

ABSTRACT

This research focuses on the application of Temporary Immersion System (TIS) combined with Internet of Things (IoT) and Gated Recurrent Unit (GRU) technology to be able to create TIS methods and GRU modeling that can predict environmental conditions in the next 1 minute. Orchids have high economic value in Indonesia, but their cultivation requires strict environmental monitoring, including temperature, humidity, and light intensity. TIS can precisely control microenvironmental conditions, reducing the risk of contamination and increasing tissue culture production.

In this study, the TIS was integrated with IoT using an Arduino UNO microcontroller for watering automation and an ESP32 for temperature and humidity monitoring. Environmental data was collected by DHT11 sensors and transmitted to the cloud for processing by the GRU model, which predicts the environmental conditions of the incubator one minute ahead.

The results show that the GRU model is able to provide temperature estimation with good accuracy, indicated by an R^2 value of 98.94%, while humidity estimation shows fairly good accuracy with an R^2 value of 86.33%. Evaluation metrics such as MAE, MBE, MSE, NMSE, NRMSE, and RMSE are used to measure model performance. The results show that the GRU model provides stable temperature predictions, although it does not always capture small fluctuations in the actual data, while humidity predictions show greater error variability.

This study indicates that the integration of TIS with IoT and GRU can improve efficiency and accuracy in orchid tissue culture production, with the potential to be applied to a variety of other crops. Further evaluation is needed to optimize the model and address weaknesses in moisture prediction.

Keywords: Orchid, Temporary Immersion System (TIS), Internet of Things (IoT), Gated Recurrent Unit (GRU), Environmental Prediction, Microcontroller, DHT11 Sensor.