Ping-Pong Playing Robot:
Computer Vision

Final Project

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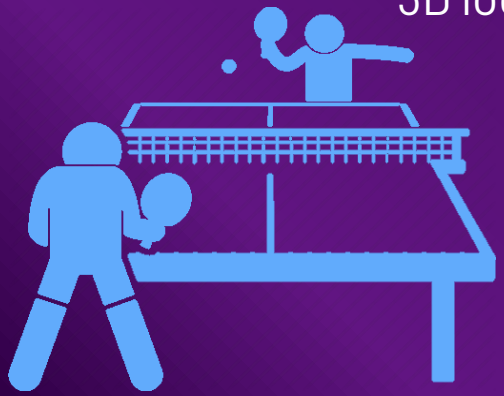
Introducion

The main goal of the project is to create a delta robot which plays ping-pong efficently. This robot must be able to have access to information such as the ping-pong ball's 3D location and speed, Thus the need for a computer vision field in this project arises



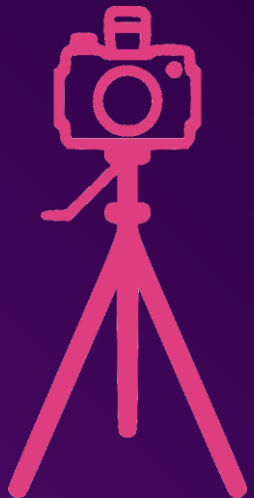
01 Purpose

Main Vision Goals

Throughout the many tasks in the computer vision field, some of the main tasks include:

- Tracking the ping-pong ball and getting the real-world 3D coordinates of it
- Obtaining the speed of the ping-pong ball
- Plotting the trajectory of the moving ping-pong ball
- Predicting the ping-pong ball's movement based on the current trajectory
- Tracking the ping-pong racket by obtaining the Euler angles of it

These tasks have successfully been achieved by implementation in Matlab



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Setup

Setup Requirements

Two Cameras

Used for tracking

Checkerboard

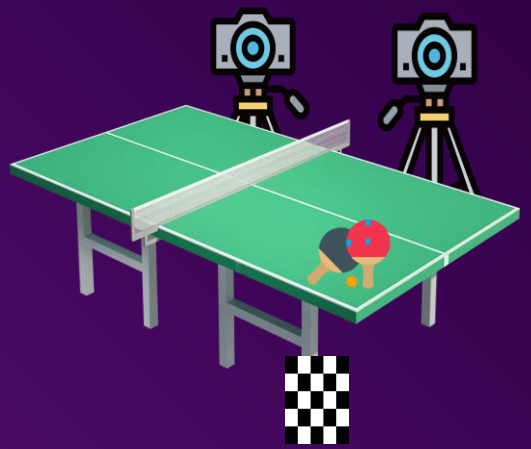
Used for Stereo Calibration

Marked Racket

Markers used to find racket euler angles

Colored ping-pong ball

Distinguished color used for easier tracking



Setup Tips

- The cameras should at least support 60 FPS to ensure high quality results
- It's best for both cameras to be the exact same model
- Both cameras should approximately be pointing in same direction
- The size of the checkerboard should at least be 297 x 420 mm

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Task Details

Tracking Objects

Color Thresholding

Color masks are created in order to separate colored objects from the enviornment. This is used in order to track the ping-pong ball and racket's markers

Calculating Speed

By comparing the real world locations of the object in two consecutive frames, and considering the FPS of the cameras, it's possible to calculate the speed at any time

Tracking Objects

Racket Tracking

Tracking of racket is performed by placing three markers on various locations of the racket.
For each of these markers, the real world locations are found, and then a rotation matrix is constructed.

Trajectory

Plotting Trajectory

By putting together all of the coordinates of the ping-pong ball throughout different frames, the trajectory of the ping-pong ball can be plotted

Predicting Points

By Considering the current velocity of the ping-pong ball in each of the X-Y-Z axis, and gravity acceleration, it is possible to predict where the ball will be in the next frames

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Future Work

On-line implementation

Since the current method relies on off-line videos to be given as input, the next logical step for this project is to take what we have here, and make it so our system is able to track the objects in real-time!

In order to do this, it may be reasonable to study on how to integrate functions OpenCV in Matlab.

Thanks for your attention!