

ABSTRACT

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Title : Sistem Pemantauan dan Pengendalian Nutrisi Hidroponik dengan *Artificial Neural Network* (ANN) berbasis *Internet of Things* (IoT)

This study designed a control and monitoring system for hydroponics based on the Internet of Things (IoT) that utilizes Artificial Neural Networks (ANN) for optimization of pH and Parts Per Million (PPM). The manually programmed ANN model (architecture 2;7;3, backpropagation gradient descent with momentum) showed better prediction accuracy ($R > 0.99$ for training, validation, and testing) compared to the MATLAB ANN Toolbox, thanks to optimized training parameters. Implementation on the Portenta H7M7 hardware, the successfully predicted the duration of pH Up (MAPE $\sim 1.4\%$), pH Down (MAPE $\sim 3.2\%$), and AB Mix (MAPE $\sim 7.9\%$) actions, with low average errors, and demonstrated responsive computational speed (average 17.7 microseconds), making it capable of real-time operations. Overall, this control system successfully adjusted solution parameters to the target range with an 88.89% success rate, supported by a strong correlation ($r > 0.7$) between pump duration and changes in the targeted parameters. Reliability testing of IoT data communication via the MQTT protocol showed good performance with 0% packet loss, an average delay of 201.2 ms, and an average jitter of 57.18 ms, ensuring the delivery of pH and PPM sensor data in full, in real-time, and stored in the MySQL database and Android application interface without interruption, despite limited throughput is limited due to device workload. These results confirm the effectiveness and reliability of the ANN system in optimizing hydroponic conditions, especially in environments approaching ideal values.

Keywords: Hidroponics, Internet of Things (IoT), Artificial Neural Network (ANN), MQTT, Portenta H7M7, pH, PPM.