SMART INDIA HACKATHON 2024

Jal Darpan

- **Problem Statement ID – 1695**
- **Problem Statement-** A software application for analysis of DWLR data and raise alarms in respect of anomalous values, faulty DWLRs etc.
- **Theme- Smart Automation**
- **PS Category- Software**
- **Team ID- 5022**
- **Team Name- Tech-Savvies**

Tech-Savvies

Jal Darpan

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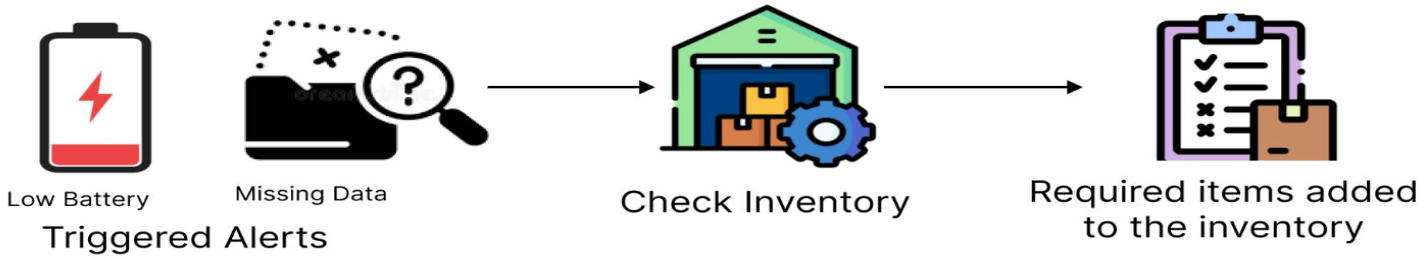
Our proposed web-based platform **Jal Darpan** helps the Central Ground Water Board (CGWB) monitor and manage Digital Water Level Recorders (DWLRs) in the network.

Challenges Faced by CGWB

➢ **Lack of Real-Time Visibility**: In the absence of a centralized system with real-time visibility, CGWB may face difficulties in promptly identifying and responding to issues with DWLR sensors.
➢ **Manual Monitoring and Data Collection** : Monitoring DWLRs sensor manually involves frequent physical checks and manual data entry. It's a time consuming process.
➢ **Inefficient Anomaly Detection**: Anomalies may go unnoticed until they lead to significant issues.

Innovation and Uniqueness

ML-Based Installation Recommendations	Inventory Management	Map-Based Visualization
A machine learning model to recommend optimal DWLR installation sites, ensuring diverse coverage for more effective groundwater monitoring	The system help to manage the stock of critical components (batteries, sensors, etc.) in the inventory based on alerts generated from DWLR sensor data.	Track every DWLR in real time with interactive mapping



Proposed Solutions To Address the Challenges

➢ Jal Darpan is a **centralized system** that helps CGWB officers monitor and manage all installed DWLR sensors in one place. It provides **real-time updates** on water levels, battery status, and generates reports for each sensor.

➢ The system uses a **telemetry setup to automatically collect data** from remote sensors, such as DWLRs. This enables seamless data transmission to a centralized remote server via GPRS(General Packet Radio Service) eliminating the need for manual data collection, saving time, and improving efficiency.

➢ The system monitors water levels, **sending notifications** after each cycle and generating reports. It **alerts CGWB officers** and vendors in real-time about data anomalies or low battery levels, ensuring timely maintenance and minimizing downtime to maintain DWLR network accuracy.

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TECHNICAL APPROACH

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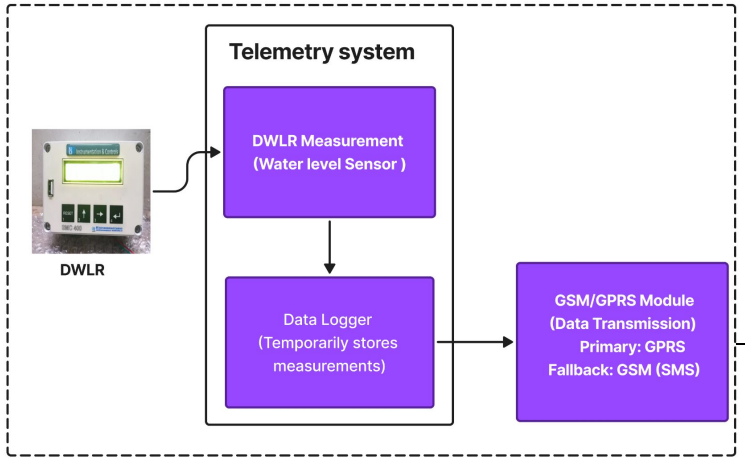
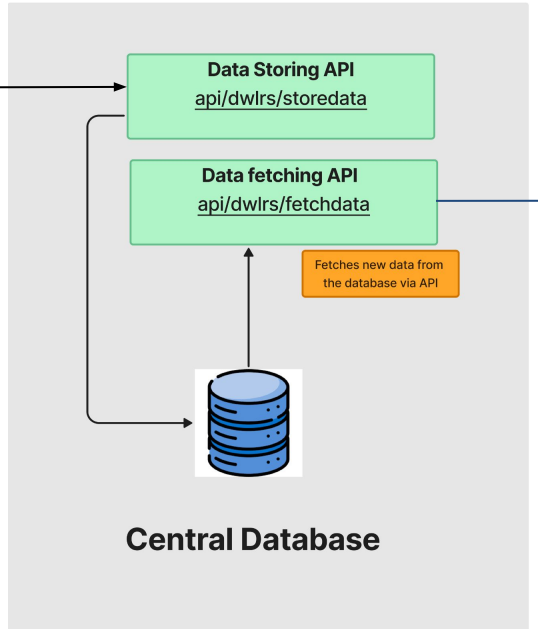
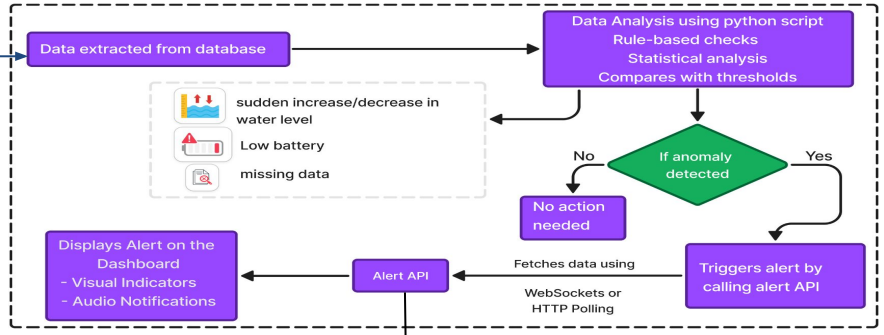
Data Collection



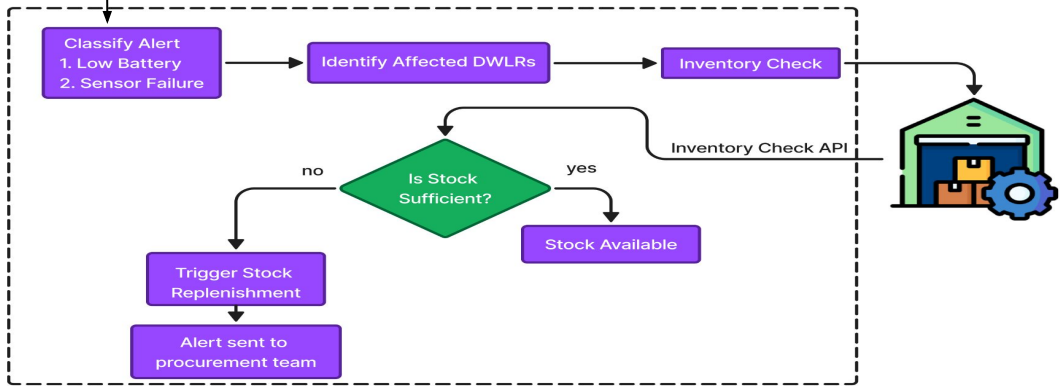
Centralized Server



Anomaly Detection Module and Alert System



Inventory Management



Technology Stack

- **Frontend:** React.js (UI)
- **Authentication:** OAuth 2.0, JWT
- **Backend:** Node.js ,Flask (to connect backend to ml model), Express.js ,Socket.io
- **Monitoring & Analytics:**ELK Stack (Elasticsearch, Logstash, Kibana) for centralized logging and real-time anomaly data analysis.
- **Security:**TLS/SSL Encryption(Encrypts data transmission between the centralized server and external devices to prevent interception and tampering).
- **Database**: MongoDB
- **Machine Learning:**TensorFlow
- **Google map API**: For map based visualization
- **Protocols**: HTTP
- **Deployment:** AWS or Heroku (for cloud hosting and deployment)

Business model (Subscription based)

Free User

- Ads and Limited Content
- Limited historical data (e.g., upto 3 months)
- ML based Site recommendation for new DWLR installation
- Limited Language Support
- . Basic FAQs and user guides

Pro User

- Ad-free Experience
- Extended Historical Data (e.g., upto 3 years)
- No Site recommendation for new DWLR installation
- Multilingual Support
- 24/7 Technical Support

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Features

➢ **Data Collection and Monitoring:** Collects data such as groundwater levels, battery status, and location from the DWLR sensors using inbuilt GPRS (General Packet Radio Service).

➢ **Map-Based Visualization:** Displays each DWLR location on the map. Each DWLR is represented as a marker. When a user clicks on a DWLR marker, a popup provides detailed information (battery status, location, last reading).

➢ **Reporting & Analytics:** Generates daily, weekly, and monthly reports on each installed DWLR sensor, including water level, battery status, and location. It lets you download the report in PDF format for record-keeping and future analysis.

➢ **Notifications & Alerts:** Notifies CGWB officers when reports are available, and these notifications will appear on the dashboard to keep them informed about the status of the DWLRs. Alerts are generated when anomalies are detected in the DWLR sensor data in real-time. These alerts are categorized by the type of anomaly (e.g., sudden spikes and drops, low battery, missing or abnormal data).

➢ **ML-Based Sensor Scheduling:** Enables scheduling of upcoming DWLR sensor installations. It recommends locations for new sensors, ensuring that they are not installed within a 5 km radius of existing ones, promoting diversity and avoiding redundancy.

➢ **Inventory management -**The system help to manage the stock of critical components (batteries, sensors, etc.) in the inventory based on alerts generated from DWLR sensor data.

FEASIBILITY AND VIABILITY

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Technical feasibility

Jal Darpan uses established telemetry systems and machine learning tools like Python and TensorFlow for anomaly detection,Twilio and Firebase for automated notifications, ensuring strong technical feasibility

Economical feasibility

The idea is economically feasible because it saves maintenance cost by early detection of faulty DWLRs,minimizes downtime and ensures continuous data collection

Operational feasibility

Jal Darpan has a user friendly interface, uses map based visualization and automated reports and alerts, making it operationally feasible.

Viability

Adaptability :- Jal Darpan can be smoothly integrated into CGWB's workflows by giving access to all the related workers and officers.

Scalability :- The infrastructure is cloud-based providing flexibility in adjusting to increasing data volumes.

Potential Challenges	Overcoming Strategies
❗ Huge volume of data	✅ Using Scalable Cloud Services like AWS, Google Cloud or Azure
❗ False positives in anomaly detection	✅ ML-models updates, Advanced Analytics and Feedback Loops
❗ Data privacy and Security	✅ Data Encryption(SSL),IP Whitelisting,Role-Based Access

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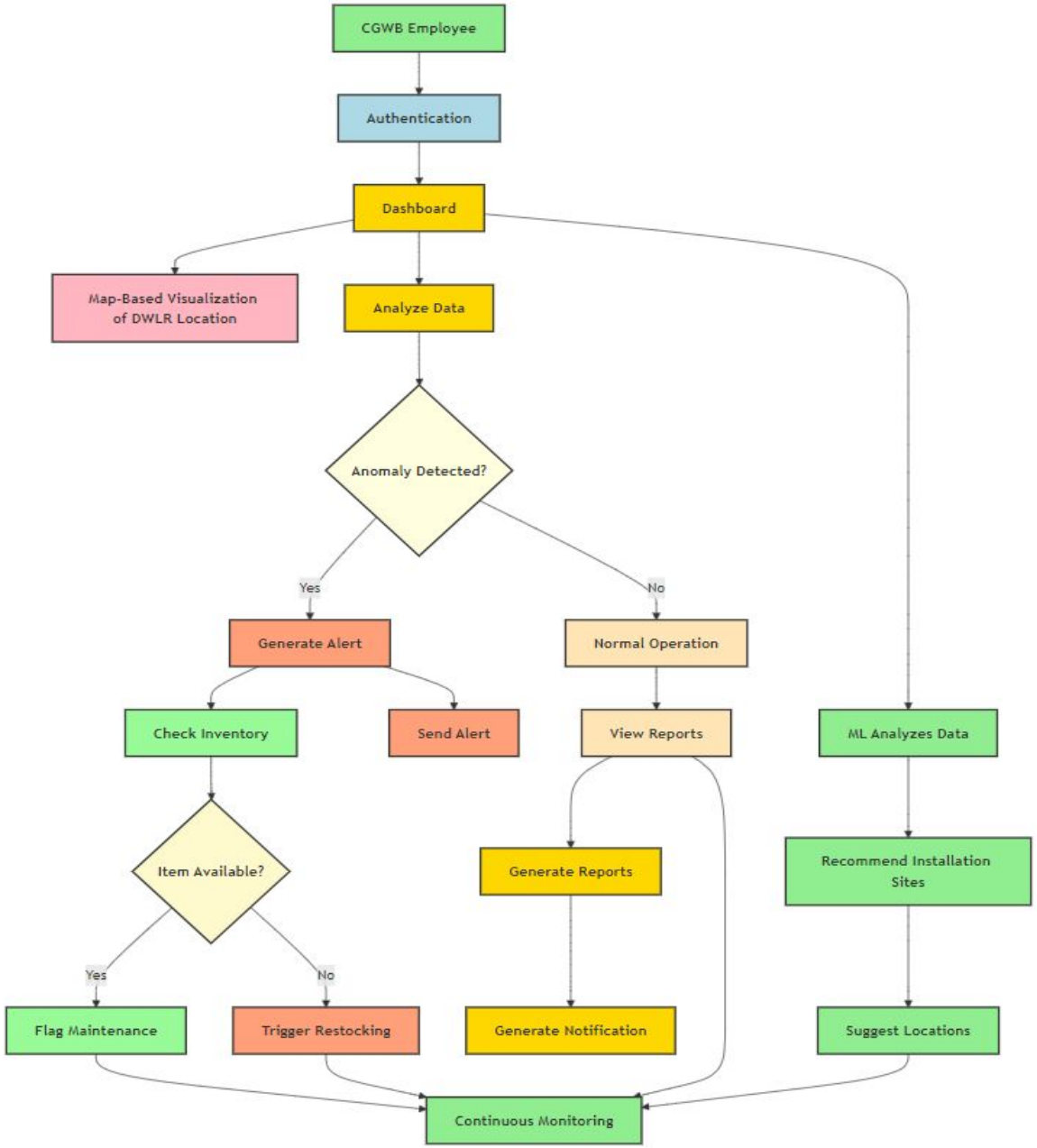
Flowchart



IMPACT AND BENEFITS

Potential impact on the target audience

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➢ **Reduced time and human resources** required for data analysis and anomaly detection.

➢ Guidance of **water allocations** for agricultural and industrial purposes though groundwater data.

➢ **Real time alerts** for anomalous values, faulty sensors and low battery levels allowing Quick Actions.

➢ **Accurate groundwater** data empowers the CGWB to make informed decisions about groundwater management.

Social Benefits

Informed agricultural practices: Farmers will be benefitted, allowing them to make better decisions about irrigation and crop selection.

Environmental Benefits

Protection against water scarcity: Ensures continuous access to groundwater for drinking, household and sanitation purposes, especially in rural areas.

Economic Benefits

Cost savings in groundwater monitoring: The system enables automated data collection reducing operational cost and help reducing maintenance cost.
Efficient Government Spending: Real-time access to accurate groundwater data enables governments to optimize budget allocation for maintenance and make better decisions about water allocation, conservation, and regulation.

RESEARCH AND REFERENCES

Map API documentation	https://developers.google.com/maps/documentation/javascript
IOT-Based Smart Inventory Management System	https://ieeexplore.ieee.org/document/10128211
CGWB official website	https://cgwb.gov.in/
DWLR features	https://swanenviron.com/water-digital-water-level-recorder.html
Location based recommendation system with machine learning	https://ymerdigital.com/uploads/YMER2105D5.pdf

PROTOTYPE