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Application Of Fuzzy Logic In Color Detection Robot Arm Simulator

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ABSTRACT
Robot is one of the important tools in the industry under certain conditions. The world of education itself has done a lot of research in the field of robotics. The robot arm is one of them, the existence of a robot arm is expected to provide a function or performance in accordance with the work of the human arm and has stronger strength. The robot arm that is built applies a fuzzy logic method that determines the color of the object and will be moved according to the predetermined color, the color consists of three colors, namely red, green and blue. Robots are designed to be flexible and easy to use. It has controllers that have to be reprogrammed at any time to suit their function, like the Arduino Uno, and actuators like servomotors that are low-voltage and easy. This is why the TowerPro SG90 Servo motor was chosen to build the robot arm manipulator.

Keywords : ***Fuzzy Logic, Robotic Arm, Colour Detection***

INTRODUCTION

Robots are mechanical devices that can perform physical tasks under human supervision and control, or through programs built into the processor. The term robot comes from the Czech "robot". It means coolies or workers who are tireless and bored (Yoel Anggun, 2015). Robots are used in a variety of ways, including industry, education, and health. Industrial and medical robots are generally designed to perform tasks that require a high degree of accuracy and precision in complex designs. On the other hand, educational robots are designed to be simple and easy to use. The purpose of this study is to simulate a robotic arm that distinguishes product types based on color and can automatically move products based on a microcontroller according to programmed instructions. The problems that arise are only limited to making an ultra-bright LDR sensor circuit that is used as a path reader, but the color sensor uses a series of LEDs and photodiodes as color detectors.

METHODS

Block Diagram

A block diagram is a simplified circuit diagram that shows a sequence of one or more circuits with their own unit of operation. Not having a certain size or shape is a hallmark of block diagrams.

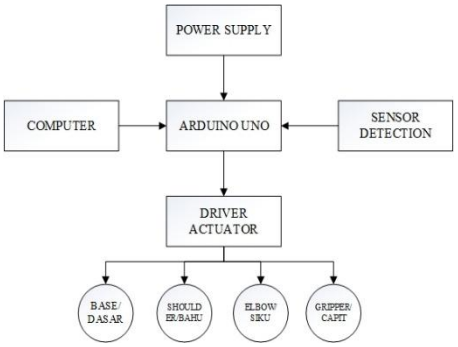

Figure 1. Block Diagram

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Flowchart System

In order to make it easier to conduct research, it is necessary to have a flow chart that helps design and build a color detection robot arm simulator using the fuzzy logic method, while the flow chart can be seen in the image below:

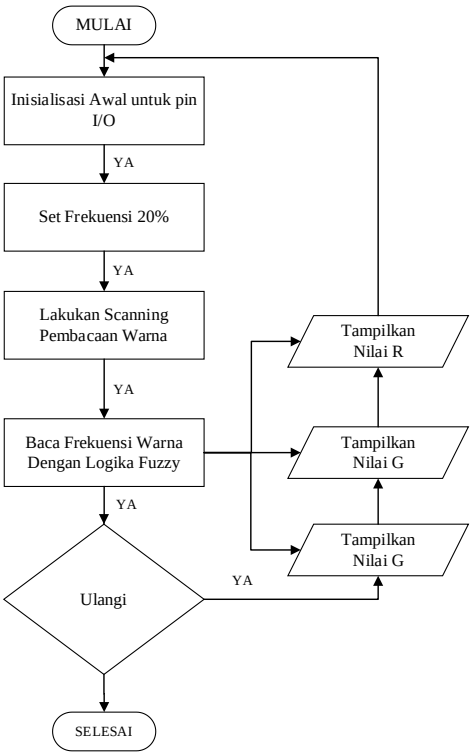

Figure 2. Flowchart System

Fuzzy Logic Rule Design

a. Membership Function Design

The error value input membership function consists of 5 sets, namely large negative (NB), small negative (NK), zero (Z), small positive (PK) and large positive (PB).

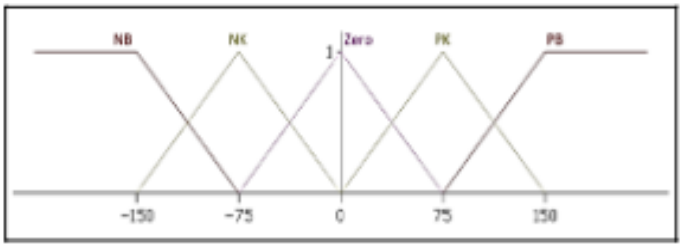

Figure 3. Membership Function

b. Fuzzy Rule Design

The fuzzy rules designed follow Table 1 below. The rules are designed in such a way that the robotic arm can follow the position of the human arm.

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Table 1. Fuzzy Rule

OR		error				
		NB	NK	Z	PK	PB
delta_error	NB	Kanan_SC	Kanan_C	Diam	Kiri_C	Kiri_SC
	NK	Kanan_SC	Kanan_C	Diam	Kiri_C	Kiri_SC
	Z	Kanan_SC	Kanan_C	Diam	Kiri_C	Kiri_SC
	PK	Kanan_SC	Kanan_C	Diam	Kiri_C	Kiri_SC
	PB	Kanan_SC	Kanan_C	Diam	Kiri_C	Kiri_SC

RESULTS AND DISCUSSION

Test Results

To be able to distinguish colors using the TCS3200 color sensor, the value obtained later is the value of the three basic colors, namely red, green, and blue. For that first is to calibrate each color used in the application. The colors used in the application are black, white and blue as diversion colors. This means only to be able to distinguish each color obtained. For the blue color, the robot will not take action if it finds a blue color on the sensor. The robot will get rid of the blue box to be able to continue on another color. Calibration on color can be seen in the following table:

Tabel 2. Colour Calibration On Robot Arm

Servo motor name	Pin used	Min PWM	Max PWM
BASE servo	0	700 ms	2400 ms
SHOULDER servo	1	1000 ms	2200 ms
ELBOW servo	2	900 ms	2200 ms
GRIPPER servo	3	700 ms	900 ms

After building a robot arm simulator by applying the fuzzy logic method, the results are as follows:

Figure 3. Colour Detection Robot Arm

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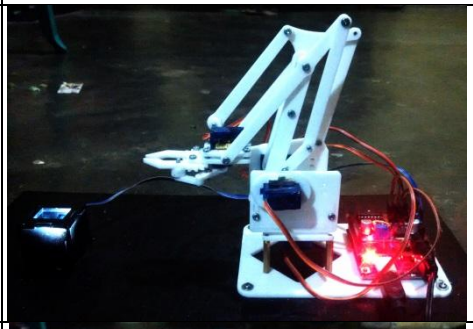
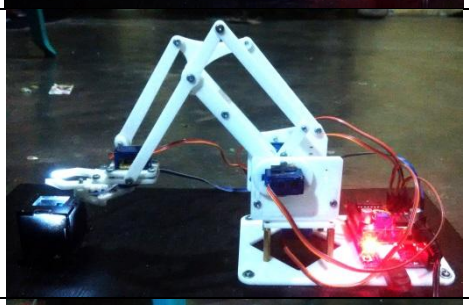
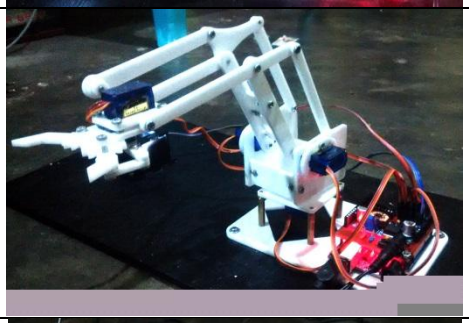
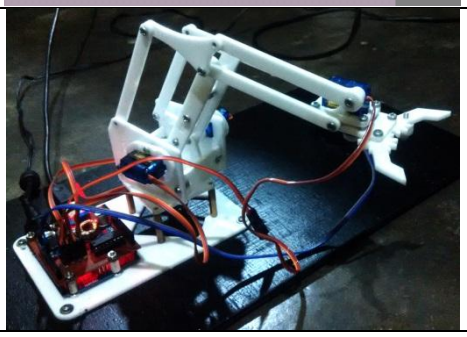
Color test results can be seen in the table below:

Table 3. Robot Arm Test

Action	Figure	Base Servo	Shoulder Servo	Elbow Servo	Gripper Servo
Parking		1500 ms	1200 ms	1300 ms	900 ms
Taking		1500 ms	1850 ms	1292 ms	700 ms to 900 ms
Place Left		2400 ms	1675 ms	1776 ms	900 ms to 700 ms
Place Right		700 ms	1675 ms	1776 ms	900 ms to 700 ms

CONCLUSIONS

As for the conclusions from the research on the application of fuzzy logic methods to this color detection robot arm simulator, several conclusions can be drawn including:

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1. Color detection robot arm simulator using ATMega 328P microcontroller, color sensor and servo motor.
2. The application of the fuzzy logic method on the color detection robot arm simulator is very effective and efficient so that it determines the color of the object correctly.

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