



Smart Access Door with Multi-Sensors

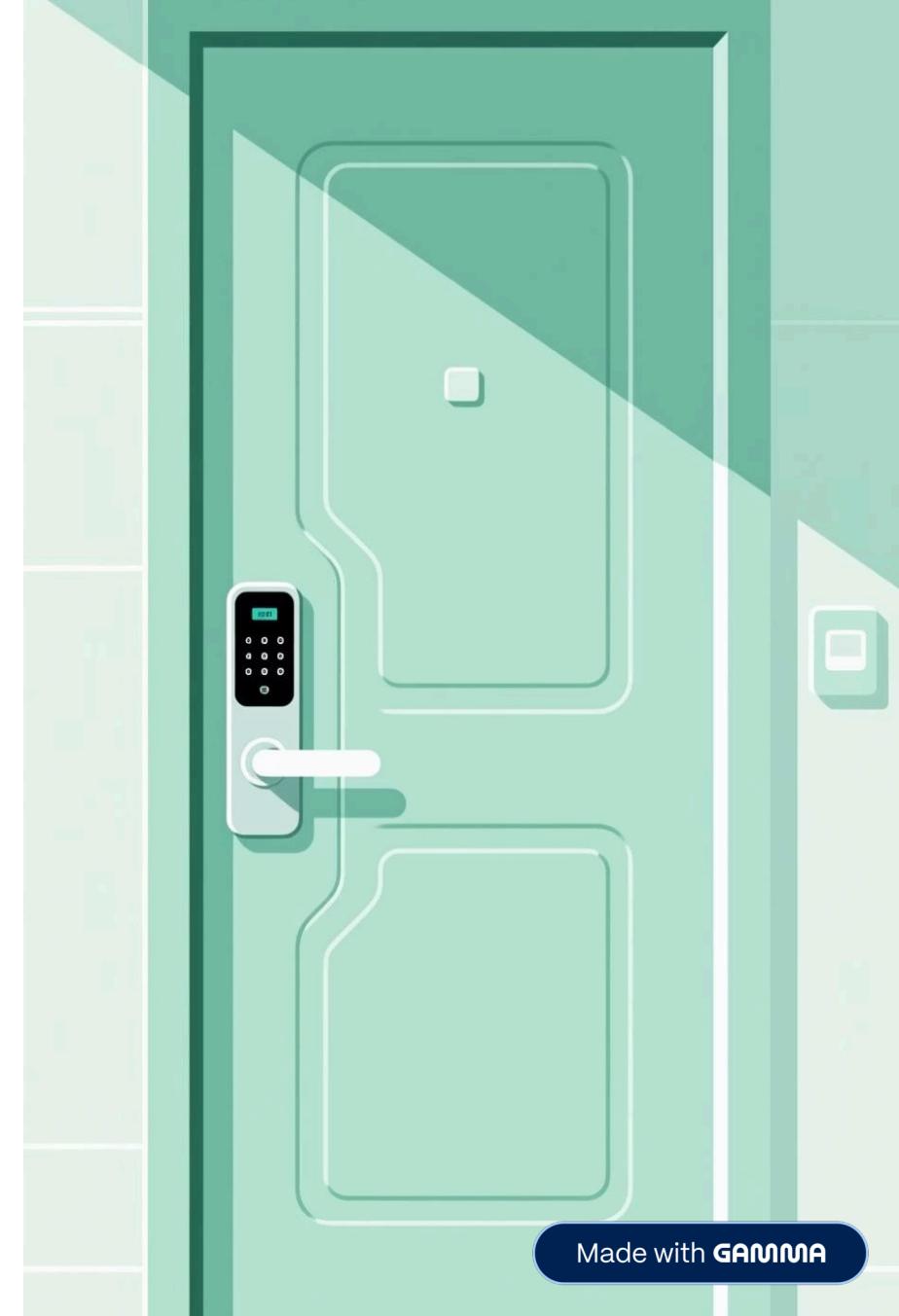
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Introduction

Welcome to the Smart IoT Access Door project, an innovative solution designed to revolutionize security and accessibility. This system integrates cutting-edge hardware and software to provide a secure, flexible, and intelligent entry experience, enhancing safety and convenience for modern environments. Explore how our multi-sensor approach, powered by ESP32 and backed by Supabase, offers advanced authentication and real-time monitoring capabilities.





problem & Motivation

Traditional access systems lack the flexibility and intelligence needed for modern security requirements. Most existing solutions are limited to single-mode access (such as a key or a single RFID card) and do not provide any form of data logging or remote monitoring. Key limitations identified include:

- Absence of real-time event logging and analytics.
- Limited or no integration with mobile/web platforms.
- Inability to respond dynamically to unsafe conditions such as fire or obstruction.



Our motivation is to design a door that goes beyond simple locking: a door that combines safety, convenience, and connectivity by integrating multiple sensors, offering flexible access, and ensuring full transparency through cloud-based event logging.



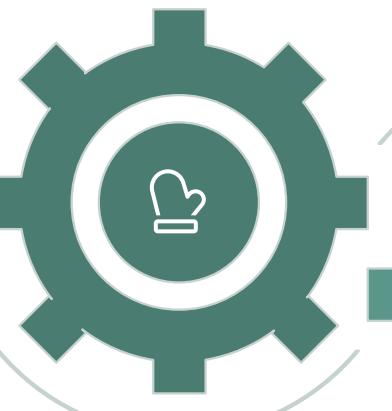
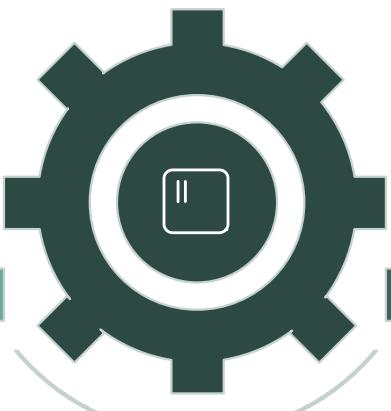
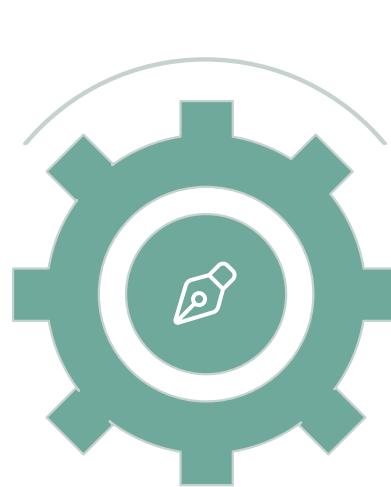
System Overview

Local Sensors

IR, Fire, Magnetic
Switch inputs

MQTT Broker

Message routing for
clients and cloud



ESP32 Hub

Central controller and
data broker

Actuators & UI

Servo motor and LCD
display

Cloud & Clients

Supabase storage and
Web/Mobile apps

The system architecture integrates hardware, connectivity, and cloud services to deliver a robust smart access solution. The ESP32 acts as the central hub, managing local sensor data and control actions, while communicating with a cloud-based MQTT broker and Supabase for data persistence and remote interaction.



Key Components



ESP32

Central processing unit for logic and connectivity.



RFID MFRC522

For secure card-based access authentication.



IR & Fire Sensor

Presence detection and emergency fire unlock.



Magnetic Switch

Verifies door open/closed status.



Keypad 4x4

PIN-based access input.



LCD I2C 16x2

User feedback and status display.

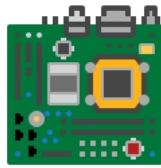


Servo

Actuates the door lock mechanism.

Each component plays a vital role, from user interaction to environmental monitoring and physical door control, ensuring a robust and responsive system.

Software Components



Arduino IDE :

Development environment used to program and upload code to the ESP32 with full library management support.



MQTT (HiveMQ Broker):

Lightweight messaging protocol that enables real-time communication between the ESP32, cloud, and client apps.



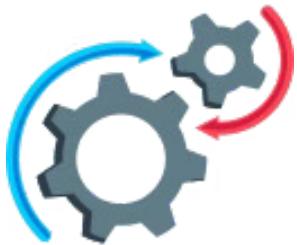
Supabase (Database + Auth):

Open-source backend providing PostgreSQL storage, authentication, and REST APIs for managing users and sensor data.

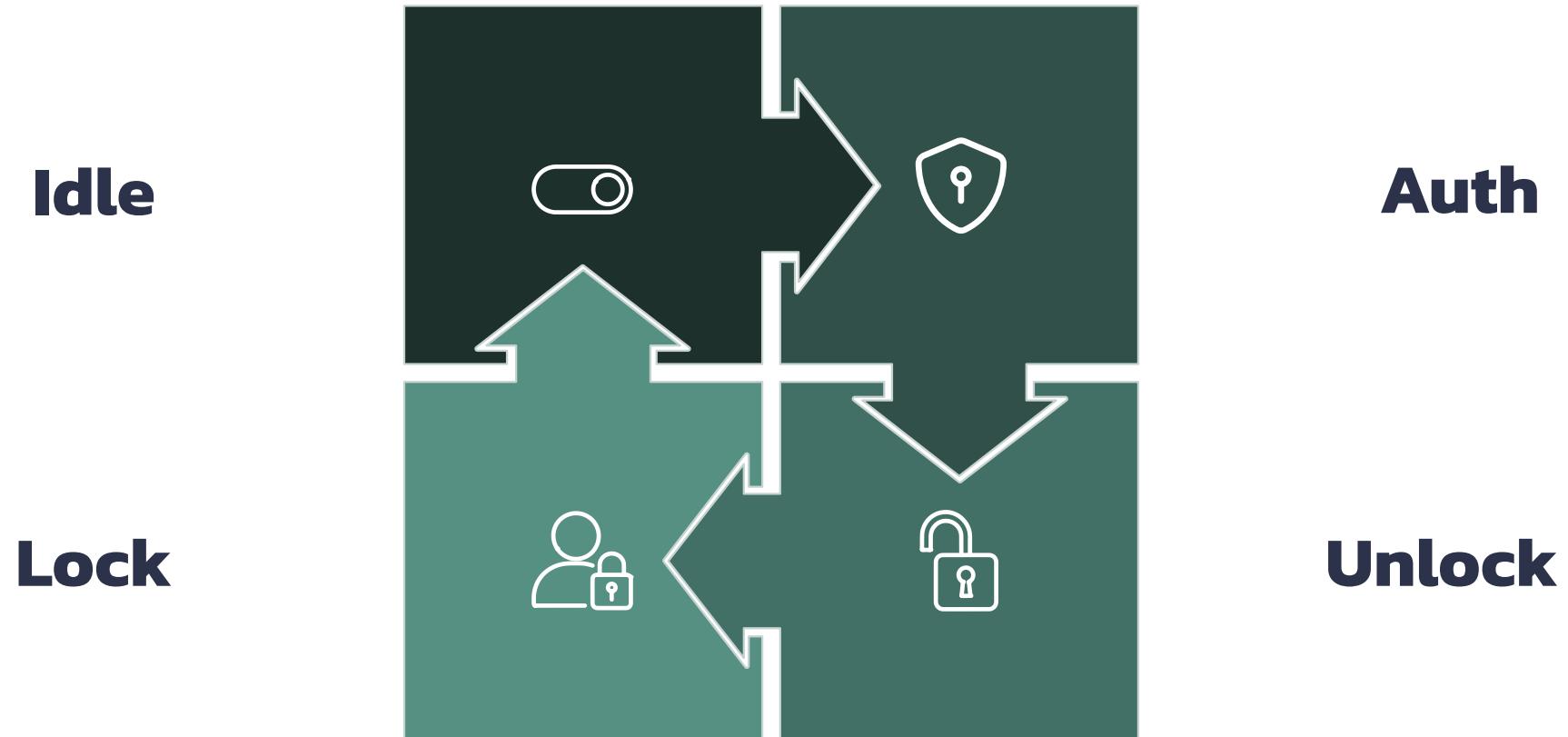


Web Application:

Cross-platform interface allowing users to monitor data, receive alerts, and control the smart door remotely.



System Operation Flow



The smart access door operates through a structured flow of four states:

- **Idle:** System waits for input from RFID, keypad, or sensors.
- **Auth:** User authentication using RFID card or PIN entry.
- **Unlock:** Servo motor opens the door, LCD displays status, and the event is logged to Supabase.
- **Lock:** The door locks only if conditions are safe, verified by IR and Fire sensors.

This flow guarantees secure, efficient, and reliable operation, covering normal access and emergency overrides.



RFID & Keypad Authentication

The system integrates dual authentication methods to ensure secure and reliable access

RFID cards and keypad PINs:-

- Valid Credential:** When a recognized RFID UID or correct PIN is entered, the system triggers the unlock sequence. The LCD immediately updates with a success message, the servo motor opens the door, and Supabase logs the event as a successful access attempt. This provides both real-time feedback and permanent traceability
- Invalid Credential:** If an unauthorized card is scanned or a wrong PIN is entered, the LCD displays "Access Denied". At the same time, Supabase records the failed attempt as a security log. This helps in auditing and monitoring suspicious activities.





IR & Fire Sensor Logic



IR Sensor (Presence)

The IR sensor detects human presence in front of the door. When triggered (LOW signal), the system unlocks the door for a short duration, enabling safe passage without requiring credentials. This is logged in Supabase as a manual exit event. By doing so, the system ensures convenience while still keeping records of all activities.



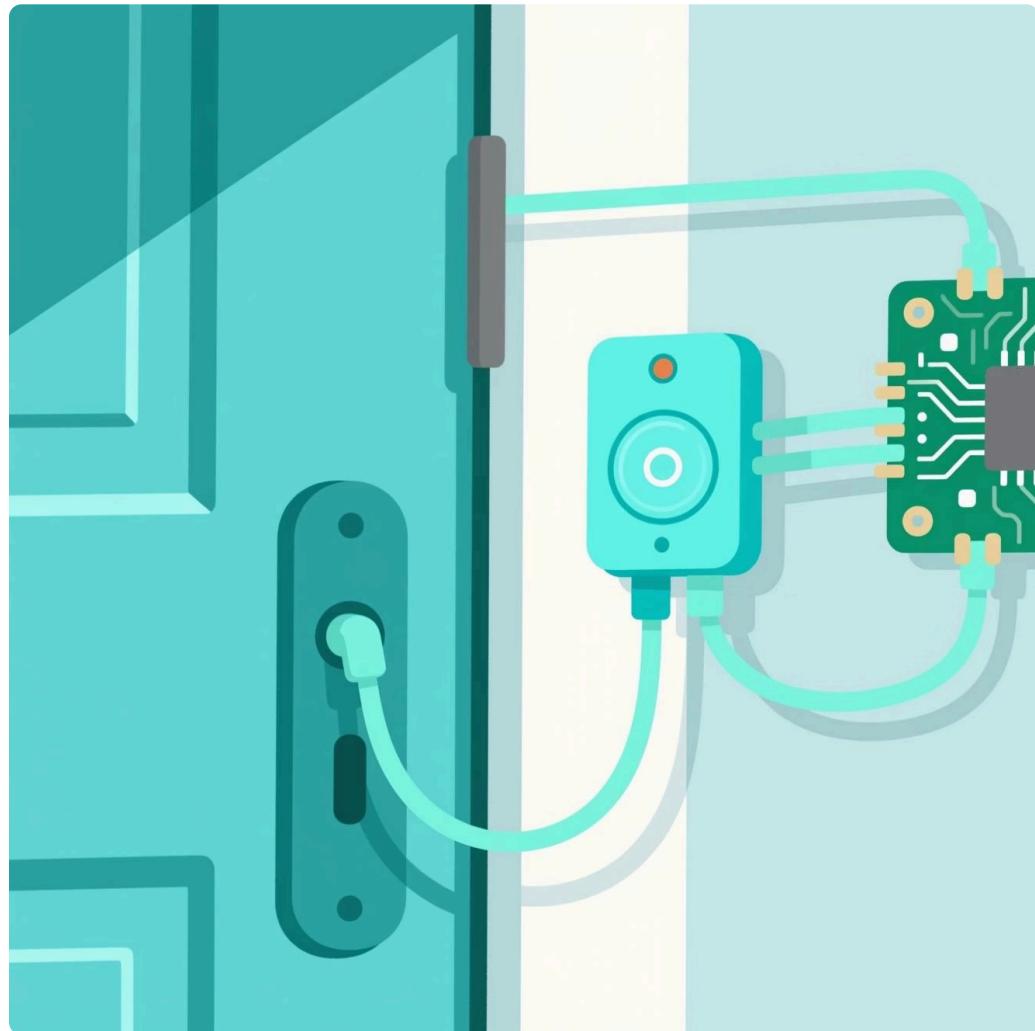
Fire Sensor (Emergency)

The fire sensor provides an essential safety mechanism. Upon detecting fire (LOW signal), the system immediately overrides all other logic and triggers an emergency unlock. This guarantees that the door remains accessible during critical situations. The event is recorded in Supabase as a critical safety event for auditing and analysis.

Together, these sensors provide critical safety features, ensuring the door responds appropriately to both everyday presence detection and emergency fire scenarios.

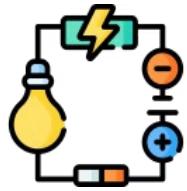


Magnetic Switch Logic



The magnetic switch is crucial for confirming the physical state of the door before initiating a lock sequence.

- **lockSystem() Check:** Before the door attempts to lock, the `lockSystem()` function calls `canLock()`, which checks the magnetic switch status.
- **Safe to Lock:** The door will only lock if the magnetic switch confirms the door is closed, AND both the IR and Fire sensors are in a "safe" state (no presence, no fire).
- **Lock Failure:** If these conditions are not met (e.g., door ajar, presence detected), the door remains unlocked, and a "lock failure" event is logged to Supabase.



Wokwi Circuit Design

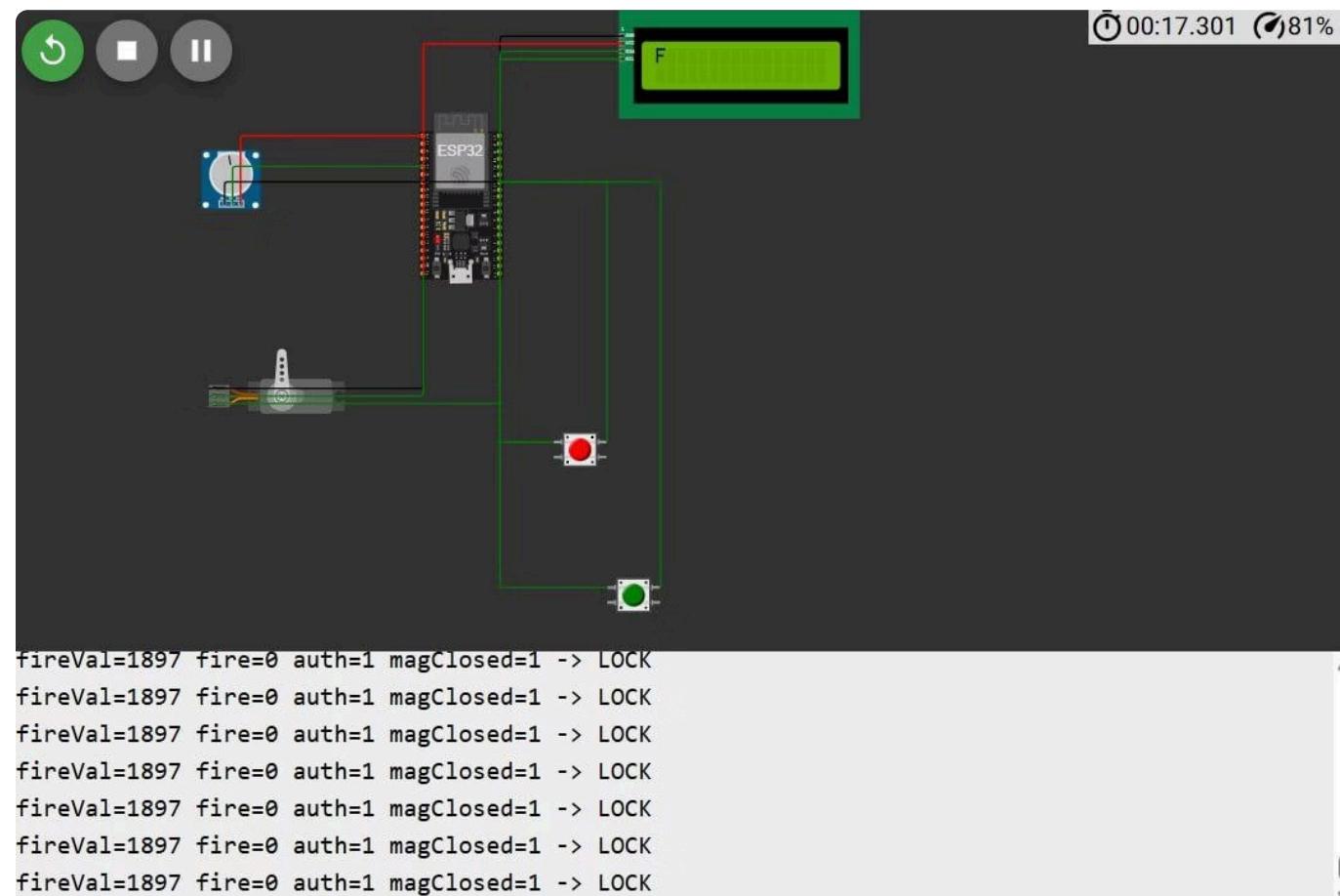
The ESP32 was simulated in Wokwi with essential components:-

Substitutes were used for unavailable sensors:

1. Potentiometer → Fire Sensor
2. Pushbutton (GPIO23) → RFID Module
3. Pushbutton (GPIO19) → Magnetic Switch
4. LCD 16x2 I2C was added for system messages.
5. Servo motor represents the door lock/unlock mechanism.

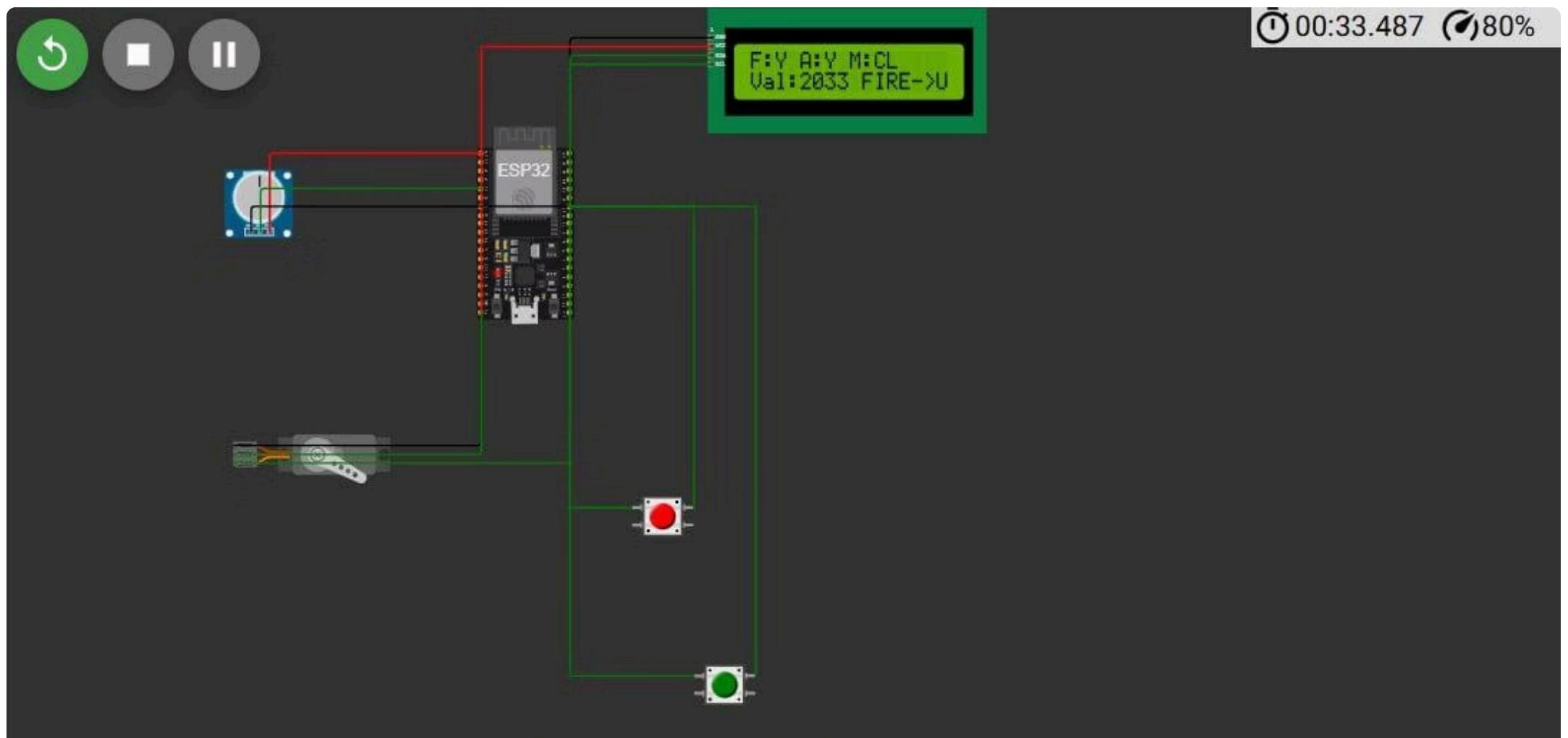
Door Locked – Normal Condition:-

- When no fire is detected → the door remains locked.
- LCD displays LOCK.
- Servo stays in the closed position.



Door Unlocked – Fire Detected:-

- When fire is detected → the door automatically unlocks.
- LCD displays FIRE→UNLOCK.
- Servo rotates to open the door for evacuation.



```
fireVal=2033 fire=1 auth=1 magClosed=1 -> FIRE->UNLOCK
```

Supabase Database & Realtime Integration

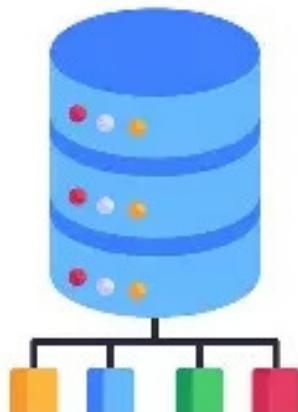
We built a complete Supabase project to serve as the core database of the system

Defined 4 main tables:-

1. **sensor_readings** → stores all sensor data from the ESP32 (fire, RFID, magnetic).
2. **users** → manages user accounts with authentication (login/signup).
3. **alerts** → records emergency events such as fire detection or unauthorized access.
4. **access_logs** → keeps a detailed history of door activity (open/close attempts).

Configured Row Level Security (RLS) Policies to ensure that only authorized users can access sensitive information.

Enabled Realtime features so that the Web/Mobile Dashboard updates instantly whenever new data is logged in the database.



This integration provided:

- Secure cloud storage for all data.
- Live monitoring of the door and sensors.
- Flexible and safe user management with proper permissions.
- With this setup, Supabase became the backbone that connects the ESP32 hardware with the web/mobile applications in a secure and realtime manner.



MQTT Integration with ESP32

Implemented MQTT (HiveMQ broker) for real-time communication between ESP32 and the cloud Uses the Publish/Subscribe model:-

- esp32/sensors/data → ESP32 publishes sensor values (fire, RFID, magnetic).
- esp32/door/control → ESP32 subscribes to door commands (open/close).
- The broker ensures lightweight and fast message delivery, ideal for IoT devices.
- Node-RED (optional) was tested as middleware to forward data to Supabase or visualize topics.

Result:

- Instant synchronization between hardware and web/mobile application.
- Door responds immediately to fire detection or valid authentication.
- MQTT is the backbone of the system's realtime communication layer.



Smart Door Website Features

- Sign in / Sign up using Supabase Authentication.
- Dashboard to view real-time sensor data (RFID, IR, Fire, Magnetic).
- Remote Door Control by sending MQTT commands (lock/unlock).
- Alerts Page for gas/fire incidents and emergency triggers.
- History Logs showing access attempts and sensor events stored in Supabase.

The web application, built with React and integrated with Supabase, provides a secure and user-friendly interface to manage the smart access door. Users can authenticate with Supabase, monitor live sensor readings, remotely control the door through MQTT, receive instant alerts in case of fire or gas detection, and review historical access logs for enhanced security and traceability.



User Dashboard & Pages



Sign Up Page

IoT Door

Login

Sign Up

Create an Account

Sign up to access your IoT Door Dashboard

Full Name

Your full Name

Email

you@example.com

Password

Enter your password

Sign Up

Already have an account? [Login here](#)



Login Page

IoT Door

Login

Sign Up

Welcome Back

Log in to access your IoT Door Dashboard

Email

you@example.com

Password

[REDACTED]

Login

[Login with Magic Link](#)

Don't have an account? [Sign up](#)

Users can create a new account with name, email, and password. A confirmation email is sent via Supabase before access.

Registered users log in with email and password. Supabase also supports a Magic Link for quick, secure access.



Realtime Dashboard

IoT Door

Dashboard

Logout

Welcome, Team 14

Realtime Dashboard

Remote Door Control

Alerts

History Logs

Realtime Access Logs (Last 10)

Time	Method	Status
8/29/2025, 11:23:51 AM	manual	success
8/29/2025, 11:23:46 AM	manual	success
8/29/2025, 11:23:42 AM	manual	success
8/29/2025, 11:23:37 AM	manual	success
8/29/2025, 11:23:33 AM	manual	success
8/29/2025, 11:23:27 AM	password	failure

Shows the latest sensor readings and access logs in real time. Helps users track door activity and monitor system status instantly. The dashboard updates automatically when new data is received from the ESP32.



Alerts Page

IoT Door

Dashboard

Logout

Welcome, Team 14

Realtime Dashboard

Remote Door Control

Alerts

History Logs



emergency

8/28/2025, 2:42:57 PM



emergency

8/28/2025, 2:41:31 PM



emergency

8/28/2025, 2:41:23 PM



emergency

8/28/2025, 2:25:23 PM

Displays emergency events such as fire or unauthorized access. When a fire is detected, a toast notification instantly appears at the top of the screen to warn users of the emergency.



Remote Door Control (Via MQTT)

Opening State

IoT Door ✓ Open command sent! Dashboard Logout

Welcome, Team 14

Realtime Dashboard Remote Door Control Alerts History Logs

Door Status

Opening...

Open Door Close Door

User sends an MQTT command to open the door. The system updates status instantly on the dashboard.

Closing State

IoT Door 🔒 Close command sent Dashboard Logout

Welcome, Team 14

Realtime Dashboard Remote Door Control Alerts History Logs

Door Status

Closing...

Open Door Close Door

User sends an MQTT command to close the door. The system confirms action and displays feedback in real time.

Made with GAMMA



History Logs (Access & Sensor Events)

- Keeps a complete record of all door access attempts and sensor triggers.
- Each entry shows time, method (RFID, PIN, manual, or remote), and status of the event.
- Logs are stored in Supabase to ensure traceability and secure auditing.
- Helps detect unauthorized access, monitor user behavior, and improve system reliability.
- Provides data for future analysis, enabling performance evaluation and system upgrades.

IoT Door

Dashboard Logout

Welcome, Team 14

Realtime Dashboard Remote Door Control Alerts History Logs

History Logs (All)

Time	Method	Status
8/29/2025, 11:24:36 AM	manual	success
8/29/2025, 11:24:33 AM	manual	success
8/29/2025, 11:24:21 AM	manual	success
8/29/2025, 11:24:18 AM	manual	success
8/29/2025, 11:24:01 AM	manual	success
8/29/2025, 11:23:55 AM	manual	success



Door Password Control

- Allows users to update the door password directly from the web interface.
- Provides a simple and secure form for entering a new password.
- Updated password is instantly applied to the system and confirmed with a success message.
- Enhances system security by giving users control to reset credentials anytime.
- Prevents unauthorized access by ensuring that outdated or compromised passwords can be replaced quickly.

The screenshot shows the IoT Door web application interface. At the top, there's a header with the text "IoT Door", a green success message "Door password updated!", and a red "Logout" button. Below the header, the user is greeted with "Welcome, mina". There are several navigation links: "Realtime Dashboard", "Remote Door Control", "Alerts", "History Logs", and "Change Door Password" (which is highlighted with a blue underline). In the center, there's a form titled "Change Door Password" with a text input field labeled "Enter new password" and a blue "Save Password" button.



RFID Tag Management

- Allows users to add or remove RFID tags directly from the web interface.
- Provides a simple and secure form for entering tag IDs.
- Updated tags are instantly applied to the system and confirmed with a success message.
- Prevents unauthorized entry by ensuring that outdated or lost RFID tags can be removed quickly.

The screenshot shows a web application interface titled "IoT Door". At the top right are "Dashboard" and "Logout" buttons. Below the title, a welcome message "Welcome, mina" is displayed, followed by navigation links: "Realtime Dashboard", "Remote Door Control", "Alerts", "History Logs", "Change Door Password", and "Manage RFID Tags" (which is underlined, indicating it's the active page). The main content area is titled "Manage RFID Tags" and contains a sub-instruction "Enter the RFID tag and select an action below." It features a text input field labeled "Enter RFID tag", a green button labeled "+ Add Tag", and a blue button labeled "- Remove Tag".



Future Work & Enhancements



Door Camera Integration

Real-time video monitoring and recording of door activity.



Gas Sensor Alert

Immediate notifications for detected gas leaks, enhancing safety.



Mobile Notifications

Instant alerts and updates directly to user smartphones.



Voice Assistant

Control the door and receive status updates via voice commands.



Advanced Analytics

Detailed insights into access patterns and sensor data trends.



Biometric Authentication

Secure access using fingerprint or facial recognition.

Conclusion

This project successfully demonstrates the integration of ESP32-based multi-sensors, a robust Supabase backend, and an intuitive web application to create a comprehensive smart access door system. We've built a secure, real-time solution for modern access control and environmental monitoring.



Full Monitoring

Real-time insights into door activity, RFID authentications, and environmental conditions like fire detection.



Secure Access & Alerts

Robust user authentication, remote control, and instant alerts for enhanced safety and security.



Future Scalability

A flexible and modular architecture ready for new features and expanded functionalities like voice control and biometric access.

Thank You