



DIGITAL TRANSFORMATION AND APPLICATIONS

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Group 6

DESIGN AND IMPLEMENTATION OF A SMART SCHOOL SHUTTLE MANAGEMENT SYSTEM



Problem Statement

Current Situation

- Student transportation is largely managed manually (paper logs, phone calls).
- Lack of real-time monitoring and supervision.

Domain: Education

Pain Points

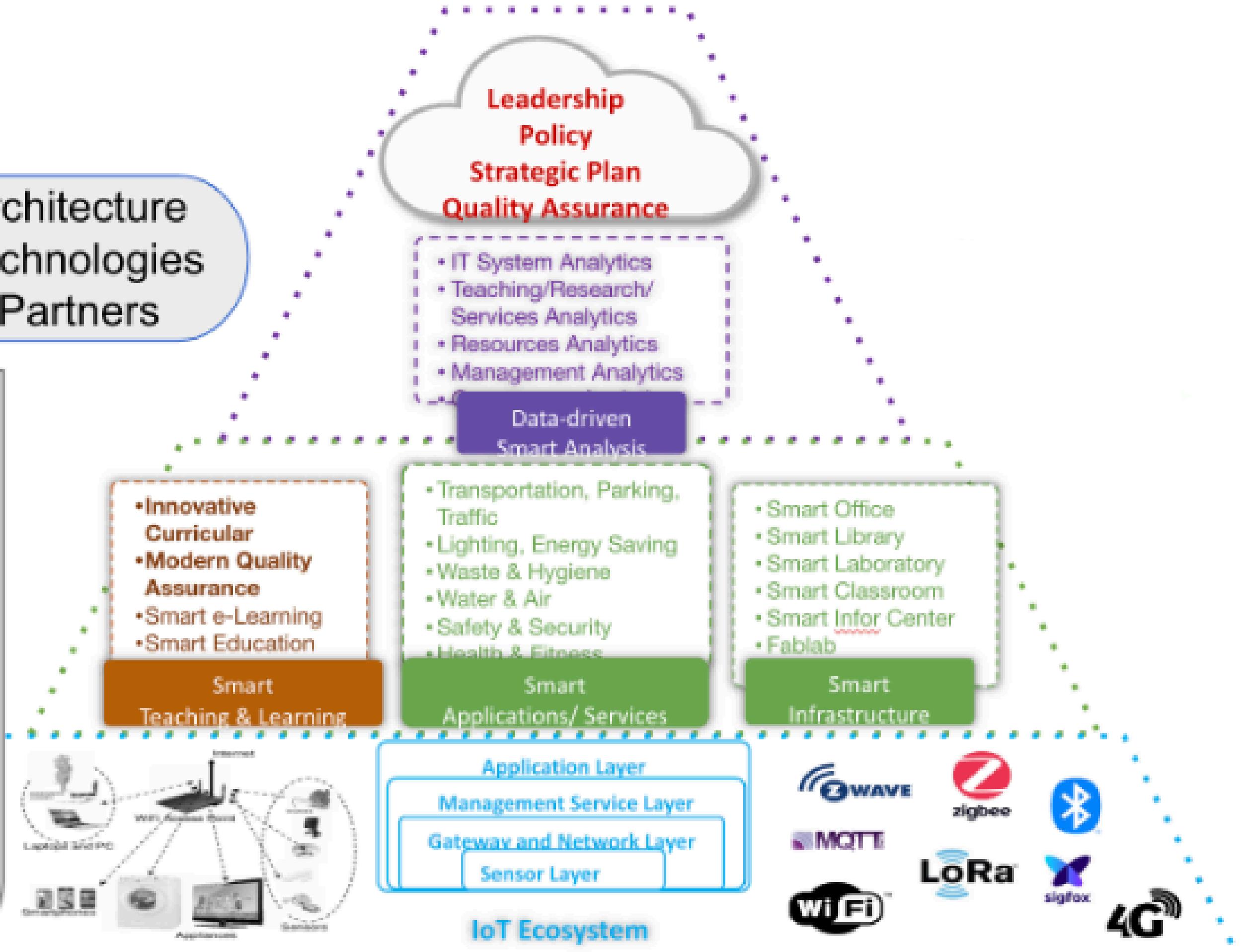
- Parents are anxious about their child's safety and location.
- Schools struggle to supervise driver routes and schedules.

Solution: An IoT-based automated system for real-time tracking and attendance.

One Architecture Multi-Technologies Multi-Partners

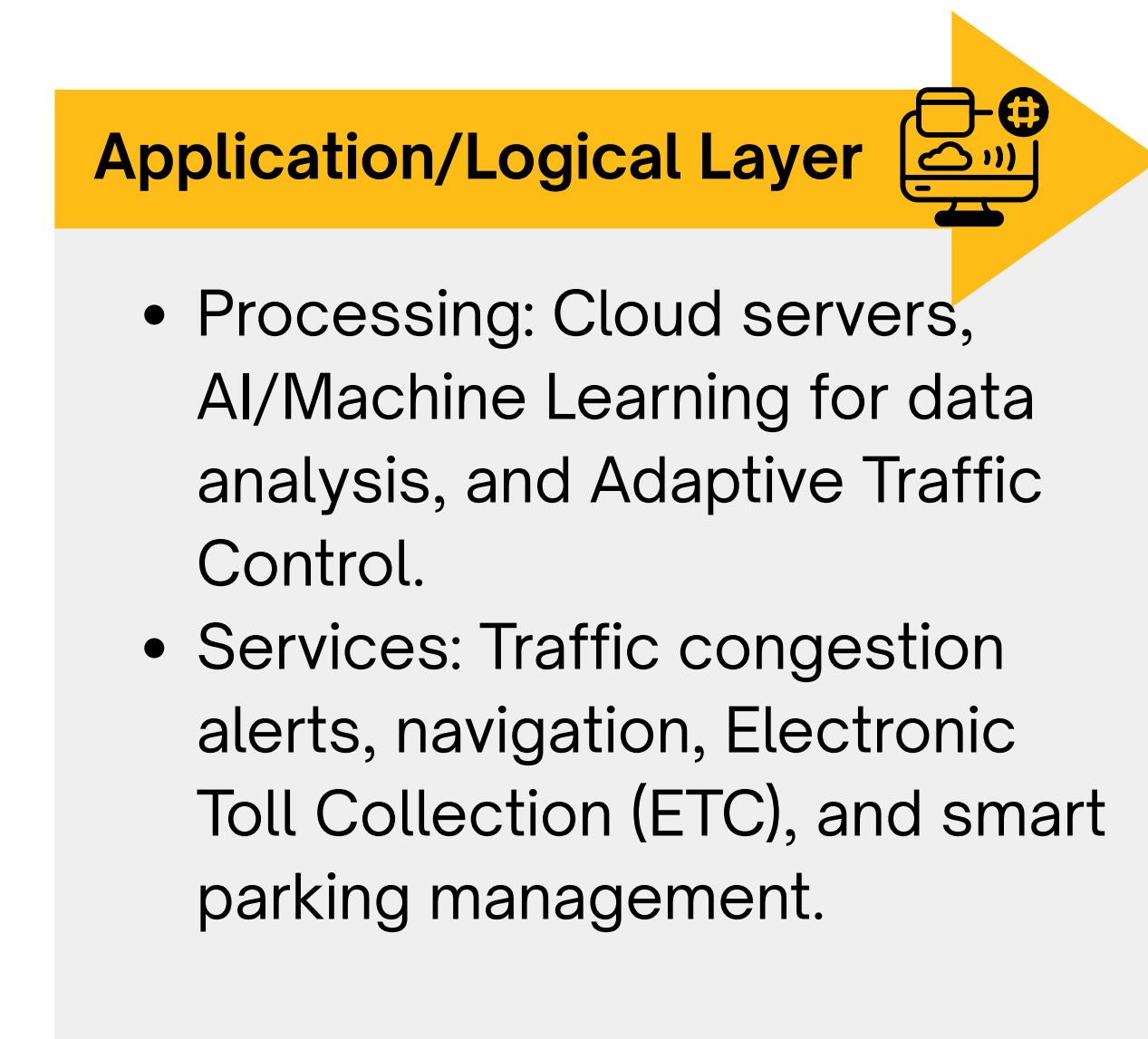
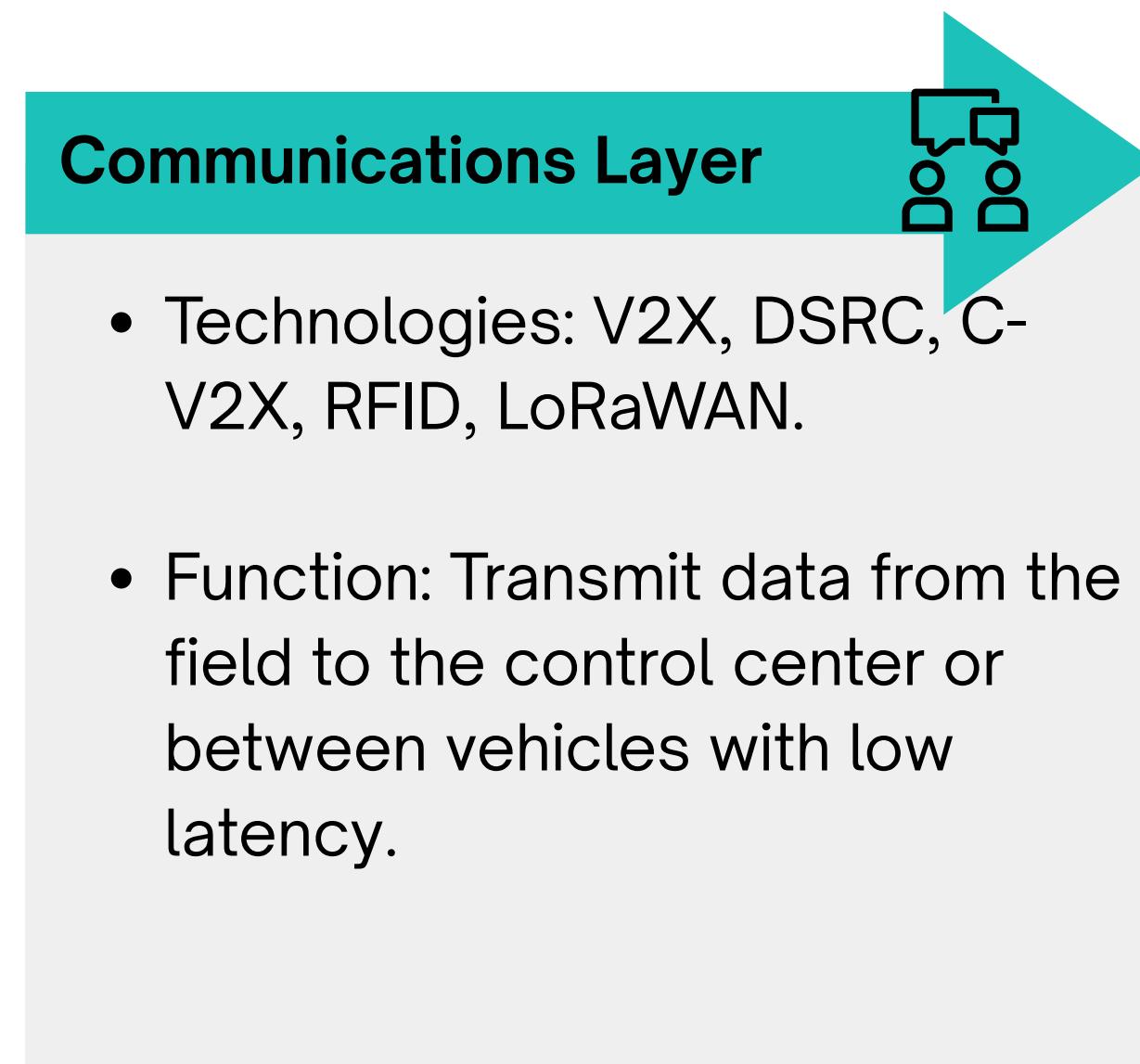
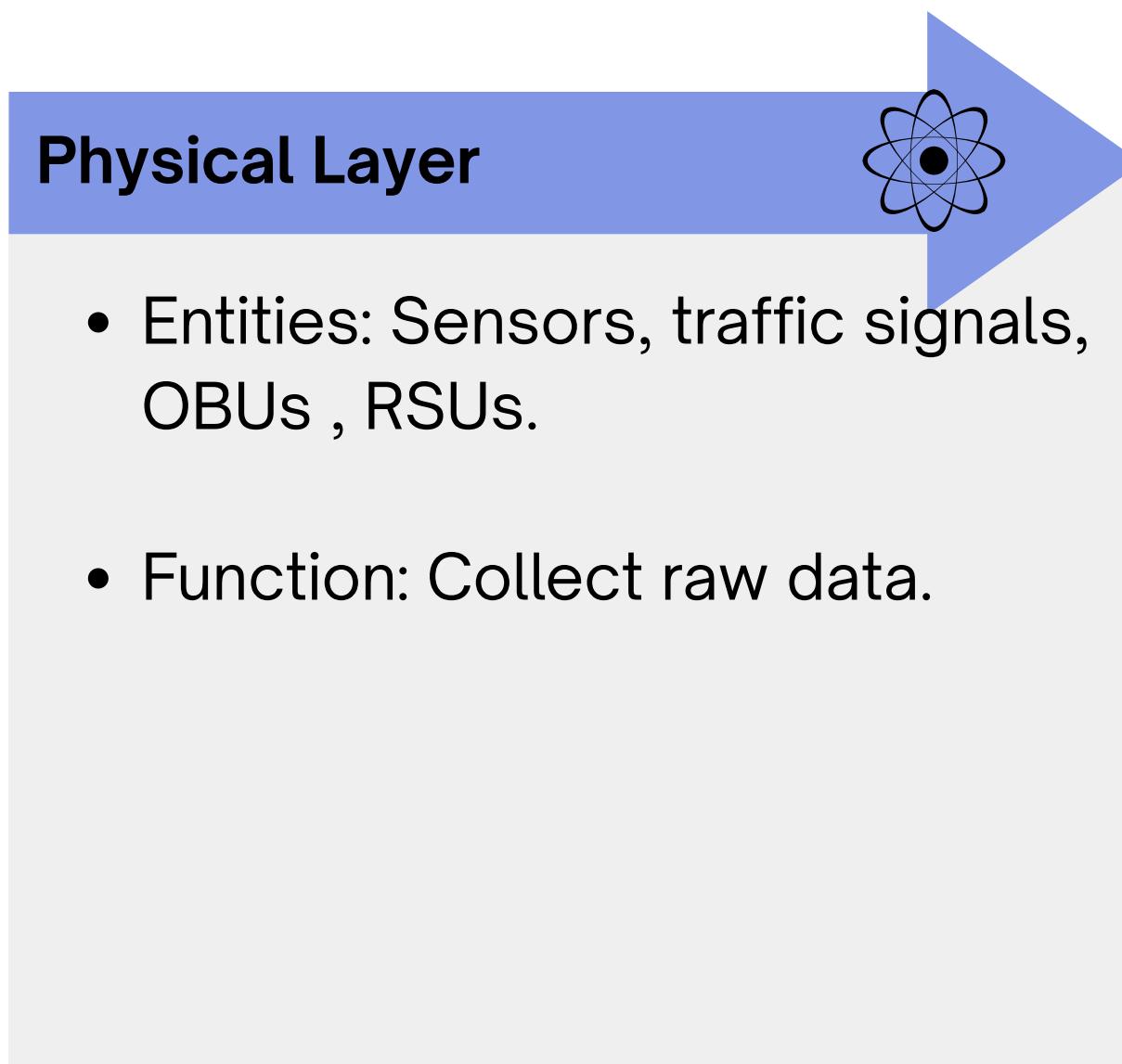
05 Domains, 27 areas

- Smart Technology - IoT Ecosystem
- Smart Environment - Facilities, Applications & Services
- Smart Teaching & Learning
- Data-driven Smart Analysis
- Leadership, Policy, Strategic plan, Quality Assurance



INTELLIGENT TRANSPORTATION SYSTEM (ITS) ARCHITECTURE FRAMEWORK

A standard ITS framework (such as ARC-IT in the US or FRAME in Europe) typically consists of 3 main layers:



AVAILABLE SOLUTION

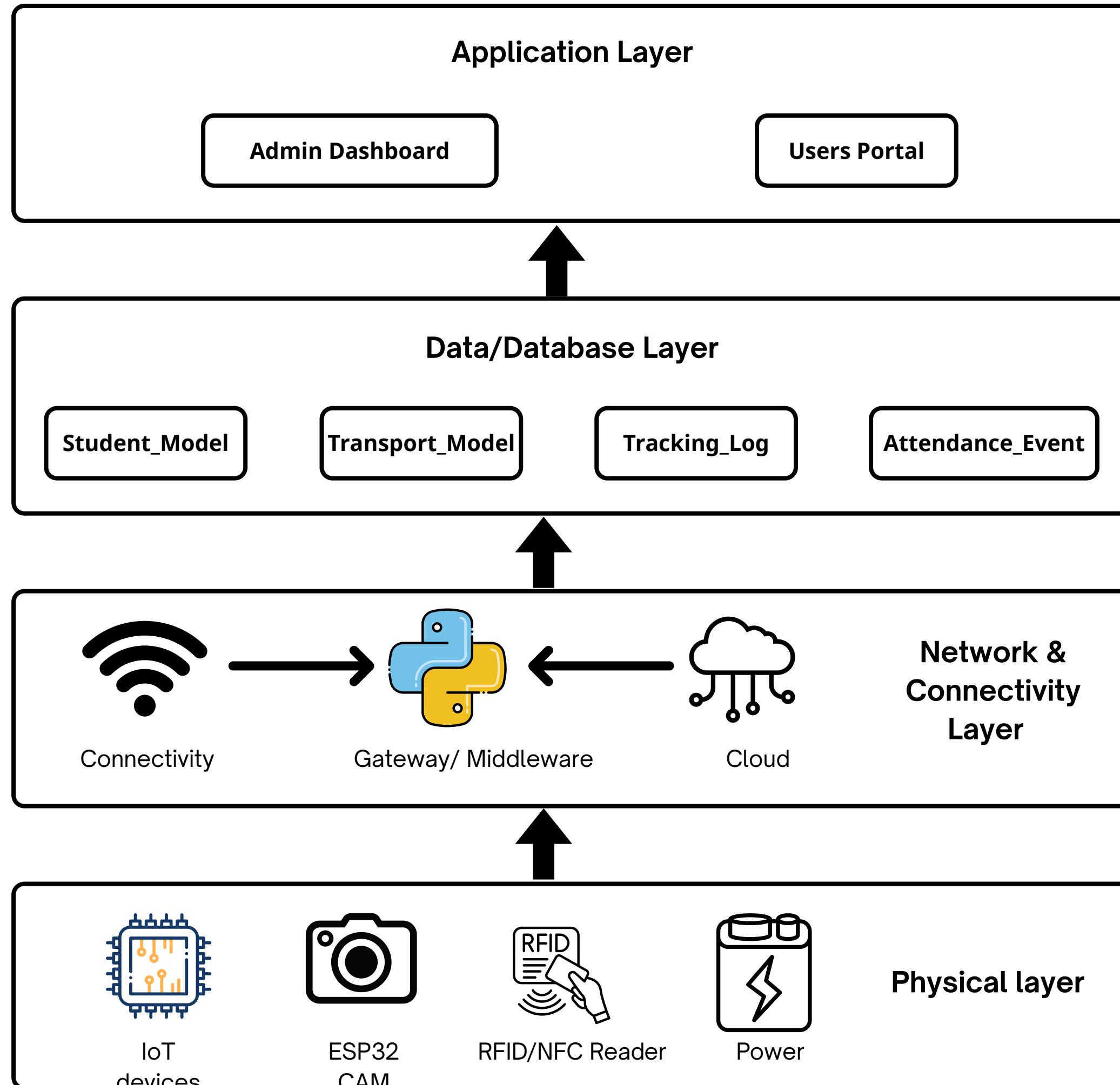


PROJECT OBJECTIVES

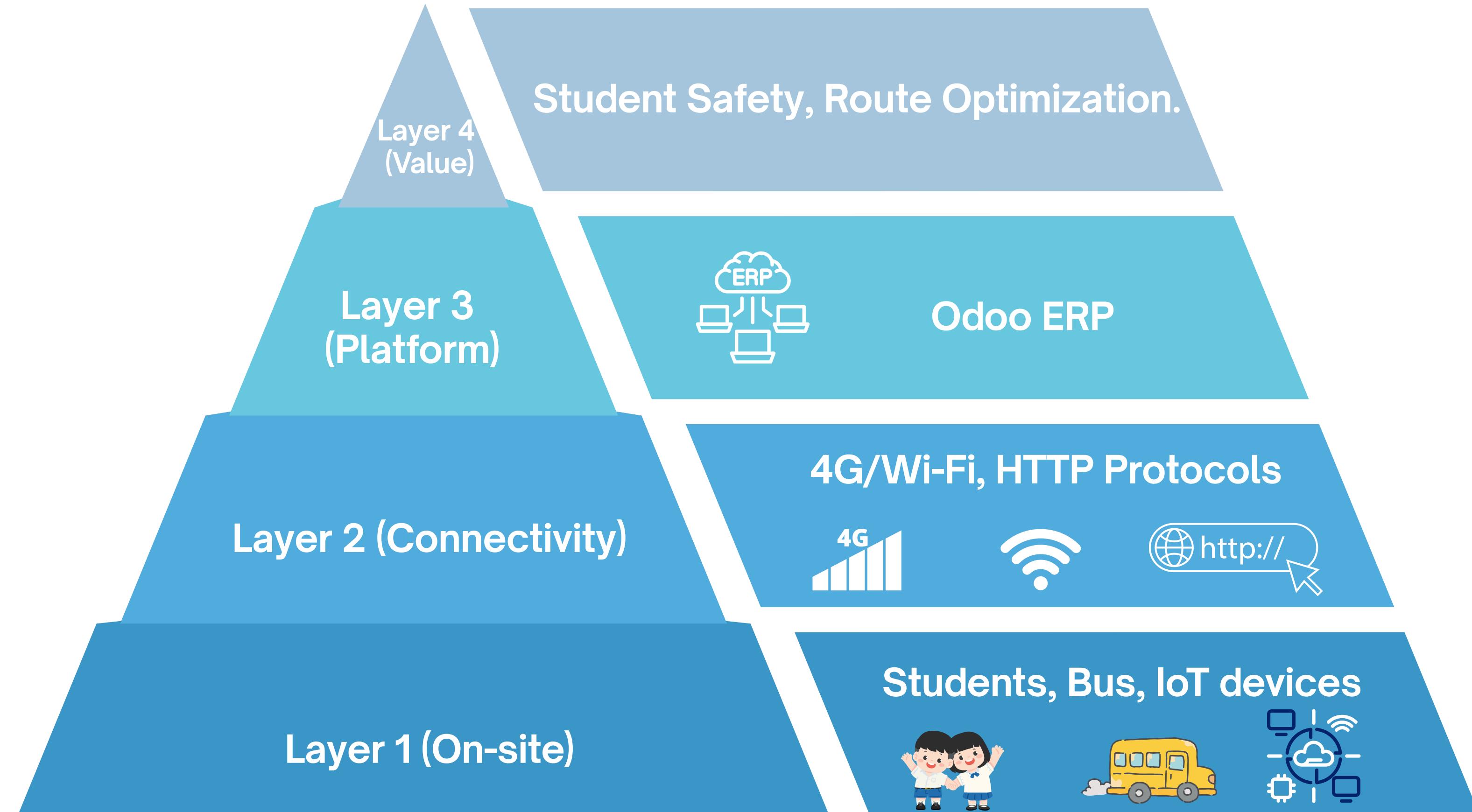
- Hardware: Develop a stable Onboard Unit (OBU) using ESP32 CAM
- Software: Build a centralized Management Server using Odoo ERP.
- Key Features:
 - Visual Attendance Check (Image Capture).
 - Instant Notifications for parents/admins.



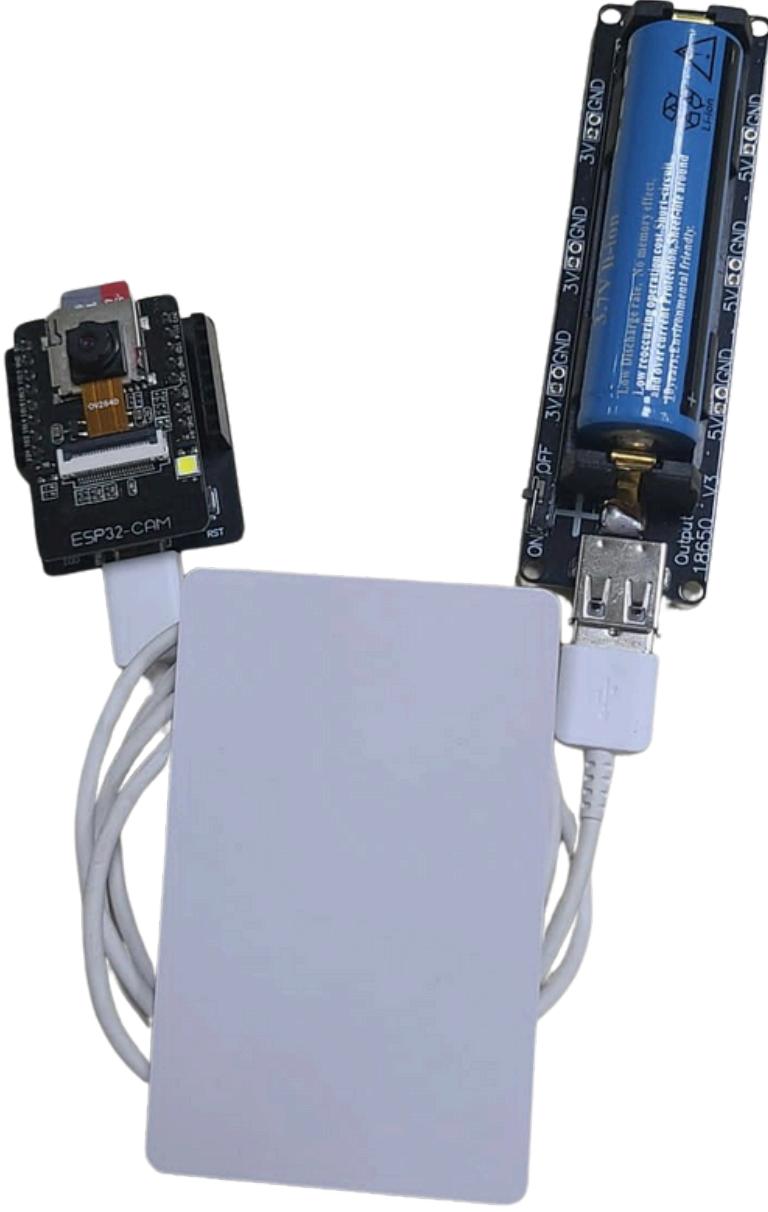
SYSTEM ARCHITECTURE



DIGITAL TRANSFORMATION ARCHITECTURE IN EDUCATION



HARDWARE DESIGN



Core Components:

- ESP32-CAM: Dedicated module for Image Capture (Visual Proof).
- Function: Captures student images to send to the server.

COMMUNICATION PROTOCOLS

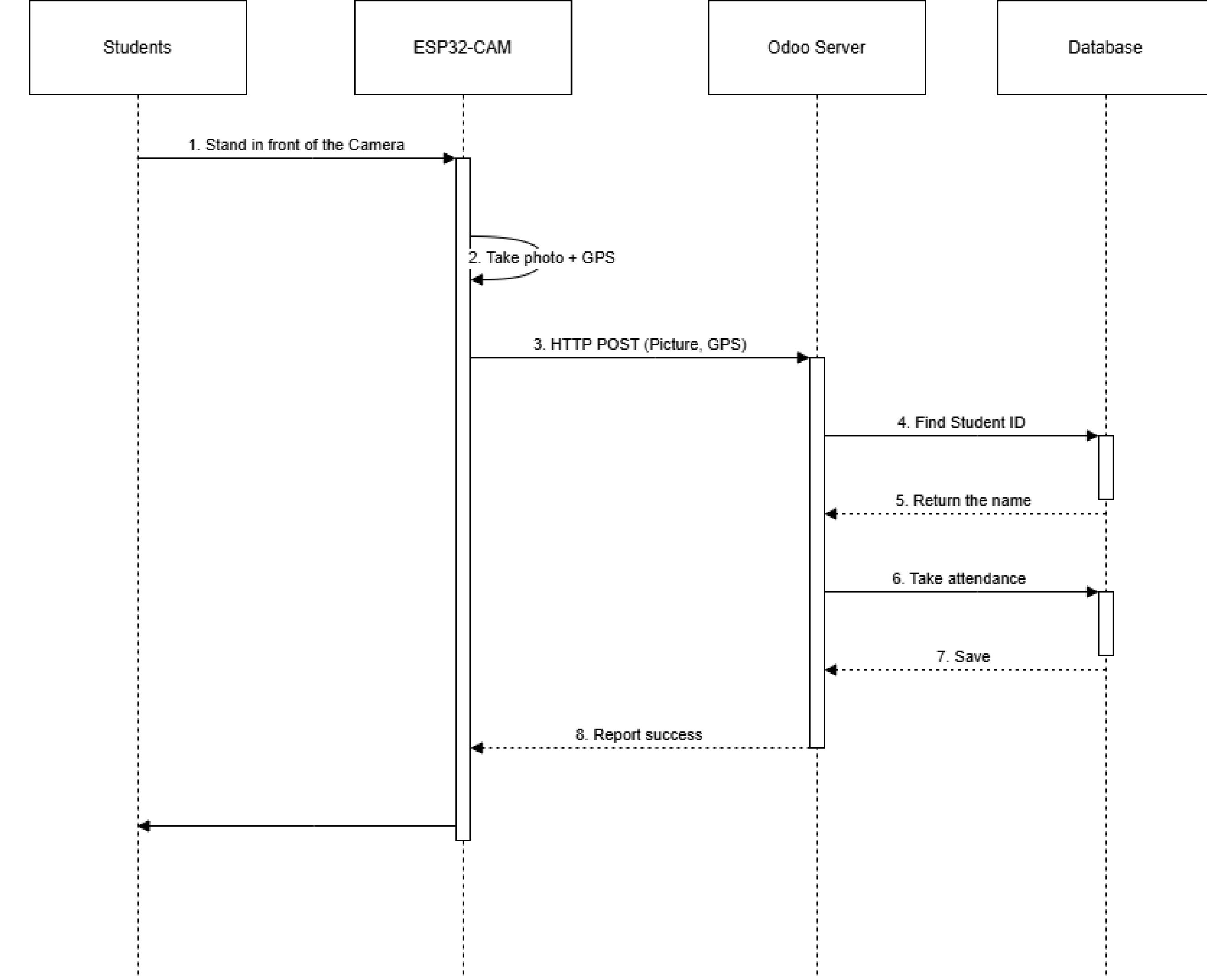
- **URL:** /school_transport/api/checkin
- **Method:** POST
- **Auth:** public
- **Type:** http
- **CSRF:** Disabled (csrf=False)
- **Description:** Endpoint for IoT devices (e.g., RFID readers on buses) to send check-in/out events.
- **Payload:**

```
{  
    "card_id": "UID_STRING",  
    "gps_lat": 16.0544,  
    "gps_lon": 108.2022,  
    "timestamp": "YYYY-MM-DD HH:MM:SS"  
}
```

- **Response:**

```
{  
    "status": "success" | "error" | "denied",  
    "message": "Description of result",  
    "student_name": "Name" (if success),  
    "student_id": 123 (if success)  
}
```

SEQUENCE DIAGRAM

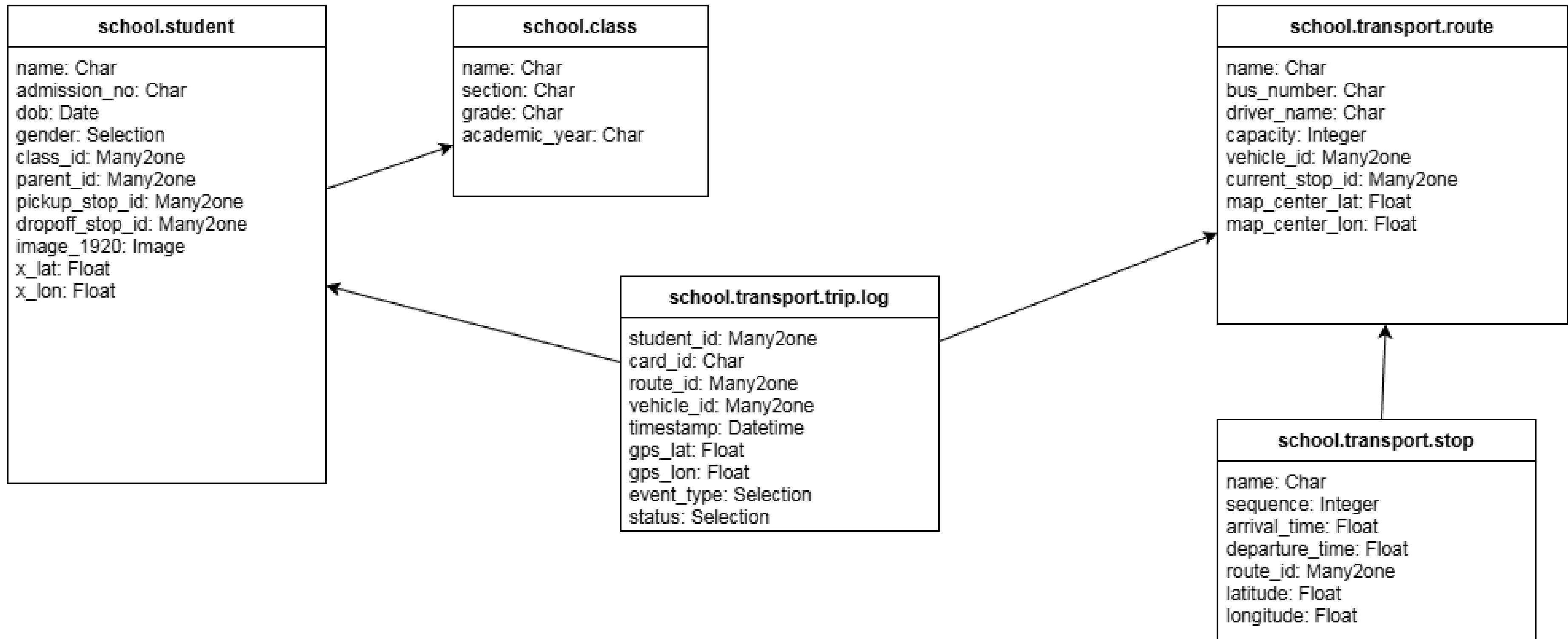


SOFTWARE IMPLEMENTATION



- Platform: Odoo ERP (Open Source).
- Custom Modules:
- school.transport: Fleet and route management.
- school.student: Student profiles and logs.
- Backend Logic: Python Controllers to handle API requests from IoT devices.

DATABASE STRUCTURE



FUNCTIONAL GAP ANALYSIS & CUSTOMIZATION STRATEGY

Business Requirements	Standard Odoo Modules	Our Custom Solution
School Bus Management	The standard fleet module only manages vehicles/drivers.	<p>Module: school_transport</p> <ul style="list-style-type: none">• Inherits fleet.vehicle model.• Adds logic for Route Geometry & Assigned Students.
IoT Attendance Check	It cannot process Image Data from IoT devices.	<p>Module: school_attendance_web</p> <ul style="list-style-type: none">• Custom Controller to receive POST API from ESP32.• Stores "Evidence Image" & GPS directly into student logs.
Real-time Tracking	Odoo has no built-in Live Map interface for moving assets.	<p>Map View Integration</p> <ul style="list-style-type: none">• Integrated Google Maps/OpenStreet into Odoo Form View.• Visualizes Bus Location & Stops via JSON Geometry.

USER AUTHORIZATION MATRIX

User Role	Access Level	Key Responsibilities & Permissions
Administrator	Full Access	<ul style="list-style-type: none">System configuration & Technical maintenance.Full access to backend code and database.Manage all user accounts.
Users	Restricted Interaction	<ul style="list-style-type: none">NFC Authentication: Authenticate identity via NFC card swiping.Trigger IoT Events: Automatically generate logs for Check-in/Check-out status.Data Transmission: Send real-time metadata (Name, Student ID, Timestamp, GPS Location) to server.View-Only: View personal attendance history (via Portal/App).

New Transport Routes

Search...

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<input type="checkbox"/>	Route Name	Bus Number	Driver Name	Seating ...	Distance (km)	Assigned Students
<input type="checkbox"/>	City Center Loop	DN-01	Nguyen Van A	45	6.88	Nguyễn Đạt Trần Châu Huy Lê Tự Bảo Khánh Lê Công Thành Khoa Dương Uy Lực Trần Hoàng Minh Nguyễn Đình Sáng Ngô Thanh Thảo Trần Hoài Nhã Thi Trần Phước Diển Lê Quốc Duy
<input type="checkbox"/>	Beach Route	DN-02	Tran Thi B	40	19.61	Trần Hoàng Minh Nguyễn Minh Hoàng Nguyễn Văn Huy Hoàng Đặng Phương Huy Nguyễn Thị Tâm Võ Văn Bưu Trần Vũ Đạt Lê Văn Đức Bùi Quang Minh Trần Đặng Khánh Nam Trần Văn Thanh Nhật
<input type="checkbox"/>	University Route	DN-03	Le Van C	50	17.61	Nguyễn Thành Minh Huỳnh Quang Nhật Đặng Minh Quân Lương Như Quỳnh Phan Nguyễn Anh Tài Nguyễn Ngọc Quang Thắng Nguyễn Thành Phúc Trần Vũ Hồng Phúc Nguyễn Quang Thạc
<input type="checkbox"/>	Son Tra Peninsula Route	DN-04	Pham Thi D	35	15.10	Lê Đình Bảo Tín Đặng Tuân Anh Nguyễn Đức Hưng Phan Đình Khanh Nguyễn Việt Anh Quân Phạm Văn Tiên Trần Minh Anh Phan Bá Nguyễn Bảo Phan Dương Gia Bảo Trần Đình Bảo
<input type="checkbox"/>	DUT Route	DN-05	Nguyen Van E	45	13.30	Hoàng Tiến Đạt Nguyễn Đình Tiến Đạt Phạm Tiến Đạt Phạm Anh Hào Trần Ngọc Hiệp Phùng Đỗ Anh Khoa Lê Quang Kiệt Võ Tuấn Kiệt Đặng Văn Minh Hoàng Thị Tuyết My Trần Nguyễn Hoài Nam
<input type="checkbox"/>	Hoa Khanh Market Route	DN-06	Tran Van F	40	0.41	Nguyễn Đạt Trần Châu Huy Lê Tự Bảo Khánh
<input type="checkbox"/>	Airport Route	DN-07	Le Thi G	35	0.62	Lê Công Thành Khoa Dương Uy Lực Trần Hoàng Minh
<input type="checkbox"/>	Thuan Phuoc Bridge Route	DN-08	Pham Van H	45	0.26	Nguyễn Đình Sáng Ngô Thanh Thảo Trần Hoài Nhã Thi
<input type="checkbox"/>	Cham Museum Route	DN-09	Nguyen Thi I	30	0.27	Trần Phước Diển Lê Quốc Duy Trần Đặng Khánh Nam
<input type="checkbox"/>	Love Bridge Route	DN-10	Tran Van K	40	0.26	Trần Văn Thanh Nhật Nguyễn Thành Phúc Trần Vũ Hồng Phúc
<input type="checkbox"/>	APEC Park Route	DN-11	Le Van L	35	0.28	Nguyễn Quang Thạc Trương Ngọc Thắng Trần Chí Thành
<input type="checkbox"/>	Con Market Route	DN-12	Pham Thi M	50	0.27	Lê Đình Bảo Tín Đặng Tuân Anh Nguyễn Đức Hưng
<input type="checkbox"/>	Helio Center Route	DN-13	Nguyen Van N	45	0.28	Phan Đình Khanh Nguyễn Việt Anh Quân Phạm Văn Tiên
<input type="checkbox"/>	Mikazuki Resort Route	DN-14	Tran Thi O	40	0.26	Trần Minh Anh Phan Bá Nguyễn Bảo Phan Dương Gia Bảo
<input type="checkbox"/>	FPT City Route	DN-15	Le Van P	55	0.30	Trần Đình Bảo Phạm Minh Chiến Hoàng Tiến Đạt



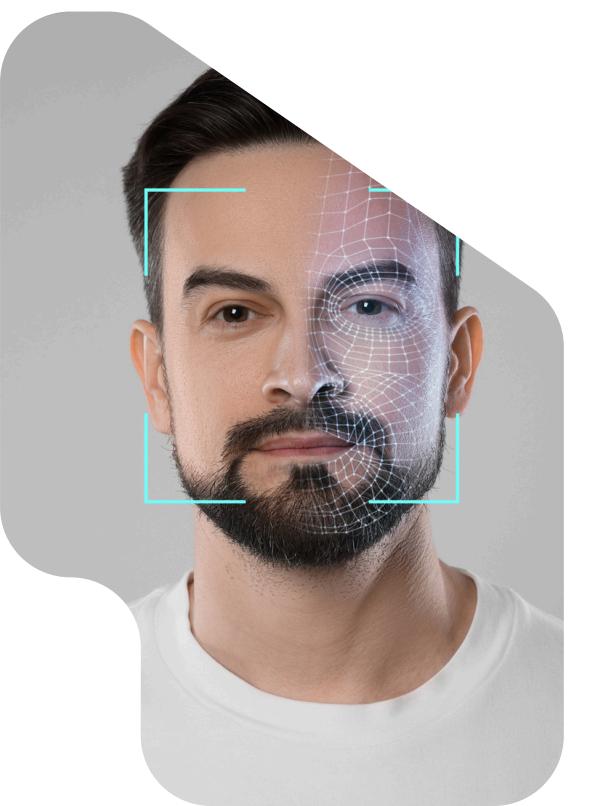
School Bus Routes

Route Name	Bus Number	Driver Name	Capacity	Next Stop	Activity (In/Out)	Passengers Onboard	Map
City Center Loop	DN-01	Nguyen Van A	45	Han Market	+0 -0	0	<button>View Map</button>
Beach Route	DN-02	Tran Thi B	40	Danang Railway Station	+0 -0	0	<button>View Map</button>
University Route	DN-03	Le Van C	50	Danang University	+0 -0	0	<button>View Map</button>
Son Tra Peninsula Route	DN-04	Pham Thi D	35	Linh Ung Pagoda	+0 -0	0	<button>View Map</button>
DUT Route	DN-05	Nguyen Van E	45	Trường Đại học Bách Khoa - Đại học Đà Nẵng	+0 -0	0	<button>View Map</button>
Hoa Khanh Market Route	DN-06	Tran Van F	40	Hoa Khanh Market	+3 -0	0	<button>View Map</button>
Airport Route	DN-07	Le Thi G	35	Danang International Airport	+3 -0	0	<button>View Map</button>
Thuan Phuoc Bridge Route	DN-08	Pham Van H	45	Thuan Phuoc Bridge	+3 -0	0	<button>View Map</button>
Cham Museum Route	DN-09	Nguyen Thi I	30	Cham Museum	+0 -0	0	<button>View Map</button>

TESTING



- **Feature:** Visual Attendance Log.
- **Outcome:**
 - Successfully captures and uploads photos to the Odoo Server.
 - Automatically records Check-in / Check-out timestamps.
 - Data is linked directly to the specific student profile.



Mark Attendance

Student Code

Submit

Today's Attendance

Time	Student Name	Status
10:35:05	Lương Như Quỳnh	Pick Up
10:34:27	Lương Như Quỳnh	Pick Up
10:32:26	Lương Như Quỳnh	Pick Up
08:49:35	Lương Như Quỳnh	Pick Up
08:13:20	Trần Hoàng Minh	Pick Up
08:10:07	Nguyễn Thị Tâm	Pick Up
07:58:26	Nguyễn Thị Tâm	Pick Up
18:09:56	Nguyễn Thị Tâm	Pick Up
18:05:48	Lương Như Quỳnh	Pick Up
18:04:42	Nguyễn Thị Tâm	Pick Up

Attendance History  Search...

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<input type="checkbox"/>	Timestamp	Student	Status	GPS Coordinates
	12/01/2025 16:35:05	Lương Như Quỳnh	<button>Pick Up</button>	16.040178, 108.258377
	12/01/2025 16:34:27	Lương Như Quỳnh	<button>Pick Up</button>	16.053759, 108.205101
	12/01/2025 16:32:26	Lương Như Quỳnh	<button>Pick Up</button>	16.057421, 108.215065
	12/01/2025 14:49:35	Lương Như Quỳnh	<button>Pick Up</button>	Web Interface
	12/01/2025 14:13:20	Trần Hoàng Minh	<button>Pick Up</button>	10.762622, 106.660172
	12/01/2025 14:10:07	Nguyễn Thị Tâm	<button>Pick Up</button>	10.762622, 106.660172
	12/01/2025 13:58:26	Nguyễn Thị Tâm	<button>Pick Up</button>	10.762622, 106.660172
	12/01/2025 00:09:56	Nguyễn Thị Tâm	<button>Pick Up</button>	Web Interface
	12/01/2025 00:05:48	Lương Như Quỳnh	<button>Pick Up</button>	Web Interface
	12/01/2025 00:04:42	Nguyễn Thị Tâm	<button>Pick Up</button>	Web Interface
	11/30/2025 23:40:53	Nguyễn Thị Tâm	<button>Pick Up</button>	Web Interface
	11/30/2025 23:38:17	Lương Như Quỳnh	<button>Pick Up</button>	Web Interface
	11/30/2025 23:31:12	Nguyễn Thị Tâm	<button>Pick Up</button>	Web Interface
	11/30/2025 23:31:07	Nguyễn Thị Tâm	<button>Pick Up</button>	Web Interface
	11/30/2025 23:30:14	Lương Như Quỳnh	<button>Pick Up</button>	Web Interface
	11/30/2025 23:29:13	Nguyễn Thị Tâm	<button>Pick Up</button>	Web Interface
	11/30/2025 23:25:29	Nguyễn Thị Tâm	<button>Pick Up</button>	Web Interface
	11/30/2025 23:25:20	Trần Hoàng Minh	<button>Pick Up</button>	Web Interface
	11/30/2025 23:15:23	Trần Hoàng Minh	<button>Pick Up</button>	Web Interface
	11/30/2025 23:15:15	Nguyễn Đình Sáng	<button>Pick Up</button>	Web Interface

New Attendance History
transport.log,82 

Student Lương Như Quỳnh

Student Code 123210101

Vehicle Plate DN-01

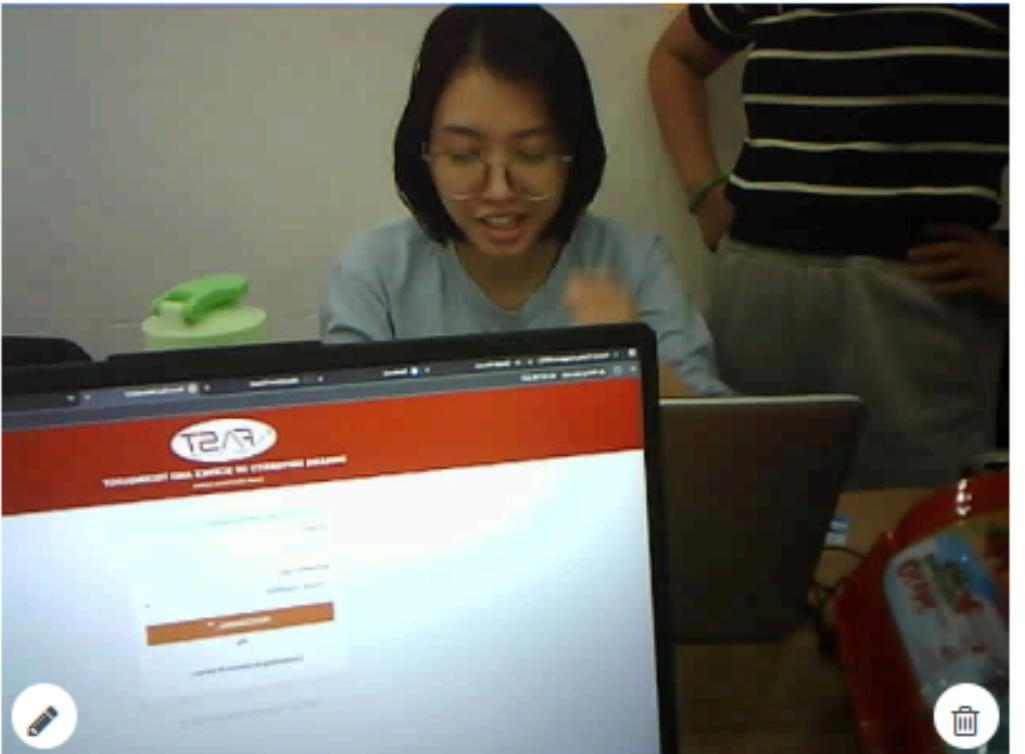
Timestamp 12/01/2025 16:34:27

Status Pick Up

GPS Coordinates 16.053759, 108.205101

EVIDENCE

Evidence Image



SYSTEM EVALUATION: SUBJECTIVE

Test Scenario	Expected Outcome	Result	Status
Identity Check	RFID retrieves correct Student Profile.	Accurate (ID: 123210091)	<input checked="" type="checkbox"/> Pass
Visual Log	ESP32 captures & uploads image via HTTP.	Success (Stored in DB)	<input checked="" type="checkbox"/> Pass
GPS Tracking	Coordinates attached to attendance log.	Precise virtual (Lat/Lon recorded)	<input checked="" type="checkbox"/> Pass
Live Map	Bus location updates on Odoo Map View.	Real-time Visualization	<input checked="" type="checkbox"/> Pass

Conclusion: The system successfully digitizes the manual check-in process.

SYSTEM EVALUATION: OBJECTIVE

Student Trương Phước Thịnh

Student Code 123210126

Vehicle Plate BUS-29A-9999

Timestamp 11/30/2025 15:30:04

Status Pick Up

GPS Coordinates 10.762622, 106.660172

EVIDENCE

Evidence Image



PERFORMANCE ANALYSIS & LIMITATIONS

- **Performance Metrics**

- Data Latency: **Average 2-3 seconds** (from Capture to Server Display).
- Synchronization: 100% Timestamp accuracy matches Server Time.
- Stability: Stable operation under standard 4G/Wi-Fi conditions.

- **System Limitations**

- Network Dependency: Data transmission delays occur in weak signal areas.
- Low-Light Performance: Image quality decreases significantly during evening drop-offs.

CONCLUSION

CONCLUSION & FUTURE WORK

- **Achievements:**
 - Successful integration of IoT Hardware and Odoo Web Server.
 - Stable operation of core features (Tracking & Imaging).
- **Limitations:**
 - Dependent on 4G/Wi-Fi signal strength.
 - Image quality decreases in low-light conditions.
- **Future Enhancements:**
 - Offline Data Buffering: Implement local storage (Store-and-Forward) to prevent data loss during network instability.
 - Image Quality Improvement: Integrate IR sensors or apply image processing algorithms for better low-light visibility.
 - System Optimization: Deploy Edge AI for local processing and optimize power management for extended battery life.

DEMO





DANANG UNIVERSITY OF SCIENCE AND TECHNOLOGY

Smart Attendance System

Student ID auto-filled from device memory.

Student ID:

123210091

Attendance Type:

Pickup (Boarding)

CONFIRM & CAPTURE

Attendance Logged Successfully!

© 2025 Smart Transport System. Powered by DUT IoT Lab.



DANANG UNIVERSITY OF SCIENCE AND TECHNOLOGY

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Student ID auto-filled from device memory.

Student ID:

123210091

Attendance Type:

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CONFIRM & CAPTURE

Attendance Logged Successfully!

© 2025 Smart Transport System. Powered by DUT IoT Lab.

Beach Route

Bus Number DN-02

Total Distance (km) 19.61

Driver Name Tran Thi B

Assigned Vehicle

Seating Capacity 40

Assigned Students Trần Hoàng Minh X Nguyễn Minh Hoàng X Nguyễn Văn Huy Hoàng X Đặng Phương Huy X Nguyễn Thị Tâm X Võ Văn Bưu X Trần Vũ Đạt X Lê Văn Đức X Bùi Quang Minh X Trần Đăng Khánh Nam X
Trần Văn Thanh Nhật X

Current Stop

Passenger Info

Route Stops

Route Map

Route Geometry (JSON)

Interactive Route Map

This map shows all stops along the route. The route is displayed in the order of the sequence field.

Center: Lat: 16.04, Lon: 108.24

Route Information

- Bus Number:** DN-02
- Total Distance:** 19.61 km
- Number of Stops:** 5 recordsStops



THANK YOU

