CHAPTER 1

INTRODUCTION

1.1. Background

In this modern and digital era, many technological tools in various fields have also increased, such as a door lock system design with an RFID-based battery backup and Arduino Uno. A door is a mandatory component of a house or room, such as an office or laboratory. A door serves not only as an entrance and a barrier between spaces, but also as a space transition, a connector between rooms, and as a safety. This tool must be backed up by a battery using a 12V power supply that gets an input voltage from PLN (State Electricity Company). This system works when the PLN electricity goes out, which provides a voltage supply to the ATS (automatic transfer switch) so that the door lock system can work properly.

In general, a door is equipped with a mechanical lock to ensure the safety and comfort of its occupants. With the development of today's technology, mechanical locks can be replaced with electronic locks. In order to control an electronic lock, a controller is needed.

This is because manual keys are easy to imitate (duplicate) so that other people will enter the house (or room) easily. Meanwhile, an electronic system will be difficult to replicate since this system uses programs.

Therefore, the design of a door lock system based on RFID (Radio Frequency Identification) was formed to control a door locking system with a backup battery.

1.2. Formulation of the Problem

The formulation of the problem in this Final Project is as follows:

1. How to design a door lock device with a backup battery using RFID and

Arduino UNO?

2. What are the automatic variables in the device design system?

1.3. Objective of the Study

The objective of designing this device is:

1. To make an electronic door security system.
2. To implement Arduino Uno and RFID control systems as a device controller.
3. To make an automatic door locking hinge movement by using the PLN or Batteries.

1.4. Significance of the Study

1. This study is expected to help the security guards.
2. Can reduce the theft rate in the room.
3. Maintain discipline of everyone who enters the room.
4. To add insight to the author and readers of this Final Project regarding knowledge of RFID systems.

1.5. Scope and Limitation

In order to avoid widening the discussion, the scope and limitation in this study are as follows:

1. A door lock controlled using a solenoid door lock.
2. The design of the system uses the Arduino Uno control device using the RFID system.
3. RFID is used to open and close the door in one direction.

1.6. Method of Research

In carrying out the device design activities, the following steps are used:

1. Literature Study: the author looks for the title of this study by reading, comparing, analyzing, and formulating problems from all the literature that has been read in the library and various Electrical Engineering journals via the internet about the problem that must be chosen as the title of the thesis.
2. Device Design: the author does the design through a drawing concept related to the device to be made, both hardware and software.
3. Device Production: the author makes the device (both software and hardware) using available tools and materials.
4. Device Testing: the author tested the device that has been made, both hardware and software, to determine whether the device has met the objectives of the research title taken in this Final Project.
5. Analysis and Discussion: the author conducts an analysis that includes measurement, calculation, observation, and recording various data that appear during the analysis.

1.7. Systematic Writing

This Final Project consists of five chapters with systematic writing in the following order:

Chapter 1 : Introduction

This chapter contains the background, formulation of the problem, the objective of making the device, the significance of the device, scope and limitation, method of designing the device, and systematic writing.

Chapter 2 : Supporting Theory

This chapter describes the supporting theory used to discuss all components, both hardware and software, which are used in the design and manufacture of this device.

Chapter 3 : Device Design Method

This chapter describes clearly how the methods in designing and manufacturing the device, both hardware and software.

Chapter 4 : Results and Discussion

This chapter contains an explanation of the results of device design, testing, and discussion.

Chapter 5: Conclusion and Suggestions

This chapter contains the conclusion and suggestions for device development.

CHAPTER 2

SUPPORTING THEORY

2.1. Arduino Uno

Arduino Uno is one of the products labeled Arduino, which is actually an electronic board containing the Atmega328 microcontroller (a chip that functionally acts like a computer). This device can be used to realize electronic circuits, from simple to complex. LED control to robot control can be implemented using this relatively small board (see Figure 2.1). With the addition of certain components, this device can be used for remote monitoring via the internet, for example, monitoring the condition of patients in hospitals and controlling home appliances.

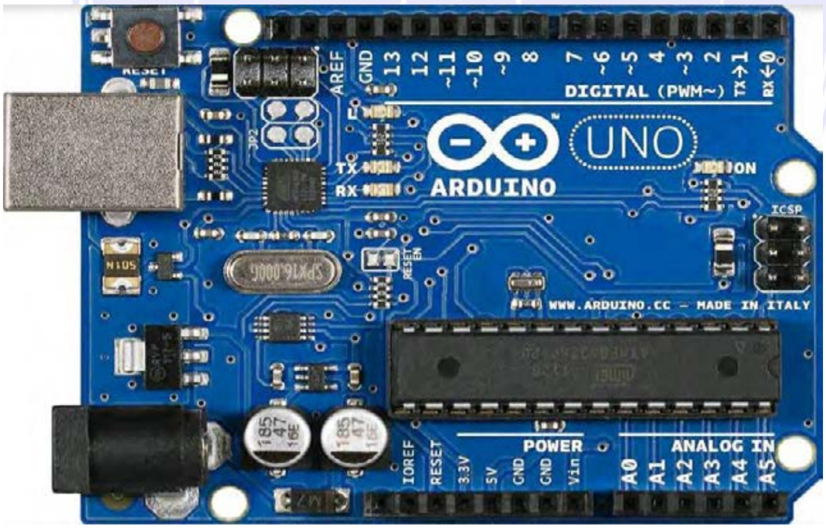


Figure 2.1: Arduino Uno Physical Form

Arduino Uno contains a microprocessor (Atmel AVR) and is equipped with a 16 MHz oscillator (which allows time-based operations to be carried out precisely) and a 5-volt regulator (voltage generator). Several pins are available on the board. Pins 0 to 13 are used for digital signals, which are only 0 or 1. Pins A0-A5 are used for analog signals. Arduino Uno is equipped with 2KB of static random-access memory (SRAM) to hold data, 32 kB flash memory, and programmable read-only memory (EEPROM) for storing programs. (Kadir, 2013).

2.1.1. Arduino Power Supply

Power supply pins are pins that provide voltage for components or circuits connected to Arduino. On this power supply, there are V-input and Reset pins. V-input is used to provide direct voltage to the Arduino without going through the voltage on the USB or adapter. Meanwhile, Reset is a pin to provide a Reset signal via a button or external circuit. (Gratitude, 2017)

Arduino Uno can be powered via a USB connection or by an external power supply. The resource is selected automatically. The external (non-USB) power source can come from either the AC-DC adapter or the battery. The adapter can be connected by connecting a 2,1 mm plug, the center of which is the positive terminal to the voltage source jack on the board. If the voltage comes from the battery, it can be directly connected via the Gnd pin header and the V-input pin of the POWER connector.

The voltage pin available on the Arduino board is as follows:

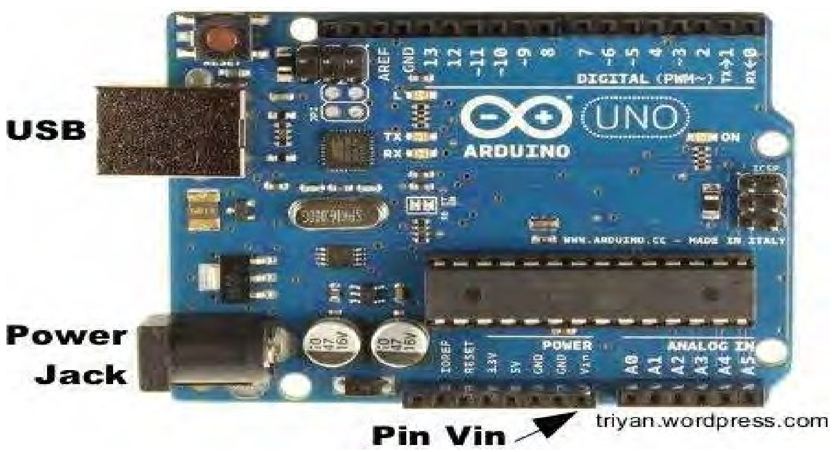


Figure 2.2: V-input Pin on Arduino

(https://triyan.wordpress.com/2015/11/23/select-power-supply-pada-arduino/)

a. VIN : VIN is the input voltage for the Arduino board when using an external power source (as a 5 Volt ‘connector’ from a USB connection or to another regulator power source). Therefore, it can supply voltage through this pin, or if supplying voltage to the board via the power jack, it can access/take voltage through this pin.

b. 5V : 5V is a pin that outputs a 5 Volt voltage regulator. From this pin, the voltage (regulator) is set from the available (built-in) regulator on the board. Arduino can be powered by a power source, either from the DC power jack (7-12 Volts), the USB connector (5 Volts), or the VIN pin on the board (7-12 Volts). Applying voltage through the 5V or 3.3V pins directly without going through the regulator can damage the Arduino board.

c. 3V3 : 3V3 is a pin that produces a voltage of 3,3 Volts. An on-board regulator generates this voltage. The maximum current generated is 50 mA.

d. GND : Ground or Mass Pin.

e. IOREF : This pin is located on the Arduino board, which serves to provide a voltage reference that operates on a microcontroller. A shield is adequately configured to read the IOREF voltage pins and select the correct power source or activate a voltage translator at the output to operate at 5 Volts or 3.3 Volts.

Each of the numbers of digital pins on the Arduino Uno can be used as an input or an output, using the pinMode(), digitalWrite(), and digitalRead() functions. Arduino Uno operates at 5 volts. Each pin can provide or receive a maximum current of 40 mA and has an internal voltage resistor (which is disconnected by default) of 20-50 kOhms. In addition, some pins have special functions, namely:

a. Serial: 0 (RX) and 1 (TX); Serial 1: 19 (RX) and 18 (TX); Serial 2: 17 (RX) and 16 (TX); Serial 3: 15 (RX) and 14 (TX). These serials are used to receive (RX) and transmit (TX) TTL serial data. Pins 0 and 1 are also connected to the ATmega16U2 Serial USB-to-TTL chip.
b. External Interrupt: Pin 2 (interrupt 0), pin 3 (interrupt 1), pin 18 (interrupt 5), pin 19 (interrupt 4), pin 20 (interrupt 3), and pin 21 (interrupt 2). This pin can be configured to trigger an interrupt at a low, increasing or decreasing value, or changing the value.
c. SPI: Pin 50 (MISO), pin 51 (MOSI), pin 52 (SCK), pin 53 (SS). This pin supports SPI communication using the SPI library. The SPI pin is also connected to the ICSP header, which is physically compatible with the Arduino Uno, Arduino Duemilanove, and Arduino Diecimila.
d. LED: Pin 13. This is available built-in on the Arduino ATmega2560 board. The LED is connected to digital pin 13. When the pin is set to HIGH, the LED is ON, and when the pin is set to LOW, the LED is OFF.
e. TWI: Pin 20 (SDA) and pin 21 (SCL). This pin supports TWI communication using the Wire library if it is not in the same location as the

TWI pin on the Arduino Duemilanove or Arduino Diecimila.

There are several other available Pins, including:

a. AREF: This is the voltage reference for the analog input. Used with the analogReference() function.
b. RESET: This LOW line is used to reset (restart) a microcontroller. This line is usually used to add a reset button to the shield that blocks the Arduino mainboard.

2.1.2. Connection to PC

Connection to a Personal Computer (PC) is made via a USB cable (Figure 2.3). In this case, the electricity needs are supplied by the PC. However, if the Arduino is used alone, an external voltage source of 9V is required.

Figure 2.3: Arduino Uno and PC Connection

If the Arduino Uno has been connected to a PC and the PC has been turned on, there will be two indicators stating that this board functions well.

1. The first indicator is a small light labeled ON that will light up.
2. The second indicator is a small light connected to pin 13 that will flash.

(Kadir, 2013)

2.2. Arduino Software

Arduino IDE (Integrated Development Environment) Program Application. In order to start an Arduino program (to make it do what it wants), users need to use the Arduino IDE (Integrated Development Environment). The Arduino IDE is open-source software that allows users to program the Arduino language in the “C” language. The IDE allows users to write a program step by step, and then the instructions are uploaded to the Arduino board. (Kadir, 2013)

The microprocessor that has been developed is considered to have limitations. Therefore, Intel continues to develop its microprocessors. With these developments, the microprocessor performance is further improved. The limitations of the microprocessor led to the invention of the microcontroller. (Udayashankara, 2009)

The term microcontroller is different from the microprocessor. The microprocessor requires external memory to run programs. In addition, the microprocessor cannot be directly connected to input/output devices. It takes peripheral chips to connect the microprocessor with input/output devices. Meanwhile, the microcontroller contains a microprocessor and one or more of the following components:

a) Memory
b) Analog to Digital Converter
c) Digital to Analog Converter
d) Parallel I/O interface
e) Serial I/O interface

f) Timers and counters

2.3. ATMega 328P Microcontroller

Microcontroller vendors other than Intel are Atmel. The company introduced the first 8-bit microcontroller in 1993. The first generation of flash microcontrollers was based on the industry standard 8051 core. It uses a separate high-voltage supply for programming. The advantage that users get from flash microcontrollers is that the microcontroller devices can be programmed before system assembly. If a bug is found in the system or some changes are needed, the microcontroller device can be removed and reprogrammed. (Svendsli, 2003)

One of the flash microcontroller products from Atmel is the ATmega 328P. This microcontroller has a RISC (Reduce Instruction Set Computer) architecture, where each data execution process is faster than the CISC (Completed Instruction Set Computer) architecture. In the ATmega328P datasheet, the features of the Atmega 328P microcontroller are as follows:

a. 130 kinds of instructions, almost all of which are executed in one clock cycle.15
b. 32 x 8-bit general-purpose registers.
c. Speed up to 16 MIPS at 16MHz frequency.
d. It has 512 Bytes EPROM (Electrically Erasable Programmable Read Only Memory) as data storage even though the power supply is turned off and 1 KB of SRAM (Static Random Access Memory).
e. 32 KB of Flash Memory, and the Arduino has a bootloader that uses 2 KB of flash memory.

f. It has 14 digital I/O pins, 6 of which are PWM (Pulse Width Modulation) outputs.
g. Voltage during operation is about 4.5 – 5.5 V.

2.4. RFID (Radio Frequency Identification)

RFID is a radio wave-based identification technology. This technology can identify multiple objects simultaneously without the need for direct contact (or at short distances). An RFID sensor is a sensor that identifies an object using radio frequencies. This sensor consists of two essential parts, namely:

a. transceivers (readers)
b. transponders (tags)

Each tag is stored with different data. The data is the tag identity data. Readers will read the data from the tag via radio waves. RFID consists of three components, namely:

1. An RFID reader is a device compatible with the RFID tag card, which communicates wirelessly with the tag card.
2. An RFID tag card is a device that stores information for object identification. RFID tag cards are also often called transponders.
3. An antenna is a device for transmitting radio frequency signals between an RFID reader and an RFID tag card.

Data identification on the RFID tag is carried out through radio frequencies that propagate through air medium at a specific range according to the features possessed by each RFID module (consisting of an RFID reader and an RFID tag) used. The unique RFID tag data is stored or embedded in a chip card. Thus, the influence of natural conditions such as dust, dirt, or air temperature will not reduce the quality of data communication. From the test results, the RFID reader can recognize all RFID tags in three different positions, with an optimal distance of 5 cm (vertical) and 2 cm (horizontal). All user activities that access the room can be recorded in the database system. From the results of this study, it can be concluded that RFID technology can be used comfortably and safely as an alternative to personal identification systems for room access systems.

2.5. Tag Card (Transponder)

An RFID tag is a device made from an electronic circuit and an antenna integrated into the circuit. RFID generally has a memory, so this tag has the ability to store data. The memory on the tag is divided into cells. Some cells store Read-Only data, such as a unique serial number stored when the tag is produced. In addition to RFID, it may also be written and read repeatedly. (Suyoko, 2012)

2.6. RFID Sensor

An RFID reader must complete two tasks, namely:

a. Receive orders from application software.

b. Communicate with RFID tags.

A Radio Frequency Identification (RFID) reader (Figure 2.4) is the connector between application software and an antenna that will radiate radio waves to an RFID tag. The radio waves emitted by the antenna propagate in the surrounding space.

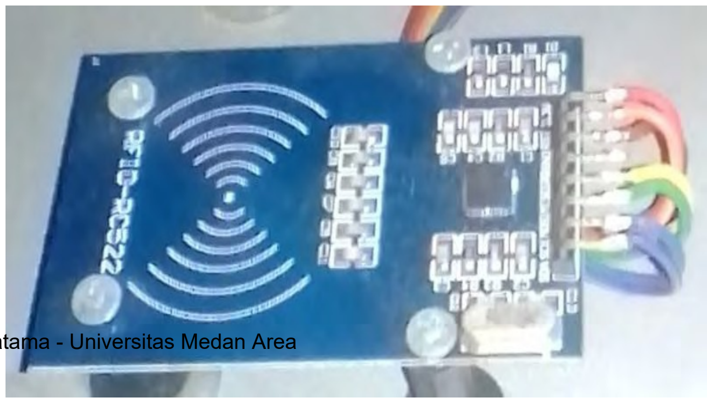


Figure 2.4: RFID Reader

2.7. Types of RFID Tags

Basically, there are two types of RFID tags according to their power source, namely active tags and passive tags. The following figure (Figure 2.5) displays the physical form of RFID tags:

Figure 2.5: RFID Tags

2.7.1. RFID Active Tags

An RFID tag device is divided into two major classes, namely active tags and passive tags. Active tags use additional power sources for their operation. This additional power source can be obtained from a battery and can also be obtained from an electrical infrastructure. The use of power sources from a battery causes an active RFID tag to have a life that depends on the energy stored in the battery. If the energy in the battery is depleted, the tag will not function as usual. (Want, 2006)

The use of active tags is usually reserved for large assets, such as containers, cargo, cars, etc. The use of active tags on large assets is because the reading range is relatively far; it can reach 20 meters or even 100 meters. The frequencies used by active tags typically operate at 455MHz, 2.45MHz, or 5.8MHz (Violino, 2005).

2.7.2. RFID Passive Tags

The use of batteries causes RFID tags to have a large size, relatively large production costs, and limited service life by the battery itself. Because of this, RFID passive tags are becoming more and more in demand. Passive tags do not require additional power sources for their operation. Passive tags also do not require special handling. In addition, passive tags have an indefinite operational life since there is no battery usage to operate them. By not using batteries, passive tags are smaller in size, making them easy to use. Passive tags only consist of three main parts, namely:

a. Antenna
b. Semiconductor Chips
c. Packaging/EncapsulationMmaterial

In order to work, an RFID reader emits radio waves with a certain power. This power is then used by the tag to operate. The tag will then send back the tag ID stored on the semiconductor chip. Antenna serves to capture radio waves, while encapsulation will defend the chip and antenna from damage caused by the surrounding environment. (Want, 2006).

2.8. RFID Working Frequency

Factors that must be considered in Radio Frequency Identification (RFID) are the RFID system’s working frequency. This frequency is the one used for wireless communication between the RFID reader and the RFID tag. (Juprianto Renungan, et al, 2014)

There are several frequency bands used for RFID systems, namely:

a. Low-Frequency tag (LF): 125 - 134 kHz
b. High-Frequency tag (13.56 MHz)
c. Ultra High-Frequency tag (UHF): 868 – 956 MHz
d. Microwave tag: 2.45 GHz

2.9. Magnetic Solenoid Door Lock

The electro-mechanical solenoid (Figure 2.6) in this device works when given a voltage of 12V. Inside the solenoid, there is a wire coiled around the iron core. When an electric current flows through the wire, a magnetic field is created to produce energy to pull the iron core inward. When not given an electric current, the magnetic field will disappear, and the energy that attracts the iron core inward will be lost as well. Thus, it can make the iron core position to the initial position. This situation is used as a door lock. (Helmi Guntoro, et al., 2013)

Figure 2.6: Magnetic Solenoid Door Lock

This magnetic door lock uses a keypad as an input device in the form of a password code, uses a relay to activate the solenoid, also uses the solenoid as an actuator that will do the function of open and lock. This tool also has the feature to change and save the new password code directly from the keypad without reprogramming it from the computer.

The solenoid serves as an actuator. The solenoid will work as a lock and will activate when a voltage of 12V is given. Inside the solenoid, there is a wire coiled around the iron core. When an electric current flows through this wire, a magnetic field is created to generate energy to pull the iron core inward.

2.10. Relay Driver Module Circuit

Relays are electrically operated switches. Many relays use an electromagnet to operate a switch mechanically. However, other operating principles are also used, such as solid-state relays. Relays are used where it is necessary to control a circuit with separate low power signals or where a single signal must control several circuits. The first relays were used on long-distance telegraph circuits as amplifiers: repeating the incoming signal from one circuit and retransmitting it on another. Relays were used extensively in early telephone and computer exchanges to perform logical operations.

A relay driver circuit acts as an electronic circuit that is usually used to control and operate something remotely. Usually, this circuit is used to simplify and also expedite work that sometimes requires a relay circuit. By using it, the relay circuit can control and operate electronic devices remotely, which of course, there is no need to shift and change seats.

A relay circuit can also be installed in various electronic equipment or devices, such as:

a. television

b. radio transmitter

c. sound system

This relay driver circuit can also be found in some electronics stores, which of course, can be found easily. We can also create it using several components, which obviously will not be hard to find.

Figure 2.7: Physical Form of Relay

1. Relay Definition

Relay (Figure 2.7) is an electronic component in the form of an electronic switch driven by an electric current. In principle, a relay is two switches with a wire wound on an iron rod (selenoid) nearby. When the solenoid is energized with 24 volts of electricity, the lever will be pulled due to the magnetic field force that occurs on the solenoid. Thus, the switch will close. When the current is stopped, the magnetic force will disappear, which then the lever will return to its original position, and the switch contacts will open again.

2. Relay Working Principle

Relay (Figure 2.8) consists of Coil & Contact. Coil is a coil of wire that gets an electric current. Meanwhile, Contact is a kind of switch whose movement depends on the presence or absence of an electric current in the coil. There are two types of contacts: Normally Open (NO); the initial conditions before being activated by open, and Normally Closed (NC); the initial conditions before being activated by the close. In simple terms, the working principle of a relay is as follows: When the coil gets electrical energy (energized), an electromagnetic force will arise that will attract the springing armature, and then, the contact will close. The working principle of this relay is: At C1 and C2, there is a coil as a driver. When C1 and C2 have not passed the current, the Com and No terminals will be connected. When C1 and C2 have passed the current, the Com plate will move to connect the Com and No terminals. In order to assemble the SPDT relay to be used on Arduino, the following things need to be considered:

a. SPDT relay 5v/12v
b. Resistor 1k Ohm
c. Transistor 2n2222
d. Diode 1n4007

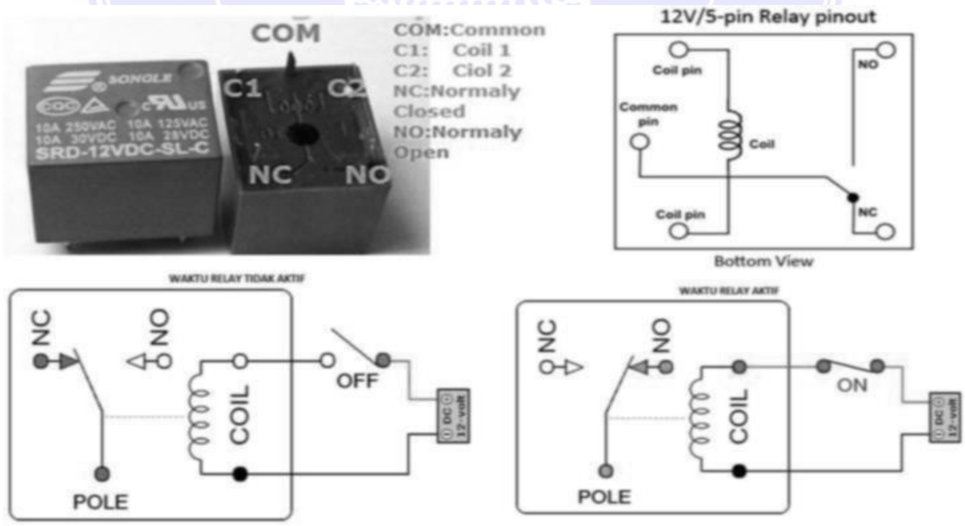


Figure 2.8: Relay Working Principle

(Spring Loaded Electromagnet. Solenoid 12V Pull Type. [Online]. Available at: http://www.engineeringshock.com/12v-pull-type-solenoid.html [January 11, 2019]

2.11 Battery (Accumulator)

A battery (Figure 2.9) is an electrochemical or Voltaic cell that can convert chemical energy into electrical energy. Based on the type of electrolyte solution, batteries are classified into two, namely wet batteries (e.g., accumulators (Accu)) and dry batteries (for example, batteries). (Latipah, 2012)

Wet batteries are widely used by cars and motorcycles. One of the characteristics of this type of battery is the presence of holes for filling water (for the accumulator). The advantage of wet accumulators is that they are affordable. While the weakness is the evaporation rate is high. Therefore, vehicles that use wet types of accumulators need to be checked regularly. Distilled water can be used to add fluid to the accumulator. The condition of the water surface below the lower line and incorrectly pouring liquid when adding accumulator fluid (such as well water, tap water) will damage the accumulator quickly. Batteries used in motorcycles usually have a voltage of 12 volts and a current of 5 Ah. Under normal conditions (normal vehicle charging system), there is no evaporation because the gas generated is absorbed by the negative plate. If the charging system condition is abnormal and there is frequent overcharging, there will be evaporation, resulting in the battery being damaged. Under normal conditions, the battery life can reach 2-3 years, provided that the use of electrical loads is not excessive, and there must be a minimum of charging each day since the battery can drop if there is no charging for days. (Supena, 2009)

Figure 2.9: GS Brand Wet Accumulator

There are two types of elements that are sources of direct current (DC) from chemical processes, namely primary elements and secondary elements. Primary elements are dry elements, while secondary elements are wet elements. The chemical reaction in the primary element that causes electrons to flow from the negative electrode (cathode) to the positive electrode (anode) cannot be reversed. If the charge is depleted, the primary element cannot be reloaded and requires replacing the reagent (dry element). Hence, from an economic point of view, primary elements can be said to be quite wasteful. An example of a primary element is a battery (dry cells). (Golberg, 2010)

Allesandro Volta, a physicist, stated that the electromotive force (emf) can be generated by two dissimilar metals and separated by an electrolyte solution. Volta found a copper (Cu) metal pair and zinc (Zn), which could generate a higher emf than the other metal pairs (later called Voltaic elements). This becomes the basic principle for the creation and use of secondary elements. Secondary elements must be charged first before use, namely by flowing electric current through them (generally known as 'unified'). However, unlike primary elements, secondary elements can be reloaded over and over again. This secondary element is better known as an accumulator. In an accumulator, a reversible electrochemical process with high efficiency takes place. What is meant by a reversible electrochemical process is that when an accumulator is being used, there is a process of chemical conversion into electric power (discharging). Meanwhile, when it is filled or loaded, a process of changing electric power into chemical energy (charging) occurs. (Supena, 2009)

The type of accumulator commonly used is a lead (Pb) accumulator. Physically, an accumulator consists of two sets of plates placed in a dilute sulfuric acid (H_2SO_4) solution. This electrolyte solution is placed in an accumulator container or vessel made of ebonite or glass. Both plates are made of lead (Pb). When first loaded, a lead dioxide (PbO_2) layer forms on the positive plate. The positive and negative plates are very close together. However, both are made not to touch each other with a separating layer that functions as an insulator (insulating material). The chemical processes in accumulators can be divided into two essential parts, namely during use and being reloaded or 'unified.' (Golberg, 2010)

2.12 Power Supply

A power supply is a source of electrical power. The device or system that supplies electricity or any energy to the output of a load or group of materials is called a PSU (power supply unit). Electronic devices need to be powered by a stable direct current (DC) supply in order to work properly. Batteries are the best source of DC power supply. However, for applications that require a larger power supply, the source of a battery is not enough. A large power supply source is a source of an alternating current (AC) from electric power plants. Hence, a power supply device that can convert AC into DC is needed. (Tampubolon, 2010)

There are many types or variations of power supply circuits with all their advantages and disadvantages. However, in principle, a power supply circuit consists of a transformer, diode, and capacitor. Transformers are used to lower or increase the AC voltage as needed.

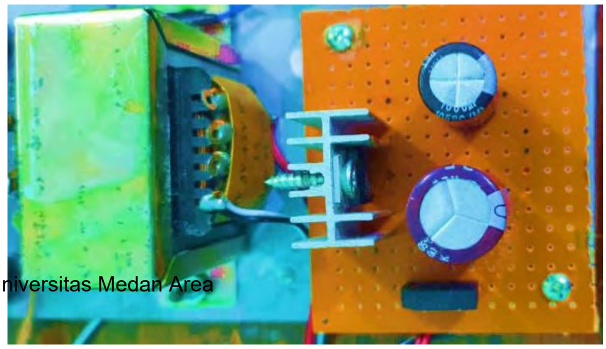


Figure 2.10: Power Supply

Power Supply is (Figure 2.10) a circuit that serves to provide power to electronic equipment. Power supply serves to provide power and voltage to the electronic equipment you use. Many power supply circuits can be found. There are two types of power supplies, namely:

a. Fixed power supply: Fixed voltage power supply circuit has an unadjustable voltage value. The value is already set by the circuit.
b. Variable power supply circuit. In contrast to a fixed power supply, the voltage value of a variable power supply circuit can be changed.

A good power supply circuit obviously has a regulator in the circuit. The installation of the regulator is used to provide stability to the output voltage (if there is a change in the voltage value received by the power supply circuit). LM 7805 is one type of regulator for a fixed voltage. This LM 7805 regulator has 3 terminals, namely Vin, GND, and also Vout. Figure 2.9 shows the physical form of a power supply.

2.13 Analog Relay

Relay (Figure 2.11) is an electronic component or circuit that is electronic and simple. A relay is composed of a switch, a coil, and an iron shaft. The use of relays in electronic devices is tremendously, especially in electronic or automatic devices.

Figure 2.11: Physical Form of Relay One Line Diagram

The way this component works begins when an electric current flows through the coil. This tool creates a magnetic field around it so that it can change the switch in the relay.

The use of relays in electronic devices has several advantages: it can control the desired electric current and voltage, maximize the amount of electrical voltage to its maximum limit, and use more than one switch or coil (adjusted as needed).

Relay is also an electronic component that functions as a mechanical switch. The function of a relay is to separate high-voltage electrical circuits from low-voltage electrical circuits.

Relay has five legs. Its two legs are used to activate a coil. These two legs are unmarked, which means that they can be reversed in installation. The other three legs function as switches consisting of the Common (COMM), Normally Open (NO), and Normally Closed (NC) feet. When the coil is not energized, the COMM pin will be connected to the NC pin. When the coil is energized, the COMM pin will be connected to the NO pin.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Research Location

The design and manufacture of this room door lock system were carried out at:

1. Location Name : Digital System Laboratory, Universitas Medan Area
2. Address : Jalan Kolam No. 1 Medan Estate

3.2 Research Time

Manufacturing and testing this research tool took time with the following details:

1. Provision of tools and materials : 2 weeks
2. Device design and manufacture : 3 weeks
3. Device testing and revision : 1 week
4. Preparation of thesis report : 2 months

3.3 Research Method

In carrying out this research activity, there were several methods used, namely:

1. Literature Study: the author looks for the title of this study by reading, comparing, analyzing, and formulating problems from all the literature that has been read in the library and various Electrical Engineering journals via the internet about the problem that must be chosen as the title of the thesis.
2. Device Design and Manufacture: the author creats the design through a drawing concept related to the device to be made, both hardware and software.
3. Device Manufacture: the author makes the device (both software and hardware) using available tools and materials.
4. Device Testing: the author tests the device that has been made, both hardware and software, to determine whether the device has met the objectives of the research title taken in this Final Project.
5. Analysis and Discussion: the author conducts an analysis that includes measurement, calculation, observation, and recording various data that appeared during the analysis.

3.4 Flowchart of the Device Work System

The following figures (Figures 3.1. A 3.2. and B) show the workflow of a room door lock system using Arduino Uno and RFID.

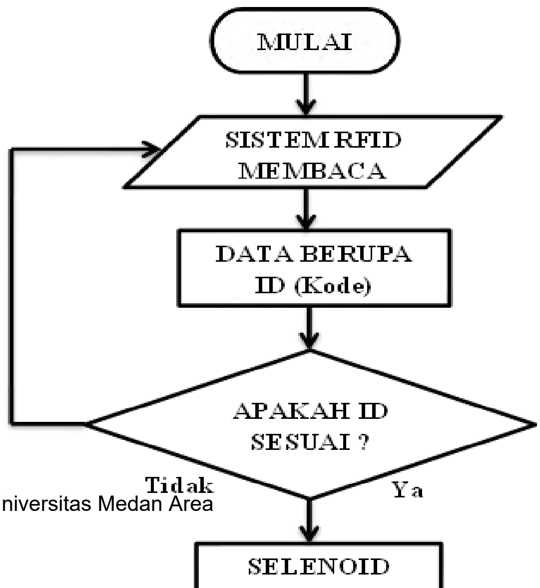


Figure 3.1 A: Flowchart of the RFID System Device by Using a Card When Users are Outdoors

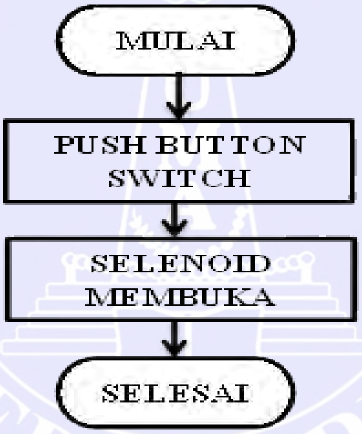


Figure 3.2 B: Flowchart of Device Work System Using a Push Button When Users are Indoors

3.5 Tools and Materials

The tools used in manufacturing “RFID and Arduino Uno-based door lock systems in rooms” are 1 set of mechanic tools, grinders, electric drills, electric soldering irons, rulers, and stationery. Meanwhile, the tools used to test the designed system performance include a multimeter and a test pen.

Furthermore, the materials or components used in the manufacture of “RFID and Arduino UNO-based door lock systems in rooms” in general are as shown in Table 3.2 below:

Table 3.1: Determination of Components (Materials)

No.	Materials/Components
1	Arduino Uno Module
2	RFID tag card
3	RFID - RC522
4	Acrylic
5	Relay Omron MY2N-J
6	ATMega 328p Microcontroller
7	Solenoid 12V
8	Rainbow Cable
9	Downloader Cable
10	Plastic Spicer
11	Push Button Switch
12	Battery
13	Buzer
14	PCB Board
15	Relay Driver Module

3.6 Structural Design

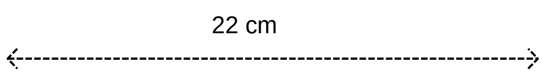
a. Entire System Mount

Mount serves as a place for the entire electrical system of the research design device, where the entire system is placed into a single unit on the board. Mount used is made of square-shaped boards with the following dimensions:

Width = 22 cm

Length = 22 cm

Figure 3.3 below shows the mounting scheme of the entire designed system:



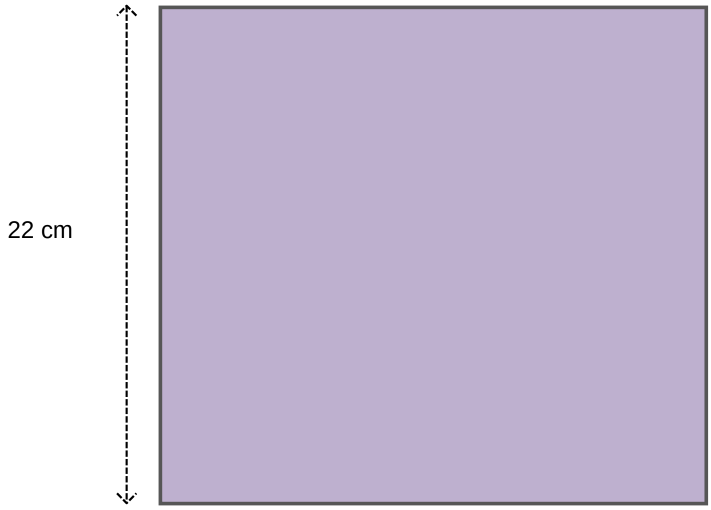


Figure 3.3: Schematic of the Entire System Mount

b. Component Layout Design

Figure 3.4 below shows a sketch of the placement of all research components.

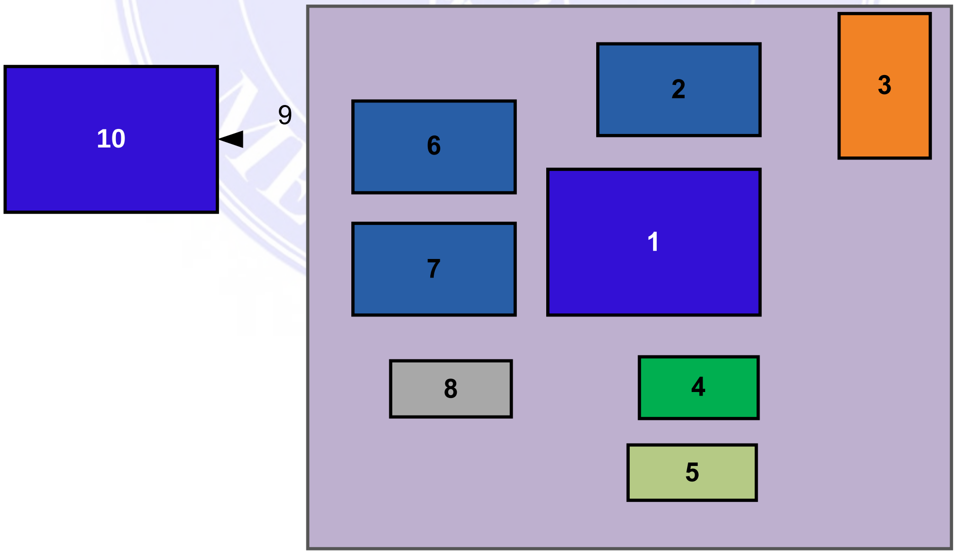


Figure 3.4: Sketch of Placement of All Components

Figure 3.4 Notes:

1. Arduino Uno Module
2. RFID – sRC522
3. Solenoid Door Lock

4. Buzzer
5. Relay Driver Module
6. Relay Omron MY2N-J
7. Power Supply /AC-DC Adapter
8. Push Button Switch
9. Connecting Cable to ACCU Battery
10. ACCU Battery

3.7 Electrical System Design

The electrical system design in question includes:

1. AC-DC Adapter System Circuit Design
2. Arduino Uno Module Circuit Design with RFID-RC522;
3. Arduino Uno Module Installation Design with Driver Relay Module;
4. Arduino Uno Module Installation Design with Push Button Switch;
5. Arduino Uno Module Installation Design with Buzzer;
6. Relay Omron MY2N-J Design with ACCU Battery;
7. Driver Relay Module Circuit Design with Solenoid Door Lock;
8. Overall System Circuit Design;

3.7.1 AC-DC Adapter System Circuit Design

The AC-DC adapter designed is an AC-DC adapter that will produce an output voltage of 12 VDC. This system has four main parts in order to produce a stable DC. The four main parts include Transformer, Rectifier, Filter, and Voltage Regulator. The specifications of the electronic components used can be seen in Table 3.2 below:

Table 3.2 Electronic Component Specifications

No	Component Name	Specification	Quantity
1.	Transformer	1A Type "0"/ Vin 220 VAC and Vout Max 12 VAC	One piece
2.	Rectifier Diode	2A/ 800V/ KBP 208G	One piece
3.	Regulator IC	LM7812/Output Current 1,5 A/Output Voltage Of 12 V	One piece
4.	ELCO 1	2200 μF/ 35 Volt	One piece
5.	ELCO 2	1000 μF/ 50 Volt	One piece

The results of the design made can be seen in Figure 3.5 below:

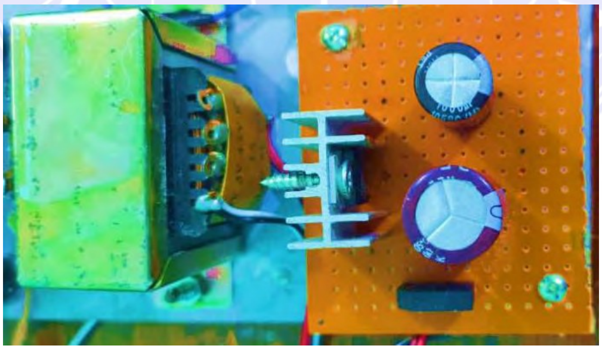


Figure 3.5: AC-DC Adapter

Figure 3.5 above shows the physical form of the AC-DC adapter. The circuit schematic in it can also be seen as shown in Figure 3.6 below:

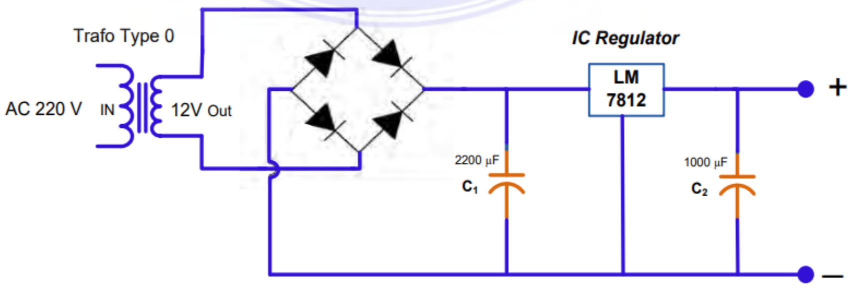


Figure 3.6: AC-DC Adapter Circuit Schematic

3.7.2 Arduino Uno Module Installation Design with RFID-RC522

Figure 3.7 below is an image showing the design of the installation circuit of the Arduino Uno module with RFID-RC522.

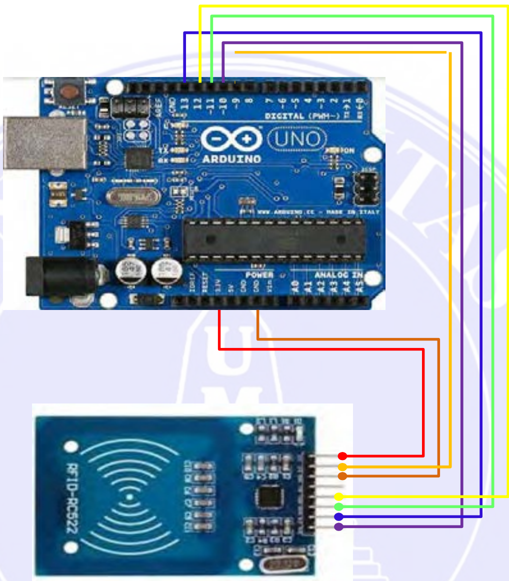


Figure 3.7: Arduino Uno Module Installation with RFID-RC522

3.7.3 Arduino Uno Module Installation Design with Relay Module

The relay module circuit design in this study also does not need to be remade since there are already ready-made ones, as described in chapter 2 of this thesis.

However, what needs to be considered is how to understand the circuit schematic so that when users use this relay module board, there will be no errors when they make connections or installations with other electrical components. Figure 3.8 below shows the circuit schematic of the relay module used.

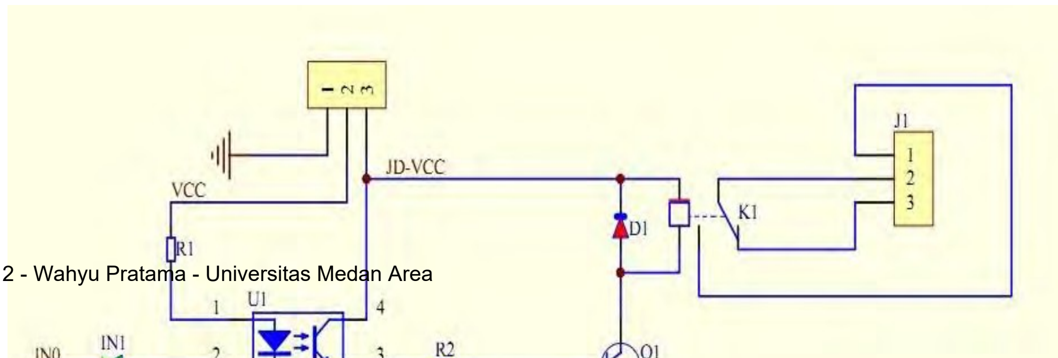


Figure 3.8: Relay Module Circuit Schematic

Furthermore, for the relay module installation circuit with the Arduino Uno module, it can be seen in Figure 3.9 below:

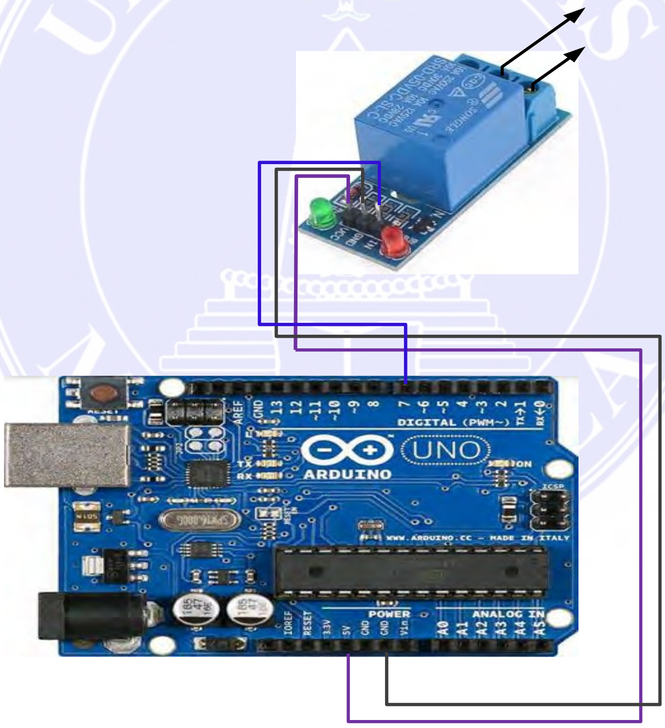


Figure 3.9: Arduino Uno Module Installation Design with Relay Module

3.7.4 Arduino Uno Module Installation Design with Push Button Switch

The following figure (Figure 3.10) shows the Arduino Uno module installation design with a Push Button Switch. The button switch in this device functions as a manual control used to open a solenoid door lock when someone who is already in the room wants to open the door to get out of the room.

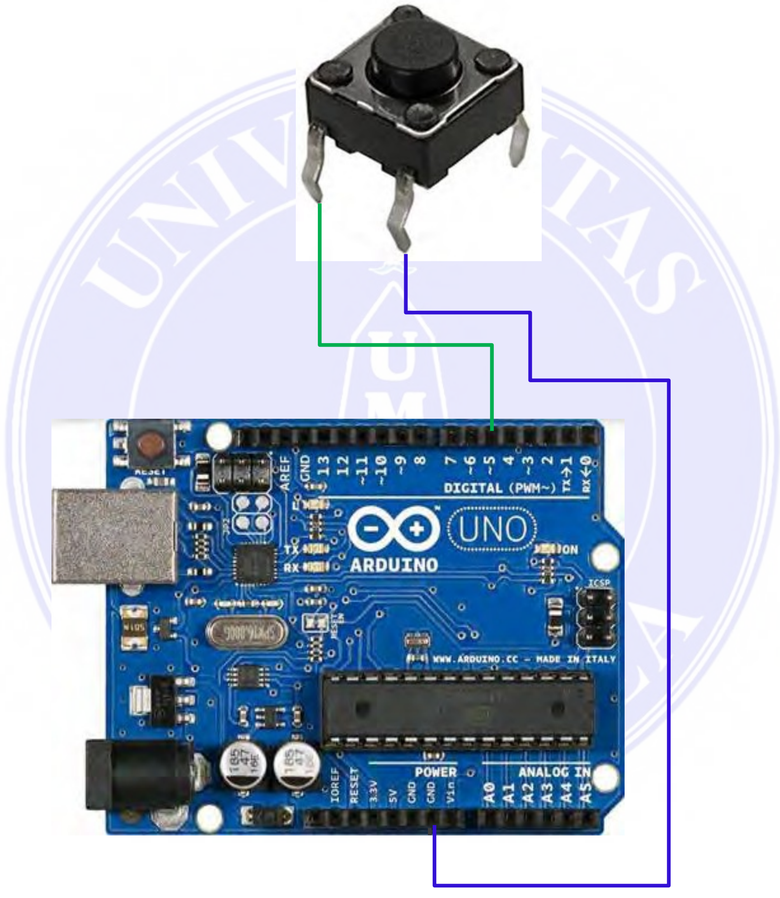


Figure 3.10: Arduino Uno Module Installation Design with Push Button Switch

3.7.5 Arduino Uno Module Installation Design with Buzzer

The following figure (Figure 3.11) shows the Arduino Uno module installation design with a buzzer. A buzzer in this device functions as an indicator that can emit a sound to indicate an error when the RFID-RC522 reads an incorrect or inappropriate

RFID tag card.

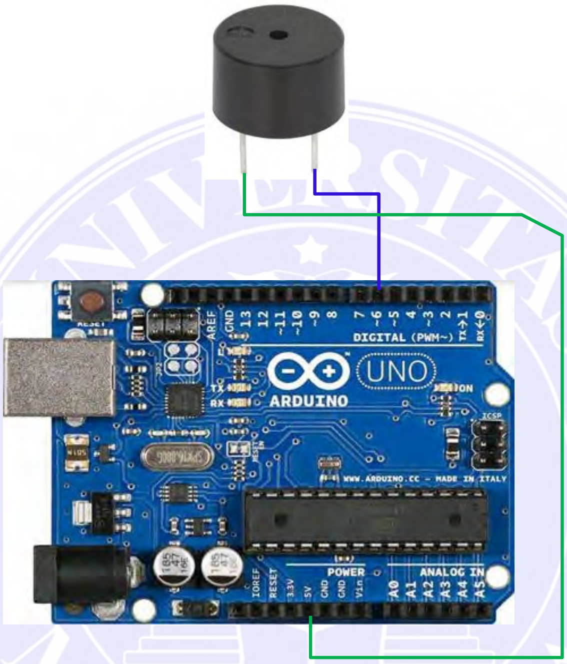


Figure 3.11: Arduino Uno Module Installation Design with Buzzer

3.7.6 Omron MY2N-J Relay Installation Design with ACCU Battery

Figure 3.12 below shows the design of the Omron MY2N-J relay installation with ACCU batteries. The Omron MY2N-J relay in this device functions as an electromagnetic switch that will connect a DC power source (ACCU battery) to the entire circuit of the device when the 220 VAC PLN goes out. On the other hand, the Omron relay device will disconnect the DC power source (ACCU battery) from the circuit when the PLN power source has turned on. Subsequently, the circuit will be reconnected to 220 VAC PLN electricity.

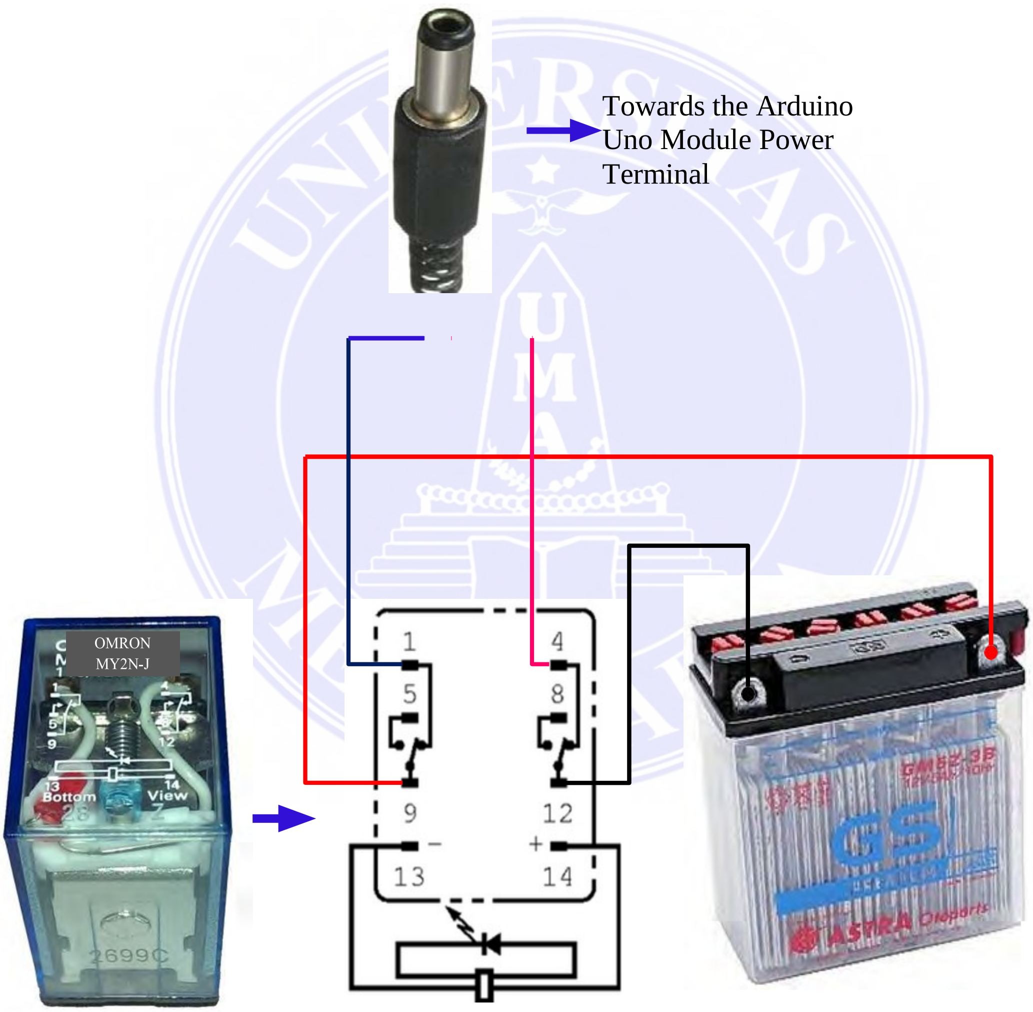


Figure 3.12: Omron MY2N-J Relay Installation Design with ACCU Battery

3.7.7 Relay Module Installation Design with Solenoid Door Lock

Figure 3.13 below shows the relay module installation circuit with a solenoid door lock. This relay module functions as an electromagnetic switch controlled via Arduino Uno to connect and disconnect the 12 VDC ACCU battery connected to the solenoid door lock.

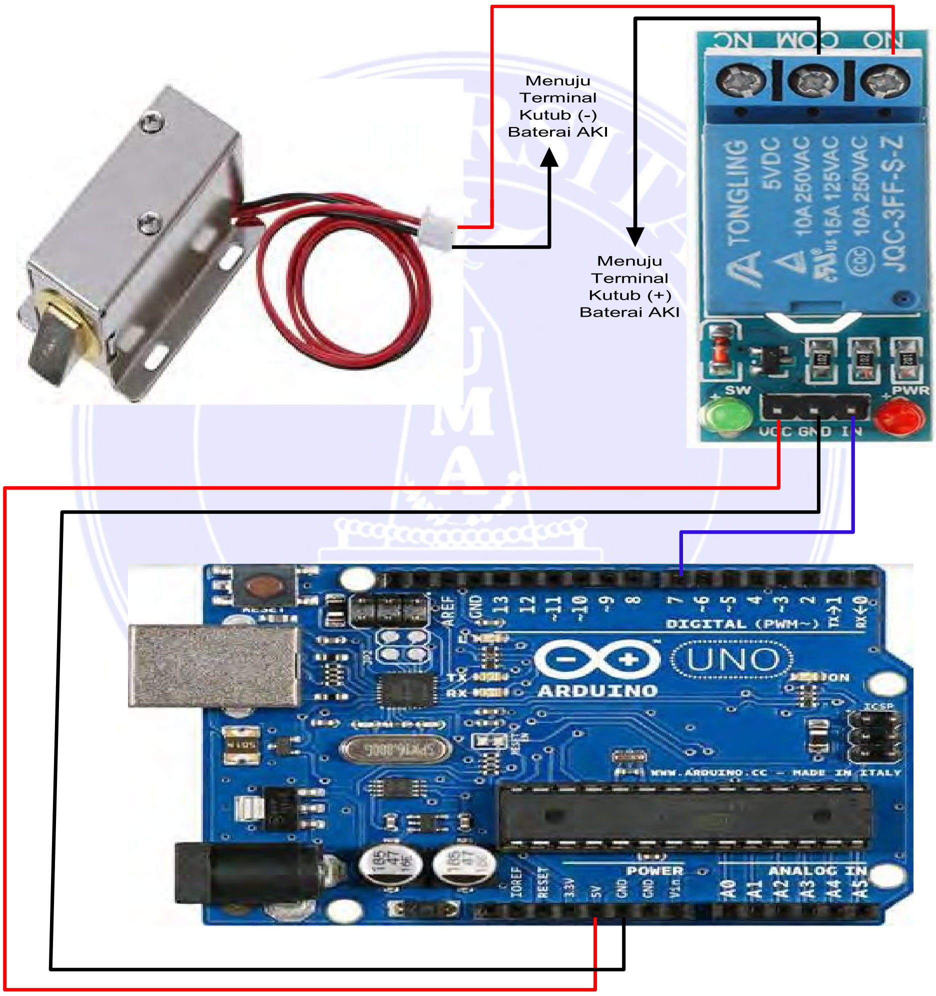


Figure 3.13: Relay Module Installation Design with Solenoid Door Lock

3.7.8 Overall System

The design and manufacture of the overall system installation mean that all components that build up this “Arduino Uno-based door lock system” will be fully combined, both mechanically and electrically. Figure 3.14 and Figure 3.15 below show a block diagram and an installation circuit for the entire system.

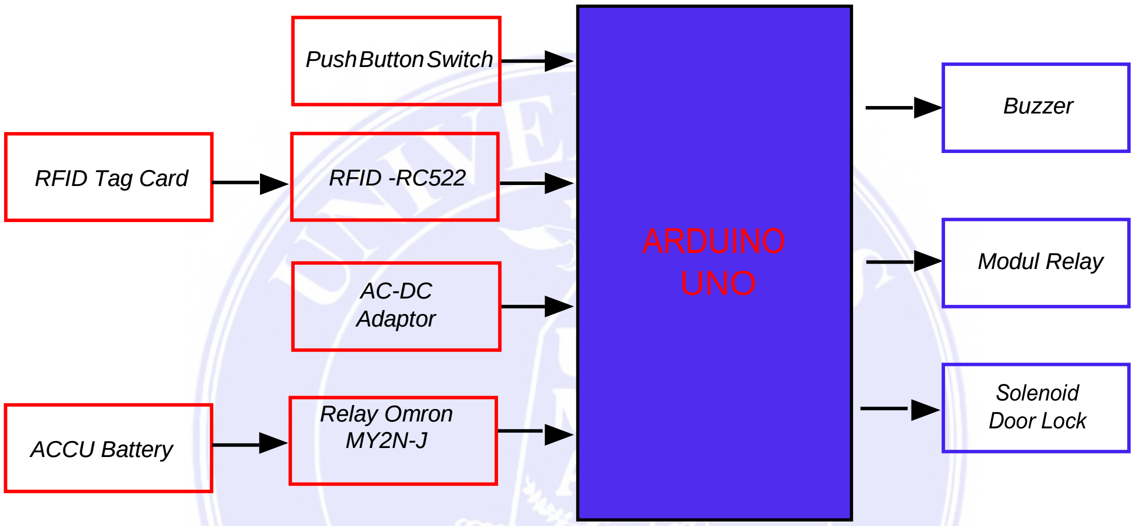
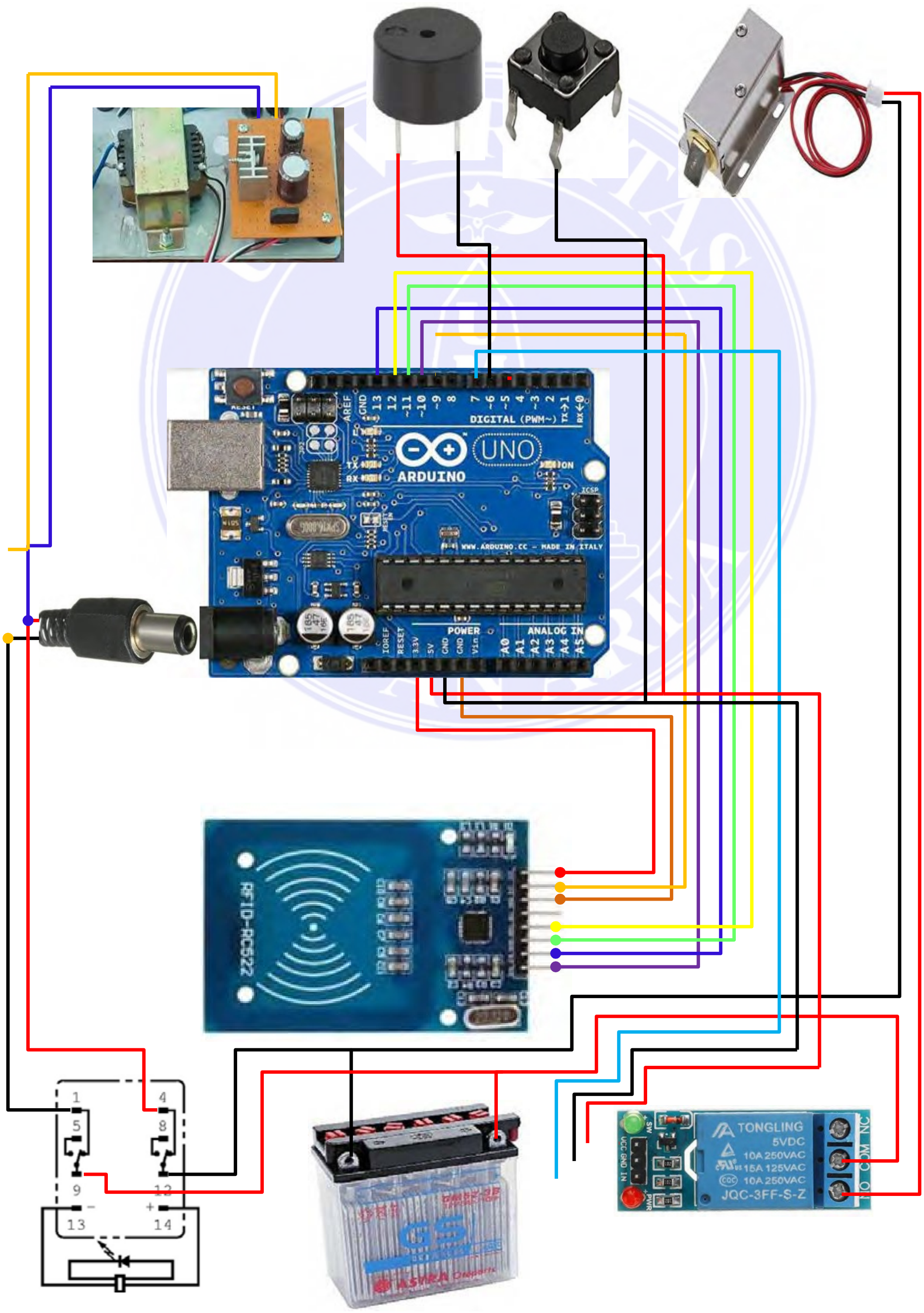


Figure 3.14: Block diagram of the Entire System Circuit



DIGITAL (PWM~)
UNO
ARDUINO
POWER
ANALOG IN
RFID-RC522
TONGLING
5VDC
10A 250VAC
15A 125VAC
10A 250VAC
JQC-3FF-S-Z
GS

Figure 3.15: Entire System Installation Circuit

3.8 ATmega 328 Microcontroller Programming on Arduino Uno

The details of the “C” language program included in the Arduino Uno system are as follows:

```
#include <SPI.h>
#include <MFRC522.h>
#define tombol 5
#define alarm 6
#define selenoid 7
#define SS_1_PIN 10
#define RST_PIN 9
#define NR_OF_READERS 2
bytes ssPins[] = {SS_1_PIN};
bytes data_button = 0;
MFRC522 mfrc522[NR_OF_READERS];
String ID_1 = "572163859";
void setup() {
   Serial.begin(9600);
   pinMode(alarm, OUTPUT);
```

```
  pinMode(selenoid, OUTPUT);
  pinMode(tombol, INPUT_PULLUP);
  digitalWrite(alarm, HIGH);
  digitalWrite(selenoid, HIGH);
  while (!Serial);
   SPI.begin(); // Init SPI bus
   for (uint8_t reader = 0; reader < NR_OF_READERS; reader++) {
     mfrc522[reader].PCD_Init(ssPins[reader], RST_PIN); // Init each MFRC522
card
     Serial.print(F("Reader "));
     Serial.print(reader);
     Serial.print(F(": "));
     mfrc522[reader].PCD_DumpVersionToSerial();
     }
 }
 String data ="0";
 void loop() {
  check_id();
  data_tombol = digitalRead(tombol);
  if(data == ID_1 || data_button == 0){
    OK();
    digitalWrite(selenoid, LOW);
    delay(2000);
    digitalWrite(selenoid, HIGH);
    data="0";
```

```
  }
  else if(data != "0"){
    Serial.println("ID tidak terdaftar");
    alarmON();
  }
    data="0";
  }
  void check_id(){
    for (uint8_t reader = 0; reader < NR_OF_READERS; reader++) {
    if (mfrc522[reader].PICC_IsNewCardPresent() &&
  mfrc522[reader].PICC_ReadCardSerial()) {
    dump_byte_array(mfrc522[reader].uid.uidByte, mfrc522[reader].uid.size);
    MFRC522::PICC_Type piccType =
  mfrc522[reader].PICC_GetType(mfrc522[reader].uid.sak);
    mfrc522[reader].PICC_HaltA();
    mfrc522[reader].PCD_StopCrypto1();
    Serial.println("ID = " + data);
    Serial.println("")
    }
  }
}
void dump_byte_array(byte *buffer, byte bufferSize) {
 data = "";
 for (byte i = 0; i < bufferSize; i++) {
  int a = buffer[i];
```

```
  data = data + String(a);
  }
}
void alarmON(){
  digitalWrite(alarm, LOW);
  delay(500);
  digitalWrite(alarm, HIGH);
  delay(300);
  digitalWrite(alarm, LOW);
  delay(500);
  digitalWrite(alarm, HIGH);
  delay(300);
  digitalWrite(alarm, LOW);
  delay(500);
  digitalWrite(alarm, HIGH);
  delay(300);
  digitalWrite(alarm, LOW);
  delay(500);
  digitalWrite(alarm, HIGH);
  delay(300);
}
  void OK(){
  digitalWrite(alarm, LOW);
  delay(100);
  digitalWrite(alarm, HIGH);
```

```
  delay(50);
  digitalWrite(alarm, LOW);
  delay(100);
  digitalWrite(alarm, HIGH);
}
```

The following figure (Figure 3.15) shows the application window screen model for writing the “C” language program above.

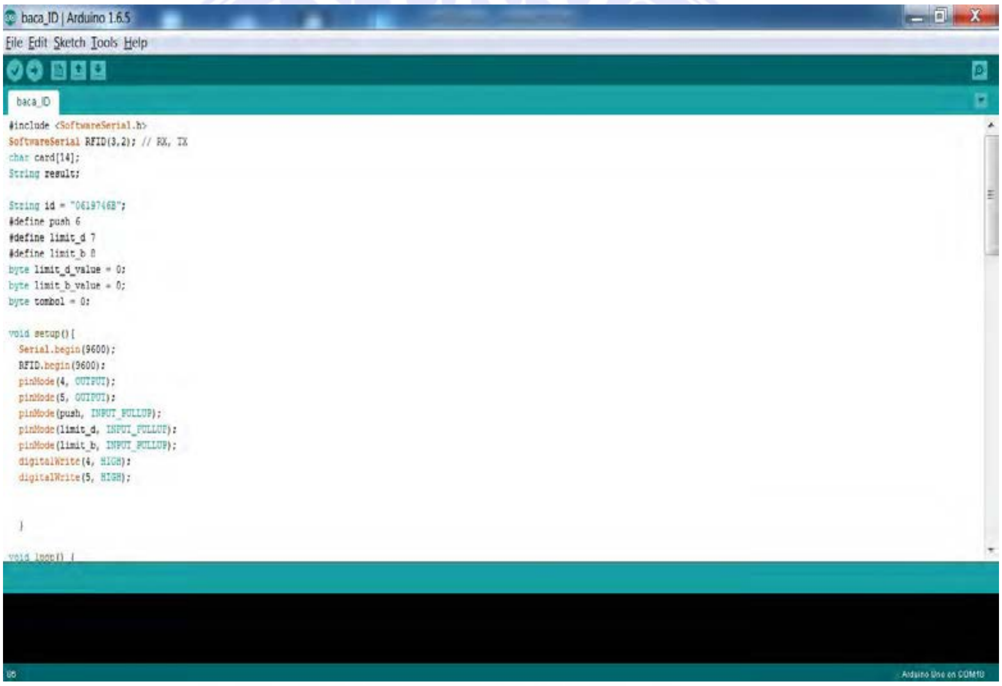


Figure 3.16: Program Writing Application Window

CHAPTER 5
CONCLUSION AND SUGGESTIONS

3.1 Conclusion

From the device design results, it can be concluded that:

1. The room door lock system has been installed in the laboratory room. This system is a digital system using an RFID Tag card-operated with an ATmega328 microcontroller as a circuit control center and programmed using Arduino IDE software.
2. Arduino and RFID systems as controllers of this device can read ID cards with a maximum distance of 3,5 cm from the RFID-RC522. From the experiments conducted in the digital laboratory, it turns out that the results achieved can read a distance of 3,5 cm when measuring.
3. The use of hinges and Omron MY2N-J Relay with ACCU batteries can keep this device active when the PLN power is off.

3.2 Suggestion

1. The room door lock system using this RFID Tag card can be further developed by adding security sensors (such as fingerprint sensors) for access control into a room.

PROOFREADING

1.	spaces,	:	spaces
2.	in	:	-
3.	with the intention of	:	to determine
4.	for the discussion of	:	to discuss
5.	conclusion	:	the conclusion
6.	arduino	:	Arduino
7.	internet;	:	internet,
8.	to be able	:	-
9.	40 mA,	:	40 mA
10.	main board	:	mainboard
11.	By virtue of	:	With
12.	Electically	:	Electrically
13.	in	:	into
14.	A RFID	:	An RFID
15.	lifetime	:	life
16.	and so on	:	etc.
17.	that will	:	to
18.	close	:	the close
19.	and	:	, and
20.	mean	:	means
21.	the manufacture of	:	manufacturing
22.	Buzer	:	Buzzer
23.	omron	:	Omron
24.	in order to	:	to
25.	Whereas	:	-
26.	so	:	so that
27.	conect	:	connect