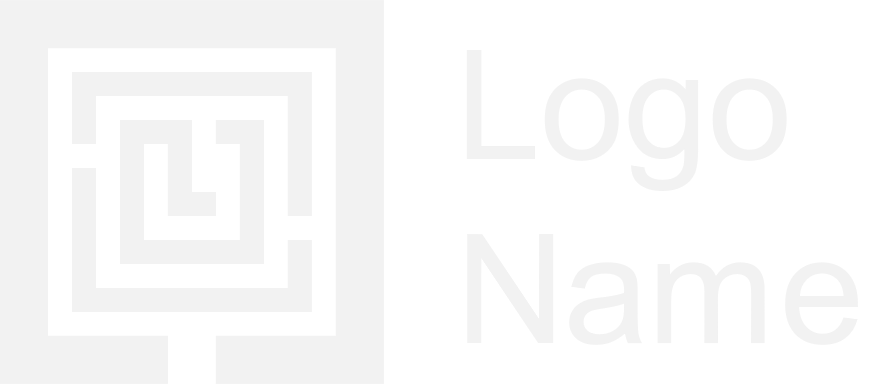


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| Mini ProjectFinal Report2022 2022 |
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| December 3  EGR 102 Mini-Project  Authored by: Andres Aguirre |



# Title Heading

# Note that this page is inserted in reports for approvals, signatures, date/time stamps, notice of publication dates, dedications by the author, and recognitions of funding/resource/guidance for the project.

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## Overview

For the EGR 102 Mini Project, you were tasked with creating a circuit and sensor, code, and mechanical device that would work to identify three different chosen materials. The project was split into three different parts, with each one focusing on a different area. In the end, each part would be important to help reach the final goal. The first section of the project was constructing the circuit and sensor which incorporated an LED, photoresistor, and servo motor, which were all previously used in other assignments. Next the code was created in MATLAB and used various ideas such as loops and if statements, which were also covered throughout the course. Lastly, the mechanical build was constructed with the servo motor to show the user which material was being sensed.

Finally, each separate piece would come together to create the final mechanical device and sense the materials. The code would control the circuit and sensor, which would detect the material, and as a result, would cause the mechanical device and servo motor to move and point to which material it was sensing. Overall, the device was effective in doing its task, and it was easily able to differentiate between the materials, as well as output to the user which material it was detecting.

## Sensor Design

When creating the sensor many problems were quickly brought up that needed to be accounted for. For example, how would you control ambient lighting, or make sure that the photoresistor wasn’t too close to the LED? However, all these concerns were resolved, and the sensor’s design was effective in minimizing any external forces that could alter the photoresistor’s readings. To start, the LED and photoresistor were placed in a sealed and closed cup to reduce the ambient light surrounding it. Inside the cup, there was a divider placed between the LED and photoresistor to make sure that the LED was too close and that the reading of the photoresistor only accurately measured the reflected light from the material.

A hand holding a white clock

Description automatically generated with low confidence

Figure 1: Sensor Design

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| Circuit Design In the figure below, a schematic of the built circuit is shown, demonstrating the three key main features of it, the LED, photoresistor, and servo motor. The LED’s have voltage going to them through PWM, and are therefore connected to the D5, D6, and D7 pins to control when they turn on or off. Each LED also has a 330 ohms resistor connected to it. The photoresistor is connected to 5 volts from the arduino, a 10k resistor, and to both ground and A0, so that voltage can be read. Lastly, the servo motor’s red wire connects to 5 volts from the arduino, its brown wire connects to ground, and its yellow wire needs PWM, so it’s connected to D9. One final detail is also that the 330-ohm resistor was selected to ensure that the correct amount of voltage was passed down to the LED, and the 10k ohm resistor was to figure out and read the voltage and find out the photoresistors resistance. **Diagram, schematic  Description automatically generated**Data Taken From Sensor Figure 2: Circuit Schematic  The three different materials used in this project were a wooden desk, red plastic, and blank paper. On average, the blank paper reflected the most amount of light back for all LED colors. Subsequently, the wooden desk had the next highest amount of light reflected for the blue and green LEDs but not the red. Lastly, the red plastic reflected the least amount of light for the blue and green colors, yet it had a higher red reflection then that of the wooden desk.   |  |  |  |  | | --- | --- | --- | --- | | **Sample** | **Average reading** | **Maximum Reading** | **Minimum Reading** | | Red – wooden desk | 3.833822092 | 3.934506354 | 3.797653959 | | Green – wooden desk | 3.190615836 | 3.377321603 | 3.108504399 | | Blue – wooden desk | 2.545454545 | 2.727272727 | 2.434017595 | | Red – blank paper | 4.436950147 | 4.442815249 | 4.428152493 | | Green – blank paper | 4.223851417 | 4.242424242 | 4.193548387 | | Blue – blank paper | 3.764418377 | 3.778103617 | 3.743890518 | | Red – red plastic | 4.06744868 | 4.076246334 | 4.061583578 | | Green – red plastic | 2.999022483 | 3.035190616 | 2.913000978 | | Blue – red plastic | 2.208211144 | 2.253176931 | 2.130987292 |   Table 1: Average, Min, and Max readings Decision Tree After collecting the data with the sensor, and inputting it into the algorithm, a very simple and direct decision tree was created. As seen in figure 3, the decision tree only relied on x1 to determine which material was being sensed; there was no need for it to use x2 or x3. However, it is important to know what these numbers represent. In the algorithm, x1 is the reflected red light, x2 is the reflected green light, and x3 is the reflected blue light.  Diagram  Description automatically generated  Figure 3: Decision Tree Final Performance Over a repeated trial of 5 tests, the device worked one hundred percent of the time and was accurate in sensing the right material. It did not have any difficulties differentiating between the three different materials.  Figure 4: Bar Graph of Trial Number vs Success  The final mechanical build was made using a paper plate and pointer. The servo motor was placed through a hole where it was then allowed to move between pointing to the left, middle, or right, representing a different material.  A picture containing text  Description automatically generated  Figure 5: Mechanical Device |
| The three different materials chosen for this project were a wooden desk, red plastic, and blank paper. The selected LED colors were red, green, and blue which were used to help detect the sensed material. |

Appendix

## Appendix A: Control Program Flow Chart

Diagram

Description automatically generated

Figure 6: Control Program Flow Chart

## Appendix B: Control Program Code

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Mini Project - Uses various ideas learned in EGR 102 to create one

final project

Author: Andres Aguirre

Assignment: EGR 102-012 Week 15 Mini Project

Changed: 1 December 2022

History: 16 November 2022 - Initial version

1 December 2022 - Final edits

Purpose: This code uses many of the skills learned in EGR 102 to create a

final code that brings together the content learned in the class. By using

a photoresistor and a LED circuit, the code measures the reflected light of

a certain material, which will then be ran through a series of if

statements. Finally, the code will then move the position of a servo motor

to demonstrate what material, it is sensing.

%}

clear;

a = arduino();

% Connect to servo

s1 = servo(a, 'D9', 'MinPulseDuration', 700\*10^-6, 'MaxPulseDuration', 2300\*10^-6)

writePosition(s1, 1);

count = 1;

% Create a while loop and prompt user to insert material

while(count > 0)

disp("Enter the material under the sensor");

count = input("Type 1 when ready: ");

pause(1);

% Measure under red light

writeDigitalPin(a, 'D5', 1); % on

pause(0.1);

red = readVoltage(a, 'A0');

pause(0.1);

writeDigitalPin(a, 'D5', 0); % off

pause(0.1);

% Measure under green light

writeDigitalPin(a, 'D6', 1); % on

pause(0.1);

green = readVoltage(a, 'A0');

pause(0.1);

writeDigitalPin(a, 'D6', 0); % off

pause(0.1);

% Measure under blue light

writeDigitalPin(a, 'D7', 1); % on

pause(0.1);

blue = readVoltage(a, 'A0');

pause(0.1);

writeDigitalPin(a, 'D7', 0); % off

pause(0.1);

if (red < 3.99804)

disp("wooden desk");

writePosition(s1, 0);

elseif (red < 4.2522)

disp("red plastic");

writePosition(s1, 0.5);

else

disp("blank paper");

writePosition(s1, 1);

end

% Prompt user if they would like to continue or stop

count = input("Press 1 to continue, or 0 to end the code: ");

end