

ABSTRAK

Perkembangan teknologi *Internet of Things* (IoT) telah mendorong penerapan sistem *smart home* yang mampu meningkatkan kemudahan dan efisiensi dalam pengendalian perangkat elektronik. Namun, sebagian besar instalasi listrik rumah masih menggunakan saklar konvensional yang hanya dapat dioperasikan secara manual. Penelitian ini bertujuan untuk merancang dan membangun saklar pintar *hybrid* yang mampu menambahkan fungsi kendali nirkabel pada saklar konvensional tanpa menghilangkan fungsi kendali manual. Sistem yang dikembangkan menggunakan dua buah Wemos D1 Mini sebagai *transmitter* dan *receiver*, modul *relay* sebagai aktuator, serta komunikasi berbasis jaringan WiFi lokal menggunakan metode *User Datagram Protocol* (UDP). Metode penelitian meliputi perancangan perangkat keras, perancangan perangkat lunak, implementasi sistem, serta pengujian fungsional dan pengujian jangkauan komunikasi pada kondisi tanpa penghalang maupun dengan penghalang berupa kaca, triplek, dan dinding beton. Hasil pengujian menunjukkan bahwa sistem mampu mengendalikan lampu melalui kendali manual maupun nirkabel dengan baik serta mempertahankan sinkronisasi kondisi lampu. Pengujian komunikasi tanpa penghalang menunjukkan koneksi stabil hingga jarak 40 meter. Pada pengujian dengan penghalang kaca, sistem bekerja stabil hingga 38 meter, mengalami *delay* pada jarak 39–43 meter, dan koneksi terputus pada jarak 44 meter. Pada pengujian dengan penghalang triplek, sistem bekerja stabil hingga 38 meter, mengalami *delay* pada jarak 39–40 meter, dan koneksi terputus pada jarak 41 meter. Sementara itu, pada pengujian dengan penghalang dinding beton, sistem bekerja stabil hingga 20 meter, mengalami *delay* pada jarak 24–28 meter, dan koneksi terputus mulai jarak 32 meter. Hasil penelitian menunjukkan bahwa saklar pintar *hybrid* yang dikembangkan mampu memberikan pengendalian lampu yang responsif, stabil, dan mudah diterapkan pada instalasi listrik yang telah ada.

Kata kunci: Internet of Things (IoT), Wemos D1 Mini, kendali nirkabel, User Datagram Protocol (UDP).

ABSTRACT

The rapid advancement of the Internet of Things (IoT) has accelerated the implementation of smart home systems, enabling more efficient and convenient control of electronic devices. However, most residential electrical installations still rely on conventional switches that can only be operated manually. This study aims to design and develop a hybrid smart switch that adds wireless control functionality to conventional switches while preserving their manual operation. The proposed system employs two Wemos D1 Mini microcontrollers as the transmitter and receiver, a relay module as the switching actuator, and a local Wi-Fi network using the User Datagram Protocol (UDP) for communication without requiring an internet connection. The research methodology includes hardware and software design, system implementation, functional testing, and communication range evaluation under unobstructed conditions and with obstacles made of glass, plywood, and concrete walls. The experimental results demonstrate that the developed system successfully controls lighting through both manual and wireless methods while maintaining synchronization between the two control modes. Under unobstructed conditions, the system maintained stable communication up to 40 meters. When tested with a glass barrier, stable communication was achieved up to 38 meters, delays occurred at distances of 39–43 meters, and the connection was lost at 44 meters. With a plywood barrier, stable communication was maintained up to 38 meters, delays occurred at 39–40 meters, and the connection was lost at 41 meters. In the concrete wall test, stable communication was achieved up to 20 meters, delays occurred at 24–28 meters, and the connection was lost from 32 meters onward. These results indicate that the proposed hybrid smart switch provides reliable, responsive, and practical wireless lighting control while remaining compatible with existing electrical installations.

Keywords: Internet of Things (IoT), Wemos D1 Mini, wireless control, User Datagram Protocol (UDP).