SMART INDIA HACKATHON 2023

# Basic Details of the Team and Problem Statement

**Ministry/Organization Name :** Ministry of Mines

**PS Code :** SIH1339

**Problem Statement Title :** Automation of drill core rock sample lithology logging

**Team Name :** NeuroTech

**Team Leader Name :** Sayan Mandal

**Institute Code (AISHE) :** U-0796

**Institute Name :** Indian Institute of Information Technology, Kalyani

**Theme Name :** Transportation & Logistics

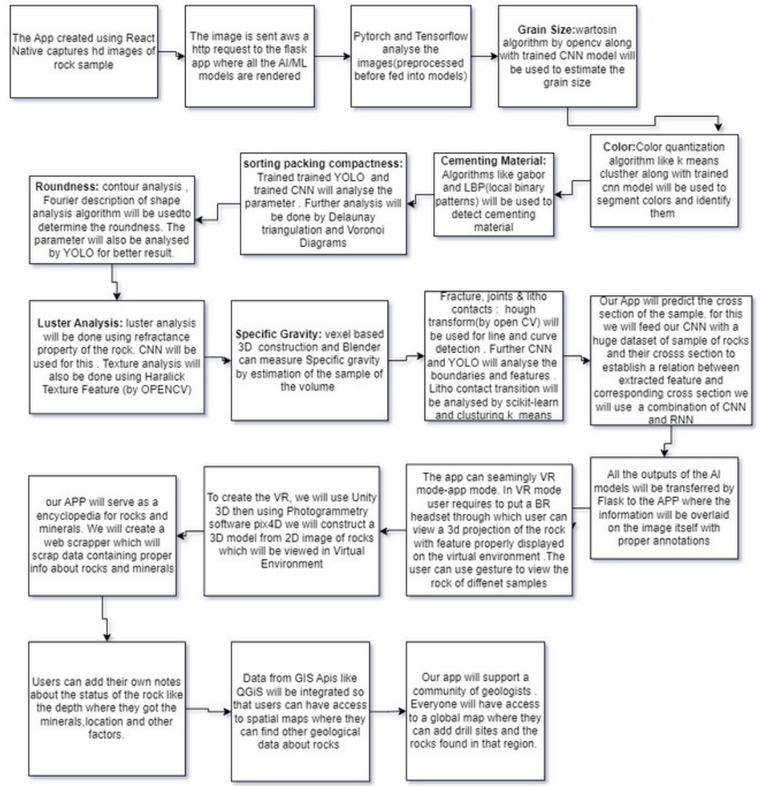
# Idea/Approach Details:

**GeoVisionPro** revolutionizes geological exploration at drill rock sites. With powerful AI-driven technology, it **automates the rock detection process**, saving time and enhancing accuracy. Geologists can **easily scan, analyze, and identify rock samples using advanced algorithms**. The Global Geological Map allows users to **share drill locations and rock findings**, fostering collaboration and data integrity through blockchain technology. It's the ultimate tool for geologists to streamline their work and connect with a global community of rock enthusiasts.

## *Features of GeoVisionPro :*

- ***Core Sample Analysis:*** Our app offers **comprehensive core sample analysis** by utilizing computer vision techniques. It identifies and **classifies rock types, recognizes geological discontinuities** such as fractures and faults, and assesses characteristics like grain size, color, sorting, packing, compactness, roundness, luster, and specific gravity. Users can access **real-time analysis results**, **providing immediate insights into core samples' properties.**
- ***Virtual 3D Projection:*** The app provides a **unique virtual reality experience by creating 3D projections of rock samples**. These projections allow users to **explore and interact with rocks in a virtual environment**, making it easier to visualize and understand their features, including fractures, joints, and more. This feature enhances geological research and education.
- ***Virtual Drill Library:*** We've incorporated a virtual drill library **containing a vast repository of information about rocks, deposits, and research papers** from around the world. Geologists can **access a wealth of data to support their research and studies**, enhancing their knowledge and understanding of geological phenomena.
- ***Global Geological Map:*** The app includes a **global geological map that serves as a hub for geologists to connect and collaborate**. Users can share their geological findings and locate them on the map. This feature **fosters knowledge exchange and contributes to a comprehensive geological database**, benefiting researchers and enthusiasts worldwide.
- ***Web Scraping Integration:*** To populate the virtual drill library, we've integrated web scraping capabilities. The app **collects data from reputable geological sources like Mindat and integrates this information into the library**, ensuring that users have access to the **latest geological data and research.**
- ***GIS Integration:*** Geographic Information System (GIS) APIs enhance the app's geospatial capabilities. Users can **view geological findings on an interactive map, making it easier to interpret data in the context of their geographical location**. The GIS API also supports location-based services, geocoding, routing, and geospatial analysis.
- ***Natural Language Processing (NLP):*** NLP technologies are employed to **retrieve relevant data from the virtual drill library and GIS** when users scan a rock. This ensures that **users receive valuable information and insights about the geological findings** they encounter, enhancing their research and understanding.
- ***Blockchain Data Provenance:*** We implement **blockchain technology to create an immutable ledger of geological data**. This ledger records the history of data changes, allowing users to trace the origin and modifications of geological information. This **enhances data security and transparency**.
- ***Predictive Cross-Section:*** The app offers **predictive modeling to visualize cross-sections of rocks**. When a rock is scanned, the app generates and displays images of cross-sections, **enabling users to explore the internal structure and features of rocks without the need for physical sampling.**
- ***Community:*** Within our app, geologists can join a **thriving community of like-minded professionals and enthusiasts**. This community serves as a hub for knowledge exchange, collaboration, and networking. Geologists can **share their findings, insights, and experiences with peers from around the world.**
- ***Global Geological Map:*** The heart of our app is the Global Geological Map, a **dynamic tool that displays drill locations from around the world**. Users can add their own drill locations and the rock samples extracted from those sites. Here's how it works:
- ***Worldwide Drill Locations:*** The map **showcases drill sites from various corners of the globe**. Users can explore these locations to see where geological research and exploration are actively taking place.
- ***User Contributions:*** Geologists and rock enthusiasts **can add their own drill locations to the map**. When they extract a rock sample, they can geotag the location, **making it visible to the global geological community.**
- ***Virtual Rock Repository:*** For each drill location, **users can upload information about the rock samples they've collected**. This includes details about the type of rock, its properties, and any unique findings**.**

# Flowchart




# Tech Stack

# Idea/Approach Details:

## Use Cases:

- ***Automated Core Sample Analysis:*** Geologists conducting fieldwork can **quickly analyze core samples using the app's computer vision techniques.** By scanning the samples, they receive **instant and accurate information about rock types, grain size, color, and other properties,** aiding in real-time lithological analysis.
- ***Educational Virtual Reality Experience:*** Students and researchers **can use the Virtual 3D Projection feature to explore virtual rock samples**. They can **interact with different rock types, inspect fractures and joints, and understand lithological characteristics** in a visually engaging manner, enhancing their geological education.
- ***Research Database Access:*** Researchers working on lithological studies **can access the Virtual Drill Library, which contains a vast repository of research papers and rock information**. They can gather data on specific lithological formations, aiding in in-depth analysis and comparative studies.
- ***Collaborative Data Sharing:*** Geologists working on similar lithological formations in different parts of the world can share their findings on the Global Geological Map. **By adding drill locations and rock samples to the map, they create a collaborative platform for comparing lithological data** globally, promoting knowledge exchange.
- ***Enhanced Field Surveys with GIS Integration:*** During field surveys, geologists can **use the GIS Integration feature to overlay geological findings on interactive maps.** This helps them visualize lithological variations in the context of geographical locations, assisting in comprehensive geological mapping and exploration.
- ***Efficient Literature Review with NLP:*** Researchers conducting literature reviews on specific lithological topics can **utilize NLP technologies to retrieve relevant research papers and publications from the Virtual Drill Library**. This accelerates the research process, ensuring access to the latest studies and findings related to specific lithological characteristics.
- ***Blockchain-Verified Lithological Data:*** Geologists collecting lithological data can **store their findings on the app's blockchain ledger**. The blockchain data provenance ensures the integrity and authenticity of the data, making it **reliable for future reference and research**, thereby enhancing the credibility of lithological studies.
- ***Predictive Lithological Modeling:*** Geologists interested in understanding subsurface lithological structures can use the Predictive Cross-Section feature. **By scanning surface rocks, the app generates cross-sectional images, aiding in predictive modeling of subsurface lithological formations** without the need for invasive drilling, saving time and resources.
- ***Community-driven Lithological Knowledge Exchange:*** Geologists interested in a specific lithological area can join the community within the app. They can **share their lithological findings, discuss unique lithological features, and collaborate on research projects**, fostering a vibrant community dedicated to advancing lithological knowledge and understanding.

## Dependencies / Show stopper:

- ***Data Accuracy and Quality:*** Inaccurate or **unreliable geological data** could lead to erroneous analysis and misinformed decisions, undermining the credibility of the app**.**
- ***Security Concerns:*** Given the sensitive nature of geological data, ensuring robust security measures to **protect user information and prevent unauthorized acces**s or data breaches is paramount.
- ***Legal and Ethical Compliance:*** Adhering to **legal regulations regarding data usage, copyright issues related to research papers, and ethical considerations** in geological research is crucial to avoid legal complications.
- ***User Adoption:*** If the app's **interface is not user-friendly or lacks intuitive design**, it might deter users from adopting the app, hindering its widespread use and impact.
- ***Technical Glitches:*** Unexpected **technical issues, bugs, or system failures could disrupt the app's functionality**, leading to a poor user experience and loss of user trust.
- ***Data Privacy:*** Ensuring **user privacy and obtaining necessary consents for data collection and usage is vital t**o comply with data protection laws and maintain user trust.

# Team Members

***Team Leader Name*** **:** *Sayan Mandal*
***Branch :*** *B.Tech* ***Stream :*** *ECE* ***Year :*** *2nd*

***Team Member 1 Name*** **:** *Abhrasnata Ray*
***Branch :*** *B.Tech* ***Stream :*** *ECE* ***Year :*** *2nd*

***Team Member 2 Name*** **:** *Sreeja Mondal*
***Branch:*** *B. Tech* ***Stream :*** *ECE* ***Year :*** *2nd*

***Team Member 3 Name*** **:** *Soumyadeep Sen*
***Branch :*** *B. Tech* ***Stream:*** *CSE* ***Year :*** *2nd*

***Team Member 4 Name*** **:** *Sayan Sarkar*
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***Team Member 5 Name*** **:** *Debraj Bose*
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**Team Mentor 1 Name:** Chandrim Bannerjee
**Category :** Industry **Expertise :** Artificial Intelligence and Machine Learning, Generative AI , Smart City Advisor and Smart Grid Advisor.
**Domain Experience (in years):** 27 years

**Team Mentor 2 Name:** Manas Kumar Das
**Category :** Industry **Expertise :** IT Industry, CEO of Exabyte Infotech PVT.LTD.
**Domain Experience (in years):** 32 years