Predictive Analysis of Well Penetration in the Rio Grande Basin (Closed Basin) Aquifer in Saguache County, Colorado.

Introduction

The Rio Grande Basin (Closed Basin) Aquifer, situated in Saguache County, Colorado, holds significant importance in ensuring the water supply of the region. Gaining insights into the probability of well penetration through the smectite clay layer and accurately predicting the depth of penetration are essential for maintaining sustainable water management practices. This project proposal aims to devise an interface, gather pertinent data, construct a comprehensive dataset, and employ a deep learning model to determine the likelihood of a well site, based on township range and section, penetrating the smectite clay layer. Furthermore, the model will provide an estimation of the depth at which the penetration may occur.

Primary Objectives

1. Design an intuitive and user-friendly interface to facilitate data collection and visualization.
2. Collect comprehensive data on well sites, township range, section, and associated geological characteristics.
3. Build a dataset combining collected data and theoretical information on the smectite clay layer.
4. Develop a deep learning model capable of predicting the likelihood of well penetration through the smectite clay layer.
5. Provide accurate depth estimations for wells that are likely to penetrate the clay layer.

Methodology

Interface Design:

Design and develop an interactive interface for data collection, allowing users to input wellsite information, township range, and section.

Incorporate visualization capabilities to display relevant geological information, including the smectite clay layer and other relevant data layers.

Data Collection:

Gather historical well data, including well locations, township range, section, and associated geological characteristics. Acquire theoretical information on the smectite clay layer, such as thickness, permeability, and other relevant properties. Ensure the data collection process adheres to ethical guidelines and regulations.

Dataset Creation:

Combine the collected historical well data with theoretical information on the smectite clay layer. Cleanse and preprocess the dataset, handling missing values, outliers, and inconsistencies. Conduct feature engineering to extract meaningful features from the data, such as proximity to known geological formations and aquifer characteristics.

Deep Learning Model Development:

Implement a deep learning model architecture, such as a convolutional neural network (CNN) or a recurrent neural network (RNN), suitable for the predictive task. Split the dataset into training, validation, and testing sets. Train the model using the training set and optimize its performance through iterative experimentation. Validate and fine-tune the model using the validation set to achieve the best possible predictive performance. Include appropriate data visualizations.

Model Evaluation and Deployment:

Evaluate the trained model using the testing set, measuring performance metrics such as accuracy, precision, recall, and depth estimation error. Deploy the trained deep learning model into the interface for real-time predictions. Continuously monitor the model's performance and make necessary updates and improvements based on user feedback and additional data.

Deliverables

- A user-friendly interface for well site information input and visualization of geological data layers.
- A comprehensive dataset combining historical well data and theoretical information on the smectite clay layer.

- A trained deep learning model capable of predicting the likelihood of well penetration and providing depth estimations.
- Documentation outlining the project methodology, data collection process, model architecture, and instructions for using the interface.

Tasks

- Interface design and development.
- Data collection and dataset creation.
- Deep learning model development and optimization.
- Model evaluation and interface deployment.
- Finalizing project documentation and presentation.

Resources Required

- Access to historical well data in Saguache County, including township range, section, and geological information.
- Theoretical data on the smectite clay layer, including thickness, permeability, and other relevant properties.
- Computational resources (e.g., CPUs, GPUs) for data processing, model training, and inference.
- Relevant software tools and libraries, such as Python, TensorFlow, or PyTorch, for deep learning model development.

Conclusion

This project proposal aims to develop a predictive deep learning model to assess the likelihood and depth of well penetration through the smectite clay layer in the Rio Grande Basin (Closed Basin) Aquifer in Saguache County, Colorado. The proposed interface will provide users with real-time predictions and visualizations to support decision-making in sustainable water management practices within the region. The successful completion of this project will deliver valuable insights that will assist stakeholders in ensuring the efficient and responsible utilization of water resources in the Rio Grande Basin.