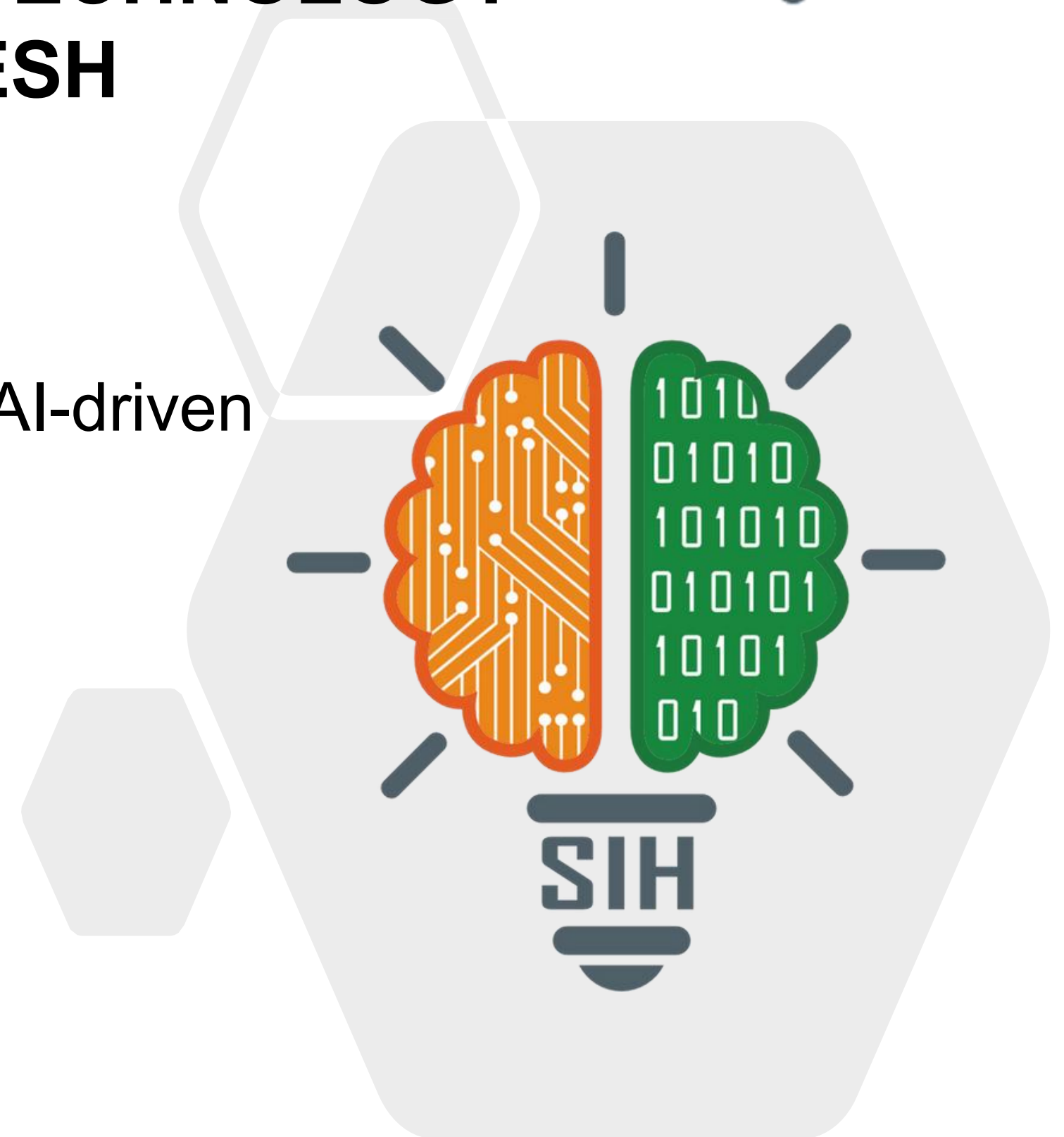# NATIONAL INSTITUTE OF TECHNOLOGY ANDHRA PRADESH

- **Problem Statement ID –** 25066

- **Problem Statement Title -** Developing an AI-driven ChatBot for INGRES as a virtual assistant

- **Theme -** Smart Automation

- **PS Category-** Software

- **Team ID - 100690**

- **Team Name -** NeuroNetics

AQUABOT – GROUNDWATER INSIGHTS CHATBOT

Idea

Real-time groundwater data assistant that uses AI to interpret user queries in natural language and converts them into actionable insights. It integrates with the INGRES database to deliver interactive maps, graphs, and trends, with explanations linked to verified sources. Designed with multilingual and voice support, it ensures easy access for farmers, policymakers, and NGOs, even in areas with limited internet connectivity.

Problems

- Complex and scattered groundwater data, difficult to navigate.
- Low tech literacy and limited internet access among users.
- Lack of transparency and trust in government data sources.
- Data inconsistencies and outdated information hinder decision-making.
- Limited access to localized and actionable groundwater insights for planning and conservation.

Solutions

- **AI Chatbot Integration:** Connects with the INGRES database to provide groundwater data instantly.
- **User-Friendly Interaction**: Supports natural language, multiple languages, and voice for easy access by all users.
- **Instant Insights**: Shows data through maps, graphs, and trends for quick understanding.
- **Explainable Results**: Links every answer to its data source to build trust and ensure accuracy.

TECHNICAL APPROACH

Neuro Netics

Tech Stack

Frontend:
- React + Streamlit for quick, responsive UI (web + PWA)

Backend:
- Python (FastAPI) for APIs
- LangChain for AI-driven query processing

AI Components:
- LLM-based Query Understanding (Ollama / other LLM API), MCP
- Retrieval-Augmented Generation (RAG) pipeline with INGRES database
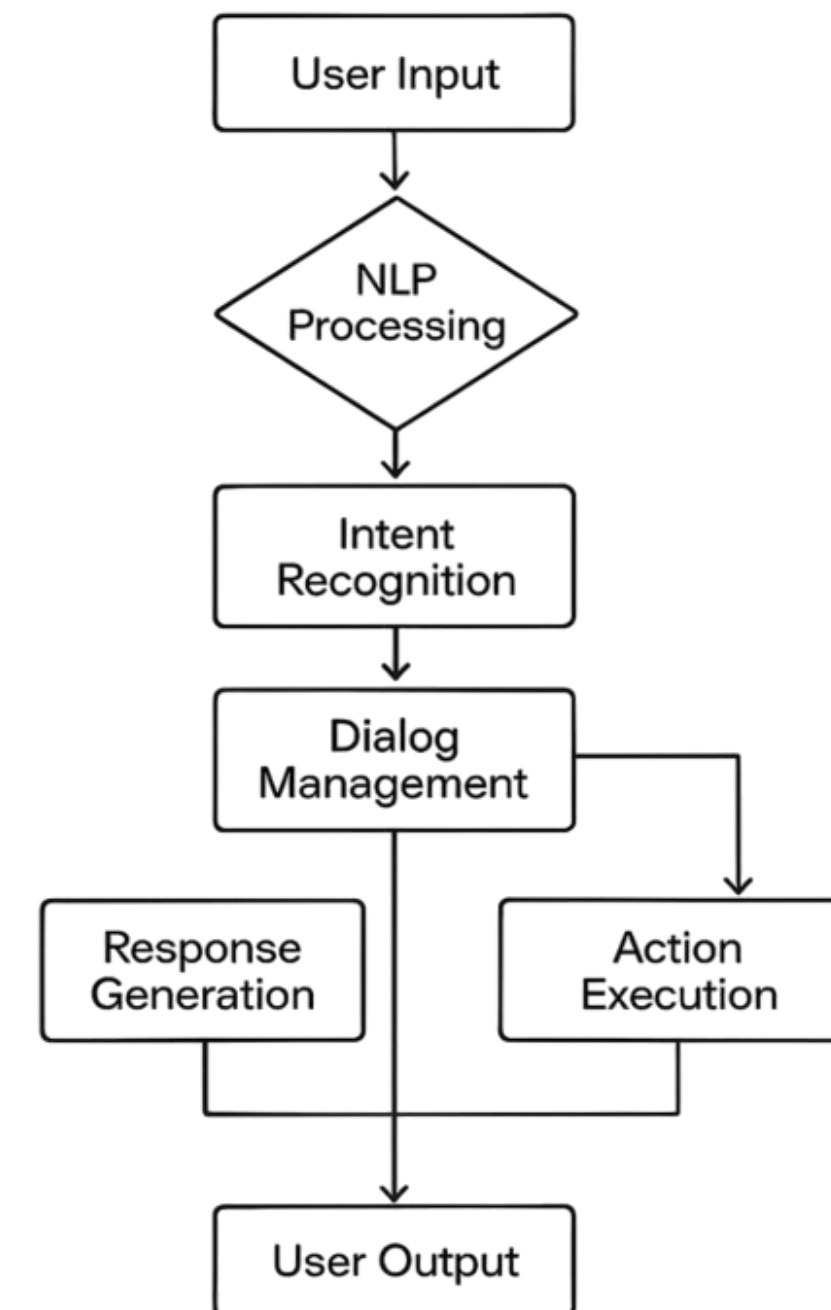- Multilingual support using Indic NLP libraries

Data Visualization:
- Plotly / Matplotlib for charts and graphs
- GIS Maps using Leaflet or Mapbox for spatial data

Database Integration:
- INGRES APIs for groundwater data access
- PostgreSQL for structured data storage

INGRES AI Chatbot

FEASIBILITY AND VIABILITY

Analysis of the feasibility - Highly feasible

1. **Structured Data from INGRES**: Existing groundwater datasets are well-organized, making integration simpler and faster.
2. **Open-Source Tools**: Using tools like FastAPI, LangChain, and GIS libraries speeds up development and reduces costs.
3. **Available LLM APIs**: Pre-built language models allow quick prototyping without building complex AI systems from scratch.
4. **Offline Caching Support**: Local data storage ensures usability even in areas with unstable or limited internet connectivity.

Potential challenges and risks

- Handling inconsistent or incomplete datasets
- Avoiding hallucinated or misleading AI responses.
- Scaling for large numbers of users in drought situations.
- Internet connectivity and device limitations in rural regions.

Strategies for overcoming these challenges

- Hybrid query system (SQL + AI fallback) ensures accuracy.
- Source transparency and timestamping increase trust.
- Lightweight UI with offline mode for slow networks.
- User onboarding via tutorials, FAQs, and community partnerships.

IMPACT AND BENEFITS

Impacts

- Democratizes access to groundwater information.

- Enables data-driven irrigation and conservation planning.

- Builds trust between citizens and government data systems.

- Empowers farmers, NGOs, and researchers with insights..

Benefits

- Social: Inclusive access to environmental data, fostering community participation.
- Economic: Reduces costs from over-extraction and inefficient irrigation.
- Environmental: Supports sustainable groundwater use and long-term water security.
- Governance: Encourages transparency and informed policy-making.

UNIQUENESS

- **Conversational AI Interface:** First chatbot designed specifically for groundwater data queries.
- **Hybrid RAG + SQL System**: Combines structured database queries with AI-driven understanding for accuracy.
- **Explainable & Trustworthy Results**: Shows data sources and visualizations to build user confidence.

- **Voice + Text Multilingual Access:** Accessible to users with low literacy or limited internet access via multiple languages.
- **Offline-First Design**: Provides key data even in rural areas with poor connectivity.
- **Offline-First Design**: Provides key data even in rural areas with poor connectivity.

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Research Papers

- NEP 2020: Data-driven decision support in rural development
- AI chatbots in governance (MIT, Stanford case studies)
- Explainable AI techniques in structured data querying
- Offline-first application design for low connectivity regions

Datasets

- INGRES Portal – https://ingres.iith.ac.in
- CGWB & IIT Hyderabad groundwater reports
- PostgreSQL documentation for structured queries
- LangChain: Retrieval-Augmented Generation (RAG) methods
- Indic NLP libraries for multilingual support
- Plotly, Matplotlib, Leaflet for visualization tools