SHOWCASE

INTRODUCTION

The students of IITJ can now showcase their achievements to the IITJ Junta.

Students are getting the chance to present their research/projects/achievements during NIMBLE via a poster presentation event.

EVENT RULES AND SPECIFICATIONS

1. RULES

- Presenter will be given space to present his/her idea in front of the crowd.
- The presentation will be held like an exhibition.
- Students/teams will have to submit their posters (Example Template given below) before the given deadline, which will be printed and displayed behind the presenter at the time of presentation.
- The students can also bring prototype if available.
- The specifications of the poster are:
  - The poster should be made to be printed on A0 Size (1189mm X 841 mm).
  - The images should be placed in highest quality available, thus increasing the clearness and readability.
- The following elements should be included in the poster:
  - Title of the project.
  - Team members details, name of the supervisor.
  - Abstract.
  - A brief introduction of the project.
  - Methods used/ outcomes generated/results along with the graphs/pictures of the observation.
  - Future possibilities in the project/work to be done.
  - References/bibliography/special credits.
  - Please keep the written content short and precise. Try to incorporate pictorial representations more.
  - Changes to the layout can be done as per requirements.
  - Students registered for the event will get an email containing the editable template file which can be used to make the poster.
  - An example template of the poster is given below:

CONTACT DETAILS

Aksh chordia (9530200403)

Object Tracking and Visual Servoing of Ball using UR5 Robotic Arm

Kartik Ramachandruni, Shivam Jaiswal (Final year B-Tech students, Mechanical Engineering, IIT Jodhpur)
Under the guidance of Dr. Suril V. Shah, Assistant Prof., IIT Jodhpur

Abstract

The initial objective of our project is to perform object tracking of a circular object (ball) using UR5 collaborative robot. Two-dimensional (tracking in X, Y directions) tracking is achieved using a monocular camera system, while Three-dimensional (by generating disparity map and 3-D point cloud) will be done using stereo-camera setup.

After completing the initial objective, the next step will be to perform a hitting action on a free-flying ball by estimating its trajectory in real time in order to predict the optimal striking point and successfully deflect the ball.

Introduction

UR5 is a collaborative 6-DOF robotic arm developed by Universal Robotics. Control of UR5 robot is being done using ROS environment, which is a software framework for robot software development. The main advantage of using ROS is that it is an open-source platform that can easily be integrated with all types of hardware.

The current work on real time object detection (predicting trajectory of ball) followed by catching and hitting algorithms have many applications. An application of human-robot interaction is the playing of table tennis where the prediction system has to continuously track the ping-pong ball and successfully return the ball to its opponent player. Another application can be in industrial applications where objects need to be picked up from a conveyer belt.

Fig. 1. UR5 collaborative robot.

Fig. 2. Human robot interaction: Ping-Pong playing robotic arm

Methods and Materials

1. The first task is visual servoing for tracking the ball in 2D. This task required us to use pin-camera model for determining the X and Y coordinates of the object from its image coordinates, as shown in Fig. 3. PID control is then used in configuration space in order to follow the object.

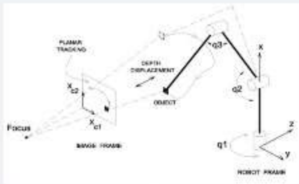

Fig. 3. Pin-Camera Model.

2. Second task is to do same tracking by also obtaining the depth dimension. Stereo cameras achieve this task by triangulating its position using the two images obtained from both its cameras. In our case, the Microsoft Kinect has two cameras along with an IR sensor for accurate estimation of depth.

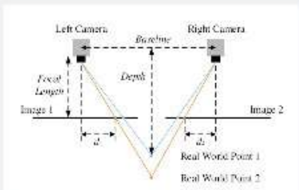

Fig. 4. Stereo Camera model

3. Third task is to estimate the optimal location of hitting the free flying object. The above 3D object tracking algorithm along with trajectory estimation of the flying object will provide us with the intersection of the balls trajectory with the workspace of the robot, allowing us to further perform path planning.

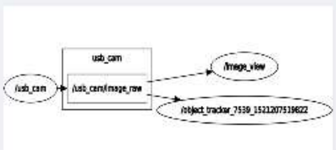

Fig. 5. RQT graph showing ROS environment for 2D object tracking

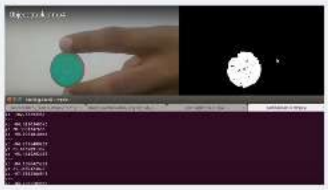

Fig. 6. Blob detection using Monocular Camera

Fig. 7. 3D point cloud using Microsoft Kinect

Further Work

After achieving successful deflection of the ball these are some of the additions we would like to implement:

1. Implement hitting algorithm for rebound model of the ball as well. This can be done using learning algorithms in order to estimate the elastic coefficient of rebound and is very useful for a game playing application.
2. Object catching for a linear object (ball object considered as point object). Again, this task requires us to either explicitly model the non-linear dynamics of the linear object or use learning by demonstration techniques to teach the robot successful capture trajectories.

References

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