

ABSTRAK

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GREEN SMART HYDROPONIC: SISTEM MONITORING DAN KONTROL NUTRISI OTOMATIS BERBASIS SOLAR CELL 800 WP DENGAN IOT WIRELESS TERINTEGRASI MOBILE UNTUK IMPLEMENTASI PROJECT MAPEL IPAS DI SMKN 1 MAJALAYA

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Proyek *Green Smart Hydroponic* berbasis Solar Cell dan Internet of Things (IoT) di SMK Negeri 1 Majalaya merupakan implementasi pembelajaran dibidang energi terbarukan dan otomasi pertanian berkelanjutan. Penelitian ini bertujuan mengembangkan sistem hidroponik cerdas yang hemat energi, ramah lingkungan, serta mendukung pembelajaran berbasis *green technology* di lingkungan Sekolah Menengah Kejuruan (SMK). Sistem dirancang dengan mengintegrasikan Pembangkit Listrik Tenaga Surya (PLTS) berkapasitas 800 Wp sebagai sumber energi utama dengan mikrokontroler ESP32 sebagai pusat kendali otomatis. Sistem monitoring memanfaatkan beberapa sensor, yaitu sensor pH, TDS, dan suhu (DS18B20) untuk memantau kualitas larutan nutrisi tanaman secara *real-time*. Energi listrik dari modul surya disimpan pada baterai 12V/100Ah melalui *combiner box* DC, kemudian dikonversi menjadi arus AC menggunakan inverter. Hasil pengujian menunjukkan sistem kelistrikan bekerja stabil dengan tegangan inverter sebesar 221 V, frekuensi 50 Hz, dan tegangan baterai 26,5 V. Dari sisi budidaya tanaman, parameter lingkungan menunjukkan nilai PPM 1050, pH 5,61, dan suhu udara 27,4°C yang berada pada kisaran optimal untuk pertumbuhan tanaman kangkung. Sistem otomatis mampu menjaga keseimbangan nutrisi dengan mengendalikan pompa DC 10 W berdasarkan data sensor. Hasil evaluasi menunjukkan bahwa sistem *Green Smart Hydroponic* dapat beroperasi secara stabil, efisien, dan mandiri energi. Inovasi ini berpotensi menjadi media pembelajaran teknologi IoT, energi terbarukan, dan sistem kontrol otomatis, sekaligus model penerapan teknologi hijau serta pengembangan *teaching factory* di SMK.

Kata kunci: hidroponik cerdas, energi surya, IoT, green technology, otomasi pertanian.

ABSTRACT

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GREEN SMART HYDROPONIC: AN AUTOMATIC NUTRITION MONITORING AND CONTROL SYSTEM BASED ON AN 800 Wp SOLAR CELL WITH MOBILE-INTEGRATED WIRELESS IOT FOR IMPLEMENTATION OF A SCIENCE PROJECT AT SMKN 1 MAJALAYA

Under the guidance of Ir. Luqmanul Hakim Effendi, S.T, M.T, IPM

The Green Smart Hydroponic project based on solar cells and the Internet of Things (IoT) at SMK Negeri 1 Majalaya is an implementation of learning in the field of renewable energy and sustainable agricultural automation. This research aims to develop a smart hydroponic system that is energy-efficient and environmentally friendly, and supports green technology-based learning in a Vocational High School (SMK) environment. The system is designed by integrating an 800 Wp Solar Power Plant (PLTS) as the main energy source with an ESP32 microcontroller as the automatic control center. The monitoring system utilizes several sensors, including pH, TDS, and temperature sensors (DS18B20), to monitor the quality of the plant nutrient solution in real time. Electrical energy from the solar module is stored in a 12V/100Ah battery via a DC combiner box, then converted to AC current using an inverter. Test results showed the electrical system operated stably with an inverter voltage of 221V, a frequency of 50Hz, and a battery voltage of 26.5V. From a plant cultivation perspective, environmental parameters showed a PPM of 1050, a pH of 5.61, and an air temperature of 27.4°C, which are within the optimal range for kale growth. The automated system maintained nutrient balance by controlling a 10W DC pump based on sensor data. Evaluation results showed that the Green Smart Hydroponic system can operate stably, efficiently, and energy-independently. This innovation has the potential to become a learning tool for IoT technology, renewable energy, and automatic control systems, as well as a model for implementing green technology and developing a teaching factory in vocational schools.

Keywords: smart hydroponics, solar energy, IoT, green technology, agricultural automation.