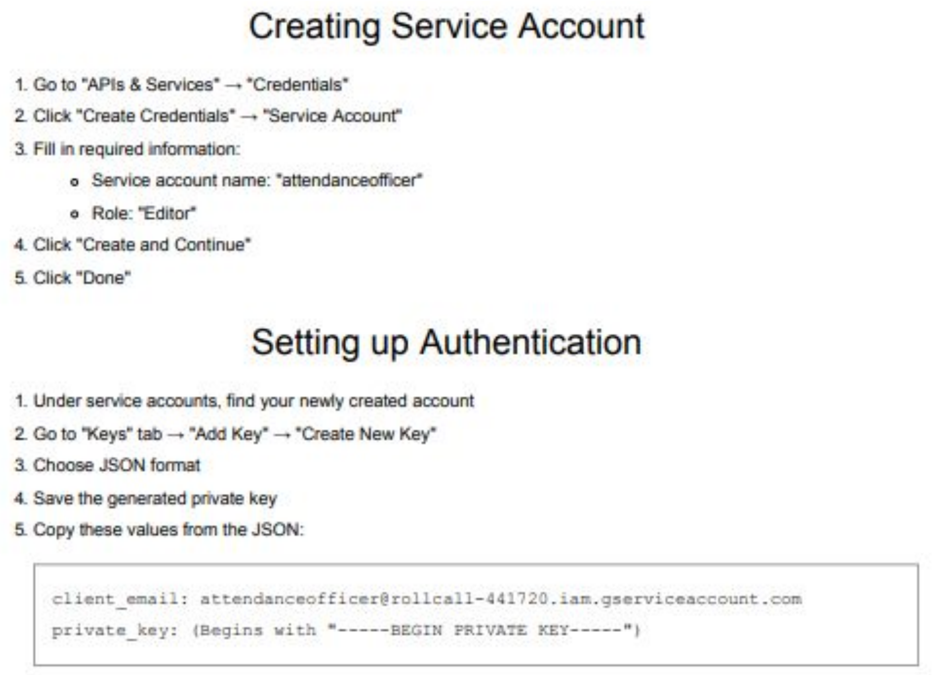


Setting up Google Cloud Project

1. Go to Google Cloud Console (console.cloud.google.com)
2. Create a new project named "rollcall" (or your preferred name)
3. Note your Project ID (e.g., "rollcall-441720")

Enabling Google Sheets API

1. In Google Cloud Console:
   - Navigate to "APIs & Services" → "Library"
   - Search for "Google Sheets API"
   - Click "Enable"



Creating Service Account

1. Go to "APIs & Services" → "Credentials"
2. Click "Create Credentials" → "Service Account"
3. Fill in required information:
   - Service account name: "attendanceofficer"
   - Role: "Editor"
4. Click "Create and Continue"
5. Click "Done"

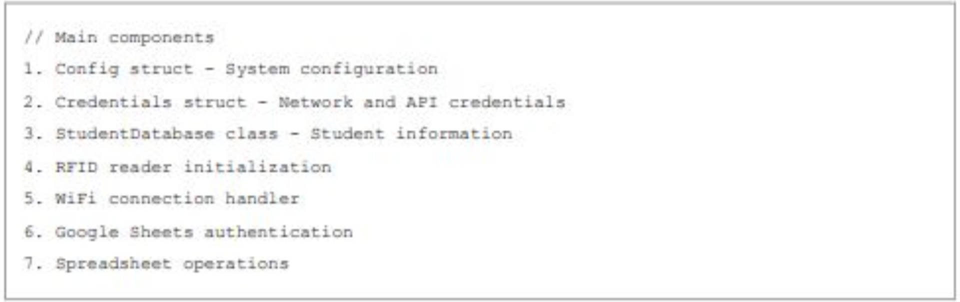
Setting up Authentication

1. Under service accounts, find your newly created account
2. Go to "Keys" tab → "Add Key" → "Create New Key"
3. Choose JSON format
4. Save the generated private key
5. Copy these values from the JSON:

```
client_email: attendanceofficer@rollcall-441720.iam.gserviceaccount.com
private_key: (Begins with "-----BEGIN PRIVATE KEY-----")
```

Programming & Implementation

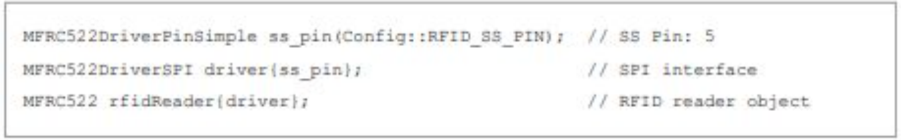
Core Code Structure



```
// Main components
1. Config struct - System configuration
2. Credentials struct - Network and API credentials
3. StudentDatabase class - Student information
4. RFID reader initialization
5. WiFi connection handler
6. Google Sheets authentication
7. Spreadsheet operations
```

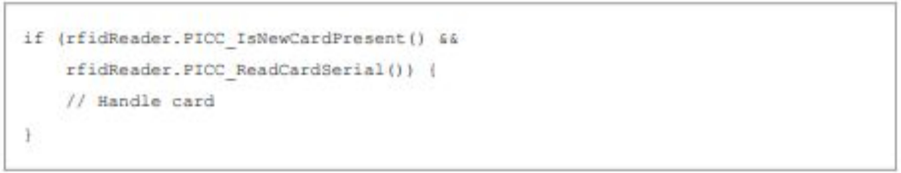
RFID Reading Implementation

1. Hardware Setup:

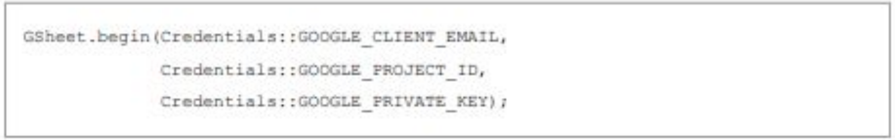


```
MFRC522DriverPinSimple ss_pin(Config::RFID_SS_PIN);  // SS Pin: 5
MFRC522DriverSPI driver{ss_pin};                      // SPI interface
MFRC522 rfidReader{driver};                           // RFID reader object
```

2. Card Detection:

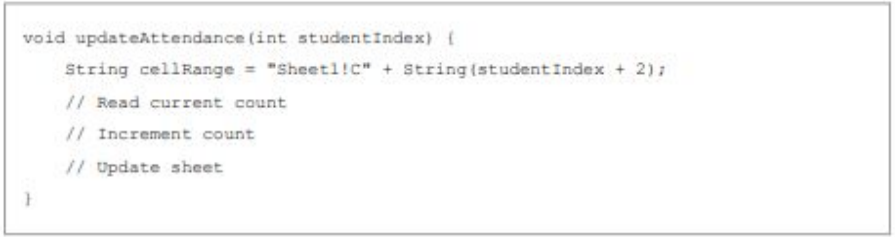


```
if (rfidReader.PICC_IsNewCardPresent() &&
    rfidReader.PICC_ReadCardSerial()) {
    // Handle card
}
```



```
GSheet.begin(Credentials::GOOGLE_CLIENT_EMAIL,
             Credentials::GOOGLE_PROJECT_ID,
             Credentials::GOOGLE_PRIVATE_KEY);
```

2. Update Attendance:



```
void updateAttendance(int studentIndex) {
    String cellRange = "Sheet1!C" + String(studentIndex + 2);
    // Read current count
    // Increment count
    // Update sheet
}
```

Optional 3D printed enclosure for MVP.