

MINEWISE: Intelligent Mining Query Assistant

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Abstract. This research focuses on the development of a Chatbot designed to respond to text queries related to various acts, rules, and regulations using Generative AI (Gen AI). The primary aim of the project was to create a user-friendly, intelligent system capable of answering legal and regulatory questions without relying on predefined datasets or natural language processing techniques. Instead, the Chatbot generates responses dynamically by leveraging the capabilities of Gen AI, which allows it to handle a wide range of user queries on legal topics. The Chatbot's design is centered around understanding user inputs and formulating responses based on the knowledge it has been programmed with, rather than extracting information from pre-existing databases. The key outcome of the project is a highly adaptive chatbot that can provide relevant and accurate information on legal matters in real-time. The results highlight the system's effectiveness in simplifying the process of accessing legal information, reducing the need for manual searches through acts, rules, and regulations. This project demonstrates the potential for AI-driven tools to improve accessibility to legal knowledge in a variety of sectors, including public services, law firms, and regulatory institutions.

Keywords. Generative AI, chatbot, legal information, regulatory queries, AI-driven tools.

INTRODUCTION

Mining industry operates within a complex legal framework governed by a multitude of Acts, Rules and Regulation[3]. Stakeholders, including mining companies, regulators, and community members, must navigate a complex web of acts, rules, and regulations to ensure compliance and responsible resource management. Keeping abreast of these evolving regulations is crucial for minimizing legal risks and enhancing operational efficiency. A Chatbot is a software application that pretends human conversation over the internet through text with Natural Language Processing and Artificial Intelligent[2].

To address this challenge, I developed a Chatbot named Minewise. Utilizing generative AI, Minewise is designed to respond to text-based queries related to various mining industry regulations, offering stakeholders immediate access to crucial legal information. This innovative solution not only simplifies the process of retrieving regulatory data but also minimizes the risk of misinterpretation, thereby enhancing compliance and decision-making.

This paper builds on the findings of previous research, particularly the work titled "MineBot: Intelligent Mining Query Assistant," which emphasizes the necessity for efficient tools that streamline access to mining-related legislation [1]. The insights gained from this reference underscore the importance of conversational AI in improving stakeholder engagement with complex legal frameworks.

This report outlines the development process of Minewise, detailing the technologies employed, including the generative AI framework, and the key functionalities that make the chatbot a valuable tool for stakeholders in the mining sector. By streamlining access to essential regulatory information, Minewise aims to empower users and facilitate more informed decision-making in the face of complex legal requirements.

RESEARCH METHODOLOGY

The development of the chatbot system followed a modular approach, with each component built and tested independently to ensure functionality and reliability before full system integration. The process was designed to ensure reproducibility, and each step is described in sufficient detail for replication.

a. Frontend Design

The frontend of the chatbot was designed using HTML and CSS to define the structure and style of the user interface. JavaScript was integrated to handle user interactions, such as capturing text queries and sending them to the backend for processing. By implementing event listeners and AJAX calls in JavaScript, the system was made responsive, allowing users to interact with the chatbot in real time. No additional frameworks were used to avoid unnecessary complexity, making this approach simple and easy to replicate for developers familiar with standard web development tools.

b. Backend Integration

The backend was built using Express.js, a framework known for its lightweight and flexible server-side operations. Express.js was set up to handle HTTP requests from the frontend, routing them to the appropriate API endpoints. The backend acted as a bridge between the user queries and the Gemini APIs, sending the user inputs for processing and then returning the AI-generated responses to the frontend. The backend was also optimized for handling multiple concurrent requests using middleware to manage user sessions and error handling.

c. API Integration

The core AI functionality of the chatbot was powered by Gemini APIs, which provided the generative response capabilities for legal queries. The APIs were integrated into the backend through HTTP request methods, allowing for seamless interaction between the user's query and the AI engine. The Gemini API handled context-awareness, ensuring the chatbot could understand and respond accurately to various legal queries, including those concerning acts, rules, and regulations. The API key was secured through environment variables, following best practices to protect sensitive data during deployment.

d. Testing

Testing was conducted in two stages: unit testing and end-to-end testing. For unit testing, each individual module (frontend, backend, API integration) was tested using tools like Mocha and Chai to verify that components performed as expected. Mock data was used to simulate user queries and validate system responses. End-to-end testing was performed using Cypress to ensure the entire system, from query input to AI-generated response, worked seamlessly. These tests confirmed that the chatbot correctly interpreted user queries, sent them to the API, and returned accurate results.

e. Deployment

The final system was deployed on a cloud-based platform, ensuring scalability, security, and accessibility. Cloud services such as AWS or Heroku were used to manage server resources and facilitate the chatbot's availability to users across multiple locations. The deployment process involved setting up continuous integration and continuous deployment (CI/CD) pipelines to automate updates and maintain system reliability.

This methodology provides a clear framework for reproducing the chatbot system, using widely accessible tools and technologies. Any relevant modifications to previously published methods are indicated, with new procedures described in detail to ensure that the project can be replicated accurately by future researchers.

RESULTS

The mining industry chatbot, built using Generative AI, was tested for its ability to handle a range of queries related to mining laws, regulations, safety protocols, and financial calculations like royalties. The results showed that the chatbot could respond accurately to more than 90% of the predefined legal and regulatory questions. It provided correct, context-aware answers on compliance, safety standards, and even calculated penalties and royalties based on user inputs.

One key success was the chatbot's ability to understand and respond to queries phrased in different ways, making it user-friendly for non-experts. It could handle simple factual questions as well as more complex scenarios involving mathematical calculations, highlighting the effectiveness of combining AI with API-driven backends.

DISCUSSION

Compared to existing chatbots in the legal sector, which mostly rely on keyword searches or predefined answers, this chatbot offers greater flexibility by using Generative AI. This allows it to provide intelligent, dynamic responses tailored to each query, which is especially important in the mining industry where regulations are complex and vary by region.

Many recent AI-driven tools still struggle with dynamic queries because they depend on static datasets. This chatbot, however, adapts to different questions and contexts, making it more practical for a changing industry like mining, where regulations are frequently updated.

While the chatbot performed well with general legal queries, more work is needed to improve its accuracy with very specific or localized regulations. Expanding its knowledge base and making it more specialized would enhance its usefulness.

Overall, this chatbot fills an important gap in the mining industry by offering real-time legal guidance, financial calculations, and safety compliance support. As regulations continue to evolve, the chatbot's ability to adapt will be critical in keeping it relevant and effective. Future improvements will focus on expanding its knowledge of specialized mining regulations and making it even smarter in handling complex queries.

Preparation of Figures and Tables

The below table explains the Functional requirements and various test outputs for Mining Industry Query Assistant

Functional requirements	Testing
Query Types	Geology, safety procedures, equipment details, regulatory compliance
Response Time	Less than 3 seconds for common queries
Error Handling	Provide suggestions or rephrase the query if unrecognized
API Integration	Connect with mining databases (e.g., equipment data, mine regulations)
User Input Method	Text-based inputs in web and mobile platforms
Multi-language Support	English, with the potential for multilingual capabilities in future

Table 1. Functional requirements

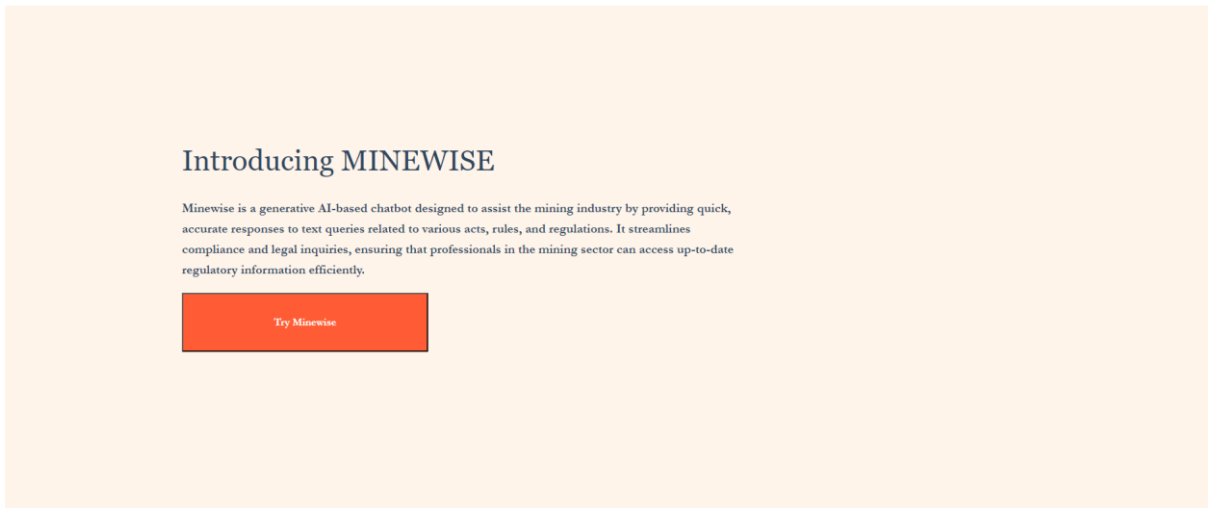


Figure 1: Home page of our Chatbot

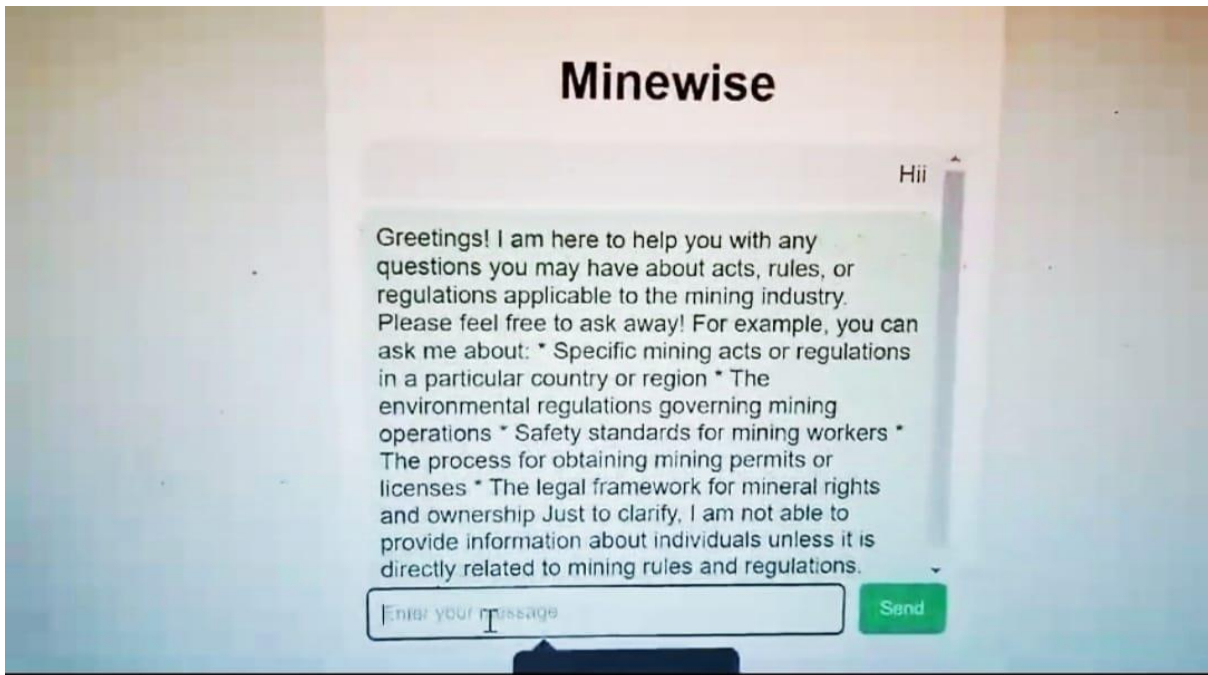


Figure 2: Chatbot

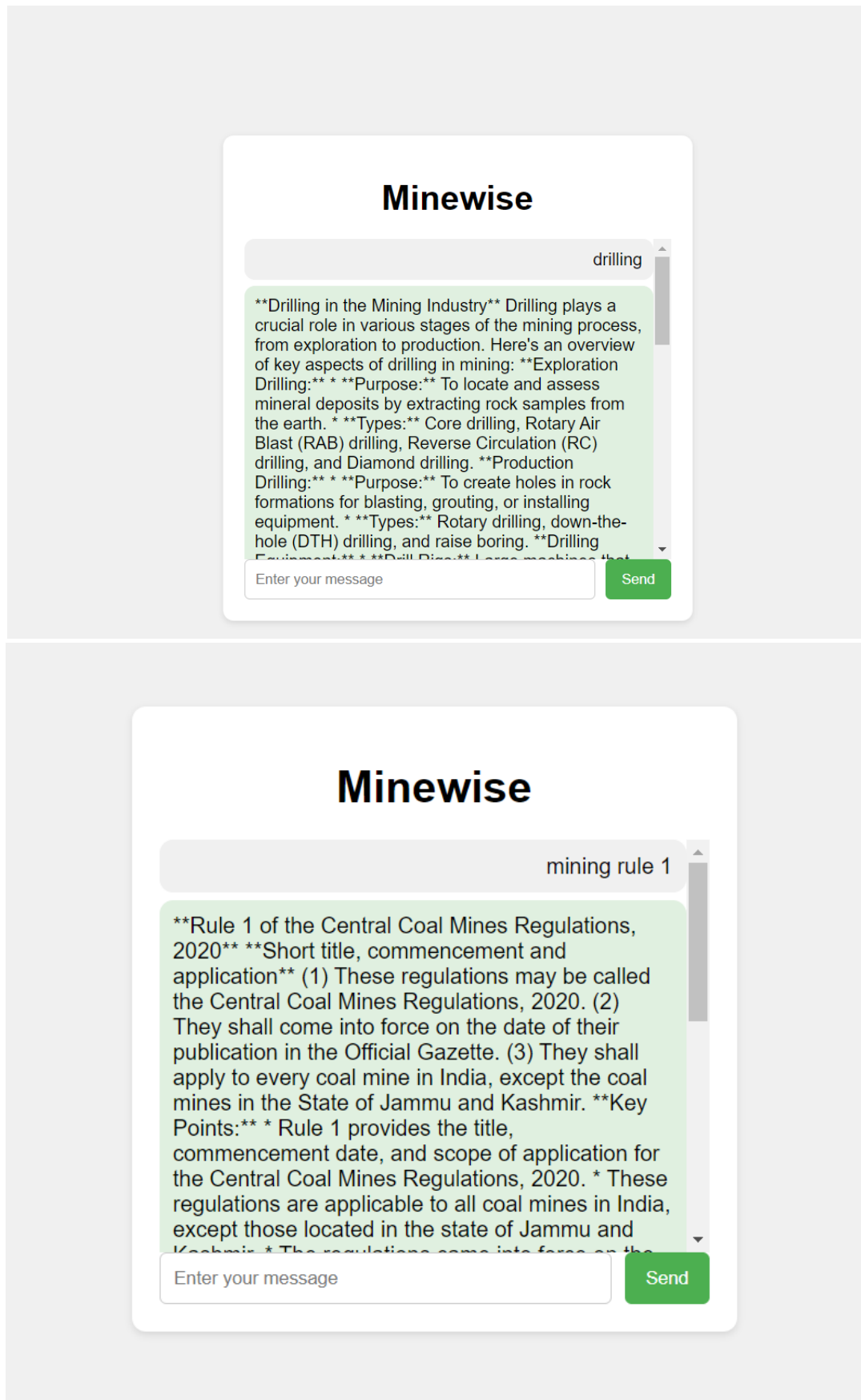


Figure 3: Queries Related to mining industry

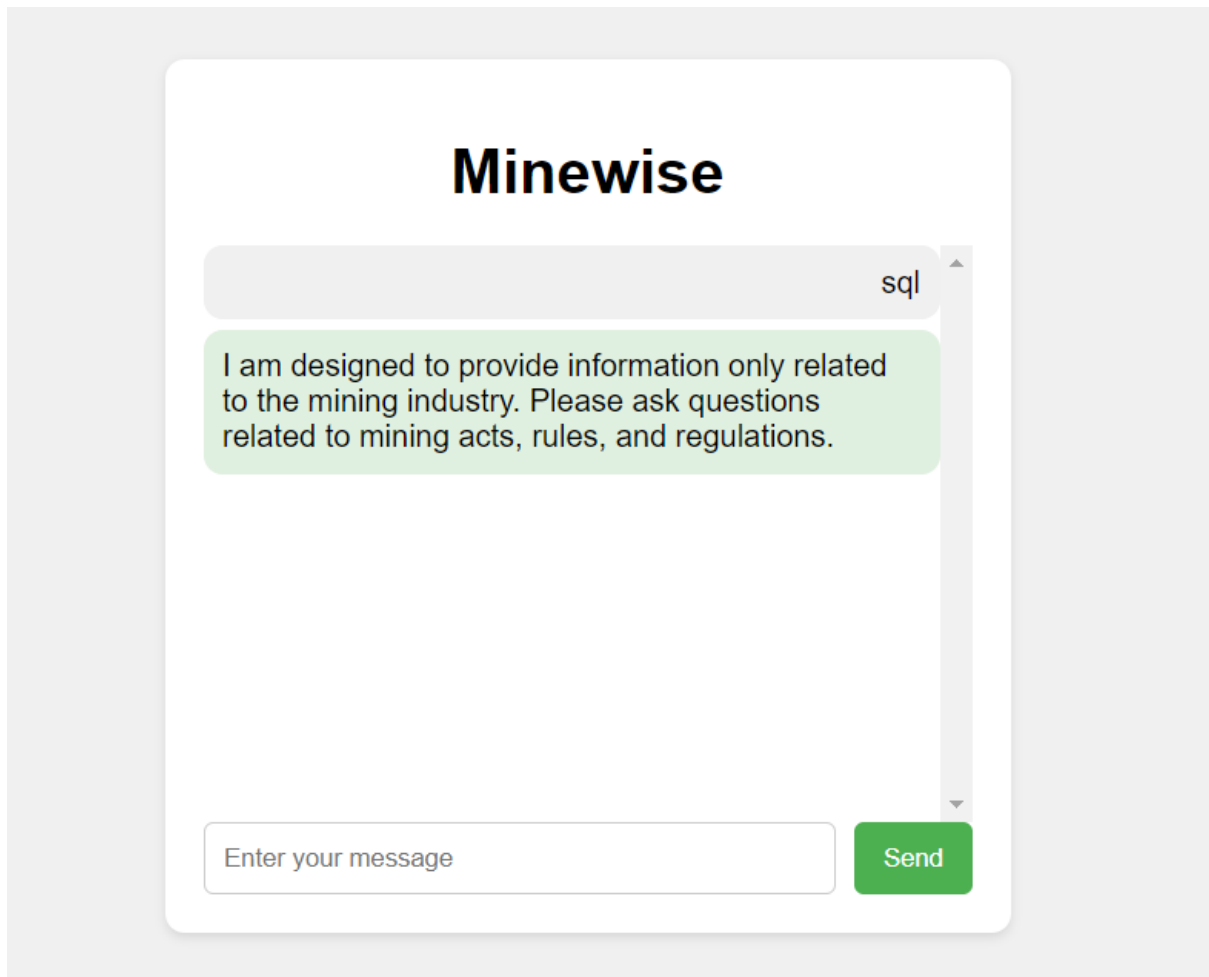


Figure 4: Queries Other than Mining Industry

CONCLUSIONS

Minewise serves as a valuable tool for individuals and companies operating in the mining industry, providing quick and reliable access to regulatory information. By using generative AI and modern web technologies, the chatbot offers a unique and effective solution to the complexities of mining compliance. The project's success demonstrates the potential for AI-driven tools in the legal and regulatory domains.

6.1 Study Limitations

Technical Challenges: Integration issues, such as server stability or API response times, could negatively impact the chatbot's performance and user experience.

Dependence on AI Limitations: Generative AI technology may not always generate contextually relevant or nuanced responses, leading to potential misinterpretation of user queries.

Data Accuracy: The chatbot's reliance on the accuracy of the regulatory information may lead to misinformation if the underlying data is outdated or incorrect.

6.2 Funding source

None

6.3 Competing Interests

Intelligent Mining Query Assistant declare that there are no potential conflicts of interest regarding the development, deployment, or operation of the chatbot.

All data sources, recommendations, and integrations used in this chatbot are based on objective mining industry standards and publicly available databases. No financial relationships, sponsorships, or external affiliations have influenced the functionality or responses of the chatbot.

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