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An Intelligent Early Flood Forecasting and Prediction Leveraging Machine and Deep Learning Algorithms with Advanced Alert System

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Abstract: Flood disasters are a natural occurrence around the world, resulting in numerous casualties. It is vital to develop an accurate flood forecasting and prediction model in order to curb damages and limit the number of victims. Water resource allocation, management, planning, flood warning and forecasting, and flood damage mitigation all benefit from rain forecasting. Prior to recent decades' worth of research, this domain demonstrated to be promising prospects in time series prediction tasks. Therefore, the main aim of this study is to build a forecasting model based on the exponential smoothing-long-short term memory (ES-LSTM) structure and recurrent neural networks (RNNs) for predicting hourly precipitation seasons; and classify the precipitation using an artificial neural network (ANN) model and decision tree (DT) algorithm. We employ the dataset from the Australian commonwealth office of meteorology named Historical Daily Weather dataset to test the effectiveness of the proposed model. The findings showed that the ES-LSTM and RNN had achieved 3.17 and 6.42 in terms of mean absolute percentage error (MAPE), respectively. Meanwhile, the ANN and DT models obtained a prediction accuracy rate of 96.65% and 84.0%, respectively. Finally, the outcomes revealed that ES-LSTM and ANN had achieved the best results compared to other models.

Keywords: flood forecasting and prediction; multilayer perceptron (MLP); time series analysis; es-lstm; machine learning (ML); deep learning (DL); artificial neural network (ANN); decision tree (DT); recurrent neural network (RNN); exponential smoothing

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1. Introduction

Natural disasters frequently result in major and long-lasting disturbances in the entire socioeconomic system. A single catastrophic event, such as a flood, can devastate complex infrastructure systems, resulting in recurring failures and significant socioeconomic harm, so impeding progress. Ample precipitation will immediately result in unharvestable crop, floods and waterlogging disasters, rendering crops, resulting in events that lead to disasters such as landslides, collapses, waterlogging, and mudslides [1].

Precipitation causes are extremely complicated because of the bundle impact of monsoon, geography, evaporation, urbanization, and temperature adding difficulties in forecasting precipitation [2–4]. In addition, rainfall has some set properties, and the elements affecting it, such as terrain, urbanization, and temperature, will not change significantly in short term. Furthermore, precipitation exhibits a high degree of predictability. Accurate