

ABSTRACT

The increasing demand for electricity in orchard areas, including those located near residential zones, drives the utilization of renewable energy sources to create efficient and independent lighting systems. Solar energy is one of the best options, as it is a renewable source that can be effectively implemented to reduce dependence on the national grid (PLN). This research aims to design and develop a prototype of an off-grid rooftop solar power system specifically for orchard lighting at night.

The research methodology includes literature study, hardware and software design, as well as comprehensive system testing. The system consists of a monocrystalline solar panel, PWM solar charge controller, 12V 12Ah battery, 5W DC LED lamp, and an ESP32 microcontroller integrated with a BH1750 light sensor, PIR motion sensor, and IRLZ44N MOSFET as a load controller. In addition, the system is equipped with an LM2596 step-down module for voltage regulation and WS2812B LED as a system status indicator.

The lamp's light intensity is automatically controlled based on readings from the BH1750 light sensor and motion detection from the PIR sensor. The test results show that the system can provide a stable power supply for night-time lighting, with accurate sensor response and good overall performance. With its automatic control features and remote monitoring capability, this system can serve as a renewable energy solution for orchard areas.

Kata Kunci: *Rooftop PV System, Off-grid, ESP32, Orchard Lighting, BH1750, PIR, IoT*