



Design of Human Followers Trolley Robot Based on Object Tracking (Color Detection) Method

Denny Irawan¹, Misbah² and Jefry R Baihaqi³

Research Scholar ¹⁻³

Electrical Engineering Department

Muhammadiyah University

Gresik

Indonesia

ABSTRACT

The development of the robot world is very rapid, including the humanoid robot, bioloid, not least the type of mobile robot. The robot is created to have advantages that are not owned by humans. One of them is unlimited compatibility. This requires that the robot has a variety of sensor components for the creation of intelligent autonomous behavior in robots. This research is titled " design of human followers trolley using object tracking (colour detection) method ". The goal is to facilitate the transfer of goods from one place to another. This tool will detect the color of clothing from humans that will be followed by using the camera (webcam) as the sensor and the camera captured will be processed using C# by utilizing the open source library AForge.NET to determine the point X and Y at the position of the object to be followed. This data will be processed again to determine some angle of the object that appears on the frame, then this data will be sent on the Arduino as a minimum system to translate data from C# so that both DC motors can run and the robot always follows the object based on the color. In the design of this tool generated a prototype trolley followers of humans with the camera, can already be used with a good camera readings and ultrasonic sensor readings are perfect. The sending of data from C# on Arduino runs smoothly as long as the Arduino monitor series is not used for other purposes.

Key Words: Freight Trolley, Color Followers Robot, Video Tracking, Camera, Arduino, Serial Port Application C #, AForge.NET.

1. INTRODUCTION

Robots have been developed by several countries throughout the world. Among them are humanoid robots, bioloid, including the type of mobile robot. Mobile robots are widely used in several studies equipped with various sensors, including using ultrasonic sensors and cameras [1]. This aims to help create intelligent autonomous behavior and movement control which makes it very important for the application of mobile robots discussed [2]. The camera is one type of hardware that can be used as a sensor to help identify the surrounding environment and can be connected with C # [3]. C # programming language functions as digital image processing and produces an output that will be used as a control reference to follow a target based on color on human follower robots [4]. C # also has an open source library, one of which is AForge.NET. AForge.NET is designed for developers and researchers in the field of computer vision and artificial artificial nerves, genetic algorithms, fuzzy logic and robotics [5].

This research discusses the design and build new innovations from the target mobile robots. The researcher will implement for goods trolley. The benefit of robot that can facilitate transfer of goods from one place to another. The traditional and conservative manual trolley is not effective in terms of time and effort cause by the trolley system is using the hand or manual trolley when moving items. This shows that the importance of automatic trolleys makes it easier for trolley supermarket's users. This tool will then follow the target using a camera sensor by detecting the colors R, G and B from the target color using C # which uses AForge.NET as an open source library to simplify the image processing for robot. So that this trolley can help humans move things and create a sense of comfort and efficiency while doing these activities.

2. LITERATURE REVIEW

2.1. Image

Image is a representation (description), resemblance, or imitation of an object. Image is divided into 2, there are analog images and digital images. Analog images are images that are continuous such as images on a television monitor, X-ray photos, results of CT scans etc. Whereas in digital images are images that can be processed by a computer.

2.2 Microsoft Visual C

C # or C sharp is a simple programming language that is used for general purposes, in the sense that programming language can be used for various functions such as server-side programming on websites, building desktop or mobile applications, game programming and so on.

2.3 WebCam

WebCam or Web Camera is a name for the camera that is connected to a computer that can be seen through the video calling application. This WebCam is aimed at technology in general, until the word WebCam is sometimes replaced with other words that give the view displayed by the camera.

2.4 Ultrasonic Sensors

Ultrasonic sensors are sensors which have function to convert physical quantities (sounds) into electrical quantities or vice versa. The workings of this sensor are based on the principle of wave reflection. The results of reflection of sound waves are used to interpret the existence (distance) of an object with a certain frequency.

2.5 Arduino Microcontrollers

Arduino is an open source micro-single controller, derived from the Wiring platform, designed to facilitate electronic use in various fields. Arduino hardware uses an Atmel AVR processor and the software uses a Java IDE.

2.6 Motor Driver

The L298N driver module uses the ST L298N chip which can directly control two 3-30V DC motors, and provides an interface output 5 V, we can easily control the speed and direction of movement of the DC motor, we can also control the 2-phase stepper motor.

2.7 DC motor

DC or DC Electric Motors Motor is a device that converts electrical energy into kinetic energy or motion. This DC motor can also be called a Direct Current Motor. As the name suggests, DC motors have two terminals and require direct current to be able to move them.

3. SYSTEM DESIGN

3.1. Study of Literature

In designing and making trolleys for human followers are using the object tracking method (color detection). Reference sources are obtained from direct and indirect sources. Direct sources are obtained from the results of discussions or consultations with lecturers, while indirect sources are obtained from writing reports of previous studies, books, the internet and other references relating to the design and making the robot.

3.2. Robot Parts

The design of the human follower trolley design system using the object tracking method (color detection) is divided into 2 parts, namely hardware consisting of Arduino, ultrasonic sensors, webcam, laptop, motor driver and a frame to places controller in the form of a mobile robot. While the software uses the ArduinoIDE application and Microsoft visual C #.

3.3. Robot Architecture

In the process of designing human trolley using the method of object tracking (color detection) is designed to be able to follow humans based on the color of the shirt. The program can be explained in Figure 3.1.

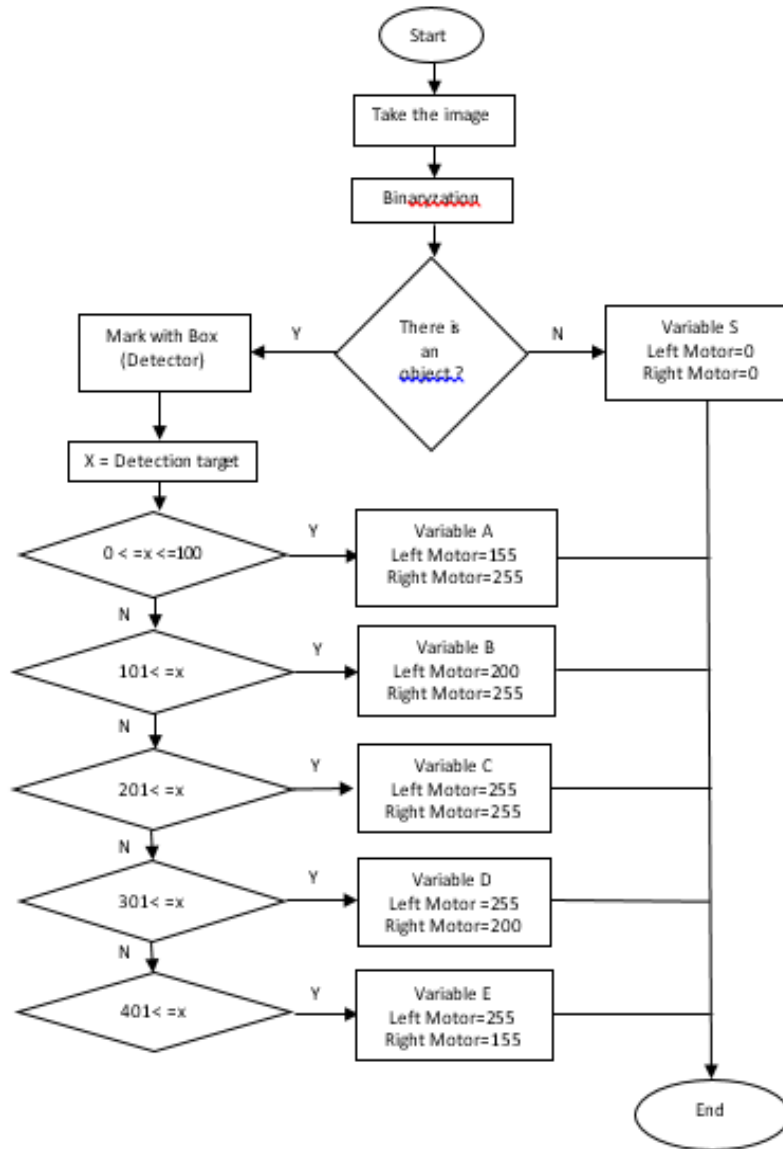


Figure 3.1. Flowchart of color coordinates and control detection

So that when the follow-up stop, the tool will also stop then the system as described in Figure 3.2.

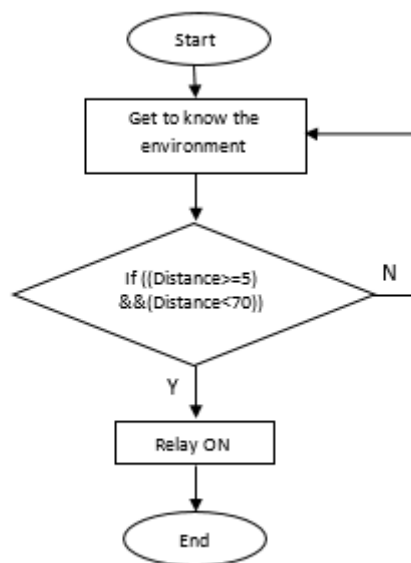


Figure 3.2. Distance detection flowchart

The hardware design of the tool can be seen in Figure 3.3. which displays the image of the tool in two viewpoints.



Figure 3.3 Design of hardware looks front and side

Figure 3.4 shows a system block diagram in general or the whole of the design automation of trolleys of human followers using the object tracking method (color detection).

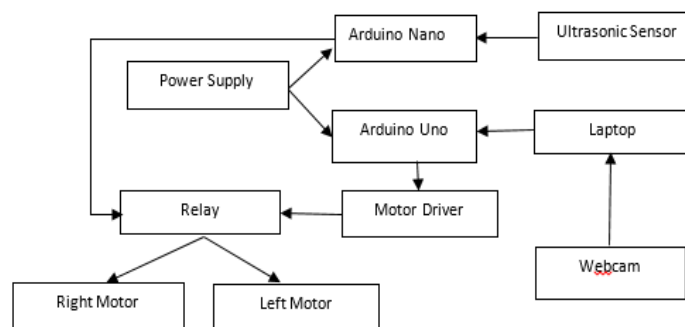


Figure 3.4. Block diagram of trolleys controlling human followers

3.4. Robot Parts

The testing phase includes 2 aspects, namely: software and hardware. The hardware consists of an Arduino microcontroller, an ultrasonic sensor, a webcam as an image taker, a laptop as an image process, a motor driver as a speed controller and a frame for a webcam place.

The software that applied to robot is writing a program on ArduinoIDE that has been written into an Arduino microcontroller that is used to move the left and right motors and Microsoft visual C # as the image capture process so that this prototype can follow humans based on the color of the clothes they use.

4. IMPLEMENTATION AND TESTING

This stage is the implementation stage of the application design that has been made.

4.1 Testing of Ultrasonic Sensors and Relays

In this discussion is the testing of ultrasonic sensors, the purpose of the test is to find out whether the ultrasonic sensor can work well and the distance generated is the same as the distance value using other measurements (ruler). By measuring the starting point of the robot does not move until the robot stops, the results can be seen as shown in Table 1.

Table 1 Results of testing ultrasonic sensors

No	Goods	Distance	Measuring results	Error
1.	Clothes	70 cm	69 cm	1 cm
2.	Book	70 cm	70 cm	0 cm
3.	Banner	70 cm	70 cm	0 cm
4.	Bag	70 cm	69 cm	1 cm
5.	Wall	70 cm	70 cm	0 cm
Percentage				60 %

From the results of the ultrasonic sensor experiments in Table 1 it can be concluded that the response of the ultrasonic sensor to different objects has an error rate, this is caused by the surface of the object being detected unevenly.

4.2 Trolley Wheel Testing

In this discussion, namely trolley wheel testing, the purpose of the test is to find out whether the two trolley wheels can function properly and know the speed of the robot when it is run. The results are seen in Table 2.

Table 2 Test results of trolley wheels

No	Distance (Cm)	Time (Second)	Velocity (Cm/Second)
1	100	6.29	15.89825119
2	100	5.36	18.65671642
3	100	5.43	18.41620626
4	100	6.08	16.44736842
5	100	6.03	16.58374793
6	100	5.31	18.83239171
7	100	5.41	18.48428835
8	100	5.57	17.95332136
9	100	5.49	18.21493625
10	100	6.18	16.18122977
Average			17.56684577

From the results of the experiments in Table 2 there is a difference in the speed of the robot, the first experiment produces a speed of 15.89 cm / second and the ninth experiment produces a speed of 18.21 cm / second. And the average speed is 17.55 cm / second. This shows that the speed of the robot changes, the faster the robot runs, the better the response will be carried out.

4.3 Testing Coordinates

Coordinates testing is done by running the program using 5 blue LED lights with each LED representing the X position coordinates which have been divided into 5 categories.

Category A is sent with variable A to the Arduino microcontroller with X values ranging from 0 to 101. By turning on the leftmost light. As shown in Figure 4.1.



Figure 4.1 X coordinates starting from 0 - 101

Category B is sent to the Arduino microcontroller with an X value ranging from 101 to 200. With the left light in Figure 4.2.



Figure 4.2 X coordinates starting from 101 - 200

Category C is sent with variable C to the Arduino microcontroller with X values starting from 201 to 300. By turning on the center light. As shown in Figure 4.3



Figure 4.3 X coordinates starting from 201 - 300

Category D is sent with variable D to the Arduino microcontroller with X values ranging from 301 to 400. By turning on the center light. As shown in Figure 4.4.



Figure 4.4 X coordinates starting from 301 - 400

Category E is sent with variable E to the Arduino microcontroller with X values ranging from 401 to 500. By turning on the right light. As shown in Figure 4.5.



Figure 4.5 X coordinates starting from 401 - 500

In reading the color coordinates it is very appropriate and in accordance with the color detection displayed on the frame with x coordinates values ranging from 0 to 500.

4.4 Test Path

In this test the aim is to measure the accuracy of the prototype in following the target. The track being tested has 4 tracks. This experiment was conducted 9 times with each color being tested three times. The experimental results are shown in Table 3.

4.4.1 Straight track testing

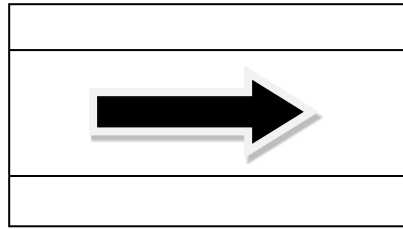


Figure 4.6. Straight test track

In this test allows the prototype to follow a moving object straight. Thus it can test the accuracy of the work system from the prototype.

4.4.2 Test the trajectory turn left

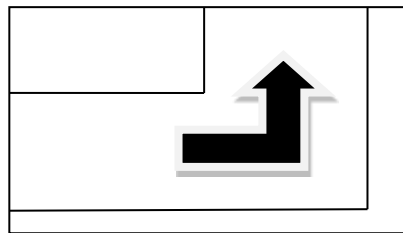


Figure 4.7. Test track turns left

The acceleration test of the wheel is by following an object that moves to the left so that prototype will follow an object that moves to the left.

4.4.3 Test trajectory turn right

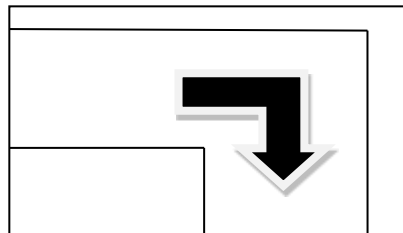


Figure 4.8. Test track turns right

Acceleration testing turns right where the prototype must follow the object that goes right so that the accuracy of the color reading will be tested and the motor response will be able to know the level of accuracy.

4.4.4 Zigzag trajectory testing

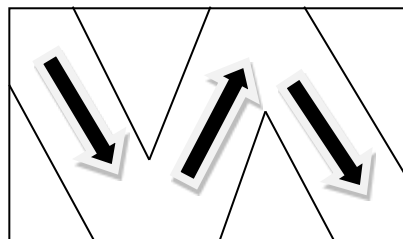


Figure 4.9. Zig-zig test track

Zig-zag trajectory testing where the prototype will follow a zigzag moving object. Where testing liki will show the success of testing the track properly.

Table 3 Test path

STRAIGHT CROSSES		
Color	Trial	Result
Red	1	Following Target
	2	Following Target
	3	Fail
Green	4	Following Target
	5	Following Target
	6	Following Target
Blue	7	Following Target
	8	Following Target
	9	Following Target
PERCENTAGE SUCCESS		88%
CROSSING RIGHT		
Color	Trial	Result
Red	1	Following Target
	2	Following Target
	3	Fail
Green	4	Following Target
	5	Following Target
	6	Following Target
Blue	7	Following Target
	8	Following Target
	9	Following Target
PERCENTAGE SUCCESS		88%

CROSSING LEFT		
Color	Trial	Result
Red	1	Following Target
	2	Fail
	3	Following Target
Green	4	Following Target
	5	Following Target
	6	Following Target
Blue	7	Following Target
	8	Following Target
	9	Fail
PERCENTAGE SUCCESS		77%
ZIG-ZAG TRAFFIC		
Color	Trial	Result
Red	1	Following Target
	2	Following Target
	3	Fail
Green	4	Following Target
	5	Following Target
	6	Fail
Blue	7	Following Target
	8	Following Target
	9	Fail
PERCENTAGE SUCCESS		66%

In the above experiment it can be concluded if the straight movement is the accuracy level to follow the target to 88%. Whereas if the zigzag drops to 66%.

5. CONCLUSION

After several stages of testing on a trolley robot, it can be concluded that:

1. Testing of ultrasonic sensors produces a maximum distance of 500 cm, so the distance used is 1 cm to 70 cm to turn on the relay.
2. Changes in lighting to the target affect the reading of the camera, so the reading results change slightly and are not too significant, so the values of R, G, B on the readings can be adjusted to maximize camera readings.
3. Merging C # with Arduino sketches using the serial port runs well during the Arduino serial monitor not used for other purposes.
4. The more movement of the robot then the accuracy will decrease slightly.

REFERENCES

- [1] Hartati Dwi Endang, "Designing a Mobile Robot Tracking of Moving Objects Based on PD (Propositional-Derivative) Using an AVR Atemega8535" Microcontroller, Department of Electrical Engineering, Faculty of Engineering, Diponegoro University, Semarang, Indonesia.
- [2] Latif, M., [2012], "Implementation of Neuro Fuzzy in Robot Speed Control of Human Followers" Master Program in Mechatronics Expertise, Electro Study Program of Industrial Technology Faculty, Ten November Institute of Technology, Surabaya. EECCIS 2012.
- [3] Shinta Pramu Ervika, "Webcam Application to Detect Movement of Objects", Department of Electrical Engineering in Electronics and Telecommunication Concentration at Diponegoro University, Semarang, Indonesia.
- [4] Latif, M. [2013], "Design of Target Detection Based on Color of Human Clothing", Proceedings of the National Information and Multimedia Technology Seminar, Yogyakarta. 06-1-06-6.
- [5] Umam Fatkhul, "Object Tracking in Smart Autonomouse Wheelchairs", Department of Electrical Engineering, Faculty of Engineering, Diponegoro University, Semarang, Indonesia.