PERANCANGAN SISTEM *MONITORING* TERMOGRAFI BERBASIS *THERMAL IMAGING CAMERA* PADA *GROWTH CHAMBER*

INTISARI

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Sistem *monitoring* merupakan salah satu basis penting dalam pertanian presisi. *Monitoring* secara konvensional memiliki kelemahan seperti rentan menimbulkan kelelahan operator, bias data, subjektif, dan hasil yang kurang akurat. Tempat *monitoring* secara khusus seperti *growth chamber* memungkinkan *monitoring* dapat berjalan dengan baik karena minimnya pengaruh dari faktor luar. Tanaman sebagai makhluk hidup poikiloterm dapat mengalami gradien temperatur saat melakukan aktivitas biologis. Perubahan suhu pada dapat mengindikasi adanya penyakit seperti virus, jamur, maupun bakteri. *Monitoring* termografi dapat mendukung optimalisasi dan antisipasi saat pertumbuhan tanaman. Tujuan dari penelitian ini yaitu merancang sistem *monitoring* termografi pada tanaman berbasis *thermal imaging camera*. Tanaman yang digunakan sebagai objek pengamatan yaitu sawi pakcoy. Penelitian ini menggunakan metode verifikasi dan validasi untuk mengukur keakuratan hasil perancangan sistem. Cara kerja *thermal imaging camera* yaitu dengan mengakuisisi data termal secara otomatis dan berulang setiap lima menit sekali. Selain itu untuk mendukung hasil implementasi sistem *monitoring* termografi, dilakukan pengambilan data kondisi lingkungan pada *growth chamber*. Data hasil *monitoring* dianalisis menggunakan RStudio dengan segmentasi algoritma *ROI* untuk menentukan area objek yang diamati. Uji validasi dilakukan dengan tiga metode yaitu uji regrei linier, *RMSE (Root Mean Square Error)*, dan *MAPE (Mean Absolute Percentage Error)*. Hasil validasi menunjukkan bahwa nilai *R square* tertinggi sebesar 0,992, nilai *RMSE* terkecil yaitu 0,120 ^{o}C, dan nilai *MAPE* terkecil yaitu 0,306%. Visualisasi data termal ditunjukkan oleh *heatmap* dan distribusi suhu objek. Berdasarkan implementasi sistem *monitoring* termografi, suhu tanaman berkorelasi positif dengan suhu lingkungan yang memiliki nilai R sebesar 0,801.

Kata kunci: data termal, sistem *monitoring*, termografi, *thermal imaging camera*.

THERMOGRAPHIC MONITORING SYSTEM DESIGN BASED ON THERMAL IMAGING CAMERA IN GROWTH CHAMBER

ABSTRACT

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The monitoring system is one of important basis in precision agriculture. Conventional monitoring has weaknesses such as operator susceptibility, data bias, subjectivity, and inaccurate results. A special monitoring area such as a growth chamber allows monitoring to run well because it is not influenced by external factors. Plants as poikiloterm living things can experience temperature gradients when carrying out biological activities. Changes in temperature can indicate diseases such as viruses, fungi, or bacteria. Thermographic monitoring of plants can support optimization and anticipation during plant growth. The purpose of this research is to design plant thermographic monitoring system based on a thermal imaging camera. The plant used as the object of observation was mustard pakcoy. This research used verification and validation methods to measure the accuracy of the system design results. The way a thermal imaging camera works was that it acquire data automatically and repeat itself every five minutes. In addition, to support the results of plant thermographic monitoring, data collection on environmental conditions was carried out in the growth chamber. The monitoring data were analyzed by using RStudio with the ROI algorithm segmentation to determine the area of the object were being observed. The validation test was carried out by three test methods, namely linear regression, RMSE (Root Mean Square Error), and MAPE (Mean Absolute Percentage Error). The validation results showed that the highest R square value is 0.992, the RMSE value is at 0.120 ^{o}C, and the smallest MAPE value is 0.306%. Data visualization shown by heatmap and temperature distribution of objects. Based on the implementation of the thermographic monitoring system, plant temperature is positively correlated with environmental temperature that R value is 0.801.

Keyword: thermal data, monitoring system, thermographic, *thermal imaging camera.*