Design Project 3 – Revenge of the Recycling System

ENGINEER 1P13 – Integrated Cornerstone Design Projects in Engineering

Tutorial T07

Team Thurs-14

LUAY ALABED ALKADER(ALABEDAL)

Dante Finoro (finorod)

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Submitted: March 4, 2024

Course Instructors: Dr. McDonald, Dr. Doyle, Dr. Ebrahimi, Dr. Fleisig, Dr. Hassan, Dr. Zurob

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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.

Yazan Khatib 400531344

_____ _____

(Student Signature)

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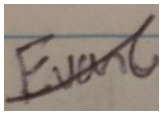
Evan Chadwick 400519884



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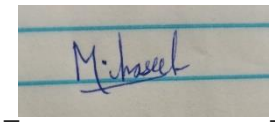
Muhammad Haseeb Aslam 400449291



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Dante Finoro 400449985

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Luay alabed alkader 400526433

_____

Executive Summary

The primary objective of our project was to design and implement a system for sorting and recycling containers based on their material composition, encompassing both virtual and physical environments. The motivation behind this initiative stems from the urgent need to improve recycling processes, reduce environmental impact, and promote sustainability. By automating and optimizing the sorting and recycling of containers, we aimed to contribute to a more efficient and eco-friendly waste management system. In the virtual environment, the computing sub-team focused on developing programs to control the Q-bot's actions. The Q-arm was utilized to load containers onto the Q-bot, and a while-loop ensured that specific conditions were met before the process repeated: the weight limit was not exceeded, no more than three containers were loaded, and the containers were destined for the same bin. Line following sensors were utilized to guide the Q-bot along a set path until it reached the designated bin. The color sensor was used to alert the Q-bot to stop following the line and go to the assigned bin. After completion, the Q-bot returned to the starting position by retracing the line. The real environment implementation mirrored the virtual process. Line following sensors directed the Q-bot towards the designated bin, and the color sensor detected the bin, signaling the Q-bot to halt. This strategy ensured a seamless transition from the virtual model to the physical environment, creating a unified and efficient sorting system. The modeling sub-team focused on designing a mechanism capable of utilizing a linear actuator to lift and retract a sorting bin for the transportation and unloading of different types of waste. This mechanism, designed using Inventor and 3D-printed for practical testing, featured a slider on the baseplate that interacted with a top plate connected to another slider. This configuration allowed the linear actuator to lift the hopper, facilitating the precise and controlled sorting of containers in the physical environment. The real baseplate served as a reliable platform for testing the mechanism's functionality and efficiency.

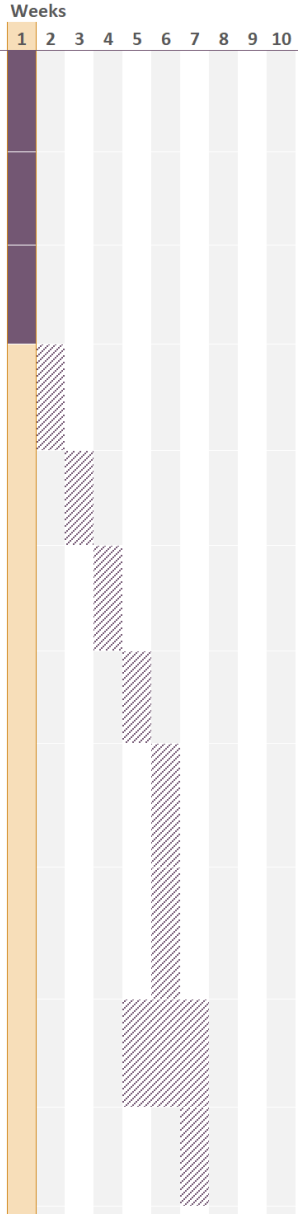
In summary, our project seamlessly integrated virtual and physical environments to create an automated sorting and recycling system. The computing sub-team's programming ensured precise actions of the Q-bot in both environments, while the modeling sub-team's mechanism design provided a reliable and effective solution for lifting and retracting sorting bins.

Appendices

Appendix A: Project Schedule

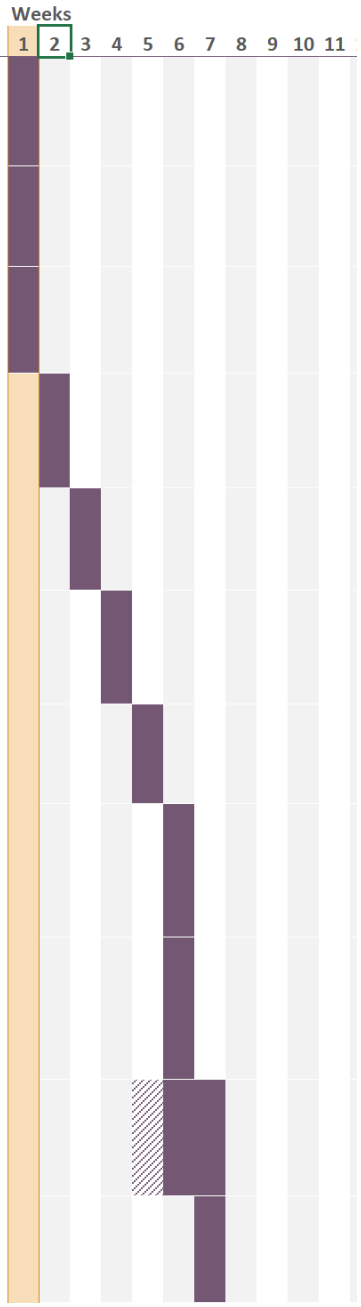
Initial Gantt Chart:

ACTIVITY	PLAN START	PLAN DURATION	ACTUAL START	ACTUAL DURATION	PERCENT COMPLETE
Milestone 0	1	1	1	1	100%
Milestone 1 (Individual)	1	1	1	1	100%
Milestone 1 (Team)	1	1	1	1	100%
Milestone 2 (Team)	2	1	0	0	0%
Milestone 3 (team)	3	1	0	0	0%
Milestone 4 (team)	4	1	0	0	0%
Milestone 5 (team)	5	1	0	0	0%
Mechanism Design & Interview	6	1	0	0	0%
Computer Program & Interview	6	1	0	0	0%
Design Project report	5	3	0	0	0%
Infographics assignment	7	1	0	0	0%



Final Gantt Chart:

ACTIVITY	PLAN START	PLAN DURATION	ACTUAL START	ACTUAL DURATION	PERCENT COMPLETE
Milestone 0	1	1	1	1	100%
Milestone 1 (Individual)	1	1	1	1	100%
Milestone 1 (Team)	1	1	1	1	100%
Milestone 2 (Team)	2	1	2	1	100%
Milestone 3 (team)	3	1	3	1	100%
Milestone 4 (team)	4	1	4	1	100%
Milestone 5 (team)	5	1	5	1	100%
Mechanism Design & Interview	6	1	6	1	100%
Computer Program & Interview	6	1	6	1	100%
Design Project report	5	3	6	2	100%
Infographics assignment	7	1	7	1	100%



Appendix B: Scheduled Weekly Meetings

Weekly Design Studio Meeting Minutes:

DS-1 January 11:

- Worked through Milestone 0 and 1
- Framed the problem, made sure to have the right objectives.
- Computing Team: Explored different options of available sensors.
- Modelling Team: Brainstormed different ideas and made sketches foe the mechanism using different actuators.
- Post Meeting Activities: Computing Team to decide on which sensors to choose.
  Modelling Team to choose and create mechanism sketches.

DS-2 January 18:

- Completed Milestone 2
- Computing Team started working on their Python program.
- Modelling Team created several key parts of their design.
- Informal TA-check in: The TA gave affirmation on the Mechanism design.
- Post-Meeting Activities: Computing Team to keep working on the execution of their program.
  Modelling Team to prepare a complete design of their mechanism and assembly.

DS-3 January 25:

- Completed Milestone 3
- Modelling Team prepared an assembled and constrained design prior to DS.
- Modelling Team started to 3D Print some parts of the design.
- Computing Team successfully executed one cycle of the Python program.
- Informal TA check-in: Verified the accuracy of the Python Program.
  Modelling Team had a fully assembled design, but the printing time was too high. The team had to refine their dimensions to decrease the printing time.

DS-4 February 1:

- Worked on Milestone 4.
- Modelling Team continued 3D Printing and added a few more components to the design.
- Computing Team executed the full mechanism of their program, which was verified by the TA.
- The TA checked in to see the progress of our team and was satisfied by our work.
- Post-Meeting Activities: Finish 3D Printing the parts.

DS-5 February 8:

- The IAI came for a detailed design review for both the sub-teams.
- The Design Review was successful as both the mechanism and Python program were successful.
- Modelling Team kept 3D Printing for their design.
- After 3D Printing, the modelling team started assembling the mechanism with the parts.
- Post-Meeting Activities: Complete the assembly of the mechanism design.

Design Demonstration and Verification February 13:

- The Modelling Team assembled their mechanism with the hopper to demonstrate it.
- Computing Team had to demonstrate their program by connecting to the bot.
- The TA/IAI asked questions individually about the design.
- The hopper deposit mechanism was demonstrated successfully.
- The Python program was executed successfully.

ATTENDANCE

Role	Name	Mac ID	Attendance (Yes/No)
Manager	**Luay alabed alkader**	**alabedalch**	**Yes**
Administrator 1	Dante Finoro	finorod	**Yes**
Administrator 2	**Yazan Khatib**	**Khatiy2**	**Yes**
Coordinator	**Muhammad Haseeb Aslam**	**aslamm14**	**Yes**
Coordinator	**Evan Chadwick**	**chadwe1**	**Yes**

AGENDA ITEMS

1. Review each others sketches.
2. .What sketches are the most viable?
3. .
4. .
5. .

MEETING MINUTES

1. .Show initial designs
    a. How can they be improved
2. .
    a.
3. .
    a.
4. .
    a.
5. .
    a.

POST-MEETING ACTION ITEMS

1. Create refined sketches for the sliding mechanism (open view) [Evan]
2. (closed view) [Yazan]
3. make drawing more accurate by showing the constraints in the joints and connectors of the mechanism clearer in the drawing and how things connect to each other.
4. Keep working on the model and try to figure out the appropriate angle to use to lift up the top plate.

ATTENDANCE

Role	Name	Mac ID	Attendance (Yes/No)
Manager	**Luay alabed alkader**	**alabedalch**	**Yes**
Administrator 1	Dante Finoro	finorod	**Yes**
Administrator 2	**Yazan Khatib**	**Khatiy2**	**Yes**
Coordinator	**Muhammad Haseeb Aslam**	**aslamm14**	**Yes**
Coordinator	**Evan Chadwick**	**chadwe1**	**Yes**

AGENDA ITEMS

1. .Review assembly before TA comes os that the whole group understands
2. .
3. .
4. .

MEETING MINUTES

1. .Talk to ta about viability and how we can simplify our design
    a.
2. .
    a.
3. .
    a.
4. .
    a.
5. .
    a.

POST-MEETING ACTION ITEMS

1. Need to figure out and work on how things will be assembled when the model is printed, so basically finding which types of screws to use [Yazan]
2. 3D printing time needs to be reduced, meaning thickness/width of objects needs to be adjusted [Evan]

ATTENDANCE

Role	Name	Mac ID	Attendance (Yes/No)
Manager	**Luay alabed alkader**	**alabedalch**	**Yes**
Administrator 1	Dante Finoro	finorod	**Yes**
Administrator 2	**Yazan Khatib**	**Khatiy2**	**Yes**
Coordinator	**Muhammad Haseeb Aslam**	**aslamm14**	**Yes**
Coordinator	**Evan Chadwick**	**chadwe1**	**Yes**

AGENDA ITEMS

1. .Talk about how we are going to print since we probably cant get it all done in ds
2. .What screws are we going to use
3. .
4. .

MEETING MINUTES

1. . Ask ta if they are any other options for printing outside of ds
    a.
2. .What clearance should be used for 3d printing holes
    a.
3. .
    a.
4. .
    a.
5. .
    a.

POST-MEETING ACTION ITEMS

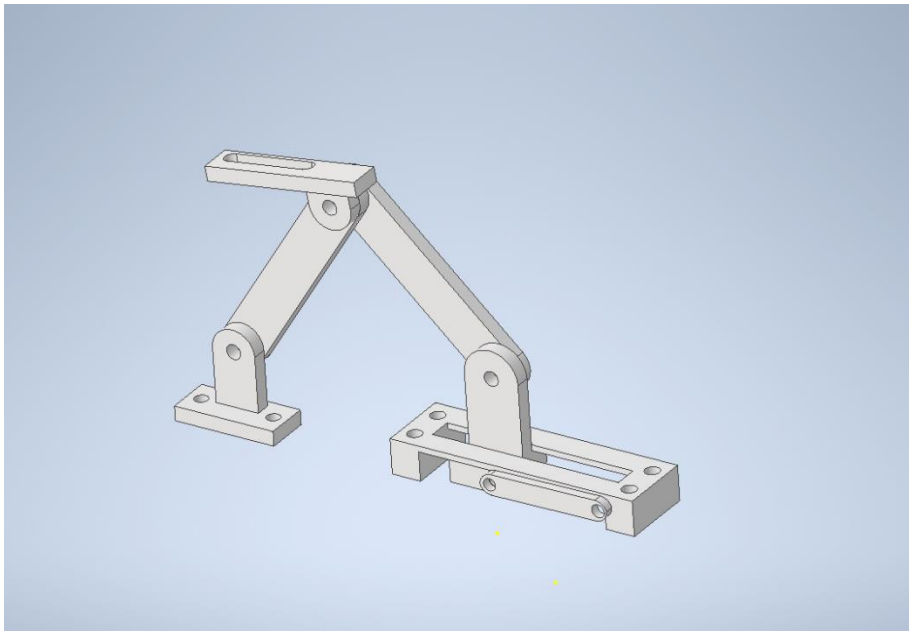
1. Finish 3d printing all parts outside of design studio [Evan]
2. Start assembling the parts after 3d printing [Team]
3. Add the connection from the linear actuator to the sliding connector [Yazan]
4. Choose appropriate screws for assembly [Yazan]

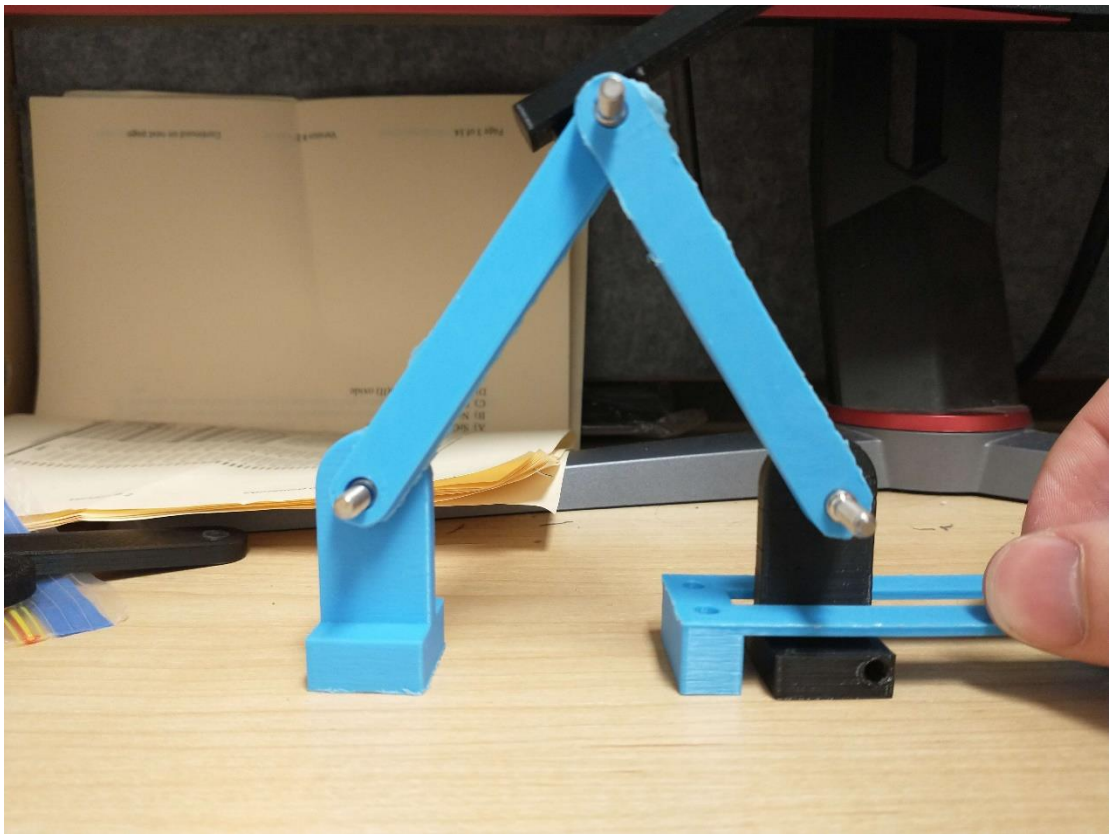
Appendix C: Comprehensive List of Sources

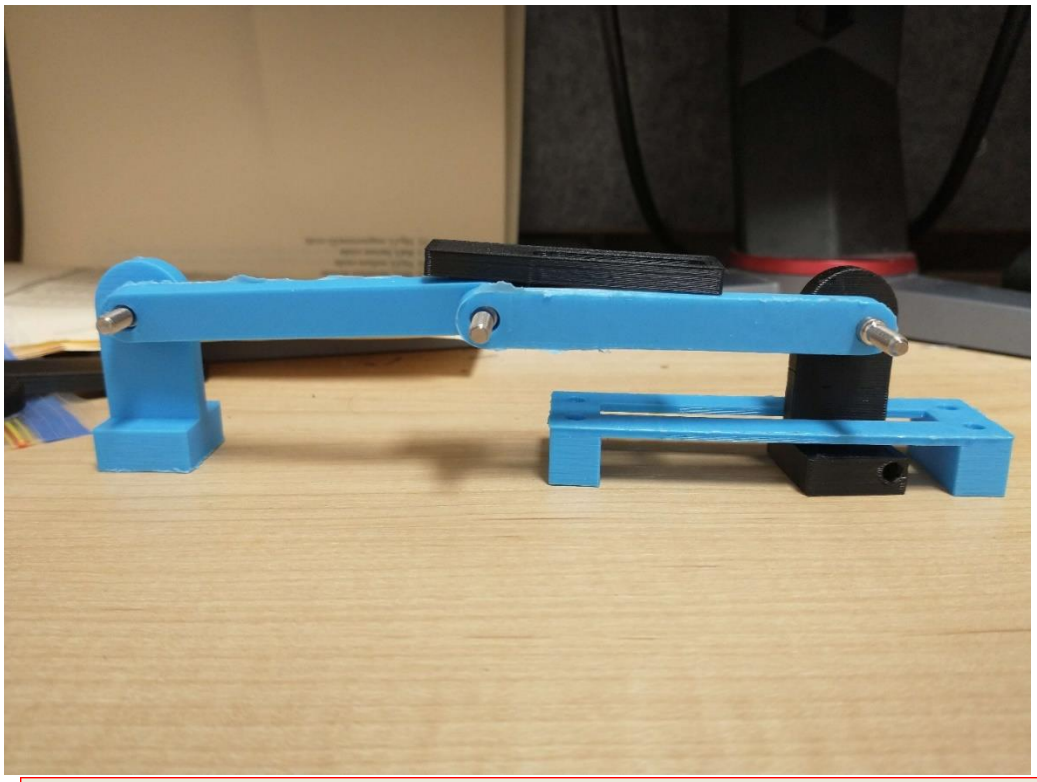
“P3 Project Module”, ENGINEER 1P13 class materials, Department of Engineering, McMaster University, Fall 2023.

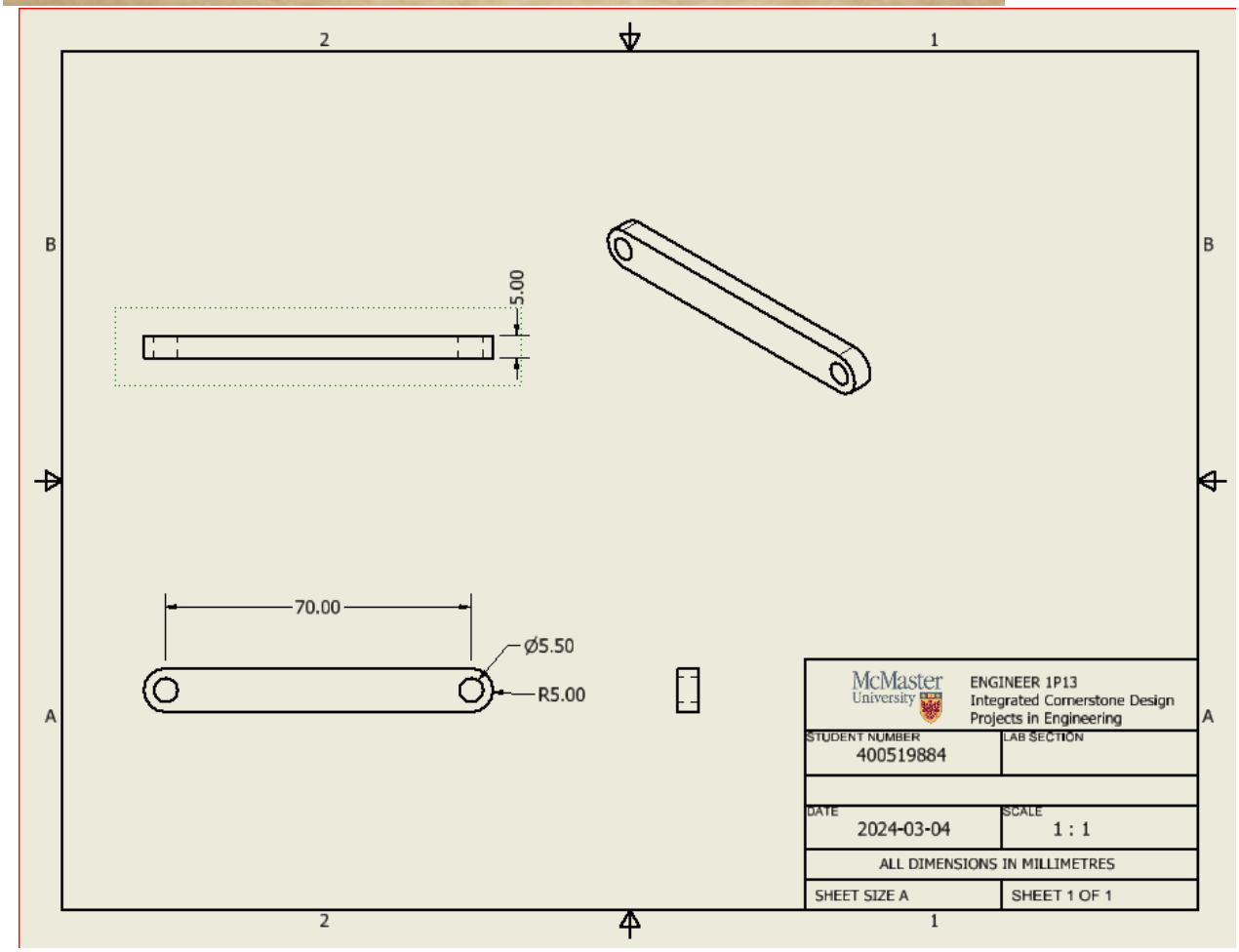
Autodesk, "Autodesk Inventor: 3D CAD software for product development," (https://www.autodesk.com/company/legal-notices-trademarks/trademarks/guidelines-for-use).

Appendix D: Additional Documentation





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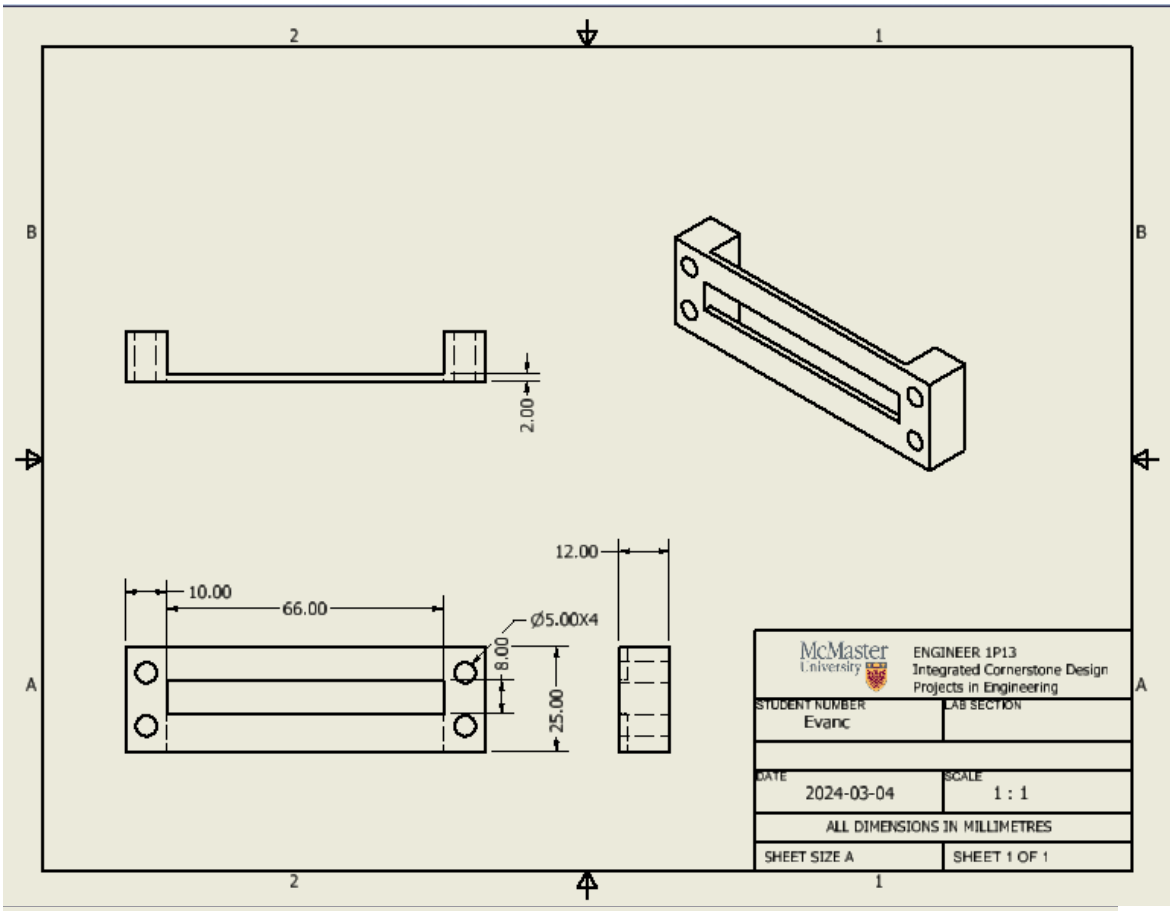
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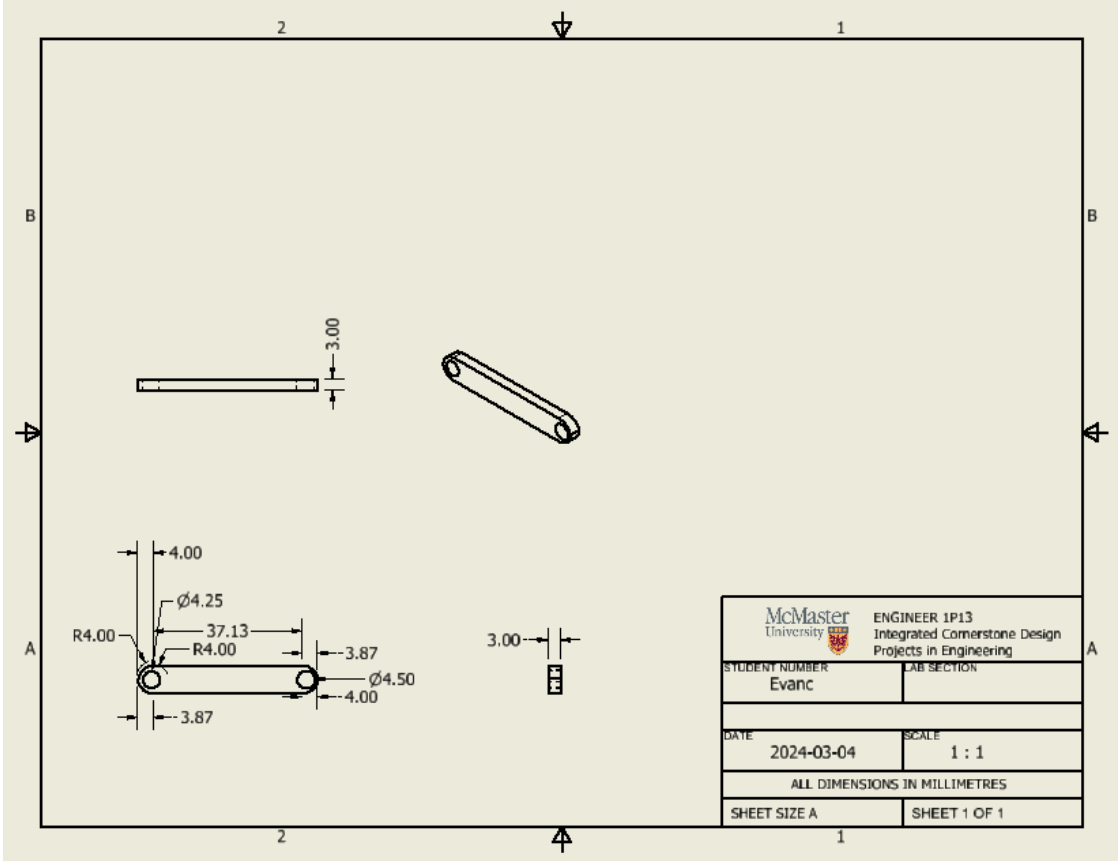
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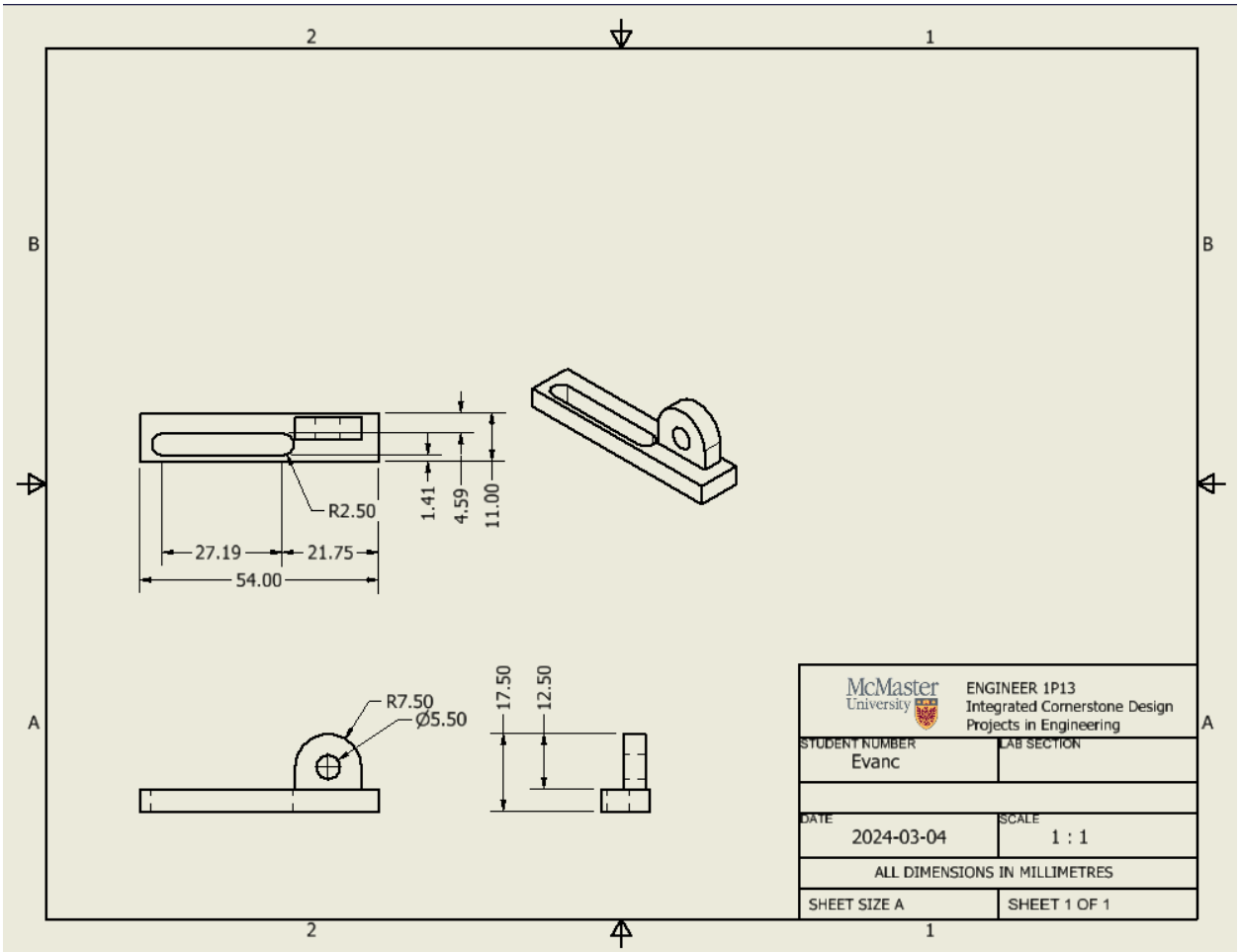
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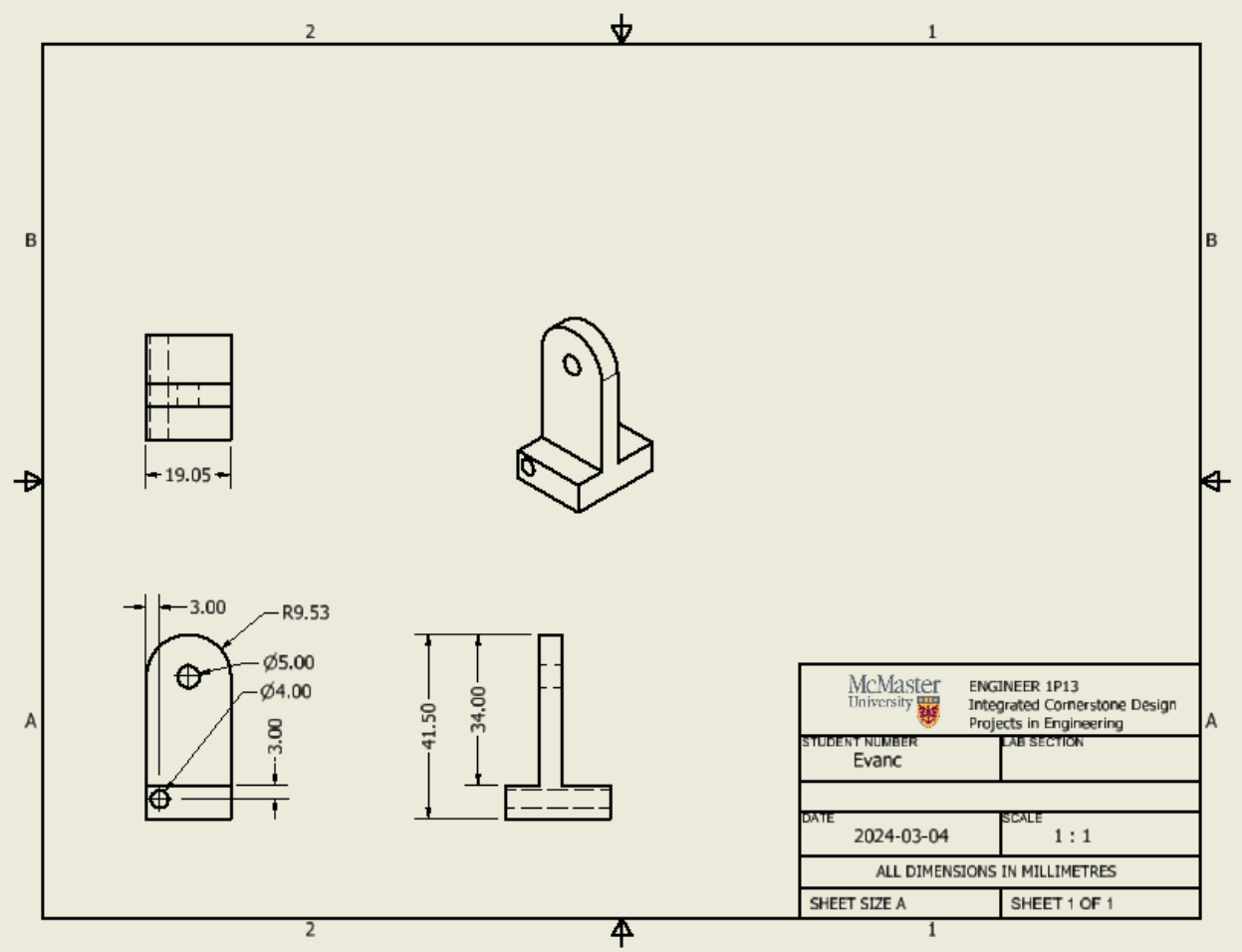
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```
#-------------------------------------------------------------------------------
# STUDENT CODE BEGINS
#-------------------------------------------------------------------------------
import random
bot.activate_color_sensor()
bot.activate_line_following_sensor()
bot.activate_ir_sensor()
HQ = bot.position()
print(HQ)

def dispense_container():#this function dispenses 1 container #Dante
    global container
    container = table.dispense_container(random.randint(1,6),True)# container variable holds container properties
    print(container)

def load_container():# loads 1 container onto the q-bot # Luay
    time.sleep(.5)
    arm.rotate_elbow(-30)
    time.sleep(1)
    arm.rotate_shoulder(45)
    time.sleep(1)
    arm.control_gripper(40)
    time.sleep(1)
    arm.rotate_shoulder(-45)
    time.sleep(1)
    arm.rotate_base(-90)
    time.sleep(1)
    arm.rotate_shoulder(15)
    time.sleep(1)
    arm.rotate_elbow(12)
    time.sleep(1)
    arm.control_gripper(-40)
    time.sleep(1)
    arm.home()

def load_container_first():# loads the first container alittle futher back  # Luay
    time.sleep(.5)
    arm.rotate_elbow(-30)
    time.sleep(1)
    arm.rotate_shoulder(45)
    time.sleep(1)
    arm.control_gripper(40)
    time.sleep(1)
    arm.rotate_shoulder(-45)
    time.sleep(1)
    arm.rotate_base(-90)
    time.sleep(1)
    arm.rotate_elbow(-2)
    time.sleep(1)
    arm.rotate_shoulder(28)
    time.sleep(1)
    arm.control_gripper(-40)
    time.sleep(1)
    arm.home()
```

```
def load_containers():#loads multiple containers until one of the coditions are met     Dante
    if counter < 1:
        dispense_container()
    load_container_first()#calls dispense and load container functions
    global og
    og = container[2]#og holds the originals containers bin Id
    weight = container[1]
    i=0
    while i < 2:#loop to reapeat process up to 2 more times
        time.sleep(2)
        dispense_container()
        weight += container[1]
        if weight <= 90 and og == container[2]:
            load_container()
        else:
            i=2
            print("Cannot load another container")
        i=i+1




def colour_detection(): #Dante
    colour=bot.read_color_sensor()[0]
    return colour#returns the colour


def transfer_container(): # Dante
    a=1
    while a==1:#this is the line folloing loop
        l=bot.line_following_sensors()
        if l==[1, 1]:
            bot.set_wheel_speed([0.1, 0.1])
        elif l==[1, 0]:
            bot.set_wheel_speed([0.05, 0.1])
        elif l==[0, 1]:
            bot.set_wheel_speed([0.1, 0.05])
        else:
            print("line not detected")
        bin_colour=colour_detection()
        if bin_colour == [1,0,0] and og == 'Bin01':#stops the q-bot when the colour matches the bin ID
            a=0
            print("bin found")
            bot.stop()
        elif bin_colour == [0,1,0] and og == 'Bin02':
            a=0
            print("bin found")
            bot.stop()
        elif bin_colour == [0,0,1] and og == 'Bin03':
            a=0
            print("bin found")
            bot.stop()
        elif bin_colour == [0,0,1] and og == 'Bin04':
            a=0
            print("bin found")
            bot.stop()
```

```
def deposit_container(): # Luay
    line = bot.line_following_sensors()
    if og == 'Bin01':#directs the q bot to the bin then doposits and goes back to the line
        bot.rotate(90)
        bot.forward_distance(0.15)
        bot.rotate(-90)
        bot.forward_distance(.2)
        bot.activate_linear_actuator()
        bot.rotate_hopper(30)
        time.sleep(0.5)
        bot.rotate_hopper(60)
        time.sleep(2)
        bot.rotate_hopper(0)
        bot.set_wheel_speed([0.05, 0.1])
        if line == [1, 1] or [0, 1] or [1, 0]:
            bot.stop()
    elif og == 'Bin02':
        bot.rotate(90)
        bot.forward_distance(0.15)
        bot.rotate(-90)
        bot.forward_distance(.2)
        bot.activate_linear_actuator()
        bot.rotate_hopper(30)
        time.sleep(0.5)
        bot.rotate_hopper(60)
        time.sleep(2)
        bot.rotate_hopper(0)
        bot.set_wheel_speed([0.05, 0.1])
        if line == [1, 1] or [0, 1] or [1, 0]:
            bot.stop()
    elif og == 'Bin03':
        bot.rotate(90)
        bot.forward_distance(0.15)
        bot.rotate(-90)
        bot.forward_distance(.2)
        bot.activate_linear_actuator()
        bot.rotate_hopper(30)
        time.sleep(0.5)
        bot.rotate_hopper(60)
        time.sleep(2)
        bot.rotate_hopper(0)
        bot.set_wheel_speed([0.05, 0.1])
        if line == [1, 1] or [0, 1] or [1, 0]:
            bot.stop()
    elif og == 'Bin04':
        bot.rotate(90)
        bot.forward_distance(0.15)
        bot.rotate(-98)
        bot.forward_distance(.6)
        bot.activate_linear_actuator()
        bot.rotate_hopper(30)
        time.sleep(0.5)
        bot.rotate_hopper(60)
        time.sleep(2)
        bot.rotate_hopper(0)
        bot.set_wheel_speed([0.03, 0.1])
        if line == [1, 1] or [0, 1] or [1, 0]:
            bot.stop()
```

```
def home(): # Luay
    a=1
    while a==1:#line following loop
        l=bot.line_following_sensors()
        if l==[1, 1]:
            bot.set_wheel_speed([0.1, 0.1])
        elif l==[1, 0]:
            bot.set_wheel_speed([0.05, 0.1])
        elif l==[0, 1]:
            bot.set_wheel_speed([0.1, 0.05])
        else:
            print("line not detected")
        pos = bot.position()#stops bot when it is in the home range
        if 1.4 < pos[0] < 1.6 and -0.01 < pos[1] < 0.01 and -0.01 < pos[2] < 0.01:
            a=0
    bot.stop()
    print("I have found Home")



def main(rep):#calls all functions # Dante
    global counter
    counter = 0
    while counter < rep:
        load_containers()
        transfer_container()
        deposit_container()
        home()
        counter += 1
main(5)



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

```
#-------------------------------------------------------------------------------
# STUDENT CODE BEGINS
#-------------------------------------------------------------------------------
def transfer_container():
    bot.activate_line_following_sensors()
    bot.activate_color_sensor()
    a=1
    while a==1:#this is the line folloing loop
        l=bot.line_following_sensors()
        try:
            if bot.read_color_sensor()[0] == [1,0,0]
                bot.stop()
                a = 0
        except:
            time.sleep(0.1)
            continue
        if l==[1, 1]:
            bot.set_wheel_speed([0.1, 0.1])
        elif l==[1, 0]:
            bot.set_wheel_speed([0.05, 0.1])
        elif l==[0, 1]:
            bot.set_wheel_speed([0.1, 0.05])
        else:
            print("line not detected")
            bot.stop()




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

Appendix E: Design Studio Worksheets

TEAM WORKSHEETS:

ENGINEER 1P13:
PROJECT THREE WORKSHEETS (TEAM)

PROJECT THREE: MILESTONE ZERO (TEAM): TEAM DEVELOPMENT AND PROJECT PLANNING

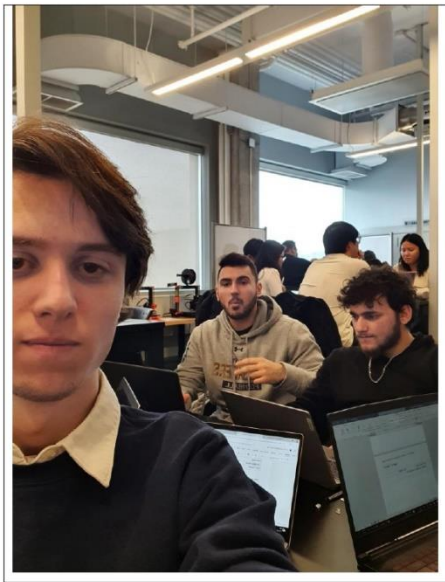
Milestone 0 – Cover Page

Team ID: Thurs-14

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

Full Name:	MacID:
Muhammad Haseeb Aslam	aslamm14
Yazan Khatib	khatiy2
Dante Finoro	finorod
Luay alabed alkader	alabedal
Evan Chadwick	chadwe1

Insert your Team Portrait in the dialog box below



Milestone 0 – Team Charter

Team ID: Thurs-14

Incoming Personnel Administrative Portfolio:

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

	Team Member Name:	Project Leads
1.	Muhammad Haseeb Aslam	☒M ☒A ☐C ☐S
2.	Yazan Khatib	☒M ☐A ☒C ☐S
3.	Dante Finoro	☒M ☒A ☐C ☐S
4.	LUAY ALABED ALKADER	☒M ☐A ☒C ☐S
5.	Evan Chadwick	☒M ☒A ☐C ☐S

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	Luay alabed alkader	alabedal
Administrator 1	Dante Finoro	finorod
Administrator 2	Yazan Khatib	Khatiy2
Coordinator	Muhammad Haseeb Aslam	aslamm14

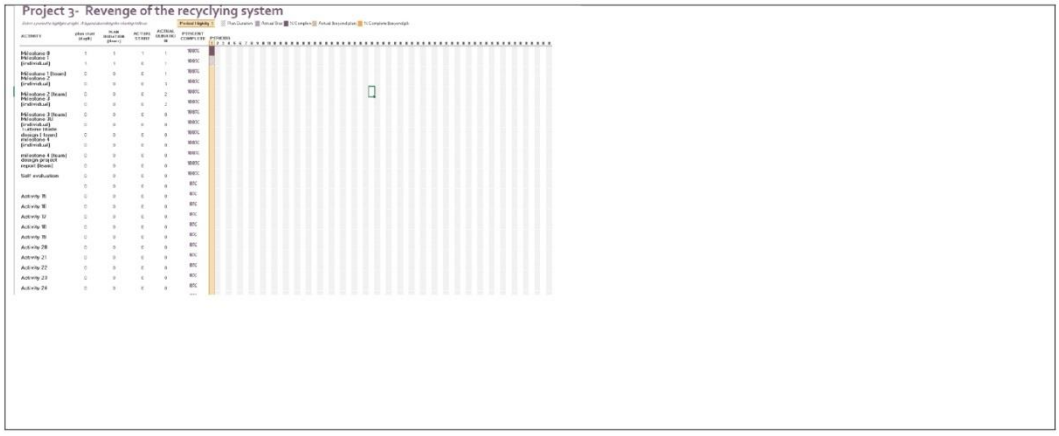
Coordinator	Evan Chadwick	chadwe1

Milestone 0 – Preliminary Gantt Chart (Team Manager Only)

Team ID: Thurs-14

Full Name of Team Manager:	MacID:
Luay alabed alkader	alabedal

Preliminary Gantt chart



PROJECT THREE: MILESTONE ONE (TEAM): PROBLEM FRAMING AND CONCEPTUAL DESIGN

Milestone 1 – Cover Page

Team ID: Thurs-14

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

Full Name:	MacID:
Dante FInoro	finorod
Muhammad Haseeb Aslam	aslamm14
Yazan Khatib	khatiy2
Evan Chadwick	chadwe1
Luay alabed alkader	alabedal

Milestone 1 (Stage 1) – Initial Problem Statement, Objectives and Constraints

Team ID: Thurs-14

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.

We need to make a system that determines whether the container is recyclable or not, what type of recyclable it is and where to deliver the container. We need a system to recycle our trash, since we are running out of places to put our trash, and having a good sorting system for recycling helps yield higher quality recycled products. Design a recycling system that prevents waste of recyclable materials to prevent losing recyclable materials and overfilling facilities. 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	- Determine what category container is, deliver it to the correct drop-off, return home - Maximize Recyclables - detect and identify containers as accurately as possible - Smooth motion as to not require maintenance - Quickly identifies type of recycling to function as fast as possible
Constraints	- Sensor limitations, space restrictions, processing speed - Hopper must must hold a maximum of three containers. - Container must include a hopper for holding containers during transfer. - Assembly model must be properly constrained to base plate along with actuator. - Device must mount to a base plate on top of the Qbot.

	- Q arm range of motion - Number of containers cannot exceed 3 or be signficantly over 90 grams

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 2*** of the milestone

Milestone 1 (Stage 2) – Refined Problem Statement

Team ID: Thurs-14

Refined Problem Statement

1. As a team, write the refined problem statement below. Kindly refer to the Refined Problem Statement rubric in the P3 Project Module. This will guide your group in creating a valid statement.

Approximately 30 percent of items placed in recycling bins are not recyclable, leading to significant loses of materials annually, having a recycling system that sorts trash will help yield higher quality and a smaller loss of materials.

PROJECT THREE: MILESTONE TWO (TEAM): PRELIMINARY DESIGN

Milestone 2 – Cover Page

Team ID: Thurs-14

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

Full Name:	MacID:
Luay alabed alkader	alabedalch
Evan Chadwick	chadwe1
Dante FInoro	finorod
Muhammad Haseeb Aslam	aslamm14

Milestone 2 (Stage 1) – Sensor Selection and Computer Program Workflow (Computation Sub-Team)

Team ID: Thurs-14

1. As a sub-team, discuss the results of your individual sensor demo activity 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):

   Ultrasonic sensor and colour sensor

Decision making tools and/or justification:

We can use the colour sensor to differentiate between bins and we can use the ultrasonic sensor to determine how close we are to the bins.

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 under the appropriate task

Dispense Container

Dispense random container
Note mass of container to determine what bin it needs to be deposited at

Load Container

q-arm to grab container
q-arm pick up container

q-arm move to above q-bot
q-arm release container
Repeat until there are 3 containers or total mass of containers does not exceed 90 grams or the next container has a different container id

Transfer Container

Activate colour sensor
q-bot following line on floor to the bins
Sensor can determine which bin it needs to stop at based on the information it has already received and the colour of the bin

Deposit Container
Use ultrasonic sensor to determine if q-bot is close enough to the bin
If it is not q-bot should move toward bin and adjacent to it
Dump containers into bin
Add pause
Move back to line if necessary

Return Home
Q-bot follow line back to home

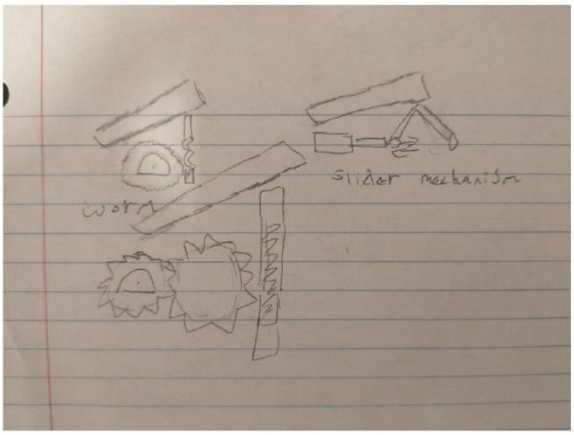
Milestone 2 (Stage 2) – Detailed Sketches of Mechanism Assembly (Modelling Sub-Team)

Team ID: Thurs-14

1. As a sub-team, review your concept 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.

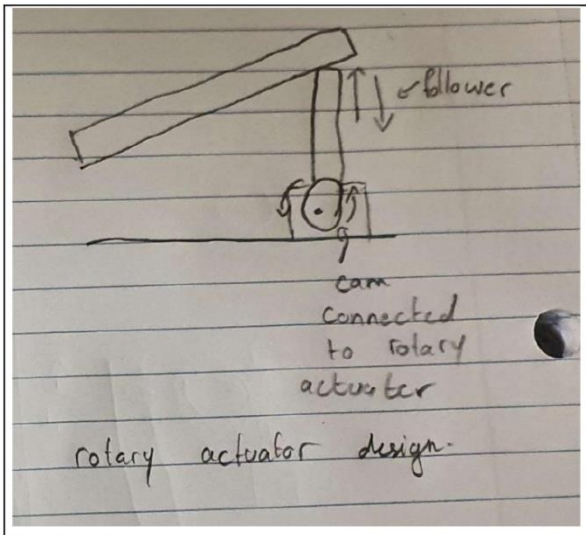
Name: Yazan Khatib	MacID: Khaity2
Evan Chadwick	chadwe1
Muhammad Haseeb Aslam	aslamm14

Show your decision-making process below, and clearly identify which mechanism concept your team will pursue.



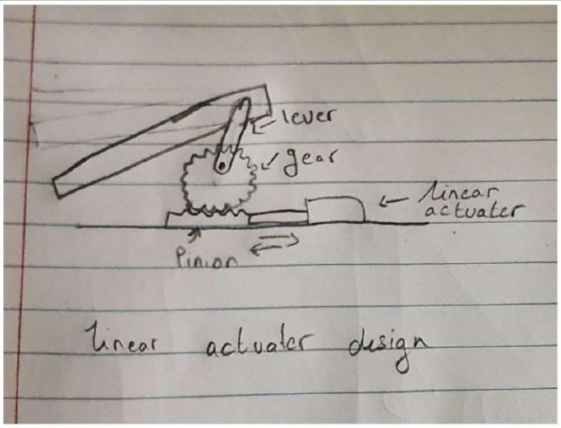
Worm Design:
Pros:
High Torque
Low Vibration (System is more Stable)
Cons:
Hard to Fabricate
Hard to Install
Parts have heavy load on them (could break)

Slider Mechanism Design:
Pros:
Simple Design
Easy to Install/Fabricate
Easy to control
Easy to program
Accurate
Cons:
Might not be enough force to move the top plate
Might need to make parts long to move the top plate at a high enough angle



Pros: Accurate

Cons: The follower can only extend as long as tthe cams radius is, so cam would need to be really big to put it at a high enough angle to tilt the top plate but the problem is that would make it hard to fit the cam and to also get the top plate back down.

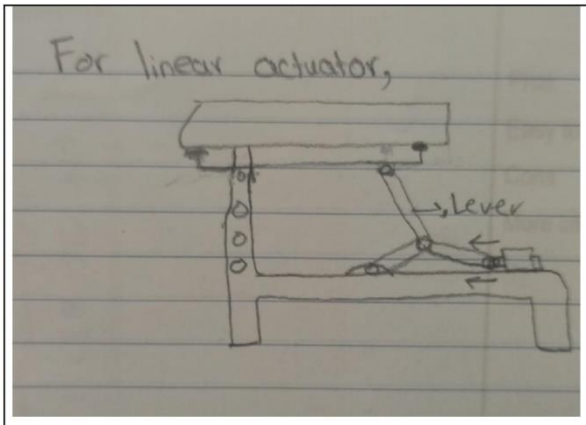


Pros:

Easy to lift mechanism to specific points/accurate

Cons:

More complex design containing multiple moving components



Pros:

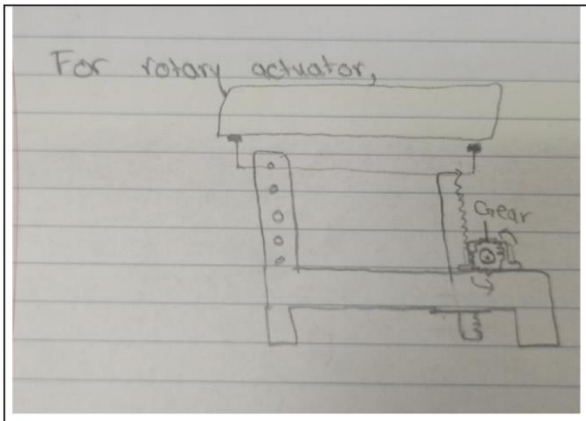
More flexible design

Cons:

Complex Mechanism

Hard to install

Levers and joints might break from excessive use



Pros:

Stable Design

Easy to install

Simple mechanism

More stable and less risk of breaking

Cons:

Hard to insert the pinion through the base plate.

The pinion might touch the ground due to its length.

Decision: We have decided to go with the sliding mechanism according to these lists of pros and cons. The design and action of the sliding mechanism is much more efficient than the rest of our options.

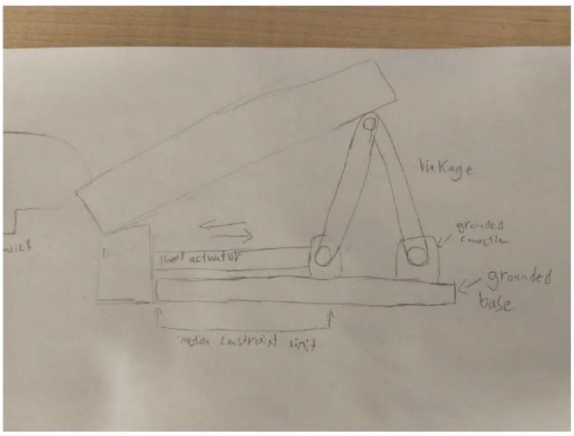
Team ID: Thurs-14

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 in the space below

Team ID: Thurs-14

Name: Evan Chadwick	MacID: Chadw1

*Insert picture of the **transfer** detailed sketch below*



Description: In our sliding mechanism, we use a linear actuator to move one sliding joint (as seen on the left) across the base. The joint on the right is the grounded connection. As the left joint slides across the base, the linkage pushes the hopper above which transfers the containers to the correct location.

Constraints:
The linear actuator has a limited stroke length, which means we need levers of certain length to rotate the hopper to an appropriate degree.

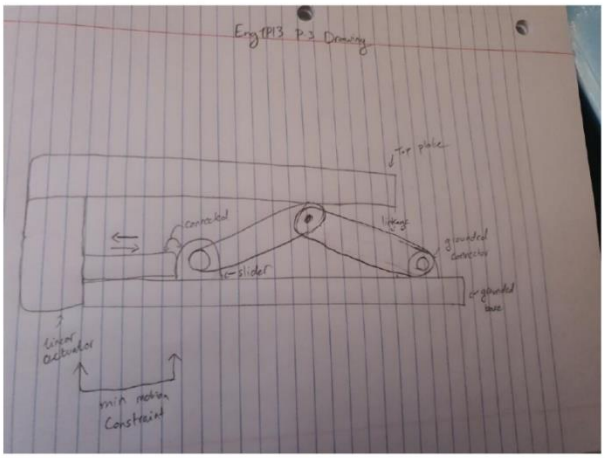
The base should be designed in a way that allows the joint to slide with minimal friction.

Limited space.

Name: Muhammad Haseeb Aslam MacID: aslamm14

Team ID: Thurs-14

Name:Yazan Khatib	MacID Khatiy2
*Insert picture of the **deposit** detailed sketch below*	



Milestone 2 (Stage 5) – Informal TA check-in (Modelling Sub-Team)

Team ID: Thurs-14

☐ Sketches include ONE actuator (linear or rotary) that is the input of the mechanism

☐ Sketches in both deposit and transfer position are drawn.

- Components are identified and labelled
- Any relationships and constraints (such as assembly constraints and motion constraints) are highlighted.
- Component that will serve as the grounded part of the assembly once conducted is identified.

Output of the mechanism allows for rotation of the connecting plate/hopper. Rotation angle is sufficient to allow for container deposit.

☐ The mechanism attaches to both the baseplate and the connecting plate (below the hopper)

☐ Mass of all components is considered

- The design should intentionally minimize materials

Mentor Comments: Use the space below to document mentor feedback for your design, including requirement for reviewing progress next design studio.

- No major concerns but make drawing more accurate by showing the constraints in the joints and connectors of the mechanism clearer in the drawing and how things connect to each other.

Action Items: Use the space below to propose design refinements based on feedback.

Keep working on the model and try to figure out the appropriate angle to use to lift up the top plate.

Milestone 2 (Stage 5) – Informal TA check-in (Computing Sub-Team)

Team ID: Thurs-14

☒ A sensor(s) has been selected. Discuss reasons as to why the group chose said sensor(s).

☒ The following tasks have been planned either in pseudocode or flowchart format:

→ Dispense container
→ Load container
→ Transfer container
→ Deposit container
→ Return home

☒ The following tasks are planned in pseudocode or flowchart format as their own functions:

→ Load container
→ Transfer container
→ Deposit container

☒ Do the tasks cover the following:

- Container attributes are determined
- Containers are positioned in the sorting station
- Q-arm loads the containers until one of the following conditions are met:
  - A container with a different ID is placed in the sorting station
  - The total mass of the bottle placed in the sorting station and the bottles loaded on the Q-bot is greater than 90 grams
  - 3 bottles have been placed on the Q-Bot
- Q-bot transfers the containers to the correct recycling bin
- Q-bot deposits the containers into the bin
  - If needed, Q-bot turns 90 degrees to face the required bin, and then locomotes to bin
- Q-bot returns home
- Cycle repeats

Mentor Comments: Use the space below to document mentor feedback for your design, including requirement for reviewing progress next design studio.

-Need to add pause in the pseudocode when disposing of container to allow time for it to fall in to bin

-Also need to figure out how the bot knows where home is

Action Items: Use the space below to propose design refinements based on feedback.

-Can simply use the time.sleep() function to make a pause

-We can store the co-ordinates of the starting position as a variable and tell the bot to stop when it gets to that point

PROJECT THREE: MILESTONE THREE (TEAM): WORK PERIOD / INFORMAL TA CHECK-IN

Milestone 3 – Cover Page

Team ID: THU-14

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

Full Name:	MacID:
Luay Alabed Alkader	alabedal
Dante Finoro	finorod
Evan Chadwick	chadwe1
Muhammad Haseeb Aslam	aslamm14
Yazan Khatib	Khatiy2

Milestone 3 (Stage 3) – Informal TA check-in (Modelling Sub-Team)

Team ID: Thu-14

☐ Assembly includes one actuator (linear or rotary) that is the input of the mechanism

☐ Output of the mechanism allows for rotation of the connecting plate/hopper. Rotation angle is sufficient to allow for container deposit.

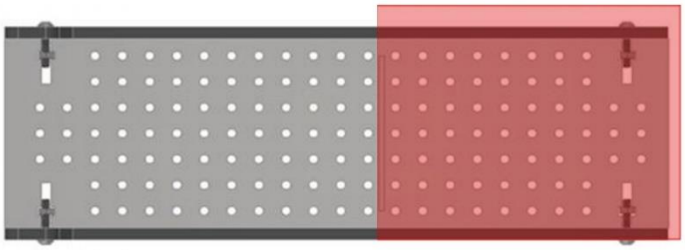
☐ Assembly is complete and constrained properly

→ No interference between parts, clean assembly model, no errors, one part grounded

→ Proper assembly constraints (define position of components in assembly)

→ Proper motion constraints (define motion ratios between assembly components)

☐ The mechanism attaches to both the baseplate and the connecting plate (below the hopper)



☐ All *holes* on the chosen actuator housing are *attached* WITHIN the highlighted region (see figure above)

☐ Mass of all components is considered

- The design should intentionally minimize materials

☐ Total print time of ALL 3D printed components does not exceed 2 hours

- Discuss a prototyping plan. Is it within the time constraint to re-print or redesign if needed?
- Discuss if components need any support for 3D printing (i.e., for any overhanging features). If so, TAs will assist the sub-team in adding supports

- Discuss/suggest potential for laser-cutting (flat components in particular)

☐ ALL features of 3D printed parts are feasible for printing

- Features and spaces are suggested to be 2mm or greater (Features between 2mm and 4mm are appropriately sized and will not compromise the printed design)

☐ Consideration of additional materials

- Students have considered and sourced any additional materials as necessary (i.e. fasteners)

Mentor Comments: Use the space below to document mentor feedback for your design, including requirement for reviewing progress next design studio.

- Overall, the design looks good and has a very likely chance of working in real life
- 3D printing time needs to be reduced, meaning thickness/width of objects needs to be adjusted
- Need to figure out and work on how things will be assembled when the model is printed, so basically finding which types of screws to use

Action Items: Use the space below to propose design refinements based on feedback.

- Will heavily optimize by reducing any bloat/wasted material and shaving off alot of thickness on pieces and trying to minimize the size of each part.
- Will figure out how to attach all the parts using real life screws by simulating everything in inventor before printing.

Milestone 3 (Stage 3) – Informal TA check-in (Computing Sub-Team)

Team ID: Thur-14

✅ All 5 program tasks are accounted for (dispense container, load container, transfer container, deposit container, return home)

✅ One cycle (for ONE container of the sub-team's choice) sufficiently executes based on requirements outlined in project module

- The general flow: home → dispense → load → transfer → deposit → home

✅ The following tasks are written as their own functions:

- Load container
- Transfer container
- Deposit container

✅ The return home task executes properly by following the yellow line *around the loop* and back to the sorting station

✅ No errors in program

✅ Commenting their code (i.e., headers explaining purpose of functions & any other appropriate comments where needed)

Mentor Comments: Use the space below to document mentor feedback for your design, including requirement for reviewing progress next design studio.

- Missing the comment of the codes.

- Adjust how far the bins are from the line.

- small adjustments on making deposit the bottles in the bin more accurately.

Action Items: Use the space below to propose design refinements based on feedback.

- We've fine-tuned the bin distances to enhance efficiency and expedite the cycling process.

- We've meticulously documented and elucidated every line of code and command, clearly outlining their respective roles and the sequence in which they are executed.

- We've implemented precision enhancements to ensure the robot accurately deposits waste into the bins, minimizing the risk of any spills or scattered debris in the surrounding area.

PROJECT THREE: MILESTONE FOUR (TEAM): WORK PERIOD / INFORMAL TA CHECK-IN

Milestone 4 – Cover Page

Team ID: Thur-14

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

Full Name:	MacID:
Luay alabed alkader	Alabedal
Evan Chadwick	chadwe1

Milestone 4 – Informal TA check-in (Modelling Sub-Team)

Team ID: Thurs-14

☐ Design Meets Design Objectives

→ Facilitates container depositing (visual inspection that the hopper rotates enough for container depositing)

☐ Physical model is complete and works as intended

→ All components are ready for assembly or assembled

☐ Mass of all components is considered

→ The design should intentionally minimize materials

☐ ALL features are reasonably sized

→ No components contain small features that are likely to break

☐ Consideration of additional materials

→ Students have considered and/or sourced additional materials as necessary (ie. fasteners)

☐ APPROVED FOR PHYSICAL ENVIRONMENT

Mentor Comments: Use the space below to document mentor feedback for your design, including requirement for reviewing progress next design studio.

- Finish 3d printing all parts outside of design studio
- Start assembling the parts after 3d printing

Action Items: Use the space below to propose design refinements based on feedback.

- Add the connection from the linear actuator to the sliding connector
- Choose appropriate screws for assembly

Milestone 4 – Informal TA check-in (Computing Sub-Team)

Team ID: ☐

☐ More than one cycle of pick-up/transfer/drop-off sufficiently executes

→ At least two different containers are correctly deposited

→ The general flow should be Home → Dispense Container → Q-Arm Loads Container onto Q-Bot → Transfer Container to Proper Bin → Deposit Container → Home

→ Q-Bot should determine bin using line-following and using measured sensor values.

→ If the bins are setup so that they are far away from the yellow loop, the Q-Bot should move as specified on page 16 and 17 of the project module.

☐ All required program tasks are written as their own section of code (Dispense Container, Return Home) or function (Load Containers, Transfer Containers, Deposit Containers)

☐ No errors in program

☐ Code well commented

☐ APPROVED FOR PHYSICAL ENVIRONMENT

Mentor Comments: Use the space below to document mentor feedback for your design, including requirement for reviewing progress next design studio.

Action Items: Use the space below to propose design refinements based on feedback.

Individual Worksheets:

Yazan Khatib:

ENGINEER 1P13:
PROJECT THREE WORKSHEETS (INDIVIDUAL)

1

Table of Contents

PROJECT THREE: MILESTONE ONE: PROBLEM FRAMING AND CONCEPTUAL DESIGN

Milestone 1 (Stage 1) – Initial Problem Statement, Objectives and Constraints

Team ID: Thurs-14

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

Initial Problem Statement

1. Write the initial problem statement in the space below. This was discussed in your first lecture and is provided in the Avenue announcement.

We need a system to recycle our trash, Since we are running out of places to put our trash, and having a good sorting system for recycling helps yield higher quality recycled products.

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	Determine type of trash Be able to sort trash by material Be able to verify if bottles are clean or contaminated Drop off sorted trash into the corresponding containers
Constraints	Sensor limitations, Space limitations, Hopper must hold max of three containers, actuator assembly must fit within the space on top of the q-bot, q arm has a limited range of motion, containers cannot exceed 90 grams.

PROJECT THREE: MILESTONE ONE: PROBLEM FRAMING AND CONCEPTUAL DESIGN

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

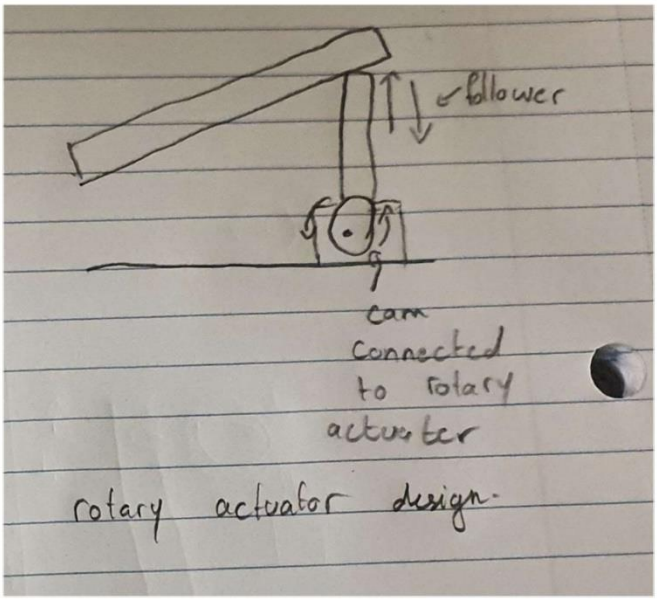
Team ID: Thurs-14

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 ID, Name and MacID for each sketch
2. Take photos of your sketches
3. Insert your photos as a Picture on the following pages

Team ID: Thurs-14

Name:Yazan Khatib	MacID: Khatiy2

Insert picture of preliminary concept sketch below



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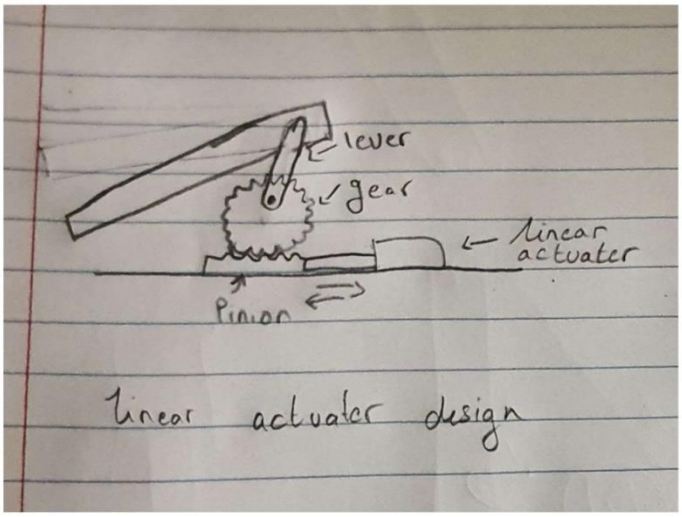
Team ID: Thurs-14

Name:Yazan Khatib	MacID: Khatiy2

Insert picture of preliminary concept sketch below



9

Dante Finoro individual worksheets:

PROJECT THREE: MILESTONE ONE: PROBLEM FRAMING AND CONCEPTUAL DESIGN

Milestone 1 (Stage 1) – Initial Problem Statement, Objectives and Constraints

Team ID: Thurs-14

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

Initial Problem Statement

1. Write the initial problem statement in the space below. This was discussed in your first lecture and is provided in the Avenue announcement.

We need to make a system that determines whether the container is recyclable or not, what type of recyclable it is and where to deliver the container.

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	Determine what category container is, deliver it to the correct drop-off, return home
Constraints	Sensor limitations, space restrictions, processing speed

PROJECT THREE: MILESTONE ONE: PROBLEM FRAMING AND CONCEPTUAL DESIGN

MILESTONE 1 (STAGE 3) – SENSOR EXPLORATION (COMPUTING SUB-TEAM)

Team ID: Thurs-14

Complete this worksheet individually *during* Design Studio.

1. Each team member is expected to complete the demo for at least four (4) of the five (5) sensors available 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. Complete your sensor research on the following page
   → Be sure to clearly write your Team ID, Name and MacID

Team ID: Thurs-14

Name: Dante Finoro	MacID: finorod

Sensor Type	Description	Attribute(s)
Ultrasonic sensor	Outputs distance in meters to the nearest object using ultrasonic sound waves.	Measures distance
Colour Sensor	Outputs rgb values of what is in front of sensor	Detects colour
Hall sensor	Outputs 1 when there is a metal object in front of the sensor, outputs 0 otherwise	Detects metal
Infrared sensor	Outputs high voltage readings when the sensor is in close proximity to a bin. If the bin is not in range the output will be a low voltage reading.	Measures proximity to bin

Muhammad Haseeb Aslam's Individual Worksheets:

PROJECT THREE: MILESTONE ONE: PROBLEM FRAMING AND CONCEPTUAL DESIGN

Milestone 1 (Stage 1) – Initial Problem Statement, Objectives and Constraints

Team ID: Thurs-14

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

Initial Problem Statement

1. Write the initial problem statement in the space below. This was discussed in your first lecture and is provided in the Avenue announcement.

Design a recycling system that prevents waste of recyclable materials to prevent losing recyclable materials and overfilling facilities.

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	- Container should be large enough to carry all the components. - detect and identify containers as accurately as possible - Effectively verify if container is recyclable or non-recyclable reliably - Deposit containers in the appropriate recycling bin reliably
Constraints	- Container must include a hopper for holding containers during transfer - Assembly model must be properly constrained to base plate along with actuator - Device must mount to a base plate on top of the Qbot

PROJECT THREE: MILESTONE ONE: PROBLEM FRAMING AND CONCEPTUAL DESIGN

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

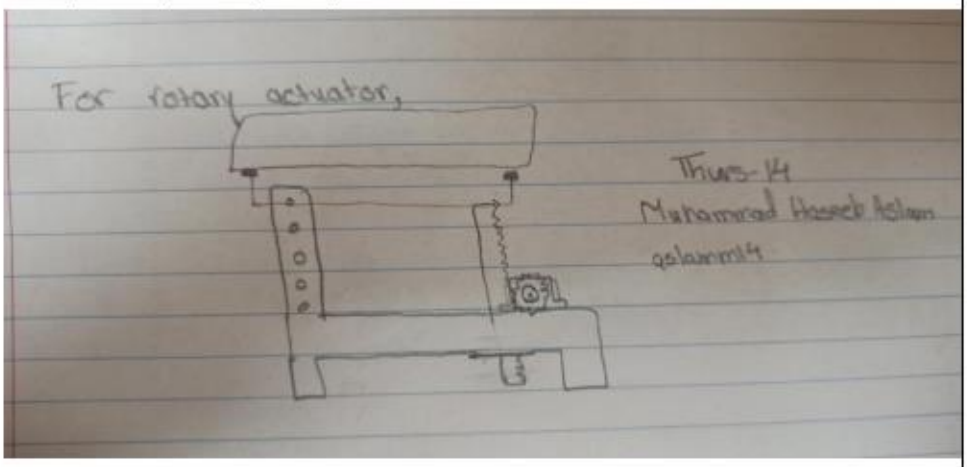
Team ID: Thurs-14

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 ID, Name and MacID for each sketch
2. Take photos of your sketches
3. Insert your photos as a Picture on the following pages

Team ID: Thurs-14

Name: Muhammad Haseeb Aslam	MacID: aslamm14

Insert picture of preliminary concept sketch below

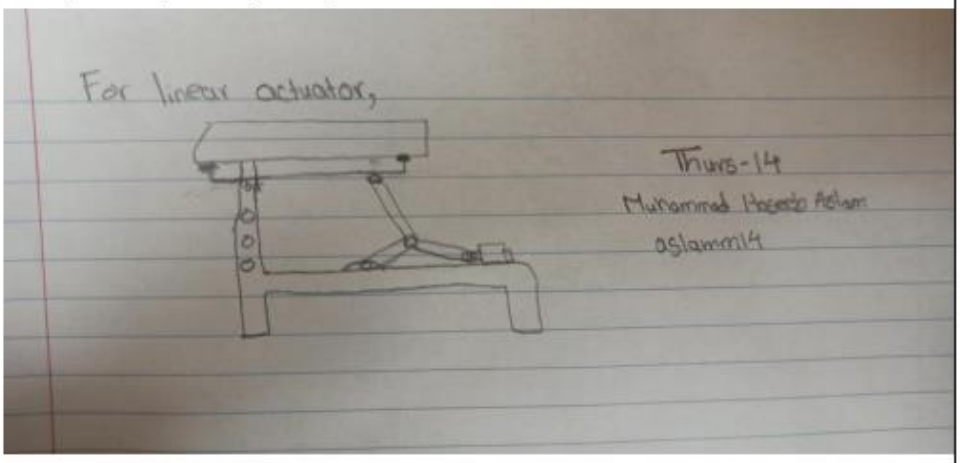


3

Team ID: Thurs-14

Name: Muhammad Haseeb Aslam	MacID: aslamm14

Insert picture of preliminary concept sketch below



Evan Chadwick's Work Sheets:

PROJECT THREE: MILESTONE ONE: PROBLEM FRAMING AND CONCEPTUAL DESIGN

Milestone 1 (Stage 1) – Initial Problem Statement, Objectives and Constraints

Team ID:	Thurs-14

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

Initial Problem Statement

1. Write the initial problem statement in the space below. This was discussed in your first lecture and is provided in the Avenue announcement.

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	-Smooth motion as to not require maintenance - Quickly identifies the type of recycling to function as fast as possible
Constraints	- Mechanism must fit within baseplate - Q arms range of motion (i.e how far it can reach) - Number of containers on q bot cannot exceed 3 or be significantly over 90 grams

PROJECT THREE: MILESTONE ONE: PROBLEM FRAMING AND CONCEPTUAL DESIGN

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

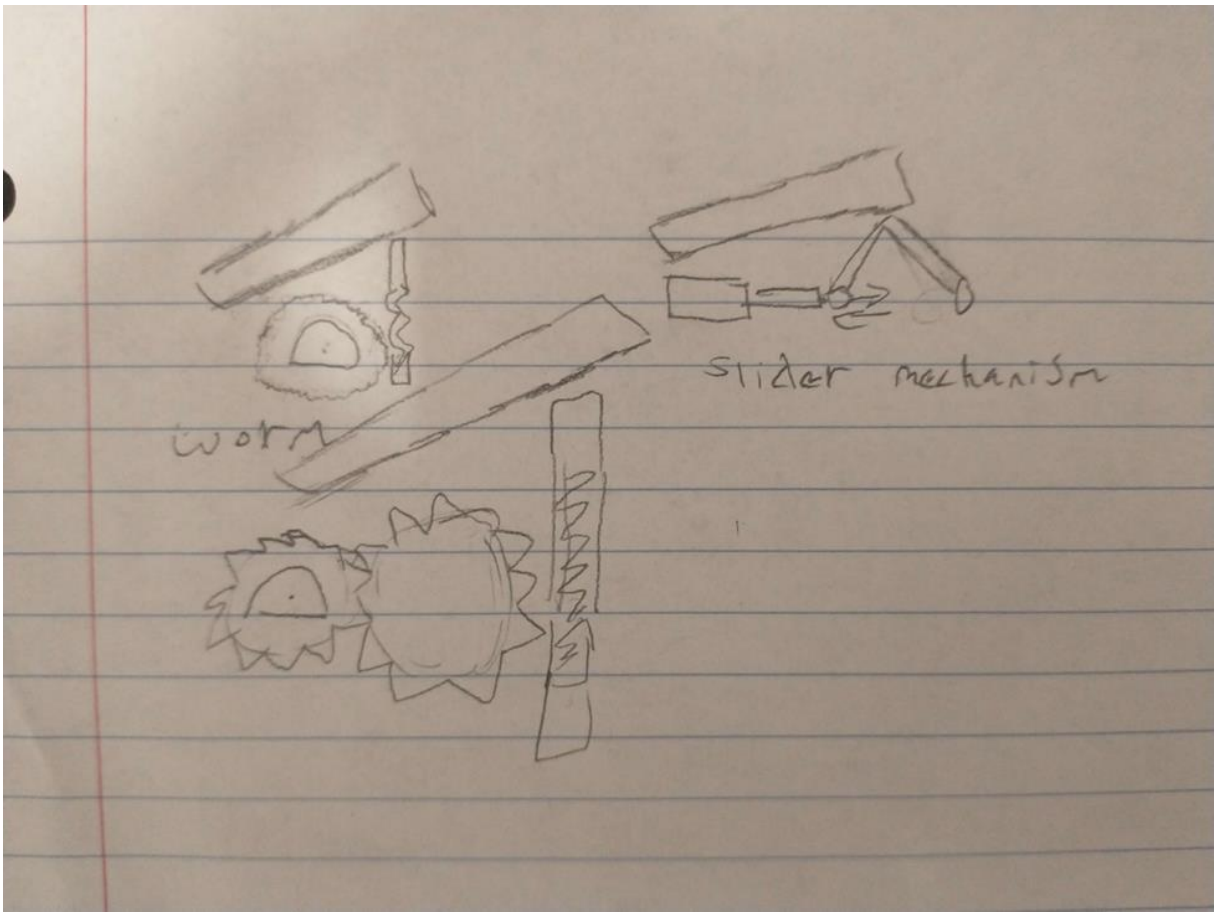
Team ID:	Thurs-14

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 ID, Name and MacID for each sketch
2. Take photos of your sketches
3. Insert your photos as a Picture on the following pages

Team ID:	Thurs-14

Name: Evan Chadwick	MacID: chadwe1

Insert picture of preliminary concept sketch below



Individual Worksheets:

Luay Alabed alkader:

PROJECT THREE: MILESTONE ONE: PROBLEM FRAMING AND CONCEPTUAL DESIGN

Milestone 1 (Stage 1) – Initial Problem Statement, Objectives and Constraints

Team ID: Thurs-14

Complete this worksheet individually before coming to Design Studio.

Initial Problem Statement

1. Write the initial problem statement in the space below. This was discussed in your first lecture and is provided in the Avenue announcement.

Develop a system that can identify and categorize various recyclable containers, directing them to their respective bins to foster a beneficial environmental influence.

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	- Maximize Recyclables - Distinguish between different types of disposable containers - Should categorize items based on which type of disposable they are
Constraints	- bot cannot exceed 90g - Hopper must hold a maximum of three containers – Must be able to identify contaminated items to be recycled

PROJECT THREE: MILESTONE ONE: PROBLEM FRAMING AND CONCEPTUAL DESIGN

MILESTONE 1 (STAGE 3) – SENSOR EXPLORATION (COMPUTING SUB-TEAM)

Team ID: Thurs-14

Complete this worksheet individually during Design Studio.

1. Each team member is expected to complete the demo for at least four (4) of the five (5) sensors available 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. Complete your sensor research on the following page
   - Be sure to clearly write your Team ID, Name and MacID

Team ID: Thurs-14

Name: luay Alabed alkader	MacID: alabedal

Sensor Type	Description	Attribute(s)
Ultrasonic sensor	Measures the distance of the target object using ultrasonic sound waves to measure the distance efficiently.	Target bin Mass

Hall sensor	It tells if the object is metal by giving the number 1 and outputs 0 otherwise for non-metals	Detects Metals
Color sensor	Outputs rgp values of the bins that's in front of the sensor	Detects Colors
Infrared sensor	sensors can emit and detect infrared radiation like heat to tell how close the object is to the sensor using voltage readings	Measures distance to the bins