DESIGNED A PROTOCOL BASE AS THE DRIVING FORCE FOR THE FREIGHT LIFT IN BUILDING I OF PEMBANGUNAN PANCA BUDI UNIVERSITY

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ABSTRACT

The protocol base system is a communication from Arduino to other Arduino, this communication can be used by more than 10 Arduino, in this case one Arduino is used as a protocol base so that it only functions as a signal receiver and sender, while as a signal provider and receiver there are four other Arduino which have their respective programs in it and every command from each Arduino is connected to each other so that there is no miss communication. Here is how the base protocol system works. When the lift has been opened for access, Arduino 1 gives a signal to Arduino 5 that the lift has been opened for access, then Arduino 5 sends a signal to Arduino 3 to issue a notification that the lift can be accessed. When the lift reaches the destination floor Arduino 2 gives a signal to Arduino 5 that the lift has arrived at the destination floor, then Arduino 5 gives a signal to Arduino 3 to notify the user that the lift has arrived and also simultaneously gives a signal to Arduino 1 so that re-closing the lift again so that it is not used carelessly. When the lift load is overloaded Arduino 4 gives a signal to Arduino 5 that the lift is overloaded, Arduino 5 gives a signal to Arduino 3 to notify that the lift is overloaded and sends a signal to Arduino 2 to turn off the motor power supply so that the motor does not move.

INTRODUCTION

Freight lift is a set of tools created to facilitate human work, by using a combination of a set of mechanical devices and also having a closed electronic circuit which is a control circuit as the control center of an Freight lift and also assisted by several relays or also with magnetic contactors and several sensors as supporting component. In general, the control system in an Freight lift uses a programmable logic control (PLC) control system. But in this study using Arduino as a control in an Freight lift, this was chosen because the costs incurred in making one Freight lift unit are cheaper compared to using a PLC which is relatively more expensive and more difficult to understand the program language. Building I of the Pembangunan Pancabudi University in Medan is the place where the author will conduct research on Freight lift design, so that the university has a modern impression and applies appropriate technology. Freight lift design requires many control systems including user interface control systems, load cell and gyro sensor control systems, RFID control systems, and motor drive control systems. The use of various control systems requires a master control to be able to access various control systems in one system so that the user can easily operate and maintain the Freight lift.

To overcome this the author wants to raise research on this Freight lift using a system called the base protocol, there is a main part in the form of a master control and several controllers that can be controlled by one master control, in this case it is applied to Arduino, namely an Arduino that can control several arduinos that already have their respective duties. A system design like this was chosen to make it easier to maintain and make repairs if damage or errors occur.

LITERATURE REVIEW

Basic structure of PLC Freight lift control system

PLC is the acronym of PLC, which combines the automation technology, computer technology and micro processing technology to develop a controller. Its main structure consists of power supply, central processing unit, function module, mmory and communication module. In operation, it can not only store internal programs, perform logical operations, control sequence information and carry out various user-oriented counting and operation instructions, but also exchange and control the production process of machinery through digital simulation. Freight lift system is a complex product produced by the combination of various specialties. From the perspective of the whole macro and micro Freight lift system, we divide the Freight lift into the following aspects. The Freight lift system can be divided into machine room part, hoistway part, floor station part and Freight lift case part. The core control system of Freight lift control system based on PLC is the main phase l of PLC. Our signal input is transmitted to the PLC host through the PLC interface. When the signal is transmitted to the PLC host, our own software in the PLC host system performs relative operation processing, and then outputs through the corresponding output interface, and then judges and processes according to the input signal information, and then displays in the phase In terms of the number of corresponding layers, the corresponding instructions are then executed according to the processing results, and finally the instructions are sent to the control system for operation. (Han, 2020)

Elevator construction in the form of a cage or train that is raised and lowered by a traction machine using steel ropes or wire ropes, through a sliding space in a building made specifically for lifts (hoistway). To prevent the train from swaying, a guide rail is used at the height of the slide room which is tied to the wall of the lift slide room.

An illustration of the overall lift components can be seen in Figure 1.

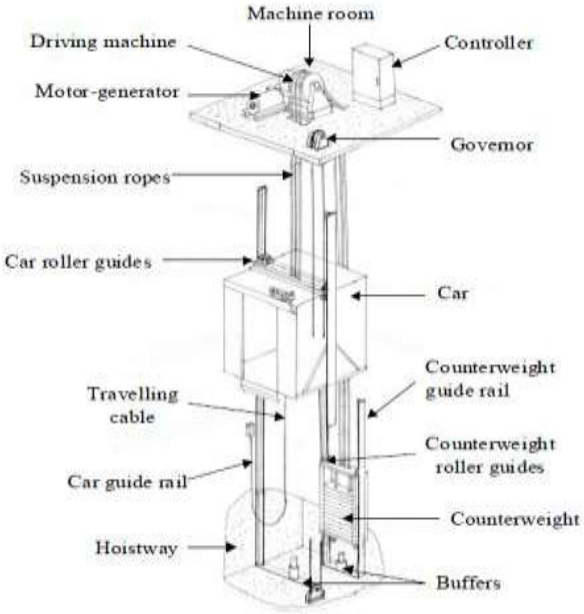

Figure 1. An illustration of the overall lift (Nugraha et al., 2015)

Arduino Microcontroller

Arduino microcontroller is an open-source that can be easily programmed and can update at any time. First Arduino was introduced in 2005. Arduino microcontroller was originally designed for professionals and students to develop devices that can interact with the environment using sensors.

Arduino microcontrollers have inputs and outputs that can be used to get information and based on received data Arduino can send output. Arduino microcontrollers can also send and receive data via the internet using HTTP requests. The simple microcontroller that can be connected to the internet is Esp board. Esp microcontrollers can be connected to a Wi-Fi server or they can act as a Wi-Fi server. Arduino platform can be divided into two: Hardware and Software. Arduino uses hardware known as the Arduino development board. Arduino software for developing the code is known as the Arduino IDE (Integrated Development Environment). Built-up with the 8-bit Atmel AVR microcontrollers that are manufactured by Atmel or a 32-bit Atmel ARM, these microcontrollers can be programmed easily using the C or C++ language in the Arduino IDE.(Ismailov & Jo'rayev, 2022)

Figure 2. kinds of arduino micro controllers (Ismailov & Jo'rayev, 2022)

RF Id

RFID systems consist of three components in two combinations: a transceiver (transmitter/receiver) and antenna are usually combined as an RFID reader. A transponder (transmitter/responder) and antenna are combined to make an RFID tag. An RFID tag is read when the reader emits a radio signal that activates the transponder, which sends data back to the transceiver. A basic RFID system consists of three components: • An antenna or coil • A transceiver (with decoder) • A transponder (RF tag) electronically programmed with unique information There are two types of transponders, which correlate to the two major types of RFID tags. • Passive transponders and RFID tags have no energy source of their own, relying on the energy given off by the reader for the power to respond. Cheaper, passive RFID tags are the most likely to be used for consumer goods. • An active transponder or tag has an internal power source, which it uses to generate a signal in response to a reader. Active transponders are more expensive than passive ones. They can communicate over miles like ordinary radio communications. They are commonly used in navigation systems for commercial and private aircraft. There are many uses of this technology around us today, although they are often invisible to users. You may find that you are already carrying and using a RFID tag, or even several. At its most basic level, RFID is a wireless link to uniquely identify objects or people. It is sometimes called dedicated short range communication (DSRC). RFID systems include electronic devices called transponders or tags, and reader electronics to communicate with the tags. These systems communicate via radio signals that carry data either unidirectional or bidirectional. As the shown in fig 3,when a transponder enters a read zone, its data is captured by the reader and can then be transferred through standard interfaces to a host computer, printer, or programmable logic controller for storage or action.(Kaur et al., 2011)

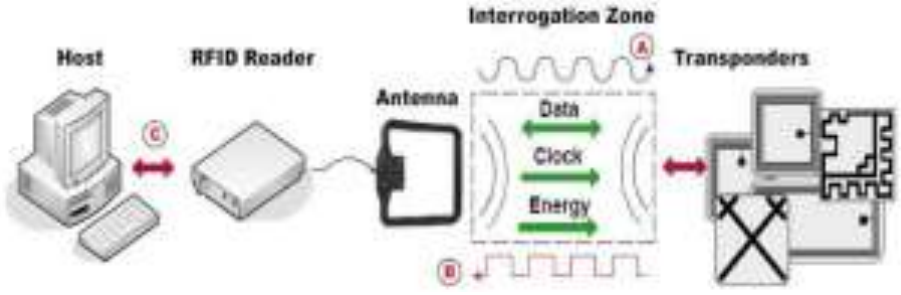

Figure 3. Principle of RF Id Tag (Hachimi et al., 2017)

Load cell

Load cells are very commonly used for force measurement. Many load cells use flexible load-bearing components or component combinations. The force applied to the elastic element causes it to flex, which is then sensed by the auxiliary sensor, which converts it into a measurable output. The output can be in the form of electrical signals, such as strain gauges and linear variable differential transducer (LVDT) type load cells, or mechanical indicators, such as verification rings and spring scales. This kind of transducer is usually called an elastic device and constitutes the main body of all commonly used load cells. There are many different elastic transducer elements, but usually they are composed of rings, cylinders or beams. It has been found

that dial gauge type load cells or strain gauge load cells have been widely used in different applications in different ranges (from a few Newton to mega Newton). This capability has made these load cells the most reliable medium for measuring force for decades(Kamble et al., 2020)

Figure 4. Load cell type S (Kurnia et al., 2019)

I2C

Inter-Integrated Circuit (I2C) interface configurations are used to communicate between the LiDAR sensor and Arduino. The sensor has two wires, serial data (SDA) and serial clock (SCL), used to carry information between the devices connected to the bus. The I2C bus operates internally at 3.3 V and can run up to 5 V with an internal level shifter. It also supports the data transmission of 400 kHz Fast Mode. Fig. 5 shows the connection between the I2C interface and the Arduino.(Bin Mat Seri et al., 2021)

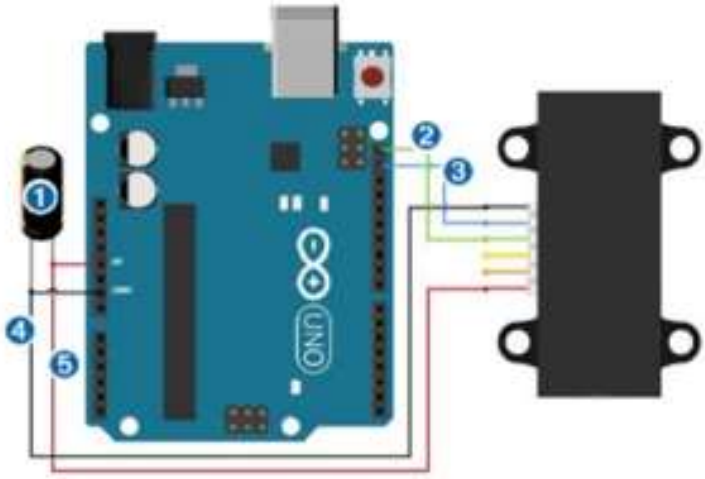

Figure 5. Standard Arduino I2C Wiring

DF Player

The DF Player module is used as a decoder audio to convert digital audio files to in sound. Audio files used is a file with the .mp3 extension inserted on SD Card with File System FAT32. DFPlayer can work alone standalone or working together with microcontroller via serial connection. Picture The DFPlayer module can be seen in Figure 6. In standalone mode, all mp3 files are on SD Card can be recognized and can be played even though it doesn't match the writing format like datasheet rules.

The DFPlayer module already has an amplifier However, the resulting power amplifier power is small so it is enough to be used on speakers small 4 – 8 Ohm. In addition, this DFPlayer has stereo DAC pins (left and right) for external amplifier input.(Pratama et al., 2020).

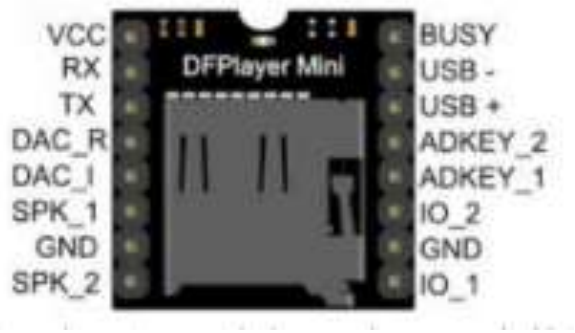

Figure 6. DF Player. (Pratama et al., 2020)

Limit Switch

A limit switch is a device that operates one or more contacts based on its position set by an object. In most basic motor operating valve (MOV) actuator applications, that use traditional mechanical switches, a cam fastened to a shaft driven by a gearbox opens or closes an electrical connection. This way, a monitoring system can easily determine if a specific position of the valve is reached. This position is regularly the end position, but intermediary position contacts can also be implemented in some cases(Nicolescu et al., 2020)

METHOD

Arduino has a standard system where there are 14 digital input output pins and 6 analog input output pins, these pins can be used to connect to other circuits such as sensors, relays, driver modules, and can also be connected to other Arduinos thanks to the SDA pin. (serial data) and SCL (serial clock line) which function as communication between Arduinos where there is an Arduino sending the signal and there is an Arduino receiving the signal, in this case the Arduino can act as a sender and receiver at the same time in one closed circuit with the condition that the entire circuit must use the same ground. This means there is only one ground in the circuit

Here the author uses a protocol base system as the freight lift control center, which can be seen in the two pictures below.

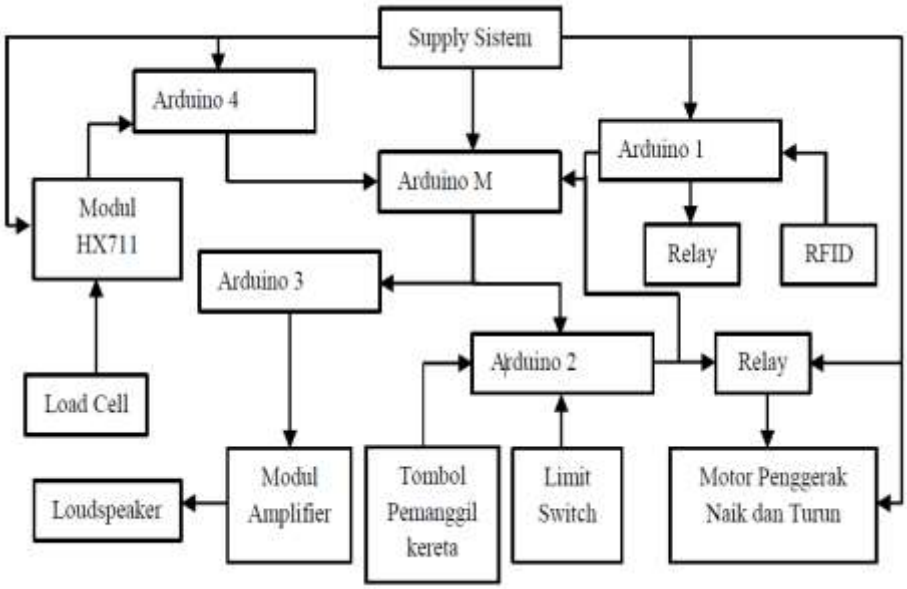

Figure 7. Block Diagram System

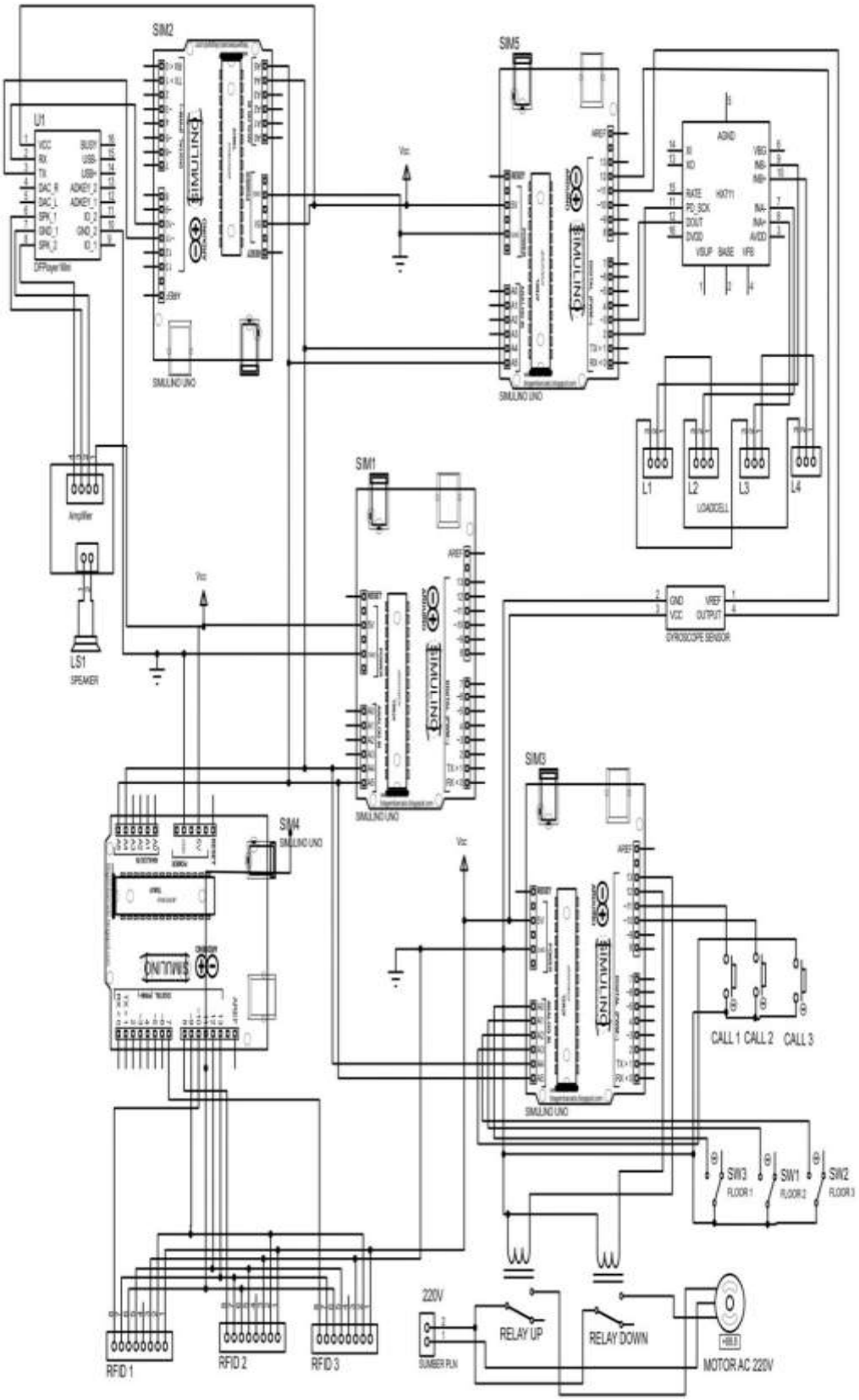

Figure 8. The Circuit

This block diagram and circiut describe a working system where there are five Arduinos that are interconnected, exchanging information, receiving and giving signals, so that the five Arduinos work simultaneously.

This system is what is called a protocol base, namely one Arduino as the Arduino protocol base which is the master or work center of an elevator. This Arduino gives and receives signals to four Arduinos, each of which has a different function.

These four Arduinos are controlled by the Arduino protocol base with a master reader and master writer communication system, which means the master reader is reading signals sent by other Arduinos, while the master writer is giving signals to other Arduinos by assigning the signal to one of the Arduinos with a signal. special and different. So that each Arduino can know whether the signal is intended for it or for another Arduino. By using serial SDA and SCL communication buses and ground which are connected between one Arduino and another Arduino, where there is only one control center for each connected Arduino.

The block diagram can be seen in the image below, it will appear that some Arduinos communicate in two directions and others communicate in one direction, both only receiving and only sending signals.

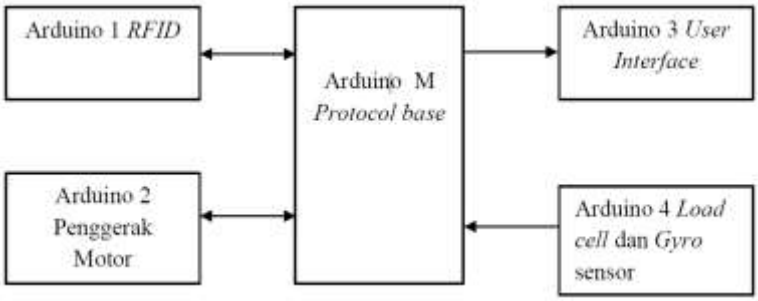

Figure 9. Ptotocol Base Concept

RESULTS AND DISCUSSION

Tool Testing

The hardware design process has been completed, the next stage is testing the tools, both hardware and software that have been designed. This test must be carried out to find out whether the hardware and software that has been designed is functioning properly or not.

And the aim is to find out whether the hardware is compatible with the software that has been programmed or flashed into each Arduino used so that the device runs optimally.

This hardware testing aims to ensure and find out that the supporting devices or components that are interconnected with the controller can carry out their functions properly. In this test, a multitester is needed as a measuring tool to measure the amount of voltage running throughout the circuit and measure the data that has been programmed into the microcontroller.

a. Power Supply Testing

Testing the power supply is measuring the voltage on the power supply which is used to supply voltage to the entire Arduino as well as all the supporting modules used in this tool. The Arduino is supplied using a 12v power supply which is connected to the 12v port on the Arduino, as well as a relay which is also connected to a 12v voltage from the adapter so that the coil on the relay works.

b. RFID Module Testing

The MFRC522 RFID module used is a standard module that is generally used. The circuit of this module has been discussed in the previous chapter. The system used in this module is connected to Arduino RFID. Because this lift is for three floors, you have to use 3 MFRC522 modules on each floor which function. When the user wants to use the lift, they have to open security access using the RFID tag that has been provided and once access is open, the user can call the lift by pressing the button. available. This module must be given a voltage of 3.3v to make the module work. The following is a picture of the 3.3v voltage on the MFRC522 module.

The next step is to test the module using a basic program taken from the example program contained in the modified MFRC522 library. The program code can be seen in the attachment section.

The program is modified in such a way that it allows three MFRC522 modules to work in one continuous control, so the user can operate it from these three modules. The pins connected from the Arduino to the MFRC522 module can be seen in the table below:

Tabel 1. Conection Arduino

Number	Arduino Uno RFID	MFRC522 1	MFRC522 2	MFRC522 3
1	Pin 7	SDA	-	-
2	Pin 8	-	SDA	-
3	Pin 10	-	-	SDA
4	Pin 13	SCK	SCK	SCK
5	Pin 11	MOSI	MOSI	MOSI
6	Pin 12	MISO	MISO	MISO
7	GND	GND	GND	GND
8	Pin 9	RST	RST	RST
9	3,3v	3,3v	3,3v	3,3v

To use this module you need a tag which is usually in the form of a card or key chain, each tag has a different code called an ID. The code from the tag is registered in the program so that the tag can be read by the Arduino so that the Arduino gives access to the tag user. To find out the ID of each tag, you must use the program code which can also be seen in the attachment.

From this program the ID can be seen using a serial monitor which is connected from the Arduino serial port to the USB port on a PC or laptop. To open the monitor display you can press Ctrl+Shift+M on the keyboard then the application will display a new serial monitor window and the ID of the tag. will appear on the serial monitor. The following is a picture of reading the ID tag on the serial monitor:

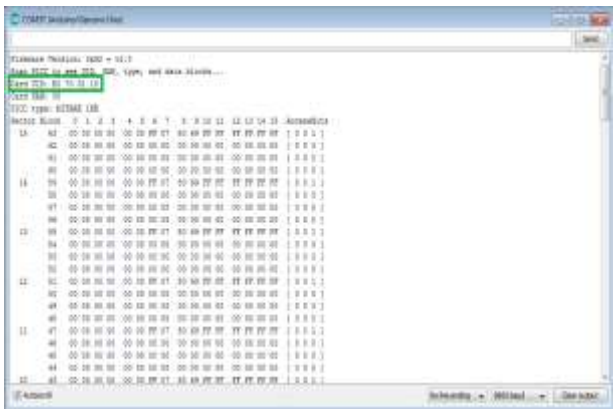

Figure 10. Reading the ID tag on the Serial Monitor

c. DFPlayer Module Testing

The use of DFPlayer is assisted by an amplifier and speaker to produce sound to guide the user in operation. The sound can be obtained from a micro SD which is connected via the micro SD port on the DFPlayer module. This DFPlayer module is connected to the Arduino user interface which has its own system and program. The pins connected from the Arduino to the DFPlayer module can be seen in the table below:

Table 2. Arduino Pin Connections, DFPlayer and Amplifier Modules

Number	Arduino Uno User Interface	DFPlayer	Amplifier
1	5v	VCC	VCC
2	GND	GND	GND
3	Pin 10/RX	TX	-
4	Pin 11/TX	RX	-
5	-	DAC_R	In R
6	-	DAC_L	In L

After connecting the wiring of all the pins used between the Arduino user interface and the DFPlayer module, the next step is to test the components using programming. The program used is a modified program from the example contained in the DFPlayer library. The test program is included in the appendix.

To use sound, first the sounds are recorded one by one using the recording application on the smartphone, then name the recording file in a sequence of numbers, namely 0001,0002,0003, then the file is saved on a micro SD and the file is played on DFPlayer and then gives a sound signal. speakers through an amplifier according to predetermined program commands.

d. Loadcell Sensor Testing

The loadcell sensor and gyro sensor on this lift function as a limiter for the maximum load that will be carried by the lift at 75 kilograms. By limiting the load that will be carried, if the load exceeds 75 kilograms, the lift will be protected by the Arduino loadcell system.

The Arduino receives a signal from the loadcell sensor which is first read by the HX711 module then conveys the signal to the Arduino and then gives a signal to the Arduino protocol base. Then the Arduino protocol base directly commands the Arduino user interface which guides the user to reduce the carrying load. The pins connected between the Arduino HX711 module and the loadcell sensor can be seen in the following.

Table 3. Pin Connections Between Arduino, HX711 Module and 4 Loadcell Sensors

No	Arduino Uno Loadcell dan Gyro Sensor	Modul HX711	Sensor Loadcell 1	Sensor Loadcell 2	Sensor Loadcell 3	Sensor Loadcell 4
1	-	E+	-	-	-	Kabel Merah
2	-	E-	Kabel Merah	-	-	-
3	-	A-	-	Kabel Merah	-	-
4	-	A+	-	-	Kabel Merah	-
5	GND	GND	-	-	-	-
6	Pin 2	SCK	-	-	-	-
7	Pin 3	DT	-	-	-	-
8	5v	Vcc	-	-	-	-

The Arduino hardware circuit, HX711 and four loadcell sensors are connected by wiring. The next step is testing by entering the program code to ensure the circuit is working properly. The programming code is modified from the basic loadcell program contained in the HX711.h library.

When using the loadcell sensor for the first time, it must be calibrated to ensure that the load is zero before placing the load. A calibration value is required that corresponds to the visible load of the four loadcell

sensors using a load whose weight value is already known, namely using dumbbells with a load of four kilograms. The calibration value obtained was 2230.0. From the calibration value, the results displayed the load according to the actual weight of the dumbbells.

Because it does not use display hardware, during calibration a serial monitor is used to see the weight of the load placed on the loadcell sensor tray. The loadcell sensor test results can be seen in the image below

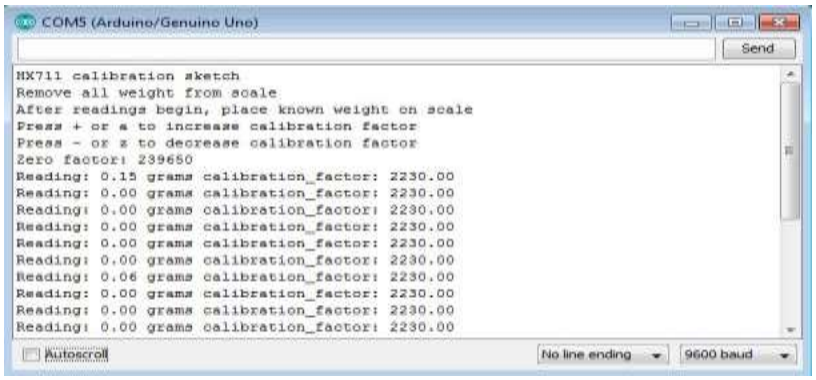

Figure 11. Loadcell Test Monitor

e. Freight Drive Motor Testing

The motor drive uses its own system which is connected to the protocol base. The motor drive system includes a limit switch sensor and call button on each floor and uses an AC voltage hoist motor which is connected via a relay. The schematic of the motor drive system circuit is as follows:

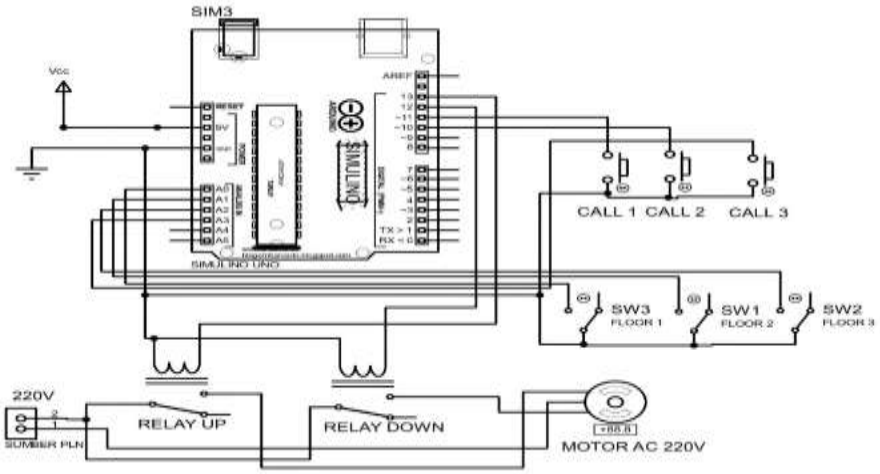

Figure 12. Motor Drive Circuit

To run this system, programming is used to make all components function properly. The program used is a simple input and output program. After programming the components according to the program code, the next step is to measure the voltage on the AC motor so that the motor does not get the wrong voltage.

Protocol Base System

The protocol base system is a communication from an Arduino to another Arduino. This communication can be used by more than 10 Arduinos, in this case one of the Arduinos is used as the protocol base so that it only functions as a signal receiver and sender, while as signal givers and receivers there are four other Arduinos. It has its own program in it and every command from each Arduino is connected to each other so that there is no miscommunication.

Testing the lbase protocol system is the main thing because the base protocol unites the four previous systems. The base protocol system uses serial data and serial clock communication which is connected to each Arduino used by uniting the grounding so that communication can be established and function properly. The pins connected between Arduino can be seen in the table below:

Tabel 4. Pin Connecting Protocol Base Arduino

Number	Arduino *Protocol base*	Arduino RFID	Arduino System motor Driver	Arduino User Interface	Arduino Loadcell
1	SDA	SDA	SDA	SDA	SDA
2	SCL	SCL	SCL	SCL	SCL
3	GND	GND	GND	GND	GND
4	VCC	VCC	VCC	VCC	VCC

After connecting the connections between the pins according to the table above, the next step is to program the Arduino protocol base so that all programs that have been flashed to other Arduinos can function so that the lift in this research works. The program used is a modification of the basic program contained in the wire.h library, the program is modified trial by trial so that it is found to be in accordance with the protocol base working system, where each Arduino has a different task, namely:

1) Arduino 1 as a security system by controlling three MFRC-522 RFID modules located on each floor to open access to use the elevator.
2) Arduino 2 controls the motor that makes the train move up and down and monitors which floor the train is on with the help of sensors on each floor.
3) Arduino 3 as a user interface by providing instructions for using the elevator by emitting sound through the speaker, as well as notifications such as having reached the destination floor and overloading.
4) Arduino 4 controls the load of the lift, namely limiting the weight of the load so that it is not overloaded. Arduino 4 also monitors the balance of the train with a gyro sensor installed on the train, so that if the train tilts then the lift will stop.
5) Arduino 5 as Arduino for the base protocol circuit.

The following is how the protocol base system works :

a) When the lift has been opened, Arduino 1 gives a signal to Arduino 5 that the lift has been opened, then Arduino 5 sends a signal to Arduino 3 to issue a notification that the lift can be accessed.
b) When the elevator has arrived at the destination floor, Arduino 2 gives a signal to Arduino 5 that the elevator has arrived at the destination floor, then Arduino 5 then gives a signal to Arduino 3 to notify the user that the elevator has arrived and also at the same time gives a signal to Arduino 1 to close the elevator again so that it is not used by random people.
c) When the lift load is excessive, Arduino 4 gives a signal to Arduino 5 that the lift load is excessive, then Arduino 5 gives a signal to Arduino 3 to notify that the lift load is excessive and sends a signal to Arduino 2 to turn off the motor power supply so that the motor does not move

CONCLUSION

From the design and implementation of the protocol base as a Freight lift driver in building I, Pembangunan Panca Budi University, testing and analysis were then carried out so that the following conclusions were obtained:

1. This research helps people in moving goods from floor to floor in building I, Pembangunan Pancabudi University.
2. This protocol base system can be used if one Arduino has reached the maximum program limit so an additional Arduino is needed.
3. By using the protocol base system, it is easier to find troubleshooting by minimizing problematic parts of the control system which is united by the protocol base.

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