

ABSTRAK

Dimas Aryo Japriansyah
Rancang Bangun *Prototype* Simulasi *Tap Changer* Otomatis
Berbasis *Iot* Untuk Mengontrol Tegangan Transformator.
Dibimbing oleh Ir. Tony Koerniawan, S.T., M.T.

Transformator distribusi merupakan komponen utama dalam sistem tenaga listrik yang berfungsi mengkonversikan tegangan menengah menjadi tegangan rendah sesuai kebutuhan konsumen. Permasalahan utama yang terjadi adalah fluktuasi tegangan akibat perubahan beban secara dinamis, sehingga menyebabkan kondisi *overvoltage* maupun *undervoltage*, sementara sistem *tap changer* konvensional yang dioperasikan secara manual dinilai tidak mampu merespons perubahan tegangan secara cepat. Proyek ini merancang dan membangun *prototype* simulasi *tap changer* otomatis berbasis *Internet of Things* (IoT) menggunakan *mikrokontroler ESP32*, sensor *PZEM-004T*, modul *relay*, kontaktor modular, transformator satu fasa skala laboratorium, serta *platform Blynk* untuk pemantauan dan kendali jarak jauh secara *real-time*. Metode yang digunakan adalah pendekatan rancang bangun berbasis eksperimen laboratorium, meliputi tahapan perancangan, implementasi, pengujian, dan analisis kinerja. Hasil pengujian menunjukkan sistem mampu menjaga stabilitas tegangan keluaran transformator sesuai standar SPLN 1:1995 (198V–231V) pada minimal dua posisi tap di setiap kondisi pembebanan 0–1.000W, dengan deviasi tegangan yang didapatkan yaitu dengan deviasi tegangan maximum +27,27% pada kondisi tanpa beban dan deviasi tegangan minimum –18,18% dengan kondisi beban 1000 watt dan Galat pengukuran di bawah 2% (maksimum 1,72%). Sehingga *prototype* ini dapat dijadikan media pembelajaran interaktif bagi mahasiswa Institut Teknologi PLN.

Kata kunci: *Tap changer*, *Internet of Things IoT*, *ESP32*, transformator distribusi, *PZEM-004T*

ABSTRACT

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Design and Development of an IoT-Based Automatic Tap Changer

Simulation Prototype for Transformer Voltage Control

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Distribution transformers are a key component in electric power systems, functioning to convert medium voltage into low voltage according to consumer needs. The main problem encountered is voltage fluctuation due to dynamic load changes, which can lead to overvoltage and undervoltage conditions. Meanwhile, conventional tap changer systems operated manually are considered incapable of responding quickly to voltage variations. This project designs and develops a prototype of an automatic tap changer simulation based on the Internet of Things (IoT), utilizing an ESP32 microcontroller, PZEM-004T sensor, relay module, modular contactor, single-phase laboratory-scale transformer, and the Blynk platform for real-time remote monitoring and control. The method used is a laboratory experimental-based engineering approach, which includes stages of design, implementation, testing, and performance analysis. The test results show that the system can maintain the transformer output voltage stability according to SPLN 1:1995 standards (198V–231V) at least at two tap positions under every 0–1,000W load condition, with the voltage deviation recorded being a maximum of +27.27% under no-load conditions and a minimum of –18.18% under a 1000-watt load, and the measurement error was below 2% (maximum 1.72%). So, this prototype can be used as an interactive learning tool for students at the PLN Institute of Technology.

Keywords: Tap changer, Internet of Things (IoT), ESP32, distribution transformer, PZEM-004T.