Robotics 41013: Lab Assignment 2

Total Subject Weight: 45%.
Group Size: 2
First Stage (group): Week 7 after Lab Class – 17:00 Monday 29th April. 17:00
Second Stage (individual): Week 9 Lab Class – 14:00 Monday 13th May
Video Submission (group): Week 11 – 23:59 Friday 31st May
Final Demonstration (group): Week 12 Lab Class – 14:00 Monday 3rd June
Final Report (individual): Week 12– 23:59 Friday 7th June
Final Viva (individual): assessment Period (after week 12). Bookings essential

Background:

After your success in introducing the robot into their assembly of parts, your company, SafeCo, is looking to expand their product range. SafeCo want to expand their business and are interesting in investigating the possibility of selling small robot systems to customers for use in the home, office or workplace. Management wants your team to spend a few weeks investigating the application of a small-scale pick and place manipulator, including integrated safety. SafeCo have made a small robot manipulator available for you to base and test your design on.


(a)


(b)


(c)


(d)

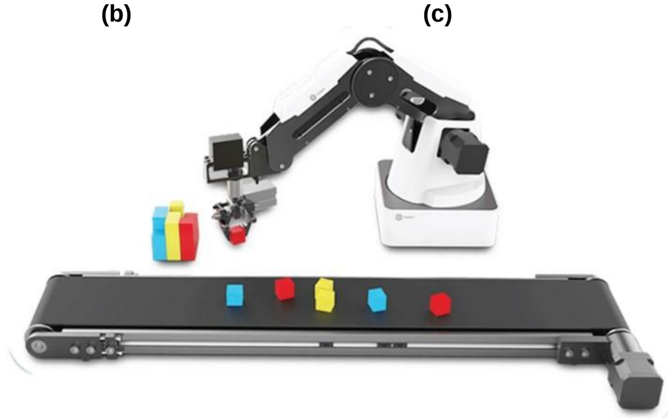
(e)

Fig 1. (a) Han's Cute[1] (previously Cyton 300e) with pincer (claw) gripper as the end effector, (b) Dobot Magician[2] with a pincer gripper end effector, (c) Dobot Magician with a suction cap gripper end effector, (d) Dobot Linear rail, (e) Dobot conveyor

SafeCo Pick-and-Place Task:

SafeCo wants you to consider a plausible application for a pick-and-place robot which can either have a pincer gripper or a suction cap gripper. The application must be something outside of the traditional factory (e.g. home, kitchen, office, car), and will involve the manipulation of (an) everyday object(s) in a novel way. There are likely to be possible collisions which your system must be able to avoid. So you need to include at least 3 forms of safety (e.g. barriers, active workspace sensing, signage, collision detection, collision avoidance and planning) modelled into your environment. Also sensor data (at least E-stop state, and simulated collisions and potentially RGBD camera data) should feed into your system.

Timeline Lab Assignment #2

Due Date	Week	Milestone	Worth	Description
Mon. 29th April 11:00	7	Distributed	0%	Assignment is distributed
Mon. 29th April 17:00	7	First Stage	2%	Team submits the following details via a Google Form[3]: • Names and students numbers of group members, • Team project title • 100 word description of intended project • The robot you intend to use and why • The BitBucket[4] project URL for your code (note if you make the project private please invite tutors to join)
Mon. 13th May 14:00	9	Second Stage	3%	• Progress report (1page & approx. 250 words) from each team member summarising progress. • Attach BitBucket commit summary in appendix for evidence of progress. • Spark+ report on participation of other team member(s)
Fri. 31st May 23:59	11	Promotion Video	10%	• Create 3-5 minute video promoting your system in which all group members clearly contribute. • Include footage of the system's purpose, its features and the system working.

[1] http://en.hansrobot.com/prod_view.aspx?TypeId=10&Id=174&FId=t3:10:3
[2] http://www.dobot.cc/downloadcenter/dobot-magician.html?sub_cat=73#sub-download
[3] Google Form to submit group details of Robotics 41013 Lab Assignment #2 http://goo.gl/c5weiF

[4] Atlassian's BitBucket web-based Git hosting service: http://bitbucket.org/

				• Upload to a sharing platform of your choosing (preferably YouTube), then share the link on the discussion board.
Mon. 3rd June. 11:00	12	Final Demo	39%	Final demonstration (**see detailed task breakdown**)
Fri. 7th June 23:59	12	Final Report & Group's Code	36%	Final report and assessment of group's code in the repository, and accuracy of self/peer marking (**see detailed task breakdown**)
Assessment period	A1-A2	Final individual code viva	10%	Each student will be examined closely on all the submitted code in a face-to-face viva (i.e. interview). For full marks assessors can ask any questions about the code, or bugs intentionally inserted into the code. No robots will be used in the viva (just simulated code). Students may request to be examined on only a portion of the code (which they wrote); however, their marks will be reduced accordingly.

Extreme-Difficulty Option (can be in a group of 3)

There is the option to take on the extreme difficulty option and you can work in a group of 3 students, with additional scrutiny during the Viva. This will require that you undertake one of the extended options that is expected to require significant unassisted use of ROS:

- Mobile Manipulation (Dobot on a Turtlebot unstructured navigate, pick and manipulate),
- Multirobot Collaboration (gripper design/manufacture and two UR3 robots doing handover or working together **without** direct communication). Sensor integration is a must for this task.

Final Submission (demo + report): Detailed Task Breakdown

Due: Week 12.

Worth 75% of the overall assignment mark

1) Build a simulated model of your chosen arm and environment (based upon your scenario)
2) On the submission day, separate to the video (submitted the week before), each team needs to demonstrate the system working both in simulation and ideally also on the real robot. The simulated system must include a user interface, safety hardware (e.g. barriers, warning signs/lights/sirens), and this may be implemented on the real robot as well and augmented with active sensors whose data is read and controlled in Matlab.
3) Incorporate safety
   a) To react to an asynchronous stop signal by a user. The system will stop based upon an action from the user (e.g. press an emergency stop button, or walk through a light curtain).
   b) To prevent collisions. When a simulated object (that you make and control) is placed in the path of the robot, it will stop until there is no predicted collision or move to avoid the collision.
4) Include an advanced “teach” Matlab GUI which allows jogging the robot. It should include both individual joint movements (like the Toolbox’s “teach”) plus enable [x,y,z] Cartesian movements. A valid addition is to use a joystick or gamepad instead of a GUI to send commands to your system.
5) Write a (1000+ words approx. 4-5 pages) professional report including references where appropriate. Use figures and diagrams to assist to describe in detail your findings, and reflections.
   - Demonstrate development and learning to solve your novel task
   - Demonstrate regular code commits and participation as proven by report of BitBucket commits
   - Reflect on challenges of working in a group and your strategies to overcome them (e.g. definitely include some reflection on the shared code repository).
   - Robotics sensing:
     a) Reflections on how sensor data is currently incorporated into your system
     b) Ideas for better sensors that would be applicable and give the robot more capabilities
     c) Ideas for improved system safety
   - Future predictions for robotics in the given scenario with reference to the literature.
6) Ensure the team’s Matlab code is available on BitBucket for tutors to access and download. On the submission date, the code will be downloaded and marked against the given code standards (see UTSOnline).

Marking Scheme:

The assignment is worth 45% of the subject, half will be a group mark which is then assigned used Spark+, the other half will be an individual mark based upon your own report submitted via TurnItIn. All reports are to be written individually. Bonus marks are available for incorporating additional hardware or sensors with your real robot platform.

Criteria (task)	**Weight (%)**
First Stage Submission **(Due week 7)** (group task)	**2%**
Second Stage Submission **(Due week 9)** (individual task)	**3%**
Promotion video of your specific project **(Due week 11)** (group task)	**10%**
As a group (Spark to assign these marks at the end):	***50%***
Demonstration of specified task in class and group presentation (10 minutes per group): Path plan between several poses and the final joint state given a unique environment (developed by each group) and the simulated model. Creatively use a real robot that mimics and/or enhances the simulation and application.	*30%*
Safety in Demo: (1) System reacts to user's emergency stop action	*3%*
Safety in Demo: (2) Trajectory reacts to simulated sensor input (e.g. light curtain)	*3%*
Safety in Demo: (3) Trajectory reacts to a forced simulated upcoming collision	*3%*
Code aesthetics: (1) Comments & Neatness ***(marked with final report)***	*3%*
Code aesthetics: (2) Compliance to standard ***(marked with final report)***	*3%*
Groups marking all other groups (mark = average dist. to the mean), ***(marked with final report)***	*5%*
Individual learning experience reflections report (1000 words approx. 4-5 pages with diagrams)	***25%***
Demonstrate development and learning to solve a problem with a novel robotic solution	*4%*
Report has professional presentation (language, figures, document style)	*4%*
Group challenges and strategies taken to overcome them (both taken and planned in future)	*4%*
Robotics sensing: Ideas for applicable sensors that would (1) give the robot more capability; and (2) Improve the system's safety	*5%*
Evidence-based future predictions for robotics in the given scenario	*4%*
Appendix: BitBucket commit report showing regular code commits and participation	*4%*
Code Viva	**10%**
Total	**100%**
Bonus (1): Up to 5% bonus marks for incorporating additional hardware together with your **real robot arm**: e.g. for safety, collision detection, an end-effector.	+10%
Bonus (2): Up to 5% bonus marks for having the robot system (real or simulated) react to **real RGB-D sensor data (includes use of the remote lab)**, which will require some combination of the following: calibration, mapping, object recognition, image processing.	+10%