LABORATORY REPORT

MECHATRONICS SYSTEM INTEGRATION

MCTA 3203

SEMESTER 2 2023/2024

WEEK 9

LAB: COLOR DETECTION AND ANALYSIS

SUBMISSION DATE:

GROUP: 6

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ABSTRACT

This experiment explores the use of the Pixy camera, a beginner-friendly vision sensor designed to integrate with microcontrollers such as the Arduino Board. The primary focus is on detecting and tracking objects based on their color signatures, which is essential for applications in quality control, automation, and interactive projects. Ensuring secure hardware connections and performing accurate color calibration are critical steps in the process. The PixyMon software is utilized to configure and verify color signatures, enabling the Pixy camera to effectively distinguish between different colors. This study demonstrates the potential of the Pixy camera for various practical applications by emphasizing the importance of proper setup and calibration.

INTRODUCTION

The Pixy camera is a user-friendly vision sensor designed for seamless integration with microcontrollers, such as the Arduino Board. It is capable of detecting and tracking objects based on their color signatures, which positions it as a valuable tool for a variety of applications, including quality control, automation, and interactive projects. This lab report investigates the process and effectiveness of using the Pixy camera for object detection and tracking. Emphasis is placed on the importance of secure hardware connections and the critical step of accurate color calibration. Proper color calibration ensures the Pixy camera can accurately identify and distinguish between the colors of targeted objects.PixyMon software is employed to configure and verify these color signatures, thereby enhancing the camera's tracking performance.This report aims to provide a comprehensive overview of the procedures and outcomes associated with optimizing the Pixy camera for specific experimental applications.

MATERIALS AND EQUIPMENT

1. Pixy Camera: Vision sensor capable of detecting and tracking objects based on their color signatures.
2. Arduino Board: Microcontroller board to interface with the Pixy camera.
3. PixyMon Software: Software used for configuring and verifying color signatures detected by the Pixy camera.
4. USB Cable: For connecting the Pixy camera to a computer for configuration via PixyMon.
5. Connecting Cables: Wires to connect the Pixy camera to the Arduino Board.
6. Power Supply: Appropriate power source for the Arduino Board and Pixy camera.
7. Colorful Objects: Objects with distinct colors for the Pixy camera to detect and track.
8. Computer: For running PixyMon software and programming the Arduino Board.
9. Breadboard (optional): For prototyping and making secure connections between components.
10. Resistors and Jumper Wires: For creating stable electrical connections on the breadboard.
11. Stand or Mount: To position and stabilize the Pixy camera during the experiment.
12. Arduino IDE: Integrated Development Environment for programming the Arduino Board.
13. Screwdriver Set: For assembling and securing hardware components.
14. Notebook and Pen: For recording observations and data during the experiment.

METHODOLOGY

1. Setup and Hardware Connection
    - Connect the Pixy camera to the Arduino Board using the appropriate connecting cables. Ensure that all connections are secure and correctly aligned with the specified ports.
    - Connect the Arduino Board to the computer using a USB cable for power and programming purposes.

2. Power Supply
    - Ensure that the Arduino Board and Pixy camera have a stable power supply. Use an external power source if required to maintain consistent power levels.

3. Software Installation and Configuration
    - Install the PixyMon software on the computer.
    - Launch PixyMon and connect the Pixy camera to the computer via USB cable.
    - Follow the on-screen instructions in PixyMon to calibrate the camera. This involves selecting and saving the specific color signatures of the objects to be detected.
    - Configure the Pixy camera settings through PixyMon to optimize detection accuracy and tracking performance.

4. Programming the Arduino Board
    - Open the Arduino IDE on the computer.
    - Write a program to interface with the Pixy camera, utilizing its library functions to process the color signature data and control the Arduino's response.
    - Upload the program to the Arduino Board using the Arduino IDE.

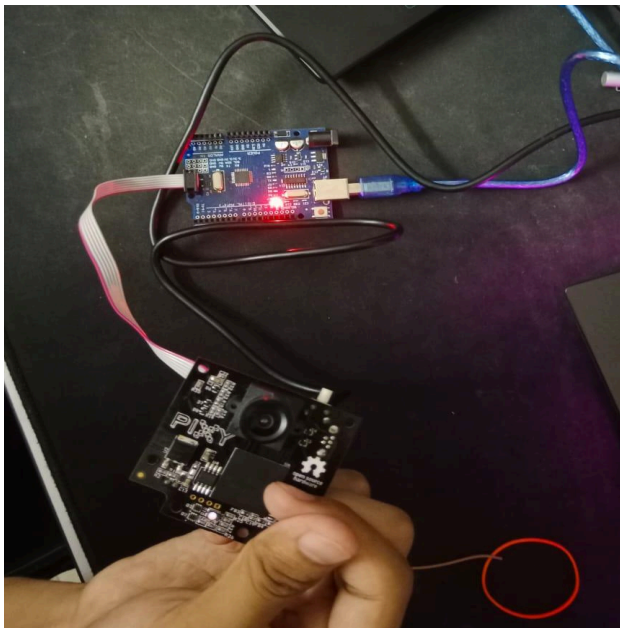
5. Calibration and Testing
    - Position the colorful objects in the camera’s field of view.
    - Use PixyMon to adjust and fine-tune the color signatures, ensuring the Pixy camera can reliably detect and differentiate each object.
    - Conduct initial tests to verify that the Pixy camera correctly tracks and identifies the objects based on their colors.

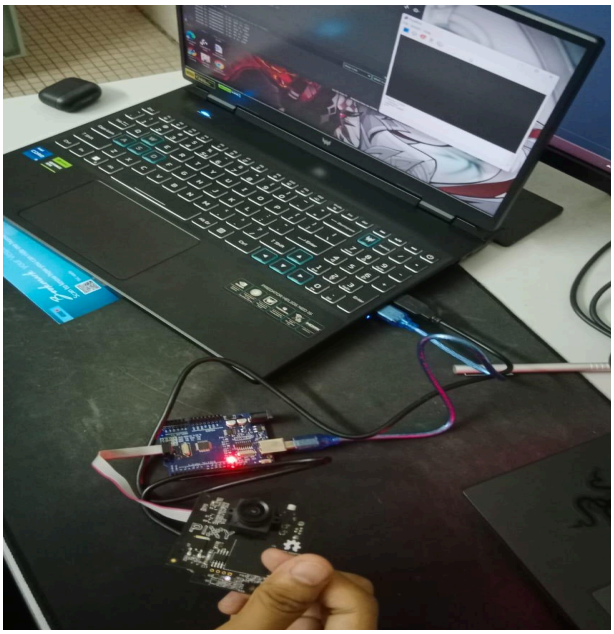
6. Experiment Execution
    - Run the experiment by allowing the Pixy camera and Arduino Board to operate autonomously.
    - Observe the system’s performance in real-time, noting any discrepancies or issues with object detection and tracking.
    - Make necessary adjustments to the color calibration or Arduino program based on observations.

7. Data Collection and Analysis
    - Record the results of the object detection and tracking, including the accuracy and consistency of the Pixy camera.
    - Analyze the data to determine the effectiveness of the color calibration and overall system performance.
8. Documentation
    - Document all steps of the experiment, including setup, calibration, programming, and observations.
    - Include any troubleshooting steps taken and adjustments made to improve the system's performance.

9. Conclusion
    - Summarize the findings of the experiment, highlighting the Pixy camera's capabilities and limitations.
    - Provide recommendations for further improvements or potential applications based on the experimental results.

RESULTS





DISCUSSION

The Pixy camera is a beginner-friendly camera with a vision sensor that can be integrated with microcontrollers like the Arduino Board. It has the ability to detect and track objects based on their colour signatures. This makes it suitable for many applications such as quality control, automation or interactive projects.

In the experiment, it is very important to make sure that the connection between the hardware is secured. The colour calibration step is particularly important, as it allows the Pixy camera to accurately identify the specific colours of the objects you want to detect. Then we can utilize the PixyMon software to configure the colour signatures and to ensure that the camera can distinguish between the colours correctly.

CONCLUSION

The experiment of building a system using an Arduino Uno and Pixy camera to detect three different coloured objects is a good demonstration of how to integrate computer vision technology with control from a microcontroller. The experiment showcases the potential of combining affordable hardware components like the Arduino Uno and Pixy camera to create innovative projects. It also highlights the importance of proper hardware setup, power management, and colour calibration in ensuring the reliability and accuracy of the object detection system.

RECOMMENDATIONS

- We can enhance the detection algorithm which can provide more details such as object shape, distance between the camera, etc.
- We also can integrate additional sensors. For example, an infrared sensor to add proximity detection if the object is nearby
- Other than that, we can develop a user interface, which will visualise the object that has been detected by the sensor and camera showcasing its colours and shapes or other included details.

ACKNOWLEDGEMENT

A special thanks goes out to Dr. Wahju Sediono, Dr. Ali Sophian, Dr. Zulkifli Bin Zainal Abidin, our teaching assistants and our peers for their invaluable help and support in finishing this report. Their advice and guidance have greatly improved the quality and understanding of the project. Their commitments are greatly appreciated.

STUDENT DECLARATION

We, hereby declare that this project is entirely our own work except the documents that were given as references. Any external sources utilized for reference or inspiration have been properly cited and credited.

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