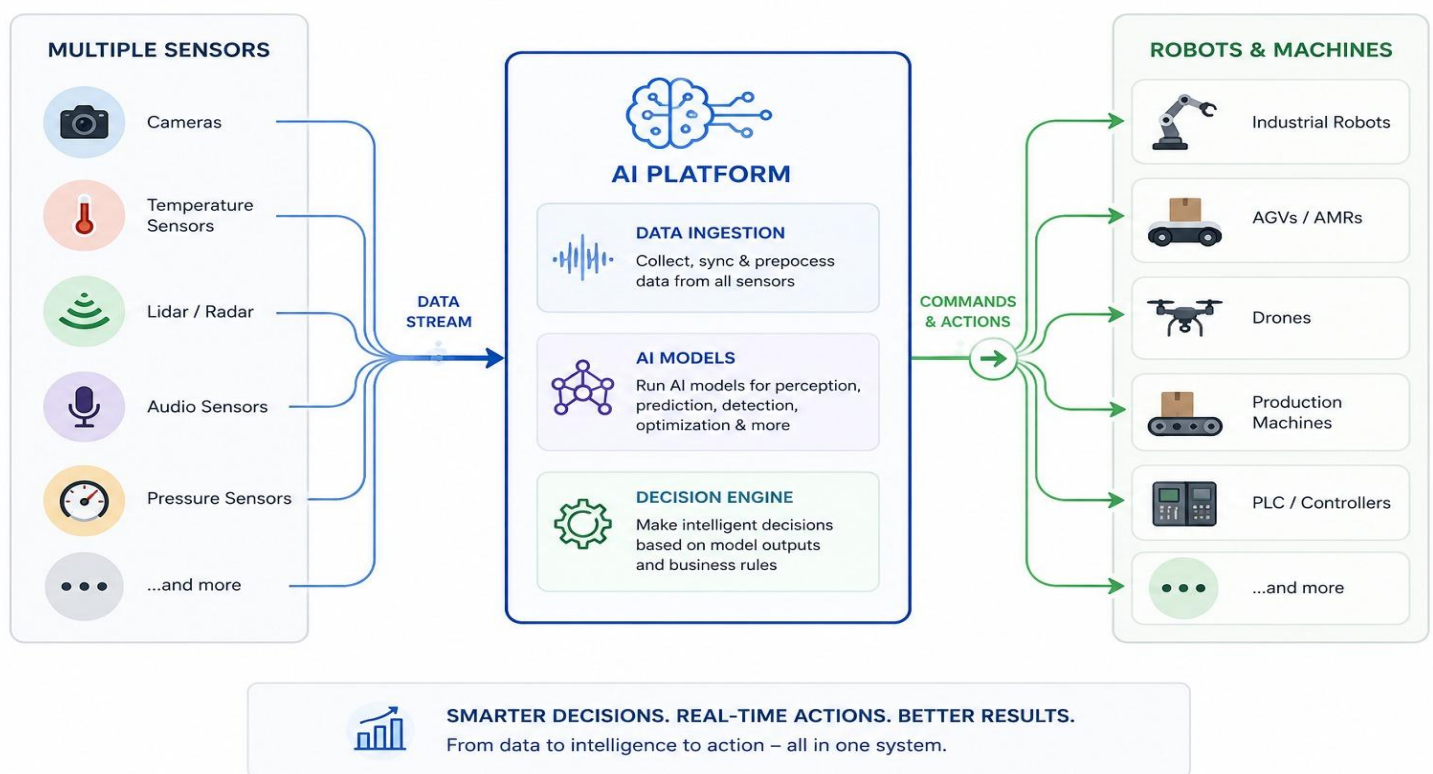


Project Specification: "UniSensor" Platform

Status: Operational Work Plan – "Living Lab" | Updated: May, 2026 | Location: Holon Institute of Technology (HIT)



1. System Overview & Vision

The "UniSensor" Platform is a generic and unified System of Systems that bridges the gap between real-time field data, AI-driven inference, and autonomous robotic execution. The platform serves as a centralized "Generic Brain," integrating environmental, acoustic, and visual sensor data to remotely control physical sub-systems across academic, urban, and agricultural environments.

2. Key Advantages

- **Unified Management:** Control over dozens of sensor types and sub-systems via a single management interface.
- **Proactivity:** Early detection of hazards (air pollution, heat islands, construction irregularities) before they impact public health or escalate into infrastructure failures.
- **Sustainability & Health:** Optimization of power and water resources while maintaining strict air quality standards and preventing environmental damage.
- **Scalability:** An architecture designed for rapid integration of new components without altering the core logic.

3. Research Methodology & Data Processing

The system operates as a Living Lab utilizing a Perception-Inference-Action framework:

- **Perception:** Normalization of sensor data, noise reduction (Kalman Filters), and extraction of visual features (Pose Estimation / LiDAR) and acoustic patterns.
- **Inference:** The AI agent performs Sensor Fusion, cross-referencing Digital Twin data with occupancy levels, air pollution markers (CO₂, NH₃, particulates), and radiation levels.
- **Action:** A decision-making engine that responds to environmental changes in real-time, prioritizing safety and health policies over routine optimizations.

4. UniSensor-Based Applications

- **Air Pollution Monitoring and Management:** The system continuously monitors pollutant concentrations (PM_{2.5}, PM₁₀, NO₂, NH₃) and identifies local "pollution clouds." In the event of an anomaly, the AI agent autonomously activates filtration systems, adjusts building ventilation regimes, and generates alerts to reroute urban traffic to reduce emissions.

- **Smart Agriculture - Precision Irrigation and Fertilization:** Utilizing soil volumetric water content (VWC), substrate temperature, electrical conductivity (EC), and pH sensors. The AI agent analyzes plant needs in real-time and autonomously operates targeted irrigation and fertilization systems, preventing resource waste and groundwater contamination.
- **EcoVision AI:** Real-time remote monitoring and identification of plant diseases and pests across vast areas. The project integrates AI and Computer Vision with climate data cross-referencing (temperature and humidity) from the central system to provide accurate diagnostics, hazard alerts, reduction in pesticide use, and proactive maintenance.
- **Smart Health - "Biological Flow Meter":** Designed to resolve quantitative uncertainty in direct breastfeeding. The mechanism is based on a combination of physical flow sensors and real-time data processing algorithms to monitor and accurately measure the volume of milk expressed.
- **Construction Irregularity Detection:** An AI-based system that compares planning models against field data to identify structural changes, illegal construction, or hazardous buildings. Through visual analysis of drone imagery and Point Clouds, the system automatically detects illegal additions, changes to building envelopes, or the placement of temporary structures without permits, generating oversight alerts that include precise locations and visual documentation.
- **Micro-climate and Dynamic Shading:** Identification of "urban heat islands" and activation of shading systems (louvers, awnings) to reduce heat loads and save energy. This is based on temperature and humidity sensors that detect abnormal heat accumulation, radiation sensors, and thermal cameras that scan the area to generate real-time "heat maps."
- **Dynamic Shading:** A smart control system for motorized umbrellas in public spaces. Serving as the operational arm of UniSensor, the system makes real-time decisions regarding the opening, closing, rotation, and tilt of the umbrella. The system responds to changes in the sun's path, wind intensity, and human presence to ensure maximum shaded area with minimum mechanical risk.
- **Smart Autonomous Crosswalk:** An active system based on sensors and detectors utilizing cameras and Artificial Intelligence (AI). Designed specifically for un-signalized crosswalks, the system automatically detects pedestrians and activates visual and auditory alerts to enhance pedestrian safety.

- **Smart Transportation:**
 - **Traffic Light Optimization:** Development of an AI agent for decision-making regarding "green light" duration based on dynamic traffic loads rather than fixed timing.
 - **Real-Time Object Detection and Classification:** Implementation of Computer Vision algorithms to analyze video streams from intersections for the automatic prioritization and classification of vehicles (private cars, public transport, emergency vehicles) in each lane.
- **Smart Energy (Agrivoltaics):** An autonomous system for the intelligent integration of agriculture and electricity generation across large areas. Solar panels are mounted on motorized robotic structures managed by sensors that track the sun's path. This creates a dynamic system that maximizes dual benefits: commercial power generation through solar tracking and optimized shading for crops.
- **Full Bin Detection:** A system based on ultrasonic volume sensors installed within existing waste containers. The sensors transmit fill levels to a central control unit, which automatically generates maps for dynamic and optimal waste collection routes, focusing exclusively on full bins.
- **Epidemiological Wastewater Surveillance:** Biochemical sensors and automated samplers installed at urban sewage junctions to analyze real-time data for traces of viruses (such as COVID-19 or Polio) or residues of drugs and medications. The system provides an "early warning" of disease outbreaks in specific neighborhoods before symptoms manifest in the population, enabling targeted healthcare responses.
- **OmniCare AI:** A multi-sensory hybrid system (Vision, Audio & IoT) integrating computer vision, real-time acoustic analysis, and wearable sensors. The system utilizes Sensor Fusion to ensure maximum accuracy in detecting falls and distress situations, while providing two-way voice communication, specifically designed for the elderly population.
- **Violence Detection in Public Spaces:** A hybrid monitoring system for the autonomous detection of unusual events, combining Computer Vision and AI models for violence and weapon detection with Audio Analysis to identify shouting, verbal aggression, and vocal anomalies. The system performs Sensor Fusion between video and audio channels to verify assaults in real-time, reduce false alarms, and send immediate, context-based reports to municipal dispatch to improve public security.

-
- **EcoPulse LoRa – Portable Meteorological Station:** A portable, IoT-based meteorological station designed to optimize irrigation and monitor micro-climates. It integrates high-resolution sensors (ESP32/MicroPython) to measure temperature, humidity, and barometric pressure. The system utilizes LoRa technology for long-range, low-power data transmission, processing environmental metrics via a Python-based backend and an interactive dashboard to calculate precise evapotranspiration rates. By analyzing the correlation between shading levels and local climate fluctuations, the project provides a data-driven model for sustainable water management and advanced agricultural research.

Integrated Sub-Systems (Powered by UniSensor):

- **Smart-Farming:** Monitors soil/weather data to remotely control agricultural machines. *A live operational trial will be conducted in the campus "Tribuna yard".*
- **Smart Building & Campus:** Monitors human presence and air quality to optimize energy consumption.
- **Smart-City:** Manages urban infrastructure, including remote shelter locking, smart bin capacity detection, and an **Autonomous Smart Crosswalk** system powered by Edge AI and Computer Vision to enhance pedestrian safety.

5. Strategic Research Questions

- **Predictive Health:** Can the AI predict "pollution outbreaks" or structural infrastructure failures weeks in advance to alert at-risk populations?
- **Autonomous Efficiency:** How does the system balance the reduction of carbon emissions with the maximization of indoor air quality and occupant well-being?
- **Safety Engineering:** How does multi-modal monitoring shorten response times to critical safety events?

Expected Research Questions per Sub-Project:

- **Smart-Farming:** How can real-time soil and microclimate data optimize automated irrigation and shading to maximize crop yield while minimizing water consumption?
- **Full-Bin-Detection (Smart-City):** To what extent can AI-driven waste level monitoring reduce municipal collection costs and minimize the city's carbon footprint?
- **Shelter Locking (Smart-City):** How does centralized remote control of emergency infrastructures improve municipal response times during security events?
- **Smart Building & Campus:** What is the correlation between human presence, CO2 levels, and energy consumption, and how can predictive AI models optimize HVAC operations?
- **Smart Education Cloud Platforms:** How does integrating real-world campus IoT data into virtual labs impact student engagement and applied research capabilities?
- **Autonomous Smart Crosswalk:** How effectively can Edge AI and computer vision predict pedestrian intent, and what is its measurable impact on reducing near-miss incidents at un-signalized crosswalks?

6. Roadmap (2026)

- **April – June:** Full installation of the environmental health, air quality (CO2), and structural sensor network.
- **August:** Completion of AI model training for construction anomaly detection, pollution patterns, and the intelligent agent.
- **September:** Final deployment of shading systems, enforcement mechanisms, and autonomous robots.

7. Executive Summary & Stakeholder Synergy

The UniSensor platform is not merely a technological monitoring tool, but an Operating System for physical space. The project creates a synergistic ecosystem that provides unique value to its target audiences:

- **Students:** Gain hands-on experience with real-time data in a "Living Lab" environment. The platform allows them to develop capstone projects and ventures in AI, robotics, Digital Twins, and environmental engineering, while engaging in applied learning of life-saving and health-preserving technologies.

8. Integrated Project Management and Control Platform

The program operates through an advanced management ecosystem utilizing industry-standard development and control tools (such as GitHub) and Agile methodologies. The platform enables full oversight of approximately 250 students annually via real-time progress monitoring, data-driven evaluation for program optimization, and a feedback system for academic staff and industry mentors. Additionally, it features a dedicated infrastructure for tracking alumni career placement as a key performance indicator (KPI) of the program's success.

RESPONSIBILITIES

Aharon: Project Supervisor & Director of Innovation

Eliel: Project Manager, Server, Translator, Client Database, Basic Anomaly Detection.

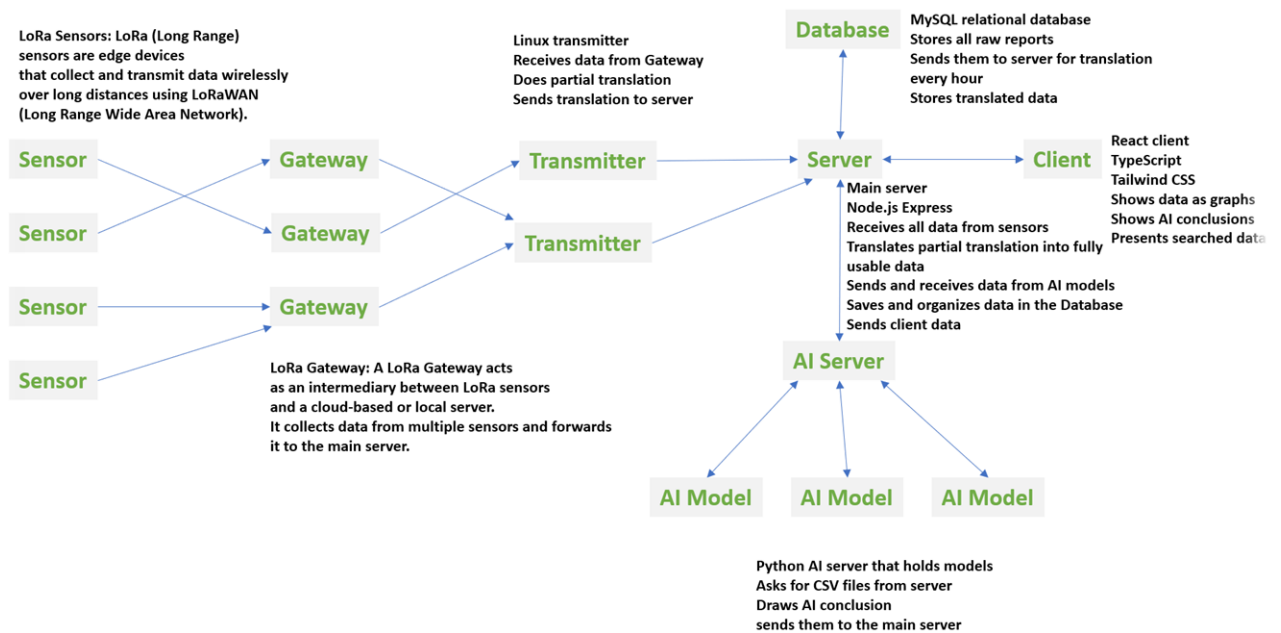
Shiran: Testing, Administration, User Management, Student Participation.

Dvir: Sensor Installments, Sensor Data Organizing, Data Reporting, Sensor Database management.

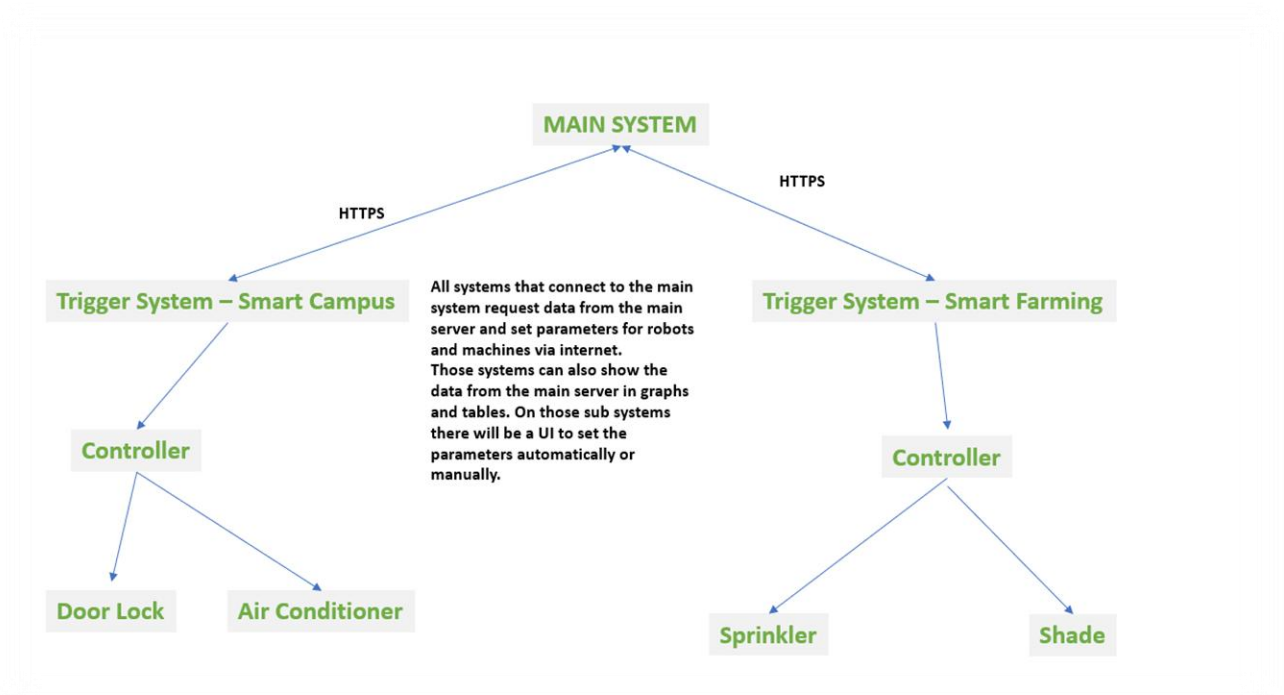
Maya and Shimon: Anomaly Detection, AI Models, AI server.

Flow

Main System:



Sub Systems:



Main Technologies

- LoRaWAN- Sensors and gateways
- Node.js- Server
- Python- Server
- Python- AI and Machine learning
- MySQL- relational database
- React- Frontend

Updated System Architecture (Based on Smart Campus Generic Architecture)

To ensure seamless operation across all sub-systems, the UniSensor platform utilizes a comprehensive architecture:

Platform services are designed to be:

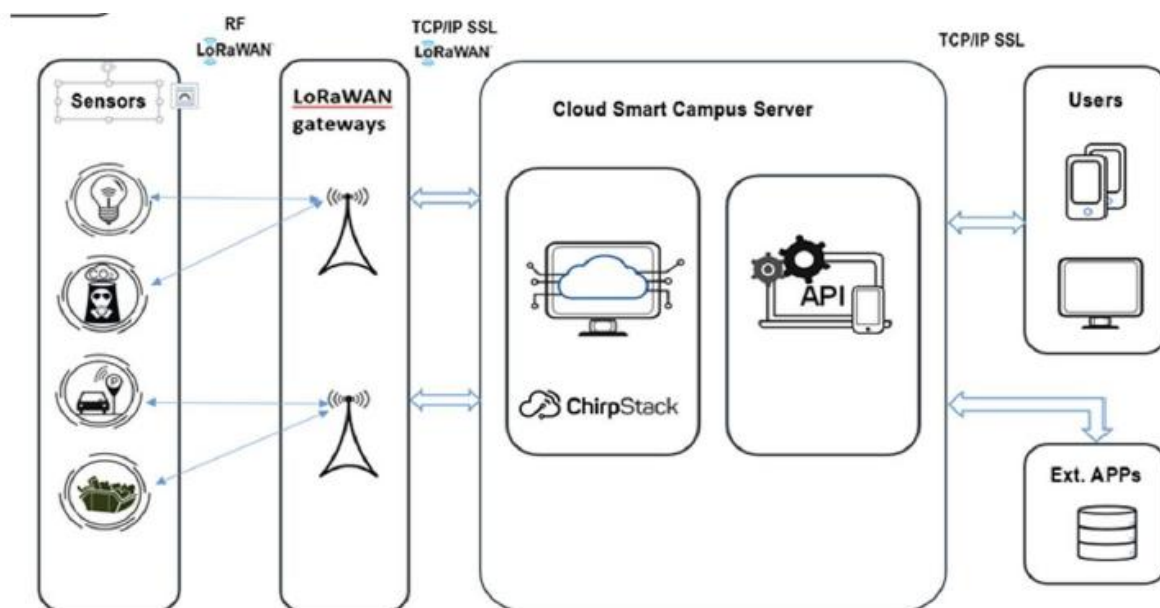
- **Scalable:** Horizontally scalable platform, built using leading open-source technologies.
- **Fault-tolerant:** No single-point-of-failure, every node in the cluster is identical.
- **Robust and efficient:** A single server node can handle tens or even hundreds of thousands of devices depending on the use-case. The platform cluster can handle millions of devices.
- **Durable:** Never lose your data. The platform supports various queue implementations to provide extremely high message durability.
- **Customizable:** Adding new functionality is easy with customizable widgets and rule engine nodes.

The diagram below shows key system components and the interfaces they provide. Let's walk through them.

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- **Devices & Sensors:** Connected via LoRaWAN and other IoT protocols (HTTP, MQTT, CoAP, SNMP, LwM2M).
- **Gateways:** Utilizing the **ChirpStack** open-source LoRaWAN Network Server, which supports Modbus, OPC-UA, and forwards data efficiently via MQTT.
- **Core System & Processing:** A self-developed Core and Rule Engine process the incoming data, linked through internal message queues (such as Kafka or RabbitMQ) to handle large data volumes.
- **Databases:** Data is stored using a relational database (PostgreSQL/MySQL) for structured sensor logs, alongside NoSQL databases for unstructured data handling.
- **Frontend & Integrations:** A self-developed UI (built with React) displays the live data, while REST APIs and WebSockets allow integrations with external systems and mobile apps.

UNISENSOR – CAMPUS LIVING LAB

1. VISION AND SYSTEM OBJECTIVES

Project UNISENSOR introduces a pioneering paradigm for a Smart Academic Campus, managed as an autonomous, secure, and dynamic Living Lab. The system seamlessly fuses a campus-wide hybrid, distributed, and hardened IoT network with three independent robotic complexes. This infrastructure entirely eliminates the need for human intervention in day-to-day operations, delivers open real-time data streams for academic research, and maximizes resource optimization alongside public health safety.

The system orchestrates and synchronizes 3 Living Lab Verticals:

Smart Micro-Agriculture: Automated, precision irrigation and fertigation management for 10 independent growing containers and a complex vertical herb wall.

Student Wellbeing and Sustainability: Micro-climate and UV radiation mitigation in public campus spaces, driven by the real-time meteorological triggering of 4 distinct mechanical shading systems.

Campus Environmental Monitoring and Safety: Continuous, real-time tracking of air quality, particulate matter (PM2.5/PM10), and toxic gases to proactively safeguard public health. The operational core relies on a Mobile Meteorological and Air Quality Monitoring Station that dynamically maps environmental metrics at variable campus hotspots.

2. ROBOTIC COMPLEXES AND FIELD ACTUATORS

The field architecture relies on three distinct robotic complexes, managed by dual-core ESP32-S3 microcontrollers running under the FreeRTOS real-time operating system to ensure deterministic multitasking and industrial-grade stability:

Node 1-Smart Agrorobot: Regulates hydraulic pressure and dispenses nutrients based on real-time soil moisture and evapotranspiration demands across 10 containers and a 3-tier vertical herb wall (High, Mid, Low). Actuation is executed via 12V DC Latch Solenoid Valves, which require only a 50ms electric pulse to toggle states, preventing continuous power draw and enabling reliable solar-assisted battery operation.

Node 2-Dynamic Shading Robot: Simultaneously controls four distinct mechanical shading solutions tailored to specific campus architectural spaces:

Vertical Herb Wall Louvers: Motorized aluminum slats with dynamic tilt control to block peak solar radiation while allowing optimal light penetration for photosynthesis
Lawn Retractable Tension Sails: Large-scale sails deployed over open seating lawns, driven by heavy-duty steel cables and industrial winches equipped with cable-tension diagnostics.

Cafeteria Articulated Awning: A structural folding awning that extends outward to dynamically expand shaded student gathering spaces during peak heat loads.

Cafeteria Dynamic Mesh Canopy: A horizontal solar mesh moving on fixed steel guide-rails to finely modulate micro-climate comfort.

Mechanical Self-Protection: Upon receiving a critical wind speed alert (greater than 40 km/h) from the meteorological station, the shading robot triggers an immediate, safety-critical High-Wind Emergency Override, retracting all 4 structures to a secure "Home Position" within 20 seconds to prevent mechanical tearing or structural failure.

Node 3-Mobile Meteorological Station (Mobile Met-Bot): Acts as the environmental "brain" and primary Data Provider for the campus cross-automation engine. It integrates a laser-scattering particulate matter sensor (PM2.5/PM10) and a metal-oxide (MOX) multi-gas array inside an actively ventilated aspiration shield to eliminate stagnant air pockets. Wind metrics are gathered via a solid-state ultrasonic anemometer with zero moving parts to ensure maintenance-free outdoor survival. The unit is fitted with a GPS/GNSS receiver for automated GIS mapping updates upon field relocation and features built-in internal anti-condensation heating elements

3. HYDRAULIC INFRASTRUCTURE AND FERTIGATION LOOP

The hydraulic design is engineered to commercial water-delivery and pressure-compensated distribution standards:

Headworks and Main Line: Water intake features a 20mm Polyethylene (Class 10) primary supply pipe equipped with an approved Backflow Preventer (RPZ), a heavy-duty 120 Mesh disc filter, and a mechanical pressure regulator locked at 2.5 Bar. A smart proportional fertigation pump injects liquid NPK nutrients directly into the pressurized main stream at calibrated volumetric ratios.

Four-Zone Operational Manifold: The main 20mm line branches out through a manifold of latching solenoid valves into four independent 16mm blind distribution lines [10.4]: Zone 1 (Containers 1-5), Zone 2 (Containers 6-10), Zone 3 (Upper/Middle tiers of the vertical wall), and Zone 4 (Lower tier of the wall, managed with shorter run times to compensate for natural gravity drainage).

Internal Distribution and Pressure Compensation: Fluid delivery from the 16mm lines into the containers is executed via flexible 4/7mm micro-tubes [10.5]. Output is discharged through 4 pressure-compensating, anti-siphoning (PC/CN) button drippers per container (2 Liters/Hour each). The integrated CN check-valve mechanism hermetically seals the emitters when line pressure drops below 0.12 Bar, preventing line drainage and guaranteeing instant, uniform water and nutrient distribution across all zones simultaneously upon the next automated cycle.

4. HARDWARE ARCHITECTURE AND MAIN CONTROL CABINET (IP65/IP66)

The centralized control cabinet is engineered for rugged outdoor environments and organized on modular industrial DIN-rails:

Electrical Protections and Smart Metering: Features a 16A Class C main circuit breaker, a heavy-duty Type 2 Surge Protective Device (SPD) to isolate lighting/grid spikes, and an RS485 Modbus Smart kWh Meter for real-time telemetry of cabinet power draw [9.1]. Power is stepped down into isolated DC buses: 24V DC (10A) for actuators/motors, 12V DC (5A) for forced cabinet ventilation and active sensors, and 5V DC (5A) for the computing core .

Smart Uninterruptible Power Supply (Smart UPS): Incorporates a premium 24V 10Ah Lithium Iron Phosphate (LiFePO₄) battery pack managed by a smart DC-UPS charging controller. It ensures up to 4 hours of full operational runtime during grid blackouts and communicates instant power-loss alerts to the telemetry server.

Edge Gateway Compute Core: Driven by a fanless industrial embedded computer (IPC) with a ruggedized solid-state drive (SSD), operating on a hardened Linux Ubuntu Server distribution. The IPC hosts the local MQTT Broker and the event-driven rules engine, ensuring real-time control loop execution (Latency under 50ms) and total operational survivability even during a complete external internet failure. All output signal loops are protected via an opto-isolated relay array to shield the computing core from field feedback surges.

5. HYBRID COMMUNICATION NETWORK AND DATA ROUTING

To achieve robust campus coverage across indoor, outdoor, and remote zones, the network layout leverages three concurrent communication protocols:

Lora WAN: Utilizes an industrial 8-channel gateway card deployed at the main cabinet, communicating with a mast-mounted 5dBi Omni antenna . This long-range, low-power network secures wireless sensor tracking from remote growing containers at a radius of up to 2.5 km.

Wi-Fi 6 (WPA3-Enterprise): Provides a high-bandwidth, low-latency wireless fabric for the shading complexes and the mobile Met-Bot located near campus structures. All IoT network traffic is rigidly partitioned inside a dedicated virtual network layer (VLAN 30- IoT Isolated), completely cut off from the public campus student network .

Cellular 4G LTE/5G: A dual-SIM industrial cellular router provides secondary WAN backhaul. In the event of a campus fiber grid failure, the system automatically redirects telemetry streams through a secure encrypted VPN tunnel directly to the cloud dashboard.

6. EXTERNAL ALERTING SYSTEM

To maximize public safety and asset protection, the edge server runs an active multi-channel alert dispatch engine operating independently of the local web dashboard:

Multi-Channel Dispatch: Next-generation alerting utilizes programmatic Webhooks, SMS gateways, and secure Telegram API relays to push mission-critical notifications.

Severity Escalation Architecture (SLA Matrix):

Warning Level (Maintenance Required): Battery drops below 20%, low fertilizer levels, or minor network jitter are routed exclusively to the maintenance team's Telegram logging channel.

Critical Emergency Level (Immediate Threat): Toxic gas spikes detected by the Met-Bot, structural failures, or a shading motor stall during high-wind override bypass standard queues, dispatching flash SMS alerts directly to the mobile devices of campus security, operations managers, and safety officers.

Alert Debouncing and Anti-Fatigue Filters: Features an algorithmic deadband lock. Triggering a critical threshold fires an initial alert and suppresses identical sequential logs for 15 minutes, ensuring administrators are not flooded with redundant messages during an active incident unless risk levels escalate sharply.

7. COMMAND AND CONTROL DASHBOARD & PEDAGOGICAL TRACKS

The centralized management system (React.js & Grafana WebApp) serves as the unified command platform for the project, delivering real-time telemetry updates for both facilities operations teams and Living Lab researchers:

GIS Campus View (Map-Based Synoptic Layout): A dynamic vector map displaying the precise geographic location of the eight robotic complexes. The system automatically updates the position of the mobile meteorological station via its embedded GNSS module and generates a real-time Air Quality Index (AQI) heatmap overlay of its surroundings.

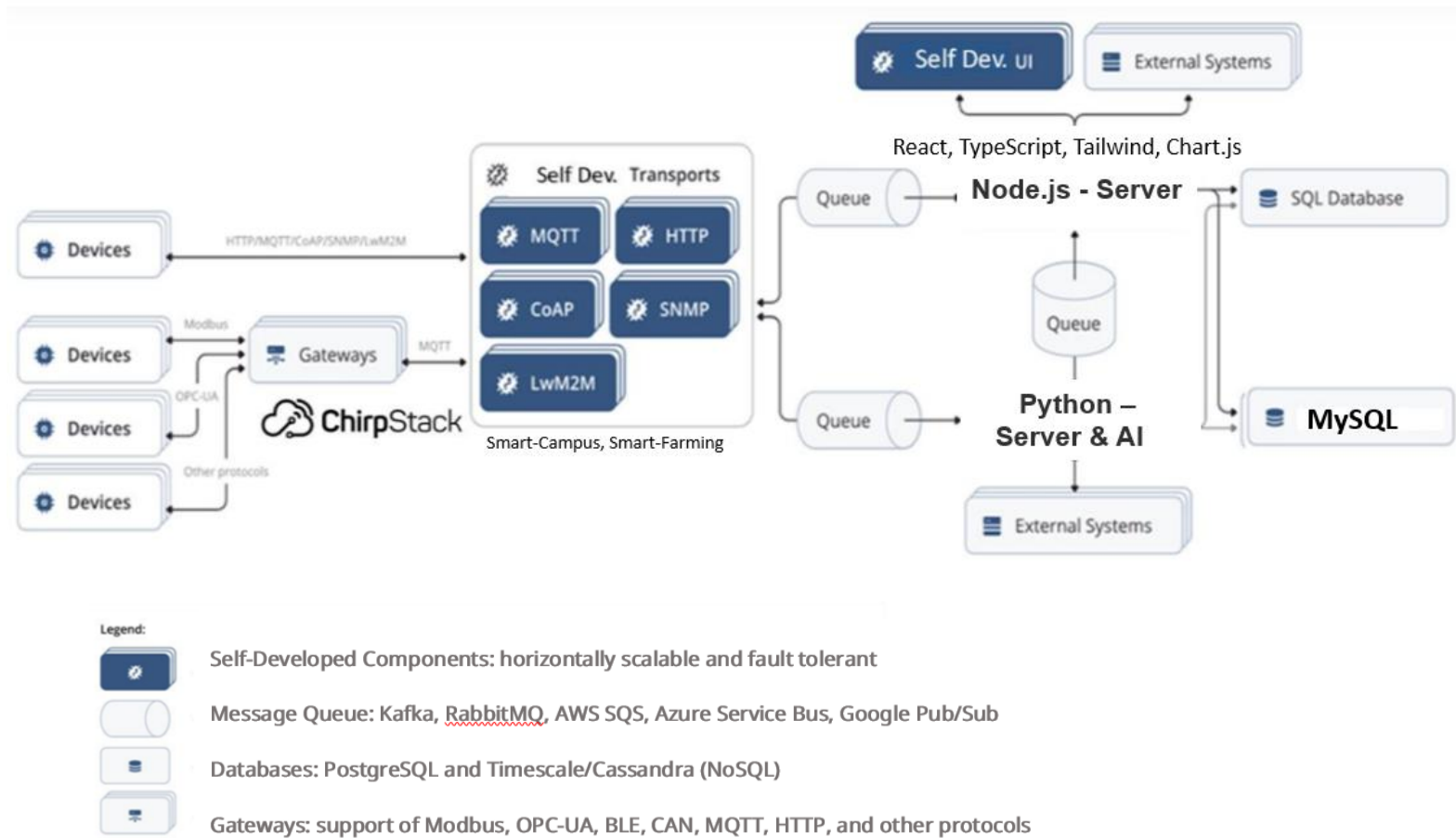
Agro Panel (Hydraulic Management Matrix): Displays soil moisture percentages, electrical conductivity fertilization metrics, and root temperatures for the 10 growing containers and the vertical herb wall. This layer features real-time state animations of the latching solenoid valves and provides time-restricted manual override capabilities.

8. The engineering architecture is based on a strict partitioning between the main cabinet and the field environment:

the control cabinet houses a centralized cluster controller which acts as the system's "logical brain" hosting the local MQTT broker, the time-series database, and the event-driven rules engine, while each of the eight robotic complexes in the field is operated by an independent edge microcontroller (ESP32-S3) that is hardwired to the physical assets to sample sensors and actuate motor drives.

This distributed computing layout (Edge Computing) grants critical local survivability (Fail-Safe modes) to the system—in the event of a wireless disconnect or central gateway failure, the field microcontrollers do not crash but switch within milliseconds to an internal backup profile driven by FreeRTOS, operating the robots autonomously to protect the physical field hardware.

GENERIC ARCHITECTURE



Current UI of data monitoring system



24 hours report by day

1. Pick a Sensor

Found 8 sensors on the server:

a123
c123
b123
647fda0000009aca

647fda000000cace
647fda0000011736

647fda0000011741
647fda0000011733

Sensor Collection : PrototypeSensors

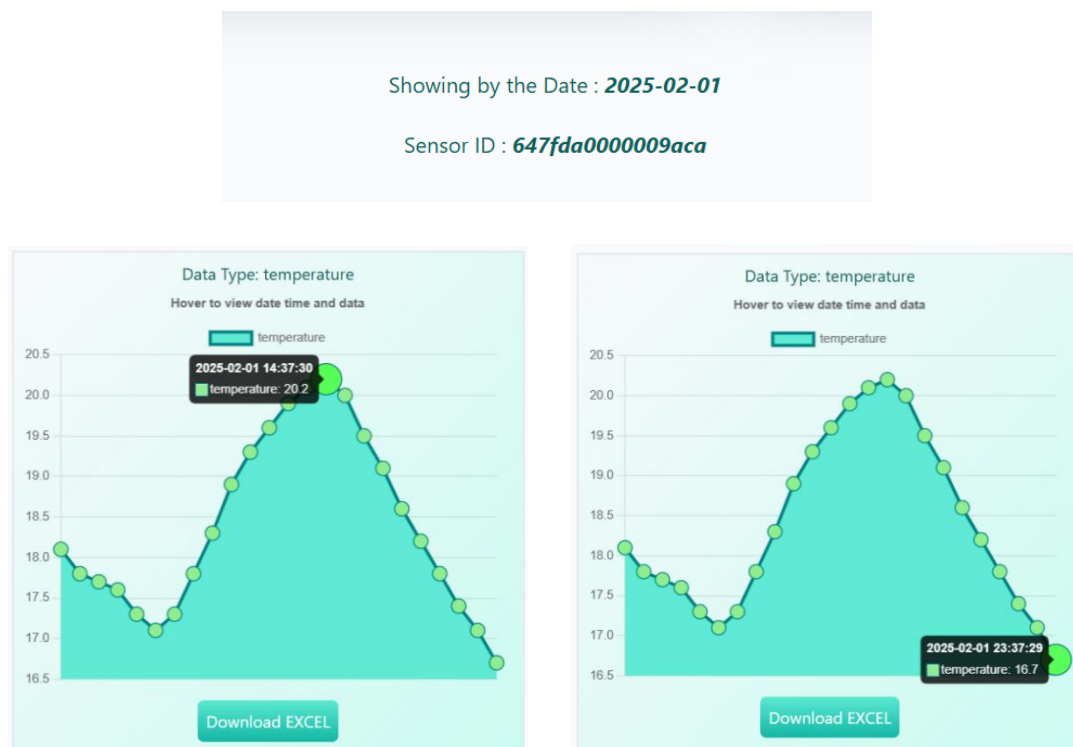
2. Display

Show Last 50

01/02/2025

Show By Date

Example: Minimum and Maximum Temperatures



Details

UNIQUE SENSORS

TEKTELIC COMFORT Smart Room Sensor Base

- +Temperature & Relative Humidity
- +Accelerometer
- +doors drawers cabinets
- +Light Detection
- +Magnetic Switch for doors
- +can check if a device is on or off (probably for computers)

TEKTELIC VIVID SMART ROOM SENSOR – PIR

- +reports motions (if something else moves)

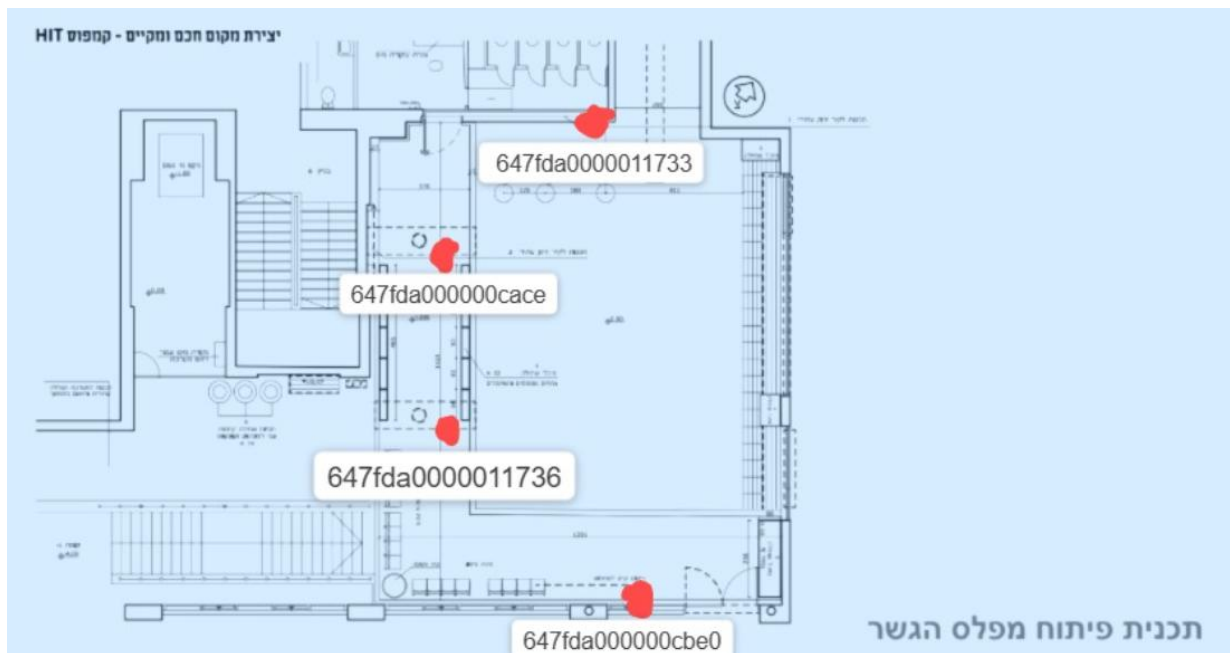
Tektelic Breeze CO2 Smart Room Sensor

- +co2 detection
- +barometric air pressure

SATEK PM130 PLUS

- + monitoring voltage, current, power, energy, and other electrical parameters

Sensor Placements



UNIQUE DATA PARAMETERS FROM ALL SENSORS

All the data above will be stored in the database.

Dvir (today):

Sensors Installed So Far

As part of the initial development of Smart Campus, I have installed sensors to measure temperature and humidity. These sensors have been placed at strategic locations on campus, such as shared learning areas and offices, to collect real-time data on environmental conditions. The data is sent through the gateway to the central server, which allows us to monitor changes and ensure that the system is functioning properly. So far, the system has proven stable and reliable in transmitting information.

Future Sensors and Installation Plan

In the future, I plan to install additional sensors to expand the capabilities of Smart Campus. Below is the plan:

1. **Motion Sensor** – Will be installed in key passage areas such as building entrances and libraries. The goal is to monitor the flow of people and assist in resource management planning (e.g., lighting and air conditioning).
2. **Air Quality Sensor** – Will be placed in enclosed spaces like classrooms and auditoriums to monitor CO2 levels and particulate matter, improving air quality for students.
3. **Lighting Sensor** – Will be installed in outdoor and indoor spaces to measure light intensity and assist in optimizing electricity consumption.

Location and Installation Phases

The installation will be carried out in phases with the help of students, in coordination with the campus maintenance team.

Author: Dvir

Version: 1.0

Date: 1/12/26

Server REST API

Routes

Client Routes: will send the web clients

/client

- /fake_sensor – returns a web client that sends mock data for testing.
- /client2 – Gives the React client that shows the data

Loader Routes: returns data of sensors

/load

- /buildings – return list of buildings.
- /rooms – returns list of rooms in a building.
- /get_sensors – returns list of sensors.
- /get_sensor_data – returns list of data reports from a sensor.
- /get_sensor_data/at – returns list of data reports from a sensor in a time period.

Saver Routes: saves reports on the database

/save

- /sensor – saves a raw sensor data report in the database.

/translate_all – goes through the untranslated raw data reports and tries to translate and extract data from each report.

Management Routes:

/manage

- /register_sensor – tell database where sensor is (building , room)
- /delete_sensor_registration
- /delete_reports_of_sensor

Client Side – Sensor Monitor

Will use the latest frontend technologies to present sensor data, research results and more.

- React
- TypeScript
- Tailwind CSS
- Bootstrap CSS
- Chart.js
- Google Maps / OpenLayers

Downloadable data as CSV for AI and research

Report Type : temperature		
Report ID	Report Time	temperature
1191	2025-01-23 17:37:39	19.6
1188	2025-01-23 16:37:39	20
1184	2025-01-23 15:37:39	20.3
1181	2025-01-23 14:37:39	20.6
1178	2025-01-23 13:37:39	20.6
1174	2025-01-23 12:37:39	20.5
1170	2025-01-23 11:37:39	20.2
1166	2025-01-23 10:37:39	20
1163	2025-01-23 09:37:39	19.3
1159	2025-01-23 08:37:39	18.5
1156	2025-01-23 07:37:39	18.2
1152	2025-01-23 06:37:39	18
1149	2025-01-23 05:37:39	17.9
1145	2025-01-23 04:37:39	18.2
1142	2025-01-23 03:37:39	18.4
1139	2025-01-23 02:37:39	18.6
1134	2025-01-23 01:37:39	18.9
1129	2025-01-23 00:37:39	19.2
1125	2025-01-22 23:37:40+00:00	19.5
1121	2025-01-22 22:37:40	19.8
1117	2025-01-22 21:37:40	20.2
1112	2025-01-22 20:37:40	20.5
1107	2025-01-22 19:37:39	20.9
1100	2025-01-22 18:37:39	21
1086	2025-01-22 17:37:39	21.2
1079	2025-01-22 16:37:39	21.4
1078	2025-01-22 15:37:39	21.7

*ore Sub-Projects Technical Specifications (MVP - Built by Students)

Sub-Project 1: Smart-Farming

Description of client

Sensor Data Needed:

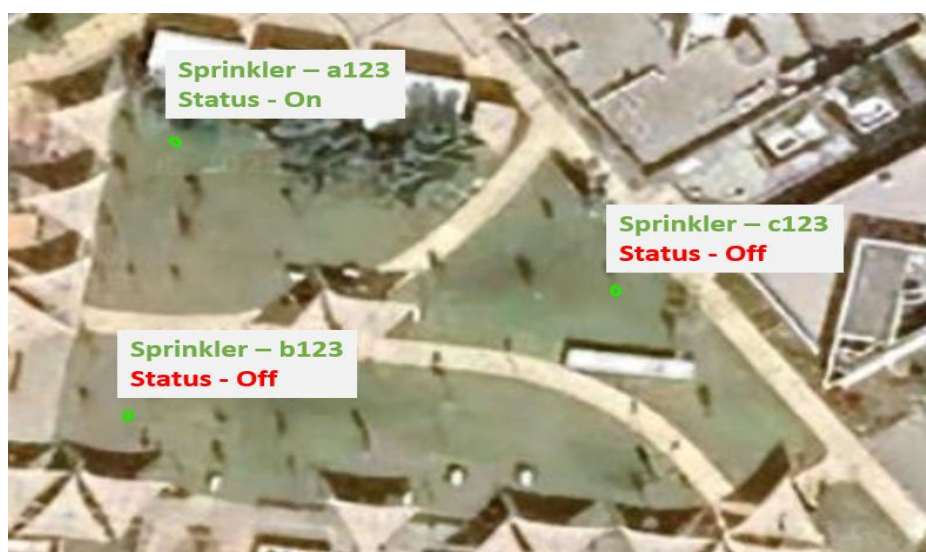
- Humidity
- Light intensity
- Temperature
- Wind
- Ground moisture
- Plant growth measurer

Machines Needed: (remotely controlled)

- Shader
- Sprinkler
- Fertilizer

The sensor data and the machines will be presented on a map and they will be easily monitored and controlled.

UI example:



Shading System Output

Sub-Project 2: Full-Bin-Detection

Description of client

Sensor Data Needed:

- Bin Capacity sensor
- Bin Weight

Machines Needed:

- None.

The sensor data will be present on a map and full bins will be views easily.

UI example:



Sub-Project 3: Shelter Locking

Description of client

Sensor Data Needed:

- Open door
- Locked door
- Human Counter

Machines Needed:

- Remote Lock

The sensor data will show on the map and we could lock or open shelters remotely from the web client.

UI example:



Sub-Project 4: Smart Building (MVP Platform) Description of client:

The primary functional foundation of the Smart Campus, designed to optimize facility management and reduce the ecological footprint. This module includes two main systems:

- **Energy & Water Monitoring/Management System:**
 - Human Presence Monitoring System (optimizing room utilization).
 - Lighting system in the dark (smart illumination).
 - System of specific indoor sensors (Temperature, Humidity, CO2).
- **Microclimate Cells in Public Space:**
 - Weather Monitoring System.
 - Solar Power System.

Sub-Project 5: Smart Education Cloud Platforms Description of client:

An integrated cloud environment utilizing the campus IoT infrastructure to enhance learning reliability, work efficiency, and research capabilities for students and academic staff. This includes:

- **Digital Portals:** Providing easy access to data and campus services.
- **Virtual Labs:** Allowing students to interact with campus sensor data remotely.
- **Distance Learning:** Supporting remote education initiatives integrated with real-time campus data.

Sub-Project 6: Autonomous Smart Crosswalk Vision:

Enhancing pedestrian safety at un-signalized crosswalks through an active alert system, activated only when a real hazard is detected.

Technological Solution: An Edge AI system that integrates Computer Vision for real-time analysis of the road environment. The system identifies pedestrians waiting on the sidewalk or crossing the street and activates visual signaling to alert drivers.

Key System Components:

- **Imaging & Processing:** A high-resolution IP camera connected to a dedicated AI processor (such as NVIDIA Jetson) for object detection and intent prediction.
- **Green Energy:** An independent solar power system including a photovoltaic panel, a charge controller (MPPT), and a deep-cycle battery for continuous 24/7 operation.
- **Alert Interface:** In-road LED strips and illuminated signage that are dynamically activated only when a pedestrian is present.

Emergency Reporting & Control:

- **Incident Detection:** Utilizing AI to identify emergencies, such as a pedestrian lying on the road or sudden emergency braking.
- **Automated Alerts:** Immediate transmission of alerts, including GPS location and status snapshots, to the Municipal Command Center (MCR) and emergency services via a cellular modem.
- **Management Interface:** A dashboard enabling city officials to view live feeds during an incident and manage safety systems intelligently.

AI models for sub projects (built by students and Maya)

AI Algorithm Requirements & Target Anomalies:

- **Dataset Requirements:** The AI models require a dataset of at least 100,000 rows, including sensor measurements from both summer and winter seasons in Israel to ensure accurate environmental baselines.
- **Anomalies to Detect:**
 - Temperature discrepancies (e.g., identifying open windows or doors while the AC is running).
 - Abnormal water and electricity consumption indicating technical issues or wasteful behavior.
 - Unexpected human movement in classrooms or facilities during off-hours.
 - Inadequate environmental conditions in lavatories.
 - Data anomalies that may signify a sensor's instability or malfunction.

Course Program

1: Smart Campus

Course Overview:

This course will explore the application of AI in creating a smart campus environment. Students will leverage sensor data to enhance campus operations, improve energy efficiency, and enrich student experiences.

Modules:

1. Introduction to Smart Campus Concepts

- Understanding smart campuses
- Key components and technologies
- Benefits and challenges
- Types of sensors (motion, temperature, light, etc.)
- Data acquisition and exploration

2. Data Preprocessing and Management

- Cleaning and organizing sensor data
- Statistical data exploration

3. AI Model Development

- Model selection and training
- Feature extraction from sensor data
- Example: Energy Efficiency
- Analyzing energy consumption patterns
- Predictive maintenance for campus facilities
- Implementing energy-saving strategies

4. Project Implementation and Evaluation

- Running models on CSV data from sensors
- Evaluating model performance and accuracy
- Presenting findings and recommendations

Course Program 2:

Urban Agriculture

Course Overview:

This course focuses on applying AI to enhance urban agriculture practices. Students will work with sensor datasets available online to optimize crop growth and sustainability within urban environments.

Modules:

1. Introduction to Urban Agriculture

- Overview of urban farming techniques
- Importance and benefits in urban settings
- Challenges in urban agriculture
- Sensor Technology in Agriculture
- Types of agricultural sensors (moisture, CO2, light, etc.)
- Data collection methods

2. Data Analysis for Crop Optimization

- Understanding plant growth metrics
- Analyzing environmental conditions
- Data-driven decision-making
- Cleaning and organizing dataset
- Statistical data exploration

3. AI

- Machine learning models for agriculture:
- Example: Predicting crop yields and health
- Project Design and Execution
- Gathering datasets for urban agriculture
- Training AI models on sensor data
- Testing and validating model outcomes

Course Program 3:

Climate Change

Course Overview:

This course examines the role of AI in understanding and mitigating climate change. Students will utilize sensor data to analyze environmental changes and predict future trends.

Modules:

1. Fundamentals of climate science

- Human impact and global challenges
- Key indicators and metrics

2. Data Collection

- Collecting and managing environmental data
- Checking data accuracy and reliability

3. Data Analysis

- Statistical methods for climate data
- Identifying patterns and anomalies
- Correlating data with climate events

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- Machine learning approaches to climate data
- Developing prediction models
- Evaluating model performance

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