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Prototype of Arduino Based Parking Rotation System

M Sodiq* and H Hasbullah

Departement Electrical Engineering of Education, Universitas Pendidikan Indonesia, Jl. Dr. Setiabudhi No. 207 Bandung 40154, Indonesia

*muhammad.sodiq@student.upi.edu

Abstract. As car users increase, parking areas can not keep up with car growth. One solution to reduce this problem is to use a rotary parking system. The rotary parking system is an automated parking system that utilizes relatively narrow space using a rotation system. This rotary parking design uses 6 parking shelves that arranged vertically and rotate. The design uses stepper motor as an actuator and some push buttons. The Arduino Uno module is used as the controller that governs all the above devices. The results are done by running the rotary parking system and the system can function properly.

1. Introduction

The land transportation that people use today is a car. In Indonesia alone the total number of cars recorded by KORLANTAS POLRI from 2010 to December 2017 continues to increase to 5.9 million units.

To overcome all the problems mentioned above, we need an efficient parking system which would help to reduce traffic congestion and improve air quality at important locations where traffic rush is more [1].

Increase in the number of cars is not proportional to the available parking area, causing congestion when choosing a vehicle parking lot. From the problem, then created a prototype rotary parking system [2]. The concept of a rotational car park is one of the mechanical car park systems where its controls automatically with drives and cars are stored on vertical rack chains arranged on both sides. The main idea is to piled up six cars in the space usually occupied by two cars [3].

The control using a microcontroller arduino uno module that is able to control various types of electronics related equipment such as servo module, stepper motor, and some push button.

2. Material and method

In table 1 is a list of tools in the prototype design of arduino-based rotation parking system.

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Table 1. Material

No	Tools	Specification	Amount
1	Microkontroler	Arduino uno	1 pcs
2	Motor	Nema 17	1 pcs
3	Resistor	3k5 Ohm	5 pcs
4	Resistor	900 Ohm	1 pcs
5	Driver Motor	A4988	1 pcs
6	Push Button	PBS - 11B	5 pcs
7	Led	RGB 2 pin	1 pcs
8	Power Suplay	14 Volt	1 set
9	Framework	Galvanum	2 m
10	Timming Belt	MXL GT-2	1 loop
11	Transmission	Cam Chain	2 loop
12	Pallet	Iron Plat	50 cm^2
13	Gear	Cam Gear	2 pcs
14	Cable	Rainbow Cable	40 pcs
15	Bolt	2mm	30 pcs
16	Bearing	6,8mm	4 pcs

2.1. Arduino Uno design

This microcontroller uses the Arduino Uno Module in figure 1 and the specification in table 2 as follows:

Table 2. Specifications Arduino Uno

Microcontroller	ATmega328P
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limit)	6-20V
Digital I/O Pins	14
PWM Digital I/O Pins	6
Analog Input Pins	6
DC Current per I/O Pin	20 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	32 KB
SRAM	2 KB
EEPROM	1 KB
Clock Speed	16 MHz



Figure. 1 Arduino Uno

To control input push button and output of stepper motor used Arduino Uno module as input processor and give data for stepper motor to rotate. Arduino Uno design is shown in figure 2.

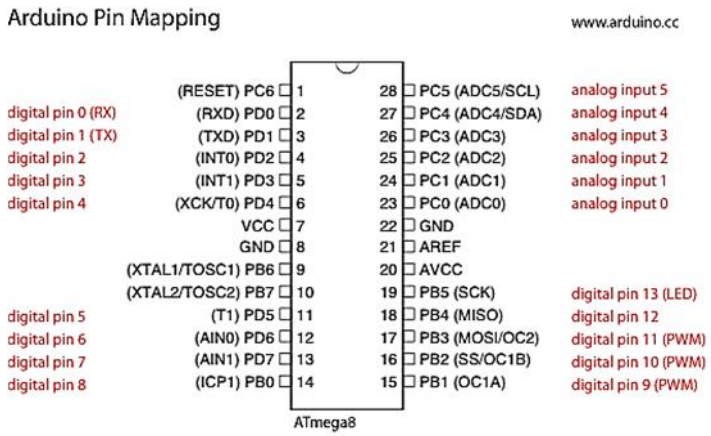

Figure 2. I/O Atmega328P

2.2. Driver Motor Stepper design

The stepper motor control module used is A4988 Stepper Motor Driver module. The function of this driver is to control the direction of rotation and speed of the motor work on step by step according to instructions from Arduino Uno. The image of the A4988 Stepper Motor Driver module is shown in Figure 3.



Figure 3. A4988 Stepper Motor Driver

2.3. Motor Stepper design

The stepper motor used is NEMA 17 which has a voltage input of 12-19 Volts and has a maximum torque of 4.0 kg cm, as shown in Figure 4 (a). This stepper motor has 4 inputs, the axes 1a = negative, 1b = positive, and 2a = negative, 2b = positive, as shown in Figure 4 (b).

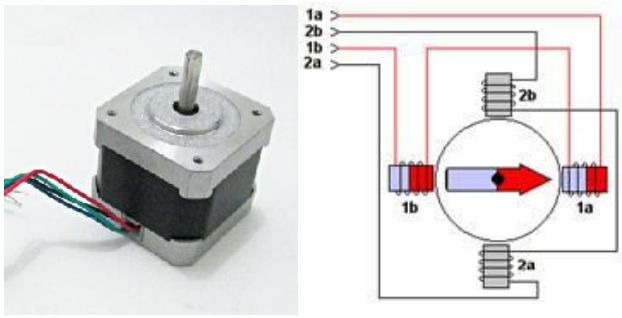

Figure 4. (a) NEMA 17 (b) Conceptual Stepper Motor

2.4. Block Diagram

Includes the system block diagram shown in figure 5,

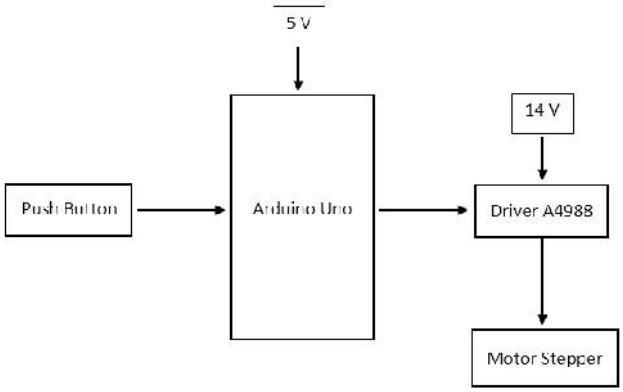

Figure 5. Block diagram

2.5. Design frame

The design of the framework using galvalum materials along 2 m to be cut into a prototype frame rotary parking system according to Figure 6.

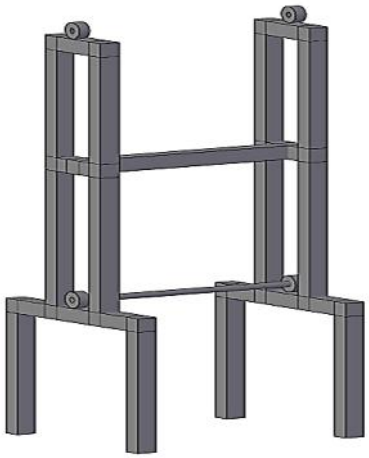

Figure 6. Design Framework

2.6. Tool design

And the design drawing tool shown in Figure 7 [4].

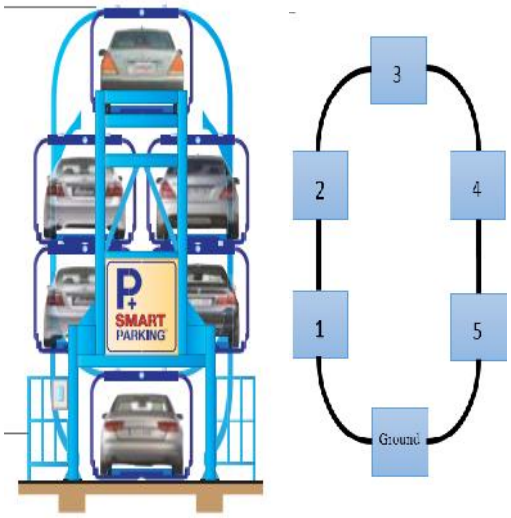

Figure 7. (a) Parking shelf order (b) Parkir Number

The design of rotational parking charging system is designed with the following specifications:

- Model parking rotation system made of 6 parking shelves that can accommodate 6 cars.
- Movement of the rotational parking system model using a stepper motor and using a timming belt to connect to the rotational parking chain [5].
- The rotation parking numbering model can be seen in Figure 7 (b).

2.7. Flowchart

Figure 8 shows the overall flow diagram Prototype of Arduino Based Parking Rotation System.

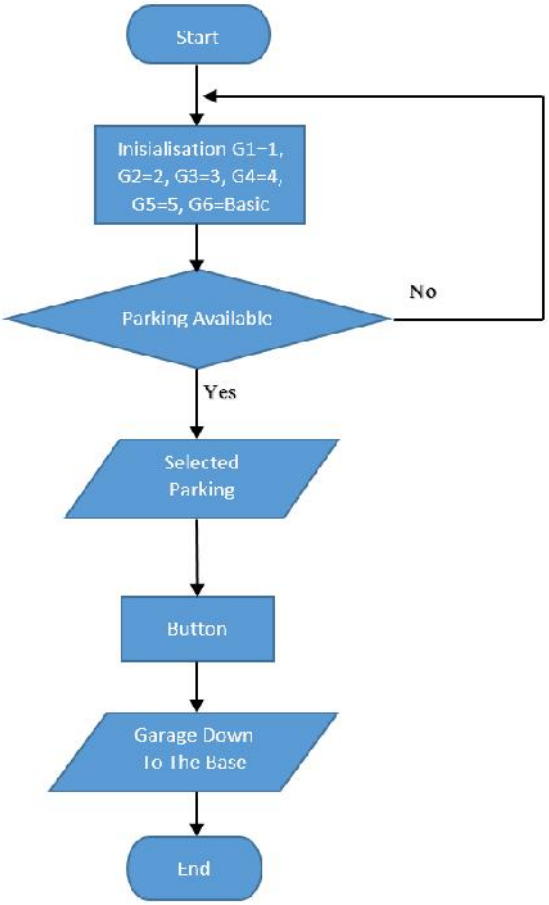

Figure 8. Flowchart

2.8. Design Control Circuits

The control circuit on this tool is shown in Figure 9.

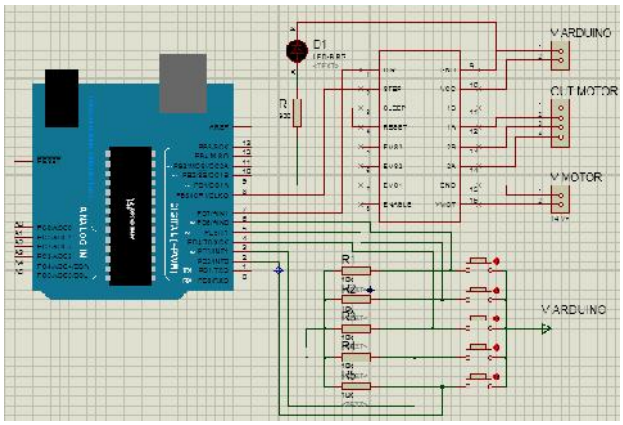

Figure 9. Control Circuits

3. Result and Discussion

3.1. Arduino IDE Program

Programming used Arduino IDE application, here is the program image for the rotary parking system prototype shown in Figure 10.

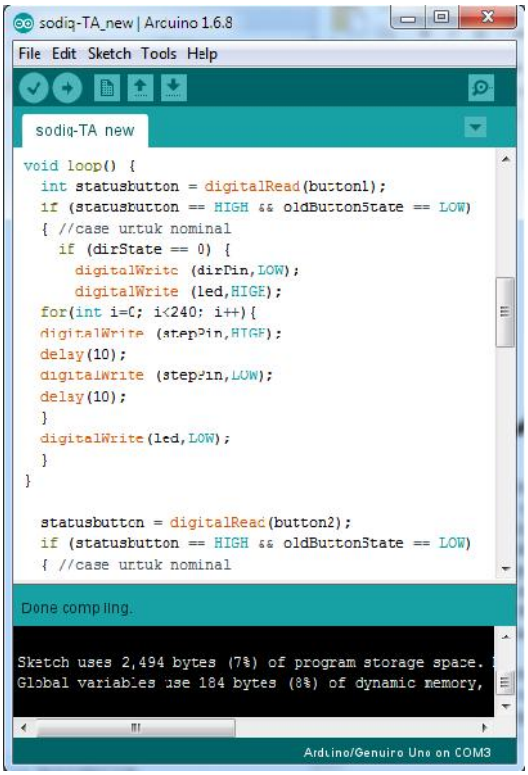

Figure 10. Arduino IDE

The movement of the rotary parking system model is determined by the position of the 1, 2, 3, 4, and 5 toward the position of the basic parking rack on the prototype rotary parking system. The determination of the setpoint is measured by how many step by step movements of the stepper motors to the base parking rack [6].

3.2. Box Panel

Testing each push button as shown in Figure 11.



Figure 11. Box Panel

- Button 1
  Moving to the left by 240 step
- Button 2
  Moving to the left by 477 step
- Button 3
  Moving to the right by 710 step
- Button 4
  Moving to the right by 477 step
- Button 5
  Moving to the right by 240 step

3.3. Working principles

The workings of the tool are as follows:

- Using a 5 volt voltage source for arduino uno and 14 volt modules for stepper motor driver.
- The system input comes from several push buttons that will command the program from arduino to the stepper motor driver.
- Each push button has a number corresponding to the laying of the parking shelf in this rotation parking system.
- Push button number 1 is pressed then arduino ordered stepper motor to move perstep and will stop on the basic parking shelf as ordered from arduino.
- The steps if you want to park the car, the first consumer just push the push button according to the empty parking rack, and automatically the empty parking shelves will go down to the basic shelf and the car can be placed directly on the parking shelf. And so next if you want to park the vehicle again.
- The first steps of taking the car is that the consumer only visually looks at the number of the parking lot of his car, and then simply pushes the push button according to the number of car parking shelves to be picked up.

3.4. Experiment data

3.4.1. System Error Testing. Real Time Car Parking System using Processing [7]. The test is done by comparing the real time of the test tool with time calculation based on the delay that is controlled by Arduino Uno to find the value of system error. In theory, the error can be calculated by the formula:

$$E = \left[\frac{s \quad x\, ti \quad d}{r \quad ti}\right] x100\%$$

3.4.2. Time and Error Testing. Testing time based on the position of parking shelves to the basic parking shelf, among others:

Table 3. Time Rotary Parking Systems

No. Rack Parking	time(second)	Error (%)
P1	4,5	0,53
P2	9,1	0,52
P3	14	0,50
P4	9,1	0,52
P5	4,5	0,53

4. Conclusion

The conclusions that can be taken in making this research are as follows:

- Use of Arduino Uno as an On-Off controller can be used as a total step by step regulator of stepper motor rotation and parking rack in rotary parking system prototype with step division between 240, 477, 710, 477, 240.

- Time-test results show that the average error rate in the push button experiment 1 is 0,52%, the push button 2 is 0,53%, the push button 3 is 0,50%, the push button 4 is 0,53%, and on the push button 5 of 0,52%. The results of this test indicate that the time taken to generate the response as planned and can be applied to the prototype rotary parking system to achieve the intended position.

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