Transformer Health Monitoring System

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Abstract

Transformer failures in power distribution systems lead to outages, equipment damage, and considerable financial losses. As transformers play a critical role in voltage regulation and energy transfer, early detection of abnormalities is essential to maintaining grid reliability. Conventional maintenance approaches rely heavily on manual inspections and lack real-time visibility, resulting in delayed identification of issues such as overheating, overloading, insulation degradation, and oil level reduction. To address these limitations, an IoT-based Transformer Health Monitoring System (THMS) is developed using an ESP32 microcontroller integrated with voltage, current, temperature, and oil-level sensors. The system continuously monitors key parameters and provides real-time data through cloud platforms such as ThingSpeak. Automated responses, including activation of cooling systems and alert mechanisms, enhance safety by preventing fault escalation. Live dashboards allow remote monitoring, trend analysis, and predictive maintenance decisions based on long-term data patterns. The design is scalable, cost-effective, and suitable for deployment in urban and rural networks. By combining IoT technology, automation, and cloud analytics, the proposed THMS improves reliability, enhances operational safety, and extends transformer lifespan while enabling a proactive and data-driven maintenance approach.