ENGINEERING

McMaster University

Project Three – Revenge of the Recycling System:

Design a System for Sorting and Recycling Containers

ENGINEER 1P13 – Integrated Cornerstone Design Projects

Tutorial 06

Team Tues-35

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Submitted: March 6, 2022

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Academic Integrity Statement

The student is responsible for performing the required work in an honest manner, without plagiarism and cheating. Submitting this work with my name and student number is a statement and understanding that this work is my own and adheres to the Academic Integrity Policy of McMaster University.

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x Teghveer

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x Peter DeForest

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x

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Viktorjia Todorovic 400387857

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Executive Summary

Introduction

Sustainability is a growing topic in our world today. Currently, we would need 1.75 earths for our population to be sustained in terms of required resources. This number is only going to grow as the global population increases [1]. Our goal for our P3 project was two-fold. Firstly, we had to create a code that would successfully sort recyclables and secondly create a mechanism to properly deposit these recyclables into appropriate locations as needed. This project is based in the concept of recycling. If performed on a global scale (consistently and properly), recycling can help create a more sustainable future.

Modelling Sub-Team

The Modelling Sub-team's goal was to create a mechanism that could be mounted to and be controlled by an actuator. Our design satisfied constraints while accomplishing the task. The mechanism was able to lift a baseplate/hopper to allow the objects in the hopper to fall. Through exploration of many ideas, sketches, and prototypes, we came to the decision that our final design would use a linear actuator.

Our model consisted of a mounting bracket screwed to the front of the baseplate. Two arms connected the bracket to the actuator. At the top, the arms connected to the bracket via a long bolt and nut (Refer to Appendix A: Figure 2 a) and b), for the full 3D-Model). The arms connected to the actuator by using another long bolt and multiple nuts which acted as spacers to give the actuator clearance. When the actuator was completely extended the hopper was parallel to the baseplate. As the actuator engaged and pulled inward, the arms push upward cause the hopper to tilt. This caused anything in the hopper to fall.

Computing Sub-Team

The Computing team's goal was to create a program that controlled a Q-arm and Q-bot in which they worked together to deliver containers to their designated bins. We were required to use sensors to aid in determining bin location, the line on the floor, and weight of the containers.

The Q-arm had the job of transferring the containers from the turntable to the Q-bots hopper. Whereas the Q-bot had the job of being positioned to the designated bin, dispensing it, and then returning to its original location, all while following a yellow line on the ground. The Q-bot can is only allowed to hold three containers, the total weight cannot exceed 90 grams, and the bin locations all had to be the same for the Q-bot to start its loop.

Conclusion

Our development process to create a working model included sketching, planning, designing, writing pseudocodes and multiple tests of our program and mechanism. The result was that the modelling Sub-Team designed a device that would dump recyclables using a linear actuator. Concurrently the Computing Sub-Team was able to design a program to move a Q-arm and Q-bot that would bring the recyclables to the desired location and drop the recyclables off in the correct locations.

References:

[1] "Carrying Capacity - World Population." https://worldpopulationhistory.org/carrying-capacity/ (accessed Mar. 04, 2022).

Source Materials Database

[2] "5 - P3 Python Library Documentation - (DS) - ENGINEER 1P13A:Integrated Cornerstone Design Projects in Engineering." https://avenue.cllmcmaster.ca/d2l/le/content/418235/viewContent/3538807/View (accessed Mar. 04, 2022).

Appendices

Appendix A – Supporting documents

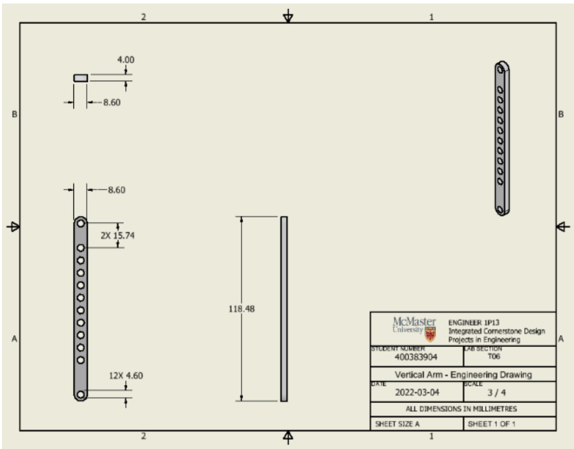


Figure 1a) Fully dimensioned Engineering Drawing of the Vertical Arms

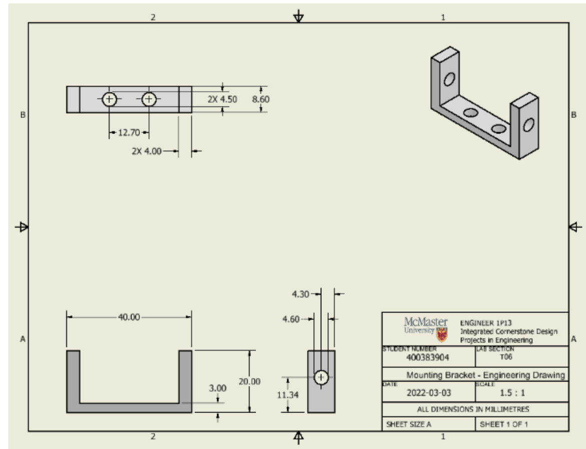


Figure 1b) Fully dimension engineering drawing of the Top Mounting Bracket

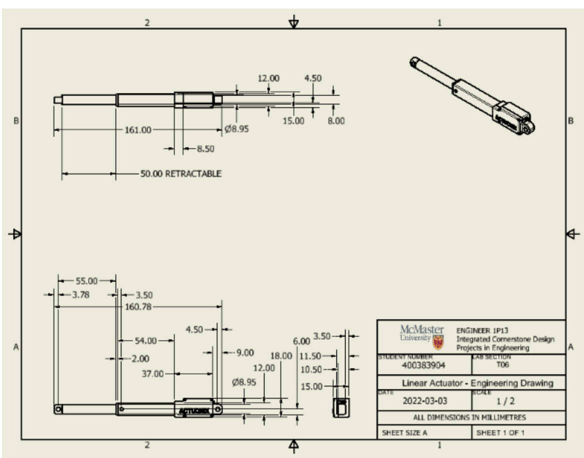


Figure 1c) Fully dimensioned Engineering Drawing of the Linear Actuator Used

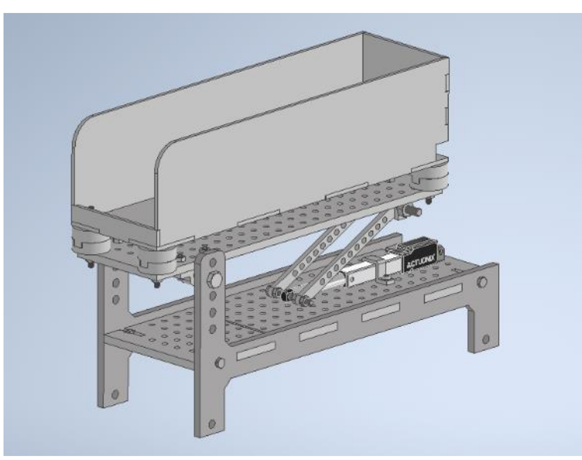


Figure 2a) 3D-Model in the resting position

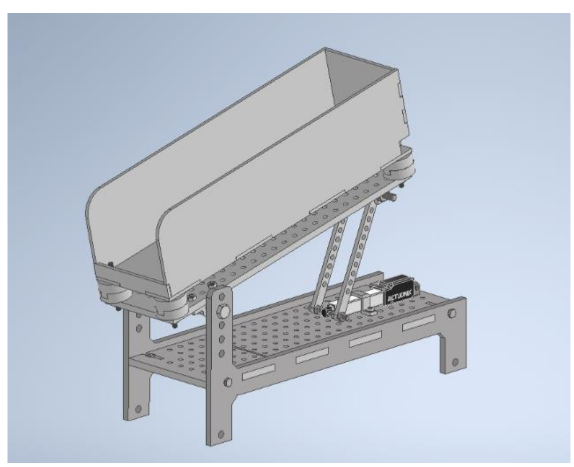


Figure 2b) 3D-Model in the dumping position

Final Program

```
import sys
sys.path.append('../')
from Common.project_library import *

# Modify the information below according to you setup and uncomment the entire section

# 1. Interface Configuration
project_identifier = 'P3B' # enter a string corresponding to P0, P2A, P2A, P3A, or P3B
ip_address = '255.255.255.0' # '169.254.48.137' # enter your computer's IP address
hardware = False # True when working with hardware. False when working in the simulation

# 2. Servo Table configuration
short_tower_angle = 315 # enter the value in degrees for the identification tower
tall_tower_angle = 90 # enter the value in degrees for the classification tower
drop_tube_angle = 180#270# enter the value in degrees for the drop tube. clockwise rotation from zero degrees

# 3. Qbot Configuration
bot_camera_angle = 0 # angle in degrees between -21.5 and 0

# 4. Bin Configuration
# Configuration for the colors for the bins and the lines leading to those bins.
# Note: The line leading up to the bin will be the same color as the bin

bin1_offset = 0.17 # offset in meters
bin1_color = [1,0,0] # e.g. [1,0,0] for red metal
bin2_offset = 0.17 #green
bin2_color = [0,1,0]# green paper
bin3_offset = 0.17 #blue
bin3_color = [0,0,1]# blue plastic
bin4_offset = 0.17 #black
bin4_color = [0,0,0] # black garbage

#--------------- DO NOT modify the information below -----------------------------
```

```python
#-------------------------------------------------------------------------------
# STUDENT CODE BEGINS
#-------------------------------------------------------------------------------

import random
import math

# intializes container bin and weight lists for use in any function
container_bin=[]
container_weight=[]

# returns the bin where the container needs to go to, records container weight as well
def random_dispense():
    container=random.randint(1,6) #variable name for the 6 different containers
    container_info=table.dispense_container(container, True) #dispenses container and store information
    location, weight, bin_num = container_info #variables for values in list
    return weight, bin_num #return weight and bin number

#Load Containers
def movement_arm(container_amount):
    #movement of arm to pick up container and rotate to face qbot
    arm.home()

    # grabs container with qarm, uses sleep functions for efficiency
    time.sleep(1)
    arm.move_arm(0.65,0,0.27)
    time.sleep(1)
    arm.control_gripper(36)
    time.sleep(1)
    arm.move_arm(0.2,0,0.4)
    arm.rotate_elbow(-30)
    arm.rotate_base(-90)
    time.sleep(1)

    if container_amount == 0: #if no containers have been loaded, move to first position on hopper
        # if bot is in range of arm, place container right away
        if bot.position()[0]-2.1 >= -0.643:
            # qarm coordinates are based on position of qbot, x at +.12
            arm.move_arm(-bot.position()[1]+.12,bot.position()[0]-2.1,0.52)
            time.sleep(1)
            arm.control_gripper(-10)
            time.sleep(2)
            arm.rotate_shoulder(-20)
        else:
            # if bot is not in range of arm when at home, bot must move forward for arm to place container
            bot.forward_distance(0.05) # 5 cm is enough in all cases
            arm.move_arm(-bot.position()[1]+.12,bot.position()[0]-2.1,0.52)
            time.sleep(1)
            arm.control_gripper(-10)
            time.sleep(2)
            arm.rotate_shoulder(-20)
            # uses time.time() library for more reliable version of sleep()
```

```
        # uses time.time() library for more reliable version of sleep()
        start_time = time.time()
        current_time = 0
        while(current_time < 0.5): # waits half a second
            current_time = time.time() - start_time
        # bot returns to line since it moved off of it
        bot.rotate(180)
        bot.forward_distance(0.05)
        bot.rotate(-180)

elif container_amount == 1: #if 1 container has already been loaded, move to next position on hopper
    # -0.643 is max range for y coordinate of qarm
    if bot.position()[0]-2.1 >= -0.643:
        arm.move_arm(-bot.position()[1]+.04,bot.position()[0]-2.1,0.52)
        time.sleep(1)
        arm.control_gripper(-10)
        # use sleep() instead of time.time() for better readability and efficiency
        time.sleep(2)
        arm.rotate_shoulder(-20)
    else:
        # only runs if bot is out of range of arm
        bot.forward_distance(0.05)
        # x coordinate of qarm at +.04
        arm.move_arm(-bot.position()[1]+.04,bot.position()[0]-2.1,0.52)
        time.sleep(1)
        arm.control_gripper(-10)
        time.sleep(2)
        arm.rotate_shoulder(-20)
        # time library used for reliability
        start_time = time.time()
        current_time = 0
        while(current_time < 0.5):
            current_time = time.time() - start_time
        # bot returns to line
        bot.rotate(180)
        bot.forward_distance(0.05)
        bot.rotate(-180)

elif container_amount == 2: #if 2 container has already been loaded move to this position
    if bot.position()[0]-2.11 >= -0.643:
        arm.move_arm(-bot.position()[1]-.05,bot.position()[0]-2.11,0.52)
        time.sleep(1)
        arm.control_gripper(-10)
        time.sleep(2)
        arm.rotate_shoulder(-20)
    else:
        # only runs if bot is out of range of arm
        bot.forward_distance(0.05)
        # x coordinate of qarm at -.05
        arm.move_arm(-bot.position()[1]-.05,bot.position()[0]-2.11,0.52)
        time.sleep(1)
```

```
            arm.control_gripper(-10)
            time.sleep(2)
            arm.rotate_shoulder(-20)
            # time library substitute for sleep()
            start_time = time.time()
            current_time = 0
            while(current_time < 0.5):
                current_time = time.time() - start_time
            # bot returns to line
            bot.rotate(180)
            bot.forward_distance(0.05)
            bot.rotate(-180)

    start_time = time.time() # rest so that the arm has time to let go of the container
    current_time = 0
    while(current_time < 1):
        current_time = time.time() - start_time
    arm.rotate_elbow(-20)
    arm.home()

# loading hopper with qarm
# main function initially rotates qbot, dipenses containers and stores their info
# also calls all functions and initiates while loop to run continuously
def main():
    container_amount=0 #no container in the hopper
    total_mass=0 # no mass on hopper
    old_location="" # intializes old location to store desired bin for container
    container_on_hopper = False
    bot.rotate(-95) # rotates bot for easy access to hopper

    weight, bin_num = random_dispense() #container dispenses
    container_exists = True #container exists to pick up

    while True:
        new_mass= weight # stores values of newly dispensed container
        new_location= bin_num
        # if constriants don't apply, run arm movement
        # contraints: over 3 containers on hopper, hopper mass over 90,
        # new container does not match destination of previous container
        if container_amount < 3 and total_mass < 90 and (new_location == old_location or old_location == ""):
            total_mass += new_mass
            old_location = new_location
            # calls movement arm function with parameter so it knows where to place container
            movement_arm(container_amount)
            container_amount +=1
            # container amount on hopper incr., no more container in sorting station
            container_exists = False

            weight, bin_num = random_dispense() #container dispenses
            container_exists = True #container exists to pick up
```

```
        #once contraints apply, move qbot
        else:
            # qbot sets out to deliver loaded containers at specified location
            move_qbot(old_location)
            deposit_container()
            return_home()
            bot.rotate(-95) # qbot is rotated for easy access to hopper
            # mass, container, location variables are reset
            container_amount=0
            total_mass= 0
            old_location = new_location
# main function loops indefinitely as system sorts randomly dispensed containers

# dispenses one red can into the sorting station,
# initiates all other functions for one full sorting cycle
# useful for troubleshooting and diagnostics
def dispense_red_can():
    x = table.dispense_container(2, True)
    print("printing x", x)
    movement_arm()
    lower_cont_1()
    move_qbot(x[2])
    deposit_container()
    return_home()
# weighs red can, loads qbot, qbot deposits can, qbot returns home

# function to move q bot while detecting for correct box attributes (attr)
def move_qbot(bin):
    # activate both sensors, record starting (home) position
    bot.rotate(95) #-90
    bot.activate_ultrasonic_sensor()
    bot.activate_color_sensor()
    home_position = bot.position()
    # starts qbot at slow speed, initializes target values for sensing bin
    bot.set_wheel_speed([0.04, 0.04])

    # depending on container attributes:
    # qbot will be looking for the corresponding bin
    if bin == "Bin01":
        # distance to detect bin 1, 2 are greater as they're more prone to error
        dist_attr = 0.08
        color_attr = [1, 0, 0]
        print("Going to Bin 01!")
    elif bin == "Bin02":
        dist_attr = 0.06
        color_attr = [0, 1, 0]
        print("Going to Bin 02!")
    elif bin == "Bin03":
        dist_attr = 0.05
        color_attr = [0, 0, 1]
```

```
        print("Going to Bin 03!")
    else:
        dist_attr = 0.05
        color_attr = [0, 0, 0]
        print("Going to Bin 04!")

    # while loop continues to run until correct bin sensed
    while True: # bot.read_color_sensor() != color_attr or bot.read_ultrasonic_sensor() > dist_attr:
        # continues to sense presence of yellow guideline
        color = bot.read_color_sensor()[0]
        distance = bot.read_ultrasonic_sensor()
        if distance <= dist_attr and color == color_attr:
            print("I see the bin!", bot.read_ultrasonic_sensor(), bot.read_color_sensor()[0])
            break
        # adjusts direction of qbot if yellow guideline not sensed
        line = bot.line_following_sensors()
        if(line[0] == 1 and line[1] == 1):
            bot.set_wheel_speed([0.04, 0.04])
        elif(line[0] > line[1]):
            bot.set_wheel_speed([0.04, 0.064])
        elif(line[0] < line[1]):
            bot.set_wheel_speed([0.064, 0.04])
        # safety break if qbot is off course
        elif(line[0] == 0 and line[1] == 0):
            bot.stop()
            break
        # continues to print values detected for style points
        print("Colour Sensor:", color)
        print("Ultrasonic Sensor:", distance)
        print("Line Sensors:", bot.line_following_sensors())
    # stops qbot and moves forward extra 5 cm to account for early detection
    print("Stopping...")
    bot.stop()
    bot.forward_distance(0.05)


# function to deposit containers from q bot at a safe position
# hopper raised incrementely to ensure no container stays on it
# also ensures no container is launched into the stratosphere
def deposit_container():
    # rotates hopper in 30, 45, 60, and 90 deg increments
    # waits between each movement to allow containers to fall
    bot.activate_stepper_motor()
    bot.rotate_hopper(30)
    start_time = time.time()
    current_time = 0
    while(current_time < 1.5):
        current_time = time.time() - start_time
    bot.rotate_hopper(45)
    start_time = time.time()
```

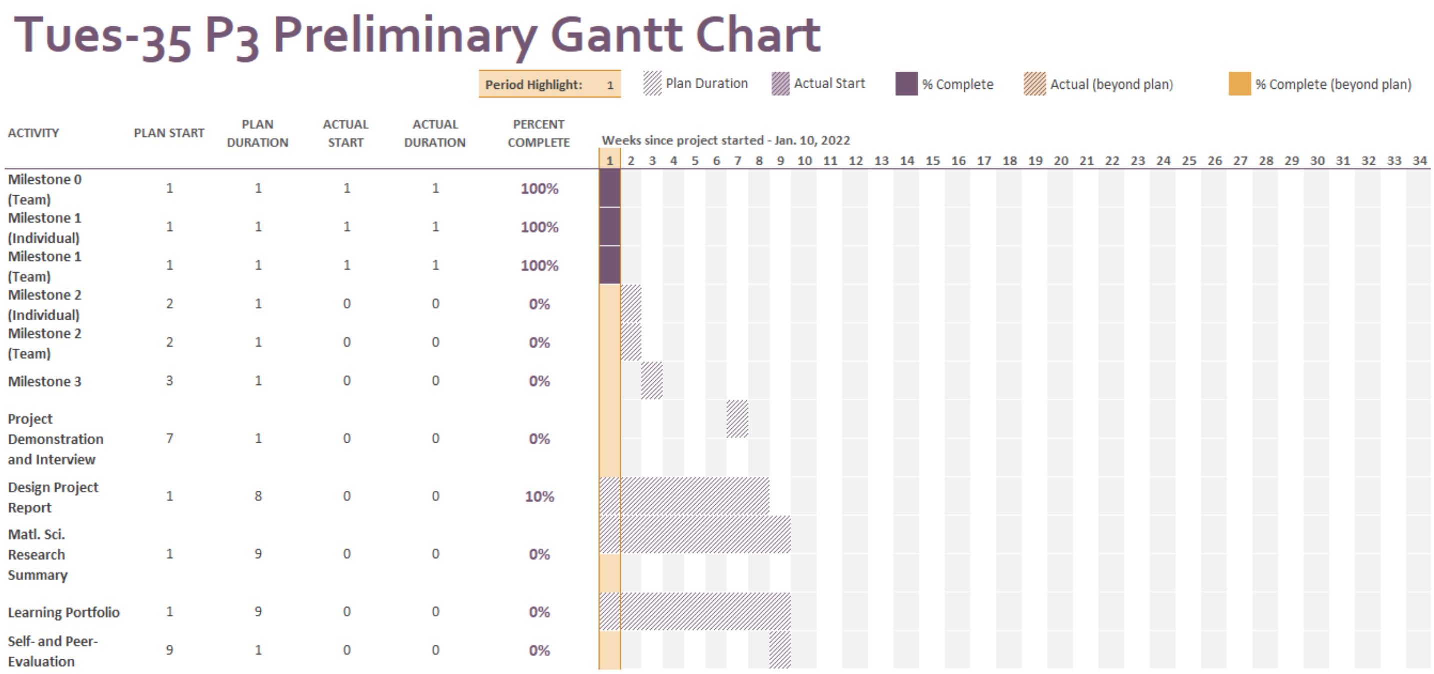
```
    current_time = 0
    while(current_time < 1.5):
        current_time = time.time() - start_time
    bot.rotate_hopper(60)
    start_time = time.time()
    current_time = 0
    while(current_time < 1.5):
        current_time = time.time() - start_time
    bot.rotate_hopper(90)
    start_time = time.time()
    current_time = 0
    while(current_time < 1):
        current_time = time.time() - start_time
    # hopper retreats to original position
    bot.rotate_hopper(0)


# function for returning q bot to home position
def return_home():
    # starts qbot at nice, slow speed
    bot.set_wheel_speed([0.04, 0.04])
    # initializes position (pos) variable
    pos = bot.position()
    # while loops continues to run until qbot reaches home
    while not(1.3 < pos[0] < 1.7 and 0 < pos[1] < 0.2):
        line = bot.line_following_sensors()
        pos = bot.position()
        print("Bot Position:", pos[0], pos[1])
        print("Line Sensors:", line)
        # adjusts course of qbot if yellow line not detected
        if(line[0] == 1 and line[1] == 1):
            bot.set_wheel_speed([0.05, 0.05])
        elif(line[0] > line[1]):
            bot.set_wheel_speed([0.02, 0.08])
        elif(line[0] < line[1]):
            bot.set_wheel_speed([0.08, 0.02])
        else:
            bot.set_wheel_speed([-0.05, -0.05])
    bot.stop()

# records and prints home position as soon as starting the program
home_position = bot.position()
print(home_position)

#---------------------------------------------------------------------------------
# STUDENT CODE ENDS
#---------------------------------------------------------------------------------
```

Appendix B – Project Schedule

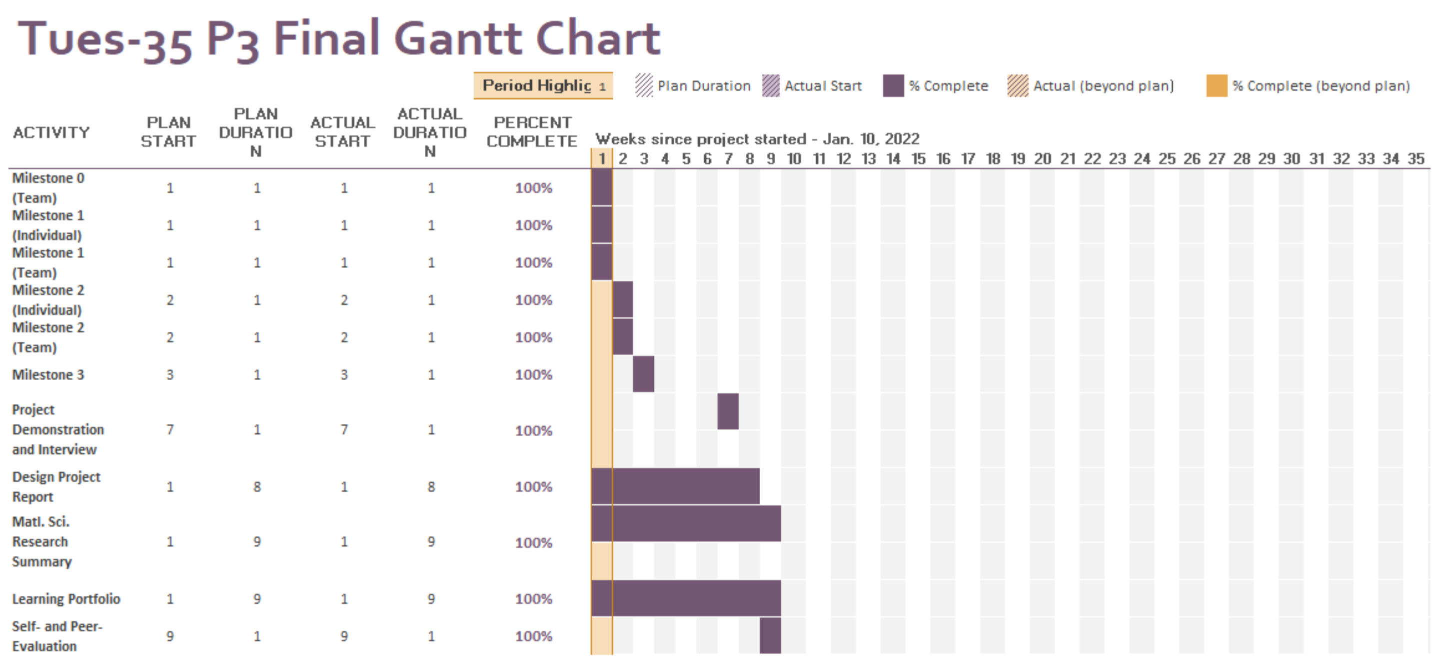


Tues-35 P3 Preliminary Gantt Chart

Period Highlight: 1 | Plan Duration | Actual Start | % Complete | Actual (beyond plan) | % Complete (beyond plan)

Weeks since project started - Jan. 10, 2022

ACTIVITY	PLAN START	PLAN DURATION	ACTUAL START	ACTUAL DURATION	PERCENT COMPLETE
Milestone 0 (Team)	1	1	1	1	100%
Milestone 1 (Individual)	1	1	1	1	100%
Milestone 1 (Team)	1	1	1	1	100%
Milestone 2 (Individual)	2	1	0	0	0%
Milestone 2 (Team)	2	1	0	0	0%
Milestone 3	3	1	0	0	0%
Project Demonstration and Interview	7	1	0	0	0%
Design Project Report	1	8	0	0	10%
Matl. Sci. Research Summary	1	9	0	0	0%
Learning Portfolio	1	9	0	0	0%
Self- and Peer-Evaluation	9	1	0	0	0%



Tues-35 P3 Final Gantt Chart

Period Highlig 1 | Plan Duration | Actual Start | % Complete | Actual (beyond plan) | % Complete (beyond plan)

Weeks since project started - Jan. 10, 2022

ACTIVITY	PLAN START	PLAN DURATION	ACTUAL START	ACTUAL DURATION	PERCENT COMPLETE
Milestone 0 (Team)	1	1	1	1	100%
Milestone 1 (Individual)	1	1	1	1	100%
Milestone 1 (Team)	1	1	1	1	100%
Milestone 2 (Individual)	2	1	2	1	100%
Milestone 2 (Team)	2	1	2	1	100%
Milestone 3	3	1	3	1	100%
Project Demonstration and Interview	7	1	7	1	100%
Design Project Report	1	8	1	8	100%
Matl. Sci. Research Summary	1	9	1	9	100%
Learning Portfolio	1	9	1	9	100%
Self- and Peer-Evaluation	9	1	9	1	100%

Logbook

Date of Meeting	**Members who Attended**	**Work Completed**
Jan 22	Viktorjia, Teghveer , Peter, Spring	Coding: Figured out things for next meeting with the TA; split up the workload; discussed how they’re going to make it work, created a plan for everything Modeling: Split up the work load, discussed the project and the designs further
Jan 23 (Morning)	Viktorjia, Teghveer	Discussed the code, worked through the code together, discussed, fixed any issues
Jan 25	Spring, Peter	Modelling team met up to go over the model before design studio
Jan 29	Viktorjia, Teghveer	Fixed Milestone 3 for Design Studio
Jan 31	Spring, Peter	Modelling team met up again to go over the model before the design studio and work out the problems with the assembly (a couple joints etc were not happy)
Feb 2	Viktorjia, Teghveer	Worked on finishing the code – was running into some new issues (turntable and dispense portion need to be modified)
Mar 3	Viktorjia, Teghveer , Peter, Spring	Compiling of all work into the final design report

Appendix C – Weekly Meetings

Weekly Agenda for TA meetings:

Week 1 – Jan 11, 2022:

- Basic Introductions
- Getting done the two milestones

Week 2 - Jan. 18, 2022:

- Discuss problem statement from milestone 1.
    - In hindsight – does stating Q-bots imply a solution?
- Review preliminary computation flowchart and pseudocode from milestone 1.
- Review preliminary modelling concept sketches from milestone 1.
- Discuss pros and cons of linear actuator vs rotary actuator.
- Debate design choices for mechanism.
- Debate best sensor(s) for the job.

Week 3 - Jan. 25, 2022:

- Present preliminary design and working cycle of code in design review.
- Review concept sketches/designs from milestone 2 and current design.
    - In hindsight – what new improvements or ideas have we thought of after the design review?
- Review sensor decisions from milestone 2 and code after design review.

Week 4 - Feb. 1, 2022:

- Present working cycle of code in 2nd design review.
- Discuss next steps on code and best methods for continuously looping.
- Review first set of parts to be printed/fabricated for mechanism.

Week 5 - Feb. 8, 2022:

- Discuss and remedy issue with Quanser in which code will randomly not work anymore.
- Review second set of parts to be printed/fabricated for mechanism.
- Discuss importance of scale in the Quanser environment and if we're meant to weigh the containers.

Week 6 - Feb. 15, 2022:

- Review final set of parts for printing.

- Prepare for bonus opportunity.
- Review almost final version of code
- Discuss code modifications needed for bonus.

Week 1

Attendance

Role	Name	Mac ID	Attendance (Yes/No)
Manager	**Teghveer Ateliey**	**atelieyt**	**Yes**
Administrator 1	**Viktorjia Todorovic**	**todorv1**	**Yes**
Administrator 2	**Peter DeForest**	**deforesp**	**Yes**
Coordinator	**Spring Fu**	**fus26**	**Yes**
Guest	**Charlotte**	**-**	**-**

Agenda Items

1. Basic Introductions
2. Milestones 0 + 1

Meeting Minutes

1. Attendance & Updates
   a. How is everybody doing?
   b. Basic Introductions, Ice Breakers
2. Milestones 0 + 1
   a. Completed, no problem

Post-Meeting Action Items

1. Nothing 😊

Week 2 - Jan. 18, 2022:

Attendance

Role	Name	Mac ID	Attendance (Yes/No)
Manager	**Teghveer Ateliey**	**atelieyt**	**Yes**
Administrator 1	**Viktorjia Todorovic**	**todorv1**	**Yes**
Administrator 2	**Peter DeForest**	**deforesp**	**Yes**
Coordinator	**Spring Fu**	**fus26**	**Yes**

Guest	**Charlotte**	**-**	**-**

Agenda Items

3. Discuss problem statement from milestone 1.
4. Review preliminary computation flowchart and pseudocode from milestone 1.
5. Review preliminary modelling concept sketches from milestone 1.
6. Discuss pros and cons of linear actuator vs rotary actuator.
7. Debate design choices for mechanism.
8. Debate best sensor(s) for the job.

Meeting Minutes

3. Attendance & Updates
   a. How is everybody doing?
   b. Anything we can help each other out with?
4. Milestone 1
   a. Discuss Problem Statement
   b. Review flowchart + Pseudocode (Computation)
   c. Review Prelim Sketches
      i. Discuss Design Choices used for the mechanisms
5. Actuators + Sensors
   a. Discuss the two actuators and why we should potentially use each
   b. Discuss which Sensors make the most sense given the situation

Post-Meeting Action Items

2. Work on writing the first cycle code

Week 3 - Jan. 25, 2022:

Attendance

Role	Name	Mac ID	Attendance (Yes/No)
Manager	**Teghveer Ateliey**	**atelieyt**	**Yes**
Administrator 1	**Viktorjia Todorovic**	**todorv1**	**Yes**
Administrator 2	**Peter DeForest**	**deforesp**	**Yes**
Coordinator	**Spring Fu**	**fus26**	**Yes**
Guest	**Charlotte**	**-**	**-**

Agenda Items

1. Present preliminary design and working cycle of code in design review.

2. Review concept sketches/designs from milestone 2 and current design.
    a. In hindsight – what new improvements or ideas have we thought of after the design review?
3. Review sensor decisions from milestone 2 and code after design review.

Meeting Minutes

4. Attendance & Updates
    a. How is everybody doing?
    b. Any Concerns?
5. Prelim Designs
    a. Subteams Discussed their own parts (Code and Sketches/Designs)
    b. Presented Prelim Design and Working Cycle of Code
    c. Discussed Potential Improvements
6. Coding Team Discussed Sensor Decisions

Post-Meeting Action Items

1. Finish Working on the first cycle
2. Model the parts + Print them at home to check if there is anything that needs to be changed

Week 4 - Feb. 1, 2022:

Attendance

Role	Name	Mac ID	Attendance (Yes/No)
Manager	**Teghveer Ateliey**	**atelieyt**	**Yes**
Administrator 1	**Viktorjia Todorovic**	**todorv1**	**Yes**
Administrator 2	**Peter DeForest**	**deforesp**	**Yes**
Coordinator	**Spring Fu**	**fus26**	**Yes**
Guest	**Charlotte**	**-**	**-**

Agenda Items

1. Present working cycle of code in 2nd design review.
2. Discuss next steps on code and best methods for continuously looping.
3. Review first set of parts to be printed/fabricated for mechanism.

Meeting Minutes

1. Attendance & Updates
    a. How is everybody doing?
    b. Anything we can help each other out with?
2. Next Steps

a. Coding Team: Discuss continuous looping
b. Modelling: Review first set of parts, made edits to the design based off which parts didn't work

Post-Meeting Action Items

1. Create the full code
2. Edit the Model with the information gained, get it ready for printing (slicing)

Week 5 - Feb. 8, 2022:

Attendance

Role	Name	Mac ID	Attendance (Yes/No)
Manager	**Teghveer Ateliey**	**atelieyt**	**Yes**
Administrator 1	**Viktorjia Todorovic**	**todorv1**	**Yes**
Administrator 2	**Peter DeForest**	**deforesp**	**Yes**
Coordinator	**Spring Fu**	**fus26**	**Yes**
Guest	**Charlotte**	**-**	**-**

Agenda Items

1. Discuss and remedy issue with Quanser in which code will randomly not work anymore.
2. Review second set of parts to be printed/fabricated for mechanism.
3. Discuss importance of scale in the Quanser environment and if we're meant to weigh the containers.

Meeting Minutes

1. Attendance & Updates
   c. How is everybody doing?
   d. Anything we can help each other out with?
2. Quanser Issues
   e. Discussed why the code potentially wouldn't work randomly
   f. Fixed the problem
3. Double Checking
   a. Checked if we were meant to weight the containers; discussed importance of scale in quanser

Post-Meeting Action Items

1. Get the Laser Cut parts ready
2. Keep trying to make the code better

Week 6 - Feb. 15, 2022:

Attendance

Role	Name	Mac ID	Attendance (Yes/No)
Manager	**Teghveer Ateliey**	**atelieyt**	**Yes**
Administrator 1	**Viktorjia Todorovic**	**todorv1**	**Yes**
Administrator 2	**Peter DeForest**	**deforesp**	**Yes**
Coordinator	**Spring Fu**	**fus26**	**Yes**
Guest	**Charlotte**	**-**	**-**

Agenda Items

1. Review final set of parts for printing.
2. Prepare for bonus opportunity.
3. Review almost final version of code
4. Discuss code modifications needed for bonus.

Meeting Minutes

1. Attendance & Updates
    a. How is everybody doing?
    b. Anything we can help each other out with?
2. Final Components
    a. Reviewed the final parts, discussed the design
    b. Reviewed the almost final version of the code; discussed code modifications for the bonus
3. Indicated we wanted to do the bonus opportunity

Post-Meeting Action Items

1. Fix the Laser Cut piece
2. Keep working on the code

Appendix D – Worksheets

ENGINEER 1P13 – Project Three: *Revenge of the Recycling System*

PROJECT THREE: MILESTONE 0 – COVER PAGE

Team Number: Tues-35

Please list full names and MacID's of all *present* Team Members

Full Name:	MacID:
Viktorija Todorovic	todorv1
Teghveer Ateliey	atelieyt
Peter-Anthony Deforest	deforesp
Spring Fu	fus26

Insert your Team Portrait in the dialog box below

MILESTONE 0 – TEAM CHARTER

Team Number: Tues-35

Incoming Personnel Administrative Portfolio:

Prior to identifying Leads, identify each team members incoming experience with various **Project Leads**

	Team Member Name:	Project Leads
1.	Viktorija Todorovic	☒M ☒A1 ☐A2 ☐C
2.	Teghveer Ateliey	☐M ☐A1 ☒A2 ☒C
3.	Peter-Anthony Deforest	☒M ☒A1 ☐A2 ☐ C
4.	Spring Fu	☐M ☐A1 ☒A2 ☐C

To 'check' each box in the Project Leads column, you must have this document open in the Microsoft Word Desktop App (not the browser and not MS Teams)

Project Leads:

Identify team member details (Name and MACID) in the space below.

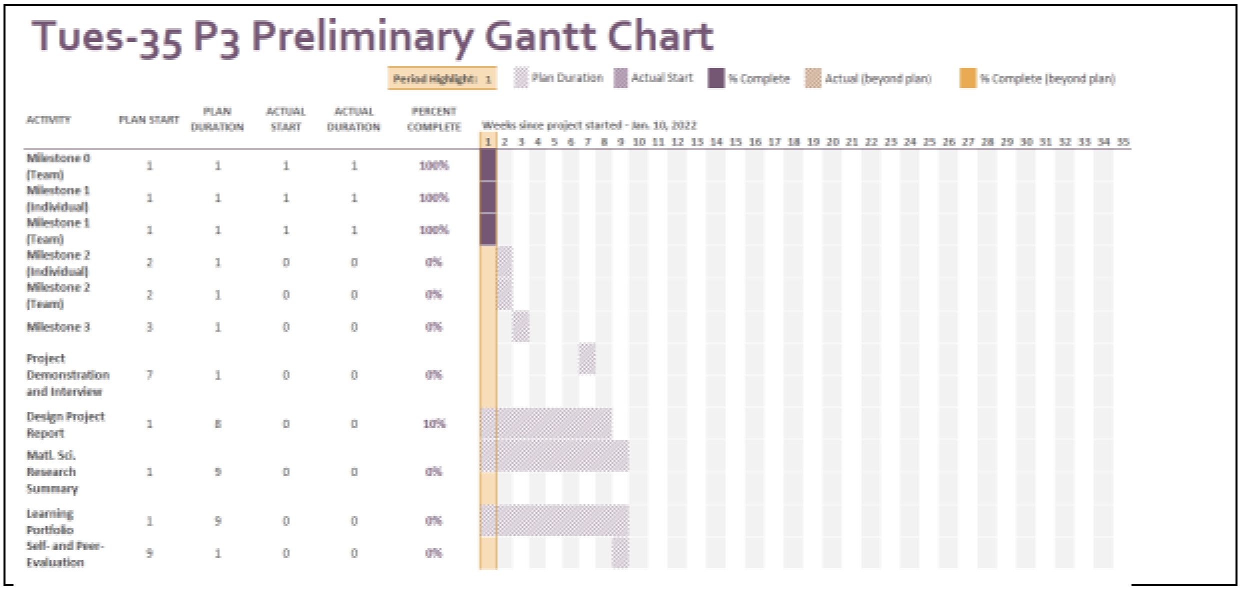
Role:	Team Member Name:	MacID
Manager	Teghveer Ateliey	atelieyt
Administrator 1	Viktorija Todorovic	todorv1
Administrator 2	Peter DeForest	deforesp
Coordinator	Spring Fu	Fus26

MILESTONE 0 – PRELIMINARY GANTT CHART (TEAM MANAGER ONLY)

Team Number:	Tues-35

Full Name of Team Manager:	MacID:
Teghveer Ateliey	atelieyt

Preliminary Gantt chart



ACTIVITY	PLAN START	PLAN DURATION	ACTUAL START	ACTUAL DURATION	PERCENT COMPLETE
Milestone 0 (Team)	1	1	1	1	100%
Milestone 1 (Individual)	1	1	1	1	100%
Milestone 1 (Team)	1	1	1	1	100%
Milestone 2 (Individual)	2	1	0	0	0%
Milestone 2 (Team)	2	1	0	0	0%
Milestone 3	3	1	0	0	0%
Project Demonstration and Interview	7	1	0	0	0%
Design Project Report	1	8	0	0	10%
Matl. Sci. Research Summary	1	9	0	0	0%
Learning Portfolio	1	9	0	0	0%
Self- and Peer-Evaluation	9	1	0	0	0%

ENGINEER 1P13 – Project Three: *Revenge of the Recycling System*

MILESTONE 1 (STAGE 1) – INITIAL PROBLEM STATEMENT, OBJECTIVES AND CONSTRAINTS

Team Number: Tues-35

Complete this worksheet individually *before* coming to Design Studio 13.

Initial Problem Statement

1. Write the initial problem statement in the space below. This will have been defined in a previous lecture, prior to your scheduled Design Studio.

Design a system for sorting and recycling containers.

Objectives and Constraints

Create a list of objectives and constraints in the table below. The exact number you should have depends on what information you have gathered from the Project Module and previous lectures.

Objectives	Sort materials in dedicated bins Deposit containers Transfer containers Recycle Reusable (can run infinitely) Efficient
Constraints	Must sort correctly Must use actuator Must use Q-arm for transferring to q-bot that sorts Must use a hopper to hold containers

	Must use provided sensors Can only hold up to 90 grams

At the beginning of Design Studio, we will be asking that you copy-and-paste your work into the **Milestone 1 Team Worksheet.** It does seem redundant, but there are valid reasons for this:

- Each team member needs to submit their individual work with the **Milestone 1 Individual Worksheet** document so that it can be ***graded***
- Compiling your individual work into this **Milestone 1 Team Worksheet** document allows you to readily access your team members' work
  - This will be especially helpful when completing ***Stage 2*** of the milestone

MILESTONE 1 (STAGE 2) – REFINED PROBLEM STATEMENT

ENGINEER 1P13 – Project Three: *Revenge of the Recycling System*

Team Number: Tues-35

Name: Viktorija Todorovic	MacID: todorv1

Sensor Type	Description	Attribute(s)
Ultra Sonic Sensor	-A high frequency sound wave is emitted -measures distance by using an equation that uses the time it takes for the soundwave to return back to the sensor	-It can help determine the boxes if the they are set different distances away -Within the program you can set it so as certain distance away is a specific box
Active (IR) Infrared Sensor	-infrared waves are emitted -it detects the reflected emission that is sent out -It can detect bright colours and won't detect dark colours like black	- It can help for the q-bot following the line. -If it loses the detection, it can be programed to move back in the direction to where it need to go -It can also be used to measure the distance from the q-bot to the bin. Which can be used if the bins are different distances away

References

"Week 1 Lab (Winter) – Pre-Project P-3 Interactive Demonstrations," Notes for ENG 1P13, Engineering, McMaster University.

"Detection Based on "Ultrasonic Waves" What is an Ultrasonic Sensor?" Keyence. https://www.keyence.com/ss/products/sensor/sensorbasics/ultrasonic/info/. (accessed January 16, 2022).

Jeremy S. Cook. "The Right Tool for the Job: Active and Passive Infrared Sensors. https://www.arrow.com/en/research-and-events/articles/understanding-active-and-passive-infrared-sensors. (accessed January 16, 2022).

Milestone 1 Teghveer

ENGINEER 1P13 – Project Three: *Revenge of the Recycling System*

MILESTONE 1 (STAGE 1) – INITIAL PROBLEM STATEMENT, OBJECTIVES AND CONSTRAINTS

Team Number: Tues-35

Complete this worksheet individually *before* coming to Design Studio 13.

Initial Problem Statement

1. Write the initial problem statement in the space below. This will have been defined in a previous lecture, prior to your scheduled Design Studio.

Design a system for sorting and recycling containers.

Objectives and Constraints

Create a list of objectives and constraints in the table below. The exact number you should have depends on what information you have gathered from the Project Module and previous lectures.

Objectives	• Should be easy to operate. • Should operate efficiently in terms of speed and energy used. • Should use least amount of materials possible. • Should be able to run continuously.
Constraints	• Must use a linear or rotary actuator. • Actuator must mount to base-plate directly. • Must accurately categorize and sort materials. • Must be built from authorized materials and machines. • Must be able to transport and deposit containers in specified locations.

Milestone 1 Spring

ENGINEER 1P13 – Project Three: *Revenge of the Recycling System*

MILESTONE 1 (STAGE 1) – INITIAL PROBLEM STATEMENT, OBJECTIVES AND CONSTRAINTS

Team Number: Tues-35

Complete this worksheet individually *before* coming to Design Studio 13.

Initial Problem Statement

1. Write the initial problem statement in the space below. This will have been defined in a previous lecture, prior to your scheduled Design Studio.

Design a system for sorting and recycling containers.

Objectives and Constraints

Create a list of objectives and constraints in the table below. The exact number you should have depends on what information you have gathered from the Project Module and previous lectures.

Objectives	Arm mechanism should be lightweight (minimal material) Arm mechanism should be easy to use (intuitive) Arm mechanism should move freely Code should be intuitive and move precisely
Constraints	Arm mechanism must be able to successfully move in such a way to successfully deposit containers in bins Must be less than 90 g total Arm mechanism must fit on baseplate Code must be able to successfully move arm to deposit containers in correct bins

Milestone 1 Peter

ENGINEER 1P13 – Project Three: *Revenge of the Recycling System*

MILESTONE 1 (STAGE 1) – INITIAL PROBLEM STATEMENT, OBJECTIVES AND CONSTRAINTS

Team Number: Tues-35

Complete this worksheet individually *before* coming to Design Studio 13.

Initial Problem Statement

1. Write the initial problem statement in the space below. This will have been defined in a previous lecture, prior to your scheduled Design Studio.

Design a system for sorting and recycling containers.

Objectives and Constraints

Create a list of objectives and constraints in the table below. The exact number you should have depends on what information you have gathered from the Project Module and previous lectures.

Objectives	To deposit the container into the correct bin The system should be autonomous (No outside help after it has started) The process should be completed in a timely manner Limit the amount of material used
Constraints	Total mass of containers held by Q-Bot must be less than 90 grams Mechanism must be mounted to a baseplate and be attached to a hopper The mechanism must be movable and able to drop off the containers when needed The mechanism must be able to fit and mount onto the baseplate The system must determine whether the item is recyclable or not

ENGINEER 1P13 – Project Three: *Revenge of the Recycling System*

PROJECT THREE: MILESTONE 1 – COVER PAGE

Team Number: Tues-35

Please list full names and MacID's of all *present* Team Members

Full Name:	MacID:
Viktorija Todorovic	todorv1
Teghveer Ateliey	atelieyt
Peter-Anthony Deforest	deforesp
Spring Fu	fus26

Milestone 1 Viktorija

ENGINEER 1P13 – Project Three: *Revenge of the Recycling System*

MILESTONE 1 (STAGE 1) – INITIAL PROBLEM STATEMENT, OBJECTIVES AND CONSTRAINTS

Team Number: Tues-35

You should have already completed these tasks individually *prior* to Design Studio 13.

Initial Problem Statements

Copy and paste the initial problem statement(s) below.

Design a system for sorting and recycling containers.

Objectives and Constraints

Copy and paste each team member's Objectives and Constraints tables here or combine the objectives and constraints into the single table below.

Objectives	• Should be easy to operate. • Should operate efficiently in terms of speed and energy used. • Should use least amount of materials possible. • Should be able to run continuously. • To deposit the container into the correct bin • The system should be autonomous (No outside help after it has started) • The process should be completed in a timely manner • Arm mechanism should be lightweight (minimal material again) • Arm mechanism should be able to move freely • Code should be intuitive and precise
Constraints	• Must use a linear or rotary actuator. • Actuator must successfully deposit containers in bins • Actuator must mount to baseplate directly. • Must accurately categorize and sort materials. • Must be built from authorized materials and machines.

ENGINEER 1P13 – Project Three: *Revenge of the Recycling System*

	• Must be able to transport and deposit containers in specified locations. • Must use provided sensors • Total mass held by Q-Bot must be less than 90 grams • Mechanism must be mounted to and fit onto the given baseplate and be attached to a hopper • The mechanism must be movable and able to drop off the containers when needed

We are asking that you submit your work on both worksheets. It does seem redundant, but there are valid reasons for this:

- Each team member needs to submit their work with the **Milestone 1 Individual Worksheet** document so that it can be ***graded***
- Compiling your individual work into this **Milestone 1 Team Worksheet** document allows you to readily access your team member's work
    - This will be especially helpful when completing ***Stage 3*** of the milestone

ENGINEER 1P13 – Project Three: *Revenge of the Recycling System*

MILESTONE 1 (STAGE 2) – REFINED PROBLEM STATEMENT

Team Number: Tues-35

Refined Problem Statement

1. As a team, write the refined problem statement below. Kindly refer to the Refined Problem Statement rubric provided on Avenue (see P3 Milestone Rubrics). This will guide your group in creating a valid statement.

Create a system which accurately sorts containers using sensors, actuators, and Q-bots to increase the amount of waste correctly processed in the community.

ENGINEER 1P13 – Project Three: *Revenge of the Recycling System*

MILESTONE 1 (STAGE 3) – COMPUTER PROGRAM WORKFLOW (COMPUTATION SUB-TEAM)

Team Number: Tues-35

1. **One sub-team** member should write out a pseudocode outlining the *high-level workflow* of your computer program on the following page
   → Be sure to clearly indicate the Team Number, Name and MacID of the sub-team member who completed the pseudocode
2. **The other sub-team member** should create a flowchart or storyboard outlining the workflow of your computer program on the following page
   → Be sure to clearly indicate the Team Number, Name and MacID of the sub-team member who completed the flowchart/storyboard
   → Insert your photo as a Picture (Insert > Picture > This Device)

ENGINEER 1P13 – Project Three: *Revenge of the Recycling System*

Team Number: Tues-35

Name: Viktorija Todorovic	MacID: todorv1

Write out a pseudocode outlining the high-level workflow of your computer program in the space below

Q-arm
Stay at home position home
If 3 containers have been placed in the qbot
If weight will exceed on 90grams on qbot
If a container with a different id is already on the q-bot
If none apply repeat start arm

Repeat
Position gripper to coordinate adjacent to container
Grip container
Position gripper to coordinate above the Q-bot
Release container by opening gripper
Return home

Q-bot
If hopper is full
Activate sensors
Drive q-bot forward

Identify id for bins
Identify id for containers

If containers are Plastic
Navigate to designated bin by using sensors to identify it
If container is paper
Navigate to designated bin by using sensors to identify it
If container is metal
Navigate to designated bin by using sensors to identify it
If dirty
Navigate to designated bin by using sensors to identify it
Then stop right before the bin

At destination
Rotate qbot 90 degrees so hopper is perpendicular to bin
Activate actuator to dispense the containers

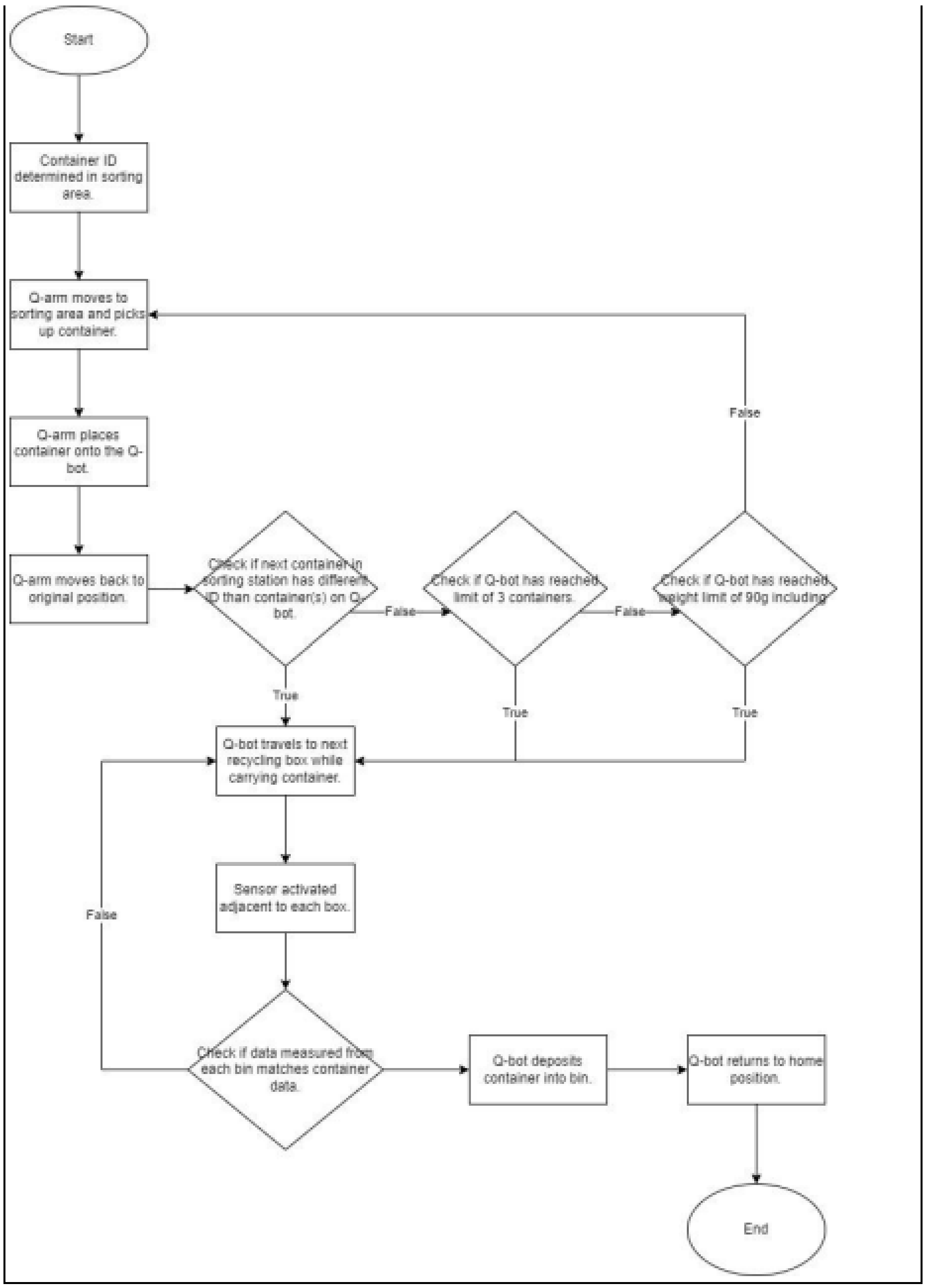
Lower hopper
Rotate 90 degrees so qbot is facing away from bin
Move forward
Follow the yellow line back to home
Rotate qbot 90 degrees so the hopper is perpendiclar to the qarm
End program

Team Number: Tues-35

ENGINEER 1P13 – Project Three: *Revenge of the Recycling System*

Name: Teghveer Ateliey	MacID: atelieyt
Insert picture of your flowchart or storyboard below	

ENGINEER 1P13 – Project Three: *Revenge of the Recycling System*



ENGINEER 1P13 – Project Three: *Revenge of the Recycling System*

MILESTONE 1 (STAGE 4) – MECHANISM CONCEPT SKETCHES (MODELLING SUB-TEAM)

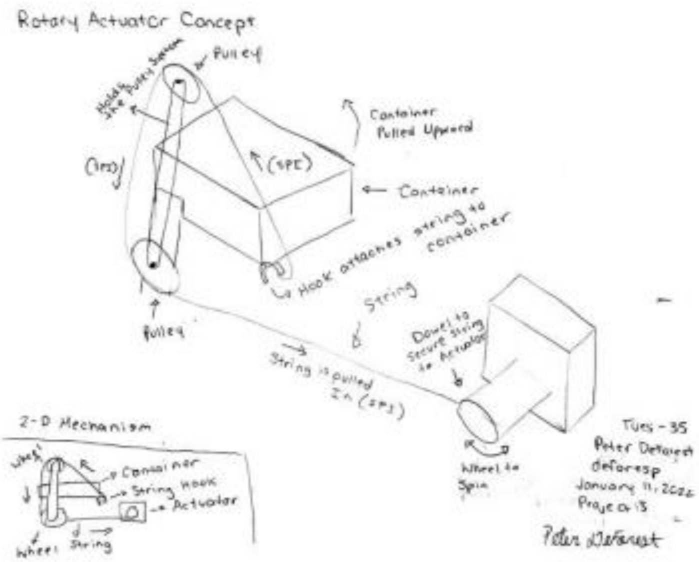
Team Number: Tues-35

1. Each team member is required to complete **two (2)** preliminary concept sketches for the mechanism design. You should incorporate a different actuator for each sketch.
   → Each sketch should be on a separate piece of paper
   → Be sure to clearly write your Team Number, Name and MacID for each sketch
2. Take photos of your sketches
3. Insert your photos as a Picture (Insert > Picture > This Device) on the following pages

ENGINEER 1P13 – Project Three: ***Revenge of the Recycling System***

Team Number: Tues-35

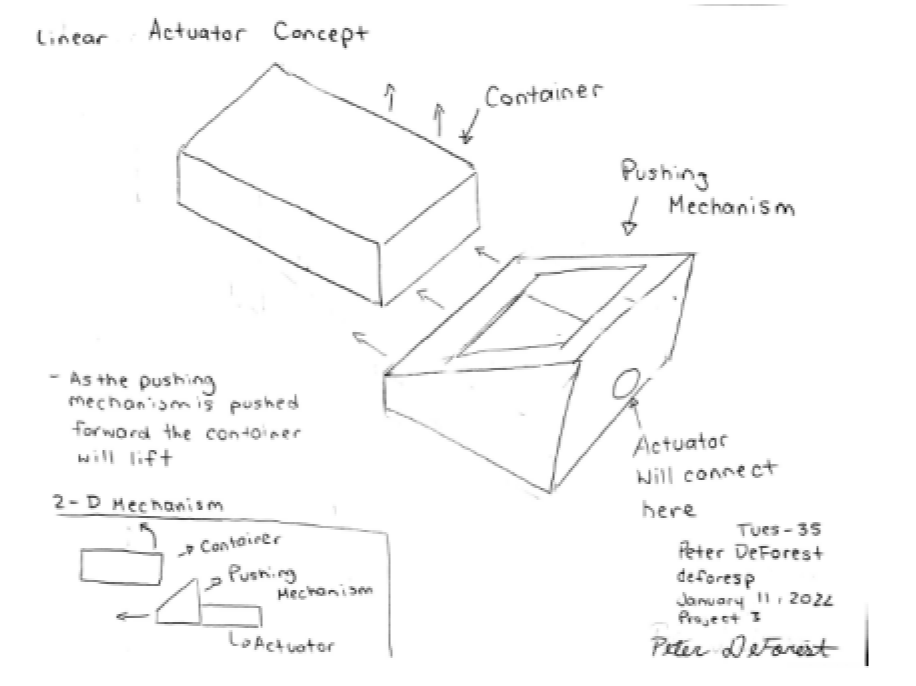
Name: Peter Deforest	MacID: deforesp
Insert picture of preliminary concept sketch below	



ENGINEER 1P13 – Project Three: ***Revenge of the Recycling System***

Team Number: Tues-35

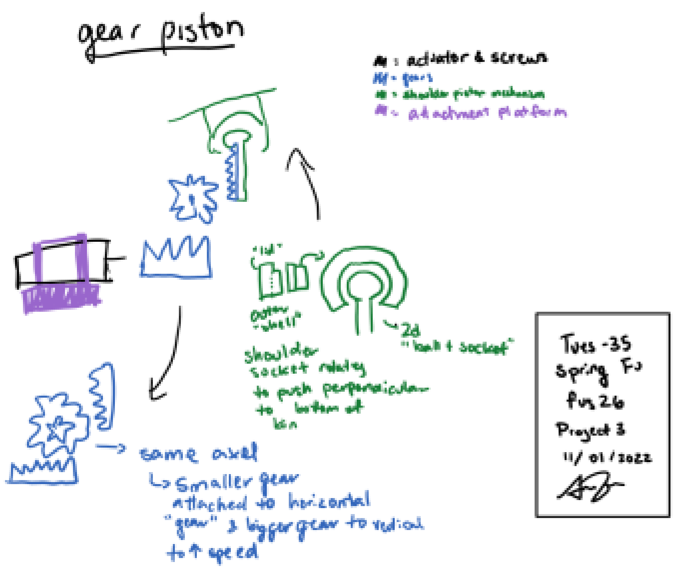
Name: Peter Deforest	MacID: deforesp
Insert picture of preliminary concept sketch below	



ENGINEER 1P13 – Project Three: *Revenge of the Recycling System*

Team Number: Tues-35

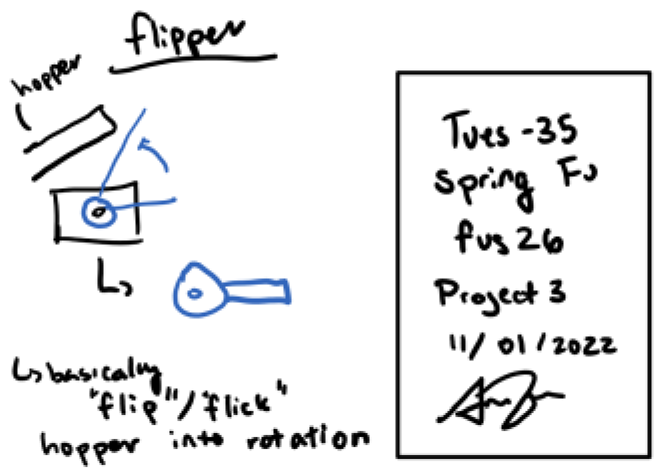
Name: Spring Fu	MacID: fus26
Insert picture of preliminary concept sketch below	



ENGINEER 1P13 – Project Three: *Revenge of the Recycling System*

Team Number: Tues-35

Name: Spring Fu	MacID: fus26
Insert picture of preliminary concept sketch below	

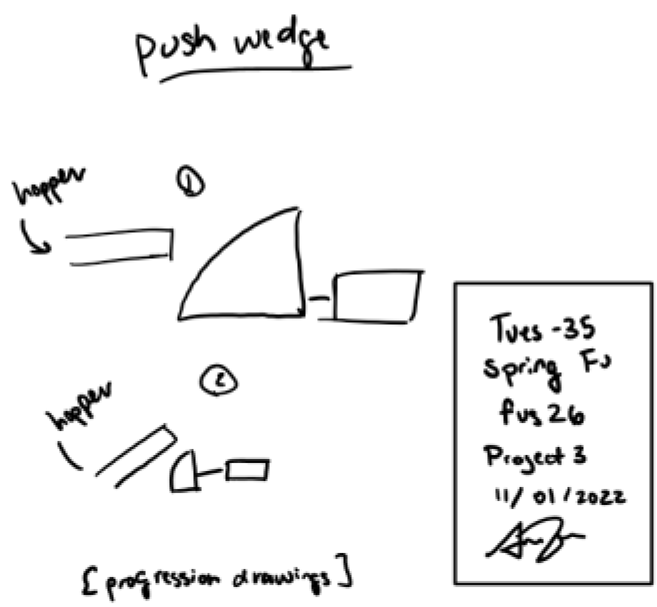


ENGINEER 1P13 – Project Three: *Revenge of the Recycling System*

Team Number: Tues-35

Name: Spring Fu	MacID: fus26

Insert picture of preliminary concept sketch below



ENGINEER 1P13 – Project Three: *Revenge of the Recycling System*

PROJECT THREE: MILESTONE 2 – COVER PAGE

Team Number: Tues-35

Please list full names and MacID's of all *present* Team Members

Full Name:	MacID:
Viktorija Todorovic	todorv1
Teghveer Ateliey	atelieyt
Peter DeForest	deforesp
Spring Fu	fus26

ENGINEER 1P13 – Project Three: *Revenge of the Recycling System*

MILESTONE 2 (STAGE 1) – SENSOR RESEARCH (COMPUTATION SUB-TEAM)

Team Number: Tues-35

You should have already completed this task individually *prior* to Design Studio 14.

1. Each team member is expected to research two (2) types of sensors for characterizing bins
   → Refer to Table 3 in the Project Objective 3 section of the Project Module for a list of available sensors
2. For each sensor:
   → Briefly describe how the sensor works
   → Indicate the attribute you would measure to characterize each bin
3. Copy and paste each sub-team member's sensor research onto the following pages
   → Be sure to clearly write your Team Number, Name and MacID

We are asking that you submit your work on both worksheets. It does seem redundant, but there are valid reasons for this:

- Each team member needs to submit their sensor research with the **Milestone 2 Individual Worksheets** document so that it can be ***graded***
- Compiling your individual work into this **Milestone 2 Team Worksheets** document allows you to readily access your team member's work
  - This will be especially helpful when completing ***Stage 3*** of the milestone

ENGINEER 1P13 – Project Three: *Revenge of the Recycling System*

Team Number: Tues-35

Name: Teghveer Ateliey	MacID: atelieyt

Sensor Type	Description	Attribute(s)
Light Dependent Resistor	• LDRs are variable resistors, like potentiometers. They change resistance based on the amount of light detected [1]. • LDR consists of photosensitive material. As more photons excite the material, valence electrons will be able to move more freely [2]. • More light detected -> less resistance, greater current • Less light detected -> more resistance, less current	Measure light intensity at bin location to distinguish between bins.
Colour Sensor	• Colour sensors pick up the light reflected from the object it is detecting [3]. • Different wavelengths of light correspond to different colours. The sensor determines colour by measuring the wavelength [1]. • Often colour sensors will come equipped with white LEDs which shine onto the objects it's trying to detect.	Determine the colours of each of the bins to tell them apart.

References:

[1] "Week 1 Lab (Winter) – Pre-Project P-3 Interactive Demonstrations," class notes for ENG 1P13, Engineering, McMaster University, winter term, 2022.

[2] WatElectronics, "What is a Light Dependent Resistor and Its Applications," WatElectronics.com [Online]. Available: https://www.watelectronics.com/light-dependent-resistor-ldr-with-applications/#:~:text=Working%20Principle%20of%20LDR&text=These%20devices%20depend%20on%20the,light%20its%20resistance%20will%20decrease. [Accessed: Jan. 17, 2022].

[3] "UNDERSTANDING COLOUR SENSORS: WORKING PRINCIPLE AND APPLICATIONS," BesTech [Online]. Available: https://www.bestech.com.au/blogs/understanding-colour-sensors-working-principle-and-applications/. [Accessed: Jan. 17, 2022].

ENGINEER 1P13 – Project Three: *Revenge of the Recycling System*

Team Number: Tues-35

Name: Viktorija Todorovic	MacID: todorv1

Sensor Type	Description	Attribute(s)
Ultra Sonic Sensor	-A high frequency sound wave is emitted -measures distance by using an equation that uses the time it takes for the soundwave to return back to the sensor	-It can help determine the boxes if the they are set different distances away -Within the program you can set it so as certain distance away is a specific box
Active (IR) Infrared Sensor	-infrared waves are emitted -it detects the reflected emission that is sent out -It can detect bright colours and won't detect dark colours like black	- It can help for the q-bot following the line. -If it loses the detection, it can be programed to move back in the direction to where it need to go -It can also be used to measure the distance from the q-bot to the bin. Which can be used if the bins are different distances away

**Copy and paste this table on a new page below for Computing Sub-Teams of 3 members.*

References:

[1] "Week 1 Lab (Winter) – Pre-Project P-3 Interactive Demonstrations," Notes for ENG 1P13, Engineering, McMaster University.

[2] "Detection Based on "Ultrasonic Waves" What is an Ultrasonic Sensor?" Keyence. https://www.keyence.com/ss/products/sensor/sensorbasics/ultrasonic/info/. (accessed January 16, 2022).

[3] Jeremy S. Cook. "The Right Tool for the Job: Active and Passive Infrared Sensors. https://www.arrow.com/en/research-and-events/articles/understanding-active-and-passive-infrared-sensors. (accessed January 16, 2022).

ENGINEER 1P13 – Project Three: *Revenge of the Recycling System*

MILESTONE 2 (STAGE 2) – CONCEPT SKETCHES (MODELLING SUB-TEAM)

Team Number: Tues-35

You should have already completed this task individually *prior* to Design Studio 14.

1. Each team member is required to complete two (2) refined concept sketches for the design
   → Each sketch should be on a separate piece of paper
   → Be sure to clearly write your Team Number, Name and MacID
2. Copy and paste each sub-team member's refined sketches on the following pages (1 sketch per page)
   → Be sure to indicate each team member's Name and MacID

We are asking that you submit your work on both worksheets. It does seem redundant, but there are valid reasons for this:

- Each team member needs to submit their concept sketches with the **Milestone 2 Individual Worksheets** document so that it can be ***graded***
- Compiling your individual work into this **Milestone 2 Team Worksheets** document allows you to readily access your team member's work
  - This will be especially helpful when completing ***Stage 4*** of the milestone

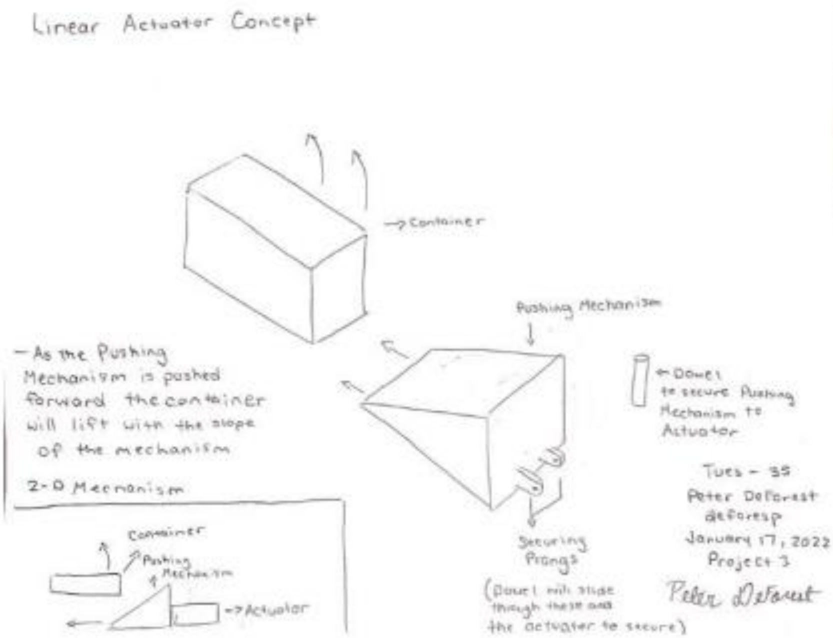
ENGINEER 1P13 – Project Three: ***Revenge of the Recycling System***

Team Number: Tues-35

Name: Peter DeForest	MacID: deforesp

Insert picture of refined concept sketch below

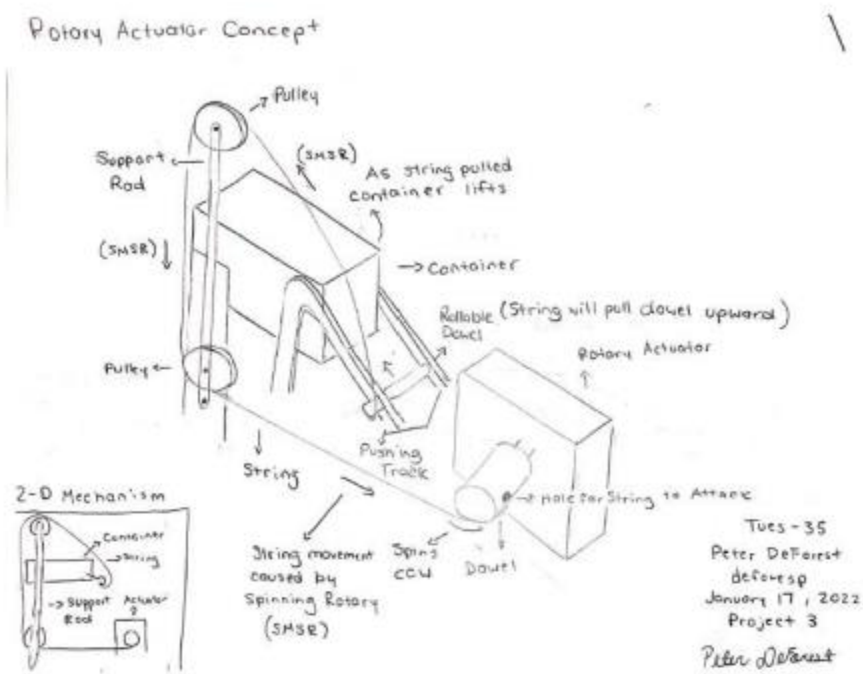
Design 1



ENGINEER 1P13 – Project Three: *Revenge of the Recycling System*

Team Number: Tues-35

Name: Peter DeForest	MacID: deforesp
Insert picture of refined concept sketch below	
Design 2	



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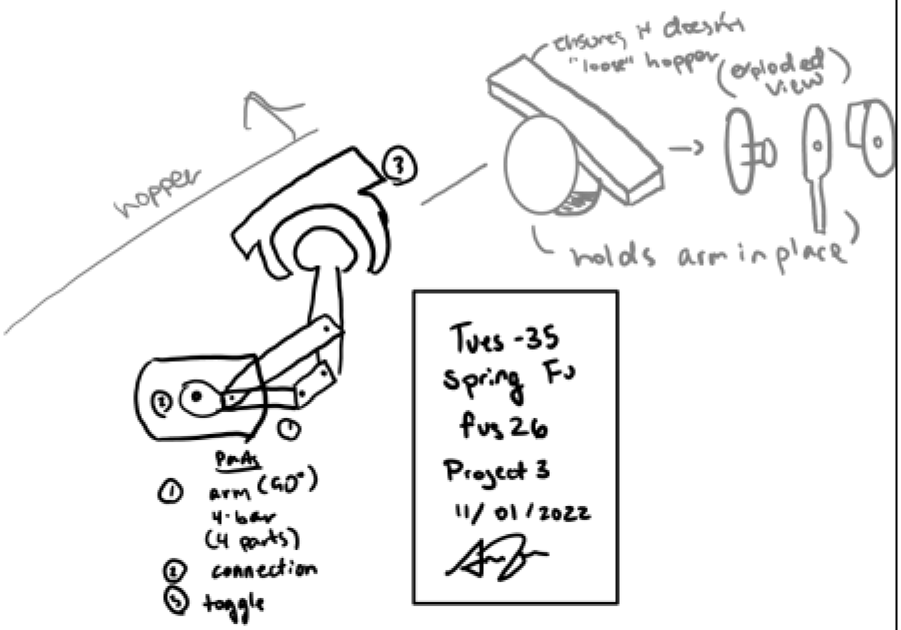
Team Number: Tues-35

Name: Spring Fu	MacID: fus26

Insert picture of refined concept sketch below

Design 3



*The TA said this was sufficient

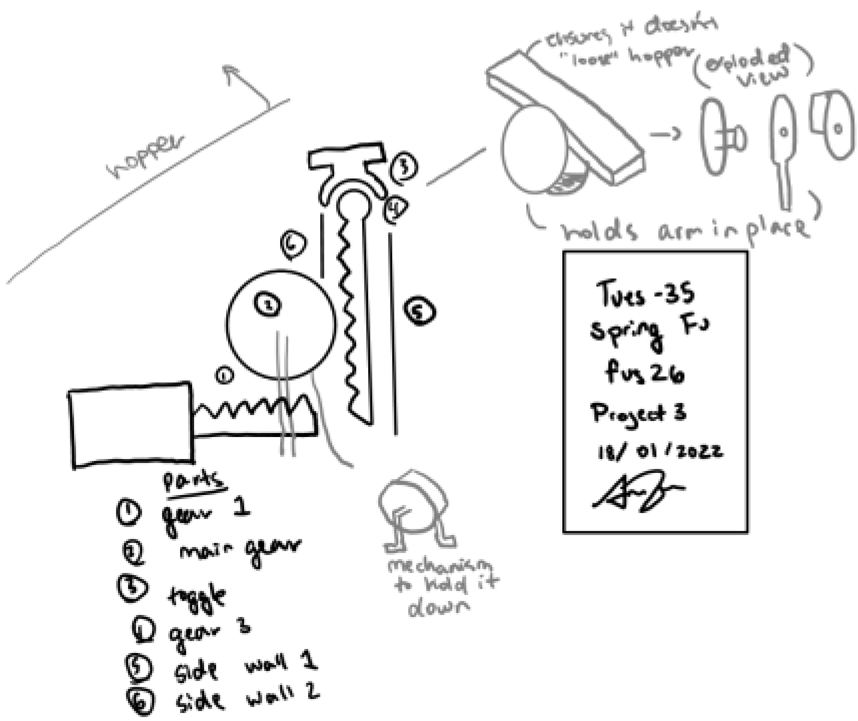
ENGINEER 1P13 – Project Three: *Revenge of the Recycling System*

Team Number: Tues-35

Name: Spring Fu	MacID: fus26

Insert picture of refined concept sketch below

Design 4



*The TA said this was sufficient

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MILESTONE 2 (STAGE 3) – SENSOR SELECTION AND PROGRAM TASK PLANNING (COMPUTATION SUB-TEAM)

Team Number: Tues-35

1. As a sub-team, discuss the results of your individual sensor research and select the sensor(s) that you will use in your project. Identify the sensor(s) in the box below and include any decision-making tools or justification in the space provided.
Teams are allowed to use a maximum of 2 sensors

Chosen Sensor(s): Ultra Sonic Sensor and Colour Sensor

Decision-making tools and/or justification:

- During the first lab of the semester, the ultra sonic sensor and colour sensor seemed to work the most consistently.
- Colour of the bins are easy to change and can be detected easily.
- Distance from the bin will be easy to change and will have more room for error as we can control the differences between distances. (ex: light from the room affected LDR)
- Two different sensors will allow us to accurately verify whether or not the Q-bot has reached the correct bin in case one sensor is malfunctioning.
- Light dependent resistors are too easily affected by the environment and were unpredictable during our lab with the sensors.
- Active (IR) Infrared Sensor simply detects whether an object is present or not, we felt that this was not sufficient to distinguish between four bins.

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2. As a sub-team, write out the pseudocode or create a flowchart for the indicated tasks in the space below
   → If creating a flowchart, complete your flowchart on a separate sheet of paper, take a photo of your sketch and insert photo as a Picture (Insert > Picture > This Device) under the appropriate task

Dispense Container

q-arm starts at home

Determining containers to their bin

  If the container weighs approximately 15 grams or more

    The container needs to go to the metal bin (Bin 1)

  If the container weighs approximately 10 grams

    The container needs to go to the paper bin (Bin 2)

  If the container weighs approximately 9.25 grams

    The container needs to go to the plastic bin (Bin 3)

  If the container weighs more than 9.25 grams and less than 10 grams

    The container needs to go to the garbage bin (Bin 4)

  If the container weighs more than 10 grams and less than 15 grams

    The container needs to go to the garbage bin (Bin 4)

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Load Container

Pick up containers

Position arm adjacent to the container

Then grip the container

Position the container the arm is hold above the q-bot

Release container

Constraints,

Stop q-arm if any are true

If 3 containers have filled up the hopper

If a container picked up doesn't match the container already on the hopper

If the total mass on the hopper 90grams or larger including container held by Q-arm

Return home if any apply

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Transfer Container

Once q-arm has been terminated
- Activate q-bot sensors

Differentiating Bins with ultra sonic sensor
- If the containers need to be delivered to Bin 1
  - Stop at bin that is a specified distance away
- If the containers need to be delivered to Bin 2
  - Stop at bin that is a specified distance away
- If the containers need to be delivered to Bin 3
  - Stop at bin that is a specified distance away
- If the containers need to be delivered to Bin 4
  - Stop at bin that is a specified distance away

Follow path of yellow line

Continue driving straight until bin is detected

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Deposit Container

Q-bot stopped beside container.

Both sensors continue to verify container attributes

    If colour sensor and ultra sonic sensor do not detect correct attributes twice in a row

        Q-bot will leave that bin and move to find correct bin

    If colour sensor and ultra sonic sensor detect correct attributes at least once

        Q-bot stays at bin and begins depositing

If bin attribute suggests that bin is distanced away from Q-bot path

    Q-bot rotates 90 deg clockwise

    Q-bot moves forward certain distance depending on bin

    Q-bot rotates 90 deg counterclockwise

Actuator activated to lift hopper at an angle

Sleep 5 seconds

Actuator returned to home position to lower hopper

If bin attribute suggests that bin is distanced away from Q-bot path

    Q-bot rotates 90 deg clockwise

    Q-bot moves forward certain distance depending on bin, back to path

    Q-bot rotates 90 deg counterclockwise

Return Home

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Q-bot stopped beside partially filled container Q-bot moves forward detecting and following yellow path while not at home position Q-bot stops when home position is reached

MILESTONE 2 (STAGE 4) – DETAILED SKETCHES OF MECHANISM ASSEMBLY (MODELLING SUB-TEAM)

Team Number: Tues-35

1. As a sub-team, review your refined mechanism concept sketches, and use a decision-making tool of your choice to decide which mechanism design to pursue. Examples of decision-making tools include simple or weighted decision matrices (Slide 22 of the P1 Milestone 3A Slides). Show evidence of your decision-making below, and clearly identify which mechanism design your sub-team has chosen.

Name: Spring Fu, Peter DeForest	MacID: fus26, deforesp
Show your decision-making process below, and clearly identify which mechanism concept your team will pursue. - *Designs listed in chronological order above - Design chosen: Design 3 - See the chart below for decision making	

Criteria	Weight	Design 1		Design 2		Design 3		Design 4	
		Score	Total	Score	Total	Score	Total	Score	Total
Creativity	2	1	2	5	10	5	10	5	10
Likelihood for power of the actuator to be enough	5	4	20	4	20	5	25	4	20
Likelihood of the design fitting on the footprint (vertical +	4	3	12	5	20	4	16	3	12

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horizontal) while being effective									
Fragility (5 being not, 1 being very)	3	4	12	2	6	4	12	3	9
	Total		46		56		63		51

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Team Number: Tues-35

2. As a sub-team, select a design for your mechanism, then use that one (1) design for the detailed sketches.
   → Each sub-team member is responsible for one (1) detailed sketch of the same design, either in the transfer position or the deposit position
   → For sub-teams with 3 members, the work of 2 sketches should be split evenly between members. For example, 2 members could complete the sketches while the other member adds labels, descriptors, and constraints to both sketches.
   → Complete your sketches on a separate sheet of paper
      i. Be sure to indicate each team member's Name and MacID
   → Take a photo of your sketch
   → Insert your photo as a Picture (Insert > Picture > This Device) in the space below

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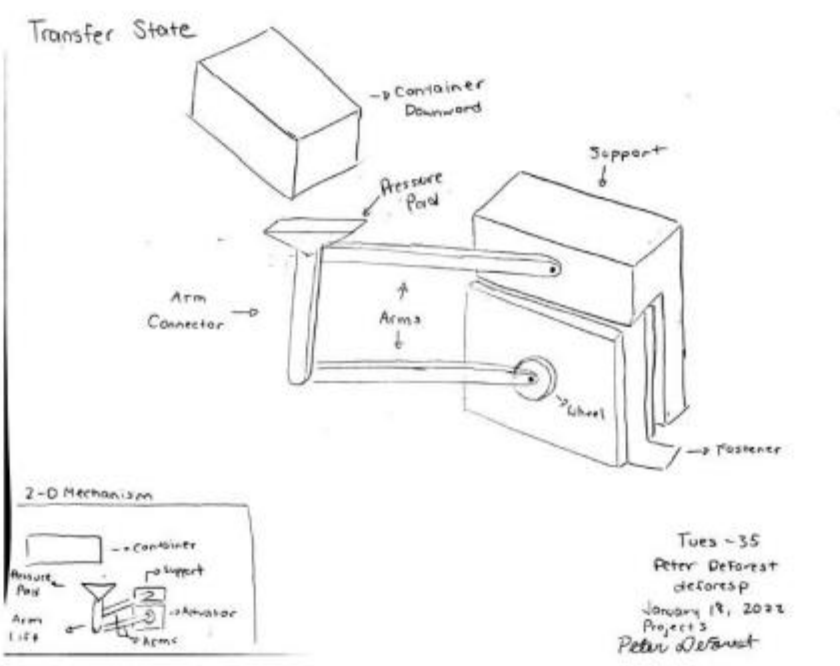
Team Number: Tues-35

Name: Peter DeForest	MacID: deforesp
*Insert picture of the **transfer** detailed sketch below*	



ENGINEER 1P13 – Project Three: ***Revenge of the Recycling System***

Team Number: Tues-35

Name: Peter DeForest	MacID: deforesp
*Insert picture of the **deposit** detailed sketch below*