

ABSTRAK

Ghaotama Akbar Abiansyah. 2026. Implementasi Kebutuhan Irigasi Tanaman Berbasis *Machine learning* Terhadap Data Kondisi Tanah dan Mikroklimat Pada Sistem IoT. *Skripsi*. Program Studi Teknik Informatika, FT, Universitas PGRI Madiun. Pembimbing (I) Moch. Yusuf Asyhari, S.Tr.Kom., M.Kom. (II) Muh. Nur Luthfi Azis, S.Kom., M.Kom.

Proses penyiraman tanaman secara konvensional yang masih mengandalkan kebiasaan petani tanpa mempertimbangkan kondisi tanah dan lingkungan menyebabkan penggunaan air menjadi tidak efisien. Penelitian ini bertujuan merancang dan membangun sistem irigasi otomatis berbasis Internet of Things (IoT) dan machine learning yang mampu memprediksi kebutuhan air tanaman berdasarkan kondisi tanah dan mikroklimat secara real-time. Sistem dikembangkan menggunakan metode Prototype dengan lima tahapan, yaitu Communication, Quick Plan, Modeling Quick Design, Construction of Prototype, dan Deployment Delivery & Feedback. Perangkat IoT dibangun menggunakan mikrokontroler ESP8266 NodeMCU yang membaca data suhu dan kelembapan udara, suhu tanah, serta kelembapan tanah, dan mengendalikan pompa air melalui relay. Prediksi kebutuhan irigasi dilakukan menggunakan algoritma Decision Tree yang dilatih dengan data sekunder Stuard Tomato Dataset, kemudian di-deploy pada server FastAPI berbasis Hugging Face Space dan diakses oleh perangkat IoT melalui API. Hasil pengujian menunjukkan model machine learning memperoleh akurasi sebesar 96,72%, precision kelas ON sebesar 83,33%, recall kelas ON sebesar 75,00%, F1-Score kelas ON sebesar 78,95%, dan nilai AUC sebesar 0,8788 yang termasuk kategori baik. Pengujian fungsional sistem menggunakan teknik black box terhadap seluruh skenario uji menunjukkan hasil valid, termasuk mekanisme cadangan berbasis ambang batas yang tetap menjaga keberlangsungan irigasi saat koneksi server terganggu. Dengan demikian, sistem yang dikembangkan terbukti mampu mendukung pengambilan keputusan irigasi secara otomatis dan efisien berdasarkan kondisi tanah dan mikroklimat.

Kata Kunci : Irigasi otomatis, *Internet of Things*, *Machine learning*, *Decision Tree*, mikroklimat.

ABSTRACT

Ghaotama Akbar Abiansyah. 2026. *Implementation of Machine Learning-Based Plant Irrigation Requirements Using Soil Condition and Microclimate Data in an IoT System*. Undergraduate Thesis. Informatics Engineering Study Program, Faculty of Engineering, Universitas PGRI Madiun. Advisors (I) Moch. Yusuf Asyhari, S.Tr.Kom., M.Kom. (II) Muh. Nur Luthfi Azis, S.Kom., M.Kom.

Conventional plant watering, which still relies on farmers' habits without considering soil and environmental conditions, leads to inefficient water use. This study aims to design and develop an automated irrigation system based on the Internet of Things (IoT) and machine learning that is capable of predicting plant water requirements based on soil and microclimate conditions in real time. The system was developed using the Prototype method, which consists of five stages: Communication, Quick Plan, Modeling Quick Design, Construction of Prototype, and Deployment Delivery & Feedback. The IoT device was built using an ESP8266 NodeMCU microcontroller that reads air temperature and humidity, soil temperature, and soil moisture data, and controls a water pump through a relay. Irrigation requirement prediction was carried out using the Decision Tree algorithm, trained on the secondary Stuard Tomato Dataset, then deployed on a FastAPI server hosted on Hugging Face Space and accessed by the IoT device through an API. The test results show that the machine learning model achieved an accuracy of 96.72%, a precision of 83.33% for the ON class, a recall of 75.00% for the ON class, an F1-Score of 78.95% for the ON class, and an AUC value of 0.8788, which falls into the good category. Functional system testing using the black box technique on all test scenarios produced valid results, including a threshold-based fallback mechanism that maintains irrigation continuity when the server connection is disrupted. Therefore, the developed system is proven capable of supporting automated and efficient irrigation decision-making based on soil and microclimate conditions.

Kata Kunci : Automated irrigation, *Internet of Things*, *Machine learning*, *Decision Tree*, microclimate.