

Project Design Phase-II

Technology Stack (Architecture & Stack)

Date	03 November 2025
Team ID	NM2025TMID01374
Project Name	To Supply Leftover Food to Poor
Maximum Marks	4 Marks

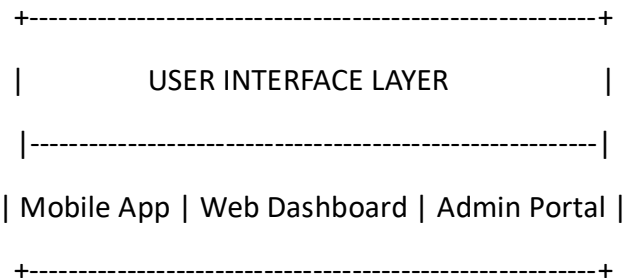
System Architecture Overview

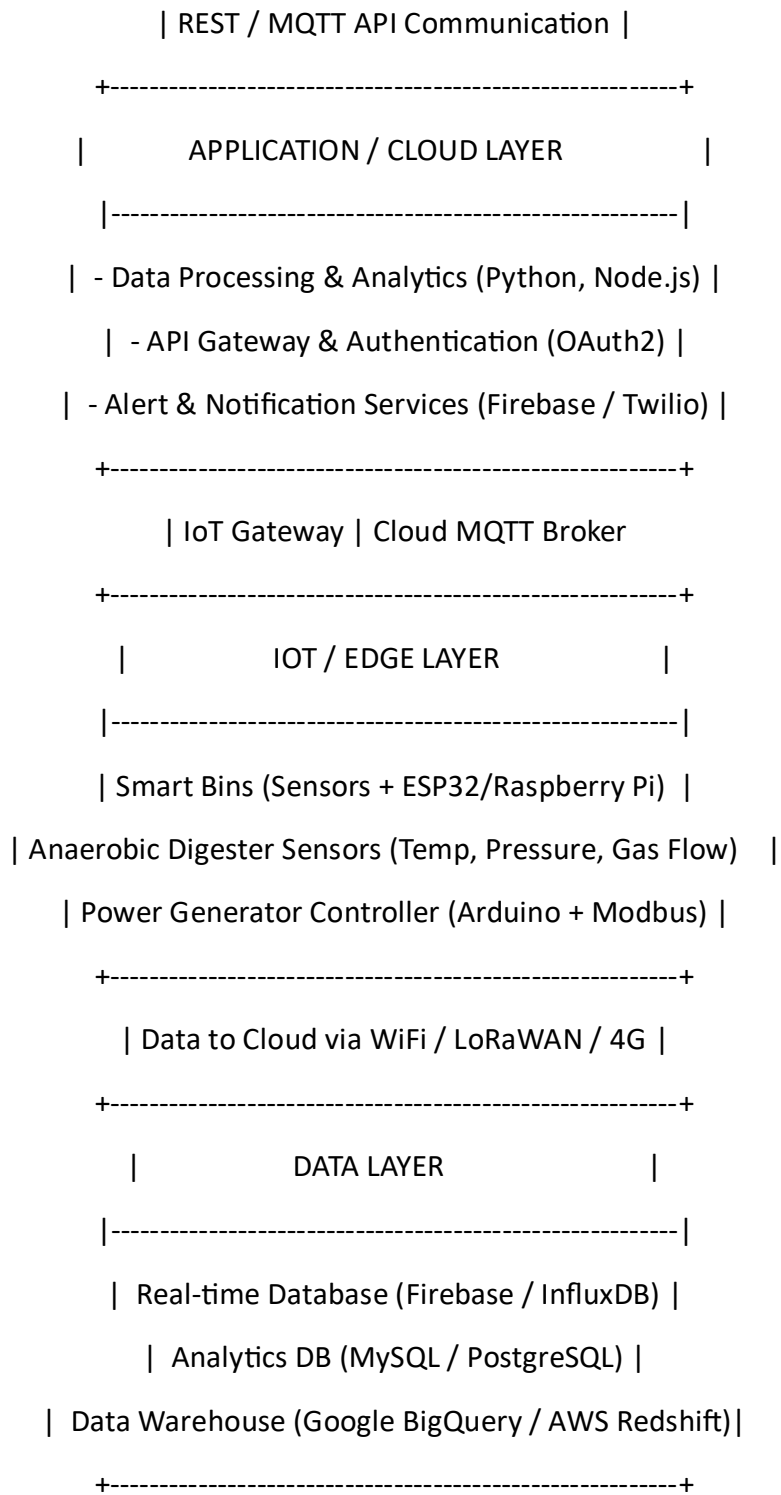
Architecture Layers

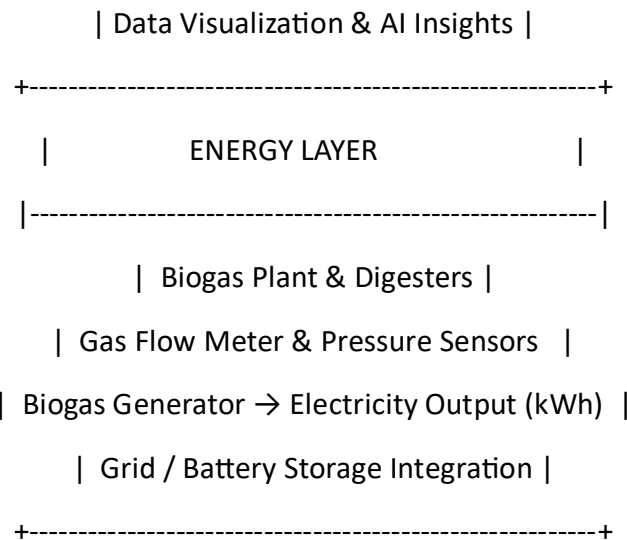
1. User Interaction Layer (Frontend)
- Interfaces for users, admins, and operators.

○ Devices: Mobile app, web dashboard, control panels.
2. Application Layer (Backend Services)
- Handles data processing, analytics, and system logic.
3. IoT Layer (Hardware & Edge Devices)
- Smart bins, sensors, microcontrollers, and digester instrumentation.
4. Data Layer (Storage & Processing)
- Cloud and on-premise databases for sensor, energy, and analytics data.
5. Integration Layer
- APIs for connecting IoT, power systems, and dashboards.
6. Energy Layer
- Physical systems for anaerobic digestion, biogas storage, and power generation.

High-Level System Architecture Diagram (Text Description)







Technology Stack (Detailed Breakdown):

Layer	Technology / Tool	Purpose / Description
Frontend	React.js / Angular	Web dashboard for monitoring and control
	Flutter / React Native	Mobile app for users & operators
Backend	Node.js / Express	API development and system logic
	Python (Flask / FastAPI)	Analytics and ML-based prediction models
IoT Hardware	Arduino / ESP32 / Raspberry Pi	Sensor data collection and control logic
	Ultrasonic, Gas, Temp Sensors	Measure waste levels, CH <sub>4</sub> %, temperature
IoT Communication	MQTT / HTTP	Lightweight protocol for IoT data exchange
	LoRa / WiFi / GSM	Connectivity options for rural/urban setups
Cloud Platform	AWS IoT Core / Google Cloud IoT / Azure IoT Hub	Device management, scaling, and monitoring

Layer	Technology / Tool	Purpose / Description
	Firebase Realtime DB	Real-time data sync for web & mobile
<b>Database</b>	MySQL / PostgreSQL	Core structured data (users, logs)
	InfluxDB / MongoDB	Time-series and sensor data storage
<b>Analytics / AI</b>	TensorFlow / Scikit-learn	Predict energy yield and waste patterns
	Power BI / Grafana	Visualization of energy and waste data
<b>Energy Systems</b>	Anaerobic Digesters, Biogas Generators	Core hardware for power generation
	PLC / Modbus Integration	Communication between generator and control unit
<b>Security</b>	OAuth 2.0 / JWT	Secure user authentication
	AES-256 Encryption	Data encryption at rest & in transit
<b>DevOps</b>	Docker / Kubernetes	Containerization & scalability
	GitHub / Jenkins / CI-CD	Continuous integration & deployment
<b>Notification System</b>	Firebase Cloud Messaging / Twilio	Real-time alerts & SMS notifications

#### Example Data Flow:

1. **User drops food waste** → Smart bin sensor detects weight/volume → sends data via **ESP32** → **MQTT Broker**
2. **Server processes waste data** → Updates **dashboard & mobile app**
3. **Collected waste processed in digester** → CH<sub>4</sub> sensor data → stored in **InfluxDB**
4. **Energy generation recorded** → Stored in **cloud database** → Shown in **Power BI dashboard**
5. **Reports and alerts** automatically sent to users and admins