LAB REPORT

MCTA 3203

SECTION 1

GROUP D

EXPERIMENT 9a

Image/Video input interfacing with microcontroller and computer based system: Software and hardware

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Abstract

The subsequent report consists of comprehensive details on an experiment conducted in the field of mechatronics system integration. The experiment involves creating Image/Video input interfacing with a microcontroller and computer based system, software and hardware for colour detection and analysis. In this experiment we build a system using an Arduino Uno and Pixy camera to detect three different coloured objects. The system involves hardware setup including connecting the pixy camera to the Arduino Uno through the UART interface along with ensuring appropriate power supply to Arduino Uno and also colour calibration using PixyMon software wherein we configured the colour signatures for three objects before initiating the detection process.

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Introduction

In this experiment, we will use a Pixy camera to capture image /video input interfacing with Arduino UNO R3 and Python. The main objective of this experiment is to build a system using an Arduino Uno and Pixy camera to detect three different coloured objects, which are RGB colours (red, green, and blue). The Pixy camera is linked together with Arduino UNO R3 and I2C. Because the Pixy camera is capable of detecting the colours, we use Python to code the configuration and we also use PixyMon software to configure colour signatures for each of the three objects. Based on this experiment, we learn that there is a specific colour signature for every colour that exists in this world and there are various ways to use colour detection techniques.

Materials and Equipment

1. Pixy camera
2. Arduino UNO R3
3. I2C module
4. Jumper wires
5. Breadboard
6. RGB LED
7. Computer with Arduino IDE and Python installed
8. USB cable for Arduino UNO R3
9. Arduino board
10. Servo motor

Experimental Setup

Hardware setup:

1. The Pixy camera was connected to the Arduino Uno.
2. For the I2C interface, the GND, +5V, SDA, and SCL pins were connected.
3. The servo motor was connected to the Arduino.
4. All connections were tightened and secured.
5. The Arduino Uno was powered either via USB or an external power supply.

Programming:

1. The Pixy camera was calibrated for the three different coloured objects.
2. The Pixy camera was connected, and colour signatures for each of the three objects were configured using PixyMon.
3. The Pixy Library in the Arduino IDE was downloaded.
4. A code for the colour detection and servo motor rotation was written.

Methodology

Procedure:

1. RGB colour has been searched on the website to set up the colour into the Pixy camera.
2. The camera was placed to face the RGB colour on the screen and the colours were selected to be assigned as variables using PixyMon.
3. The Pixy camera was connected with the laptop to upload the Arduino code.
4. The code for the Arduino board was uploaded into the microcontroller using Arduino IDE.

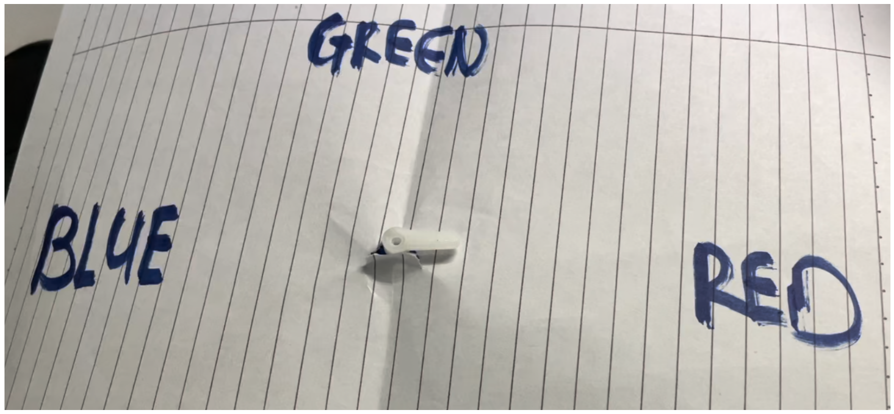
Arduino code:

```
#include <Pixy.h>
Pixy pixy;

#include <Servo.h>
Servo myservo;

void setup() {
  Serial.begin(9600);
  pixy.init();
  myservo.attach(8);
}
void loop() {
  int blocks = pixy.getBlocks();
  if (blocks) {
    for (int i = 0; i < blocks; i++) {
      Serial.print("Block ");
      Serial.print(i);
      Serial.print(": ");
      Serial.print("Signature: ");
      Serial.print(pixy.blocks[i].signature);
      Serial.print(" X: ");
      Serial.print(pixy.blocks[i].x);
      Serial.print(" Y: ");
      Serial.println(pixy.blocks[i].y);

      if (pixy.blocks[i].signature == 1) {
        myservo.write(0);
      } else if (pixy.blocks[i].signature == 2) {
          myservo.write(90);
      } else if (pixy.blocks[i].signature == 3) {
          myservo.write(180);
      }
      delay(100);
    }
  }
}
```

Results (Observation)

90°

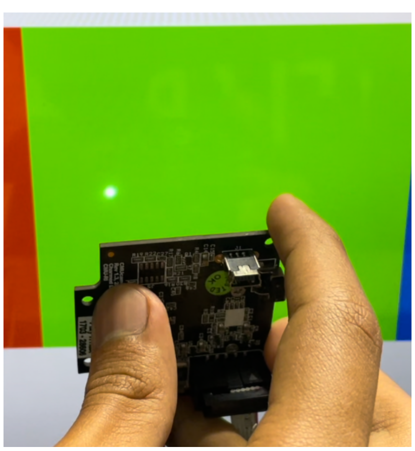
180°



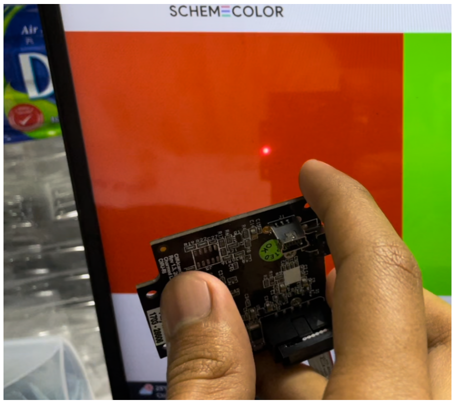
0°

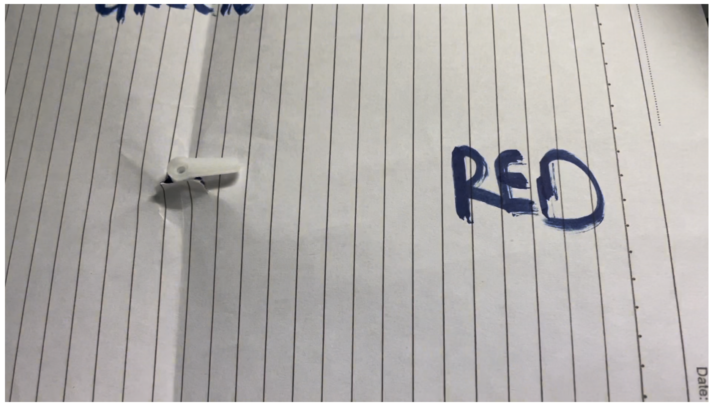
Case 1 - when the colour detected is BLUE:

Case 2- when the colour detected is GREEN:



Case 3- when the colour detected is RED:





Link for the video:

https://drive.google.com/file/d/1w6UHc2APfbnmz29Z8QkeMp67WohdDDEW/view?usp=sharing

Discussion

In our test, the pixy camera is able to find and tell the difference between colours. Green, blue, and red are the three colours that were picked up. From what we've seen, the findings are correct. On the serial interface of Arduino IDE, the right data is shown if the pixy camera picks up on this colour. Colour recognition happens very quickly, and the result is shown on the serial monitor right away.

To get accurate recognition, we changed the range of colour patterns in the PixyMon software's settings. This means that the range of blue is shrunk while the ranges of red and green are widened. This is because the pixy camera shows a blue picture of the background. These are the results of tests done in different lighting conditions: It's possible to see the green, red, and blue in normal, bright, and dim light. But when the room was dark, the Pixy camera couldn't see any colours. This shows how good the Pixy camera is and how flexible the system is, which lets it be used for many things.

In this experiment, we configure the camera's pixy output to control the movement of the servo.When the servo is red, it is positioned at 0 degrees.However, when the colour is green, the servo is positioned at 90 degrees, and when the colour is blue, the servo is positioned at 180 degrees.The output is displayed with precision.

Conclusion

To summarise, the Pixy camera exhibited dependable colour detection with immediate outcomes in our trial. Although it performs well in a range of lighting settings, its inability to function effectively in dark areas highlights the necessity for supplementary illumination options, confirming its general adaptability for different uses.

Recommendations

To begin with, investigate the incorporation of machine learning techniques to augment the adaptability and recognition capabilities of the system. Training a model for the specific recognition of objects can enhance the accuracy and dynamism of detection, particularly when confronted with diverse object shapes, sizes, or orientations. Explore machine learning libraries compatible with Arduino to facilitate the seamless integration of these techniques.

Next, consider the development of an intuitive user-friendly interface to elevate the system's usability. A graphical user interface (GUI) has the potential to furnish users with a visual representation of detected objects and their corresponding information. This not only enhances user interaction but also streamlines troubleshooting and facilitates effective system monitoring.

Finally, broaden the scope of objects and scenarios tested to verify the system's effectiveness across a spectrum of conditions. Introduce objects with diverse textures, shapes, and colours, surpassing the initial three selections. Assess the system's reliability and versatility by testing it in scenarios featuring intricate backgrounds, dynamic lighting variations, and various object arrangements. This comprehensive testing will ensure the system's robust performance in real-world applications.

Acknowledge

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References

1. https://dronebotworkshop.com/pixy2-camera/ Pixy2 Camera – Object Recognition with Arduino & Raspberry Pi
2. https://www.youtube.com/watch?v=391dXDjqzXA Pixy2 Camera - Image Recognition for Arduino & Raspberry Pi (2018) 38'
3. https://www.youtube.com/watch?v=Y7V7uf4-v70 Arduino Prototyping Inputs #63: Image Tracking with the PIXY! Camera (2019)

Student's Declaration

Certificate of Originality and Authenticity

This is to certify that we are responsible for the work submitted in this report, that the original work is our own except as specified in the references and acknowledgment, and that the original work contained herein has not been untaken or done by unspecified sources or persons.

We hereby certify that this report has not been done by only one individual and all of us have contributed to the report. The length of contribution to the reports by Each individual is noted within this certificate.

We also hereby certify that we have read and understand the content of the total report and no further improvement on the reports is needed from any of the individual contributor to the report.

We, therefore, agreed unanimously that this report shall be submitted for marking and this final printed report has been verified by us

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