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Research Article

Iot-Based Rfid Door Lock System (Dls) Security for File or Value Protection

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Abstract

Security both at home, office and community environment is very necessary. Security is important, because along with the crime continues to increase. There is a lot of news through print, electronic, and viral news on social media related to crime. This security door lock system has various types offered by the industry. Industrial security door lock system that offers easy access and locking, and is equipped with user data storage capabilities. RFID door lock system, a device capable of having digital locking, accessing and setting features as well as storage. The RFID door lock system still works individually and has not been integrated into the existing scheduling system. In addition, the authentication process at the time is used for the presence system. The research was conducted to optimize the RFID door lock system that can store data in EEPROM. Input Output Data is changed, processed using Arduino IDE. This study hopes to integrate the RFID door lock system with the presence system in the agency or company.

Keywords

DLS, EEPROM, RFID, ARDUINO IDE.

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Introduction

RFID (Radio Frequency Identification) technology is currently growing rapidly. This technology is widely applied as a supporting medium for warehouse management to identify an object. RFID has advantages that cannot be obtained by previous technologies, namely barcodes, because RFID is able to read object data without going through direct contact and does not have to be parallel to the object. Archives are activities or events in various forms and media in accordance with the development of information and communication technology made and accepted by state institutions, regional governments, educational institutions, companies, political organizations, community organizations and individuals in the implementation of social, national and state life (Blazy & Leroy, 2009). However, there are still many agencies that have not implemented RFID to manage warehouses to secure important files or files. There are so many archival documents in government agencies and the importance of recording accountability files for every activity in an institution or agency. So it is very necessary to increase security which currently uses metal keys which have the weakness that they can be duplicated without the knowledge of the archivist so that they are vulnerable to losing important files. With the security of the RFID door lock system, which is safer and not easily broken into by any perpetrator. Currently, if an RFID door lock system is needed in an institution or agency, using an automatic door lock system. The study in this research is to build an RFID door lock system and improve security with RFID for rooms with important archives or documents. So it is hoped that the RFID door lock system can secure documents or archives from document theft cases, and also prevent unauthorized people from entering the archives or stored documents. The practical benefits of an RFID door lock system have a direct impact on the security of documents or archives and provide convenience for archivists of institutions or agencies. The scope of this research revolves around: (1) Implementation of door locks with RFID PPSDM Geominerba, (2) Using the ATMega A328P-U Microcontroller, (3) Using RFID, (4) Using Solenoid or electric locks, (5) Buzzer Module, (6) LCD I2C Module, (7) 16 x 2 LCD, (8) 12v Adapter, (9) Breadboard and (10) 4 x 4 Keypad.

Literature

RFID (Radio Frequency Identification)

The following is an image of RFID (Radio Frequency Identification), see Figure 1 as follows:

Figure 1: RFID Module (Federici, 2011)

Identification of an object is closely related to data retrieval. One of the identification methods that are considered the most profitable is auto-ID or Automatic Identification. Namely, the method of collecting data by identifying objects automatically without any human involvement. Auto-ID works automatically so as to increase efficiency and reduce errors in data entry. Because auto-ID does not require humans to operate, the existing human resources can be focused on other areas. Barcodes, smart cards, voice recognition, biometric identification such as retinal scans, Optical Character Recognition (OCR) and Radio Frequency Identification (RFID) are technologies that use the auto-ID method (Zhao, Guo, & Cao, 2005). Radio Frequency Identification or better known as RFID is an object identification method that uses radio waves.

The identification process is carried out by an RFID reader and an RFID transponder (RFID tag). An RFID tag is attached to an object or an object to be identified. Each RFID tag has a unique identification number (ID number), so that no RFID tag has the same ID number.

1. RFID Tags, RFID tags can be stickers, paper or plastic with various sizes. Inside each of these tags there is a chip capable of storing an ID number and a certain amount of information and an antenna. An RFID transponder or RFID tag consists of an integrated circuit chip and an antenna. The electronic circuit of the RFID tag generally has a memory. This memory allows the RFID tag to have the ability to store data. The memory on the tag is divided into cells. Some cells store Read Only data, such as an ID number. All RFID tags get an ID number when the tag is produced. In addition to the RFID tag allows the RFID tag to be written (Write) and read repeatedly. Each tag can carry unique information, such as ID number, date of birth, address, title, and other data of the object to be identified. The amount of information that can be stored by an RFID tag depends on its memory capacity. The more functions an RFID tag can perform, the more complex the circuit will be and the larger the size will be.
2. Active Tag, this tag can be read (Read) and written (Write). The battery contained in this tag is used to transmit radio waves to the reader so that the reader can read the data contained in this tag. With an internal battery, this tag can transmit information over a longer distance and the reader only needs a small amount of power to read this tag. The disadvantages of this type of tag are that it is expensive and larger in size (Zhao et al., 2005).
3. Passive Tags, these tags can only be read (Read) and do not have an internal battery like active tags. The power source to activate this tag is obtained from the RFID reader. When the radio wave field from the reader is approached by a passive tag, the antenna coil contained in this passive tag will form a magnetic field. This magnetic field will induce an electric voltage that powers the passive tag. The advantages of these tags are that they are simpler to assemble, cost much less, are smaller in size, and are lighter in weight. The disadvantage is that the tag can only transmit information within a short distance and to read this tag, the RFID reader must emit radio waves large enough to use a large amount of power.

RFID Reader

The RFID reader will read the ID number and other information stored by the RFID tag. The RFID reader must be compatible with the RFID tag in order for the RFID tag to be read. The RFID reader is a liaison between the application software and the antenna that will radiate radio waves to the RFID tag. Radio waves transmitted by the antenna propagate in the surrounding space. As a result, data can be transferred wirelessly to an RFID tag located adjacent to the antenna. ID-12 is a reader that specifically detects RFID tags with a frequency of 125 kHz. ID-12 compatible RFID tags include GK4001 and EM4001. By reading about ± 12cm. The physical form of ID-12 that is often found is shown in Figure 3 ID-12 does not have the ability to read-write (Read-Write) on a tag. The data format generated by ID-12 is ASCII and Wiegand 26. Complete specifications for ID-12 RFID reader module. For an explanation picture, see Figure 2.

Figure 2: RFID Reader ID-20LA (Hussain & Haque, 2012)

The state selection for pin 5, pin 7, and pin 8/pin 9 on ID-12 is used to select the desired data output. Pins 3 and 4 are used for adding external antennas and tuning capacitors. Pin 10 is used to turn on the buzzer or LED as a marker of a read tag. The ID-12 pin configuration is given in Figure 3 below.

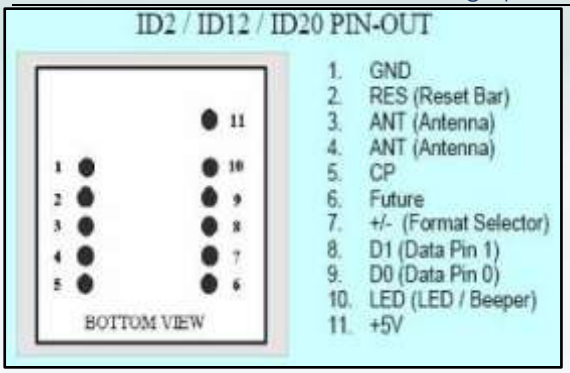


Figure 3: Pin Specification (Hussain & Haque, 2012)

The ID-2, ID-12, and ID-20 RFID Reader ID-12 has the following specifications:
1. The voltage on pin 11 is +4.6 Volts to +5.5 Volts.
2. The frequency used is 125 KHz..
3. Digital data output can be in the form of ASCII format or Wiegand format on foot 8 and foot 9.
4. Can only capture data from RFID Tag Card type EM 4001 or GK4001.

ATMega A328P-U Microcontroller

Microcontroller is an IC chip where there is a microprocessor and program memory (ROM) and multipurpose memory (RAM). Unlike computers, which are capable of handling various application programs (eg word processing, number processing and so on), the microcontroller can only be used for one particular application. The following is picture 4 of the AT Mega A328P-U Microcontroller.

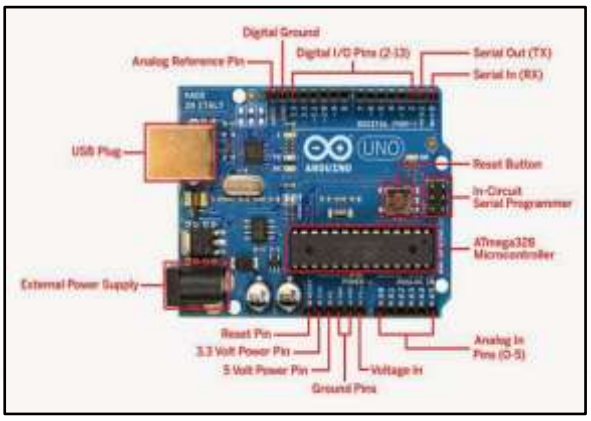


Figure 4: Physical Form of the ATMega A328P-U Microcontroller

Some of the facilities owned by the AT Mega A328P-U Microcontroller are as follows (Sarin, Hindersah, & Prihatmanto, 2012):
1. An 8 bit Central Processing Unit.
2. Oscillate: Internal and timer circuit.
3. RAM internal 128 byte.
4. Flash memory 2 Kbyte.
5. Five interrupt lines (two external interrupts and three internal interrupts).
6. Four programmable I/O ports.
7. A serial port with full duplex UART serial control.
8. Ability to carry out arithmetic operations and logical operations.
9. Speed in executing instructions per cycle 1 microsecond at a frequency of 12.

Electric Door Lock PGS 701-A and Working Principle

Electric door lock is an electric locking device that is electromagnetic in nature because this tool consists of coils, iron and magnets arranged in such a way, so that when an input voltage is given an induction will occur which can produce a magnetic force, and the lever on the PGS 701-A can lock automatically. See figure 5 physical form. And see figure 6 as the electronic circuit.

Figure 5: Electric Door Lock PGS 701-A

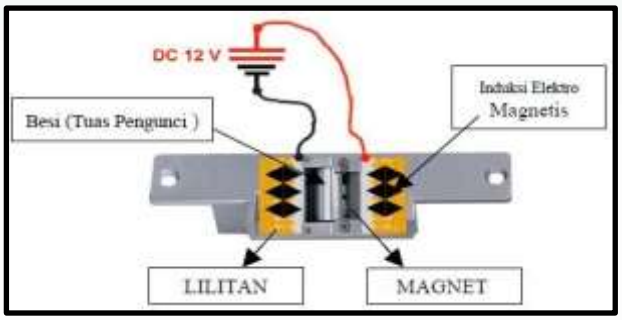


Figure 6: Electric Door Lock Construction (Federici, 2011)

When given a voltage of 12 volts DC, the winding will induce a magnet, because the magnet in the device is faced with the same polarity, resulting in a magnetic repulsion between the two. Because the winding produces electromagnetic induction, the magnet will provide repulsion to the iron, so that the iron moves and provides a gap for the lock lever on the door so that the door can be opened.

Interfacing LCD 2x16

LCD (Liquid Crystal Display) is a viewer module that is widely used because of its attractive appearance. The most widely used LCD today is the refurbished M1632 LCD because the price is quite cheap. LCD M1632 is an LCD module with a 2x16 display (2 rows x 16 columns) with low power consumption. The module is equipped with a specially designed microcontroller to control the LCD. Common LCDs, some are up to 40 characters long (2x40 and 4x40), where we use DDRAM to set the storage area for these characters. The starting address of the character is 00H and the end address is 39H. So, the starting address in the second line starts at 40H. If you want to put a character in the 2nd row of the first column, it must be set at address 40H. See figure 7 below.

Figure 7: 16x2 LCD

The following is a physical image of the LCD display used in this circuit. The character display on the LCD is set by the EN, RS and RW pins. The EN line is called Enable. This line is used to tell the LCD that you are sending data. To send data to the LCD, through the EN program, a logic low "0" and

set (high) must be made on the other two control lines, RS and RW. The RW line is the Read/Write control line. When RW is logic low (0), then the information on the data bus will be written on the LCD screen. When RW has a high logic "1", then the program will read the memory from the LCD. Whereas in general applications the RW pin is always given a logic low (0). See figure 8 of the configuration.

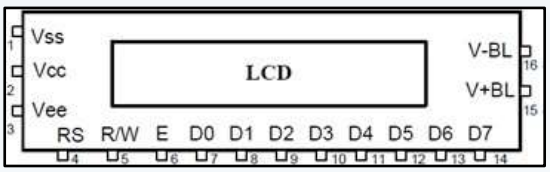


Figure 8: Pin Configuration on LCD

LCD drivers such as the HD44780 have two registers whose access is set using the RS pin. When RS has logic 0, the registers accessed are commands, while when RS has logic 1, the registers accessed are data registers. In order to activate the LCD, the initialization process must be done by setting the RS bit and clearing the E bit with a minimum delay of 15 ms. Data will be sent to 30H and delayed again for 5 ms. This process must be done three times, then send the initials 20H and the data interface length with a width of only 4 bits (28H). After that the display is turned off (08H) and cleared (01H).

I2C

Inter Integrated Circuit or often called I2C is a two-way serial communication standard using two channels specifically designed to send and receive data. The I2C system consists of SCL (Serial Clock) and SDA (Serial Data) channels that carry data information between the I2C and the controller. Devices connected to the I2C Bus system can be operated as Master and Slave. Master is a device that initiates data transfer on the I2C Bus by generating a Start signal, ending data transfer by generating a Stop signal, and generating a clock signal. Slave is a master-addressed device. See figure 9 below.

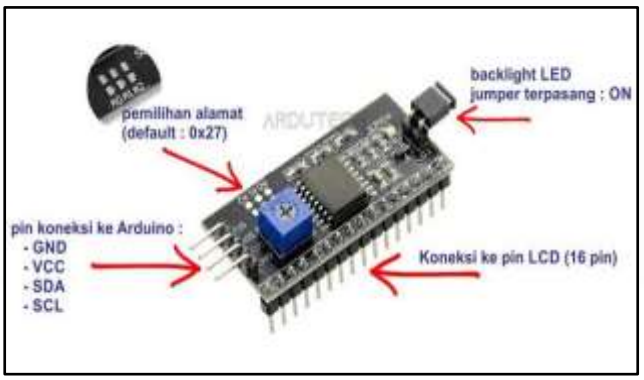


Figure 9: I2C

Keypad 4 x 4

The 3x4 keypad module is a keypad module measuring 3 columns x 4 rows as shown in Figure 10. This module can be used as input in applications such as digital security, attendance, motor speed control, robotics, and so on. The use of the keypad is done by making three columns as scanning outputs and four rows as scanning inputs.

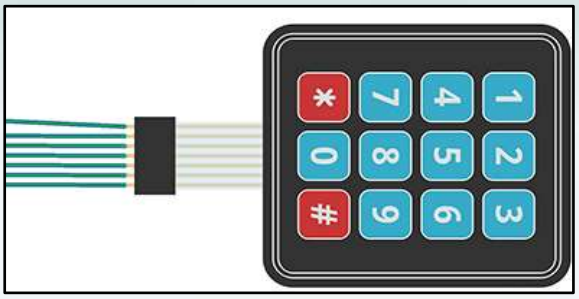


Figure 10: Physical Shape of the Switch

System Design and Implementation

Network Diagram Data

Block diagram of the circuit door lock system with RFID is one of the most important parts in the design of a device, because from this block diagram of the circuit diagram can be known how the whole circuit works. So that the whole block diagram of the network will produce a system that can function or can work according to design. The circuit block diagram of the key system with RFID can be seen in Figure 11.

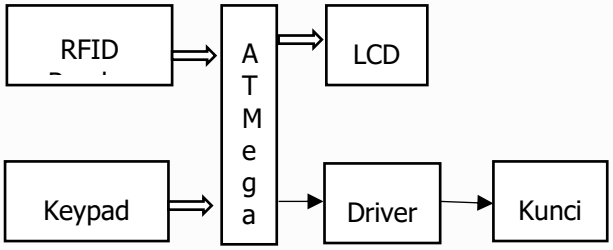
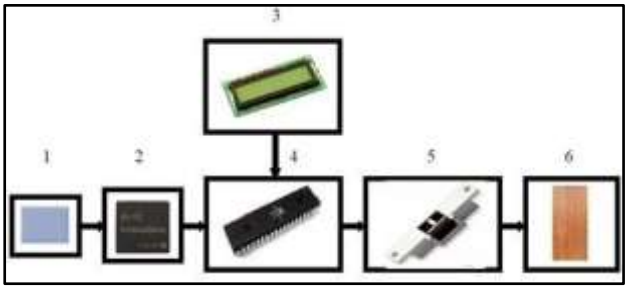


Figure 11: Network Diagram Data

From the block diagram above, it can be seen that the system configuration of this robot consists of input, controller and output. From the input side consisting of a keypad and an RFID reader, the controller used is a microcontroller of the MCS-51 type or family, namely AT Mega A328-PU, while from the output side there is a relay driver to unlock and display using a 16× LCD. 2.

Network Diagram Block Overview

Broadly speaking, Door Security System Design Using RFID-Based Microcontroller AT Mega A328-PU. This security system consists of an RFID Reader, RFID Tag Card, LCD, and an electric door lock. The block diagram of this system is shown in Figure 12, the following is an overview of the RFID system circuit based on the equipment used.



Gambar 12: Diagram Blok Rangkaian

Description of Figure 12 below: (1) RFID Tag Card, (2) RFID Reader, (3) LCD, (4) Microcontroller, (5) Electric door lock, and (6) Door.

RFID Door Lock System Program Flowchart

In operating a microcontroller requires a series of programming instructions that must be downloaded into it. Before making a door lock system program with RFID, it is better to first make a flowchart (hereinafter referred to as a flowchart) as the first step of the program to be created. With a flowchart, it can be understood how the work of the program to be made and will make it easier to make programs from a device (device) that is designed. The flowchart of the door lock system program with RFID can be seen in Figure 13 below.

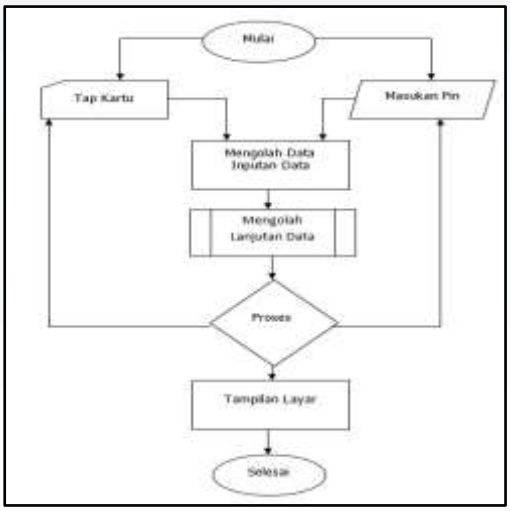


Figure 13: RFID & Keypad System Program Flowchart

The basic principle of this tool is as an electronic door access controller with two levels of security using RFID as the first security and the keypad input code as the second security, from the flowchart it can be explained that the step of this tool is to detect the presence of an RFID card if there is then read the UID code on the card if registered then activate the keypad to retrieve the code entered manually, if correct then the lock will be unlocked. If the second code is incorrect then the lock will remain closed and ask for a return code.

RFID Operator Electronic Network

The implementation and design of the RFID system will be tested in certain cases, with the following stages. After one power is turned on, the microcontroller will perform the LCD initialization process. Next, the sentence above "RFID door" will be displayed and the sentence below "Paste Card" on the LCD will be displayed. After that the microcontroller will wait for serial input from the RXD pin. This serial is data from the RFID Tag Card and will be converted into digital data by the RFID Reader, because the microcontroller can only process digital data. The following is an overview of the RFID controller circuit presented in Figure 14 below.

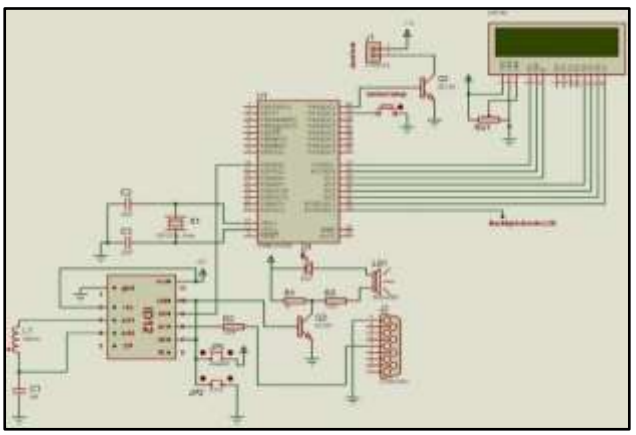


Figure 14: RFID Operator Electronic Network

After the microcontroller gets data from the RFID Reader, the data will be compared by the microcontroller, if the incoming data matches the data that has been set beforehand, the first stage of the security system has been penetrated, then the LCD will display "The door is opened" and the electric door lock will automatically be activated or unlocked. And if the data does not match, the LCD will display "Wrong Card" then the electric door lock will not open or remain locked. Broadly speaking, Door Security System Design Using RFID-Based Microcontroller AT Mega A328-PU. This security system consists of an RFID Reader, RFID Tag Card, LCD, and an electric door lock. The block diagram of this system is shown in Figure 15 below.

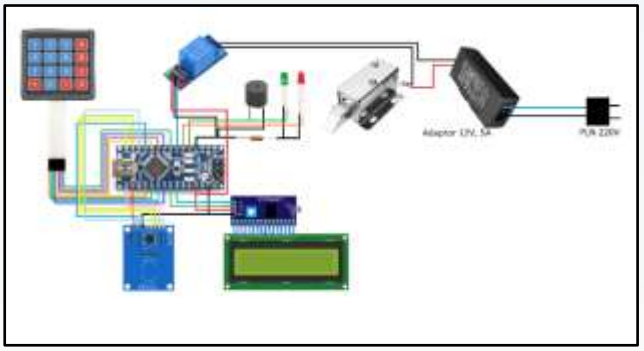


Figure 15: Tool Prototype

Implementation of RFID Tools

Overall, this system is designed using two designs, namely hardware (hardware) and software (software). This hardware is used to provide input data from the RFID Tag Card which is assisted by the RFID Reader ID-12 to the microcontroller, in this case the port of the RFID reader ID-12 port P4 D0 is connected to port PD0 on the microcontroller. Then the data in the form of ASCII is compared in the microcontroller with the data that has been inputted into the microcontroller program, namely the ID number rfid tag. If the id number from the tag and the id number on the microcontroller match, then the PA0 port on the microcontroller sends a voltage of 0.5 VDC to the transistor base and the transistor is saturated so that the collector foot can activate the Door Lock. To close the Door Lock, a push button is needed which is connected by ground and when the pushbutton is pressed, the ground will be connected to port A1 so that port A1 will detect a low signal which causes the microcontroller to return to its original position, causing the Electric Door Lock to be locked. See figure 16 below. The software on this system is focused on regulating or controlling the work of this system, especially the microcontroller, so that the system can run according to the desired stages or work steps. By understanding the workings of the hardware and software programming algorithms that can ultimately be used to support the functioning of this system.

Figure 16: Implementation of Tool Prototype Top View

RFID Reader Module

This RFID circuit serves as the first stage in the security that has been made. The RFID Reader is given a stable power supply of +5 Volts, so an IC LM 7805 is needed. When the RFID Tag Card approaches the RFID Reader at a distance of approximately 5 cm, the RFID Tag Card will be

powered by the RFID Reader, then the RFID Tag Card will emit a wave. RF which contains analog data which will then be captured by the RFID Reader while turning it into digital data in the form of ASCII or Wiegand data. If the desired output data is ASCII then the 7th leg of the RFID Reader must be grounded, whereas if the desired output data is Wiegand then the 7th leg of the RFID Reader must be supplied with a +5 Volt power supply. When the data is captured by the RFID Reader, the digital data will be issued on the 8th and 9th legs of the RFID Reader, but the data that is issued on the 9th leg of the RFID Reader has been inputted first. In the state of receiving data, the RFID Reader on foot 10 will drive the transistor so that the LED and buzzer will light up whenever data is received by the RFID Reader, while if it does not receive data, the transistor will not be active because it is not driven by the RFID Reader foot 10 which is connected to the The LED and buzzer will not light up. See figure 17 below.

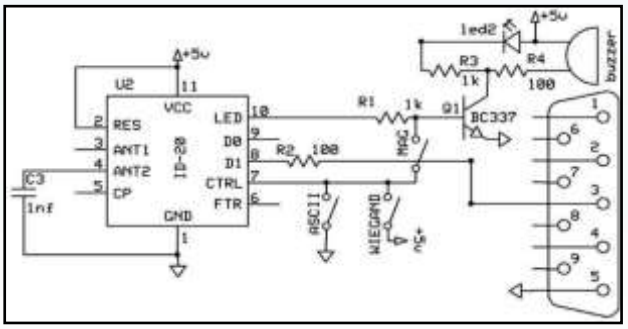


Figure 17: RFID Schematic

Minimum System Circuit ATMega A328-PU Microcontroller

This network serves as the control center of the entire existing system. The main component of this circuit is the AT Mega A328-PU microcontroller IC. On this IC all the programs are loaded, so that the network can run as desired. The supporting components are an IC LM 7805, a crystal along with a number of resistors, capacitors, and a reset button if needed. IC LM 7805 is needed so that the input into the AT Mega A328-PU is relatively stable at +5 Volts. Crystal is needed as a wave generator (clock) required by the AVR AT Mega A328-PU. This crystal is connected to pin 12 and pin 13 on the AVR AT Mega A328-PU. Crystal used has a frequency of 4 Mhz.

16 x 2 LCD Network

LCD (Liquid Crystal Display) is a viewer module that is widely used because of its attractive appearance. The most widely used LCD today is the refurbished M1632 LCD because the price is quite cheap. LCD M1632 is an LCD module with a 2x16 display (2 rows x 16 columns) with low power consumption. So, even if the LCD used is 2x16 or 2x24, or even 2x40, the writing of the program is the same. CGRAM is a memory to describe the pattern of a character, where the shape of the character can be changed as desired. However, the memory will be lost when the power supply is not active so the character pattern will be lost. The difference with the standard LCD is on the 1 VCC pin, and the 2 Gnd pin. This is the opposite of a standard LCD. This section only consists of a 2 x 16 character dot matrix LCD that serves as a display of measurement results and display of some information. The LCD is connected directly to Port C of the microcontroller which functions to transmit the processed data to be displayed in alphabetical and numeric form on the LCD.

Conclusion

Based on the research that has been done, it can be concluded that:

1. That the way RFID works makes it easy for employees to get in and out.
2. That RFID is able to improve security solutions at the Geo Minerba PPSDM office, especially in the archive room.
3. It is necessary to program the interface between the RFID module and the RFID sensor so that it can save time and be more efficient.

4. In the future, it can be developed not only door locks, but also digital security locks and systems such as RFID sensors or body temperature checks or thermal systems whose use is very much needed during this covid-19 pandemic.
5. The working system of this tool is still simple, for that it should be further developed into the actual tool so that it can be directly applied.
6. To speed up access to open the door from the inside, it is necessary to add an interface or equipment.

Reference

Blazy, S., & Leroy, X. (2009). Mechanized semantics for the Clight subset of the C language. *Journal of Automated Reasoning, 43*(3), 263-288. doi:https://doi.org/10.1007/s10817-009-9148-3

Federici, S. (2011). *A minimal, extensible, drag-and-drop implementation of the C programming language*. Paper presented at the Proceedings of the 2011 conference on Information technology education. doi:https://doi.org/10.1145/2047594.2047646

Hussain, T., & Haque, M. M. (2012). AVR microcontroller Implementation for customized Sound generation. *International Journal of Electrical and Computer Engineering, 2*(1), 112. Retrieved from https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.300.6420&rep=rep1&type=pdf

Sarin, S., Hindersah, H., & Prihatmanto, A. S. (2012). *Fuzzy PID controllers using 8-Bit microcontroller for U-Board speed control.* Paper presented at the 2012 International Conference on System Engineering and Technology (ICSET). doi:10.1109/ICSEngT.2012.6339355

Zhao, B., Guo, C., & Cao, Y. (2005). A multiagent-based particle swarm optimization approach for optimal reactive power dispatch. *IEEE transactions on power systems, 20*(2), 1070-1078. doi:10.1109/TPWRS.2005.846064