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Cosi 119a

Project Proposal for Robotics Arm interfacing

Overview

The goal of this project will be to implement a robotics arm to the campus rover (see Appendix A). This entails setting up the required low level hardware in arduino including rotation sensors. Then, We need to implement respond to ROS nodes such as twist messages (see robotics Arm interfacing sources). Two extension projects could be to program the arm to push an elevator button or pick up a package (see robot navigating elevator and robot picking up object).

This is an interesting project because it will contribute to the existing campus rover project, especially by creating a framework to easily add components to it. In addition, it will allow us to test the concept of interfacing by seeing if a user not familiar with the arm can control it with ROS. Finally, this project will allow us to learn the low-level details of ROS. If successful, this project will establish a framework for other contributors to add components to the campus rover using ROS best practices.

Background

I have researched existing tutorials and implementations of interfacing arduino components to ROS. Getting a motor to move with a ros command seems to be fairly well documented, but the challenge seems to be properly implementing abstracted interfaces. In other words, I can tell the servo to move, but I don't know how to tell it to respond to specified velocity messages.

Mini Plan

An order of tasks will be to:

- Move arm in arduino and report sensor data
- Build ROS wrapper class for Arduino
- Combine sensors and ros subscriber to implement nuanced motor control
- Show the arm is useful by using it for a campus rover task, or by picking up an object

To split the work between different students, one student could get the robot to move at all and implement ROS interfacing, and a third could implement advanced ROS interfacing with cmd vel responses. Then both students could work together on the application tasks.

Resources:

The existing robot arm can be used, but I need rotation sensors similar to the dynamixel motors on the turtlebot to implement advanced ROS commands.

Deliverables:

We will deliver:

- a well documented github repository of all the programs generated
- A video of the robot arm moving when responding to ros commands along with echos of ros nodes
- A video of the robot arm performing a campus rover extension task
- Documentation on how to interface arduino to a robotic arm, along with a new student's reflection on how useful it is

Assessment:

The project should be assessed on: how elegant the ROS- robot arm interface is, how well a student can replicate the interfacing given our documentation, and whether the arm can be used in the campus rover project.

Sources

Robotics Arm Interfacing

Robotic arm interfacing with ROS:
https://www.instructables.com/id/ROS-MoveIt-Robotic-Arm-Part-2-Robot-Controller/
Servo with Arduino https://www.youtube.com/watch?v=hQ_VP-s7Zpw
http://wiki.ros.org/rosserial_arduino/Tutorials/Servo%20Controller
http://library.isr.ist.utl.pt/docs/roswiki/rosserial_arduino(2f)Tutorials(2f)Servo(20)Controller.html
Arduino ROS Node for Car Control
https://www.jetsonhacks.com/2016/08/02/jetson-racecar-11-arduino-ros-node-for-car-control/
Arduino Interfacing for ROS projects
https://www.servomagazine.com/magazine/article/november2016_ros-arduino-interfacing-for-robotics-projects

Robot Navigating Elevator

Multi Degrees of Freedom Arm https://www.youtube.com/watch?v=FGQlG39j3hU
TurtleBot Style Robot https://www.youtube.com/watch?v=kJ32gqN9uj4
Simple Arm https://www.youtube.com/watch?v=3FtSVEFnlMY
Camera with Robot Arm https://www.youtube.com/watch?v=ECWLUy25ERo
Pole Arm https://www.youtube.com/watch?v=qyRWBqdiQzY

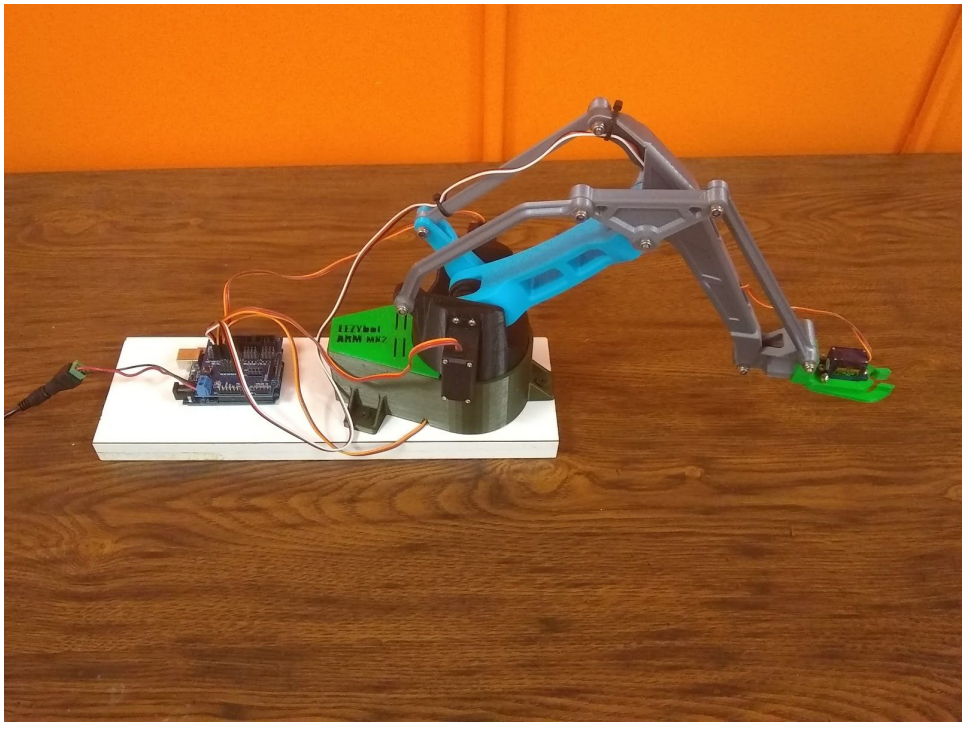
Robot Picking Up Object

Simple Arm Turtlebot style https://www.youtube.com/watch?v=4Z7sZMY43E8
Multi Degree Freedom Turtlebot arm https://www.youtube.com/watch?v=wZCPGiORz8k
https://www.youtube.com/watch?v=P82pZsqpBg0
https://www.youtube.com/watch?v=WrEXsStNUHk
Arm mounted off of robot https://www.youtube.com/watch?v=_z6LXOft7aQ
3d Printed arm https://www.youtube.com/watch?v=2RcTTqs17O8

Appendix A: Pictures

Current Campus Rover Iteration

EeezyBot Arm to Interface



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In Depth Project Proposal

Working summary

10/29/2019: I installed Arduino to the laboratory computer linux.

1) Install Arduino on Ubuntu
   https://www.youtube.com/watch?v=978Bs5gyFlU
2) Install this background library
   https://github.com/netlabtoolkit/VarSpeedServo
3) Use this command to solve the download permission error
   https://www.youtube.com/watch?v=kztOYM3TjlE , use USB instead of ACM