ABSTRACT

Wind is the horizontal movement of air with physical components in the form of speed and direction, caused by differences in air pressure in a certain area. Wind energy offers great potential as an alternative solution to reduce dependence on fossil fuels, as it is renewable and environmentally friendly. However, wind speed fluctuates with time, seasons, and geographical conditions, creating challenges in maintaining the stability of energy systems that rely on it. On the other hand, anemometer networks as wind speed measuring instruments often experience disruptions such as sensor failures, resulting in data loss during the repair process. This study aims to develop a wind speed estimation model based on the Internet of Things (IoT) by utilizing a combination of Attention Layer Neural Networks and the Particle Swarm Optimization (PSO) optimization method. The model architecture consists of a combination of LSTM and GRU, enhanced with an attention layer to capture the dynamic patterns of wind speed time-series data. PSO is used to optimize the number of neurons in the model to obtain the best configuration that delivers high accuracy with efficient complexity. The test data were obtained from an anemometer sensor that recorded wind speed hourly, followed by training and evaluation using four main metrics: Mean Absolute Error (MAE), Root Mean Square Error (RMSE), Mean Absolute Percentage Error (MAPE), and the coefficient of determination (R^2). The results show that the model optimized with PSO achieved superior estimation performance, with an average R^2 value of 98.38%, higher than the non-PSO model's average R^2 of 98.16%, resulting in an accuracy improvement of 0.218%. For future development, the model could include exploration of other architectures, comparison of optimization methods such as PSO with alternative approaches, integration into web or mobile-based applications, and the addition of weather parameters to enhance accuracy and real-world applicability.

***Keywords**: Wind Speed Estimation, Internet of Things, Attention Layer Neural Networks, Particle Swarm Optimization.*