AQUA NOVA

A Smart Buoy for Ocean Monitoring

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PROBLEM STATEMENT

Oceans, rivers, and coastal waters are increasingly affected by pollution, climate change, and unmonitored human activities. Traditional water quality monitoring methods are manual, expensive, and not capable of providing real-time data. This lack of continuous and remote monitoring makes it difficult to detect sudden changes in water conditions like pollution spikes, salinity shifts, or temperature rises, which are crucial for marine safety, aquaculture, and environmental protection.
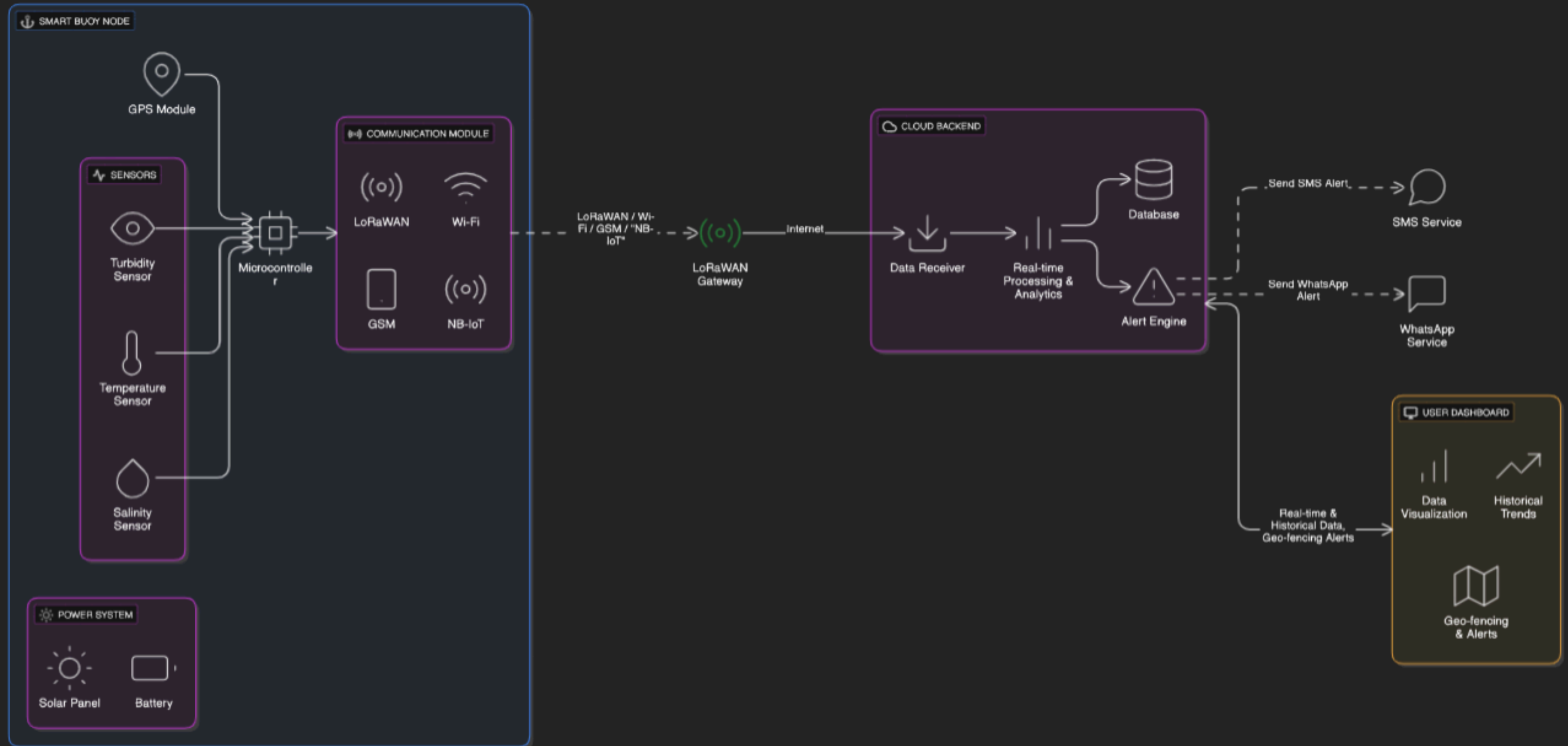
SOLUTION

To design an autonomous Smart Buoy IoT system for real-time ocean monitoring. The buoy should be equipped with sensors to measure temperature, salinity, and turbidity, powered by solar energy for sustainable, long-term deployment. It must use a microcontroller to process sensor data and transmit it wirelessly to the cloud via Wi-Fi, GSM, or NB-IoT. Incorporate GPS tracking to monitor the buoy's location and alert users if it drifts beyond a designated area. The system should enable real-time data visualization and historical trend analysis through a user-friendly interface, supporting environmental monitoring and decision-making in remote ocean locations.

Ocean Monitoring System Timeline

Sensing Layer

Sensors measure ocean parameters

Processing Layer

ESP32 reads and converts data

Communication Layer

Data transmission via Wi-Fi/GSM

Cloud Layer

Data stored in cloud database

Visualization Layer

Dashboard displays live data

Alert Layer

SMS/Email alerts for anomalies

Power Layer

Solar panel charges battery

ARCHIETECHTUE DIAGRAM

TECHNICAL APPROACH

- Python : Cloud-side data analysis or script automation
- JSON: Format data for transmission and storage
- Cloud & Backend: Firebase Realtime Database
- AWS IoT Core : Manage IoT devices and cloud data pipelines
- InfluxDB : Time-series data storage and fast querying
- Visualization: ThingsBoard
- Notifications: Twilio / IFTTT
- Web Tools: HTML, CSS, JavaScript
- Google Maps API : Show buoy GPS location on map
- AI / ML: Edge Impulse / TensorFlow Lite

IMPACT AND BENEFITS

Marine Pollution

Detects changes from oil spills or waste. Helps with early cleanup planning.

Climate Research

Collects long-term ocean data for scientific research. Helps study climate change.

Port Water Quality

Tracks pollution near harbors and ships. Assists in marine traffic regulation.

Freshwater Ecosystems

Adapted for freshwater ecosystems. Useful for drinking water safety.

Aquaculture and Fisheries

Monitors water quality in fish farms. Prevents mass fish deaths.

Disaster Warning

Detects changes before storms. Used in tsunami early warning systems.

Smart City Infrastructure

Part of a smart coastal city initiative. Supports sustainable tourism.

Educational Institutions

Used in engineering, marine biology, and environmental science projects. Ideal for student research.