HACKTIVATE

PROJECT TITLE: OmniSense: Energy Optimization and Alert Smart System

TEAM NAME: Sync & Sense

Team Members:

1. **Kanchan Sharma:** Team Leader, Dashboard Layout & System Flow
2. **Diya Raj:** Circuit Design & Sensor Logic
3. **Trisha Singh**: Product Documentation

INSTITUTION NAME: Guru Tegh Bahadur Institute of Technology

THEME SELECTED: Open Innovation

PROBLEM STATEMENT

1. **Passive Energy Management:** Lack of occupancy-based automation leads to significant institutional carbon footprints and utility overhead.
2. **Environmental Cognitive Load:** Poor air quality and thermal discomfort directly impact student focus and health.
3. **Manual System Dependency:** Reliance on human intervention for attendance and safety monitoring slows emergency response times and wastes instructional hours.
4. **Energy Waste:** 20-30% of power is lost to vacant, unmanaged classrooms.

WHO IS AFFECTED?

- Students
- Faculty
- Administrators
- Facility Staff

SOLUTION PROPOSED

- **Temperature Control:** DHT22 monitors room temperature and humidity, automatically activates relay (fan) above 25°C threshold.
- **Occupancy Detection:** PIR sensor identifies human presence to control lighting, preventing energy waste.
- **Smoke Detection:** MQ-2 gas sensor with threshold triggers immediate buzzer alarm for fire safety.

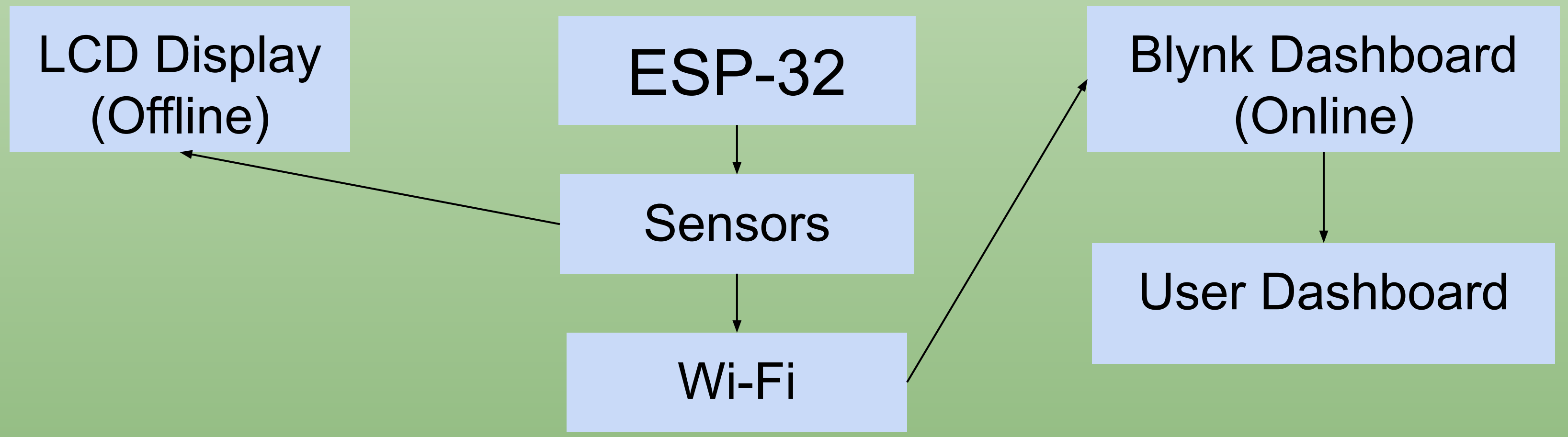
WHY IT'S DIFFERENT?

- **Low-cost installation** into existing infrastructure without major rewiring.
- Unlike basic IoT projects, OmniSense features a local **I2C LCD interface** for real-time monitoring even during network outages.

TECHNOLOGY STACK

1. **Hardware**: ESP32, DHT22, HC-SR501 (PIR), MQ-2 (proxy for smoke and combustible gas detection.), I2C LCD (16X2), 5V Relay(proxy for Fan), Buzzer.
2. **Software**: C++ (Arduino Framework), Blynk IoT Cloud.
3. **Simulation**: WokWi

ARCHITECTURE



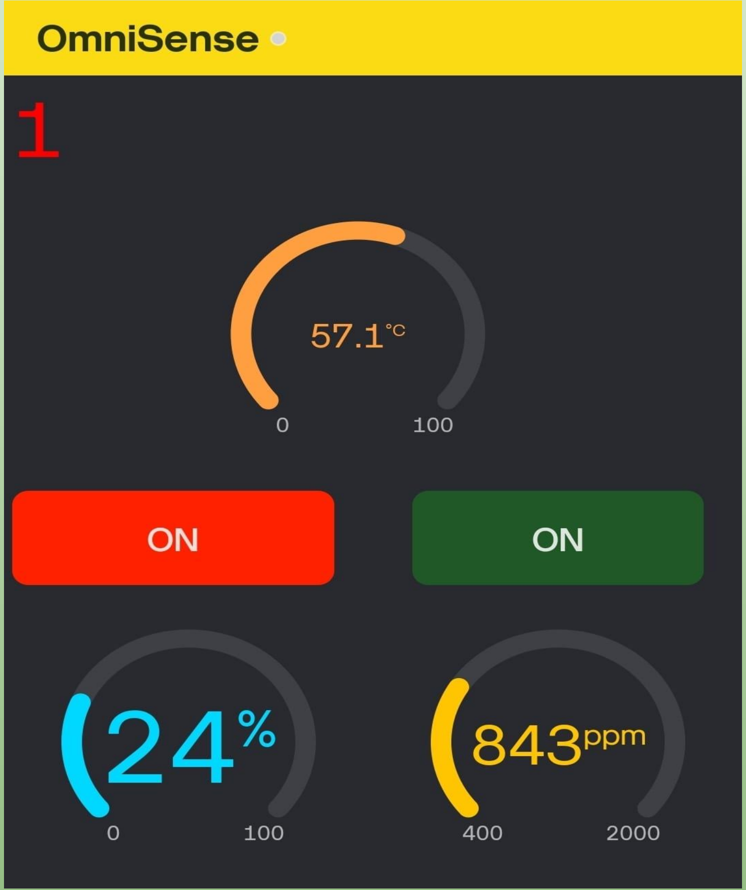
Presentable Links

- **Demo Link (youtube)** : https://youtu.be/1yirrnzVDjc?feature=shared
- **Github Link**: https://github.com/DiyaR-2006/OmniSense-HackTivate-.git

Live Simulation (wokwi) :

- **offline:** https://wokwi.com/projects/453951590301233153
- **online:** https://wokwi.com/projects/454308317695279105

Dashboard Layout



SUSTAINABILITY LINK

- **Energy Consumption Optimization:** Real-time motion-tracking via PIR sensors and automated relay logic minimizes electricity waste in unoccupied classrooms.
- **Scalable Hardware Lifecycle:** Designed for modular sensor upgrades (e.g., swapping MQ-2 for NDIR CO2 sensors) to maintain long-term industrial safety standards.
- **Resource Resilience:** Edge-first programming ensures the system remains functional during network downtime, reducing dependency on constant high-bandwidth infrastructure.

PROJECT INSIGHTS

1. Projected Impact

- **Estimated Energy Savings:** By automating high-voltage relays via PIR motion sensing, the system is projected to reduce passive electricity waste in vacant classrooms by **20–30%**.
- **Safety Response Reliability:** Localized I2C LCD and Buzzer logic ensures critical alerts trigger, completely bypassing cloud-dependency risks.
- **Operational Accuracy:** Utilizing the DHT22 and MQ-2 provides a precise environmental baseline, allowing for automated climate regulation.

2. Technical Feasibility

- **Edge-First Logic:** Our testing in Wokwi proves that critical safety and energy functions can be decoupled from the internet, making the system viable for institutions with unstable Wi-Fi.
- **Modular Integration:** The C++ firmware architecture allows for the seamless addition of real-world sensors without significant hardware restructuring.

BUSINESS MODEL

DEPLOYMENT MODEL

- Install IoT sensors (occupancy, air quality, temperature) in classrooms.
- Connect devices to a centralized cloud platform

OPERATING MODEL

- Automated, real-time monitoring and control.
- Central dashboard for administrators and facility teams.
- Minimal human intervention after setup.

SUSTAINABILITY IMPACT

- 20–30% reduction in energy consumption.
- Lower operational costs and carbon emissions.
- Supports long-term green campus initiatives.

UNIQUE SELLING POINT

1. **Occupancy-driven intelligence:** Energy, attendance, and safety decisions are based on real-time classroom usage, not fixed schedules.
2. **Sustainability-first design:** Delivers energy savings and measurable carbon reduction, not just automation.
3. **Low-cost & retrofit-friendly:** Works with existing lighting and HVAC systems—no expensive building redesign required.
4. **Scalable & modular architecture:** Easy expansion from a single classroom to an entire campus.
5. **Faster ROI than traditional BMS:** Affordable hardware.

FEASIBILITY AND SCALABILITY

FEASIBILITY

- Built using standard IoT libraries achievable within hackathon limits.
- Logic verified via high-fidelity Wokwi virtual simulation.
- Uses low-cost, widely available IoT components (PIR sensors, temperature & air-quality sensors, ESP32).
- Initial investment is moderate, but energy savings reduce electricity bills.
- Low maintenance costs due to automated operation.
- Supports green campus and sustainability policies.

SCALABILITY

- Each classroom acts as an independent IoT node.
- Easy to add or remove sensors without redesigning the system.
- Can be deployed across schools, colleges, offices, and institutions.
- Adaptable to different geographic and climatic conditions.

THANK YOU

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