

ABSTRACT

Climate change and increasing weather variability demand the availability of accurate local weather data and timely predictions. Conventional weather stations are often expensive and complex, limiting their accessibility to the general public and specific applications. This study aims to develop a Smart Mini Weather Station based on the Internet of Things (IoT) and Deep Learning that is capable of acquiring real-time weather data and predicting weather parameters with high accuracy. The system integrates an ESP32-S3 microcontroller with BME280 sensors (temperature, humidity, pressure), and an anemometer (wind speed) for automatic data collection, which is then stored in Google Spreadsheet. The collected data then goes through a pre-processing process including cleaning, handling missing values, normalization using Min-Max Scaling, and sequence formation for time series models. Predictive modeling is done using Deep Learning Long Short-Term Memory (Long Short-Term Memory (LSTM)) architecture optimized with Keras Tuner. The model is trained to predict temperature, humidity, pressure, and wind speed. The model evaluation results show excellent prediction performance for numerical parameters, with high R-squared (R^2) values 0.8321 for temperature, 0.9656 for humidity, and 0.9595 for pressure, as well as low Mean Absolute Error (MAE) and Root Mean Absolute Error (RMEA) values. In addition, the model also shows weather classification capabilities (Rainy, Sunny) with an overall accuracy of 88%. The end-to-end system built, including FastAPI-based API and React Native Expo mobile application, was successfully implemented and serves as an informative interface for users. This study successfully proves the effectiveness of the combination of IoT and Deep Learning in providing accurate and affordable weather monitoring and prediction solutions.

Keywords: Smart Mini Weather Station, Internet of Things (IoT), Deep Learning, Long Short-Term Memory (Long Short-Term Memory (LSTM)), Weather Prediction, Weather Classification.