LIFELINE MEDS

DRONACHARYA College of Engineering

SMART INDIA HACKATHON 2023

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Sahil Aggarwal
Aaryan Nara
Saurabh Parmar
Manas Thakur

Team Mentors:- Dr Manoj Kumar
Tamanna Sehgal

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Problem Statement:-

The lithology of drilled core samples in exploration is usually identified on the basis of grain size, colour, cementing material, mixing of grains of different sizes (sorting), packing and compactness of grains roundness of grains. The Lustre and specific gravity of the sample also play a crucial role in the identification of core rock samples with respect to dimensions. The geological discontinuities are identified on the basis of fractures, joints, and litho-contacts. Hence, the development of a device assembly, that scans the drill core rock sample and identity the lithology and geological discontinuities on the basis of above said parameters by the artificial intelligence with given standards.

Solution:-

- **Software Platform for Image Analysis:**
  - Developing a tool to analyse drill core images using different techniques.
- **CNNs for Lithology Sorting:**
  - Using CNNs to organize rock types in visible light images based on colour and texture.
- **Mineral Classification in Hyperspectral Data:**
  - Creating a system to identify minerals and rock types in detailed hyperspectral data using machine learning.
- **CNN-Based Model for Discontinuity Detection:**
  - Designing a model using CNNs to spot geological features like fractures in visible light images.
- **Real-Time Analysis Interface:**
  - Building an interface for instant analysis of core samples.
- **User-Friendly Interface for Geologists:**
  - Developing an easy-to-use platform for geologists to upload images, checking AI reports, and collaborating.
- **Secure Data Storage:**
  - Establishing a secure storage system for images and results, ensuring privacy and enabling detailed geological reports.

Roadm

1. **Develop Software**
•Multi-source imag
•Incorporate variou
techniques
2. **Lithology Sortin**
•Train CNNs for visi
•Sort lithology base
grain characteristic
3. **Hyperspectral M**
•Build a module for
classification
•Utilize detailed spe
wavelengths
4. **Geological Disco**
•Design CNN-based
•Identify fractures
images
5. **Real-Time Analy**
•Create an interface
analysis
•Ensure seamless in

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Roadmap

1. Develop Software Platform
•Multi-source image analysis
•Incorporate various image processing techniques
2. Lithology Sorting with CNNs
•Train CNNs for visible light images
•Sort lithology based on colour, texture, and grain characteristics
3. Hyperspectral Mineral Classification
•Build a module for mineral and lithology classification
•Utilize detailed spectrum information across wavelengths
4. Geological Discontinuity Detection
•Design CNN-based model
•Identify fractures and joints in visible light images
5. Real-Time Analysis Integration
•Create an interface for instant core sample analysis
•Ensure seamless integration with AI models
6. User-Friendly Geologist Interface
•Develop an intuitive platform
•Enable geologists to upload images, review reports, and collaborate
7. Secure Data Storage
•Establish a secure storage system
•Safeguard images, results, and user interactions
8. Generate Detailed Reports
•Enable comprehensive lithology and geology reports
•Provide valuable insights for exploration activities
9. Continuous Improvement
•Gather feedback from geologists
•Iterate on the system for enhanced performance
10. Deployment and Training
•Deploy the system for field use
•Provide training and support for users

Technolo

- **Programm**
  - Pytho
  - JavaSc
- **ML & DL**
  - Tenso
  - Scikit-
- **Image Pr**
  - Opene
- **Web Dev**
  - MERN
    Node.
- **App Deve**
  - React
- **Database**
  - Mong

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Technology stack

- **Programming Languages:**
  - Python
  - JavaScript
- **ML & DL Frameworks:**
  - TensorFlow or PyTorch
  - Scikit-learn
- **Image Processing Libraries:**
  - OpenCV
- **Web Development (User Interface):**
  - MERN (MongoDB, Express.js, React, Node.js)
- **App Development (User Interface):**
  - React Native
- **Database:**
  - MongoDB

Features

- **Multi-Source Fu**
  - Integrates assessme
- **Adaptive Image**
  - Uses adap dynamic a
- **Hybrid CNN Mo**
  - Combines for sortin
- **Spectral Intellige**
  - Leverages precise cl
- **Fracture and Join**
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Features

- **Multi-Source Fusion:**
  - Integrates data for more accurate assessments.
- **Adaptive Image Processing:**
  - Uses adaptive techniques for dynamic enhancement.
- **Hybrid CNN Models:**
  - Combines colour, texture, and grain for sorting.
- **Spectral Intelligence:**
  - Leverages detailed spectrum info for precise classification.
- **Fracture and Joint Proficiency:**
  - Specialized models for identifying fractures and joints.
- **Real-Time Integration Agility:**
  - Enables swift integration with evolving AI models.
- **Intuitive Collaboration Hub:**
  - User-friendly interface for seamless collaboration.
- **Secure Data Vault:**
  - Safeguards images and results with robust privacy measures.
- **Comprehensive Reporting Engine:**
  - Generates detailed lithology and geology reports.
- **Feedback-Driven Evolution:**
  - Gathers user feedback for iterative improvements.
- **End-to-End Support:**
  - Provides full support from deployment to user training.

Market In
- **Efficiency and**
  - Reduce
- **Exploration E**
  - Improve
- **Technology A**
  - Lead in
- **Competitive**
  - Streamli
- **Data-Driven**
  - Provide
- **Risk Mitigatio**
  - Mitigate
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Market Impact

- **Efficiency and Cost Savings:**
  - Reduce manual analysis time and costs.
- **Exploration Effectiveness:**
  - Improve accuracy for better mineral exploration.
- **Technology Adoption:**
  - Lead in AI adoption for geological exploration.
- **Competitive Advantage:**
  - Streamline operations for a competitive edge.
- **Data-Driven Insights:**
  - Provide insights into subsurface conditions.
- **Risk Mitigation:**
  - Mitigate exploration and mining risks.
- **Market Differentiation:**
  - Stand out with advanced exploration solutions.
- **Increased Productivity:**
  - Focus experts on higher-level analysis.
- **Global Accessibility:**
  - Enable remote collaboration for global teams.
- **Technology Transfer:**
  - Extend applications beyond mining industry.

Future Sc

- **Advanced AI M**
  - Ongoing r
- **Integration wit**
  - Explore p integratio
- **Broader Geolog**
  - Extend te broader g
- **Real-Time Fiel**
  - Develop r analysis.
- **IoT Integration**
  - Integrate comprehe
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- **Advanced AI Models:**
  - Ongoing refinement for higher accuracy.
- **Integration with Technologies:**
  - Explore quantum or edge computing integration.
- **Broader Geological Applications:**
  - Extend technology to borehole data and broader geological studies.
- **Real-Time Field Analysis:**
  - Develop portable AI systems for on-site analysis.
- **IoT Integration:**
  - Integrate with IoT devices for comprehensive data.
- **Advanced Visualization Tools:**
  - Develop intuitive tools for data interpretation.
- **Global Collaboration Platforms:**
  - Facilitate real-time global collaboration.
- **Automated Reporting Systems:**
  - Implement systems for detailed automated reports.
- **Expanded Industry Adoption:**
  - Standardize practices across the industry.
- **Integration with Mining Operations:**
  - Seamlessly integrate with mining planning and operations.
- **Environmental Impact Assessment:**
  - Assess environmental impact for responsible mining.
- **Training and Skill Development:**
  - Develop training programs for geologis
- **Regulatory Compliance Tools:**
  - Tools for accurate and standardized assessments.
- **Cross-Industry Collaboration:**
  - Explore collaborations with related industries.

Use Case

- **Mineral Exp**
  - Identify
- **Constructio**
  - Ensure
- **Environmer**
  - Analyse environ
- **Hydrocarbo**
  - Detect
- **Geological**
  - Facilita
- **Real-Time D**
  - Guide
- **Educational**
  - Assist feature

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Use Cases

- **Mineral Exploration:**
  - Identify valuable minerals in rocks efficiently.
- **Construction Material Assurance:**
  - Ensure rock material suitability for construction.
- **Environmental Impact Analysis:**
  - Analyse soil and rock contamination for environmental impact.
- **Hydrocarbon Reservoir Detection:**
  - Detect subsurface hydrocarbon reservoirs.
- **Geological Research Support:**
  - Facilitate research through core sample analysis.
- **Real-Time Drilling Guidance:**
  - Guide drilling rigs in real-time.
- **Educational Support:**
  - Assist geology students in learning lithology and feature detection.

How U

1.Dashboard
1. Clean
2.Navigation
1. User
3.Image Uplo
1. Simpl
4.Analysis Re
1. Clear
5.Collaborati
1. Real-
6.Data Contro
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7.Reporting:
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reports
8.Feedback S
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How UI looks?

1.Dashboard:
1. Clean, intuitive overview.

2.Navigation:
1. User-friendly for easy exploration.

3.Image Upload:
1. Simple section for drill core image uploads.

4.Analysis Results:
1. Clear display of AI-generated results.

5.Collaboration Hub:
1. Real-time space for geologist collaboration.

6.Data Controls:
1. Secure storage and privacy settings.

7.Reporting:
1. Integrated module for lithology and geology reports.

8.Feedback Section:
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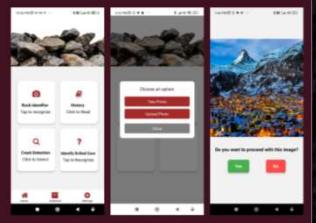
9.Real-Time Guidance:
1. Module for drilling rig guidance.

10.Educational Resources:
1. Section supporting geology student learning.



Rock Cla Model

- Import Libraries:
  - Tensorf
  - Keras pre
  - MobileNet
- Load Pre trained M
  - Use Mobil
  - Exclude to
- Model Customizatio
  - Freeze Ba
  - Add Custo
- Compile Model:
  - Adam opti
  - Monitor ac
- Data Augmentation
  - Create Ima
  - Apply real
- Load Images:
  - Load train
- Define Callbacks:
  - Set Early
- Initial Training Pha
  - Train with
  - Apply call
- Optional Fine-tunin
  - Unfreeze
  - Recompile
- Save Model:
•Save the trained mod

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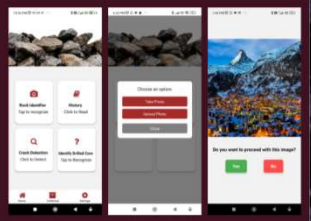

Rock Classification Model

- **Import Libraries:**
  - TensorFlow for model building
  - Keras preprocessing for image handling
  - MobileNetV2 model for transfer learning
- **Load Pre-trained Model:**
  - Use MobileNetV2 pre-trained on ImageNet
  - Exclude top layers for customization
- **Model Customization:**
  - Freeze Base Model Layers
  - Add Custom Layers: Flatten, Dense, Dropout
- **Compile Model:**
  - Adam optimizer, categorical cross-entropy loss
  - Monitor accuracy during training
- **Data Augmentation & Preparation:**
  - Create ImageDataGenerators for training/validation
  - Apply real-time augmentation transformations
- **Load Images:**
  - Load training and validation images from directories
- **Define Callbacks:**
  - Set EarlyStopping and ReduceLROnPlateau
- **Initial Training Phase:**
  - Train with frozen base layers
  - Apply callbacks during training
- **Optional Fine-tuning:**
  - Unfreeze top base layers for further training
  - Recompile with lower learning rate
- **Save Model:**
  - Save the trained model for future use or deployment.

Drilled Ro Detection

- **Input:**
  - Raw data
- **Preprocessing**
  - Resize a
- **CNN Processi**
  - CNN ana normaliz
  - Extracts
- **Feature Extra**
  - CNN cap
- **Bounding Bo**
  - Predicts
- **Non-Max Sup**
  - Resolves
- **Output:**
  - Processe
- **Postprocessin**
  - Addition

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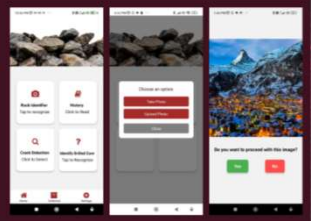

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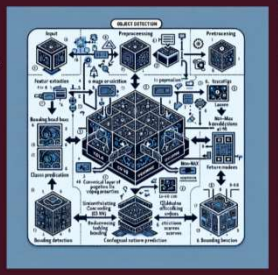

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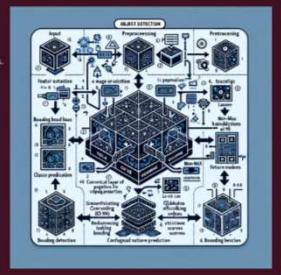

Model Outcome images

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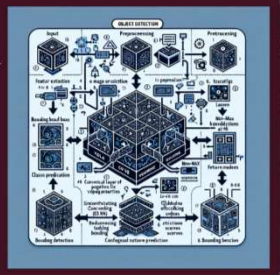

Model Outcome images

RESULT

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Model Outcome images

RESULT

Thankyou

Problem Statement:-

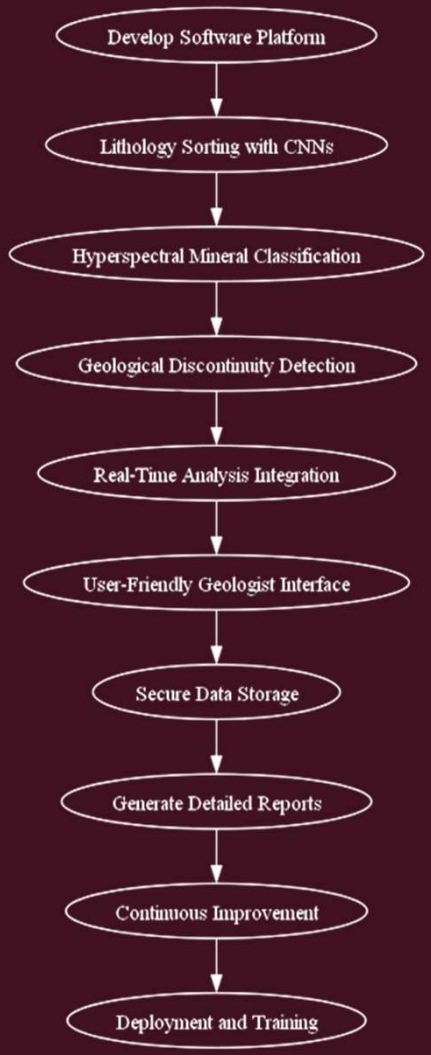
The lithology of drilled core samples in exploration is usually identified on the basis of grain size, colour, cementing material, mixing of grains of different sizes (sorting), packing and compactness of grains roundness of grains. The Lustre and specific gravity of the sample also play a crucial role in the identification of core rock samples with respect to dimensions. The geological discontinuities are identified on the basis of fractures, joints, and litho-contacts. Hence, the development of a device assembly, that scans the drill core rock sample and identity the lithology and geological discontinuities on the basis of above said parameters by the artificial intelligence with given standards.

Solution:-

- **Software Platform for Image Analysis:**
  - Developing a tool to analyse drill core images using different techniques.
- **CNNs for Lithology Sorting:**
  - Using CNNs to organize rock types in visible light images based on colour and texture.
- **Mineral Classification in Hyperspectral Data:**
  - Creating a system to identify minerals and rock types in detailed hyperspectral data using machine learning.
- **CNN-Based Model for Discontinuity Detection:**
  - Designing a model using CNNs to spot geological features like fractures in visible light images.
- **Real-Time Analysis Interface:**
  - Building an interface for instant analysis of core samples.
- **User-Friendly Interface for Geologists:**
  - Developing an easy-to-use platform for geologists to upload images, checking AI reports, and collaborating.
- **Secure Data Storage:**
  - Establishing a secure storage system for images and results, ensuring privacy and enabling detailed geological reports.

Roadmap

1. Develop Software Platform
•Multi-source image analysis
•Incorporate various image processing techniques
2. Lithology Sorting with CNNs
•Train CNNs for visible light images
•Sort lithology based on colour, texture, and grain characteristics
3. Hyperspectral Mineral Classification
•Build a module for mineral and lithology classification
•Utilize detailed spectrum information across wavelengths
4. Geological Discontinuity Detection
•Design CNN-based model
•Identify fractures and joints in visible light images
5. Real-Time Analysis Integration
•Create an interface for instant core sample analysis
•Ensure seamless integration with AI models
6. User-Friendly Geologist Interface
•Develop an intuitive platform
•Enable geologists to upload images, review reports, and collaborate
7. Secure Data Storage
•Establish a secure storage system
•Safeguard images, results, and user interactions
8. Generate Detailed Reports
•Enable comprehensive lithology and geology reports
•Provide valuable insights for exploration activities
9. Continuous Improvement
•Gather feedback from geologists
•Iterate on the system for enhanced performance
10. Deployment and Training
•Deploy the system for field use
•Provide training and support for users



Technology stack

- **Programming Languages:**
  - Python
  - JavaScript
- **ML & DL Frameworks:**
  - TensorFlow or PyTorch
  - Scikit-learn
- **Image Processing Libraries:**
  - OpenCV
- **Web Development (User Interface):**
  - MERN (MongoDB, Express.js, React, Node.js)
- **App Development (User Interface):**
  - React Native
- **Database:**
  - MongoDB

Features

- **Multi-Source Fusion:**
  - Integrates data for more accurate assessments.
- **Adaptive Image Processing:**
  - Uses adaptive techniques for dynamic enhancement.
- **Hybrid CNN Models:**
  - Combines colour, texture, and grain for sorting.
- **Spectral Intelligence:**
  - Leverages detailed spectrum info for precise classification.
- **Fracture and Joint Proficiency:**
  - Specialized models for identifying fractures and joints.
- **Real-Time Integration Agility:**
  - Enables swift integration with evolving AI models.
- **Intuitive Collaboration Hub:**
  - User-friendly interface for seamless collaboration.
- **Secure Data Vault:**
  - Safeguards images and results with robust privacy measures.
- **Comprehensive Reporting Engine:**
  - Generates detailed lithology and geology reports.
- **Feedback-Driven Evolution:**
  - Gathers user feedback for iterative improvements.
- **End-to-End Support:**
  - Provides full support from deployment to user training.

Market Impact

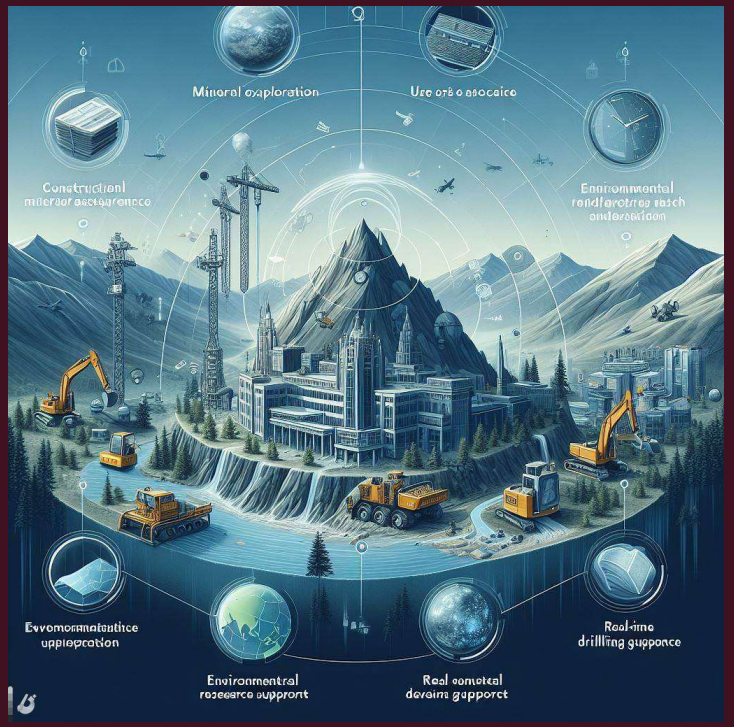
- **Efficiency and Cost Savings:**
  - Reduce manual analysis time and costs.
- **Exploration Effectiveness:**
  - Improve accuracy for better mineral exploration.
- **Technology Adoption:**
  - Lead in AI adoption for geological exploration.
- **Competitive Advantage:**
  - Streamline operations for a competitive edge.
- **Data-Driven Insights:**
  - Provide insights into subsurface conditions.
- **Risk Mitigation:**
  - Mitigate exploration and mining risks.
- **Market Differentiation:**
  - Stand out with advanced exploration solutions.
- **Increased Productivity:**
  - Focus experts on higher-level analysis.
- **Global Accessibility:**
  - Enable remote collaboration for global teams.
- **Technology Transfer:**
  - Extend applications beyond mining industry.

Future Scope

- **Advanced AI Models:**
  - Ongoing refinement for higher accuracy.
- **Integration with Technologies:**
  - Explore quantum or edge computing integration.
- **Broader Geological Applications:**
  - Extend technology to borehole data and broader geological studies.
- **Real-Time Field Analysis:**
  - Develop portable AI systems for on-site analysis.
- **IoT Integration:**
  - Integrate with IoT devices for comprehensive data.
- **Advanced Visualization Tools:**
  - Develop intuitive tools for data interpretation.
- **Global Collaboration Platforms:**
  - Facilitate real-time global collaboration.
- **Automated Reporting Systems:**
  - Implement systems for detailed automated reports.
- **Expanded Industry Adoption:**
  - Standardize practices across the industry.
- **Integration with Mining Operations:**
  - Seamlessly integrate with mining planning and operations.
- **Environmental Impact Assessment:**
  - Assess environmental impact for responsible mining.
- **Training and Skill Development:**
  - Develop training programs for geologis[illegible].
- **Regulatory Compliance Tools:**
  - Tools for accurate and standardized assessments.
- **Cross-Industry Collaboration:**
  - Explore collaborations with related industries.

Use Cases

- **Mineral Exploration:**
  - Identify valuable minerals in rocks efficiently.
- **Construction Material Assurance:**
  - Ensure rock material suitability for construction.
- **Environmental Impact Analysis:**
  - Analyse soil and rock contamination for environmental impact.
- **Hydrocarbon Reservoir Detection:**
  - Detect subsurface hydrocarbon reservoirs.
- **Geological Research Support:**
  - Facilitate research through core sample analysis.
- **Real-Time Drilling Guidance:**
  - Guide drilling rigs in real-time.
- **Educational Support:**
  - Assist geology students in learning lithology and feature detection.



How UI looks?

1.Dashboard:
1. Clean, intuitive overview.

2.Navigation:
1. User-friendly for easy exploration.

3.Image Upload:
1. Simple section for drill core image uploads.

4.Analysis Results:
1. Clear display of AI-generated results.

5.Collaboration Hub:
1. Real-time space for geologist collaboration.

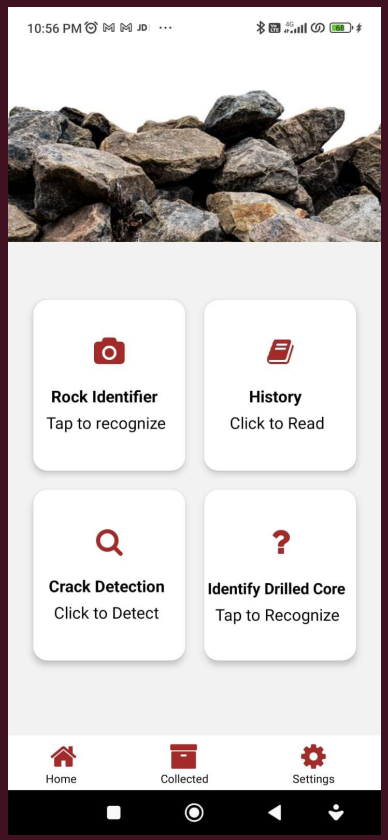
6.Data Controls:
1. Secure storage and privacy settings.

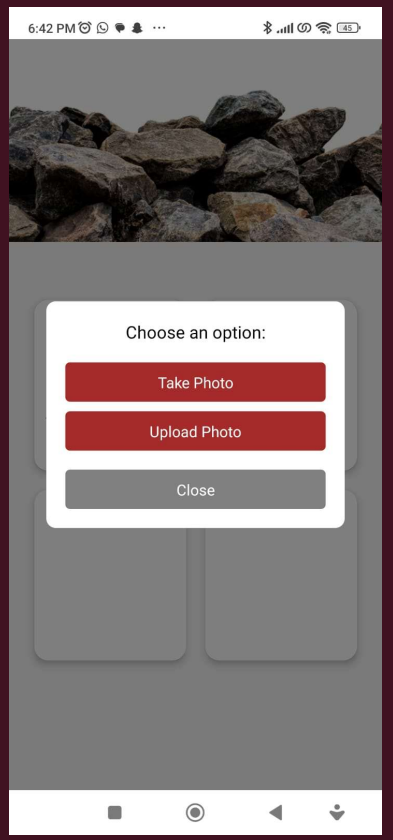
7.Reporting:
1. Integrated module for lithology and geology reports.

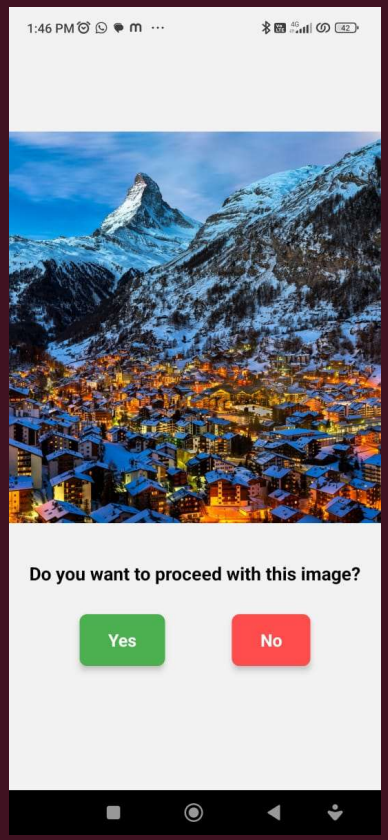
8.Feedback Section:
1. User input for continuous improvement.

9.Real-Time Guidance:
1. Module for drilling rig guidance.

10.Educational Resources:
1. Section supporting geology student learning.







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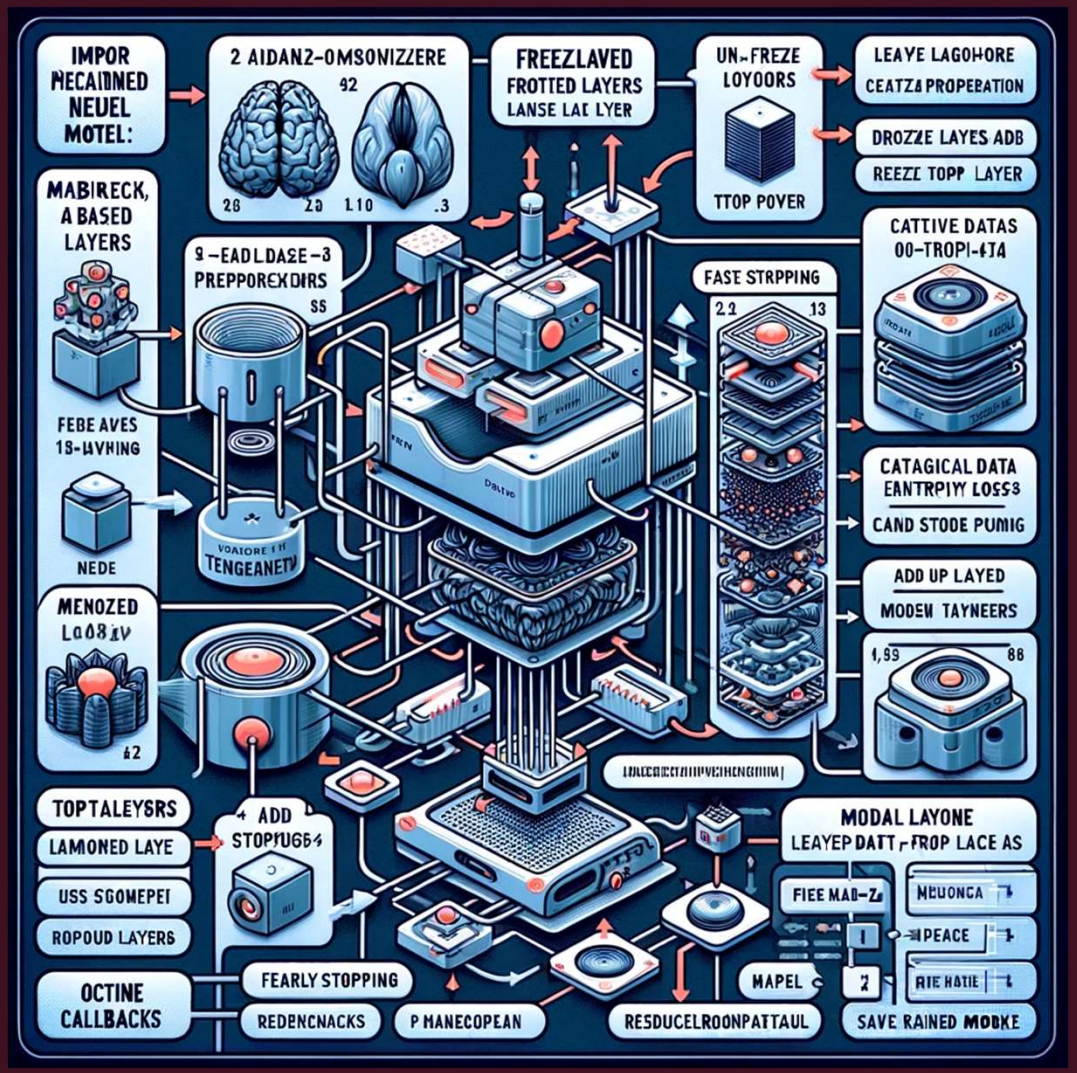

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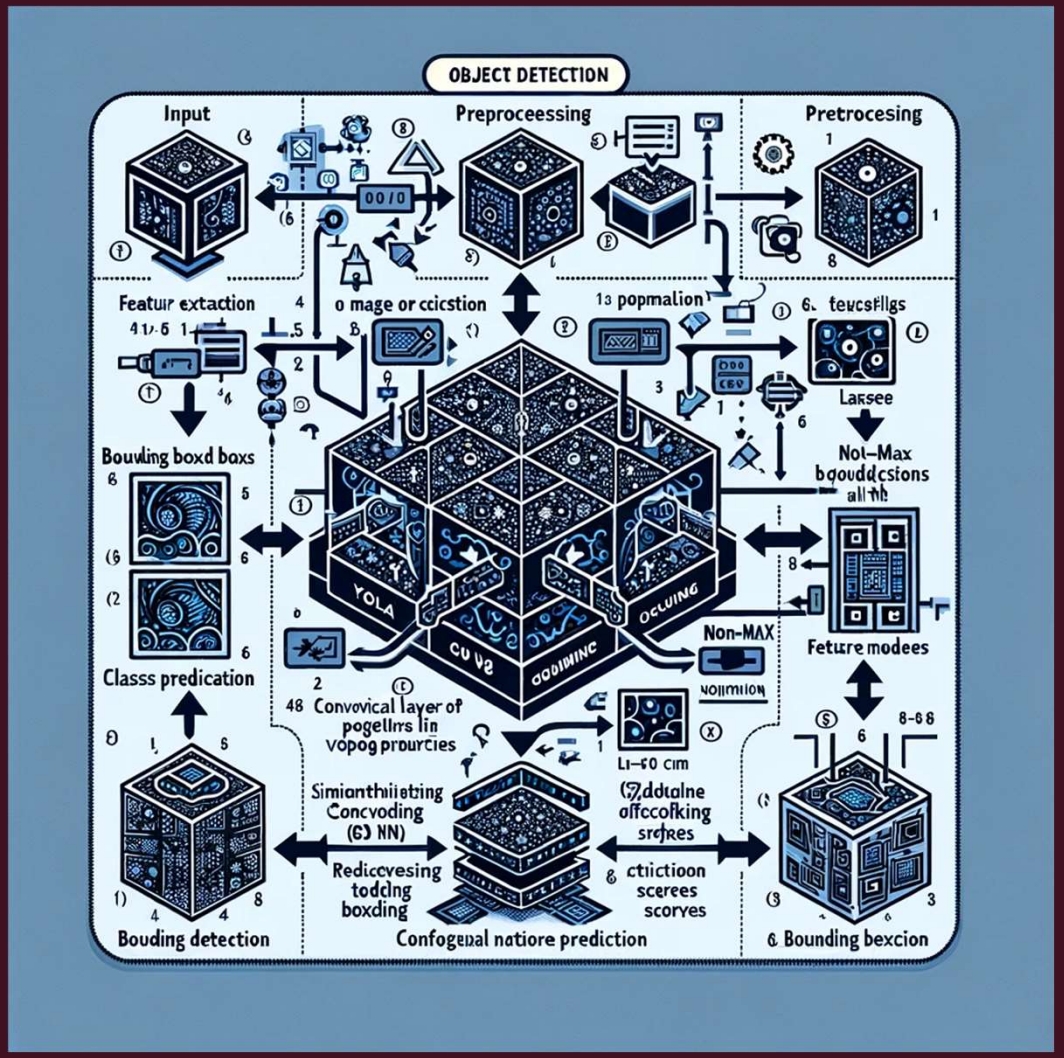

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