INTEGRAL ROBOTICS LAB

INTEGRAL UNIVERSITY LUCKNOW

BACHELOR'S THESIS

Project title: IOT-Enabled Monitoring and Automation for Sustainable Hydroponic Farming

Project Description:

This project presents a fully integrated, **solar-powered**, **AI-enhanced smart farming system** tailored for sustainable hydroponic agriculture. It combines a **multi-sensor IoT network** using ESP32 microcontrollers with a **Raspberry Pi 5** to enable real-time environmental monitoring, automated irrigation, and **plant disease detection using AI**. The system logs environmental data (temperature, humidity, CO_2, pH, TDS, water flow, level, and light intensity) and stores it on a **MongoDB Atlas cloud**. A custom AI model, trained and deployed via **TensorFlow Lite**, detects plant diseases through images captured by a Raspberry Pi camera slider, making precision farming scalable and reliable.

Tasks Involved:

- Integration of ESP32-based multi-sensor nodes for monitoring:
  DHT11, MH-Z19, YF-G1, TSL2561, HC-SR04, TDS, and pH sensors.
- Solar power system with battery backup and auto switch logic.
- Raspberry Pi 5 interfacing for sensor aggregation and camera movement.
- Flask server for data collection and API endpoint hosting.
- MongoDB data storage with real-time and rolling average entries.
- Design and training of AI model for plant disease classification (CNN using TensorFlow Lite).
- Frontend dashboard using React.js and Chart.js for live sensor visualization.
- Backend setup using Node.js + Express for device communication and REST APIs.
- Development of an automated irrigation controller using dual-relay on NodeMCU.
- Deployment of a full-stack live demo with Netlify and Railway.

Supervisor:

Supervisor:
Dr. Sheeba Praveen
Assistant Professor, Department of Computer Science & Engineering
Integral University, Lucknow

Co-Supervisor:
Dr. Atif Siddiqui
Head & Associate Professor, Department of Electrical Engineering,
Faculty of Engineering, Integral University, Lucknow

Submitted By:
Abdul Rahman
Roll No: 2300100128
B.Tech CSE - A

Mohammed Qambar Syed
Roll No: 2100100918
B.Tech CSE - C

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