

FLOORLOCK

INTELLIGENT ACCESS CONTROL

BY MATT WHISPELL, ZACHARY THORNTON, JOSEPH MIRE

HACKATHON PITCH // OFFLINE LOCAL SERVER

OTHER ACCESS SYSTEMS



Cloud Fragility

Dependency on external APIs causes system failures during standard building internet outages.

Shaft Dead Zones

Thick concrete walls and metal elevator shafts block traditional commercial building Wi-Fi routers.



Unacceptable Latency

Noticeable security delays between card scan reading and localized floor button activation.

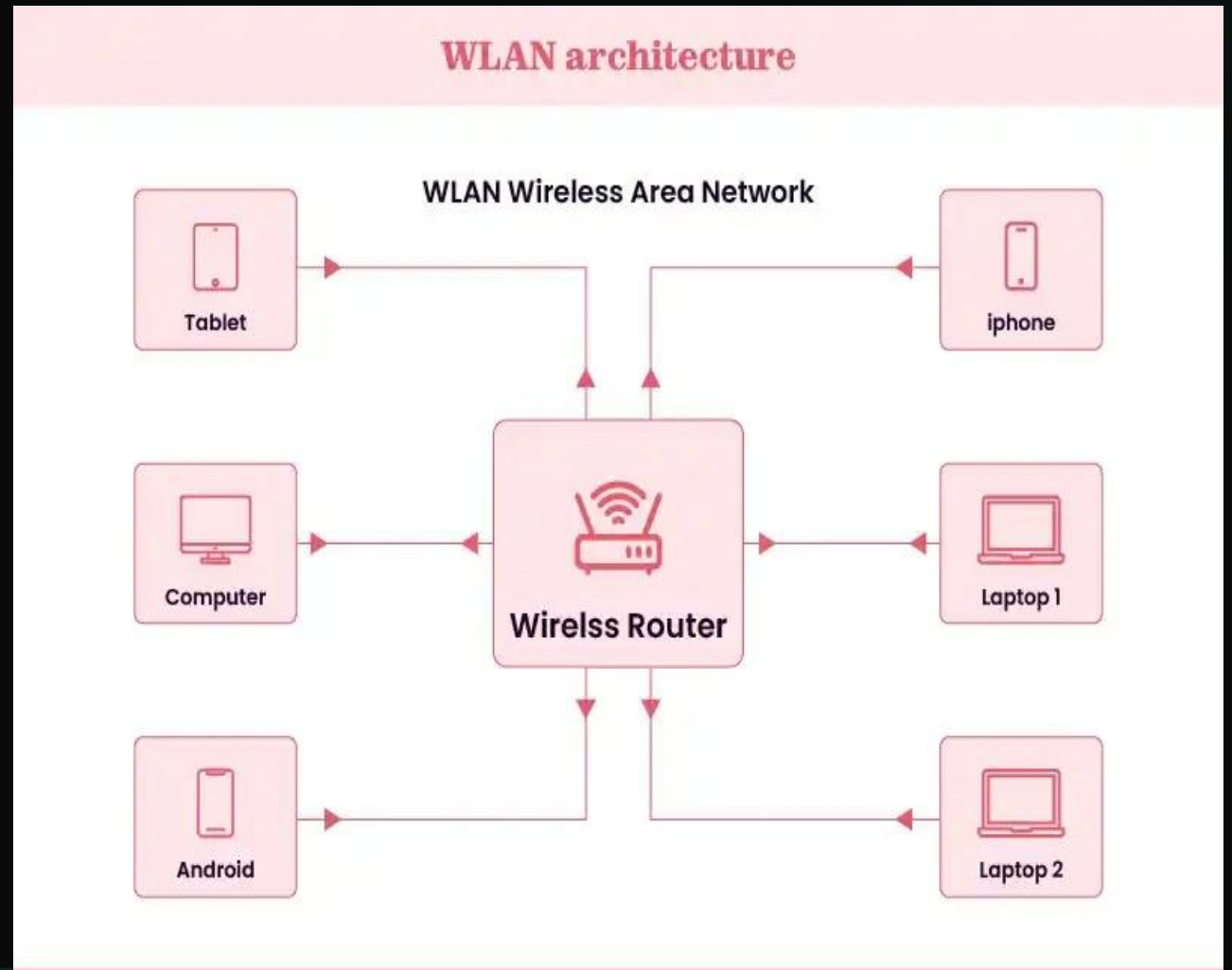
FLOORLOCK ECOSYSTEM

- > **Edge-Driven Host:** A powerful ESP32-WROOM-32 serves as the local central API server.
- > **Zero Cloud Reliance:** Validates tags, logs operations, and updates fully offline.
- > **Distributed Reader Nodes:** Dedicated ESP32 client stations deployed at elevators and doors.
- > **Direct System Response:** Sub-second round-trip time from scanning to relay trigger.



LOCAL NETWORK STRUCTURE

- > **Local AP Architecture:** Host broadcasts a secure local network (ESP32-AP) at 192.168.4.1.
- > **RESTful API Flow:** Clients make high-speed direct POST requests over localized Wi-Fi.
- > **Dynamic Upgrades:** Built-in flexibility allows rapid scale-up without enterprise router dependencies.
- > **Mesh Network Roadmap:** Future development plans transition node-to-node routing to ESP-NOW peer-to-peer.

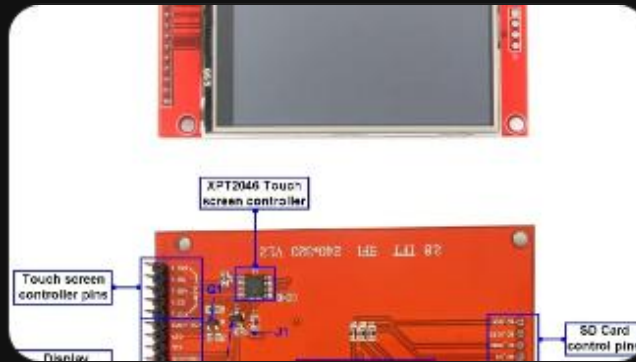


THE HARDWARE INTEGRATION



RFID Scan

Qwiic reader utilizing hardware interrupts for instant trigger detection.



TFT Selection

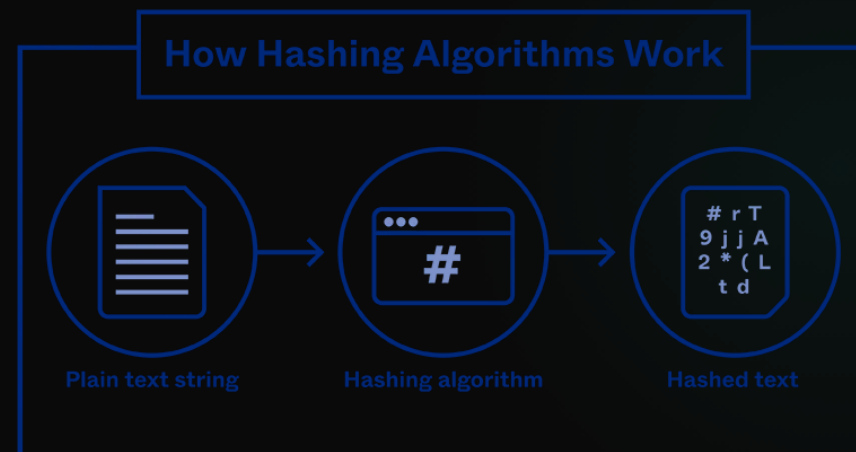
ILI9341 touchscreen for interactive, immediate floor activation.



Visual Status

Luminous NeoPixel feedback matching real-time authorization status.

CRYPTOGRAPHIC AIRWAVES



Sub-Air Hashing Security

Raw card signatures are fully isolated. Credentials get hashed utilizing local cryptographical SHA-256 generation at the node before air transmission, eliminating packet sniffer risks.

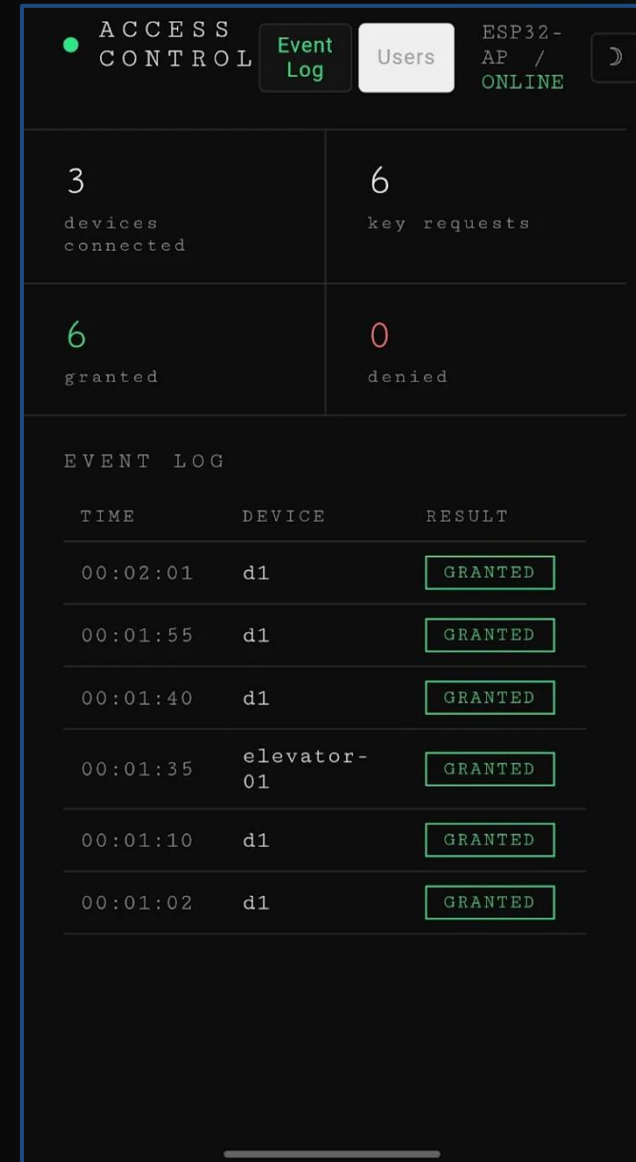


***"Security is forced at the system boundary.
Plaintext credentials never transit across
unverified air connections."***

okta

OFFLINE WEB DASHBOARD

- > **Local LittleFS System:** Entire frontend served offline from internal flash storage.
- > **Zero External CDNs:** Packaged assets render immediately without internet.
- > **Real-Time Auditing:** Live-polling telemetry shows client counts and activity records.
- > **Persistent Styles:** Toggled system preferences saved directly to client localStorage.



DYNAMIC TOKEN PROCESSING

Access Level	User	Active Permissions
E1, E5, D1	User_1	Floors 1 & 5 Access + Main Door Access
E2, E3, E8	User_2	Floors 2, 3, & 8 Access
None	User_3	No Rights

DEVELOPMENT PATH



ACCESS CONTROL

Event Log

Users

ESP32-AP / ONLINE

3

devices connected

6

key requests

6

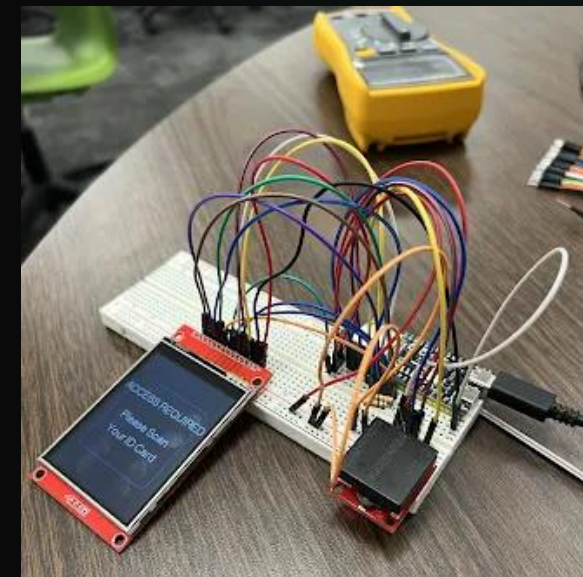
granted

0

denied

EVENT LOG

TIME	DEVICE	RESULT
00:02:01	d1	GRANTED
00:01:55	d1	GRANTED
00:01:40	d1	GRANTED
00:01:35	elevator-01	GRANTED
00:01:10	d1	GRANTED
00:01:02	d1	GRANTED



Phase 1

Inline HTML web AP configuration and digital LED verification.

Phase 2

LittleFS decoupling and dual-theme UI optimization.

Phase 3

Local REST API node communication firmware integration.

Phase 4

Integrate all pieces of system together.

HOW WE USED AI

- > **Project Evolution:** Transformed a basic RFID and touchscreen setup into an ultra-fast, secure access system using a state-machine framework.
- > **Network Modernization:** Replaced standard Wi-Fi with a partially peer-to-peer network for
- > **validation**
Custom Security Protocol: Engineered a case-insensitive parsing algorithm that handles hashed tokens, dynamically unlocks specific floors, and filters out unassigned data.
- > **AI-Accelerated Development:** Leveraged AI as a systems architect and real-time debugging partner to seamlessly merge complex hardware libraries and patch firmware errors on the fly.



FUTURE ROADMAP



Mesh Network

Migrating communication from Client-AP to Peer-to-Peer network blocks to ensure shaft penetration and sub-millisecond data delivery.



SPI SD Integration

Deploying dedicated hardware modules for offline log storage to handle long-term local tracking offline files.



OTA Updates

Implementing a system to securely upload new firmware to peer devices, allowing for easy remote feature additions and bug fixes.

QUESTIONS?

Experience localized control at our demo station.
