THE UNIVERSITY OF DODOMA

COLLEGE OF INFORMATICS AND VIRTUAL EDUCATION

DEPARTMENT OF ELECTRONICS AND TELECOMMUNICATION ENGINEERING

FINAL YEAR PROPOSAL

ACADEMIC YEAR**: 2024/2025**

TITLE: EARTHQUAKE PREDICTION SYSTEM FOR CENTRAL TANZANIA REGIONS USING AI

GROUP MEMBERS

STUDENT'S NAME	REGISTRATION NUMBER	PROGAMME	SIGNATURE
1. GOODLUCK LASWAI	T21-03-08998	Bsc-DCBE	
2.ALEX A. TWEVE	T21-O3-00862	Bsc-DCBE	
3. MARKUS KOMBA	T21-03-09167	Bsc-DCBE	

NAME OF SUPERVISOR **SIGNATURE**

MR. WILSON CHANHEMO ………………………

NAME OF COORDINATOR

MR EDSON NASORWA …………………………

TABLE OF CONTENTS

Contents

List of figures

List of tables

CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND

Earthquakes are among the most devastating natural disasters, causing significant loss of life, damage to infrastructure, and economic setbacks. The Central Tanzania regions, located in a tectonically active zone, is vulnerable to seismic activity, making it essential to develop systems that can anticipate earthquakes and mitigate their effects.

Traditional earthquake prediction methods rely heavily on geological and seismic analyses but often fail to provide accurate, timely forecasts due to the complex and nonlinear nature of seismic activity. Advances in artificial intelligence (AI) and machine learning offer a new approach to predicting earthquakes by analyzing large volumes of seismic and environmental data to identify patterns and correlations that traditional methods might overlook.

This project aims to leverage AI to create a predictive system that uses historical earthquake data, environmental variables, and geological features to forecast earthquake occurrences in Central Tanzania regions. By improving the accuracy and timeliness of predictions, the system seeks to enhance disaster preparedness and response efforts, ultimately reducing the impact of earthquakes on the region's population and infrastructure.

1.2 PROBLEM STATEMENT

The prediction of earthquakes remains a significant challenge due to the chaotic and nonlinear nature of seismic processes. Traditional methods, such as physics-based models and statistical analyses, have limited success in identifying patterns that reliably predict earthquake occurrences. These limitations are further compounded by the scarcity of high-quality seismic data, the imbalance in datasets between small and large earthquakes, and the difficulty in processing real-time seismic data. This lack of reliable prediction capabilities leads to a higher risk of loss of life, infrastructure damage, and economic disruption. Therefore, there is a critical need for an advanced, AI-driven earthquake prediction system capable of analyzing complex geophysical data, identifying patterns, and providing accurate and actionable predictions to mitigate the impact of earthquakes.

1.3 Objectives

1.3.1 Main objective.

To develop an AI-based Earthquake Prediction System for the Central Tanzania regions that utilizes seismic, environmental, and geological data to forecast the likelihood of earthquakes. This system aims to enhance disaster preparedness, improve early warning capabilities, Advancing Research in Earthquake related issues.

1.3.2 Specific objective.

i. To gather the requirements for building an AI-driven earthquake prediction system, including identifying data sources, technical specifications.
ii. To train machine learning models using historical seismic data and other geophysical inputs for predicting earthquake occurrence, location, and magnitude.
iii. To validate and evaluate the performance of the developed models using standard metrics.

1.3.3 Project significance

The Earthquake Prediction System for Central Tanzania regions Using AI is of immense significance for several reasons:

- Enhanced Disaster Preparedness:
  The system will provide early warnings by accurately predicting the likelihood of earthquakes. This will allow governments, disaster management agencies, and communities to prepare in advance, reducing potential casualties and damage.
- Innovative Use of Technology:
  Traditional methods often fail to capture the complex dynamics of seismic activity. By utilizing artificial intelligence and machine learning, this project introduces a modern, data-driven approach to earthquake prediction, showcasing the potential of technology in solving real-world challenges.
- Advancing Research in Earthquake Prediction:
  The project contributes to the growing body of knowledge in AI-driven natural disaster prediction, paving the way for further innovations and applications in similar contexts.

1.3 Project scope

The scope of the Earthquake Prediction System for Dodoma Using AI includes collecting and analyzing seismic, environmental, and geological data to develop a machine learning-based predictive model tailored to the region. The system will utilize algorithms like Linear regression, Support Vector Machine (SVM), Naive Bayes and Random Forest for the predicts likelihood of earthquakes, focusing on patterns and correlations in the data. Key deliverables include a functional prediction system, a user-friendly interface for displaying results and alerts, and integration with local disaster management systems to enhance preparedness and response. While the system may not predict exact earthquake timings or magnitudes, it will provide valuable probability-based forecasts to minimize risks and support informed decision-making. Continuous monitoring, retraining, and updates will ensure the system remains accurate and effective over time.

1.5 LITERATURE REVIEW

In recent years, machine learning models have been extensively applied to earthquake prediction, with notable studies employing Linear Regression, Support Vector Machine (SVM), Naive Bayes, and Random Forest algorithms.

Linear Regression is often used to analyze the relationship between seismic factors and earthquake frequency. Studies such as Sarkar et al. (2023) demonstrated its utility in identifying correlations between environmental variables like soil moisture and minor tremors. However, due to the non-linear nature of seismic activity, its performance is limited in predicting larger, more complex events.

Support Vector Machine (SVM) has been extensively used for classifying seismic risks. For instance, Zhao et al. (2022) achieved 89.6% accuracy in classifying earthquake risk levels using SVM. The model is particularly effective for handling non-linear data and finding boundaries between risk classes. However, SVM's computational intensity makes it less practical for very large datasets.

Naive Bayes, a probabilistic classifier, has proven effective for tasks like aftershock prediction. Khan et al. (2021) showed its ability to classify aftershocks with a precision of 93%, making it useful for disaster management. Nonetheless, its assumption of feature independence can limit its performance in handling correlated seismic variables such as depth and magnitude.

Random Forest has emerged as one of the most effective models for earthquake prediction. Chen et al. (2023) applied Random Forest to predict earthquake magnitudes, achieving a high accuracy of 92.4%. The model’s ability to handle non-linear relationships, noisy data, and missing values makes it particularly suitable for complex seismic datasets. Additionally, it offers insights into key predictors like fault line proximity and historical seismic activity.

A comparative analysis by the International Journal of Science and Technology (2024) found that Random Forest outperformed other models in accuracy and robustness, while SVM excelled in classification tasks. Naive Bayes was noted for its simplicity and speed but was less effective in handling multi-dimensional data.

In conclusion, while each model has its strengths, Random Forest stands out as the most robust for earthquake prediction, especially when dealing with complex, non-linear seismic data. These studies underscore the potential of machine learning to enhance earthquake forecasting, providing valuable tools for disaster preparedness and mitigation efforts.