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Development of a Light Intensity Monitoring System in Broiler Chicken Coops Based on Arduino IoT Cloud

Julianti Habibuddin[1, *,a] **Muhammad Fadli Azis** [2, b] **Nuritasari Azis** [3, c]
[1,2]Electrical Engineering, Politeknik ATI Makassar, 220 Sunu St, Makassar, 90211, Indonesia
[3]Mineral Chemical Engineering, Politeknik Industri Logam Morowali, Trans Sulawesi St, Morowali, 94974, Indonesia
[*, a] juliantihabibuddin@atim.ac.id (Corresponding Author)
[b] fadli@kemenperin.go.id
[c] nuritasariazis@kemenperin.go.id

Abstract—**The lighting system significantly influences the growth and productivity of broiler chickens, necessitating an efficient tool for monitoring light intensity in chicken coops. This study aims to design and develop an Arduino IoT Cloud-based light intensity monitoring system for broiler chicken coops. The system employs two BH1750 light sensors, positioned inside and outside the coop, to measure light intensity, which is then processed by an ESP32 microcontroller. The collected data is displayed on a 16x2 LCD screen and uploaded in real time to the Arduino IoT Cloud platform for remote monitoring. Testing conducted over a 6-hour period revealed that light intensity inside the coop remained stable at approximately 30 lux from 09:30 to 12:52, while the highest external light intensity reached 400 lux between 12:06 and 14:40, followed by a decrease after 14:50. These findings indicate that the system can assist farmers in timely actions, such as opening or closing coop curtains, through effective monitoring via the Arduino IoT Cloud platform.**

Keywords—Arduino IoT Cloud, ESP32, BH1750 Sensor, Light Intensity, Chicken Coop

I. Introduction

Broiler chicken coops require an optimal environment to support the chickens' health and productivity, with light intensity being a critical factor [1]. Lighting for broiler chickens is managed based on both intensity and duration, with the ideal intensity range for growth being between 2.69 and 53.8 lux [2], [3]. Adequate lighting not only enhances growth but also improves feed efficiency, reduces mortality rates, and mitigates health issues such as ascites and sudden death syndrome. Additionally, proper light intensity stimulates physical activity, contributing to bone development and leg health, while also reducing negative behaviors like cannibalism and fighting [4], [5].

Real-time light intensity monitoring is essential for farmers to maintain optimal coop conditions. With continuous data, farmers can promptly respond by adjusting the coop's curtains to regulate light levels as needed. This proactive approach not only improves animal welfare but also helps reduce operational costs, such as electricity usage.

State-of-the-art solutions in environmental monitoring for poultry farming have integrated wireless sensor networks (WSNs) and Internet of Things (IoT) technology to improve monitoring accuracy and operational efficiency. Fahmi and Riyanti [6] developed a WSN and IoT-based monitoring system for chicken coops using Arduino Uno with XBee modules for data transmission, focusing on temperature and humidity monitoring. This approach demonstrated the feasibility of WSN in providing real-time environmental data to optimize poultry welfare. Similarly, Nicolas et al. [7] implemented an IoT monitoring assistant for layer chicken farms, showing that IoT systems can improve productivity and provide scalable, cost-effective solutions. Ghazal et al. [8] presented a poultry farming control system using ZigBee-based WSN to manage environmental conditions, reducing losses from conventional farming methods by enabling real-time monitoring and control. Meanwhile, Rohan and Mahadev [9] designed an automatic monitoring and control system tailored for broiler houses, using sensors to manage temperature, humidity, and light intensity, which demonstrated effective environmental control to support broiler health and growth.

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Building on these advancements, this research aims to develop a light-intensity monitoring tool using the Arduino IoT Cloud platform, ESP32 microcontroller, and BH1750 light sensors. The system enables real-time monitoring of light conditions inside and outside the coop, allowing farmers to take corrective actions via the IoT platform. A case study was conducted at the Simbang Maros Chicken Farm to evaluate the practical effectiveness of this tool in enhancing broiler health and productivity.

II. Research Methodology

The research and design for the light intensity monitoring system were conducted from May to August 2024 across two locations: the Electronics and Instrumentation Laboratory at the Department of Automation of Machinery Systems, ATI Polytechnic of Makassar, and Simbang Village, Maros Regency, where a broiler chicken coop served as the field testing site. Tools used included soldering equipment, a desoldering pump, pliers, a laptop, insulation tape, a screwdriver, an electric drill, a grinder, a multimeter, a cutter, and a smartphone for real-time data monitoring. Essential components consisted of BH1750 light sensors, an ESP32 microcontroller, and other supporting electronics [10], [11].

This experimental research was conducted in two main phases. The first phase involved designing and assembling a light-intensity monitoring device using light sensors connected to the Arduino IoT Cloud platform [12]. The second phase entailed testing the device in both laboratory and field settings, observing its performance in monitoring light intensity inside and outside the coop in real time.

A. Design Techniques and Data Collection

The research proceeded in several stages. The initial stage, Observation and Literature Review, involved a direct survey of the environment to understand the chicken coop conditions and principles underlying the monitoring device’s functionality. This step provided critical insights into the requirements for light-intensity monitoring.

The subsequent phase, Mechanical Design, involved essential steps, beginning with device planning based on monitoring requirements. Measurements and material cutting followed to create the device's component cover. The assembly stage included positioning the sensors and microcontroller within the device. In the Software Design stage, a program was developed to control device functions, compiled, and then uploaded to the ESP32 microcontroller. A flowchart was created to illustrate the system's operational flow. The final Hardware Design stage involved constructing the coop light monitoring system. This system incorporated BH1750 light sensors to measure light intensity inside and outside the coop, while the Arduino IoT Cloud served as the platform for real-time data display.

B. Flowchart

Figure 1 illustrates the system's operational flow for monitoring light intensity within the chicken coop. The process begins with the "Start" phase, representing the system's initialization, which involves setting the initial state, powering up the components, and establishing a connection to Wi-Fi. Once initialized, the system proceeds to collect light intensity data using two BH1750 sensors placed strategically to measure illumination levels both inside and outside the chicken coop. These sensors ensure precise and reliable data capture, which is then processed by the ESP32 microcontroller. The microcontroller filters and organizes the data, preparing it for display and further analysis.

The processed data is displayed locally on an LCD screen, providing immediate feedback for on-site monitoring. Additionally, the system uploads the light intensity measurements to the Arduino IoT Cloud platform, enabling users to remotely access real-time data from any internet-connected device. This dual functionality ensures both convenience and flexibility in monitoring the chicken coop's environment. The process concludes with the "End" phase, marking the completion of data collection, processing, and transmission, while simultaneously preparing the system for the next operational cycle.

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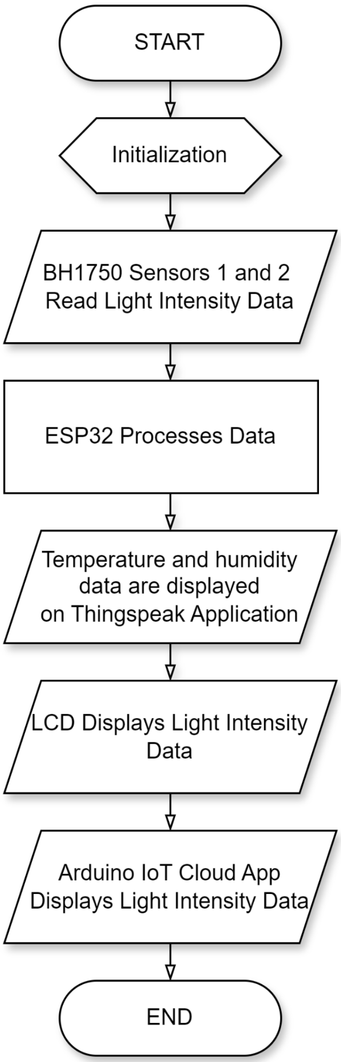

Figure 1. Flowchart

C. Block Diagram

In Figure 2, the block diagram illustrates the light intensity monitoring system with two BH1750 sensors serving as the primary input. These sensors capture light intensity readings inside and outside the chicken coop. The ESP32 microcontroller then processes the sensor data. The processed data is visually displayed on an LCD and uploaded to the Arduino IoT Cloud for online monitoring. The system is powered by a 12V power supply to support all operations.

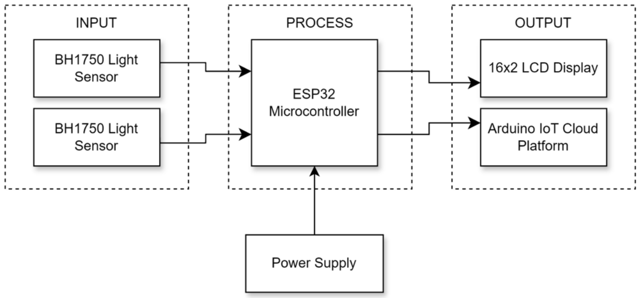

Figure 2. Block Diagram

D. Data Analysis

Data analysis for this study involved several steps to evaluate the performance of the light-intensity monitoring system in the chicken coop. Real-time light intensity data is displayed on the Arduino IoT Cloud platform for remote monitoring. Based on the collected data, farmers can observe coop lighting fluctuations and make adjustments as necessary to maintain optimal environmental conditions for the chickens.

III. Results and Discussion

A. Hardware Design

The hardware design for the light intensity monitoring system in a broiler chicken coop includes key components such as the ESP32 microcontroller, two BH1750 light sensors, a power supply, and a 16x2 LCD display. In the wiring diagram shown in Figure 3, the system is configured to monitor light intensity both inside and outside the coop. The BH1750 sensors serve as the primary input, with one sensor installed inside the coop for internal lighting measurement and the other outside for external lighting assessment. The data from these sensors is transmitted to the ESP32 microcontroller, which processes and sends it to the Arduino IoT Cloud platform for remote monitoring. Additionally, the power supply converts AC to DC, providing the necessary current for the electronic components within the system. A 16x2 LCD display is included to show real-time light intensity data on-site.

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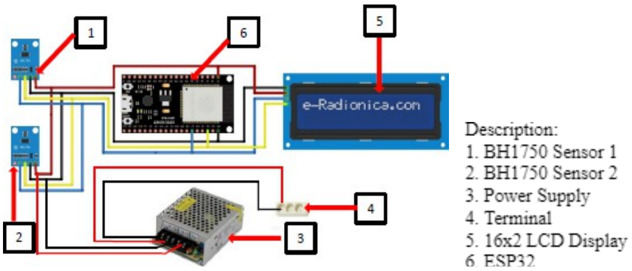

Figure 3. Wiring Diagram

As shown in Figure 4, the hardware system activates automatically when connected to the power supply. The LCD displays sensor readings in numeric format, indicating light intensity levels inside and outside the coop. Internet connectivity, required to operate the system via the Arduino IoT Cloud platform, is established using the Wi-Fi SSID "Tselhome-D6EF" and password "72482644."

Upon system activation, the LCD initially displays "COOP LIGHT MONITORING" for three seconds, indicating system startup. Afterward, it switches to show real-time readings from the BH1750 sensors, displaying light intensity levels for both the indoor and outdoor coop environments.

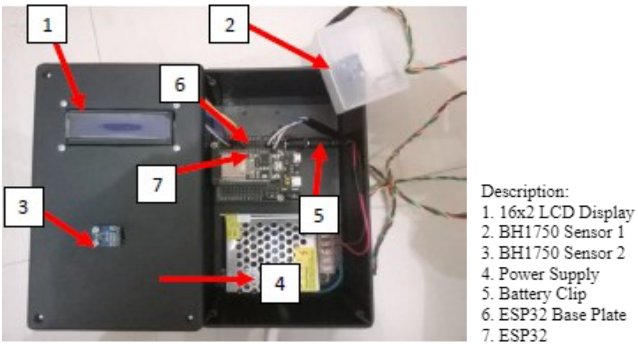

Figure 4. Hardware Design

B. Software Design

The software design for the light intensity monitoring system utilizes the Arduino IoT Cloud platform, which enables real-time monitoring of sensor data via an internet connection. Users can access light intensity information from anywhere through the platform, as shown in Figure 5, which displays light intensity monitoring data on the platform.

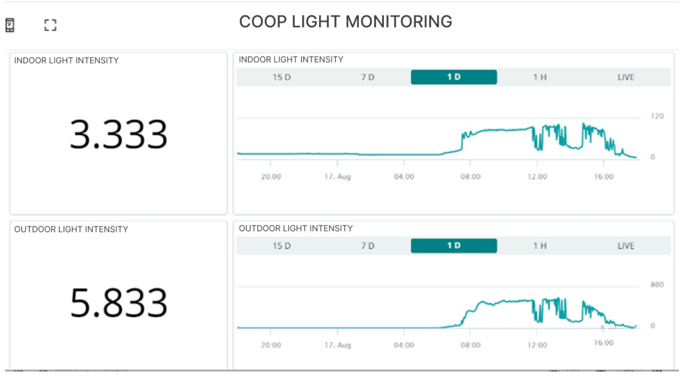

Figure 5. Software Design

In the software design, two main parameters are monitored: light intensity inside and outside the coop. Data from each BH1750 sensor is processed by the ESP32 microcontroller and displayed on the Arduino IoT Cloud dashboard.

The system is configured to take automatic actions based on sensor readings, using the following rules:

1. If both sensors inside and outside the coop read normal light intensity, the coop curtain is opened to maintain optimal ventilation and lighting.
2. If both sensors indicate high light intensity, the curtain is closed to shield the chickens from excessive light.
3. If both sensors detect low light intensity, the curtain remains closed to maintain stable conditions.
4. If the outside sensor reads high light intensity while the inside sensor reads normal or low, the curtain remains open to utilize natural lighting.
5. If the outside sensor reads low intensity while the inside sensor shows normal or high, the curtain closes to maintain ideal conditions inside the coop.

Through this software design, the system facilitates automatic curtain control in response to changes in light intensity, enhancing the broiler chickens' health and comfort within the coop.

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C. Monitoring Analysis

Data collection for light intensity monitoring was conducted over one day, assuming optimal conditions for six hours per day. Testing was carried out in Simbang Village, Maros Regency, on August 13, from 9:40 AM to 3:40 PM local time.

On August 13, 2023, data collection results are depicted in Figures 6 and 7. The coop indoor light intensity graph (Figure 6) reveals that light levels remained stable at around 30 lux from 9:40 AM to 12:52 PM. Light intensity began to decrease around 1:11 PM due to the changing position of the sun. The graph for outdoor light intensity (Figure 7) indicates a peak between 12:00 PM and 2:40 PM, reaching up to 400 lux, with intensity gradually declining after 3:00 PM as sunlight waned.

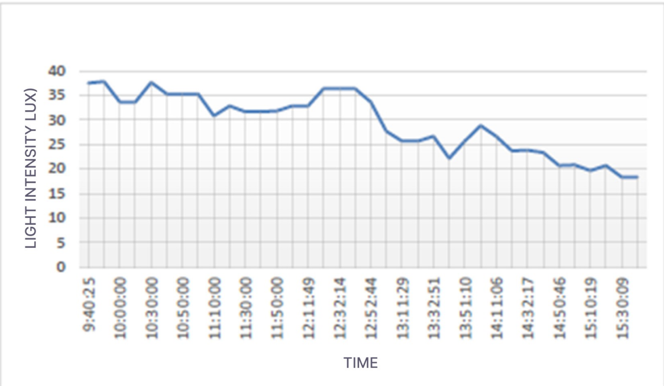

Figure 6. Monitoring of Coop Indoor Light

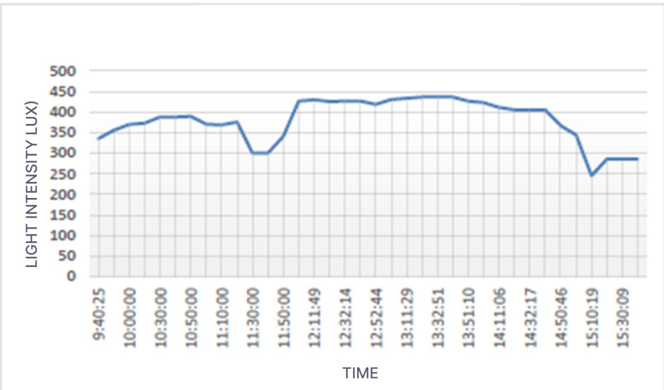

Figure 7. Monitoring of Coop Outdoor Light

These results are consistent with findings from Fahmi and Riyanti [6], who showed that WSN and IoT-based monitoring can provide real-time environmental data, enabling timely adjustments to maintain optimal conditions. Our system's ability to remotely monitor and maintain light intensity within recommended ranges aligns with their approach, which emphasized the role of IoT in supporting environmental control in poultry farming.

Similarly, Ghazal et al. [8] demonstrated the effectiveness of WSN in enhancing poultry productivity by monitoring multiple environmental parameters. In line with their findings, our system's dual-sensor setup enables farmers to adjust coop curtains based on both indoor and outdoor light levels, ensuring optimal lighting conditions throughout the day. This feature aligns with Rohan and Mahadev's [9] findings on the benefits of automated environmental control in broiler houses, supporting broiler health and reducing manual intervention.

The data-driven approach used in this study is supported by Nicolas et al. [7], who highlighted the scalability and cost-effectiveness of IoT systems in poultry farming. By using the Arduino IoT Cloud platform, this system offers farmers accessible, real-time insights for efficient lighting management, ultimately promoting better growth and productivity in broiler chickens.

IV. Conclusion

The Arduino IoT Cloud-based light intensity monitoring system for broiler chicken coops has been successfully developed and tested. This system effectively monitors light intensity inside and outside the coop in real-time using the ESP32 microcontroller and BH1750 sensors, with seamless integration into the Arduino IoT Cloud platform for smartphone accessibility. Testing conducted over a single day demonstrated that the light intensity inside the coop remained relatively stable, while the light intensity outside exhibited more variability. These results suggest that the system can assist farmers in making timely decisions regarding curtain adjustments to optimize light conditions, thereby enhancing the health and productivity of broiler chickens.

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