

EDMS: ECODRY MANAGEMENT SYSTEM INTEGRATED WITH IOT FOR NATURAL DRYING

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Abstract

The Eco-Dry Management System (EDMS) is a smart home solution that automates natural clothes drying using Internet of Things (IoT) technology. It addresses the common issue of weather unpredictability in Malaysian households, which often disrupts traditional drying (Ismail, Rahman, & Othman, 2023). EDMS uses sensors to detect sunlight, rain, and humidity in real time, paired with an ESP32 microcontroller that controls a foldable roof system. Data is sent via Wi-Fi to a cloud database and displayed through a web application built with HTML, CSS, JavaScript, and PHP. Similar IoT systems have proven the effectiveness of weather-responsive automation using ESP controllers (Abdullah, Ariffin, Zainal, & Norazmi, 2022). The system also estimates drying time based on environmental data. Development involved hardware integration, coding, testing, and user evaluation. Results from 30 participants confirmed ease of use and reliability. EDMS reduces manual effort, protects laundry, and shows strong potential for smart home integration.

Keywords: *IoT, smart home, environmental sensors, laundry drying, ESP32, web application*

1. Introduction

In Malaysia, unpredictable weather hampers traditional clothes drying outdoors, leading to inefficiency and inconvenience, especially in urban homes where space to dry clothes is confined (Abdullah et al., 2022). Eco-Dry Management System (EDMS) aims to provide an automated, climate-sensitive drying system with a motorized retractable roof. Through the integration of environmental sensors such as rain, light, and humidity sensors into an ESP32 microcontroller, the system responds in real-time to the environment. Data is transmitted on Wi-Fi and stored in a cloud-based database accessible through a simple web interface. The primary objectives are to prevent clothes from getting wet due to rain, maximize drying conditions, and reduce dependency on human intervention. EDMS emphasizes automation, cost savings, and energy efficiency, hence being a rational alternative to manual drying.

2. Methodology

The development of the Eco-Dry Management System (EDMS) was done in six sequential steps: information gathering, planning, design and construction, installation and testing, analysis, and documentation. The project began with information gathering to determine problems related to weather issues experienced by traditional laundry drying, particularly by Malaysian residents. During the planning phase, relevant hardware modules were selected like the ESP32 microcontroller, DHT11 humidity sensor module, LDR for light detection, rain sensor, and servo motor for an automatic roof.

During the design and development phase, the circuit was designed schematically and was programmed with Arduino IDE to enable sensors to work with the ESP32. A web interface based on HTML, CSS, JavaScript, and PHP was also developed to graphically present live sensor readings and system status. Unit testing of all the hardware components was conducted during the implementation and testing stage followed by system level testing to ensure correct data transmission and timely

motor control. User testing was also conducted with 30 subjects, usability testing and clarity of the interface.

Analysis phase contrasted performance, accuracy, and user satisfaction based on test results and feedback. Finally, the documentation phase consolidated all results, wiring diagrams, code, and assessment reports for future reference and improvements. This systematic process ensured that the system was able to achieve its purpose in terms of automation, usability, and efficiency.

3. Results

EDMS successfully automated laundry drying based on live weather data. Testing with 3 technical experts confirmed that all sensors worked accurately, and the motorized roof responded well. The ESP32 efficiently handled data transmission, and the web interface displayed weather data without delay. In user testing, most participants found the interface easy to use and appreciated the system's quick response. Feedback was positive, highlighting convenience, reliability, and reduced manual work. Overall, EDMS met all design goals and proved effective in protecting laundry during sudden weather changes, offering a reliable, real-world smart drying system.

4. Novelty of Research

EDMS offers a unique approach to smart laundry drying by combining real-time sensing, automation, and cloud connectivity. Unlike manual systems or fixed-timer models, EDMS adapts instantly to environmental changes. Its lightweight web interface avoids the complexity of mobile apps, making it user-friendly and accessible. It is affordable and scalable, designed specifically for weather-prone areas like Malaysia. While many smart home products exist, few focus on laundry management. EDMS fills this niche by offering an efficient, low-cost, and sustainable drying solution that improves daily routines and reduces the risk of weather-related laundry damage.

5. Conclusion or Future Work

The Eco-Dry Management System successfully automates natural laundry drying using real-time weather data and IoT integration. Future improvements may include mobile app support, enhanced sensor accuracy, and solar-powered operation, making the system more accessible, energy-efficient, and adaptable for various residential environments and climate conditions.

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