CYBER-PHYSICAL SYSTEM FINAL PROJECT REPORT
DEPARTMENT OF ELECTRICAL ENGINEERING
UNIVERSITAS INDONESIA

AUTOMATIC CURTAIN SYSTEM

GROUP B7

REZKI MUHAMMAD	**2106731516**
ALIFYA ZHAFIRA ANANDA	**2106704111**
ARMOND HARER	**2106634710**
RAFI’ NOVAL HADY	**2106703153**

PREFACE

Praise and gratitude we offer to the Almighty God for His blessings, as we have completed the final laboratory report for the Cyber-Physical Systems class. This report is a documentation of our final laboratory project titled “Automatic Curtain System”. We chose this title with the intention to enhance comfort, security, and energy efficiency within a room.

This report is written to fulfill the final assignment for the Cyber-Physical Systems course. The timely completion of this report would not have been possible without the assistance and support from various parties, namely Fransiskus Astha Ekadiyanto as our lecturer. Therefore, we express our gratitude for their contributions and assistance in various forms.

The authors acknowledge that there are still many mistakes in the preparation of this report, including errors in spelling, vocabulary, grammar, ethics, and content. Hence, we earnestly request criticisms and suggestions from the readers, which we will use as evaluations. We hope that this final laboratory report will be accepted as an idea or concept that enriches intellectual wealth in the field of computer engineering. May our report be beneficial to the readers as well as to ourselves.

Depok, May 16, 2023

Group B7

TABLE OF CONTENTS

CHAPTER 1

INTRODUCTION

1.1 PROBLEM STATEMENT

The layout of furniture and room decorations plays a crucial role in creating a comfortable and elegant atmosphere within the field of interior design. Curtains are a commonly utilized element to regulate lighting and privacy in a room. However, manually opening and closing curtains can be a burdensome task, especially when dealing with hard-to-reach curtain installations. Therefore, the implementation of an automation system for curtain control becomes highly necessary, as it allows users to effortlessly adjust lighting and privacy levels in the room.

To address this need, an automatic curtain system equipped with two modes for opening and closing curtains proves to be an effective solution. This system operates based on light sensors, which detect changes in ambient light, and it also offers manual control through the use of a potentiometer. By employing this automation system, users can save valuable time and energy that would otherwise be spent on manually adjusting curtains. The system provides a convenient and efficient way to cater to individual preferences and needs regarding curtain positioning.

In conclusion, the automation of curtain control in interior design not only provides convenience but also improves comfort and safety. By incorporating light sensors and manual control, the system enables users to easily regulate lighting and privacy levels according to their preferences. Additionally, it reduces direct sunlight exposure, regulates temperature, and helps maintain privacy, thus enhancing the overall quality of indoor spaces.

1.2 PROPOSED SOLUTION

We propose a solution in the form of an automated curtain system. This system aims to assist the community in optimizing their daily energy usage by efficiently opening and closing curtains based on the presence or absence of sunlight, detected through a light sensor.

The proposed solution involves integrating a light sensor and motorized curtain controls. The light sensor will be strategically placed near the curtains to detect the intensity of sunlight in the room. When sunlight is detected, the system will automatically open the curtains, allowing natural light to illuminate the space and reduce the need for artificial lighting. Conversely, when there is no sunlight, the system will close the curtains, providing privacy and conserving energy by blocking unwanted heat transfer.

To implement this solution, the existing curtains will be equipped with motorized controls that enable automatic operation based on the input from the light sensor. A microcontroller will be programmed to process the sensor data and activate the motorized controls accordingly. This automation eliminates the need for individuals to manually adjust the curtains throughout the day, saving time and effort.

Furthermore, the system will include a manual override feature, such as a switch or remote control, allowing users to manually open or close the curtains when desired. This provides flexibility and ensures that users maintain control over the curtain operation.

The proposed solution also prioritizes energy efficiency by optimizing curtain movement based on sunlight detection. This ensures that the curtains only operate when necessary, reducing unnecessary energy consumption.

By implementing this automated curtain system, individuals can enjoy the benefits of enhanced convenience, energy savings, and improved comfort within their living spaces.

1.3 ACCEPTANCE CRITERIA

The acceptance criteria of this project are as follows:

1. Motor activation: The motor should move in response to input from a light sensor.
2. Manual control: The motor should be manually activated by pressing a button, with immediate interruption of movement when the button is pressed.
3. Responsiveness: The motor should promptly and appropriately respond to changes in the light sensor input.
4. Smooth operation: The motor should operate smoothly without jerking or unexpected behavior in both sensor-controlled and manual control modes.
5. Adaptability: The project should handle variations in lighting conditions and provide consistent motor activation based on the light sensor input.

6. Energy efficiency: The motor control system should minimize power consumption for efficient operation.
7. Safety measures: Appropriate safety measures, such as speed limitations and emergency stop functionality, should be implemented to prevent hazards or accidents

1.4 ROLES AND RESPONSIBILITIES

The roles and responsibilities assigned to the group members are as follows:

Roles	Responsibilities	Person
Role 1	Make most of code, proteus, and circuit	Rezki Muhammad
Role 3	Make a small code and circuit, make a power point	Armond Harer
Role 4	Make a report and servo code, make README	Alifya Zhafira Ananda
Role 5	Make a report and flowchart, make README	Rafi’ Noval Hady

Table 1. Roles and Responsibilities

1.5 TIMELINE AND MILESTONES

Insert Gantt Chart here. The Gantt Chart should consist of date interval for:

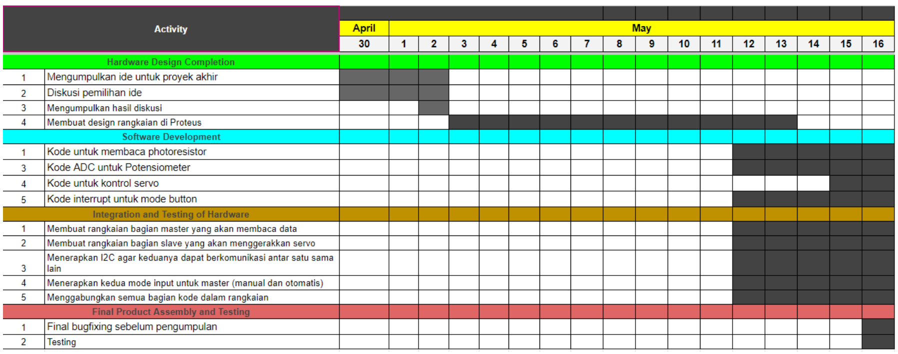


Fig 1. Gantt Chart for Timeline and Milestone

CHAPTER 2

IMPLEMENTATION

2.1 HARDWARE DESIGN AND SCHEMATIC

The hardware design for the automated curtain system comprises several key components. The central control unit is the Arduino Uno microcontroller, responsible for receiving input signals, processing data, and controlling the system. A motor is integrated into the system to enable curtain movement, while LEDs are used for visual indicators and status notifications. The system incorporates either a potentiometer or a photoresistor as a sensor to detect light levels. The potentiometer allows manual adjustment of the curtain position, while the photoresistor enables automatic adjustment based on ambient light conditions. Together, these components form the foundation of the automated curtain system, with the Arduino Uno serving as the control hub, the motor facilitating curtain movement, the LEDs providing visual feedback, and the potentiometer or photoresistor enabling light sensing capabilities.

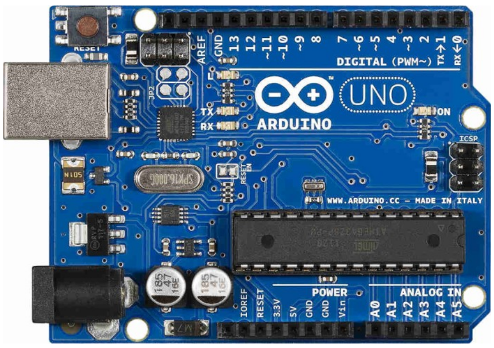


Fig 2. Microcontoller Arduino Uno

Fig 3. Photoresistor for Light Sensor

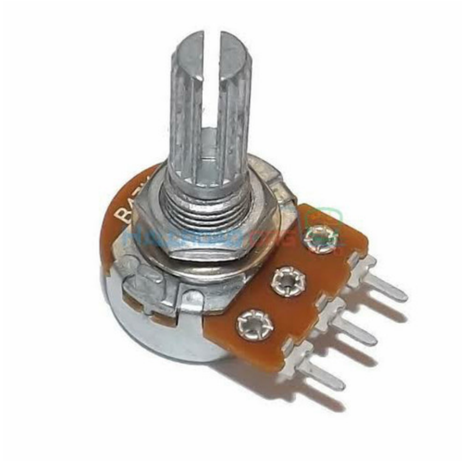


Fig 4. Potentiometer

Fig 5. LED for Indicator

The schematic diagram showcases the interconnections between various components in the project. The diagram consists of two Arduino boards, where one serves as the master and the other as the slave. The slave Arduino is linked to three input devices: a photoresistor, a potentiometer, and a button. These input components enable user interaction with the system. On the other hand, the master Arduino is connected to the slave Arduino and functions as the output module. It is responsible for controlling an LED as indicator and a servo motor, which generate the desired output based on the input received from the slave Arduino. This schematic diagram visually represents the relationship between the components, highlighting their roles and connections within the project.

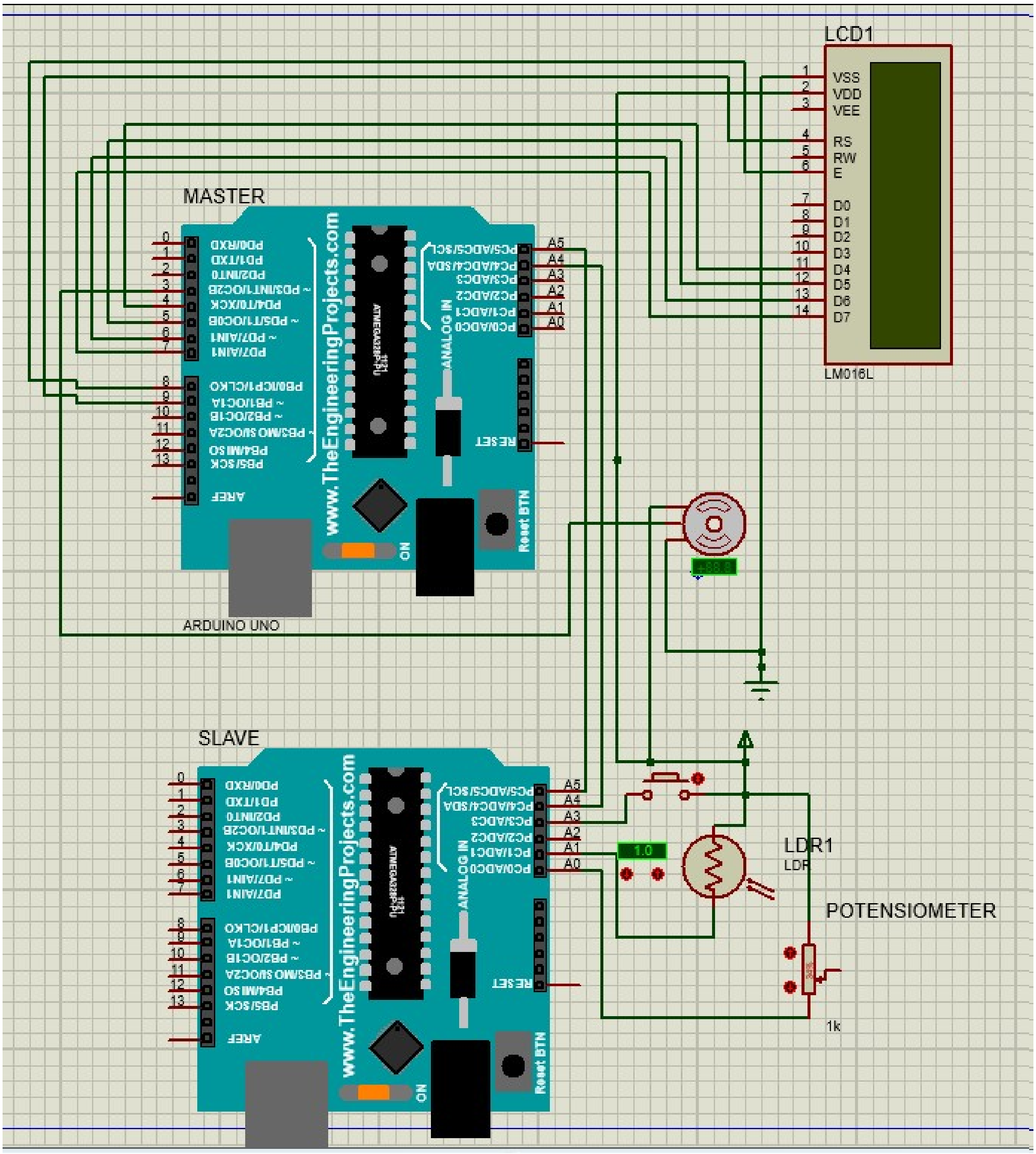


Fig 6. Schematic of System's Hardware

2.2 SOFTWARE DEVELOPMENT

The software development for the automatic curtain system involves programming Arduino boards to enable the system's automation. The photoresistor acts as an input sensor for light detection, and the Arduino slave device receives this input. A button on the slave device determines whether to read from the photoresistor or a potentiometer. The slave then communicates the data to the Arduino master using the I2C protocol. The master device interprets the received data and controls a servo motor accordingly. The software development process includes setting up the Arduino boards, writing code for the slave and master devices, integrating and testing the functionality, optimizing the performance, and documenting the process. This ensures a reliable and efficient software solution for the automatic curtain system.

In summary, the software development for the automatic curtain system involves programming the Arduino slave device to receive input from a photoresistor and communicate it to the Arduino master using I2C. The master device reads the received data and controls a servo motor based on the input. The process includes setting up the Arduino boards, writing code for the slave and master devices, integrating and testing the functionality, optimizing performance, and documenting the process. This ensures an effective software solution for automating the curtain system. The flowchart for this software development as follows:

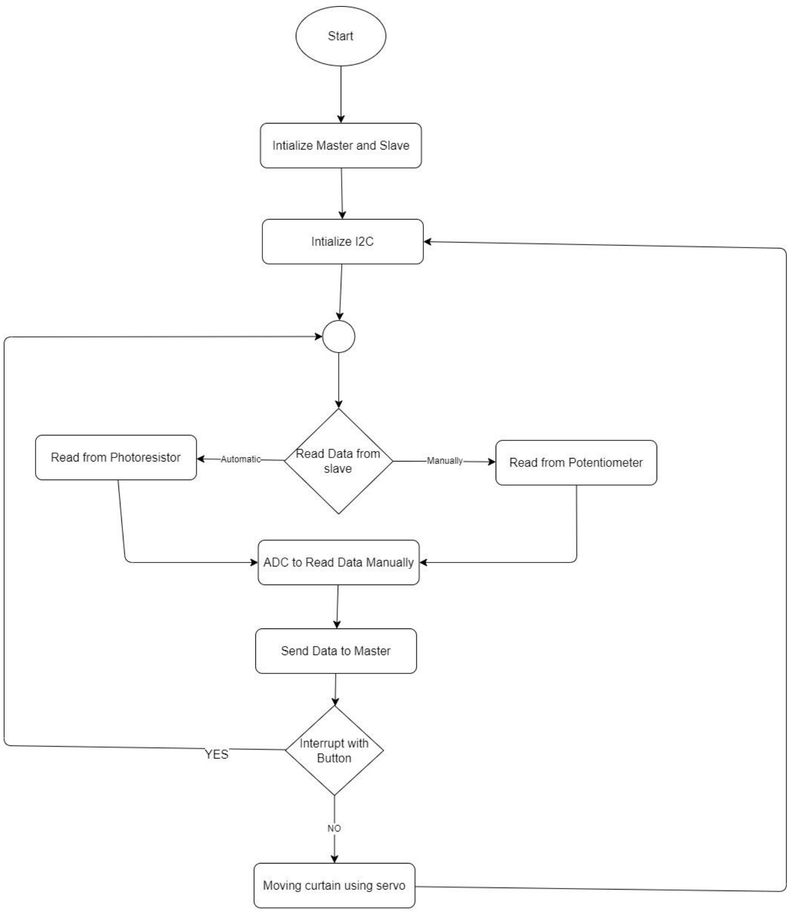


Fig 7. Flowchart

2.3 HARDWARE AND SOFTWARE INTEGRATION

In the integration phase, the first step was to connect the hardware components to the Arduino microcontroller. This involved physically wiring the sensors, output devices, and LED to the appropriate pins on the Arduino board. Each hardware component was assigned a specific pin for sensor input, output device control, or LED indication.

Once the hardware components were properly interfaced, the next step was to establish communication between the software and hardware. The software code, written in assembly language, was uploaded to the Arduino board. This code contained the instructions that defined the behavior of the system, such as how the curtain should respond to input signals from the sensors.

During the integration phase, testing and debugging were performed to ensure that the hardware and software worked together seamlessly. This involved verifying that the sensors correctly detected the desired input signals and that the software responded accordingly by controlling the output devices. Any issues or errors were identified and addressed through adjustments and refinements to the hardware and software components.

The ultimate goal of the integration phase was to achieve optimal hardware and software integration. This means that the hardware components and the software code worked harmoniously to create a cohesive system. The hardware accurately sensed the environmental conditions or user input, and the software precisely interpreted and responded to these inputs, controlling the curtain's movement accordingly.

By successfully integrating the hardware and software components, the automatic curtain system became a unified solution that could respond to changes in ambient light conditions. This integration enabled the system to provide convenience and enhanced user experience.

CHAPTER 3

TESTING AND EVALUATION

3.1 TESTING

The testing of the automatic curtain system built in assembly language using Arduino ATmega328P involves verifying the functionality and performance of various components. Firstly, the photoresistor serves as the light sensor, responsible for detecting the ambient light level to determine when to open or close the curtains. During testing, different lighting conditions should be simulated to ensure the sensor responds accurately and triggers the appropriate curtain movement.

Secondly, the potentiometer acts as a manual control for operating the curtains. The system should be tested to ensure that the potentiometer accurately adjusts the curtain position when in manual mode. The testing should cover the full range of potentiometer positions to ensure smooth and consistent curtain movement.

Next, the LED serves as an indicator for the system mode. When the LED is off, it indicates the manual mode is active, and when it is on, it signifies that the sensor mode is operational. The testing should verify that the LED accurately reflects the chosen mode and switches accordingly when the mode is changed.

Finally, the servo motor is responsible for physically moving the curtains based on the sensor input or manual control. The testing should ensure that the servo motor operates smoothly, without any jerks or interruptions, when triggered by either the photoresistor or the potentiometer. It should also be tested for its ability to accurately position the curtains at different levels.

Overall, the testing of the automatic curtain system involves verifying the proper functioning of the photoresistor, potentiometer, LED indicator, and servo motor. It is important to ensure that all components work harmoniously to provide accurate and reliable curtain movement based on the chosen mode, be it sensor-based or manual control.

3.2 RESULT

The result of the testing, it was observed that the circuit successfully achieved movement in the servo when in manual mode by making changes obtained from the potentiometer. However, in automatic mode, the results obtained could not be determined conclusively due to the need for extensive testing. This is because the photoresistor requires direct sunlight as input, specifically UV light. Therefore, further testing under direct sunlight is necessary to evaluate the performance of the automatic mode.

Additionally, the circuit successfully implemented an interrupt mechanism to switch between the auto and manual modes. This functionality was indicated by the LED light turning on when the button was pressed

These findings indicate that the circuit design and implementation were successful in achieving the desired manual mode functionality. However, further testing and adjustments are needed to evaluate and ensure the reliability and effectiveness of the automatic mode.

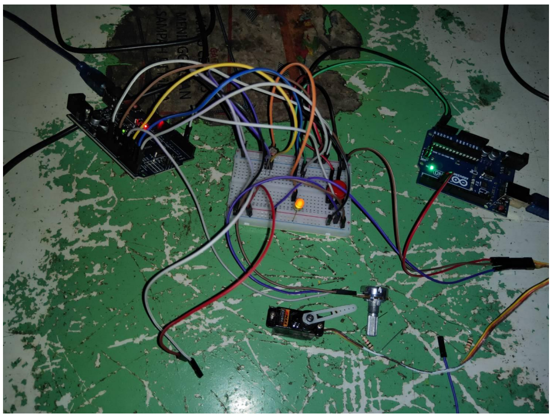


Fig 8. Testing Result

3.3 EVALUATION

Upon evaluation, it has been determined that the interrupt functionality within the Automatic Curtain System is not operating as expected. The system relies on interrupts to promptly respond to external events, such as the mode switch triggered by a push button. The evaluation will focus on identifying the root cause of the interrupt failure and resolving it to ensure a timely and accurate response to the push button input.

Additionally, the evaluation has revealed that the servo motor fails to move in alignment with the desired input. The system should exhibit precise control over the curtain's position and movement, both in manual mode utilizing the potentiometer and in automatic mode based on the sensor input. It is imperative to investigate the source of this inconsistency and address any underlying issues that might impact the servo's movement accuracy and responsiveness.

By thoroughly examining these concerns during the evaluation process, it will be possible to pinpoint the specific flaws within the program of the Automatic Curtain System. Subsequently, necessary adjustments and improvements can be implemented to ensure reliable and efficient operation of the system, resulting in a seamless user experience.

CHAPTER 4

CONCLUSION

The Automatic Curtain System is an automation system designed to provide comfort and convenience for users in controlling the opening and closing of curtains. This system uses a light sensor to measure the ambient light intensity and an SG90 servo motor to move the curtains.

By using the Automatic Curtain System, users can automatically control the opening and closing of the curtains without the need for manual adjustments. This provides high comfort and efficiency, especially for users who have windows or doors that are difficult to reach.

In its construction, this project uses simple and easily obtainable components and devices. Additionally, the project can be easily expanded to meet user needs, such as controlling the curtains remotely or scheduling the opening and closing of the curtains based on time.

In conclusion, the Automatic Curtain System is an effective and efficient solution for automating the opening and closing of curtains. It enhances user comfort and convenience by eliminating the need for manual adjustments and providing seamless control over the curtains' operation. The system's simplicity and expandability make it a versatile choice that can be customized to meet individual preferences and requirements.

REFERENCES

[1] Tim Penyusun Modul. “Modul 2 SSF : Introduction to Assembly I/O Programming”. [Online]. Digital Laboratory FTUI. 2023. Available: https://classroom.google.com/u/0/c/NTkzNjAyMDgzODQw [Accessed 15 May 2023]

[2] Tim Penyusun Modul. “Modul 4 SSF : Serial Port”. [Online]. Digital Laboratory FTUI. 2023. Available: https://classroom.google.com/u/0/c/NTkzNjAyMDgzODQw [Accessed: 15 May 2023].

[3] Tim Penyusun Modul. “Modul 5 SSF : Aritmatika”. [Online]. Digital Laboratory FTUI. 2023. Available: https://emas2.ui.ac.id/pluginfile.php/3744299/mod_resource/content/3/Modul%205%20SSF%20Aritmatika.pdf [Accessed: 15 May 2023].

[4] Tim Penyusun Modul. “Modul 6 SSF : Timer”. [Online]. Digital Laboratory FTUI. 2023. Available: https://emas2.ui.ac.id/pluginfile.php/3754317/mod_resource/content/1/Modul%206%20SSF_%20Timer.pdf. [Accessed: 15 May 2023].

[5] Tim Penyusun Modul. “Modul 8 SSF : I2C & SPI”. [Online]. Digital Laboratory FTUI. 2023. Available: https://emas2.ui.ac.id/pluginfile.php/3797142/mod_resource/content/1/ModSRul%208%20SSF_%20I2C%20_%20SPI.pdf. [Accessed: 15 May 2023].

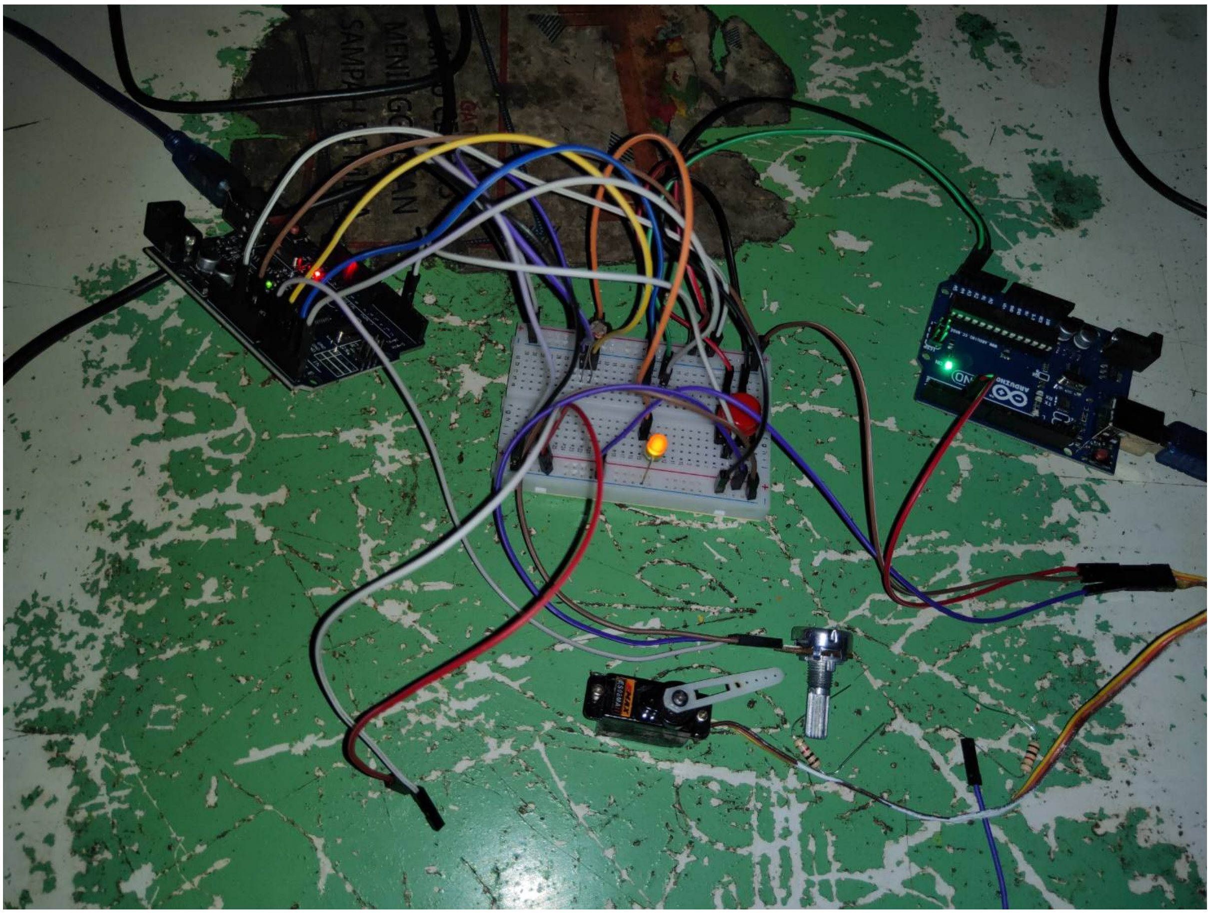
[6] Tim Penyusun Modul. “Modul 9 SSF : Sensor Interfacing”. [Online]. Digital Laboratory FTUI. 2023. Available: https://emas2.ui.ac.id/pluginfile.php/3797143/mod_resource/content/1/Modul%209%20SSF-%20Sensor%20Interfacing.pdf. [Accessed: 15 May 2023].

[7] Anas Kuzechie. “Assembly via Arduino (part 15) - Programming SPI”. (Nov. 17, 2021). [Online Video]. Available: https://www.youtube.com/watch?v=N0tmYhU9sN8. [Accessed: 15 April 2023].

[8] Anas Kuzechie. “Assembly via Arduino (part 4) – Programming ADC”. (Oct. 20, 2021). [Online Video]. Available: https://www.youtube.com/watch?v=7PVTnT59cqE [Accessed: 7 Mar 2023]

APPENDICES

Appendix A: Project Schematic



Appendix B: Documentation