ABSTRAK

Penyakit pada daun cabai merupakan salah satu faktor yang menyebabkan penurunan produktivitas tanaman karena dapat menghambat pertumbuhan dan menurunkan kualitas hasil panen. Identifikasi penyakit yang masih dilakukan secara manual memerlukan waktu, bergantung pada keahlian pengamat, dan berpotensi menghasilkan kesalahan diagnosis. Penelitian ini bertujuan merancang dan membangun sistem pemantauan kesehatan daun cabai berbasis Artificial Intelligence (AI) menggunakan metode Logika Fuzzy Mamdani sebagai algoritma kecerdasan buatan dan ESP32-CAM sebagai perangkat akuisisi citra. Sistem melakukan pengambilan citra daun, kemudian mengekstraksi fitur warna berupa persentase warna hijau dan kuning serta fitur tekstur menggunakan Gray Level Co-occurrence Matrix (GLCM) yang menghasilkan parameter contrast dan homogeneity. Selanjutnya, fitur-fitur tersebut diproses menggunakan algoritma Logika Fuzzy Mamdani melalui tahapan fuzzification, inferensi berbasis aturan (rule base), dan defuzzification untuk mengklasifikasikan kondisi daun menjadi empat kategori, yaitu daun sehat, bercak daun, keriting daun dan klorosis. Hasil identifikasi ditampilkan pada modul OLED dan dapat dipantau melalui jaringan internet menggunakan ESP32-CAM. Pengujian dilakukan terhadap 80 sampel citra daun cabai dengan berbagai kondisi kesehatan. Hasil penelitian menunjukkan bahwa sistem mampu mengidentifikasi 72 sampel dengan benar sehingga memperoleh tingkat akurasi sebesar 90%. Selain itu, pengujian perangkat keras menunjukkan seluruh komponen, meliputi ESP32-CAM, OLED, push button, dan komunikasi data, berfungsi sesuai rancangan. Berdasarkan hasil tersebut, sistem berbasis Artificial Intelligence (AI) menggunakan metode Logika Fuzzy Mamdani mampu melakukan identifikasi kondisi kesehatan daun cabai secara otomatis dengan tingkat akurasi yang baik sehingga berpotensi mendukung penerapan teknologi pertanian cerdas (smart farming).

Kata kunci: Artificial Intelligence, ESP32-CAM, Gray Level Co-occurrence Matrix, Logika Fuzzy Mamdani.

ABSTRACT

Diseases affecting chili leaves are one of the major factors contributing to reduced crop productivity, as they inhibit plant growth and decrease harvest quality. Manual disease identification is time-consuming, depends on the observer's expertise, and is prone to diagnostic errors. This study aims to design and develop an Artificial Intelligence (AI)-based health monitoring system for chili leaves using the Mamdani Fuzzy Logic algorithm as the AI decision-making method and an ESP32-CAM as the image acquisition device. The proposed system captures leaf images and extracts color features based on the percentage of green and yellow colors, as well as texture features using the Gray Level Co-occurrence Matrix (GLCM) to obtain the contrast and homogeneity parameters. These extracted features are then processed using the Mamdani Fuzzy Logic algorithm through the stages of fuzzification, rule-based inference, and defuzzification to classify leaf conditions into four categories: healthy leaves, leaf spot disease, curly leaves, and chlorosis. The classification results are displayed on an OLED module and can also be monitored remotely via the Internet using the ESP32-CAM. The system was evaluated using 80 chili leaf image samples representing various leaf health conditions. Experimental results show that the proposed system correctly identified 72 samples, achieving an accuracy of 90%. Furthermore, hardware testing confirmed that all system components, including the ESP32-CAM, OLED display, push buttons, and data communication module, operated according to the design specifications. These findings demonstrate that the proposed Artificial Intelligence (AI)-based system using the Mamdani Fuzzy Logic algorithm is capable of automatically identifying the health condition of chili leaves with satisfactory accuracy, making it a promising solution for faster and more efficient plant health monitoring in support of smart farming applications.

Keywords: Artificial Intelligence, ESP32-CAM, Gray Level Co-occurrence Matrix, Mamdani Fuzzy Logic.