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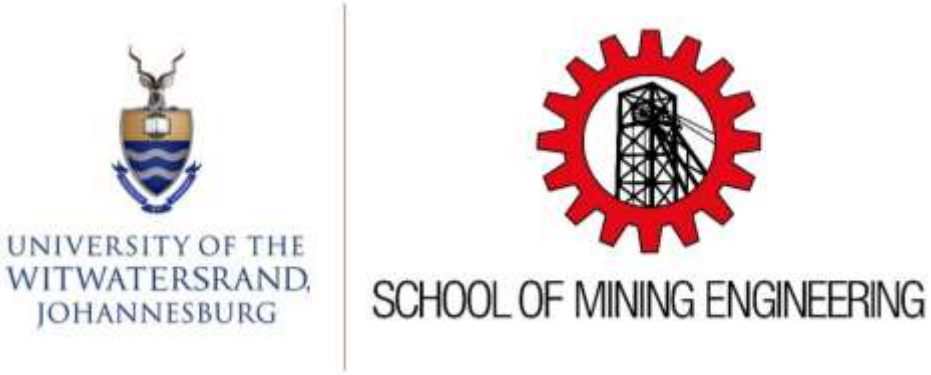


**School of Mining Engineering**

**MINN2020A: Computer Programming for Mining**

**PROJECT**

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# DESIGN, DEVELOPMENT AND DOCUMENTATION OF AN AFRICAN CRITICAL MINERALS APPLICATION

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## 1. INTRODUCTION

South Africa is a pivotal player in the global critical minerals landscape, holding significant reserves of platinum group metals (PGMs), chromium, and manganese. The country's strategic position is detailed in the Critical Minerals and Metals Strategy, published by the Department of Mineral and Petroleum Resources in May 2025. This policy framework acknowledges that while South Africa has historically been a raw mineral exporter, its future economic trajectory depends on local beneficiation; the process of adding value to minerals within the country. The strategy outlines a roadmap to leverage these resources for industrialization and job creation, identifying key interventions across the entire value chain, from exploration to downstream manufacturing [1]. This approach aligns with recent literature and policy analyses that highlight the potential for African nations to transition from mere resource extraction to becoming central hubs in the global green energy supply chain [2].

## 2. PROBLEM STATEMENT

Suppose you are hired by a major mining company, and the stakeholders have issued out the following statement after a meeting:

**CHRONO MINERALS STATEMENT**

*A key objective of our firm's strategic initiative is to address the significant data and information gaps currently hindering the development of the critical minerals sector in Africa. Our internal research, supported by external analyses from leading industry organizations, has identified a clear need for a centralized, dynamic platform to house essential data. Currently, there is no single comprehensive database for critical mineral resources on the continent, nor is there a dedicated geospatial visualization application to support strategic planning. The absence of standardized country profiles and the lack of interactive tools to track production trends and market dynamics further compound this challenge. To this end, we have commissioned a specialized team of junior engineers, leveraging their expertise in computer applications, digital technologies, and programming for mining, to develop a proprietary application. This platform will be instrumental in providing our firm and potential partners with the data intelligence required to drive sustainable growth and foster the progression of Africa's critical minerals industry.*

## 3. REQUIREMENTS

Following the stakeholders released statement, you are required to create a mining application (App) that has the following key features:

- **Access Control:** An interactive login portal with role-based access control (RBAC), allowing secure and customized access for different user roles

(Administrators, Investors, and Researchers). Each role is granted specific permissions to ensure data security, user accountability, and effective data governance.

- **Mineral Database:** A central repository of information on key critical minerals (e.g., cobalt, lithium, graphite, manganese).
- **Geographical Data Visualization:** An interactive map showing the location of major mineral deposits and production sites.
- **Country Profiles:** Detailed profiles for major mineral-producing African countries, including production statistics, economic data, and key projects.
- **Interactive Charts:** Dynamic charts and graphs to visualize trends in mineral production, exports, and market prices.

**Note:** Possible business questions to be answered by the application are listed in appendix A

## 4. TECHNICAL STACK

- Core Language: Python 3.10+
- Web Framework: Flask (lightweight and flexible for this scale of project)
- Data Analysis: pandas for data manipulation and analysis.
- Data Visualization: Plotly (for creating interactive, web-based charts) and Folium (for interactive maps).
- Data Storage: Flat-file database using JSON or CSV for simplicity.

## 5. GRAPHICAL USER INTERFACE

The Graphical User Interface (GUI) for this application should be designed for clarity, interactivity, and ease of use. It should feature a clean dashboard as the central hub, integrating the four key features seamlessly.

**The graphical user interface generally should have the following qualities**

- **Simplicity**: The design should be straightforward, allowing users to navigate easily without unnecessary complexity.
- **Consistency:** Elements should be uniform in style and behaviour, so users can predict how to interact with them across the interface.
- **Feedback:** The GUI should provide immediate feedback for user actions, confirming that inputs have been received or actions taken.
- **Accessibility:** The design should accommodate users with varying abilities, including those with visual, auditory, or motor impairments.
- **Intuitive Navigation:** Menus and controls should be logically organized, making it easy for users to find what they need.
- **Aesthetic Appeal:** A visually pleasing design can enhance user satisfaction and encourage engagement.

## 6. DOCUMENTATION

A brief report about the App of **not more than 5 pages** written in latex should be submitted. The report should have all the key aspects of a good report. These are:

- Abstract
- Introduction
- Background
- Methodology
- Results
- Conclusion and recommendations

## 7. ADVERTISING OF THE APP

A brief video less than 2 minutes to advertise the App should be created and submitted. Here are some qualities of a good advertisement video:

- **Clear Value Proposition:** Highlight the unique benefits of the App, such as advanced mapping features, data analytics, or real-time updates that make exploration easier.
- **Targeted Messaging:** Tailor the message to the specific audience, whether they are professional geologists or mining companies
- **Engaging Visuals:** Use high-quality images or animations that showcase the App's interface and features, such as maps, mineral samples, or exploration sites.
- **Concise Information:** Keep the text brief and to the point, emphasizing the key features and advantages without overwhelming the viewer.
- **Call to Action (CTA):** Include a strong, clear CTA that encourages potential users to download the app or visit the website for more information.
- **Testimonials or Endorsements:** Incorporate reviews or endorsements from industry experts or satisfied users to build credibility and trust.
- **Demonstration of Functionality:** Provide a brief demo or walkthrough of how the app works, showcasing its user-friendly interface and key features.
- **Highlight Unique Features:** Emphasize any innovative tools, such as augmented reality for fieldwork or data integration capabilities.
- **Appeal to Emotion:** Use storytelling to connect with the audience's passion for exploration and discovery, making the app feel essential for their pursuits.
- **Responsive Design:** Ensure the advert looks good on various

## 8. OUTCOMES

**Outcomes for Project 1 (Group submission and Group Post Project interview) (16th October 2025)**

- Flow charts for all the functions (5 Marks)
- Pseudo codes for all the functions (5 Marks)

- ❖ Codes (50 Marks)
- ❖ Graphical User Interface (10 Marks)
- ❖ Advertising video (15 Marks)

**Note:** Flow charts, Pseudocodes, Codes, Graphical User Interface and the Advertising video should be submitted immediately after the post Project interview.

**Outcomes for Project 2 (Group Report 24th October 2025)**

- ❖ Report (15 Marks)

**IMPORTANT TO NOTE**

- ❖ For post project interviews, students should have the entire project completed and they should be able to explain to the assessor how the work was done.
- ❖ Students should be aware that they might be asked to write part(s) of their code on paper or on a computer with no online resources during the post project interview.
- ❖ Work breakdown should be clearly indicated before the post project Interview and in the submitted report. Each student should sign alongside the work distribution.
- ❖ Each students code should be pushed into their Github account
- ❖ The entire report should be written using overleaf.

**REFERENCES**

[1]. Department of Mineral and Petroleum Resources. (2025). Critical Minerals and Metals Strategy for South Africa. Pretoria: South African Government.

[2]. Human Sciences Research Council (HSRC). (2025). Developing a Critical Minerals' Masterplan for effective participation in the electric vehicle battery supply chain. Policy Brief. HSRC Press.

**APPENDIX A**: POSSIBLE BUSINESS QUESTIONS TO BE ANSWERED BY THE APPLICATION

**Strategic and Market Analysis**

This application provides the data needed to understand the global and regional mineral landscape.

**Key questions it can answer include:**

- ❖ Where are the world's most significant deposits of critical minerals like lithium, cobalt, and manganese located?
  **Hints:** The geographical data visualization is central to answering this, helping identify key resource regions.

- What is the current state of mineral production in specific African countries? The "Country Profiles" and "Interactive Charts" provide detailed production statistics and economic data to answer this.

- How have the prices and production of a specific mineral changed over the past few years?
  **Hints:** The "Interactive Charts" showing trends in market prices and production are perfect for this historical analysis.

- Which countries are emerging as key players in the critical minerals market?
  **Hints:** By comparing country profiles and production data, you can identify growth and decline patterns.

**Investment and Risk Assessment**

The data available allows for informed decision-making regarding potential investments and risk management.

- What are the key projects and economic indicators for a country I'm considering for investment?
  **Hints:** The "Country Profiles" provide essential economic data and project information.

- What are the potential geopolitical risks associated with sourcing a mineral from a particular country?
  **Hints:** The "Country Profiles" give insight into a country's economic and political environment, which can be a proxy for risk.

- How does the production of a particular mineral in one country compared to its main competitors?
  **Hints:** You can use the "Interactive Charts" to compare the production and export trends of different countries.

**Logistics and Supply Chain Management**

For companies dependent on these minerals, the application helps optimize logistics and ensure supply chain stability.

- Where are the major production sites for a specific mineral, and what does the surrounding infrastructure look like?

**Hints:** The interactive map shows the location of production sites, which is the starting point for logistical planning.

- ❖ Are there alternative sources for a critical mineral if a primary supplier faces disruption?

**Hints:** The "Mineral Database" and "Geographical Data Visualization" can be used to identify and evaluate alternative deposits and production sites globally.

**Appendix B**

Work distribution.