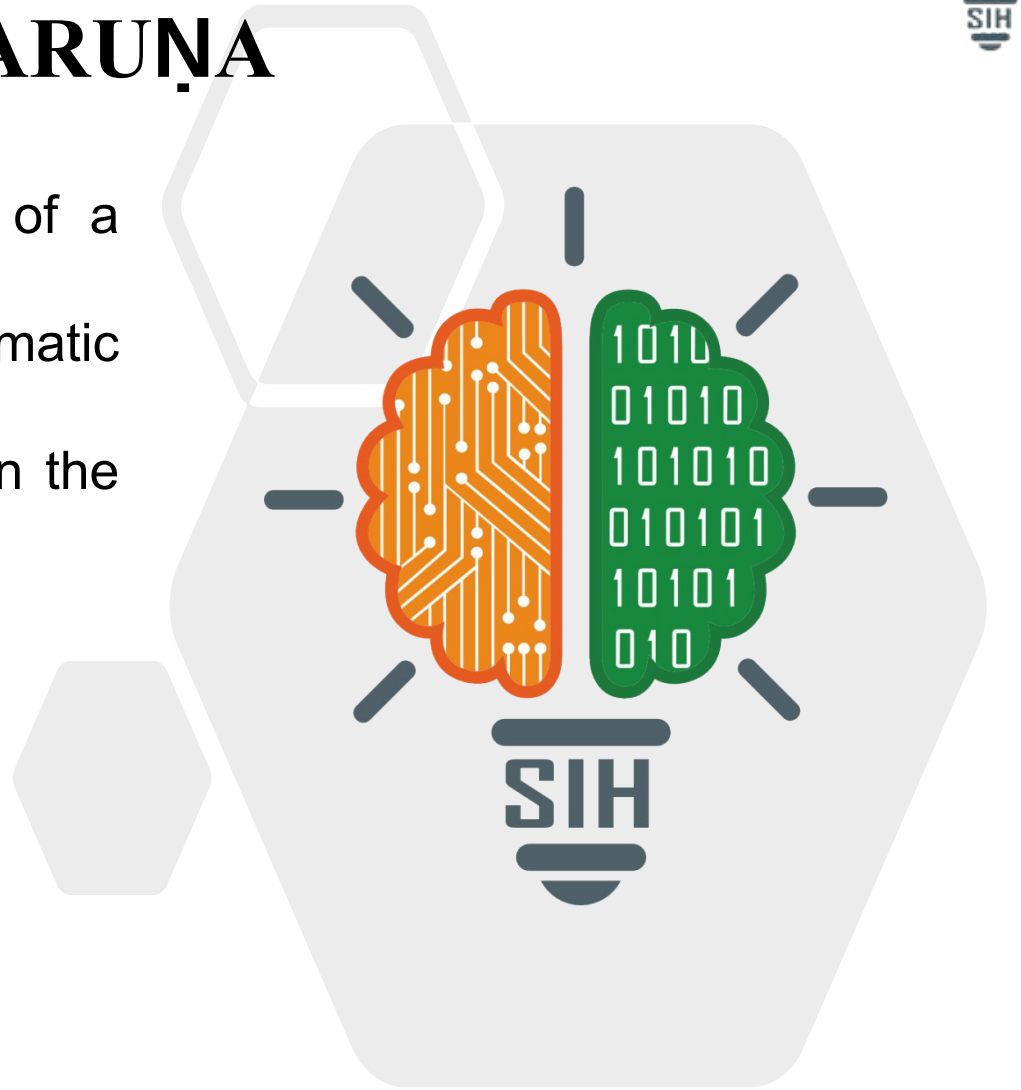
SMART INDIA HACKATHON 2025

VARUṆA

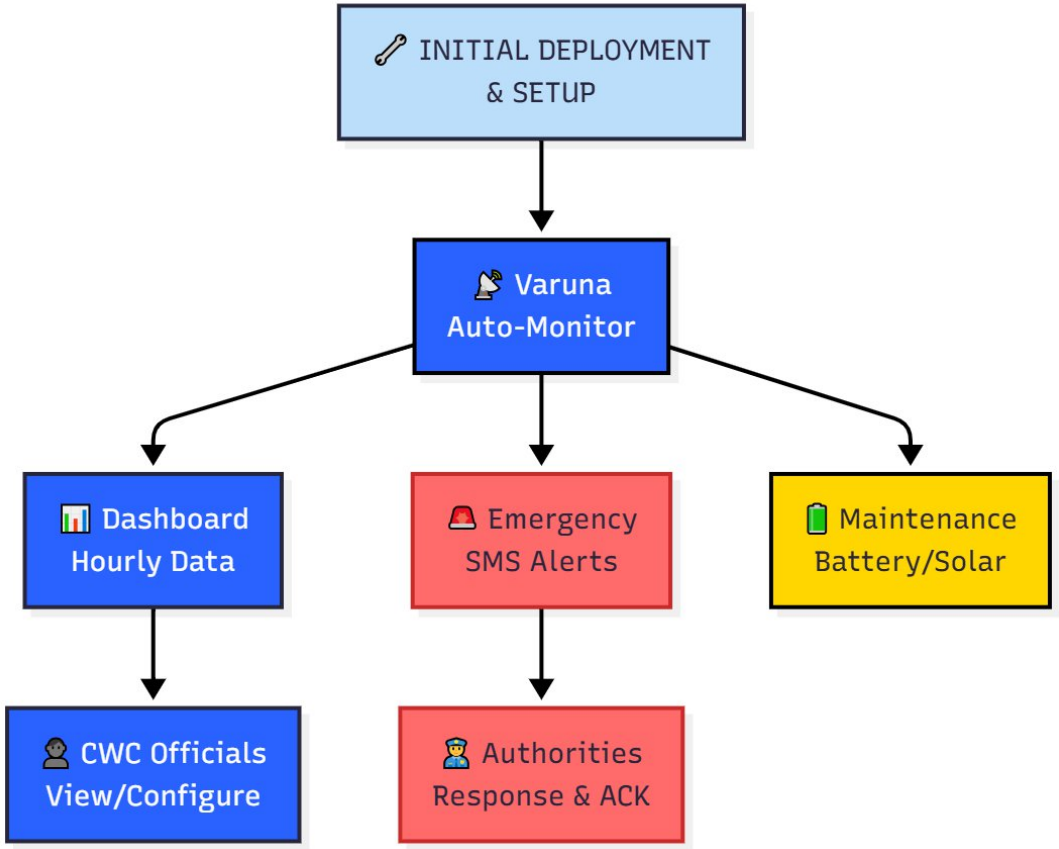
- **Problem Statement ID –** SIH25249
- **Problem Statement Title-** Development of a floating sensor based system for automatic reading and transmission of water levels in the rivers.
- **Theme-** Disaster Management
- **PS Category-** Hardware
- **Team ID-** 80160
- **Team Name-** Tejas07



❖ Proposed Solution

- **Smart Water Level Sensor**: Combines MPU-6050 IMU and dual ultrasonic sensors for **Accurate**, and **Corrosion-proof** water level measurement.
- **Hybrid Power Module**: Solar and vertical-axis wind system with MPPT/PWM control ensures **Reliable off-grid operation**.
- **Dual-Battery System**: $LiFePO_4$ main battery with **Automatic backup** switch for uninterrupted uptime.
- **GSM/GPRS Communication**: Enables **Real-time cloud transmission** and SMS alerts, with voice-call fallback during outages.
- **Local Data Backup**: Onboard SD storage with auto-resync **Prevents Data loss** during GSM downtime.
- **Remote Configuration**: SMS-based control for threshold setup, device reset, and **live diagnostics**.
- **Self-Monitoring System**: Tracks power, sensor, and network health, switching automatically between **MODES** - Normal, Low-Power, and Emergency modes.

❖ Operation flowchart



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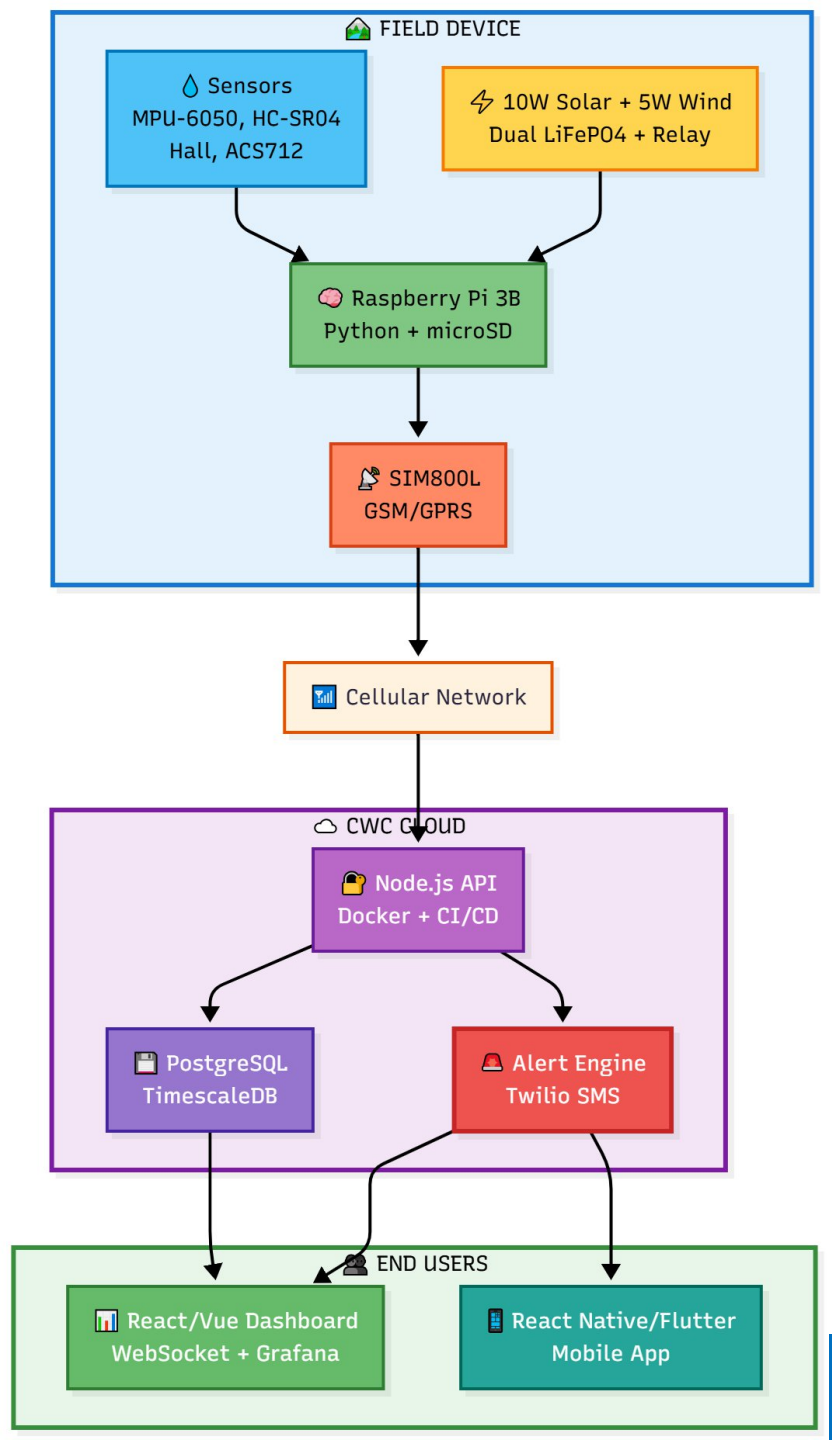
TECHNOLOGY STACK

❖ Hardware Stack :

- **Core:** Raspberry Pi 3B
- **Sensors:** MPU-6050 , HC-SR04, Hall sensor, ACS712
- **Comms:** SIM800L
- **Power:** 10W solar + 5W wind Dual LiFePO$_4$ batteries
- **Peripherals:** microSD logging, relay-based battery switch

❖ Software Stack :

- **ES Programming :** Python
- **Backend:** Node.js/Python , PostgreSQL + TimescaleDB
- **Real-time:** WebSocket ,Alert Engine, Twilio
- **Frontend:** React/Vue dashboard + React Native/Flutter mobile app
- **Infra:** Docker, CI/CD ,Prometheus/Grafana)



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FEASIBILITY AND VIABILITY

SMART INDIA HACKATHON 2025

Feasibility

- **Technical**: Low-cost hardware works via GSM.
- **Modular**: Plug-and-play sensors + QR setup enable rapid rollout.
- **Market Fit**: Automates manual readings with real-time AI alerts.
- **Economic**: < ₹ 20k/per unit; ROI under 6 months.

Challenges

- **GSM Dead Zones:** A few remote sites lack cellular coverage.
- **Cold Battery Performance:** LiFePO$_4$ efficiency drops Below 0 C.
- **SIM Management:** Tracking 1,000+ SIMs adds operational load.
- **Hardware Fatigue:** Strong currents may stress the pivot arm.

Use Cases

- **Flood Alerts**: Detects >5 cm/min rise; sends tiered SMS + call warnings.
- **Reservoir Control**: Hourly data supports precise dam releases.
- **Disaster Chain**: Geofenced alerts escalate Panchayat → State.
- **Remote Checks**: SMS logs and commands cut field visits.

Business Potential

- **Scalable**: Expands from 10 to 10K units with same stack.
- **Govt Ready**: Tailored for CWC, NDMA—Aligned with Water Policy 23
- **Partnerships**: Open-source model invites MSMEs & startups.
- **Data Value**: Hydro data usable by insurers, agri-tech,

Supporting facts :

- According to **Government e-Marketplace (GeM)** public listings, Indian vendors offer AWLR/ultrasonic level sensors and GSM/GPRS data loggers in the ~₹10k–₹30k price band**, evidencing low-cost domestic hardware availability**
- **According to CWC's own 2023 Annual Report**: Over 70% of flood-related deaths occurred due to delayed or inaccurate water level alerts — our system eliminates this gap.
- **Unlike legacy systems**, ours doesn't fail during monsoons — hybrid solar+wind power ensures 24/7 operation even when sunlight vanishes and rivers rage.

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IMPACT AND BENEFITS

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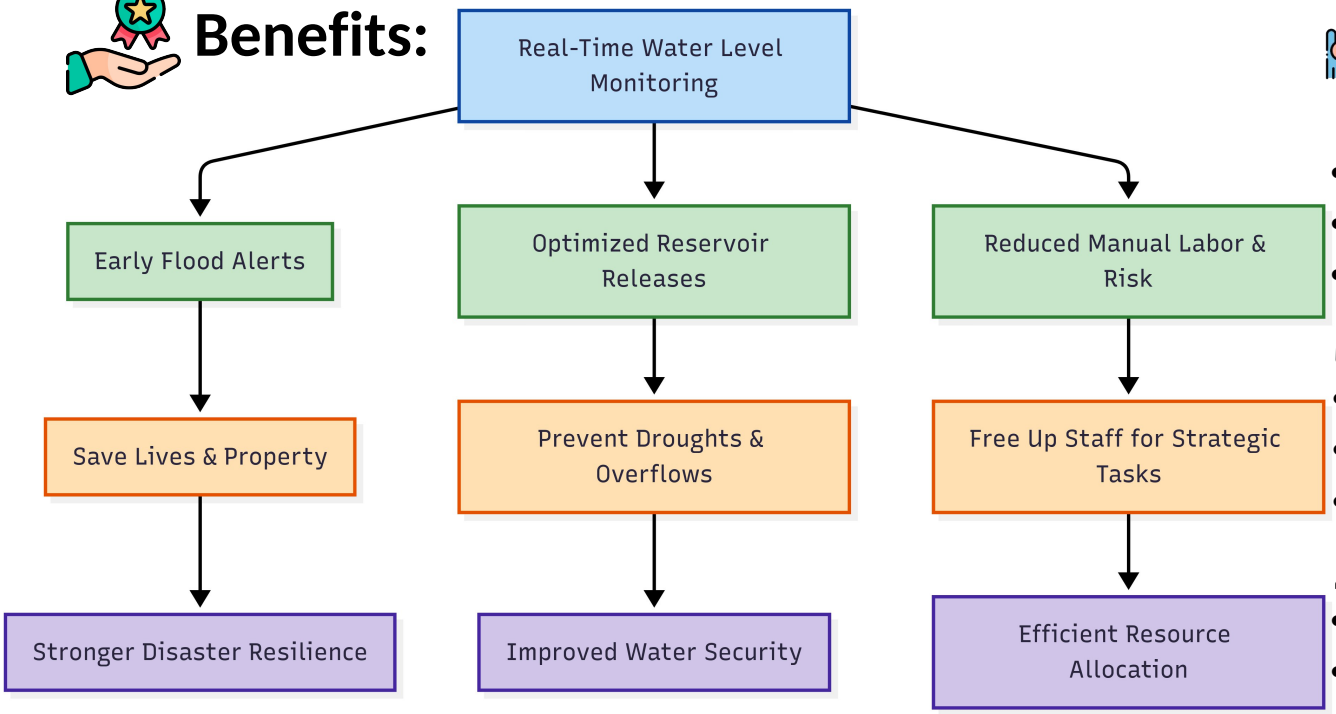
Benefits:



Benefits:

Environmental

- **Prevents uncontrolled flooding** → protects wetlands & biodiversity
- **Data-driven reservoir mgmt** → cuts water waste, boosts irrigation
- **Cuts carbon footprint** : no patrol vehicles or paper reports

Economic

- **Saves ₹50–100 Cr/year** per basin (NITI Aayog)
- **70%+ lower monitoring costs** → staff redeployed
- **Local jobs** via open-source, modular hardware

Social

- **Real-time flood alerts** for rural & vulnerable communities
- **Geofenced escalation:** Panchayat → District → State
- **Builds public trust** with transparent, auditable logs

Actual Impact on Target Audience :

CWC Field Staff: Shift from manual, risky night readings to remote monitoring — **80% reduction in field visits during monsoon**.
District Disaster Officers: Get actionable SMS/voice alerts with GPS + rate-of-rise — **30–60 mins faster response time.**
State Control Rooms: Real-time dashboard with historical trends — **enables proactive dam releases, not reactive evacuations.**
Local Communities: Receive community-level flood warnings via SMS or IVRS — **even without smartphones**.
Policy Makers: Access anonymized, high-frequency hydrological datasets for **climate adaptation planning**.

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RESEARCH AND REFERENCES

❖ References:

- https://legislative.gov.in/actsofparliamentfromtheyear/dam-safety-act-2021
- https://www.meity.gov.in/content/policy-on-adoption-of-open-source-software-for-government-of-india
- https://trai.gov.in/release-publication/reports/performance-indicators
- https://projects.worldbank.org/en/projects-operations/project-detail/P152698
- https://cwc.gov.in/flood-forecasting
- https://ndma.gov.in/Resources/Guidelines
- https://ksndmc.karnataka.gov.in/

🌍 Sustainable Development Goals Our project Tackles:

SDG 1 → Protects livelihoods (farmers/fishers/SMEs)
SDG 3 → Saves lives (flash flood alerts)
SDG 6 → Prevents water contamination
SDG 9 → Open-source, low-cost, local manufacturing
SDG 11 → Resilient cities → fewer displaced, less damage
SDG 13 → Real-time climate data → adapts to erratic rain
SDG 17 → PPP model → CWC + startups + NGOs co-deploy

❖ Comparison with other systems :

Key Capability	Varuna	Manual (CWC)	CWC Pilot IoT
Real-time automated readings	✔	✘	✔
Works during night / floods	✔	✘	✔
SMS alerts +voice call fallback	✔	✘	✘
Dual-sensor fault detection	✔	✘	✘
Hybrid power Backup	✔	✘	✘
Remote config via basic SMS	✔	✘	✘
Multi-tier emergency escalation	✔	✘	✘
Zero data loss (Offline logging)	✔	✘	✘
Vandal-proof +field-serviceable	✔	✘	⚠ **(Partial)**
Open-source & low-cost (<₹5k)	✔	✘	✘

❖ Please Refer to Our Github Repo for INDETAILED documentation And WEBSITE

https://github.com/AnuraagSun/Varuna