ABSTRAK

Pembacaan meter air analog secara manual masih banyak diterapkan dalam pengelolaan layanan air minum, khususnya pada wilayah yang belum sepenuhnya mengadopsi sistem *smart water*. Metode ini memerlukan sumber daya manusia yang besar, tidak bersifat *real-time*, serta berpotensi menimbulkan kesalahan pencatatan. Penelitian ini bertujuan untuk merancang dan mengimplementasikan sistem pembacaan meter air analog berbasis *Edge Artificial Intelligence* (*Edge*-AI) menggunakan perangkat ESP32-CAM, dengan LoRaWAN sebagai media transmisi digital berdaya rendah.

Metode penelitian eksperimental dengan pendekatan rekayasa sistem melalui perancangan sistem *end-to-end*, meliputi akuisisi citra meter air, pemrosesan citra dan *Optical Character Recognition* (OCR) secara lokal pada perangkat tepi (*Edge computing*), serta pengiriman data hasil pembacaan melalui jaringan LoRaWAN. Pengujian dilakukan pada berbagai kondisi pencahayaan dan jarak transmisi untuk mengevaluasi akurasi OCR dan keandalan komunikasi.

Hasil penelitian menunjukkan bahwa sistem *Edge*-AI mampu membaca meter air analog secara andal, dengan kinerja OCR dipengaruhi oleh kondisi pencahayaan. Dari sisi komunikasi menggunakan LoRaWAN terbukti mampu Mendukung transmisi data secara stabil. Secara keseluruhan, sistem ini terbukti layak sebagai solusi transisi menuju *smart water sistem* pada lingkungan dengan keterbatasan infrastruktur komunikasi.

Kata kunci: *Internet of Things* (IoT), *Edge*-AI, ESP32-CAM, *Optical Character Recognition*, LoRaWAN, *Smart Water Sistem*.

ABSTRACT

Manual reading of analog water meters is still widely applied in the management of drinking water services, particularly in areas that have not fully adopted smart water Systems. This method requires significant human resources, is not real-time, and has the potential to cause recording errors. This study aims to design and implement an analog water meter reading System based on Edge Artificial Intelligence (Edge-AI) using an ESP32-CAM Device, with LoRaWAN as a low-power digital transmission medium.

The research employs an experimental method with a Systems engineering approach through end-to-end System design, including water meter image acquisition, local image processing and Optical Character Recognition (OCR) on Edge computing Devices, and transmission of reading results via a LoRaWAN Network. Testing was conducted under various lighting conditions and transmission distances to evaluate OCR accuracy and communication reliability.

The results show that the Edge-AI System is capable of reliably reading analog water meters, with OCR performance influenced by lighting conditions. In terms of communication, LoRaWAN is proven to Support stable data transmission. Overall, the System is feasible as a transitional solution toward smart water Systems in environments with limited communication infrastructure.

Keywords: *Internet of Things (IoT), Edge Artificial Intelligence (Edge-AI), ESP32-CAM, Optical Character Recognition, LoRaWAN, Smart Water Sistem.*