

ABSTRAK

JOHN ANDREW TAMPUBOLON. Rancang Bangun Remotely Operated Vehicle Underwater *OCEANIC BVex* dengan Integrasi *Hybrid Surface-Relay Solar Powered* Berbasis *Internet Of Things* (IOT). Dibimbing oleh Dr. Ir. Samsurizal, ST., MT., IPM

Penelitian ini mengembangkan Remotely Operated Vehicle (ROV) untuk pemantauan lingkungan perairan dengan mengintegrasikan sistem panel surya sebagai sumber energi pada *surface boat* sistem komunikasi *hybrid*, dan sistem monitoring berbasis Internet of Things (IoT). Sistem komunikasi *hybrid* menggabungkan komunikasi Radio Frequency (RF) antara operator dan *surface boat* serta komunikasi serial RS485 melalui kabel *tether* antara *surface boat* dan ROV. Metode penelitian meliputi perancangan dan realisasi perangkat keras, integrasi sistem energi panel surya, pengembangan sistem komunikasi *hybrid*, serta pengujian kinerja sistem. Kinerja keseluruhan sistem OCEANIC BVEx menunjukkan bahwa integrasi sistem relay komunikasi *hybrid*, sistem catu daya, dan sistem monitoring telah bekerja dengan baik. Sistem komunikasi *hybrid* yang menggabungkan *Radio Frequency* (RF) dan RS-485 mampu meneruskan data kendali dari operator menuju ROV secara konsisten pada jarak 5 m, 10 m, 15 m, dan 20 m, dengan kesesuaian data antara ESP32 *Master* dan ESP32 *Slave* serta *delay time* sebesar 0–1 ms. Pada sistem catu daya, panel surya menghasilkan tegangan yang stabil pada kisaran 13,09–13,10 V, dengan daya keluaran meningkat dari 18,48 W menjadi 41,25 W seiring bertambahnya intensitas cahaya matahari. Selain itu, sistem monitoring berbasis IoT berhasil menampilkan parameter tegangan, arus, dan daya secara *real-time* melalui dashboard Node-RED. Hasil tersebut menunjukkan bahwa seluruh subsistem OCEANIC BVEx mampu bekerja secara terintegrasi, sehingga komunikasi, penyaluran daya, dan monitoring dapat berlangsung dengan baik selama proses pengoperasian. Dengan demikian, tujuan penelitian untuk merancang dan merealisasikan OCEANIC BVEx dengan integrasi sistem komunikasi *hybrid*, *solar powered surface boat*, dan monitoring berbasis *Internet of Things* (IoT) telah berhasil dicapai.

Kata Kunci: *Remotely Operated Vehicle*, Energi surya, *Radio Frekuensi*, RS485.

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This research develops a Remotely Operated Vehicle (ROV) for aquatic environmental monitoring by integrating a solar panel power system, a hybrid communication system, and an Internet of Things (IoT)-based monitoring system. The hybrid communication system combines Radio Frequency (RF) communication between the operator and the surface boat with RS485 serial communication through a tether cable between the surface boat and the ROV. The research method includes hardware design and implementation, solar power system integration, hybrid communication development, and system performance testing. The research results indicate that the OCEANIC BVEx system was successfully designed and implemented as an integrated system. The hybrid communication system was able to transmit control data consistently with a delay time of 0–1 ms, ensuring that all ROV control commands were executed successfully. The solar power system produced a stable voltage ranging from 13.09 V to 13.10 V, while the output power increased from 18.48 W to 41.25 W in accordance with the increasing solar irradiance. In addition, the Internet of Things (IoT)-based monitoring system successfully displayed voltage, current, and power parameters in real time through the Node-RED dashboard. The results demonstrate that the integration of the hybrid communication system, solar-powered surface boat, and IoT-based monitoring system effectively supports reliable ROV operation by maintaining communication reliability, power supply continuity, and real-time system monitoring.

Keyword: Remotely Operated Vehicle, Solar Energy, Radio Frequency, RS485.