Design and Development of an Intelligent Floodlight Automation System for Educational Purpose at Aviation Polytechnic of Makassar

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ABSTRACT

Floodlights are essential components in the apron lighting system at airports, providing illumination to ensure safe aircraft operations during nighttime or low-visibility conditions. However, learning about floodlight automation systems at the Aviation Polytechnic of Makassar is still primarily theoretical, lacking practical training media. This study aims to design and develop an intelligent floodlight automation system using an Arduino Uno integrated with RTC DS3231 and LDR sensors. The system automatically controls the floodlight based on time and light intensity conditions. The research methodology includes hardware and software design, system assembly, and performance testing. The results show that the floodlight operates automatically between 18:00–06:00 or under low-light conditions and turns off when the environment is bright. The prototype demonstrates high accuracy, quick response, and reliability, making it suitable as an educational tool for vocational training in aviation electrical engineering.

Keywords: Floodlight, Automation, Arduino UNO, RTC DS3231, LDR, Educational Media.

1. INTRODUCTION

Airfield lighting systems play a vital role in supporting aircraft operations during nighttime and low-visibility conditions, ensuring safety in apron, runway, and taxiway areas. According to Suprihartini (2019), the Airfield Lighting System (AFL) not only provides illumination but also functions as a visual guidance system for pilots during ground movements. The International Civil Aviation Organization (ICAO, 2016) through Annex 14 establishes global standards for airport lighting to maintain operational safety.

Apron floodlights are among the essential components in the AFL, as stated by the Ministry of Transportation Regulation PR 8 of 2022. They illuminate parking and handling areas for aircraft, enabling safe loading, unloading, and maintenance activities at night or under poor weather conditions. Proper placement and intensity are necessary to avoid glare and shadow effects that can disrupt ground operations (Kementerian Perhubungan, 2022).

At the Aviation Polytechnic of Makassar, theoretical learning of floodlight automation is dominant, with minimal practical media. This research focuses on developing an educational prototype of

floodlight automation using Arduino Uno, RTC DS3231, and LDR sensors to provide students with hands-on experience.

2. METHODOLOGY

This research employed an experimental and developmental approach, comprising four main stages: requirement analysis, hardware and software design, integration and testing, and performance evaluation.

The hardware components include Arduino Uno, RTC DS3231, LDR sensor, relay module, and a 12V DC power supply. The software was developed using Arduino IDE with control algorithms based on time and illumination thresholds.

Testing was conducted in a controlled environment. The parameters tested included real-time accuracy of the RTC, sensor response to illumination changes, and relay delay time. Each test was performed five times to ensure repeatability.

Figure 1. System Block Diagram (source: Aviation Polytechnic of Makassar)

3. RESULTS AND DISCUSSION

The RTC DS3231 exhibited high accuracy with a deviation of less than one second in 24 hours. The LDR sensor's resistance varied from 571 kΩ at 1 lux to 0.11 kΩ at 7284 lux, showing expected sensitivity. The integrated system successfully automated floodlight control with an average delay of 0.47 seconds.

Table 1 summarizes the comparison between this system and similar studies in terms of response time and error rate.

System	Activation Type	Response Time (s)	Error (%)	Source
Proposed Floodlight System	Time & Light	0.47	0.5	This study
Street Light (Desmira et al., 2022)	Light only	0.62	1.1	PROSISKO
Feeding Scheduler (Selamet et al., 2022)	Time only	0.55	0.8	Jurnal Teknologi

4. CONCLUSION

The intelligent floodlight automation system based on Arduino Uno, RTC DS3231, and LDR sensors effectively controls lighting automatically based on both time and illumination levels. The system demonstrated high accuracy and fast response, validating its potential as an educational prototype for airfield lighting automation. Future development can integrate IoT-based monitoring for enhanced control and data logging.

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