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Minebot: Chatbot to Respond to Text Queries Pertaining to Various Acts, Rules, And Regulations Applicable to Mining Industries

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ABSTRACT:

MineBot, an intelligent Chatbot tailored for the mining industry, seamlessly integrates LangChain in Python and is powered by GPT-3.5-turbo with Retrieval Augmented Generation (RAG). With a primary focus on providing stakeholders continuous and unfettered access to precise information on Acts, Rules, and Regulations governing the mining sector, MineBot operates within the resilient LangChain framework, ensuring efficient data processing. Empowered by GPT-3.5-turbo with RAG, the Chatbot elevates contextual understanding by seamlessly integrating external knowledge bases. The knowledge base undergoes strategic enrichment through the adept utilization of the Wikipedia API and Google Search Engine API via SERP API, guaranteeing stakeholders access to meticulously updated information. MineBot's applications extend beyond information access, encompassing regulatory insights, continuous availability, and a knowledge base enriched with comprehensive data. In essence, MineBot stands as an epitome of intelligent and dynamic solutions, converging cutting-edge AI technologies with potent information retrieval tools. The objective is to empower stakeholders with accurate, real-time information and a comprehensive understanding of the mining regulatory landscape, thereby facilitating informed interactions

Keywords—Python, LangChain, Chatbot, Acts and Regulation, Ministry of Coal, Retrieval Augmented Generation, RAG, ReAct, Large Language Model, Vector Database, FAISS, External Knowledge Base, Embedding Model, Huggingface, OpenAI, GPT-3.5-Turbo.

I. Introduction

The mining industry, integral to global resource extraction and energy production, operates within a complex regulatory framework governed by Acts, Rules, and Regulations. Navigating through this intricate legal landscape often proves challenging for stakeholders, requiring a deep understanding of ever-evolving compliance standards and amendments. To address these challenges, we introduce MineBot, an intelligent chatbot leveraging state-of-the-art technologies to revolutionize information accessibility within the mining sector.

A. *BACKGROUND*

The mining industry, a vital engine for global economic growth, operates within an intricate web of legislative frameworks, encompassing Acts, Rules, and DGMS Circulars. As the backbone of resource extraction and energy production, the industry's continued success hinges on navigating this complex regulatory landscape efficiently. However, traditional methods of information retrieval and compliance adherence have proven to be increasingly cumbersome and susceptible to inefficiencies.

Historically, stakeholders in the mining sector have grappled with the challenges of staying abreast of dynamic regulatory changes, amendments, and the evolving landscape of safety guidelines. Manual processes for obtaining information from Acts such as The Coal Mines Act, 1952, and The Coal Mines Regulations, 2017, are not only time-consuming but also prone to errors, hindering the sector's ability to adapt swiftly to regulatory shifts.

In light of these challenges, the inception of MineBot arises from a deep-seated commitment to transform the way stakeholders interact with regulatory information. The background of MineBot is rooted in the understanding that the mining industry, like many others, stands on the cusp of a technological revolution that can redefine how compliance and regulatory data are accessed and utilized.

MineBot integrates cutting-edge technologies, including Artificial Intelligence (AI) and Natural Language Processing (NLP), to usher in a new era of information accessibility. By providing a sophisticated chatbot capable of understanding complex queries and delivering accurate responses, MineBot aims to empower stakeholders with a seamless, 24/7 information retrieval experience.

This background emphasizes the critical need for a solution that transcends the limitations of traditional approaches, offering stakeholders a more efficient, responsive, and dynamic means of engaging with regulatory information. MineBot's vision is to not only address current challenges but to lay the groundwork for a more agile, compliant, and future-ready mining industry.

B. OBJECTIVES

MineBot is driven by a set of clear and ambitious objectives, each crafted with the aim of addressing specific challenges within the mining industry and enhancing stakeholders' interaction with regulatory information.

1) Automate Information Retrieval

MineBot's primary objective is to implement cutting-edge Artificial Intelligence (AI) and Natural Language Processing (NLP) technologies to automate the retrieval of information. By understanding and responding to text queries with human-like precision, MineBot ensures stakeholders receive instant and accurate answers related to Acts, Rules, DGMS Circulars, and other regulatory nuances.

2) External Knowledge Integration

To enhance its knowledge base, MineBot integrates external sources, including the Wikipedia API and the Google Search Engine API via SERP API. This integration ensures that MineBot remains dynamically informed about the latest amendments, updates, and industry-related information, providing stakeholders with a comprehensive and up-to-date resource.

3) 24/7 Accessibility

MineBot endeavors to break the shackles of time constraints by providing stakeholders with 24/7 accessibility to crucial information. Whether day or night, MineBot stands ready to respond to queries, fostering a continuous and seamless interaction with regulatory information, Acts, and Circulars relevant to the mining industry.

4) Facilitate Stakeholder Interaction

Beyond information retrieval, MineBot aspires to be a catalyst for informed and intelligent stakeholder interactions. By creating an intuitive and dynamic chatbot interface, MineBot seeks to facilitate meaningful conversations, aiding stakeholders and customers in navigating the intricate details of mining regulations with ease.

5) Develop a Robust Management Information System

MineBot extends its capabilities to cover queries related to land-related laws, including CBA, LA, and RandR. This expansion aims to contribute to the development of a robust Management Information System, providing stakeholders with a holistic view of legal provisions, amendments, and regulations governing coal and mineral mining in India.

The amalgamation of these objectives positions MineBot as more than just a chatbot; it's a transformative solution geared towards making information retrieval efficient, accessible, and intelligent within the dynamic landscape of the mining industry.

II. Literature Review

The literature review begins by delving into the evolution and current state of chatbot technology, specifically exploring its applications within the mining industry. The introduction establishes the importance of intelligent chatbots and information retrieval systems, emphasizing their role in addressing complex queries related to legal and compliance aspects in mining operations. By examining the historical progression of chatbots and understanding their integration with advanced technologies like Artificial Intelligence (AI) and Natural Language Processing (NLP), this section sets the stage for a comprehensive exploration of existing solutions and the proposed framework for MineBot.

Mining laws and regulations in India have long been subject to constitutional scrutiny, with the Supreme Court playing a pivotal role in their regulation and interpretation (M. P. & Yadav, 2018). Understanding and navigating these legal frameworks require robust tools and frameworks, especially in the digital age where information retrieval is key. This has led to the development of advanced technologies and models, such as Large Language Models (LLMs), which have revolutionized information processing and retrieval.

LLMs, such as GPT-3.5-turbo, have demonstrated significant advancements in natural language understanding, enabling systems like MineBot to comprehend complex user queries and generate contextually relevant responses (Naveed et al., 2023). These models have been further augmented with retrieval mechanisms, as seen in REALM (Guu et al., 2020) and RAG (Lewis et al., 2021), which improve the contextual relevance and accuracy of responses by combining language models with retrieval techniques.

The ReAct framework, as introduced by Yao et al. (2023), exemplifies the synergy between reasoning and acting in language models, enabling MineBot to simulate human-like reasoning processes. This framework guides the system through steps like Read, Explain, Ask, and Check, ensuring a structured approach to information retrieval and reasoning.

Moreover, benchmarking studies by Banerjee et al. (2023) and Chen et al. (2023) have provided valuable insights into the performance metrics and methods for evaluating LLM-powered chatbots, highlighting the importance of continual improvement and evaluation in this field.

Looking ahead, advancements in LLMs and related technologies hold immense promise. Research by He et al. (2022) and Melz (2023) suggests avenues for enhancing LLM intelligence through auxiliary memory and faithful inference techniques. Additionally, investigations into the factual knowledge boundaries of LLMs, as explored by Ren et al. (2023), shed light on the capabilities and limitations of these models in handling complex queries and scenarios.

In conclusion, the evolution of LLMs and related technologies presents a transformative opportunity in the domain of mining laws and regulations. These advancements not only enhance information retrieval and reasoning processes but also pave the way for more personalized and efficient interactions in legal and regulatory contexts.

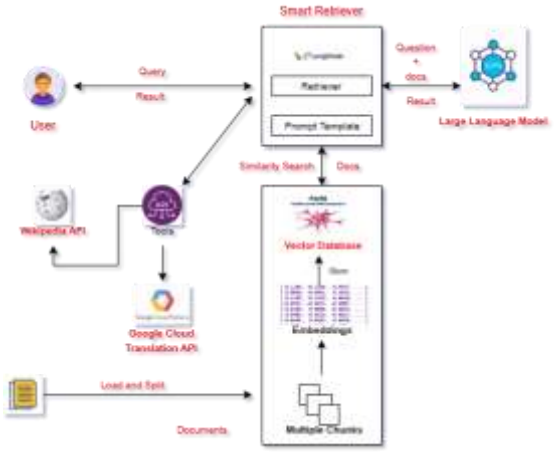
III. Existing System:

In the existing system, legal teams and professionals in the mining industry typically rely on manual methods for researching and accessing legal information. This process involves reading through a large volume of legal documents, such as mining laws, regulations, and court cases, to find relevant information. However, this manual approach is often time-consuming and inefficient, as it requires significant effort to locate specific information within lengthy documents. Additionally, legal teams may face challenges in keeping up-to-date with the latest legal developments and changes in regulations, which can impact their ability to provide accurate and timely advice.

Moreover, the complexity of legal language and terminology can make it difficult for legal professionals to quickly understand and interpret legal documents, leading to potential errors or misunderstandings. This can further hinder the efficiency and effectiveness of legal research and decision-making processes in the mining industry. Some companies have developed chatbots specifically tailored to address legal and compliance queries in the mining sector. These chatbots are designed to provide accurate and up-to-date information on various legal aspects, such as mining laws, environmental regulations, and safety standards.

Overall, the existing system for legal research and information retrieval in the mining industry is often labor-intensive, time-consuming, and prone to errors. There is a need for more efficient and effective tools and technologies to assist legal teams in accessing and analyzing legal information quickly and accurately.

IV. Proposed System:



The proposed system, MineBot, aims to revolutionize legal research and information retrieval in the mining industry by leveraging advanced technologies such as artificial intelligence and natural language processing. MineBot is an intelligent chatbot that provides legal teams and professionals with quick and accurate access to mining laws, regulations, and other legal information.

Using MineBot, legal professionals can simply input their queries in natural language, and the system will use its advanced algorithms to search through a vast database of legal documents to find relevant information. The chatbot uses the ReAct framework, which allows it to read, explain, ask, and check information to ensure accuracy and relevance.

One of the key features of MineBot is its integration with external knowledge bases such as Wikipedia and Google Search Engine API. This integration enables MineBot to provide comprehensive and up-to-date information to users, ensuring that legal teams have access to the latest legal developments and changes in regulations. Furthermore, MineBot uses advanced text embedding models and semantic search techniques to provide users with contextually relevant information. This allows legal professionals to quickly find the information they need without having to sift through large volumes of legal documents manually.

Overall, the proposed system, MineBot, offers a more efficient, effective, and user-friendly approach to legal research and information retrieval in the mining industry. By leveraging cutting-edge technologies, MineBot aims to streamline the legal research process and empower legal teams to make better-informed decisions.

V. Methodology

The development of MineBot begins with a comprehensive analysis of the requirements gathered from stakeholders, including legal professionals, mining industry experts, and end-users. These requirements are used to define the scope and objectives of the project, ensuring that the chatbot meets the specific needs of its users. Next, the system architecture and design are planned based on the gathered requirements. This involves designing the user interface, defining the workflow for information retrieval, and selecting the technologies and tools to be used in the development process

The data collection phase involves gathering mining laws, regulations, circulars, notifications, and other relevant documents from sources such as the Ministry of Coal website. These documents are then processed and organized into a format suitable for embedding and retrieval. Once the data is prepared, the documents are embedded into low-dimensional vectors using an embedding model such as BGE LARGE. This step converts the text into a format that can be efficiently searched and retrieved. The FAISS vector database is then set up to store the embedded documents. This database allows for fast and efficient retrieval of documents based on semantic similarity, ensuring that MineBot can quickly find relevant information in response to user queries.

MineBot is also integrated with external knowledge sources such as the Wikipedia API and Google Search Engine API (SERP API). This integration enhances the chatbot's knowledge base and enables it to provide more comprehensive and accurate responses to user queries. To guide its reasoning and decision-making process, MineBot implements the ReAct framework, consisting of the Read, Explain, Ask, and Check steps. This framework enables the chatbot to effectively handle user queries and retrieve relevant information in a structured and efficient manner. Before deployment, the developed system undergoes rigorous testing to ensure its functionality, performance, and accuracy. This includes testing the chatbot's responses, the effectiveness of the ReAct framework, and the integration with external knowledge sources.

Once testing is complete and the system is validated, MineBot is deployed in a production environment, making it accessible to users. Continuous maintenance and updates are essential to keep MineBot's knowledge base up-to-date with the latest legal developments, ensuring that it remains a reliable and effective tool for legal research and information retrieval in the mining industry.

VI. System Architecture:

The system architecture of MineBot is meticulously designed to ensure optimal performance, scalability, and user-friendliness. It comprises several interconnected components, each serving a specific purpose and working harmoniously to deliver a seamless experience to users. The architecture can be broadly categorized into the frontend, backend, and data layers, each of which plays a crucial role in the overall functioning of the system.

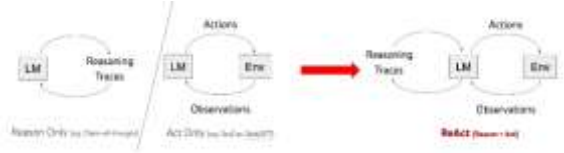
A. Frontend:

MineBot features a user-friendly interface that allows users to interact with the chatbot effortlessly. The interface is designed to be intuitive and responsive, providing users with a seamless conversational experience. The chatbot interface serves as the primary means of interaction between users and MineBot. It processes user queries, interprets their intent, and generates appropriate responses using natural language processing (NLP) techniques.

B. Backend:

Chatbot Engine: At the core of MineBot is its chatbot engine, which is responsible for processing user queries and generating responses. The engine utilizes advanced AI algorithms and NLP techniques to understand user intent and provide accurate and relevant information.

ReAct Framework: MineBot incorporates the ReAct framework, which guides the chatbot's reasoning process. The framework enables the chatbot to read, explain, ask, and check information, ensuring that it follows a logical and structured approach to information retrieval.



External APIs: MineBot integrates with external APIs, such as the Wikipedia API and Google Search Engine API (SERP API), to enhance its knowledge base and provide users with access to a vast repository of information.

C. Data Layer:

Knowledge Base: MineBot's knowledge base comprises a comprehensive collection of mining laws, regulations, circulars, notifications, and other relevant documents. These documents are stored in a structured format that allows for efficient retrieval based on user queries.

External Knowledge Sources: In addition to its internal knowledge base, MineBot leverages external knowledge sources to enrich its information repository. By integrating with external APIs, MineBot ensures that its knowledge base remains up-to-date and relevant.

Overall, the system architecture of MineBot is designed to be flexible and adaptable, allowing it to scale seamlessly to meet the evolving needs of its users. By leveraging advanced AI and NLP technologies, MineBot sets a new standard for legal research and information retrieval in the mining industry, providing users with a powerful and intelligent tool for accessing critical information.

VII. Modules

A. User Interface Module:

The User Interface (UI) module of MineBot plays a crucial role in providing a seamless and user-friendly experience for interacting with the chatbot. Built using the Streamlit framework, the UI module is designed to be highly responsive and adaptable, catering to a wide range of devices and screen sizes. Users can easily input their queries using text input boxes and navigate through the chatbot's responses with ease. One of the key features of the UI module is its intuitive design, which ensures that users, including legal professionals and the general public, can interact with the chatbot without needing technical expertise. The UI is designed to be accessible to users of all skill levels, making it easy for anyone to use the chatbot effectively. Additionally, the UI module is designed to be visually appealing, with a clean and modern design that enhances the overall user experience. The interface is designed to be user-friendly, with clear and concise prompts that guide users through the interaction process. Overall, the UI module plays a crucial role in making MineBot accessible and easy to use for all users, regardless of their technical background.

B. Chatbot Engine Module:

The Chatbot Engine module in MineBot is responsible for processing user queries and generating responses. It is built using advanced natural language processing (NLP) techniques to understand the user's intent and provide accurate and relevant information.

The Chatbot Engine module uses OpenAI's GPT-3.5-turbo model, a state-of-the-art language model, to analyze user queries and generate responses. The model is trained on a diverse range of data sources, including mining laws, regulations, and other relevant documents, to ensure that it can provide accurate and contextually relevant information. The Chatbot Engine module also includes features such as context management, conversation history tracking, and response generation. These features help the chatbot understand the context of the conversation and provide more personalized responses to users. Overall, the Chatbot Engine module is a critical component of MineBot, enabling it to provide accurate, relevant, and timely information to users seeking information related to mining laws and regulations.

C. ReAct Framework Module:

The ReAct Framework module in MineBot is designed to guide the chatbot's reasoning process, ensuring that it follows a structured approach to information retrieval. The ReAct framework consists of four key steps: Read, Explain, Ask, and Check.

1) Read: In this step, the chatbot reads and comprehends the user's query. It uses NLP techniques to understand the meaning and context of the query, ensuring that it can provide an accurate response.
2) Explain: Once the chatbot has read the query, it provides an explanation of its understanding and context. This step helps to ensure that the chatbot's responses are clear and relevant to the user's query.
3) Ask: In some cases, the chatbot may need to ask the user for more information or clarification. The Ask step allows the chatbot to gather additional information that may be necessary to provide an accurate response.
4) Check: Finally, the chatbot checks whether any tools are required for the next action based on the user's query and the chatbot's understanding. If a tool is required, the chatbot selects the appropriate tool and executes the action.

Overall, the ReAct Framework module plays a crucial role in guiding the chatbot's reasoning process, ensuring that it can provide accurate and relevant information to users seeking information related to mining laws and regulations.

D. Knowledge Base Module:

The Knowledge Base module in MineBot comprises the FAISS vector database, which is populated with documents from the Ministry of Coal website. This database serves as an external knowledge base, enabling MineBot to retrieve information efficiently. Documents from the Ministry of Coal website are divided into smaller chunks and converted into vectors using the BAAI/bge-large-en-v1.5 embedding model. This model is a fine-tuned version of the BGE Large EN model, designed to create dense vector embeddings for text. The BAAI/bge-large-en-v1.5 model improves upon its predecessors by addressing similarity distribution issues, providing more accurate similarity scores between texts, and enhancing retrieval ability. It can retrieve relevant passages without requiring explicit instructions, making it ideal for use in natural language processing (NLP) tasks. Overall, the Knowledge Base module, powered by the FAISS vector database and the BAAI/bge-large-en-v1.5 embedding model, is a critical component of MineBot. It ensures that the chatbot's knowledge base remains current and relevant, enabling it to provide users with accurate and up-to-date information on mining laws and regulations.

E. External APIs Module:

The External APIs module in MineBot integrates external APIs, such as the Wikipedia API and Google Search Engine API (SERP API), to enhance the chatbot's knowledge base and provide users with access to a vast repository of information. The Wikipedia API allows MineBot to access information from Wikipedia, a comprehensive online encyclopedia. This API provides MineBot with access to a wealth of information on various topics related to

mining laws and regulations, allowing it to provide more detailed and accurate responses to user queries. The Google Search Engine API (SERP API) allows MineBot to perform web searches and retrieve information from the internet. This API enables MineBot to access up-to-date information from reputable sources, ensuring that its knowledge base remains current and relevant. Overall, the External APIs module enhances MineBot's information retrieval capabilities, enabling it to provide users with accurate and up-to-date information on mining laws and regulations.

VIII. Advantages Of Our App:

A. User-Friendly Interface:

MineBot's user-friendly interface is designed to simplify the process of accessing information on mining laws and regulations. The chat interface, built on Streamlit, provides a familiar and intuitive environment for users to interact with the system. Users can easily input their queries and receive responses in a conversational format, mimicking natural human interactions. This user-friendly approach enhances the overall user experience, making it easier for individuals to access the information they need.

B. Comprehensive Information Retrieval:

MineBot leverages a range of tools and APIs to ensure comprehensive information retrieval. The integration of the FAISS vector store retriever allows for efficient retrieval of documents from the Ministry of Coal website, while the Wikipedia API and SERP API provide access to additional external knowledge sources. This comprehensive approach ensures that users can access a wide range of information related to mining laws and regulations, enhancing the depth and breadth of the information available through MineBot.

C. Natural Language Understanding:

MineBot's use of OpenAI's GPT-3.5-turbo enables it to understand natural language queries and generate contextually relevant responses. This natural language understanding capability enhances the conversational experience, allowing users to interact with MineBot in a more intuitive and human-like manner. By understanding the nuances of human language, MineBot is able to provide more accurate and relevant information to users, improving the overall user experience.

D. Structured Reasoning Process:

MineBot's ReAct framework guides its reasoning process, ensuring a structured approach to information retrieval. The framework's Read, Explain, Ask, and Check steps provide a systematic method for processing user queries and retrieving relevant information. This structured approach helps MineBot simulate human-like reasoning, leading to more accurate and reliable responses. By following a structured reasoning process, MineBot is able to provide users with the information they need in a logical and coherent manner, enhancing the overall user experience.

E. Integration with External Knowledge Bases:

MineBot seamlessly integrates with external knowledge bases such as the FAISS vector database, Wikipedia API, and SERP API. This integration allows MineBot to access a wide range of information sources, enriching its information repository. By integrating with external knowledge bases, MineBot is able to provide users with access to up-to-date and relevant information, improving the quality and accuracy of its responses.

F. Scalability and Modularity:

MineBot's architecture is designed for scalability and modularity, allowing for easy integration of new tools and adaptability to evolving requirements. This scalability and modularity ensure that MineBot can grow and evolve along with the needs of its users, providing a flexible and robust solution for accessing information on mining laws and regulations. This scalability and modularity also make it easier for developers to extend and enhance MineBot's functionality, ensuring that it remains a valuable tool for the mining industry.

G. 24/7 Availability:

MineBot is available 24/7, providing users with access to information at any time. This availability makes it a reliable resource for industry professionals, researchers, and policymakers in the mining sector. By being available around the clock, MineBot ensures that users can access the information they need whenever they need it, improving the overall user experience and utility of the system.

IX. Result

A. MineBot

B. MineBot Query Response

C. MineBot Backend Logs DEMONSTRATing ReAct Technique

X. Future Scope

A. Advanced Natural Language Understanding:

Continuous advancements in natural language processing (NLP) techniques offer opportunities to enhance MineBot's comprehension of complex user queries. Integration with cutting-edge NLP models, such as BERT, RoBERTa, or XLNet, could enable MineBot to parse and interpret user inputs with greater accuracy and nuance.

B. Semantic Search Capabilities:

Incorporating semantic search techniques, such as word embeddings and knowledge graph-based algorithms, could improve MineBot's ability to retrieve highly relevant information from its knowledge base. By understanding the context and relationships between concepts, MineBot can deliver more precise and contextually appropriate responses to user queries.

C. Multi-modal Interaction:

Expanding MineBot's capabilities beyond text-based interactions to support multi-modal communication, including voice input/output, images, and videos, could enhance user engagement and accessibility. Integrating with speech recognition and synthesis technologies would enable users to interact with MineBot using natural speech, making it more intuitive and user-friendly.

D. Domain-Specific Knowledge Expansion:

Continuously updating and expanding MineBot's knowledge base with domain-specific information related to mining laws, regulations, case studies, and industry best practices can further enhance its utility and relevance. Collaborating with legal experts, industry professionals, and regulatory bodies to curate authoritative content would ensure that MineBot remains a trusted source of information.

E. Personalization and Context Awareness:

Implementing personalized user profiles and context-aware recommendation systems would allow MineBot to tailor its responses based on individual user preferences, past interactions, and situational context. By learning from user feedback and behavior patterns, MineBot can deliver more personalized and relevant insights to users, enhancing their overall experience.

F. Integration with IoT and Sensor Data:

Leveraging data from IoT devices and sensors deployed in mining operations, such as drones, wearables, and environmental monitoring systems, can enrich MineBot's knowledge base with real-time data insights. Integrating with data analytics platforms and visualization tools would enable MineBot to provide actionable insights and predictive analytics for optimizing mining processes and ensuring regulatory compliance.

G. Collaborative Problem Solving:

Enabling collaborative problem-solving features, such as virtual team collaboration spaces and crowdsourced knowledge sharing platforms, can foster collaboration among stakeholders in the mining industry. By facilitating knowledge exchange, idea generation, and collective problem-solving, MineBot can serve as a catalyst for innovation and collaboration within the mining community.

H. Blockchain for Data Integrity:

Integrating blockchain technology to ensure the integrity and immutability of MineBot's knowledge base and transaction history can enhance trust and transparency. By leveraging blockchain for data authentication, verification, and auditability, MineBot can provide assurance regarding the accuracy and reliability of the information it delivers, particularly in legal and regulatory contexts.

I. Continuous Learning and Adaptation:

Implementing self-learning algorithms and reinforcement learning techniques would enable MineBot to continuously learn from user interactions, feedback, and external sources of information. By adapting its knowledge and behavior over time, MineBot can evolve to meet the changing needs and dynamics of the mining industry, ensuring its long-term relevance and effectiveness.

J. Ethical and Responsible AI:

Prioritizing ethical considerations, such as privacy protection, bias mitigation, and algorithmic transparency, is essential for the responsible deployment of MineBot. Implementing robust governance frameworks, ethical guidelines, and accountability mechanisms can ensure that MineBot operates ethically and responsibly, earning the trust and confidence of its users and stakeholders.

By pursuing these avenues of development and innovation, MineBot can continue to evolve as a valuable tool for the mining industry, empowering stakeholders with actionable insights, regulatory compliance support, and collaborative problem-solving capabilities.

XI. Reference:

[1] M. P., Ram Mohan and Yadav, Shashi Kant, Constitution, Supreme Court and Regulation of Coal Sector in India (February 19, 2018). NUJS Law Review, Volume 11 Issue 1 (2018), Available at SSRN: https://ssrn.com/abstract=3287023 or http://dx.doi.org/10.2139/ssrn.3287023

[2] Naveed, Humza & Khan, Asad & Qiu, Shi & Saqib, Muhammad & Anwar, Saeed & Usman, Muhammad & Barnes, Nick & Mian, Ajmal. (2023). A Comprehensive Overview of Large Language Models.

[3] Guu, Kelvin, et al. REALM: Retrieval-Augmented Language Model Pre-Training. arXiv:2002.08909, arXiv, 10 Feb. 2020. arXiv.org, https://doi.org/10.48550/arXiv.2002.08909.

[4] Lewis, Patrick, et al. Retrieval-Augmented Generation for Knowledge-Intensive NLP Tasks. arXiv:2005.11401, arXiv, 12 Apr. 2021. arXiv.org, https://doi.org/10.48550/arXiv.2005.11401.

[5] Yao, Shunyu, et al. ReAct: Synergizing Reasoning and Acting in Language Models. arXiv:2210.03629, arXiv, 9 Mar. 2023. arXiv.org, http://arxiv.org/abs/2210.03629.

[6] Banerjee, Debarag, et al. Benchmarking LLM Powered Chatbots: Methods and Metrics. arXiv:2308.04624, arXiv, 8 Aug. 2023. arXiv.org, http://arxiv.org/abs/2308.04624.

[7] Eapen, Joel & V S, Adhithyan. (2023). Personalization and Customization of LLM Responses. International Journal of Research Publication and Reviews. 4. 2617-2627. 10.55248/gengpi.4.1223.123512.

[8] Raiaan, Mohaimenul & Hossain, Md. Saddam & Fatema, Kaniz & Fahad, Nur & Sakib, Sadman & Mim, Most. Marufatul Jannat & Ahmad, Jubaer & Ali, Mohammed Eunus & Azam, Sami. (2023). A Review on Large Language Models: Architectures, Applications, Taxonomies, Open Issues and Challenges. 10.36227/techrxiv.24171183.

[9] Liu, Haokun & Zhu, Yaonan & Kato, Kenji & Kondo, Izumi & Aoyama, Tadayoshi & Hasegawa, Yasuhisa. (2023). LLM-Based Human-Robot Collaboration Framework for Manipulation Tasks.

[10] Gao, Yunfan, et al. Retrieval-Augmented Generation for Large Language Models: A Survey. arXiv:2312.10997, arXiv, 4 Jan. 2024. arXiv.org, https://doi.org/10.48550/arXiv.2312.10997.

[11] Bahri, Dara, et al. "Generative Models Are Unsupervised Predictors of Page Quality: A Colossal-Scale Study." Proceedings of the 14th ACM International Conference on Web Search and Data Mining, ACM, 2021, pp. 301–09. DOI.org (Crossref), https://doi.org/10.1145/3437963.3441809.

[12] Chen, Jiawei, et al. Benchmarking Large Language Models in Retrieval-Augmented Generation. arXiv:2309.01431, arXiv, 20 Dec. 2023. arXiv.org, https://doi.org/10.48550/arXiv.2309.01431.

[13] He, Hangfeng, et al. Rethinking with Retrieval: Faithful Large Language Model Inference. arXiv:2301.00303, arXiv, 31 Dec. 2022. arXiv.org, http://arxiv.org/abs/2301.00303.

[14] Melz, Eric. Enhancing LLM Intelligence with ARM-RAG: Auxiliary Rationale Memory for Retrieval Augmented Generation. arXiv:2311.04177, arXiv, 7 Nov. 2023. arXiv.org, https://doi.org/10.48550/arXiv.2311.04177.

[15] Nogueira, Rodrigo, and Kyunghyun Cho. Passage Re-Ranking with BERT. arXiv:1901.04085, arXiv, 14 Apr. 2020. arXiv.org, https://doi.org/10.48550/arXiv.1901.04085.

[16] Ren, Ruiyang, et al. Investigating the Factual Knowledge Boundary of Large Language Models with Retrieval Augmentation. arXiv:2307.11019, arXiv, 23 July 2023. arXiv.org, http://arxiv.org/abs/2307.11019.

[17] Touvron, Hugo, et al. LLaMA: Open and Efficient Foundation Language Models. arXiv:2302.13971, arXiv, 27 Feb. 2023. arXiv.org, http://arxiv.org/abs/2302.13971.

[18] Wang, Yue, et al. CodeT5+: Open Code Large Language Models for Code Understanding and Generation. arXiv:2305.07922, arXiv, 20 May 2023. arXiv.org, http://arxiv.org/abs/2305.07922.

[19] Y Arcas, Blaise Agüera. "Do Large Language Models Understand Us?" Daedalus, vol. 151, no. 2, May 2022, pp. 183–97. DOI.org (Crossref), https://doi.org/10.1162/daed_a_01909.

[20] Zhang, Hongzhi, and M. Omair Shafiq. "Survey of Transformers and towards Ensemble Learning Using Transformers for Natural Language Processing." Journal of Big Data, vol. 11, no. 1, Feb. 2024, p. 25. DOI.org (Crossref), https://doi.org/10.1186/s40537-023-00842-0.