Universitas Indonesia

Proyek Akhir Internet of Things

Aslab Pendamping:
Evandita Wiratama

ATLAS

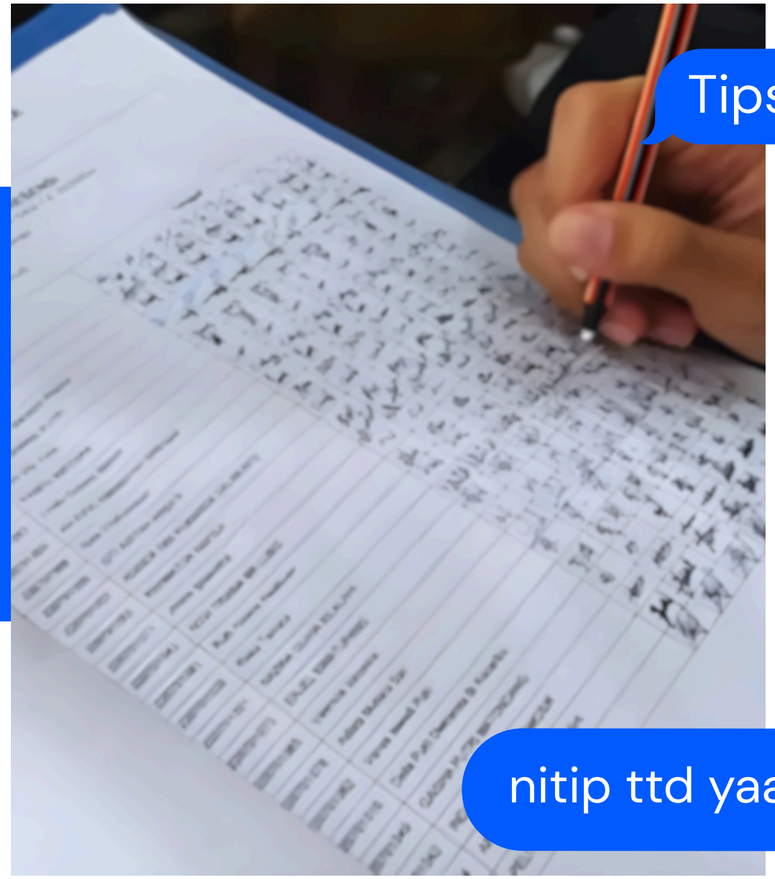
Anti-cheat Tracking & Location Attendance System

Aliya Rizqiningrum Salamun
2306161813

Bonifasius **Raditya** Pandu H.
2306242350

Calvin Wirathama Katoroy
2306242395

Zhafira **Zahra** Alfarisy
2306250636



Problem Statement

Sistem presensi manual berbasis tanda tangan rentan terhadap titip absen, yaitu praktik menitipkan kehadiran oleh mahasiswa lain. Hal ini menimbulkan beberapa dampak negatif signifikan, yaitu:

1. **Ketidakakuratan Data,** Dosen tidak mendapat data kehadiran yang valid
2. **Lack of Fairness & Integritas,** Merusak semangat belajar dan kredibilitas sistem.
2. **Kelemahan Sistem Elektronik Lama,** Kartu RFID/ID masih dapat dipinjamkan.

Solusi?

Diperlukan solusi yang menggabungkan beberapa lapisan verifikasi untuk menjamin kehadiran fisik mahasiswa di dalam ruang kelas.

Proposed Solutions

System Architecture

Client-server architecture dengan dua komponen:

- Client Node: Terminal presensi di ruang kelas
- Admin Node: Dashboard monitoring terpusat untuk dosen
- Communication: MQTT protocol over WiFi → Blynk Cloud Platform

Dual-Layer Verification Mechanism

1. **Layer 1,** Physical Authentication, RFID untuk verifikasi identitas mahasiswa melalui penempelan kartu.
2. **Layer 2,** Digital Proximity Detection, BLE beacon scanning untuk memastikan kehadiran fisik mobile device mahasiswa secara simultan dengan RFID verification.

Anti Cheat

- **Valid** Presensi diterima hanya jika RFID + BLE terdeteksi bersamaan
- **Fraud Alert,** Reject presensi jika BLE tidak terdeteksi (mencegah card sharing)

Key Features

- Real-time data transmission ke Blynk Dashboard
- Remote user registration dari admin interface
- Local database (RFID-to-BLE mapping) dengan opsi cloud expansion
- Visual feedback, LCD display + LED indicators

Implementation

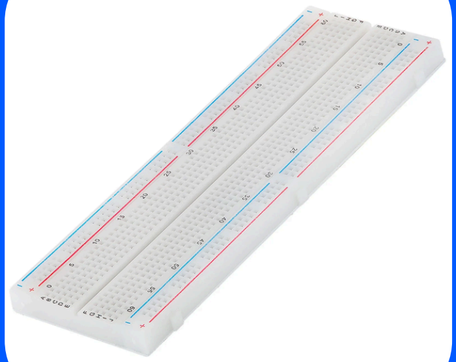
Hardware Component

ESP32 DevKit V1

Memiliki module WiFi dan *Bluetooth Low Energy* (BLE).

RFID Reader RC522

Komunikasi melalui antarmuka SPI untuk membaca UID KTM.



Breadboard

Papan untuk merancang dan menguji prototype electric circuit.

Jumper Cable

Media penghubung daya antar komponen pada rangkaian prototype.

Implementation

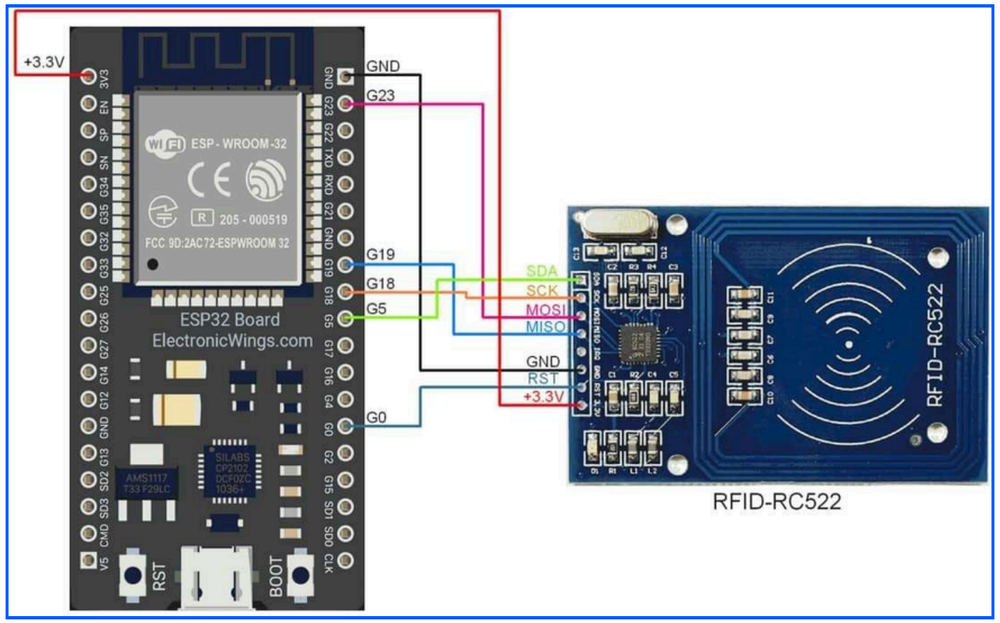
Hardware Design

Centralized Architecture

Menggunakan topologi Star untuk konektivitas optimal. Dan protokol MQTT via WiFi untuk transmisi data secara real-time, sehingga komunikasi latency rendah antar node.

Client Node (Slave)

- **ESP32 DevKit V1** dengan WiFi & BLE terintegrasi.
- **RFID Reader RC522** via antarmuka SPI.
- Ditempatkan di pintu masuk kelas.



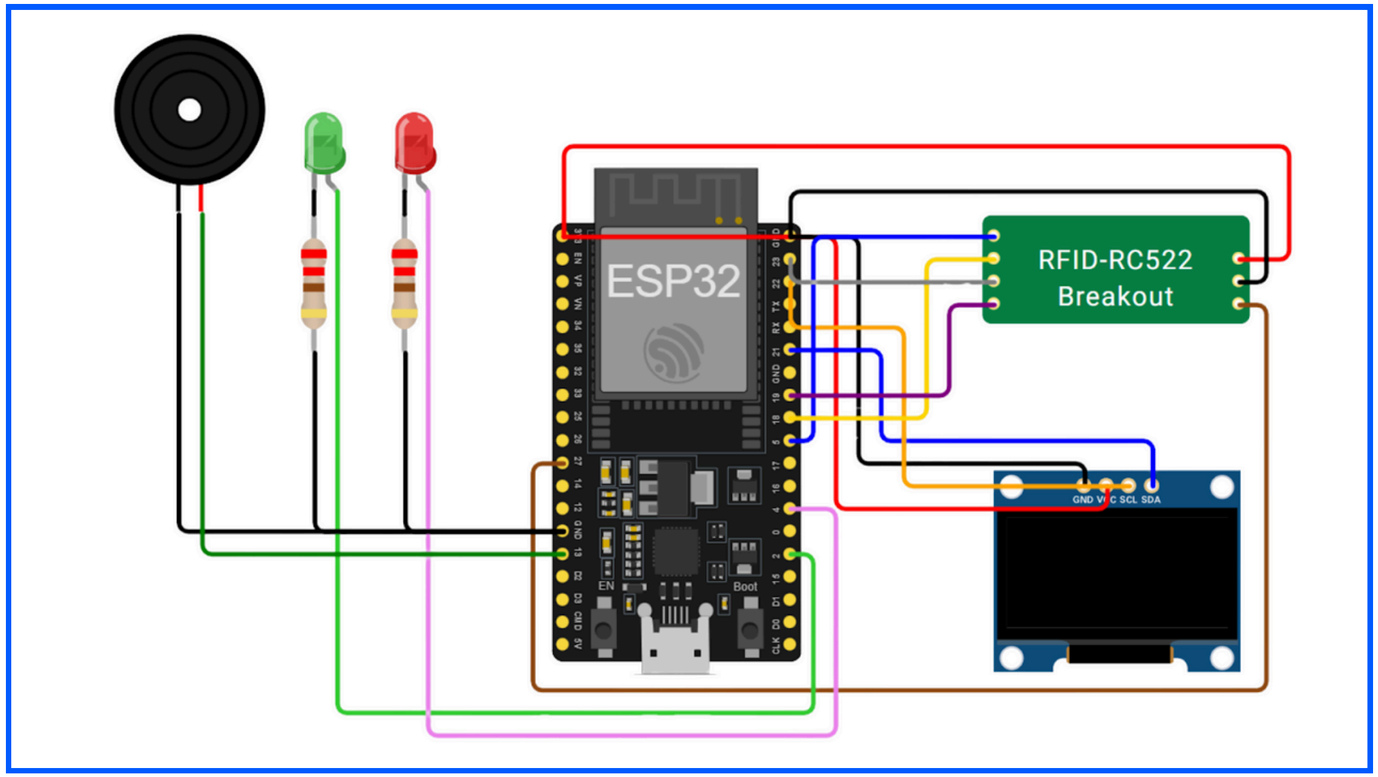
Rangkaian pada Client Node

Admin Node (Master)

- **ESP32 DevKit V1** sebagai MQTT Subscriber.
- Gateway ke Platform IoT Blynk.
- Ditempatkan di meja dosen.

Implementation

Hardware Schematic



Konfigurasi Pin ESP32 ke RFID-RC522	
SCK	GPIO 18 Serial Clock
MOSI	GPIO 23 Master Out Slave In
MSIO	GPIO 19 Master In Slave Out
SS/SDA	GPIO 21 Chip Select
RST	GPIO 22 Reset
VCC	3.3V Sumber Daya
GND	GND Ground

Implementation

Software Development

Library Utama

- **PubSubClient:** Protokol MQTT
- **MFRC522:** Pembaca RFID
- **Preferences:** Penyimpanan Lokal
- **NimBLE-Arduino:** Pemindaian BLE
- **BlynkSimpleEsp32:** Antarmuka Cloud
- **ArduinoJson:** Pemrosesan Data

RTOS Architecture

Slave Tasks

- **rfidScanTask (Core 0, Priority 2)**
  - Scan RFID reader
  - Push card data ke queue
- **validationProcessTask (Core 1, Priority 1)**
  - Process card queue
  - Handle register/validation mode
  - BLE scanning
  - ESP-NOW communication

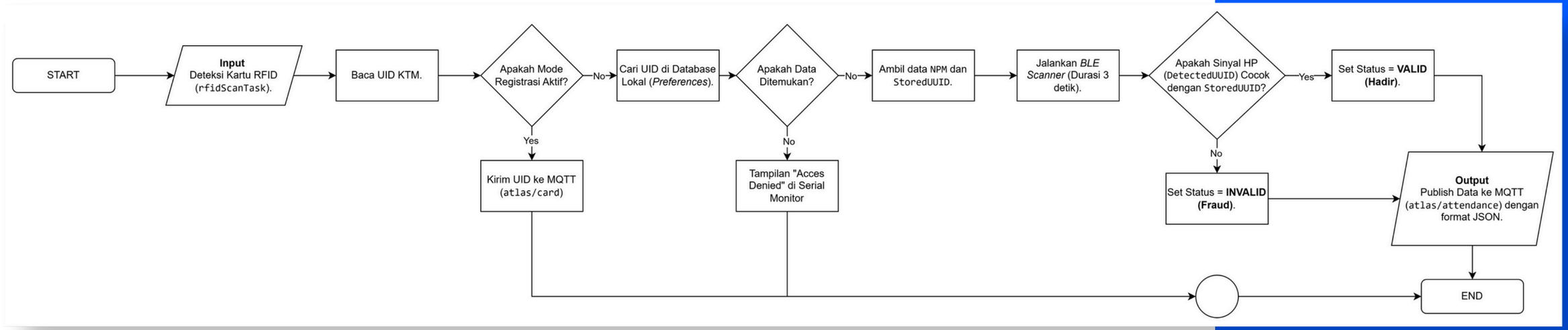
Master Tasks

- **blynkManagementTask** (Core 0, Priority 2)
  - Blynk.run()
  - Process attendance queue
  - Process registration queue
  - Update Blynk widgets
- **espnowReceiveTask (Core 1, Priority 1)**
  - Handle ESP-NOW callbacks
  - Lightweight monitoring task

Implementation

Software Development

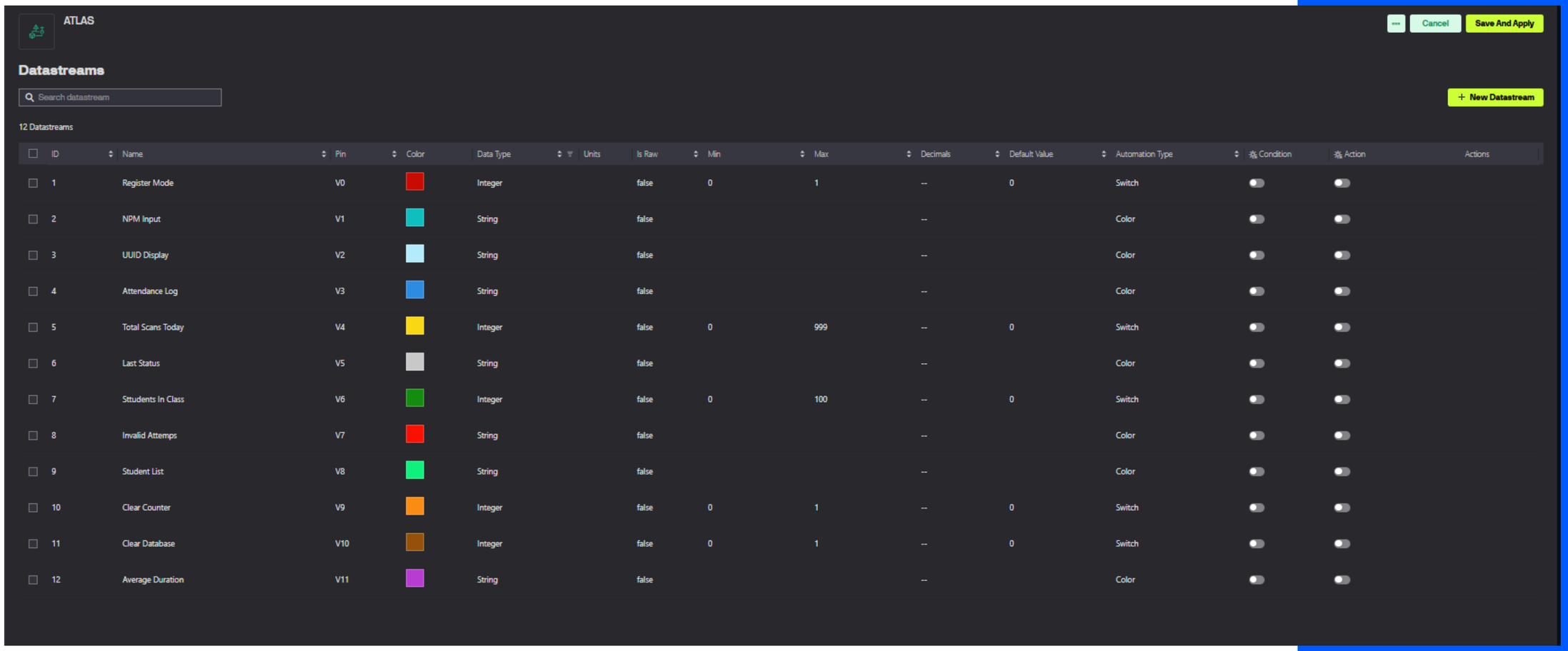
Flowchart Logika Dual-Factor pada Client Node



Implementation

Software Development

Datastreams pada Blynk

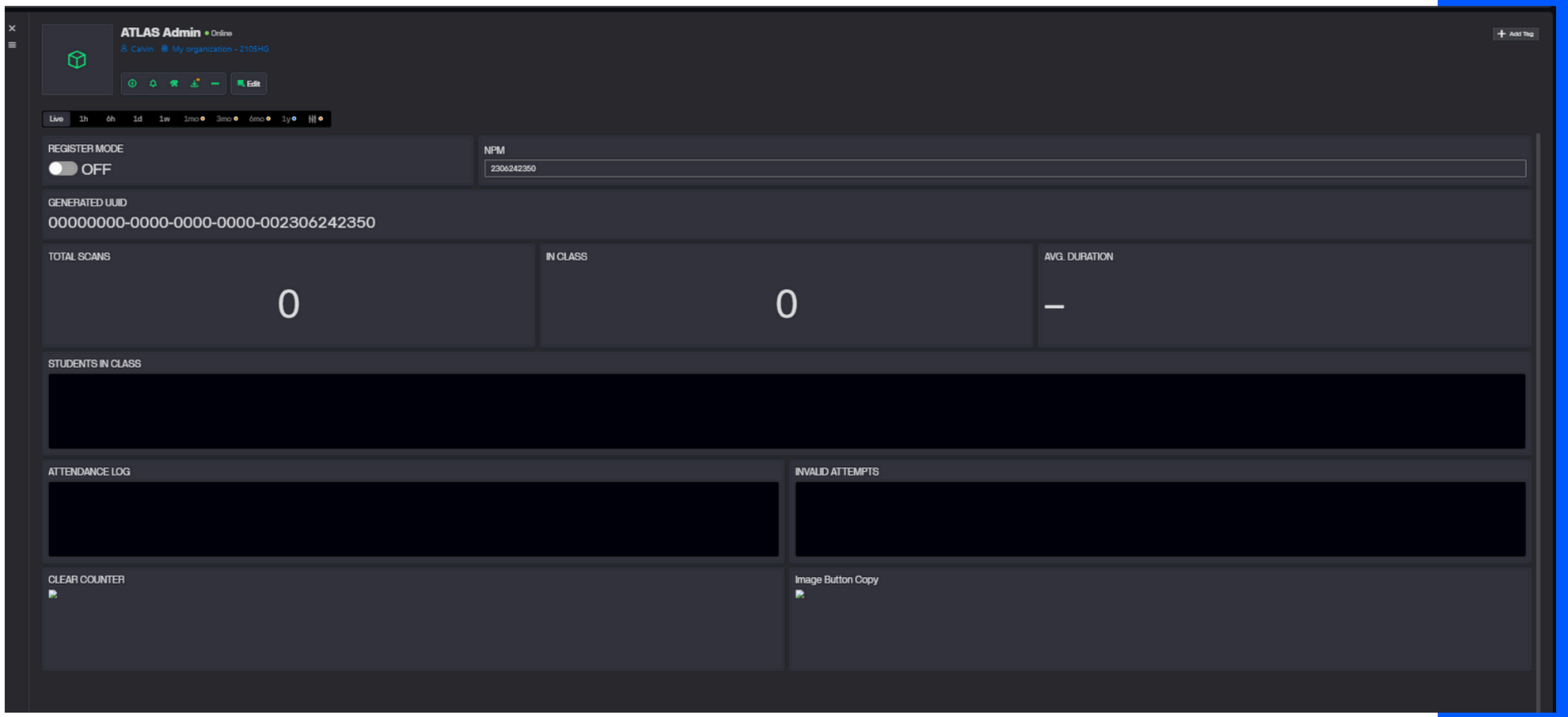


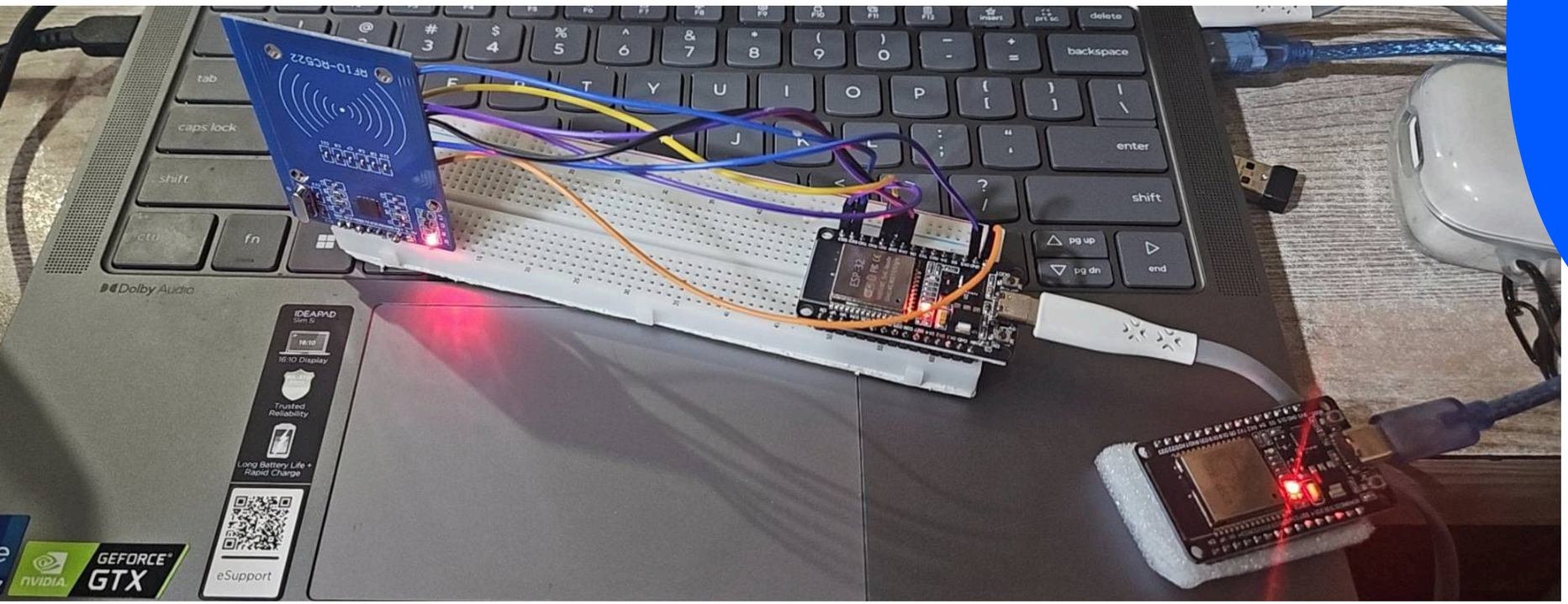
ID	Name	Pin	Color	Data Type	Units	Is Raw	Min	Max	Decimals	Default Value	Automation Type	Condition	Action	Actions
1	Register Mode	V0		Integer		false	0	1	--	0	Switch			
2	NPM Input	V1		String		false			--		Color			
3	UUID Display	V2		String		false			--		Color			
4	Attendance Log	V3		String		false			--		Color			
5	Total Scans Today	V4		Integer		false	0	999	--	0	Switch			
6	Last Status	V5		String		false			--		Color			
7	Sttudents In Class	V6		Integer		false	0	100	--	0	Switch			
8	Invalid Attemps	V7		String		false			--		Color			
9	Student List	V8		String		false			--		Color			
10	Clear Counter	V9		Integer		false	0	1	--	0	Switch			
11	Clear Database	V10		Integer		false	0	1	--	0	Switch			
12	Average Duration	V11		String		false			--		Color			

Implementation

Software Development

Dashboard Admin pada Blynk





Hardware & Software Integration

```
╔═══════════════════════════════════╗
║        KARTU TERDETEKSI           ║
╚═══════════════════════════════════╝
UID: A1 B2 C3 D4

[VALIDATION] Checking database...
NPM: 2306242350
Stored UUID: 00000000-0000-0000-0000-002306242350

[BLE] Scanning...
[BLE] Found: 00000000-0000-0000-0000-002306242350, RSSI: -65

╔═══════════════════════════════════╗
║        HASIL VALIDASI             ║
╠═══════════════════════════════════╣
║ Status: ✓✓✓ VALID ✓✓✓             ║
║ RSSI  : -65 dBm                   ║
║ ✓ Kartu: OK                       ║
║ ✓ BLE  : OK                       ║
║ ABSENSI DITERIMA                  ║
╚═══════════════════════════════════╝
```

```
[CARD] 04 6C 0D 9A 10 18 90
[BLE] Scanning 3s...
VALID #5 [MASUK] - 2025-12-08 23:02:14 | NPM: 2306242350 | RSSI: -58 dBm
```

```
[CARD] 04 6C 0D 9A 10 18 90
[BLE] Scanning 3s...
VALID #6 [KELUAR] - 2025-12-08 23:02:25 | NPM: 2306242350 | RSSI: -62 dBm
```

```
[CARD] 04 6C 0D 9A 10 18 90
[BLE] Scanning 3s...
INVALID - 2025-12-08 23:02:20 | BLE mismatch
```

Testing & Result

Konektivitas Awal

Menguji kecepatan koneksi ke WiFi dan Broker HiveMQ (< 5 detik).

Remote Registration

Admin input NPM di Blynk -> Mahasiswa tap kartu → Data tersimpan otomatis di Client.

Validasi Presensi

- Valid: Kartu + HP (Beacon Simulator Aktif) maka Sukses.
- Fraud: Kartu saja (HP mati/jauh) maka Access Denied.

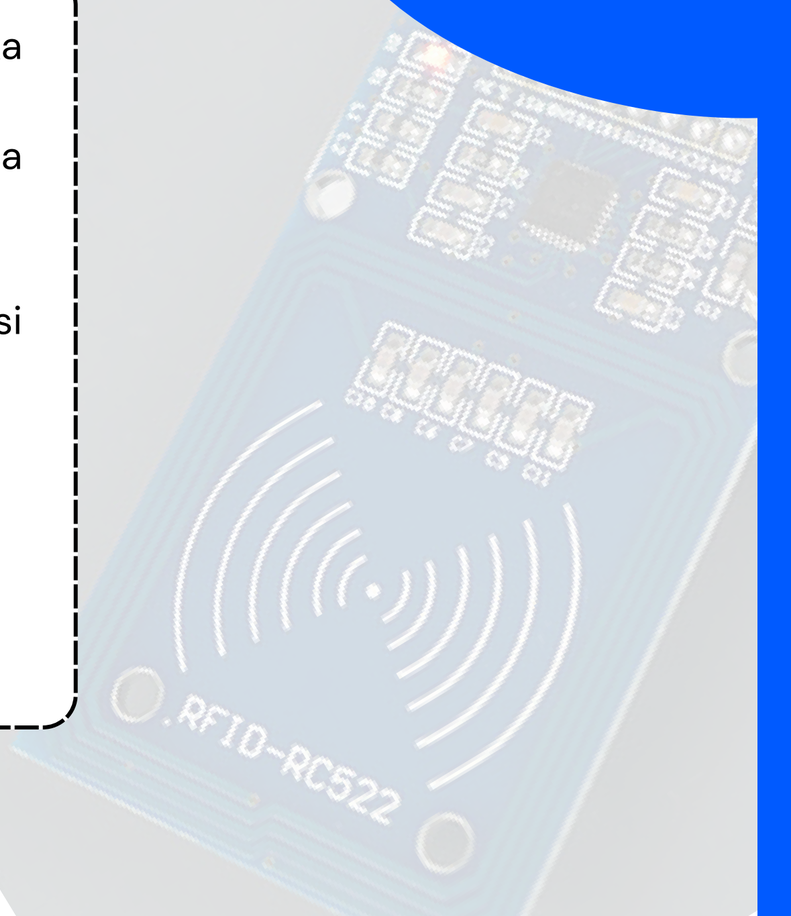
Testing & Evaluation

Evaluation

- Dual Verification (RFID + BLE) berhasil membedakan presensi valid vs fraud, maka tujuan pencegahan titip absen tercapai
- FreeRTOS Task Management membuat BLE scanning & MQTT berjalan paralel tanpa blocking
- WiFi/MQTT berhasil mengirim data presensi & fraud alert ke Blynk secara real-time
- Remote Registration Control dari Admin Node berjalan sukses dan memvalidasi centralized architecture

Limitasi sistem:

- Belum ada visual feedback (LCD/LED) di Client Node
- Database masih lokal (Preferences.h), belum scalable
- BLE range 2 meter berisiko false negative saat ada interferensi



Conclusion

- ATLAS berhasil diimplementasikan sebagai IoT-based attendance system untuk mengatasi proxy attendance
- Dual-layer verification (RFID + BLE) dapat menjamin kehadiran fisik mahasiswa
- MQTT client-server architecture + FreeRTOS menghasilkan sistem yang stable, real-time, and reliable
- Sistem mampu melakukan validasi presensi otomatis + fraud alert

Future development:

- Tambah visual feedback interface
- Migrasi ke centralized cloud database
- Perkuat security terhadap spoofing UUID

Universitas Indonesia

Proyek Akhir Internet of Things

Aslab Pendamping:
Evandita Wiratama

Thank You

Aliya Rizqiningrum Salamun
2306161813

Bonifasius **Raditya** Pandu H.
2306242350

Calvin Wirathama Katoroy
2306242395

Zhafira **Zahra** Alfarisy
2306250636