

## RANCANG BANGUN SISTEM PENGELOLAAN KONSUMSI ENERGI PADA *AUTOMATED RECORDING DEVICE* (ARD) BERBASIS *INTERNET OF THINGS* (IOT)

Rijal Dzaki Fadhlurrohman  
21/478168/TK/52691

Diajukan kepada Departemen Teknik Nuklir dan Teknik Fisika Fakultas Teknik  
Universitas Gadjah Mada pada tanggal 28 Juli 2025  
untuk memenuhi sebagian persyaratan untuk memperoleh derajat  
Sarjana Program Studi Teknik Fisika

### INTISARI

*Automated Recording Device* (ARD) berbasis *Internet of Things* (IoT) menjadi solusi untuk pemantauan data akustik lingkungan secara otomatis dan berkelanjutan, khususnya dalam mendukung upaya pemantauan kualitas lingkungan. Namun, konsumsi energi ARD yang tinggi menjadi kendala karena operasi kontinu dan keterbatasan sumber energi di lapangan. Penelitian ini bertujuan untuk merancang bangun sistem pengelolaan konsumsi energi pada ARD berbasis IoT melalui *switching* daya (*on/off*) otomatis berdasarkan fase operasi, serta mengevaluasi dampaknya terhadap konsumsi energi dan tingkat ketersediaan operasional (*availability*) ARD berbasis IoT.

Perancangan dilakukan dengan mengidentifikasi fase dan komponen ARD untuk *switching* daya, merancang blok diagram, alur kerja, dan diagram skematik. Pembangunan sistem mencakup implementasi dari rancangan yang telah dibuat. Selanjutnya, pengujian dilakukan dengan mengukur konsumsi energi dan *availability* ARD berbasis IoT setelah penerapan sistem, yang kemudian dibandingkan dengan data *baseline*.

Hasil penelitian menunjukkan bahwa sistem berhasil dirancang bangun dengan menggunakan Wemos D1 Mini, *relay*, dan integrasi komponen elektronik lainnya, serta protokol komunikasi MQTT. Sistem berhasil mengotomasi *switching* daya dengan memutuskan daya mikrokomputer ketika fase *idle*. Penerapan sistem pada ARD berbasis IoT mampu menghemat konsumsi energi per siklus sebesar 6,51% (dari 0,737 Wh menjadi 0,689 Wh), dan meningkatkan rata-rata *availability* per hari hingga 10,11% (dari 87,69% menjadi 97,80%).

**Kata kunci:** *automated recording device*, *internet of things*, pengelolaan konsumsi energi, *switching* daya otomatis

Pembimbing Utama : Ir. Sentagi Sesotya Utami, S.T., M.Sc., Ph.D., IPU.

Pembimbing Pendamping : Dr. Eng. Ir. Dwi Joko Suroso, S.T., M.Eng., IPP.



## DESIGN AND CONSTRUCTION OF AN ENERGY CONSUMPTION MANAGEMENT SYSTEM FOR INTERNET OF THINGS (IOT)-BASED AUTOMATED RECORDING DEVICE (ARD)

Rijal Dzaki Fadhlurrohman

21/478168/TK/52691

Submitted to the Department of Nuclear Engineering and Engineering Physics  
Faculty of Engineering Universitas Gadjah Mada on July 28, 2025  
in partial fulfillment of the requirement for the Degree of  
Bachelor of Engineering in Engineering Physics

### ABSTRACT

The Internet of Things (IoT)-based Automated Recording Device (ARD) serves as a solution for automated and continuous monitoring of environmental acoustic data, particularly in support of ecological quality monitoring efforts. However, the high energy consumption of ARD is a challenge due to continuous operation and limited energy sources in the field. This study aims to design and build an energy management system for IoT-based ARD through automatic power switching (on/off) based on operational phases, and to evaluate its impact on energy consumption and operational availability of the IoT-based ARD.

The design process involves identifying phases and components of the ARD for power switching, designing block diagrams, workflows, and schematic diagrams. The system construction includes the implementation of the designed components. Subsequently, testing is carried out by measuring energy consumption and availability of the IoT-based ARD after system implementation, which is then compared with baseline data.

The results show that the system was successfully designed and built using Wemos D1 Mini, a relay, and integration of other electronic components, as well as the MQTT communication protocol. The system successfully automates power switching by cutting off power to the microcomputer during the idle phase. The implementation of the system on the IoT-based ARD reduces energy consumption per cycle by 6.51% (from 0.737 Wh to 0.689 Wh), and increases average daily availability by 10.11% (from 87.69% to 97.80%).

**Keywords:** automated recording device, internet of things, energy consumption management, automatic power switching

Supervisor : Ir. Sentagi Sesotya Utami, S.T., M.Sc., Ph.D., IPU.

Co-supervisor : Dr. Eng. Ir. Dwi Joko Suroso, S.T., M.Eng., IPP.

