A Prototype car guidance system for automatic parking using the DT-Sense ultrasonic ranger

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A Prototype car guidance system for automatic parking using the DT-Sense ultrasonic ranger

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Abstract. Damage to the car body is one of the things that a driver must avoid, especially when parking his car in a narrow space. This can be caused by the driver's limited vision at night towards the back of the car. This can be avoided if there is a guidence system for the driver. Therefore, in this study a guidance system for automatic parking using the DT-Sense ultrasonic ranger was developed. The sensor is used to measure the distance between the car and the wall surface of the parking area. The system is made based on a microcontroller 328. The novelty is the variation of tests carried out on the wall surface and the distance from the car to the parking area from 105 cm to 250 cm. The test results show that the error of measuring the distance of car with a flat surface is 4.26%, a convex surface is 2.82%, and a graded surface is 4.86%.

Keywords: Car guidance system, automatic parking, microcontroller 328, DT-Sense Ultrasonic ranger

1. Introduction

The number of vehicle volumes per year in Indonesia has increased from year to year, especially in big cities like Jakarta. According to data from the Central Statistics Agency (BPS), the number of vehicles in Indonesia is in the first place, namely motorbikes as many as 98.9 million units, then in second place, namely cars with 13.5 million units and finally public transportation as many as 9 million units [1]. The availability of parking space and the disproportionate number of vehicles, often drivers park their vehicles on the shoulder of the road, thus adding to a severe congestion. This issue is regulated by Law Number 43 of 1993 concerning road infrastructure and traffic.

The availability of parking facilities that are increasingly limited, especially in big cities, makes it difficult for persons with disabilities to park their vehicles in a narrow space, not a few motorists scratch walls and hit objects when reversing the car due to limited visibility and dark night conditions so they don't know the object that is being behind the car, the consequences of these limitations make the car owner not only suffer a loss to the car but can damage the object he hit. Therefore, a parking sensor device was made to help people with disabilities park their cars easily.

In previous research, the SR-04 ultrasonic sensor was used to measure the distance between the prototype car and the parking space installed on the front-left and rear. The use of fuzzy logic control is used to determine the ultrasonic sensor to detect parking spaces and to use the PID controller to adjust the rotation and direction of the servo motor as the steering prototype of the car [2]. In other studies with measurements with the ultrasonic sensor HC-SR04, it was shown that on 24 tests of distance measurements obtained an error value of 0% for a distance of 3cm-60cm and at a distance of 60cm-

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200cm with an error value of 1.78% [3]. Whereas the results of the study [4] showed that the detection distance of a spot with a length of 72 cm and a width of 40 cm with success rates of 75% and 75% for space detection.

2. Method

At this stage of making the system diagram, a system maintains the accuracy of the proximity sensor to the object received. The system can be translated into a sensor reading the object received by comparing the data entered. There are stages in a sequence that are made coherently and precisely in order to become a complete unity so as to form a system that is accurate and functions accordingly. expectations, namely as follows. In figure 1 show about block diagram system.

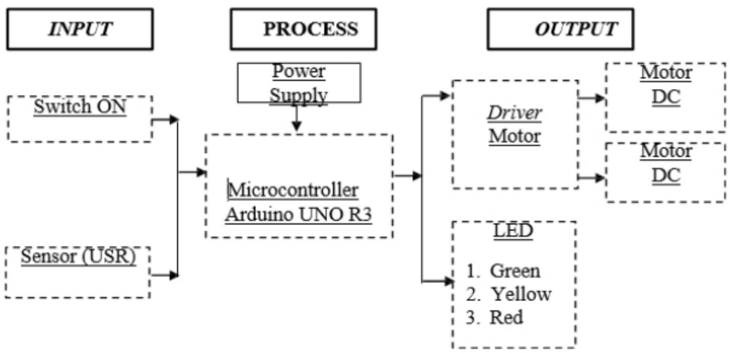

Figure 1. Overall Block Diagram System

2.1. Switch On

Switch On is an electronic component that functions to connect two or more points in an electronic circuit. One type of switch is the ON switch, which is a switch that will only connect two or more points when the button is pressed and when the button is not pressed it will decide two or more points in an electronic circuit. The Switch On is shown in Figure 2.

Figure 2. Switch On

2.2. DT-Sense Ultrasonic Ranger (USR) Sensor

The DT-Sense Ultrasonic Ranger (USR) sensor is a non-contact jatropha measuring module which is very easy to connect with different microcontroller based systems. To trigger and read measurement data, the DT-Sense Ultrasonic Ranger sensor only requires 1 microcontroller pin. In addition, a communication system is provided so that some of the DT-Sense Ultrasonic Ranger sensor modules and other equipment that supports the communication protocol can be used together with only 2 microcontroller pins. One of the specifications of the DT-Sense Ranger (USR) sensor is that it has a range: 2 cm to 300 cm [5]. The DT-Sense Sensor is shown in Figure 3.

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Figure 3. DT - USR ultrasonic sensor

2.3. Power Supply

The battery is a device that can convert the chemical energy it stores into electrical energy that can be used by an electronic device. Almost all portable electronic devices such as cellphones, laptops, flashlights or other electronic devices use their power source batteries. With the battery makes it easier to carry electronic devices. In this research, a battery with a capacity of 9 V. The power supply is shown in Figure 4.

Figure 4. Power supply

2.4. Microcontroller

The ATmega328 is an 8-bit microcontroller chip based on Atmel's AVR-RISC. This chip has 32 KB of ISP flash memory with read-write capability, 1 KB EEPROM, and 2 KB SRAM. From the 32 KB of Flash memory capacity, this chip is named ATmega328. Another chip that has 8 KB of memory is named ATmega8 and ATmega16 for those that have 16 KB of memory. The ATmega328 chip has many facilities and luxuries for a microcontroller chip. The chip has 23 general purpose I/O (input / output) lines, 32 registers, 3 timers / counters with comparison mode, internal and external interrupts, serial programmable USART, 2-wire serial interface, SPI serial port, 6 pieces. 10-bit channel A/D converter, programmable watchdog timer with built-in oscillator, and five power saving modes. The chip works on a voltage between 1.8V ~ 5.5V. The compute output can reach 1 MIPS per Mhz. Maximum operating frequency is 20 Mhz [6]. The microcontroller is shown in Figure 5.

Figure 5. Microcontroller

2.5. Motor DC

A DC motor in general is a motor that requires a direct voltage source in the armature coil and the field coil to be converted into mechanical energy. In a DC motor, the field coil which is energized by an electric current will produce a magnetic field that surrounds the armature coil in a certain direction. One type of DC motor is a brushed DC motor (brushed DC motor). Brushed DC motors are widely used in a variety of applications ranging from children's toys to driving the fins of a military rocket. Brushed

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DC motors are widely used because they are quite cheap, there are many size variants available and also because they are not too difficult to control.

DC motor specifications are as follows: Operating voltage 3 Volt - 6 Volt, Motor current 100 mA - 120 mA, Speed 120 RPM (3V) 185 (4.5V) and 250 (6V), and 50g DC motor weight. The motor DC is shown in Figure 6.

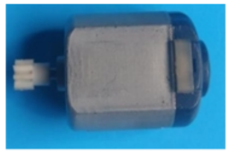

Figure 6. Motor DC

2.6. Driver Motor DC

To drive a DC motor, a driver is needed to adjust the direction of rotation of the motor. Each type of motorbike must have a different set of drivers. For brushed DC motors, the circuit most often used to move or adjust the direction of rotation is the H-bridge circuit [7]. The driver motor DC is shown in Figure 7.

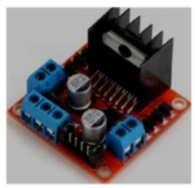

Figure 7. Driver Motor DC

2.7. LED

Light Emitting Diode or often abbreviated as LED is an electronic component that can emit monochromatic light when given forward current. LED is a family of diodes made of semiconductor materials. The colors of the light emitted by LEDs depend on the type of semiconductor material it uses. LEDs can also emit infrared rays that are not visible to the eye as we often encounter on TV remote controls or other electronic device remote controls. The LED is shown in Figure 8.

Figure 8. LED

2.8. Model back wall

In measuring the distance between the prototype car and the back wall, three areas are used, namely flat, convex and graded surface.

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(a) (b) (c)

Figure 9. model back wall. (a) flat surface, (b) convex surface and (c) graded

3. Results

As for the results of making portable cars with disabilities for parking automatic based on the Ardunino UNO R3 microcontroller using ATMega 328P DT-Senses Ultrasonic Ranger (USR) sensor as shown below:

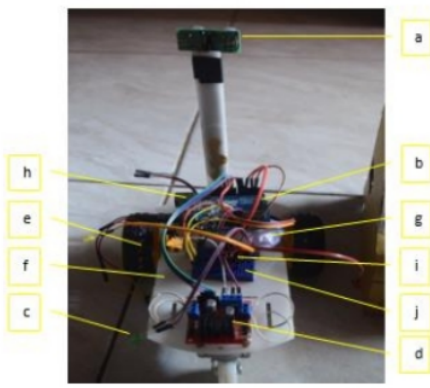

Figure 9. Prototype car

Information :

- DT-SENSE ULTRASONIC RANGER (USR) Sensor
- Ardunio UNO R3 ATMega328P
- 3 Color LED (Green, Yellow and Red)
- L298N motor driver
- 2 DC motors
- Cassis Robot Kit
- 9 Volt battery
- Cable
- Resistors
- Mini motherboard

The test results of the portable distance measurement of the car guidance system parking disabilities automatically using the DT-Sense Ultrsonic Ranger sensor (USR). The following is the path of the actual test measurements on the portable.

ISBN : 978-623-96220-1-5

3.1. Flat surface DT-USR sensor distance measurement

Table 1. The result of the distance measurement of the flat surface DT-USR sensor.

No.	Starting distance (cm)	Target parking distance (cm)	The distance measured (cm)	Error (%)
1	250	30	29	3.33
2	245		29.7	1
3	240		29.7	1
4	235		29.4	2
5	230		29.4	2
6	225		29.1	3
7	220		29.1	3
8	215		28.9	3.67
9	210		28.7	4.33
10	205		28.4	5.33
11	200		28.4	5.33
12	195		28.6	4.67
13	190		28.3	5.67
14	185		28	6.67
15	180		28	6.67
16	175		28.6	4.67
17	170		28.5	5
18	165		28.5	5
19	160		28.4	5.33
20	155		28.7	4.33
21	150		28.7	4.33
22	145		28.3	5.67
23	140		28.1	6.33
24	135		28.2	6
25	130		28.4	5.33
26	125		28.7	4.33
26	120		28.7	4.33
28	115		28.9	3.67
29	110		29.3	2.33
30	105		29	3.33
	The Average error value			4.26

Table 1 shows the results of measuring distances on a flat surface. It can be concluded that the DT-USR sensor has the smallest error value, namely 1.00% and the largest error value is 6.67%. The next test, namely measurement of the distance on a convex surface is done to find out the sensor's ability to detect distance surfaces.

ISBN : 978-623-96220-1-5

3.2. A convex surface DT-USR sensor distance measurement

Table 2. The result of the distance measurement of a convex surface DT-USR sensor.

No.	Starting distance (cm)	Target parking distance (cm)	The distance measured (cm)	Error (%)
1	250		29	3.33
2	245		29.8	0.67
3	240		29.7	1
4	235		29.7	1
5	230		29.4	2
6	225		29.4	2
7	220		28.9	3.67
8	215		28.9	3.67
9	210		28.7	4.33
10	205		28.7	4.33
11	200		28.9	3.67
12	195		29.3	2.33
13	190		29.7	1
14	185		29.7	1
15	180	30	29.4	2
16	175		29.4	2
17	170		29.5	1.67
18	165		29.4	2
19	160		29.4	2
20	155		28.6	4.67
21	150		29.6	1.33
22	145		29.3	2.33
23	140		29.3	2.33
24	135		28.9	3.67
25	130		28.9	3.67
26	125		28.9	3.67
26	120		28.7	4.33
28	115		28.7	4.33
29	110		28.4	5.33
30	105		28.4	5.33
The Average error value				2.82

From table 2 shows the results of distance measurements can be concluded the ability of the DT-USR sensor to detect convex surfaces obtained a measurement value that is almost the same as the distance measurement where the actual measurements were made at the most surface convex and obtained the smallest error value, namely 1.00% and the largest is 4.67%.

3.3. A graded surface DT-USR sensor distance measurement

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Table 3. The result of the distance measurement of a graded surface DT-USR sensor.

No.	Starting distance (cm)	Target parking distance (cm)	The distance measured (cm)	Error (%)
1	250		29	3.33
2	245		29	3.33
3	240		28.7	4.33
4	235		28.7	4.33
5	230		28.7	4.33
6	225		28.5	5
7	220		28.5	5
8	215		28.5	5
9	210		28.3	5.67
10	205		28.3	5.67
11	200		28	6.67
12	195		28	6.67
13	190		28	6.67
14	185		28.7	4.33
15	180	30	28.5	5
16	175		28.5	5
17	170		28.7	4.33
18	165		28.7	4.33
19	160		28.9	3.67
20	155		28.9	3.67
21	150		28.4	5.33
22	145		28.4	5.33
23	140		28.7	4.33
24	135		28.7	4.33
25	130		29	3.33
26	125		29	3.33
26	120		28.5	5
28	115		28.5	5
29	110		28	6.67
30	105		28	6.67
The Average error value				4.86

From table 3 shows the results of distance measurements can be concluded the ability of the DT-USR sensor to detect dotted surfaces, although in testing there are some errors on the sensor, namely the error value the smallest was 3.33% and the highest was 6.67%.

4. Conclusions

Based on the manufacture of a portable guide system for disabled cars parking automatically and the results of measurements that have been made then it can conclusions are drawn namely:

ISBN : 978-623-96220-1-5

- A major step in manufacturing a portable guide car system for persons with disabilities to park automatically is a literature study namely, seeking references from research in advance, journals as well as books related to parking sensors and microcontroller. Continue to make wiring diagrams and make the concept of the arrangement of the components for the manufacture of portable cars, then do the programming according to the command then do testing.
- The total value of the error that occurs during the distance measurement test process at flat surface ie 4.26%, on convex surface which is 2.82% and on a terraced surface which is 4.86%.

6

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