EE106A/206A / BIOE125

Project Proposal

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1 Contact Information

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2 Abstract

Our project aims to control Baxter using our own arm as reference. It will make use of an IMU and an IR camera in order to track the user's arm position and orientation. The IMU will be placed on the user's hand, and moving and rotating the user's hand will result in Baxter's end-effector going through the same movements and rotations.

3 Project Description

- **What are your project goals?**
  To build 3D tracker to translate arm position/ orientation onto Baxter.
- **What does your project do? What design criteria must your project meet?**
  Use the IMU to track orientation of the hand which will be translated to the orientation of the Baxter Hand. Use IR cameras to determine the 3D position of the hand to determine Baxter's arm position. Our project must include sensing, planning, and actuation. It must be fairly unique, robust, and accurate.
- **Why is your project interesting?**
  IMU and IR camera provide 3D orientation and position data of a moving hand. Based on those data, the robot controller can generate the motion command to the Baxter which leads the Baxter's arm to follow the motion of the moving hand.
- **How does your project incorporate sensing, planning, and actuation?**
  Our project requires sensing the end effector orientation through the IMU and position through IR sensors. Based on the sensor readings, we would translate that into Baxter's possible position ranges and move the Baxter accordingly.
- What similar work have other groups done before? How is your work different? Based on our initial checking, there were no projects that involved the use of an IMU sensor and IR camera to manually control orientation and position.

4 Tasks

1. **Build the controller** We will build the controller using an IMU .
2. **Code the controller**
3. **Implement IR camera**
   (a) **Get IR readings** Be able to acquire IR position from the sensor output
   (b) **Process IR Readings** Translate sensor output to usable position data
4. **Implement communication nodes**
   (a) **Develop publisher node** This node will send data from IMU and IR sensor
   (b) **Develop subscriber node** This node will receive data from IMU and IR sensor and control Baxter's movements
5. **Implement robotic control system**
   (a) **Code robotic control system** This node will result in Baxter moving to the desired position/orientation
6. **Develop communication node**
   (a) **Code communication node** This node will create a channel through which the microprocessor (RaspberryPi) can communicate with the computer
7. **Implement flex-sensor** If we have time
   (a) **Add flex-sensor to controller**
8. **Code flex-sensor** If we have time
   (a) **Develop flex-sensor code** Add code to publisher/subscriber to send/receive data from flex-sensor and use it to control Baxter's gripper

5 Milestones

Presentation Deadline: Dec 7

1. IMU Sensor Data Acquisition Processing
   Preliminary Deadline - Nov 2.
2. IR Camera Data Acquisition Processing
   Preliminary Deadline - Nov 2.
3. Publisher/ Subscriber Layout/ Integration
   Preliminary Deadline - Nov 9.
4. Communication between microprocessor (RaspberryPi) and Computer Preliminary Deadline - Nov 16.
5. Baxter Controls
   - Nov 9.

6 Assessment

How will you test or assess your project? What constitutes a success? What are some realistic goals? What are some "reach" goals?

Main goals/tests include:

1. Working IR camera
   Success: IR camera reports correct position coordinates
2. Working IMU
   Success: IMU reports correct orientation data
3. Communication between IMU, IR camera, and Baxter
   Success: Baxter receives correct position and orientation data from sensors
4. Working robotic control:
   Success: Having Baxter move to the given position/orientation

"Reach" goals include:

1. Adding a flex-sensor in order to control Baxter's gripper

7 Team Member Roles

- Haopeng will be in charge of tasks (1) and (2). His background is in mechanical engineering. He has taken ME 131,ME 136,ME 135,ME 102B. He has rich experiences in using sensors.
- Amanda will be in charge of task (5). Her background is in EECS. She has taken EE192,CS188,CS164,EE120. She is skilled at programming to control ROS.
- Denny will be in charge of task (2) and (3). His background is in mechanical engineering, control theory, and multiple sensors using. He has taken ME132, ME102B, ME135. He will control the IR camera and make the robotics can have a view.
- Daniel will be in charge of task (2). His background is Electrical and Electronics Engineering. He has taken part in some projects, like obstacle avoider robot, size detection robot.Absolutely, he is a suitable person who can do the architecture part(subscriber/publisher nodes set up).
- Junlin will be in charge of (4).Her background is Electronic Information Engineering. She has taken part in some projects like unmanned aerial vehicle. Based on her experience, she can do the communication between on sensors and control systems.

8 Bill of Materials

8.1 Use of Lab Resources

Please include all lab resources you plan to use, so we can ensure that all teams have sufficient access to hardware. Please indicate which robot end effectors / grippers you plan to use, if applicable.

Item	**Quantity**
Baxter (or Sawyer) (w/ parallel gripper)	1
IR Camera	2

8.2 Other Robotic Platforms

We are only using Baxter(or Sawyer)

8.3 Items for Purchase

Item	Quantity	Price	Website	Justification
IMU Sensor	1	8.49	https://goo.gl/LqBXUu	Orientation tracker
Flex Resistor	2	7.95 (+ship)	https://www.adafruit.com/product/1070	Gripper controls