PROJECT THREE: MILESTONE 2 – COVER PAGE

Team Number: Mon-32

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

Full Name:	MacID:
Gurleen Dhillon	dhillg25
Benji Richler	richlerb
Juliana Konstantinou	konstanj
Thivagar Yogaratnam	yogaratt

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

Team Number: Mon-32

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

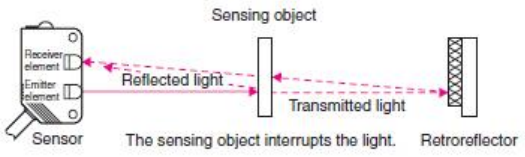
1. Each team member is expected to research 3 types of sensors for characterizing bins
   → Refer to Table 3 of the Computation Sub-Team Objectives document
2. For each sensor:
   → Briefly describe how the sensor works
   → Indicate the attribute you would measure to characterize each bin (refer to 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
  - This will be especially helpful when completing ***Stage 3*** of the milestone

Team Number:	Mon-32

Name: Juliana	MacID: konstanj

Sensor Type	Description	Attribute(s)
Colour Sensor	A colour sensor is a photoelectric sensor. It emits light on to an object from a light transmitter. Then it detects the red, blue, and green light that is reflected from the object. Using the light intensities detected, the sensor can determine the colour of the object. There are two types of colour sensors. One emits broad wavelength light and then differentiates the colours in the receiver and the other emits the three light colours independently. [1]	This sensor can help detect the different colours of the bins or its surroundings.
Active Infrared (IR) Sensor	An active IR sensor is a type of infrared sensor that has both an emitter and a receiver. The emitter (IR Light Emitting Diode or LED) shoots an IR ray toward a receiver. If the receiver gets a signal, then nothing is in the way. If the receiver does not see the ray, then an object is in the between the emitter and receiver. These sensors can help figure out the shape and location of the object. [2]	This sensor can help detect the bins.
Retro-reflective Photoelectric Sensor	Photoelectric sensors detect objects, changes in the surface and other conditions using optical properties. A retro-reflective photoelectric sensor is a type of photoelectric sensor. When there is no object, light is reflected by the reflector normally. When there is an object, light is interrupted, and the amount of light received reduces. [3]  *Figure 1 Retro-reflection sensor [3]* This sensor had light passing through the object twice, so it is good for detecting transparent objects. Not the best for objects with a mirrored finish because it just reflects the light. [3]	This can help detect the location of the bins and detect difference the between transparent and opaque bins.

Works Cited

[1] "What is a Colour sensor?", Keyence [Online]. Available: https://www.keyence.ca/ss/products/sensor/sensorbasics/color/info/ [Accessed: January 23, 2021].

[2] J. S. Cook, "The Right Tool for the Job: Active and Passive Infrared Sensors", Arrow [Online]. Available: https://www.arrow.com/en/research-and-events/articles/understanding-active-and-passive-infrared-sensors [Accessed: January 23, 2021].

[3] "Photoelectric Sensors", Omron Industrial Automation [Online]. Available: https://www.ia.omron.com/support/guide/43/introduction.html [Accessed January 24, 2021].

Team Number: Mon-32

Name: Gurleen Dhillon	MacID: dhillg25

Sensor Type	Description	Attribute(s)
Ultrasonic Sensor	The ultrasonic sensor works by sending a sound wave at a frequency that humans cannot hear. The sensor can determine how far an object is by measuring the time lapse of when the sound wave was first sent off and when it was received back. [1]	It could detect how far a bin might be and how much further the q-bot needs to travel to reach that bin. Each bin could be placed at a different distance from the yellow line.
Light-Dependant Resistor	The light-dependant resistor is very sensitive to light. Its' resistance greatly changes when the light levels change because as it gets darker, the lass electricity it would conduct. [2]	It could detect how translucent a certain object is. Each bin could allow a different amount of light to pass through.
Hall Sensor	The hall sensor measures the magnitude of a magnetic field of an object by measuring the hall voltage when the sensors are placed in said magnetic field. The hall voltage is directly proportional to the magnetic field. [3]	It could detect how metallic a certain object is (based on the magnetic field). Each bin could have different strengths in magnetic fields.

Works Cited

[1] R. Burnett, "Understanding How Ultrasonic Sensors Work" *MaxBotix Inc.*, Mar. 24, 2020. https://www.maxbotix.com/articles/how-ultrasonic-sensors-work.htm (Accessed Jan. 25, 2021).

[2] K. Spurr, "How an LDR (Light Dependent Resistor) Works," *Kitronik Ltd*, Jan. 14, 2014. https://kitronik.co.uk/blogs/resources/how-an-ldr-light-dependent-resistor-works (accessed Jan. 25, 2021).

[3] C. Woodford, "How Hall effect sensors and probes work," *Explain that Stuff*, Aug. 13, 2020. https://www.explainthatstuff.com/hall-effect-sensors.html (accessed Jan. 25, 2021).

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

Team Number: Mon-32

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

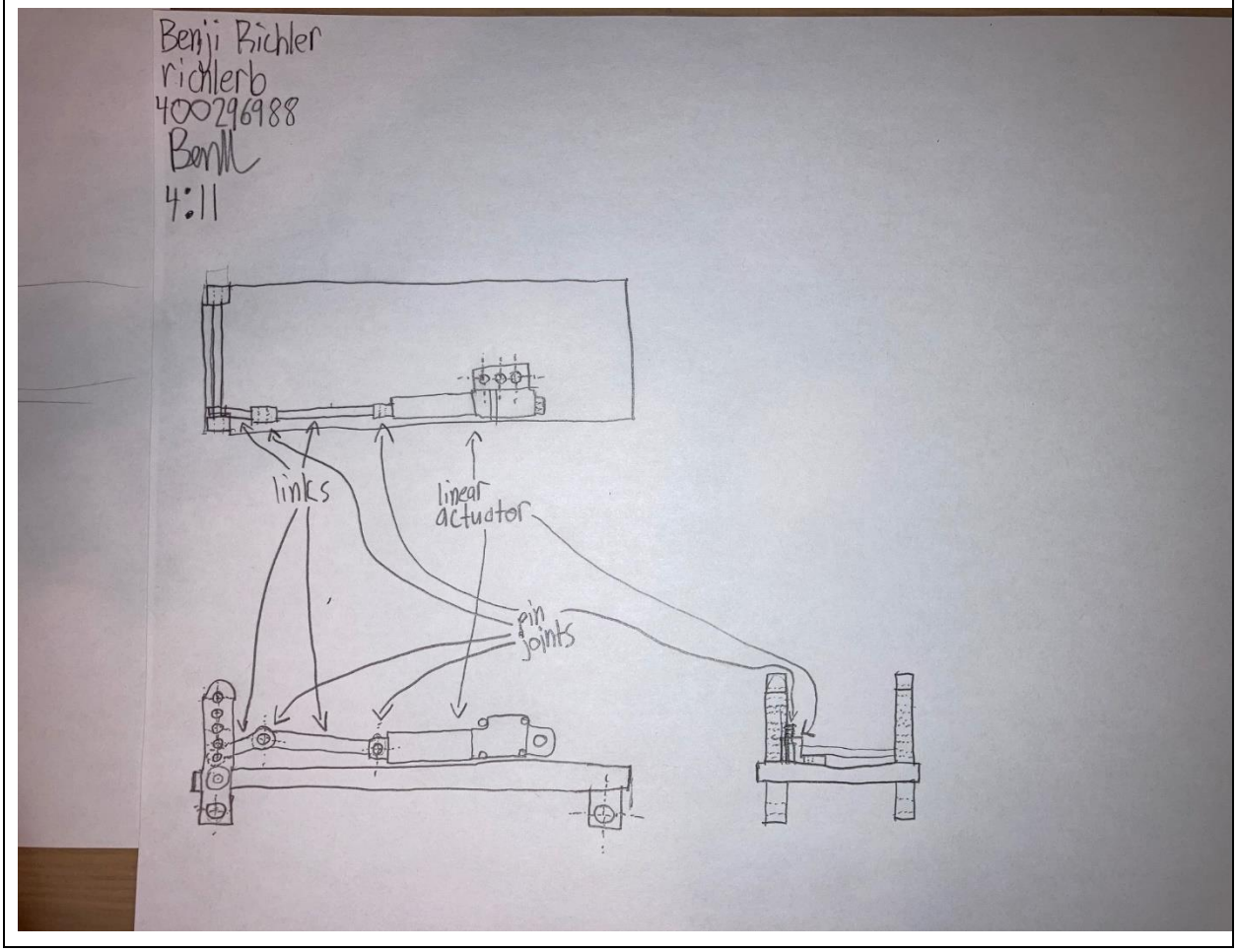
We are asking that you submit your work on both worksheets. It does seem redundant, but there are valid reasons for this:

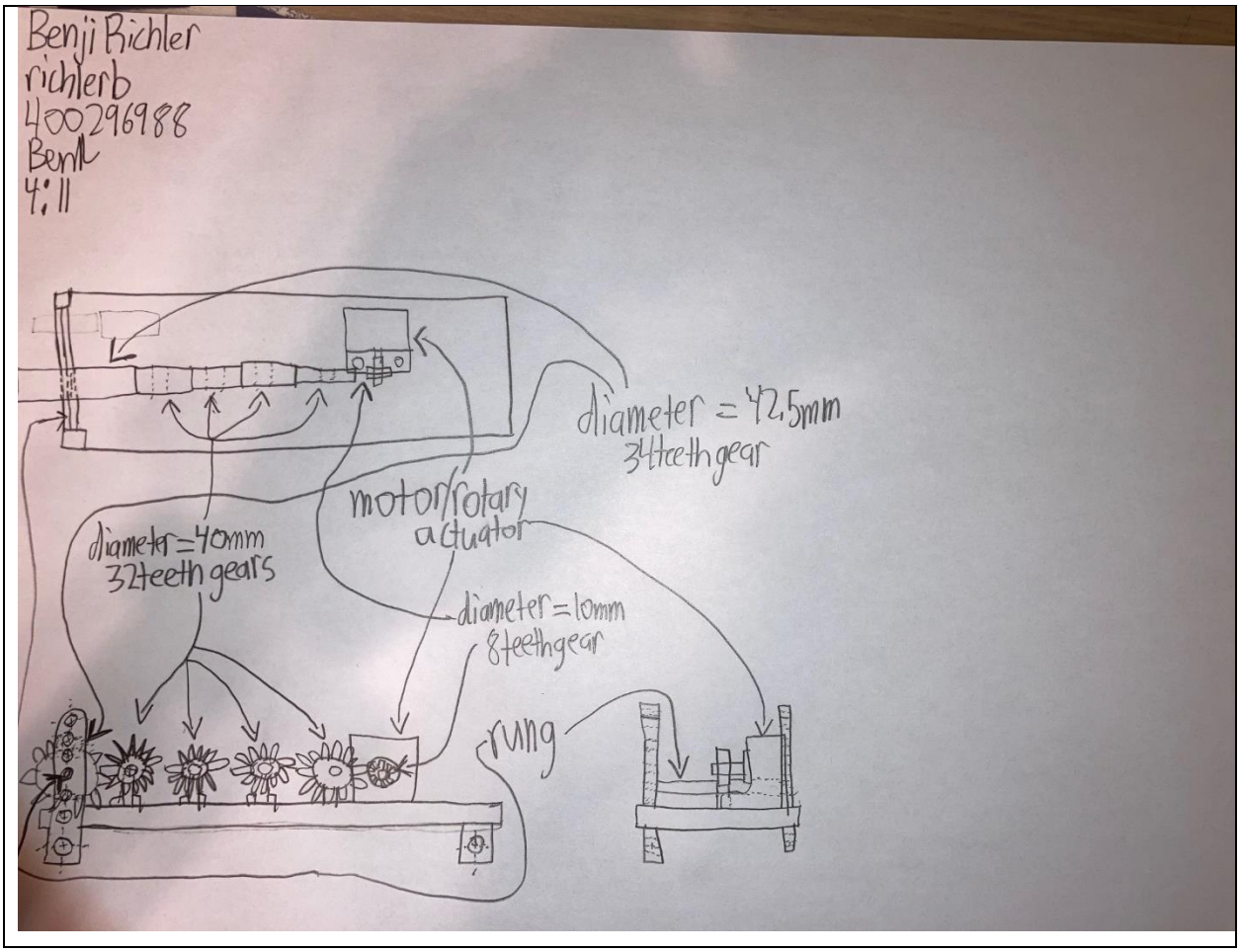
- Each team member needs to submit their concept sketches with the **Milestone Two Individual Worksheets** document so that it can be ***graded***
- Compiling your individual work into this **Milestone Two Team Worksheets** document allows you to readily access your team member's work
  - This will be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

Team Number: Mon-32

Name: Benji Richler	MacID: richlerb

Insert screenshot(s) of your concept sketches below

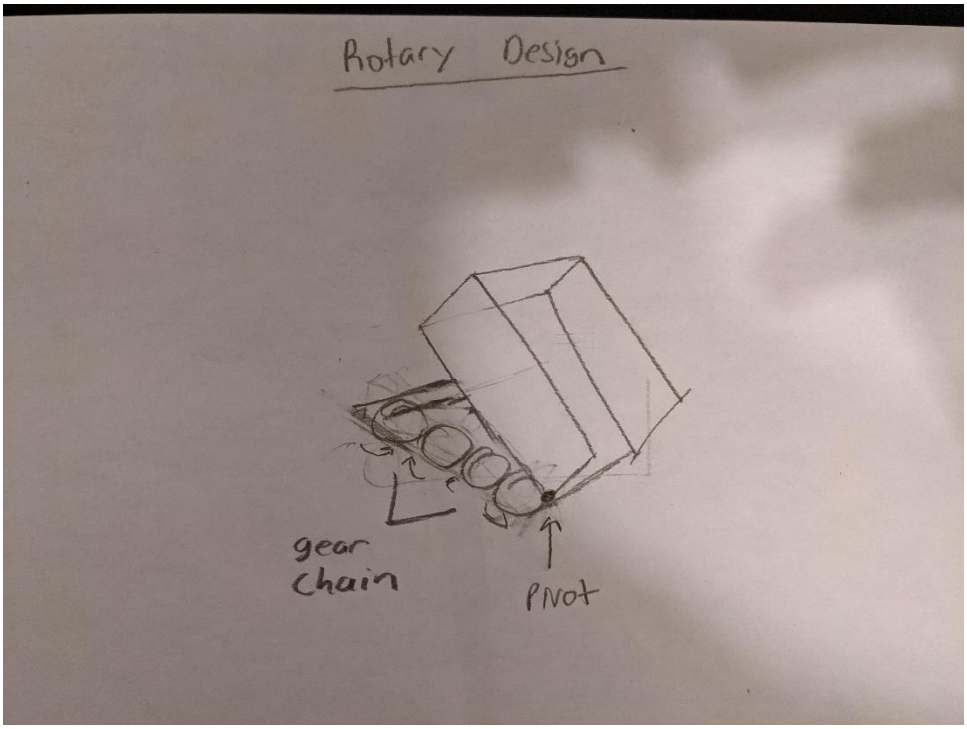


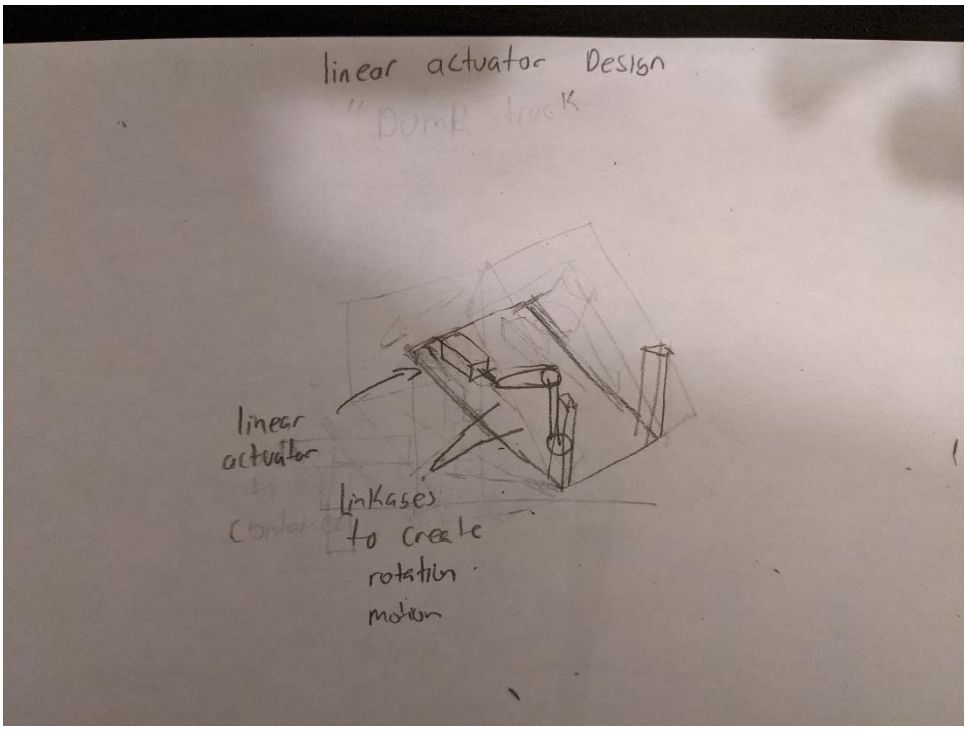

Benji Richler
richlerb
400296988
Bench
4:11
diameter = 42.5mm
34teeth gear
motor/rotary
actuator
diameter = 40mm
32teeth gears
diameter = 10mm
8teethgear
rung

Team Number: Mon-32

Name: Thivagar Yogartnam	MacID:yogaratt

Insert screenshot(s) of your concept sketches below





MILESTONE 2 (STAGE 3) – SENSOR CHARACTERIZATION (COMPUTATION SUB-TEAM)

Team Number: Mon-32

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	• Uses a sound wave to find location/distance of an object • Could be practical to use because we can see the location and how far the bins are • We decided against this sensor because it will be harder to between differentiate the different bins with a sensor that just sees how far all the bins are from it.
Light-Dependant Resistor	• Can see how much light will go through the object • Mostly looks at the transparentness of an object. • This sensor won't be much help for getting to the bins
Hall Sensor	• Can detect how metallic an object is • In the environment, the bins can either be metallic or not • Since this sensor just sees how metallic an object is, it won't be much help for differentiating between the four bins
Colour Sensor	• Good for sensing colour • If we coloured the bins and other parts of the environment, this sensor could be very practical. • This is the most practical sensor choice for us. Since we can just assign each bin a colour and the bot can easily differentiate between the 4 different bins.
Active Infrared (IR) Sensor	• Can determine shape and location of object • Since the bins are all similar in shape, this sensor won't be very useful for discerning between the bins. • Also, would not be the best to use since there will need to be a receiver on the other side of the bins.
Retro-Reflective Photoelectric Sensor	• Can see if there is something in the way based on how much light passes through

	• Since the bins are all similar, this sensor won't be very useful for discerning between the bins. • Also, reflectors would need to be behind the bins for this to work, so it's not the most practical choice

2. Identify one sensor to incorporate into your computer program

Colour Sensor

3. Identify an attribute value for each bin

Bin ID	**Attribute Value**
Bin01: Metal Bin	The bin and leading line would be coloured black. red = 0, blue = 0, green = 0
Bin02: Paper Bin	The bin and leading line would be coloured red. red = 1, blue = 0, green = 0
Bin03: Plastic Bin	The bin and leading line would be coloured blue. red = 0, blue = 1, green = 0
Bin04: Garbage Bin	The bin and leading line would be coloured green. red = 0, blue = 0, green = 0.5

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

Team Number: Mon-32

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

	Few parts used	Simple	Runtime of mechanism	Lightweight	Reliability	Smooth output	**Score**
Few parts used	N/A	1	1	0	0	0	2
Simple	0	N/A	1	0	0	0	1
Runtime of mechanism	0	0	N/A	0	0	0	0
Lightweight	1	1	1	N/A	0	0	3
Reliability	1	1	1	1	N/A	1	5
Smooth output	1	1	1	1	0	N/A	4

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

	Weight	Benji linear		Benji rotary		Thivagar linear		Thivagar rotary	
		Rating	Weighted Rating	Rating	Weighted Rating	Rating	Weighted Rating	Rating	Weighted Rating
Few parts used	2	4	8	3	6	4	8	3	6
Simple	1	4	4	4	4	5	5	4	4
Runtime of mechanism	0	4	0	3	0	4	0	3	0
Lightweight	3	3	9	3	9	2	6	2	6
Reliability	5	3	15	3	15	3	15	2	10

Smooth output	4	3	12	5	20	3	12	4	16
TOTAL		48		54		46		42	

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

We decided that with the simplicity of using just gears and no other types of levers along with the consistency and easy movement to calculate would work best with concept sketch #2.