RINGKASAN

PERANCANGAN HUMAN MACHINE INTERFACE SHOWCASE MONTANA CONTROLLER SEBAGAI SISTEM MONITORING DAN KENDALI MICROCLIMATE INDOOR FARMING DI PT INAMAS SINTESIS TEKNOLOGI

Ragil Auliya Alfarizi

Meningkatnya kepadatan penduduk mampu menyebabkan berbagai dampak, seperti semakin banyaknya kebutuhan pangan. Masalah tersebut tidak mudah diatasi disebabkan perubahan iklim yang ekstrim akan mengganggu kegiatan agrikultur. Selain itu, penyusutan lahan pertanian dapat mengancam keseimbangan antara produksi dan kebutuhan pangan. Sebagai respon, *indoor farming* muncul sebagai solusi inovatif. Hanya saja solusi tersebut memiliki tantangan tersendiri, yakni diperlukan kemudahan akses dalam pengendalian *microclimate*.

Penelitian ini merancang sebuah HMI pada Showcase Montana Controller untuk memonitor dan mengendalikan microclimate dalam sistem indoor farming. Sistem tersebut terdiri dari mikrokontroler ESP32 sebagai pusat kendali; sensor-sensor yang menangkap data nutrisi beserta data lingkungan; dan aktuator-aktuator yang mampu memanipulasi lingkungan agar nilai tersebut tetap terjaga pada target yang telah ditentukan.

Berdasarkan hasil pengujian otomasi Showcase Montana Controller melalui antarmuka HMI, ditunjukkan bahwa tingkat kesuksesan bernilai 100% dalam penjadwalan dan penyesuaian target pada nilai-nilai manajemen *indoor farming*. Selain menyediakan mode otomatis, HMI pun menyediakan mode manual. Nilai rata-rata suhu dan kelembapan dalam *showcase* adalah 25,8 - 34,2°C dan 49,3 - 80,4%, yang naik menjadi 33 - 40,9°C dan 38,3 - 55,2% saat growlight dinyalakan. *Fan* dan *exhaust* terbilang belum efektif menurunkan suhu dan kelembapan dikarenakan perubahan nilai tetap relatif sama. Rak atas dan rak bawah memiliki nilai rata-rata PPFD masing-masing 134,77 µmol/s·m² dan 105,33 µmol/s·m². Durasi nyala *growlight* diatur menjadi 16 jam, sehingga DLI yang didapatkan pada kedua rak tersebut sebesar 7,763 mol/m²/day dan 6,067 mol/m²/day. Angka tersebut berada pada rentang kebutuhan optimal pertumbuhan tanaman selada. Maka dari itu, dapat dinyatakan bahwa HMI mampu hadir sebagai solusi untuk monitoring dan kendali terhadap nilai-nilai microclimate pendukung indoor farming.

Kata kunci : *Smart Indoor Farming, Microclimate,* selada, ESP32, HMI, *Smart Agriculture, Horticulture.*

SUMMARY

DESIGN OF THE MONTANA CONTROLLER SHOWCASE: A HUMAN MACHINE INTERFACE FOR MICROCLIMATE MONITORING AND CONTROL SYSTEM IN INDOOR FARMING AT PT INAMAS SINTESIS TEKNOLOGI

Ragil Auliya Alfarizi

The increasing population density can lead to various impacts, such as a growing demand for food. This issue is not easy to tackle due to extreme climate changes disrupting agricultural activities. Additionally, the reduction of agricultural land can threaten the balance between food production and demand. As a response, indoor farming emerges as an innovative solution. However, this solution has its own challenges, including the need for easy access in microclimate control.

This research designed an HMI for the Montana Controller showcase to monitor and control the microclimate in an indoor farming system. The system consists of the ESP32 microcontroller as the control center; sensors that capture nutrient data along with environmental data; and actuators capable of manipulating the environment to ensure that these values remain on the set targets.

Based on the automation testing of the Montana Controller showcase through the HMI interface, it was shown that there was a 100% success rate in scheduling and adjusting the target values for indoor farming management. The average temperature and humidity within the showcase were 25.8 - 34.2°C and 49.3 - 80.4%, which increased to 33 - 40.9°C and 38.3 - 55.2% when the growlight was turned on. The fan and exhaust were found to be ineffective in reducing temperature and humidity, as the changes in values remained relatively the same. The upper and lower racks had average PPFD values of 134.77 µmol/s·m² and 105.33 µmol/s·m², respectively. The growlight was set to be on for 16 hours, resulting in DLIs of 7.763 mol/m²/day and 6.067 mol/m²/day for the upper and lower racks. These figures are within the optimal range for lettuce plant growth. Therefore, it can be stated that the HMI serves as an effective solution for monitoring and controlling microclimate values in support of indoor farming.

Keywords: Smart Indoor Farming, Microclimate, lettuce, ESP32, HMI, Smart Agriculture, Horticulture.