International Journal of Scientific Engineering and Science
Volume 7, Issue 5, pp. 47-50, 2023. ISSN (Online): 2456-7361

Automatic Lighting System Development in the Reading Room Library of Electronic Engineering Education Department, Faculty of Engineering, Universitas Negeri Makassar

Supriadi[1], Putri Ida Sunaryathy Samad[2], Irna. M[3]
[1,2,3]Electronic Engineering Education Department,University State of Makassar, Indonesia
[1]Supriadi6722@unm.ac.id

Abstract— *The research objectives of this study are: (1) to determine the stages of developing an automatic lighting system in the library reading room, and (2) to determine the results of functionality and usability testing of the automatic lighting system in the library of the Department of Electronic Engineering Education. This research was conducted using the R&D (Research and Development) method with the ADDED development model, which stands for Analyze, Design, Development, Evaluation, and Dissemination. The testing of this device involved two tests: functionality and usability. The functionality testing resulted in an X value of 1, which is interpreted as very good according to the test case rules. Meanwhile, the usability testing included the aspects of usefulness (93%), ease of use (92%), user satisfaction (90%), and ease of learning (94%), with an average percentage of 92%, categorized as very suitable (≥90%). Suggestions for further research include implementing the system on a larger scale and integrating it with the library's lighting installation.*

Keywords— *Automatic, Lighting, Development, Library, ADDED Syste*.

I. INTRODUCTION

The definition of a library according to Law No. 43 of 2007 is an institution that professionally manages collections of written works, printed materials, and/or recorded works with a standardized system to fulfill the needs of education, research, preservation, information, and recreation for library users. Meanwhile, according to Suhendar (2005:3), a library is a working unit of a specific organization or institution that systematically manages library materials, including books and non-book items, according to specific rules, making them usable as sources of information. Generally, a library is an institution that provides various collections of books or written works as sources of information to meet educational needs. Typically, educational institutions have library buildings or rooms that are utilized as reading spaces. One crucial factor to consider in library spaces is lighting because it greatly affects the eyes. Excessive brightness can cause eye discomfort, such as eye irritation, fatigue, dryness, and soreness, as well as headaches. Adequate lighting in reading areas is essential to ensure reader comfort and minimize disturbances. Lighting that is too bright or too dim can lead to eye strain, discomfort, and disrupted concentration while reading.

Based on the Indonesian National Standard (SNI) 03-6197-2000 regarding energy conversion in lighting systems, the recommended average light intensity for reading activities is 300 lux (BSN, 2011). Light intensity that does not meet the recommended standard can be one of the causes of visual impairment.

The determination of light intensity in a room is not only dependent on the indoor lighting fixtures but also the natural light from outside. Therefore, an automatic lighting system is needed to control and adjust the light intensity in the reading room. This system can assist in optimizing energy usage.

Based on the initial observations in the library of the Department of Electronic Engineering Education, there is currently no implementation of an automatic lighting system that can control the lighting according to the recommended light intensity standards. Therefore, this research aims to develop an automatic lighting system in the reading room of the library of the Department of Electronic Engineering Education, Faculty of Engineering, Universitas Negeri Makassar. The system will automatically control the light intensity in the reading room according to the recommended standards. The system will utilize the following components: Arduino Uno, which will control the entire system; BH1750 sensor, which will detect light and send the data to Arduino Uno; PIR sensor for motion detection; and RTC sensor for scheduling the on and off times of the lights.

II. LITERATURE

Development

In the Republic of Indonesia Law Number 18 of 2002, development is defined as scientific and technological activities aimed at utilizing proven principles and theories of science to enhance the function, benefits, and applications of existing scientific and technological knowledge or to generate new technologies.

According to Malayu Hasibuan (2015), development is an effort to improve technical, theoretical, conceptual, and moral abilities in accordance with the needs through education and training. Additionally, according to Sugiyono (2017), development involves deepening and expanding existing knowledge. The process of development includes stages of planning, implementation, and evaluation, followed by

refinement activities to achieve a satisfactory outcome. Based on these perspectives, development is the process or activity of deepening and expanding existing knowledge with the aim of producing a new product. It involves systematic and organized procedures employed throughout the process.

Library

According to Law No. 43 of 2007, a library is an institution that professionally manages collections of written works, printed materials, and/or recorded works with a standardized system to fulfill the needs of education, research, preservation, information, and recreation for library users. According to Sulistyo (1991), a library is a room, part of a building, or the building itself used to store books and other publications, usually arranged in a specific order for the use of readers, not for sale. In practical terms, the school library serves as a means for the teaching and learning process for both teachers and students. Generally, a library is a room located within a building that contains books or other materials (such as CDs, tapes, microfilms, etc.) arranged systematically according to specific rules, serving as a source of information for educational institutions, scientific research, and other users.

Light

Light is a form of electromagnetic wave energy that can be seen by the human eye, with a wavelength ranging from approximately 380 to 750 nanometers. Based on its source, lighting can be divided into two types: natural lighting, which originates from sunlight, and artificial lighting, which comes from limited energy light systems created by humans.

Sensor and Microcontroller

A sensor is a component used to detect changes in physical quantities such as pressure, force, electrical signals, light, motion, humidity, temperature, speed, and other environmental phenomena. In this research, three types of sensors are used:

1. BH1750 Sensor The BH1750 sensor is used to detect and measure the intensity of light both inside and outside the library reading room. This sensor provides input data that will be sent to the Arduino Uno for further processing.
2. PIR (Passive Infrared) Sensor The PIR sensor is used to detect human motion. When the sensor detects motion, the lights in the reading room will turn on. Conversely, if no motion is detected, the lights will turn off.
3. RTC (Real-Time Clock) The RTC is used to schedule the automatic turning off of the lights in the library reading room during non-operational hours, such as holidays and nighttime. By using the RTC sensor, the PIR sensor can be deactivated when not needed, preventing unnecessary energy consumption.

Microcontroller Arduino Uno

Arduino Uno is used as the controller for the lighting system in the reading room. Arduino Uno is a microcontroller board based on the ATmega328 chip (datasheet). It has 14 digital input/output pins, of which 6 can be used as PWM outputs, 6 analog input pins, a 16 MHz quartz crystal oscillator, USB connection, power jack, ICSP header, and a reset button. To use the microcontroller, you can simply connect the Arduino Uno board to a computer using a USB cable or power it using an AC-to-DC adapter or batteries.

LCD (Liquid Crystal Display)

The LCD used is a 2x16 LCD, which is used to display characters or output information.

Power Supply

A 5V 2A power supply is used to convert high-voltage AC current to low-voltage DC and provide suitable power for the components. It is responsible for reducing the 220V power supply to a level suitable for the requirements of the components.

III. METHOD

The type of research conducted is Research and Development (R&D). The research takes place at the Library of the Department of Electrical Engineering Education, Faculty of Engineering, UNM. The usability testing is estimated to take 4 days, aligned with the library's operational hours, involving students from the Department of Electrical Engineering Education as users.

The device is designed to generate a light intensity of 300 lux, as recommended by the standards, using components and microcontrollers based on the designed plan. All the components and devices are assembled and function according to the desired data, such as the BH1750 sensor, PIR sensor, and RTC sensor. The data from these sensors is then sent to the Arduino Uno microcontroller as the controller to process and execute commands accordingly. The output is displayed on the LCD, showing the light intensity value of 300 lux as the standard.

In the development stage, the hardware components are created for the automated lighting system in the library reading room. The following are the required hardware components: laptop, Arduino Uno, BH1750 sensor, PIR sensor, RTC sensor, LED, and enclosure box.

The creation of the electronic circuit involves connecting the pins of each component used in the system. The circuit is designed and built on a Printed Circuit Board (PCB) using Diptrace software, which is an electronic design software that allows users to create complex PCB designs. In this application, users can place electronic components on the PCB layout, connect the interconnecting traces, and ensure that each component is correctly connected according to the planned design.

After the electronic circuit is assembled, the next step is testing and programming the system using the Arduino IDE software. This software is used to create, edit, verify, and upload program code to the Arduino. Arduino IDE is an integrated development environment (IDE) specifically designed for programming Arduino microcontrollers. In this stage, the program will be coded and uploaded to the Arduino Uno to control the functions as described earlier and ensure that all components function properly and the automated lighting system in the library reading room operates according to the specified requirements. During the program

International Journal of Scientific Engineering and Science
Volume 7, Issue 5, pp. 47-50, 2023. ISSN (Online): 2456-7361

development stage, the researcher utilizes the Arduino IDE software to create and program the assembled hardware. Once the program is completed, the hardware is programmed accordingly, followed by testing to ensure there are no errors in the previously created program.

The testing is conducted in two stages: functionality testing and usability testing. In the functionality testing, the result shows a value of X=1, according to the test case rules, which can be interpreted as an excellent result. On the other hand, in the usability testing, the results are as follows: usefulness aspect achieves 93% with a highly acceptable category, ease of use aspect achieves 92% with a highly acceptable category, user satisfaction aspect achieves 90% with a highly acceptable category, and ease of learning aspect achieves 94% with a highly acceptable category.

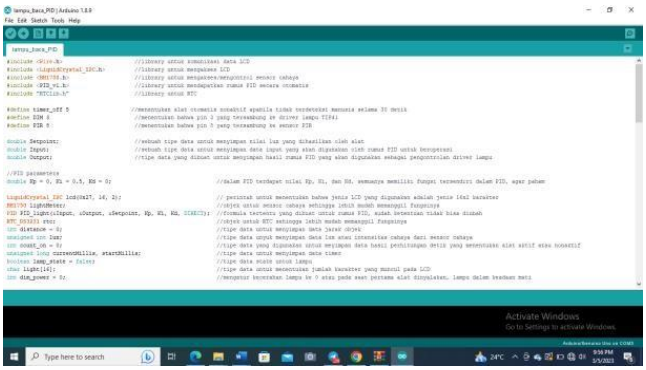

Figure 1. Listing Program

Next is the evaluation stage. The evaluation is based on feedback from expert validators, responses from students, and input from the advisor. The results of the evaluation are used as a reference for revising and improving the produced product, thus enhancing its quality.

The final stage is the dissemination stage. In this stage, the researcher introduces the developed product to the students of Electronics Engineering Education in the library. The dissemination stage takes place over four days, involving different users each day. This stage provides an introduction to the product and conducts usability testing. The results from the dissemination stage are used to determine the level of usefulness of the product.

During the dissemination stage, the researcher also observes the overall output to assess the extent to which the product functions properly. The functionality testing conducted by expert validators indicates that all components used in the device, such as the adapter, Arduino Uno, BH1750 sensor, PIR sensor, RTC sensor, LCD, and LED, function properly. Based on the suggestions from the expert validators, improvements are made to the device's appearance, the placement of the BH1750 sensor, the bolts on the device's body, and the on/off timing of the PIR sensor. As a result, the modules that have been deemed acceptable can be used with the necessary revisions.

Figure 2. Automatic Lighting System in Library Reading Room

Based on the evaluation results from expert validators and the feedback from students, the developed automatic lighting system is deemed suitable for implementation and has a high level of usefulness. The usability testing conducted during the dissemination stage also indicates that the product is highly usable, easy to use, satisfies users, and facilitates learning effectively.

Therefore, the developed automatic lighting system for the library has been successfully evaluated, implemented, and received positive responses from users.

IV. CONCLUSION

The conclusion is as follows: Based on the testing and analysis of the development of an automatic lighting system for the library of the Department of Electronic Engineering Education, Faculty of Engineering, UNM, the following conclusions can be drawn: This research utilized the ADDED model, which consists of five stages: analysis, design, development, evaluation, and dissemination. The result is a product in the form of an automatic lighting system for the library that functions to control and adjust the light intensity inside the room according to the recommended standard of 300 lux.

The testing was conducted in two stages: functionality testing and usability testing. The functionality testing resulted in a value of X = 1, which indicates excellent performance according to the test case criteria. Meanwhile, the usability testing evaluated several aspects: usefulness (93%), ease of use (92%), user satisfaction (90%), and ease of learning (94%). The average percentage score of 92% categorizes the system as highly usable (≥90%).

For future research, it is recommended to scale up the implementation of the system and integrate it into the library's lighting installation for a larger scope.

Suggestions for the development of an automatic lighting system in the library reading area are as follows:

1. Use as a reference: The results of this research can serve as a relevant reference for students working on their final projects or similar projects in the field of electronics engineering or automation systems.
2. Scale up and integration: Furthermore, this research can be applied on a larger scale, such as throughout the entire library or building, by integrating the automatic lighting system into the existing lighting installation. This can bring broader benefits and improve energy usage

efficiency.

3. Development of additional features: Additionally, future research can involve the development of additional features, such as visitor presence detection systems using other technologies, lighting adjustments based on time and temperature, or integration with existing building management systems.
4. Long-term usage evaluation: It is important to conduct long-term usage evaluations of this system after implementing it on a larger scale. Collecting data and feedback from users can help identify potential improvements and ensure that the system continues to perform optimally.
5. Further research: In further development, research can focus on sustainability and higher energy efficiency aspects, such as utilizing renewable energy sources or employing energy-efficient lighting technologies.

By implementing these suggestions, the automatic lighting system in the library reading area can be continuously enhanced and provide greater benefits to users and the environment.

ACKNOWLEDGMENT

Thank you to the Department Chair and Head of the Electronics Engineering Laboratory at the Faculty of Engineering, Makassar State University, for the use of their facilities.

REFERENCES

[1] Ansori, H, Metode Penelitian Kuantitatif. Surabaya: Airlangga University Press. 2017.
[2] Bazuki Sulistyo, Introduction to Library Science. Tangerang Selatan: Universitas Terbuka. 2014/
[3] Fitrianti Diorita. (2010). Lighting System as a Support for Reading Activities in Libraries. (Undergraduate thesis, University of Indonesia). Retrieved on March 2, 2022, from https://lib.ui.ac.id/file?file=digital/20249588-R051048.pdf.
[4] Malayu, S.P Hasibuan, Human Resource Management, fifth edition, Jakarta: PT. Bumi Aksara. 2015.
[5] Pressman, R. S, Software Engineering: A Practitioner's Approach 1st Book Approach. Yogyakarta: Andi. 2012.
[6] Indonesian National Standard, Procedure for Designing Artificial Lighting Systems in Buildings. 2001
[7] Sugiyono, Quantitative, Qualitative, and R&D Development Methods. Bandung: Alfabeta. 2015.
[8] Sulistyo Basuki (1991). Pengantar Ilmu Perpustakaan. Jakarta: PT Gramedia Pustaka Umum
[9] Law No. 18. 2002. About National Research Systems. Development, and Application of Science and Technology.
[10] Wikipedia.org. (2021). "Light", https://en.wikipedia.org/wiki/Light, accessed on March 2, 2022.