

AIGLE System Documentation

Introduction

Welcome to the AIGLE (AI-integrated Algae Bioreactor) System! A revolutionary, sustainable, and scalable solution designed to address urban air pollution and climate challenges through algae-based bioreactors, AI-powered optimization, and renewable energy. This system is equipped with a cutting-edge AI robotic bot, Aigle, which enhances user interaction and provides real-time information.

System Features

- Absorbs CO₂ and produces oxygen through algae photosynthesis.
- Optimized for varying environmental conditions using AI.
- Provides information about the system and enables multi-purpose functionality such as ticket booking in public spaces like railway or bus stations.
- Displays real-time data such as AQI index and system performance.
- Facilitates activities like ticket booking and data collection through surveys.
- Offers advertisement opportunities, creating additional revenue streams.
- Smart monitoring using CO₂ detection sensors, pH sensors, turbidity sensors, LDR sensors, water temperature sensors, and environment temperature sensors.
- Integration of Arduino and Raspberry Pi for data flow and system control.
- MongoDB for real-time data storage and multiple tank integration.
- Website backend built with Flask, MongoDB, Express.js, and Node.js.
- Aigle Bot powered by ESP32, Gemini API, and other components for communication and interaction.
- Self-sustaining unit powered by single-axis solar panels for renewable energy.

Application Use Cases

- Urban Air Purification: Enhances air quality in densely populated areas.
- Public Interactions: Aigle provides system insights and allows ticket bookings in public spaces.
- External LED screens display advertisements, create additional revenue streams, and facilitate activities like AQI index display and surveys.

- Environmental Awareness: Educates users on sustainability through interactive features.

System Architecture

****Hardware Components:****

- Sensors: CO₂, pH, turbidity, LDR, water, and environment temperature sensors.
- Actuators: Aerators, fans, and LED lights.
- Controllers: Arduino, Raspberry Pi, and ESP32.
- Power: Solar panels, power modules, and batteries.

****Software Components:****

- AI Integration: Gemini API for chatbot functionality.
- Website Backend: Flask and Express.js.
- Database: MongoDB for data storage and retrieval.

****Data Flow:****

Sensor readings -> Arduino/Raspberry Pi -> MongoDB -> Website -> User Interface. AI-based optimization through real-time analysis and feedback.

Key Benefits

- Eco-Friendly: Runs on renewable energy, reducing the carbon footprint.
- Intelligent Operation: AI adapts to dynamic conditions, ensuring optimal algae health and efficiency.
- User Engagement: Interactive features like Aigle and advertisement opportunities increase system utility.
- Scalability: Modular design allows for easy expansion and integration in diverse settings.

Final Note

This system is a Minimum Viable Product (MVP) showcasing innovative integration of AI, IoT, and renewable energy for environmental sustainability. It represents the future of smart, eco-conscious technology and is ready for further development and deployment.