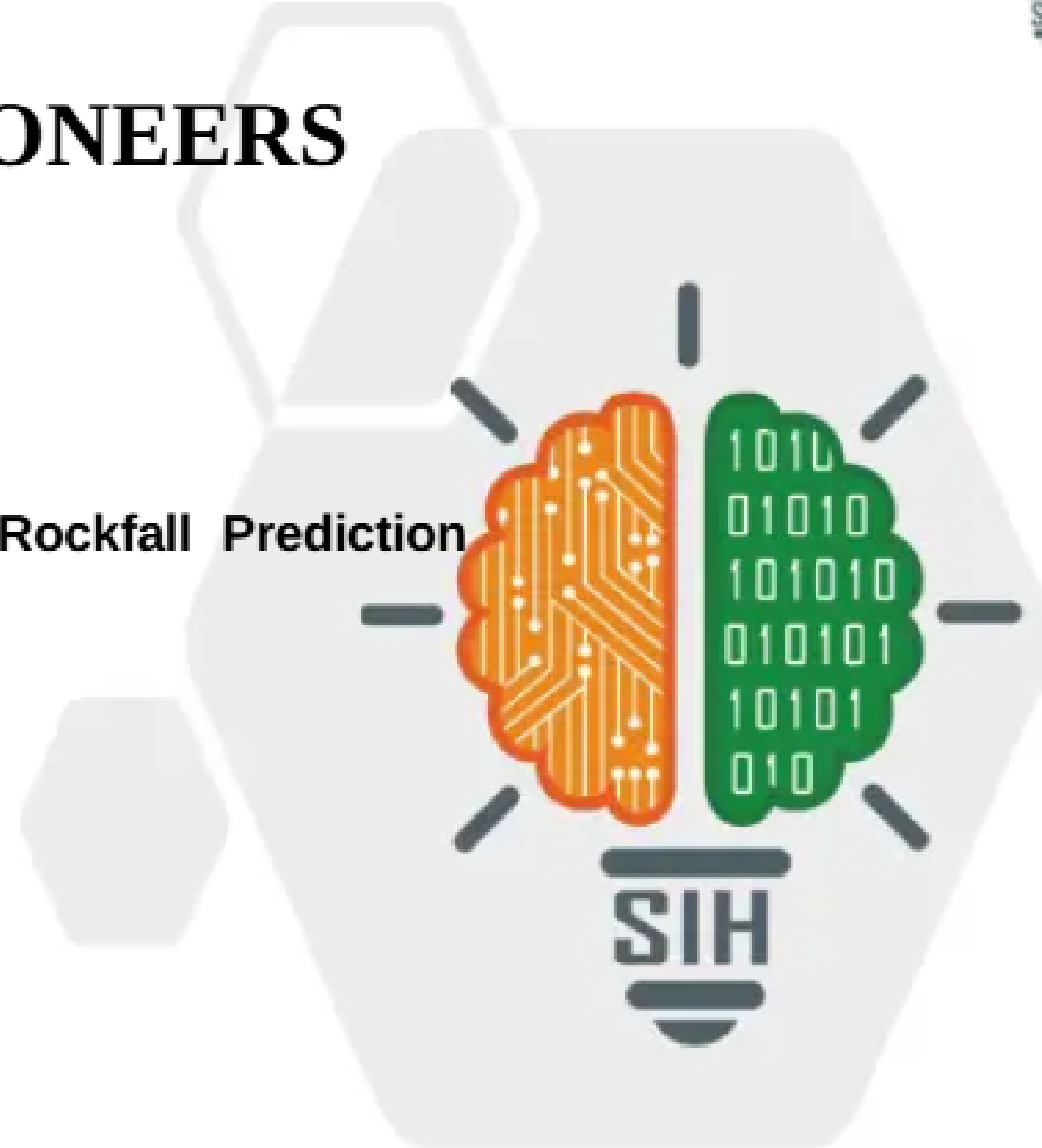
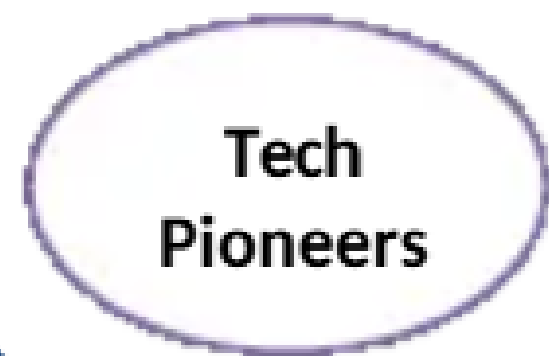




TECHPIONEERS

- **Problem Statement ID –** SIH25071
- **Problem Statement Title-** AI-Based Rockfall Prediction and Alert System for Open-Pit Mines
- **Theme-** Disaster Management
- **PS Category-** Software
- **Team ID-**
- **Team Name (Registered on portal):** TECHPIONEERS



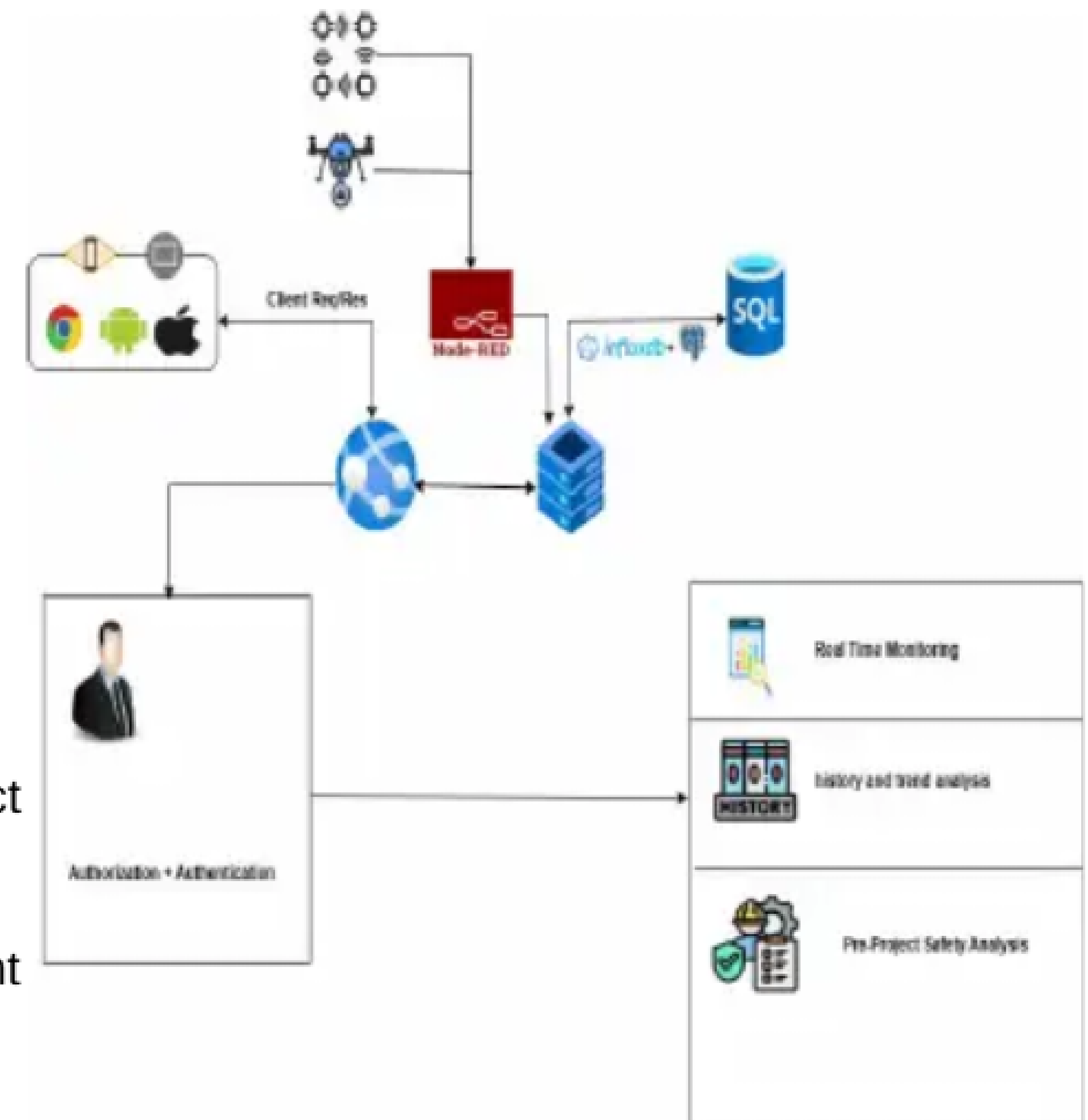


RockVision AI



❖ Proposed Solution

- **Comprehensive RockVision AI Association Platform:** A robust web and mobile application ecosystem to predict rockfall prediction in open pit mining.
- **Real-Time Monitoring:** Utilizes AI-driven algorithms to suggest overview with real-time risk status of rockfall.
- **Historical Data:** Stored the data which is predicted through AI-driven algorithms upto last 30 days only.
- **AI Chat & Consultation Features:** Intelligent mining assistant provided 24/7 availability for safety Q&A.
- **PPSA model-** Pre-Project Safety Analysis- provide equipment requirement analysis and safety verification and Automatic risk scoring based on project parameter through AI.
- **BP&S Management-** Blast Planning & Safety - facilitates blast management system to detect stability assessment and monitoring with safety and minimal geological impact.
- **Alert System-** Evacuation from rockfall site via notification on SMS and Email



❖ Technology Stack

Frontend : React.js ,React Native, vite, Redux,D3.js, Typescript,Next.js, Material-UI v5,chart.js, video.js, HLS.js, Tailwind CSS, socket.io.

Backend:FastAPI, Python, InfluxDB, PostgreSQL, MongoDB, MinIO, Pandas, Redis, Kong, Celery, SQLAlchemy,Elasticsearch.

AI/ML: Pytorch, openCV, TensorFlow, YOLOv8,Transformer, SpaCy, ONNX Runtime, scikit-learn, XGBoost, LightGBM, Keras, mlflow,.

API Services : OpenAI API,OpenWeatherMapAPI,Seismic Monitoring API,Satellite image APIs,Twilio,SendGrid,Strips.

Cloud and Deployment: Kubernetes,AWS,Docker,Grafana,GitHub lab,pytest,Prometheus.





FEASIBILITY AND VIABILITY



Feasibility :

1. **Technical:** Feasible via mature tech (AI, IoT), using sensor data to predict rockfalls and send alerts.
2. **Economic:** High costs are justified by significant returns in safety, damage reduction, and efficiency from preventing rockfalls.
3. **Operational:** Success depends on seamless integration and staff acceptance, requiring a user-friendly design and proper training.



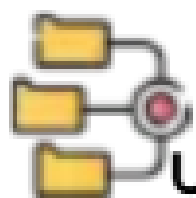
Viability:

4. **Market opportunities:** The system has a strong market opportunity due to the mining industry's need for safety. It provides a competitive advantage, is highly scalable, and has broad applications in other geotechnical fields.
5. **Sustainability and future-proofing:** The system is sustainable: its AI model improves with data, its modular design adapts to new tech, and it promotes environmental benefits by preventing incidents.



Challenges:

6. **Data Scarcity:** high-quality dataset of rockfall events is a major hurdle.
7. **False Alerts:** The model must minimize false positives and negatives to be reliable.
8. **Dynamic Environments:** system needs to continuously adapt to changing geological conditions



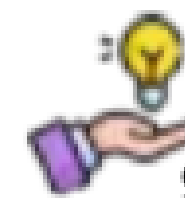
Use Cases

9. **Real-Time Alerts:** Instantly warn personnel of danger for timely evacuation.
10. **Smarter Planning:** Use risk maps to optimize work in unstable areas.
11. **Proactive Maintenance:** Identify early signs of slope failure to prevent collapses.
12. **Improved Design:** Use historical data to enhance future mine layouts ..



Business Potential :

1. **Subscription-Based Service:** Offer the system as a subscription to make it affordable for mining companies.
2. **Tiered Pricing:** Provide different pricing plans based on mine size and desired features.
3. **Strategic Partnerships:** Partner with sensor and equipment companies for broader market reach.
4. **Consulting and Support:** Include expert geological and technical support with the service.



Solutions:

5. **Robust Data & Algorithms:** We'll use a mix of historical and real-time sensor data (LiDAR, drones) to continuously improve our AI models, reducing false alarms.
6. **Seamless Integration:** The system's modular design ensures easy integration with existing mine infrastructure and future technologies.●
7. **User-Centric Design:** A simple interface will ensure staff can effectively use and trust the system.



Supporting Facts for Feasibility and Viability

Supporting Facts

Rockfalls are a major safety hazard in open-pit mines, causing fatalities and significant financial losses from equipment damage and operational

AI and machine learning have already shown promising results in geotechnical engineering for predicting slope stability and rockfall probability.

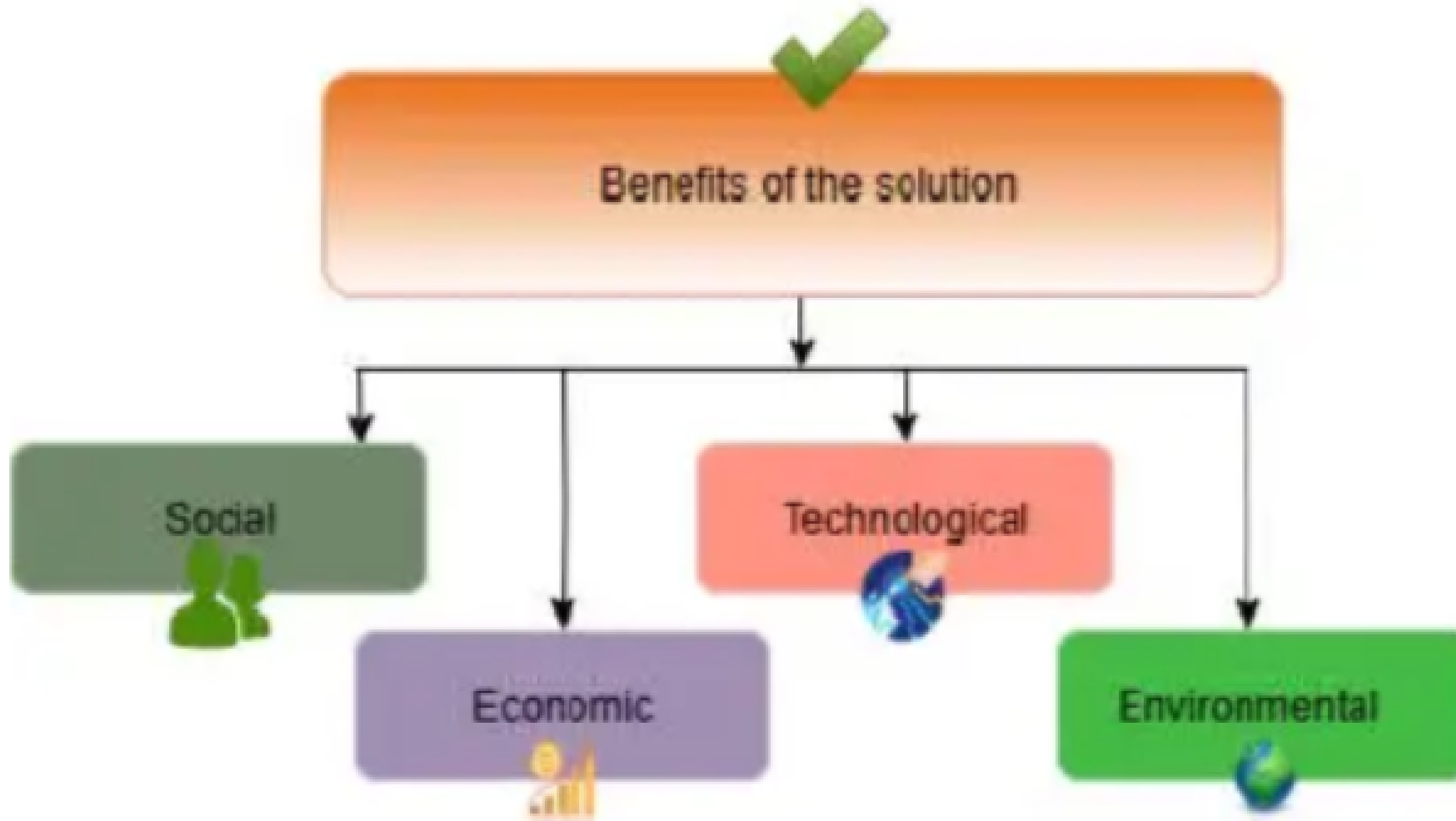
The system's predictive capabilities can provide a competitive advantage by moving from reactive to proactive rockfall management, greatly improving safety and efficiency.



IMPACT AND BENEFITS



❖ Benefits of the solution



Social:

- Enhances worker safety and the psychological stress associated with working in an unpredictable environment.
- Protect surrounding communities by ensuring the stability of mine slopes.
- Improve public perception and accountability.

Technological:

- Drives adoption of AI and ML technologies to predict rockfall incident in openpit mining.
- Promotes accuracy over latency during realtime rockfall site.
- Encourages innovation in Mining Industries, potentially over outdated monitoring system.

Economic:

- Enhances the safety improvement through 70-90% reduction in rockfall-related incidents.
- Generates early warning time in 15-60 minutes advance notice (vs current reactive approach).
- Accelerates cost savings upto \$2-5 million annually per large mining operation.

Environmental:

- Reduces land disturbance by proactively preventing rockfalls.
- Enable virtual networking and monitoring, which directly lead to protect machinery, fuel & energy consumption.
- Less need for additional,unplanned work, which in turn lowers the mine's carbon footprint.

❖ Potential impact on the target audience:

- **Mining Executives:** Protects profits and reputation by preventing costly accidents and operational disruptions.
- **Miners & Engineers:** A life-saving tool that boosts confidence and enables proactive safety decisions.
- **Regulators:** Provides a transparent, data-driven system for ensuring continuous safety compliance.
- **Local Communities:** Builds trust by proactively eliminating the risk of catastrophic events, ensuring their safety..

❖ Comparision with Existing Systems

❖ Refrences

Research & Best Practices:

- <https://www.sciencedirect.com/>
- <https://youtu.be/DEM/>
- <https://www.academia.edu/>
- <https://www.researchgate.net/>
- <https://farmonaut.com/open-pit>
- <https://agupubs.onlinelibrary.wiley.com/>
- <https://www.maptek.com/>

Open-pit Mining Platforms:

- MineGAURD: <https://www.mineguard-ai.com/>
- GeoAlert: [Geoalert AI mapping and geoanalytics platform](#)

Feature	RockVision AI	MineGUARD	RockWatch Pro	SafeMine 360	GeoAlert
Real-Time Monitoring	✓	✓	✓	✓	✓
30-Day Historical Analysis	✓	✓ (90 days)	✓ (60 days)	✗ (7 days only)	✓
AI-Powered Risk Prediction	✓	✓	✗	✓	✗
Multi-Channel Alerts (SMS/Email/Push)	✓	✓	✓	✓	✓
Document Repository System	✓	✗	✓ (Basic)	✗	✗
AI Chat Assistant	✓	✗	✗	✗	✗
Project Planning & Risk Assessment	✓	✗	✗	✓	✗
Blast Management System	✓	✗	✗	✗	✗
4K Video Processing & Analysis	✓	✓ (Basic)	✗	✓	✗