SMART INDIA HACKATHON 2025

TITLE PAGE

- **Problem Statement ID: SIH25040**
- **Problem Statement Title: FloatChat - AI Powered Conversational Interface for ARGO Ocean Data Discovery and Visualization**
- **Theme: Miscellaneous**
- **PS Category: Software**
- **Team ID: 102665**
- **Team Name: Hacknovaters**

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FloatChat

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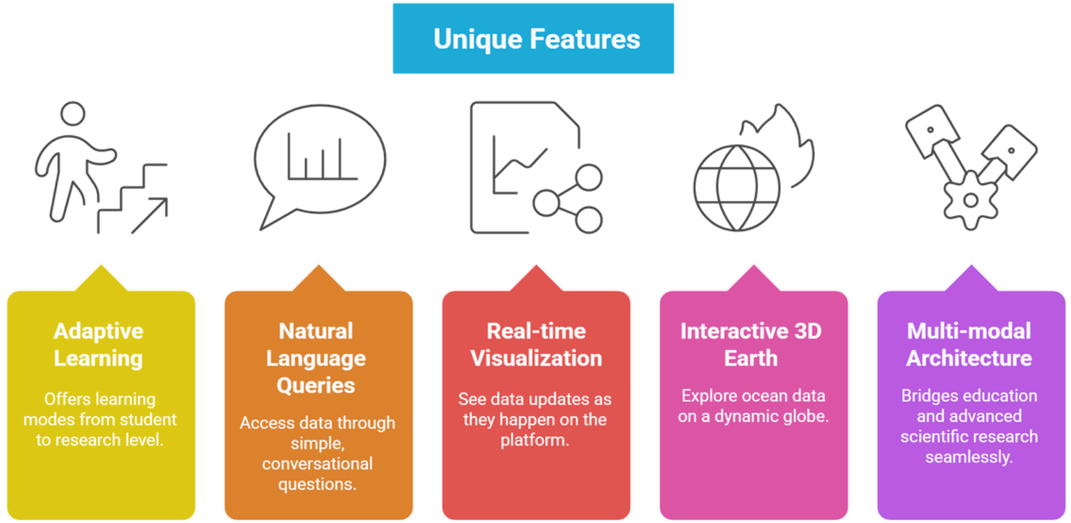
Problems

- **Complexity & Heterogeneity:**
  Oceanographic data comes from diverse sources (satellites, CTD casts, Argo floats, BGC sensors), making it **highly variable in format and structure.**
- **Volume & Velocity:**
  The datasets are **vast, frequently updated, and cumbersome** to query or process manually.
- **Accessibility & Usability:**
  Effective **querying, visualization, and interpretation** require significant domain expertise and technical skills, creating barriers for non-specialist users.



Solutions

- **Automated Data Ingestion & Structuring:**
  Reat-time access of latest ARGO NetCDF files from multiple data sources (e.g., ERDDAP, Argovis) and missions (Deep, BGC, Core), converting them into **structured SQL** and DataFrame formats suitable for analysis.
- **Guided Exploration**
  Offer **adaptive modes** tailored for students and researchers, so everyone from beginners to experts can ask questions in plain language.
- **Immersive 3D Globe Exploration**
  Visualize ARGO float profiles, temperature, pressure and salinity data on an **interactive globe**, enabling users to intuitively explore ocean patterns in three dimensions.
- **Conversational Discovery:**
  Enable a simple chat interface that turns natural language queries into **meaningful scientific insights, with interactive graphs and visualizations** to eliminate steep learning curves.
- **Voice-Enabled Interaction:**
  Allow users to input queries and commands using their voice, making data exploration even more accessible and intuitive.

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Technical Approach

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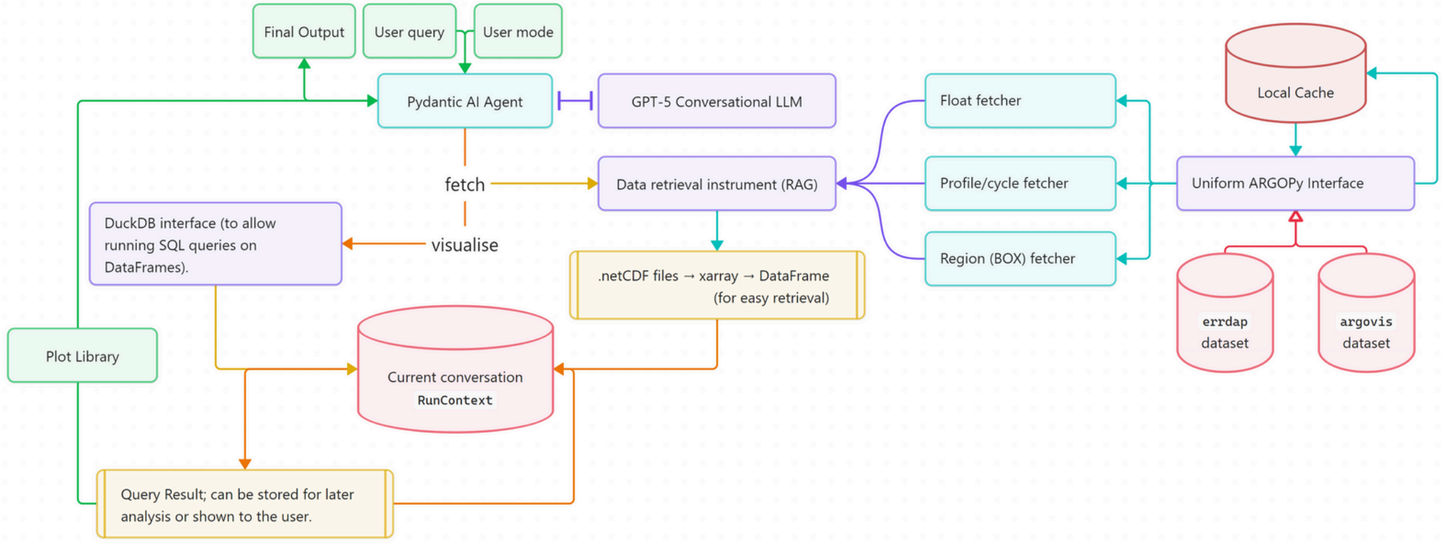
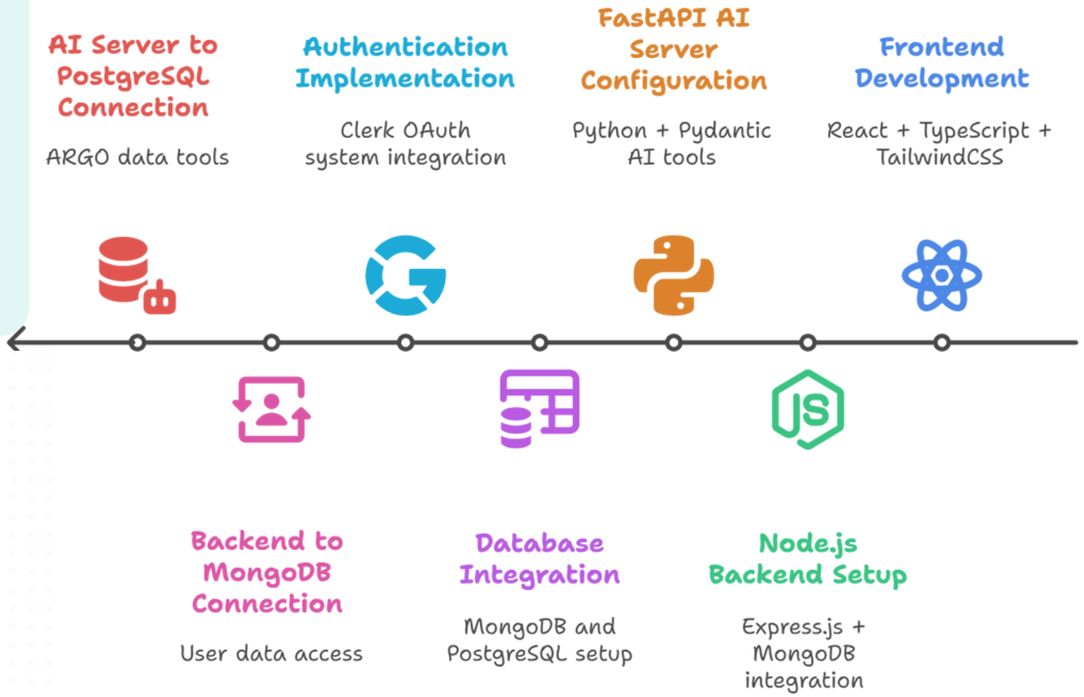
Tech Stack

Frontend: React JS, TailwidCSS, React-globe.gl, Typescript
Nodejs Server: Express JS, Mongodb, Mongoose, Axios
FastAPI Server: Python, Pydantic AI fastapi, argopy, argovis, pandas, duckDB (SQL Queries)
Database: MongoDB - chat history and messages
PostgreSQL - argo data, PostGIS for spatial queries
Authentication: Clerk, OAuth integration



FastAPI Server Architecture

FloatChat System Architecture



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FEASIBILITY AND VIABILITY

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💡 FEASIBILITY

- Uses a proven tech stack (**FastAPI, PostgreSQL, ReactJs, NodeJs**) ensuring reliability and scalability.
- Dashboard with globe visualization makes ARGO data **intuitive** and **accessible** for both experts and non-experts.
- **Multi-mode system** (Student, Research, Combined) increases adaptability for diverse use cases.

⚠️ CHALLENGES & RISKS

- Handling **large, heterogeneous NetCDF datasets** may cause slow ingestion and processing.
- Risk of inaccurate or ambiguous responses from **LLM-driven** query translation.
- **Infrastructure and hosting costs** may rise with large-scale deployment.

🎯 STRATEGIES FOR OVERCOMING CHALLENGES

- Pre-process and store data in optimized formats (**SQL/Dataframes**) to improve performance.
- Apply **validation layers**, **query templates**, and **guardrails** to reduce LLM errors.
- Use **scalable cloud deployment** and **open-source models** to manage costs effectively

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IMPACT AND BENEFIT

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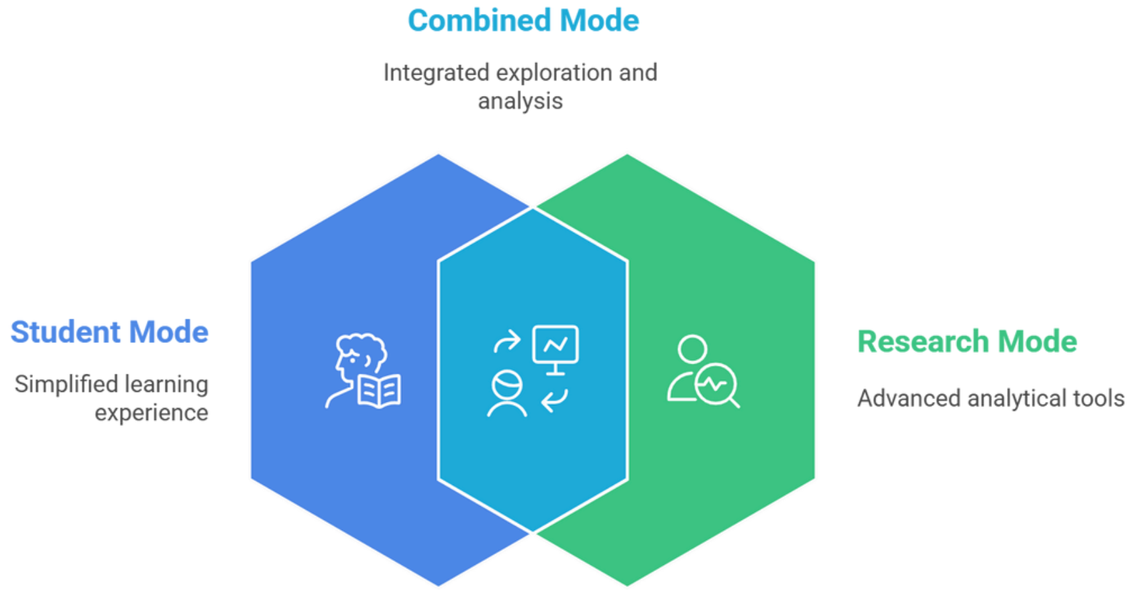
AI-Driven Data Discovery - Natural language querying reduces technical barriers, empowering wider communities to access oceanographic knowledge.

- **Global Ocean Insights** -Interactive globe dashboard visualizes ARGO floats worldwide, making ocean data more engaging and informative.
- **Improved Decision-Making** - Supports climate studies, marine policy, and environmental monitoring with real-time, actionable insights.
- **Educational & Research Utility** - Serves as both a teaching aid for students and a powerful tool for oceanographers to analyze trends and anomalies.

Unlocking Multi-Mode Accessibility for All



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RESEARCH AND REFERENCES

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- International Argo Program Data:https://www.seanoe.org/data/00311/42182/
- Indian Argo Program:https://incois.gov.in/OON/index.jsp/
- Argo Global Data Repository: ftp.ifremer.fr/ifremer/argo
- Main BioChemicalData (BCG) and Deep ARGO mission source: https://erddap.ifremer.fr/erddap/index.html
- High quality dataset source (for Research mode): https://argovis.colorado.edu/
- Argo GDAC Geo Directory: https://data-argo.ifremer.fr/geo/

Live Link:
GitHub repository: https://github.com/swastikiscoding/FloatChat-SIH
Demo Video: https://youtu.be/2Erm-SDJqcY