

# Comprehensive Report: Earthquake Magnitude Prediction Project

This report provides a detailed breakdown of the Earthquake Magnitude Prediction project, covering all phases including dataset handling, preprocessing, model selection, training, evaluation, and deployment.

## 1. Dataset Overview:

The dataset consists of various seismic features that influence earthquake magnitude. The following table outlines the dataset features:

Feature Name	Description
Latitude	Geographic coordinate of the epicenter
Longitude	Geographic coordinate of the epicenter
Depth (km)	Depth of the earthquake below the Earth's surface
Seismic Energy	Amount of energy released (Joules)
Fault Type	Type of tectonic fault responsible for the quake
Wave Velocity	Speed of seismic waves in the region
Peak Ground Acceleration	Maximum ground acceleration during shaking
Historical Magnitude	Past magnitude data from the same fault line
Magnitude	Target variable (Richter scale magnitude)

## 2. Data Preprocessing Steps:

Various preprocessing steps were applied to clean and transform the dataset:

Step	Description
Handling Missing Data	Used mean/median imputation for missing values.
Normalization	Applied MinMaxScaler for feature scaling.
Encoding Categorical Variables	Used Label Encoding for fault type.
Feature Selection	Removed low-impact features based on correlation analysis.
Outlier Removal	Used IQR method to detect and remove extreme values.

## 3. Model Selection & Training:

Several machine learning models were trained and evaluated to find the best-performing model. The following models were tested:

Model	MAE	RMSE	R <sup>2</sup> Score
Linear Regression	1.25	1.88	0.62

Decision Tree	0.85	1.36	0.75
Random Forest	0.68	1.12	0.83
XGBoost	0.59	1.02	0.87
ANN (Deep Learning)	0.52	0.95	0.91

4. Model Deployment & Applications:

- The final model was deployed using Flask API.
- A Streamlit dashboard was created for visualization.
- The model's application includes early warning systems and disaster risk management.

5. Technologies & Skills Used:

The following tools and technologies were utilized throughout the project:

Technology	Usage
Python	Used for data processing, model training, and deployment.
Pandas	Data manipulation and analysis.
NumPy	Mathematical operations and array handling.
Scikit-learn	Machine learning model training and evaluation.
TensorFlow/Keras	Deep learning model development.
Matplotlib & Seaborn	Data visualization and exploration.
Flask	API deployment for real-time prediction.
Streamlit	Building an interactive dashboard for model visualization.

6. Conclusion:

This project successfully built an earthquake magnitude prediction model, leveraging both machine learning and deep learning techniques. The final model achieved high accuracy and was deployed using Flask API and Streamlit for practical use.