PROJECT THREE: MILESTONE 2 – COVER PAGE

Team Number: Thurs-22

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

Full Name:	MacID:
Vaisnavi Shanthamoorthy	shanthav
Armon Bal	bala
Pratha Bhat	bhatp3
Jiayue Zhu	zhu3
Nolan Roney	roneyn1

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

Team Number: | Thurs-22

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

1. Each team member is expected to research 3 types of sensors for characterizing bins
   → Refer to Table 3 of the Computation Sub-Team Objectives document
2. For each sensor:
   → Briefly describe how the sensor works
   → Indicate the attribute you would measure to characterize each bin (refer to Table 4 of the Computation Sub-Team Objectives document)

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 Two Individual Worksheets** document so that it can be *graded*
- Compiling your individual work into this **Milestone Two Team Worksheets** document allows you to readily access your team member's work
  o This will be especially helpful when completing *Stage 3* of the milestone

Name:Armon Bal	MacID: bala

Sensor Type	Description	Attribute(s)
Ultrasonic Sensor	The head of the sensor can emit ultrasonic waves that will eventually be reflected at the sensor when they hit a target, thereby used primarily to measure distance. It can do so by sending these waves and measuring the interval of time it takes for the wave to have been emitted to when it returns, thereby calculating the distance from the start to end of this duration of time. This would make it most useful for detecting distance from an object.	-distance -
Hall Sensor	A Hall sensor measures the size of an electric field by outputting a voltage that is directly proportional to the magnetic field strength that passes through. By being able to detect a magnetic field it can be used for positioning, detecting speed, and checking its proximity to an object. Usually only adequate in situations where there is high-current/high-voltage.	-distance
Active-infrared Sensor	Detects infrared radiation in its environment which allows it to be useful for tracking things that give off this radiation such as heat. It is naked to the normal eye which requires a sensor to notice these waves. Composed of a light emitting diode and receiver, the sensor receives a signal of when something is close by when the infrared LED comes close to an object and reflects at the sensor, thereby acting similar to an ultrasonic sensor. Therefore, its primary use would be for detecting proximity.	-distance

[4] "What is an ultrasonic / level sensor?," *Sensor Basics*. [Online]. Available: https://www.keyence.ca/ss/products/sensor/sensorbasics/ultrasonic/info/. [Accessed: 21-Jan-2021].

[5]   "https://electronics.stackexchange.com/questions/515093/hall-effect-sensor-through-plastic," *Stack Exchange*. [Online]. Available: https://electronics.stackexchange.com/questions/515093/hall-effect-sensor-through-plastic . [Accessed: 21-Jan-2021].

[6] D. Jost, "What is an IR sensor?," *Fierce Electronics*, 29-Jul-2019. [Online]. Available: https://www.fierceelectronics.com/sensors/what-ir-sensor#:~:text=An%20infrared%20(IR)%20sensor%20is,radiation%20in%20its%20surrounding%20environment.&text=Active%20infrared%20sensors%20both%20emit,(LED)%20and%20a%20receiver.. [Accessed: 21-Jan-2021].

Team Number: Thurs-22

Name: Jiayue Zhu	MacID: zhu3

Sensor Type	Description	Attribute(s)
LDR (Light Dependent Resistor)	Light-dependent resistors are special resistors made of semiconductor materials such as cadmium sulfide or cadmium selenide. Their working principle is based on the internal photoelectric effect, meaning with the increase of light intensity, the resistance will reduce rapidly. LDR is very sensitive to light. With the absence of light, it will have a high value of resistance (most). LDR is commonly used to convert light changes into electrical changes [1].	-transparent or not
Color Sensor	The color sensor is a type of photoelectric sensor. There are two types of the color sensor. One detects the object with red, blue, and green light independently, while the other detects the object with broad wavelength light and classify red, blue, and green light within the receiver. Color sensor can compare the color of the object with the previous reference color. When the data of the two colors match within a certain error range, the sensor will give an output of detection results [2].	- color
Retro-reflective Photoelectric Sensor	Retro-reflective Photoelectric Sensor can be used to detect the presence of an object and then decide whether an object is metal or non-metal. The device can build a light path between the sensor and a special reflector. The object will be detected when it breaks the light beam [3].	- presence or absence - metal or non-mental

[1] keyence.com, "What is a color sensor?", n.d. [Online]. Available: https://www.keyence.com/ss/products/sensor/sensorbasics/color/info/. [Accessed: Jan. 20, 2021].
[2] WatElectronics, "What is a Light Dependent Resistor and Its Applications", Jul. 18, 2019. [Online]. Available: https://www.watelectronics.com/light-dependent-resistor-ldr-with-applications/. [Accessed: Jan. 20, 2021].

[3] Senasys Photosensors.com, "Retroreflective sensors", n.d. [Online]. Available: http://senasysphotosensors.com/photoelectric-sensors/retroreflective-sensors. [Accessed: Jan. 20, 2021].

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

Team Number: | Thurs-22

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

1. Copy-and-paste each sub-team member's refined sketch 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 Two Individual Worksheets** document so that it can be *graded*
- Compiling your individual work into this **Milestone Two 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

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| Name: Pratha Bhat | MacID: bhatp3 |

Insert screenshot(s) of your concept sketches below

#1 – Linear Actuator

(1)

Linear Actuator

Hopper

→ Actuator extends in order for the arm to contract, which closes elbow mechanism in order to tip over containers

Linear Actuator

Hopper

•Dispense containers
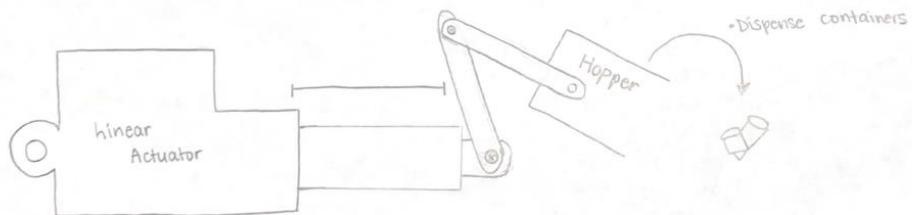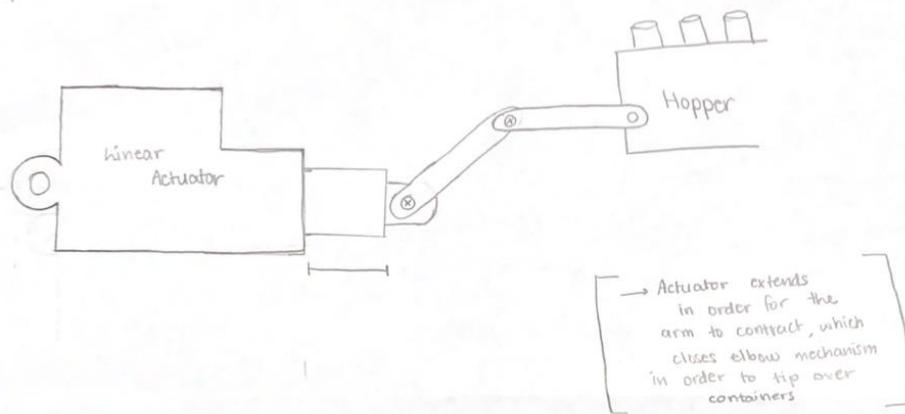
Pratha Bhat
Bratter.
Jan, 20th, 2021
1:2

Name: Pratha Bhat	MacID: bhatp3

Insert screenshot(s) of your concept sketches below

#2 – Rotary Actuator
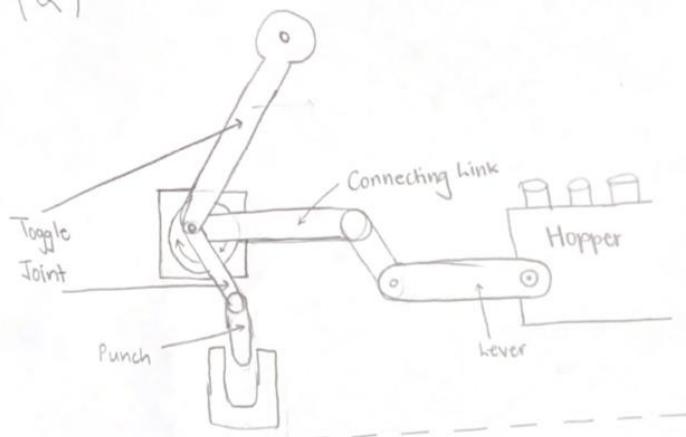
As the toggle joints form a ~straight line, the lever is made to operate (at an angle) upon the movement of the joint
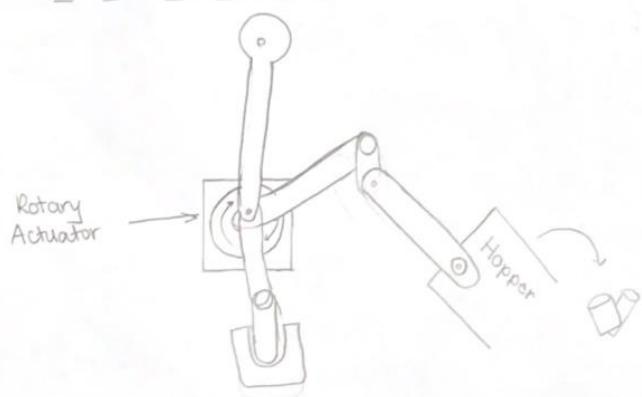
Pratha Bhat
Jan, 20th, 2021
1:2

Team Number: Thurs-22

Name: Vaisnavi Shanthamoorthy	MacID: shanthav

Insert screenshot(s) of your concept sketches below

Concept Sketch #1(using a linear actuator)

Vaisnavi Shanthamoorthy
shanthav
Team Thurs-22

hopper containers

① hook to tie rope to

lifts up on one end ②

linear actuator

base plate

rope

rung

bin

linear actuator is on

rope is pulled in (to the left)

bin
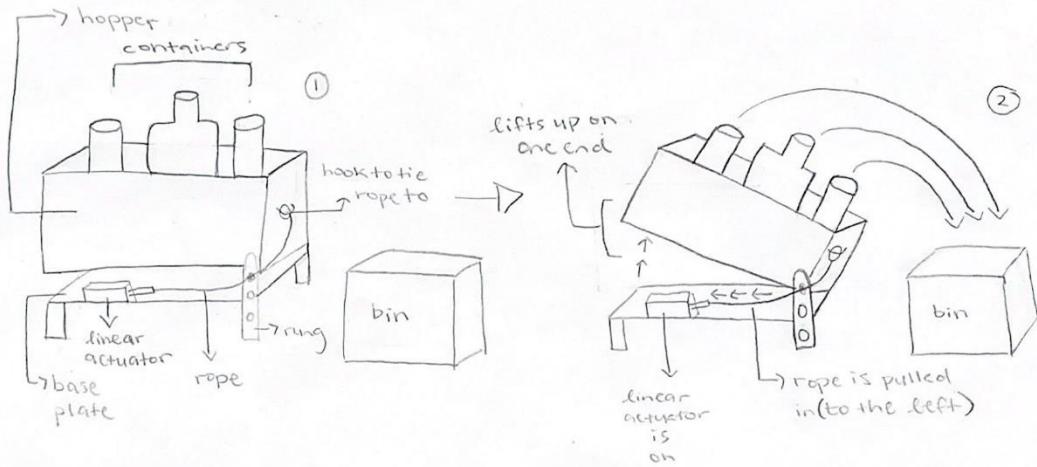
*If you are in a sub-team of 3, please copy and paste the above on a new page

Team Number: | Thurs-22

Name: Vaisnavi Shanthamoorthy	MacID: shanthav
Insert screenshot(s) of your concept sketches below *Concept Sketch #2 (using a rotary actuator)*	

Vaisnavi Shanthamoorthy
shanthav
Team Thurs - 22

hopper

containers

①

lifts up on one end.

②

hook

rope

rung

bin

bin

rotary actuator

gear

base plate

chain

rotary actuator is on

gear and chain moving in a clockwise rotation

*If you are in a sub-team of 3, please copy and paste the above on a new page

Name: Nolan Roney	MacID: roneyn1

Concept Sketch 1: Linear Actuator

TOP view

fixed point
of rotation

left   right

spring-like
linkage mechanism

linear
actuator

Nolan Roney
roneyn1
Thurs-22
Milestone 2

LEFT view

actuator

RIGHT view

actuator

fixed

ledge for the
leg to slide on
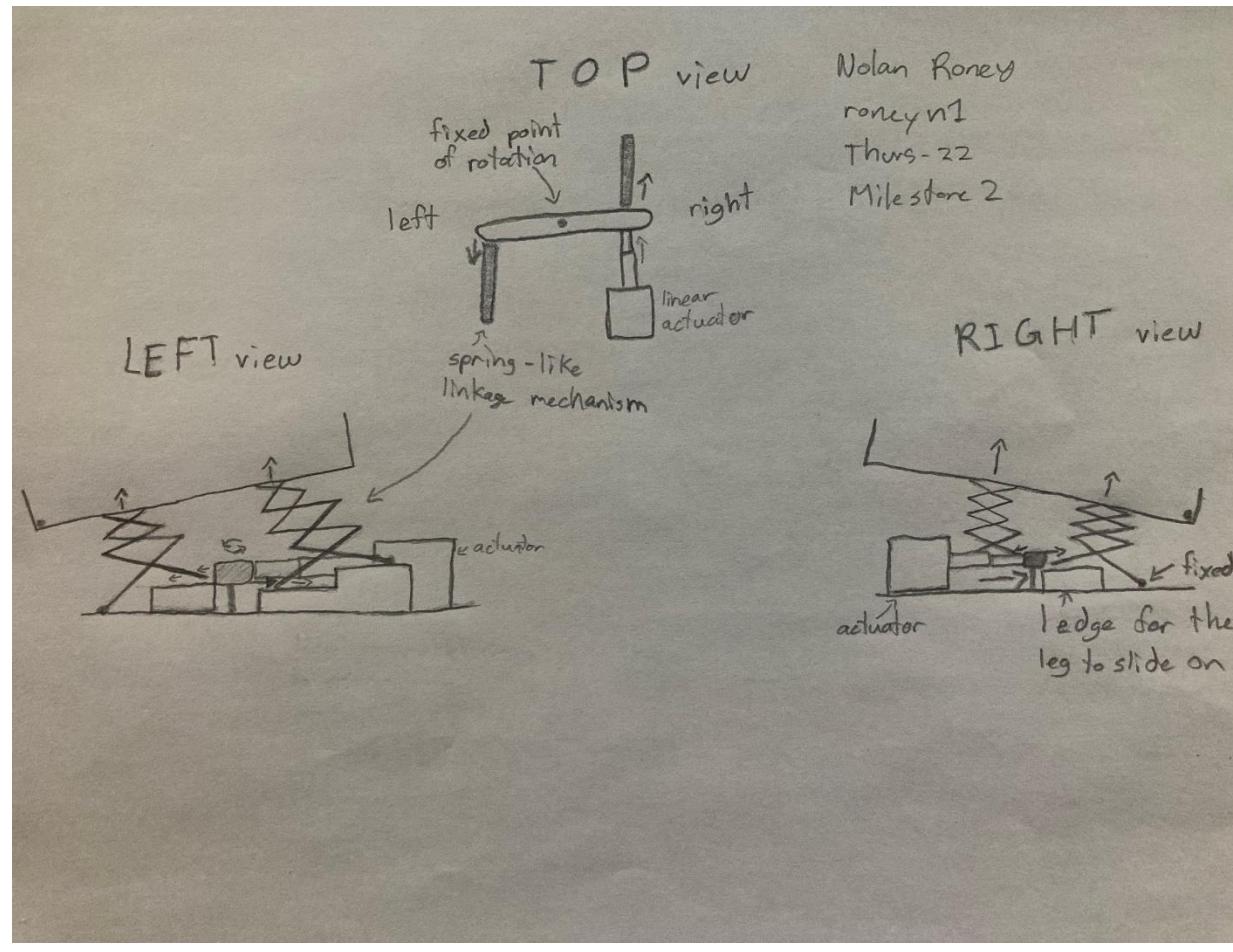
Name: Nolan Roney	MacID: roneyn1

Concept Sketch 2: Rotary Actuator
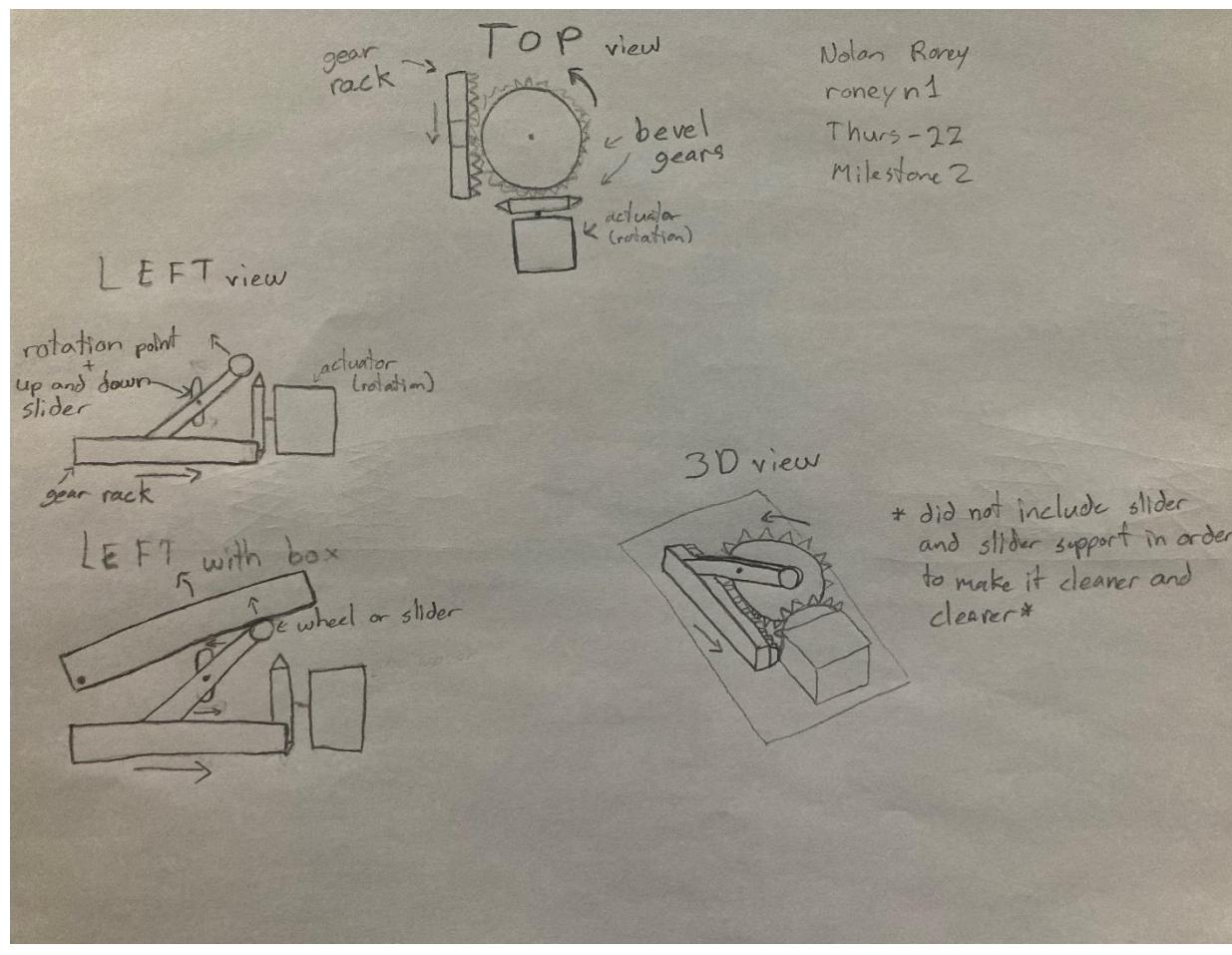
MILESTONE 2 (STAGE 3) – SENSOR CHARACTERIZATION (COMPUTATION SUB-TEAM)

Team Number: | Thurs-22

1. As a team, consolidate the results of your individual sensor research
    → Discuss your findings and appropriateness of each sensor for your application
    → Keep discussion brief, using point form

Sensor Type	Findings and Appropriateness for Application
Ultrasonic Sensor	• Useful for calculating distance by emitting waves • Emits Ultrasonic waves that are optimal for the current scenario of detecting bins spaced from the line
Hall Sensor	• Requires a high voltage/high current to be fully functional • Good for motors • Can be disrupted
Active-Infrared Sensor	• Useful for calculating distance • Accurate for finding distance between objects • Similar to an ultrasonic sensor
LDR (Light Dependent Resistor)	• Sensitive to light, can convert light changes into electric changes
Color Sensor	• Detect colors of the objects
Retro-reflective Photoelectric Sensor	• Detect the presence of an object and then decide whether an object is metal or non-metal

2. Identify one sensor to incorporate into your computer program

We will be using the ultrasonic sensor to incorporate into our computer program. We can change the distance from the line on the floor and use the sensor to detect each bin.

3. Identify an attribute value for each bin

Bin ID	Attribute Value
Bin01: Metal Bin	0cm
Bin02: Paper Bin	25cm
Bin03: Plastic Bin	50cm
Bin04: Garbage Bin	75cm

MILESTONE 2 (STAGE 4) – DECISION MATRIX (MODELLING SUB-TEAM)

Team Number:

Thurs-22

1. As a team, establish a weighting factor for each criterion
   → Move row-by-row
     - If *Criteria 1* is preferred over *Criteria 2*, assign a 1. Otherwise, assign 0
     - If *Criteria 1* is preferred over *Criteria 3*, assign a 1. Otherwise, assign 0
   → Add additional rows/columns as needed

	Feasibility	*Easy to assemble*	*Easy to mount actuator in specified location*	Securely attached to baseplate + supports hopper	High range of motion	**Score**
Feasibility	1	1	0	1	1	**4**
Easy to assemble	0	1	0	1	1	**3**
Easy to mount actuator in specified location	1	1	1	1	1	**5**
Securely attached to baseplate + supports hopper	0	0	0	1	0	**1**

High range of motion	0	0	0	1	1	**2**

2. As a team, evaluate your concepts against each criterion using your weighting
   → Add additional rows as needed

	Weight	Concept 1		Concept 2		Concept 3		Concept 4		*Concept 5*		Concept 6	
		Rating	Weighted Rating	Rating	Weighted Rating	Rating	Weighted Rating	Rating	Weighted Rating	Rating	Weighted Rating	Rating	Weighted Rating
Feasibility	4	4	**16**	1	**4**	3	**12**	4	**16**	3	**12**	3	12
Easy to assemble	3	5	**15**	1	**3**	4	**12**	2	**6**	3	**9**	3	9
Easy to mount actuator in specified location	5	3	**15**	2	**10**	5	**25**	5	**25**	5	**25**	5	25
Securely attached to baseplate + supports hopper	1	4	**4**	3	**3**	2	**2**	3	**3**	5	**5**	3	3
High range of motion	2	3	**6**	5	**10**	2	**4**	4	**8**	5	**10**	4	8
TOTAL			**56**		**30**		**55**		**58**		61		**57**

3. Discuss conclusions based on evaluation, including what concept you've chosen

We chose concept 5 as our base mechanism, we chose to build of this because it scored highly on our weighted matrix. This design includes a linear actuator. The reason for this was because the accordion-like structure made the mechanism flexible in order for it extend further away than other designs, this satisfies our condition to tilt our hopper so that we can release the containers into the bins. Concept 5 had two points of contact, holding the hopper from the bottom of its base; providing it maximum stability. Lastly, this design was feasible as it was inspired by Lego dump truck structures, Lego's a great building tool as they make great connectors and were very similar to the linkages seen in the sketch.