PROJECT THREE: MILESTONE 2 – COVER PAGE

Team Number: Tues -26

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

Full Name:	MacID:
Sana Khan	khans288
Yash Patel	pately28
Ahmed Mohamed	mohaa97
Amine Hassine	hassinem

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

Team Number: Tues-26

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:	Tues-26

Name: Yash Patel	MacID: pately28

Sensor Type	Description	Attribute(s)
Ultrasonic Sensor	An ultrasonic sensor uses ultrasonic sound waves that cannot be heard by the human ear to detect the distance of objects from it [1]. It uses the speed of the waves and the time taken for the waves to bounce back to the sensor to calculate its distance from an object. For the purpose of this project, the different bin types can be offset from the yellow line in the QLab environment. Using this, a distance can be set for the offset of each bin type, for example, the metal bin is 20cm from the yellow line whereas the plastic bin is 40cm, so on and so forth. The ultrasonic sensor will then face towards the side of the bins and according to the data transmitted from the Q-arm of the corresponding bin distance from the yellow line, the ultrasonic sensor will detect the correct bin. The Q-bot can then drop the container into the bin. [1] R. R. Dam, H. Biswas, S. Barman and A. Ahmed, "Determining 2D shape of object using ultrasonic sensor," 2016 3rd International Conference on Electrical Engineering and Information Communication Technology (ICEEICT), Dhaka, 2016 [Online] Available: https://ieeexplore.ieee.org/document/7873143/citations#citations [Accessed: January 18, 2021]	Distance from Yellow Line
Hall Sensor	Hall sensors essentially use the laws of electromagnetism to detect proximity to an object and electric fields [2]. A constant voltage on the hall sensor cycles through a metal plate, when a magnet or metal creates an external magnet field, the electrons are attracted or repelled indicating the presence of an object. In terms of project 3, it is difficult to incorporate this sensor purely because it only detects metals/magnets so there is only a yes, it is a metal or no it is not option but there are 4 bins that need to be characterized individually. What could be done is using a ultrasonic sensor along with a hall sensor, two metal bins can be placed at different distances and two non-metal bins can be placed at different distances.	Material of Bin

	This help us individualize each container, so the Qbot can detect how far and if it is a metal bin or not, helping it find the correct bin. [2] A. Gofuku, N. Yokomitsu, T. Yano and N. Kasashima, "A Rotor Posture Measurement System by Analyzing Sensed Magnetic Field from Arrayed Hall Sensors," 2019 12th International Symposium on Linear Drives for Industry Applications (LDIA), Neuchatel, Switzerland, [Online] Available: https://ieeexplore.ieee.org/document/8770988 [Accessed: January 18, 2021]	
Active Infrared (IR) Sensor	Hall sensors essentially use the laws of electromagnetism to detect proximity to an object and electric fields [3]. A constant voltage on the hall sensor cycles through a metal plate, when a magnet or metal creates an external magnet field, the electrons are attracted or repelled indicating the presence of an object. In terms of project 3, it is difficult to incorporate this sensor purely because it only detects metals/magnets so there is only a yes, it is a metal or no it is not option but there are 4 bins that need to be characterized individually. What could be done is the bins can be staggered individually so the strength of the electromagnetic fields being radiated from each bin changes, hence helping individualize the bins. (Built in proximity sensor) [3] Y. I. Gudkov, V. N. Azarov and A. L. Tuv, "Active infrared sensor for monitoring protected areas," 2017 International Conference "Quality Management,Transport and Information Security, Information Technologies" (IT&QM&IS), St. Petersburg, 2017, [Online] Available: https://ieeexplore.ieee.org/document/8085927 [Accessed: January 18, 2021]	Distance from Yellow Line

Team Number: Tues-26

Name: Ahmed Mohamed	MacID:mohaa97

Sensor Type	Description	Attribute(s)
LDR(Light dependent Resistor)	Light dependent resistors, LDRs or photoresistors are used in circuits where it is necessary to detect the presence of light. LDRs or photo-resistors are particularly convenient to use in many electronic circuit designs since they provide large change in resistance for changes in light level. LDR will help the transporter to detect the color of the bin by calculating the resistance each color will show	Color Intensity
Color Sensor	A color sensor identifies the color of the material. This sensor usually detects color in Red, Blue and Green scale. These sensors are also equipped with filters to reject the unwanted IR light and UV light. The Color sensor will easily detect the color of the bin by emitting light from a transmitter, and then detects the light reflected back from the detection object with a receiver. Lastly, the sensor will initiate a signal to the robotic arm that this specific bin is either Red, Green or blue and the arm will identify which bin stores which material.	Color of the bins
Retro-reflective Photoelectric Sensor	A photoelectric sensor emits a light beam (visible or infrared) from its light-emitting element. A reflective-type photoelectric sensor is used to detect the light beam reflected from the target. A thrubeam type sensor is used to measure the change in light quantity caused by the target crossing the optical axis. Retro-reflective Photoelectric Sensor have the emitter and	Distance of the bins

	receiver co-located. Once the light is emitted it will travel across the detection zone and bounce of a prismatic retroreflective, the receiver will then detect that the light has returned, once the light beam is broken the sensor will indicate that an object is present Lastly, the Retro-reflective Photoelectric Sensor will detect the colored bins and depending on the color of the bin the sensor will read a specific voltage and will initiate a signal to the robotic arm that contains the color of the bin.	

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

Team Number: Tues-26

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:

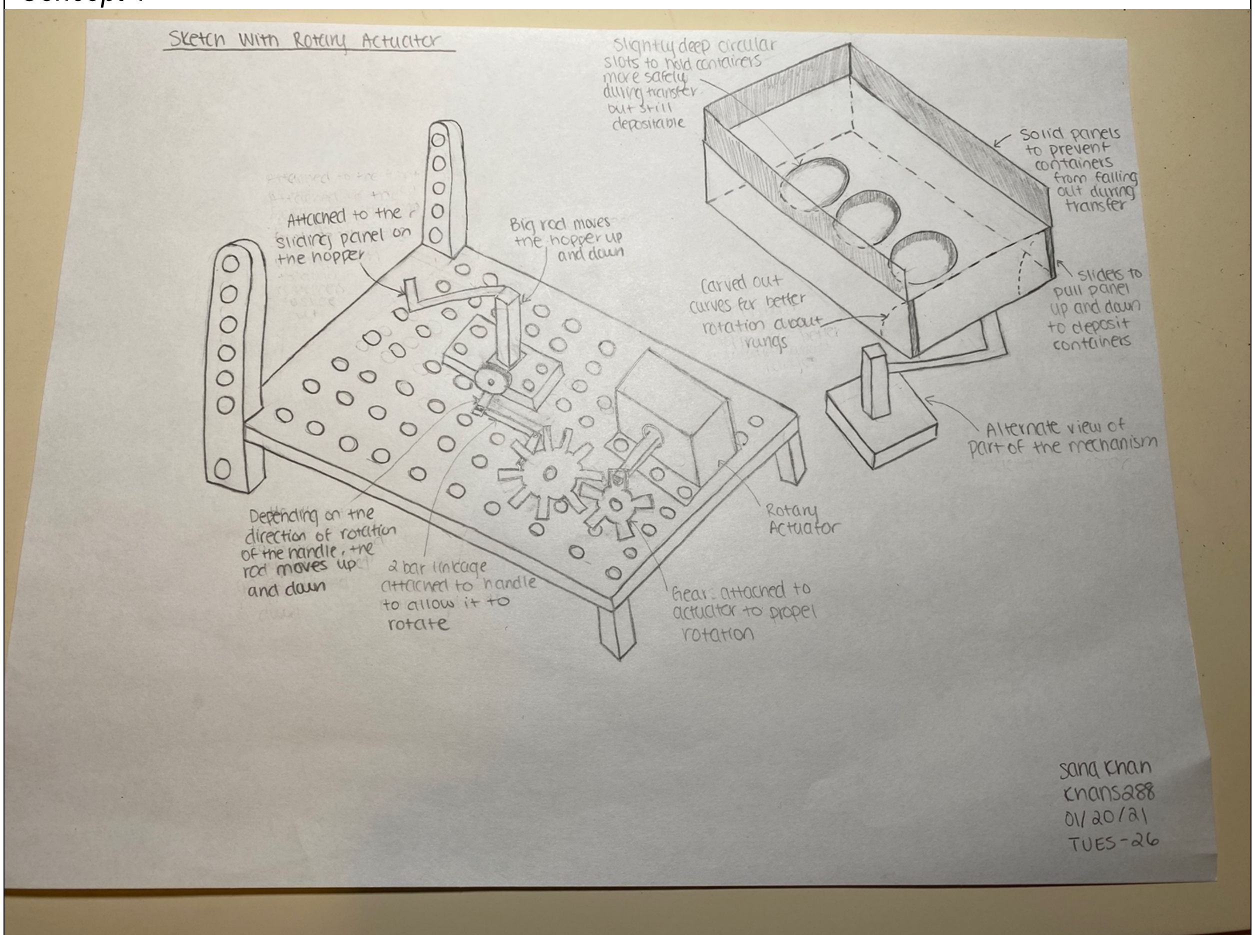
- Each team member needs to submit their concept sketches with the **Milestone Two Individual Worksheets** document so that it can be ***graded***
- Compiling your individual work into this **Milestone Two Team Worksheets** document allows you to readily access your team member's work
  - This will be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

Team Number: Tues-26

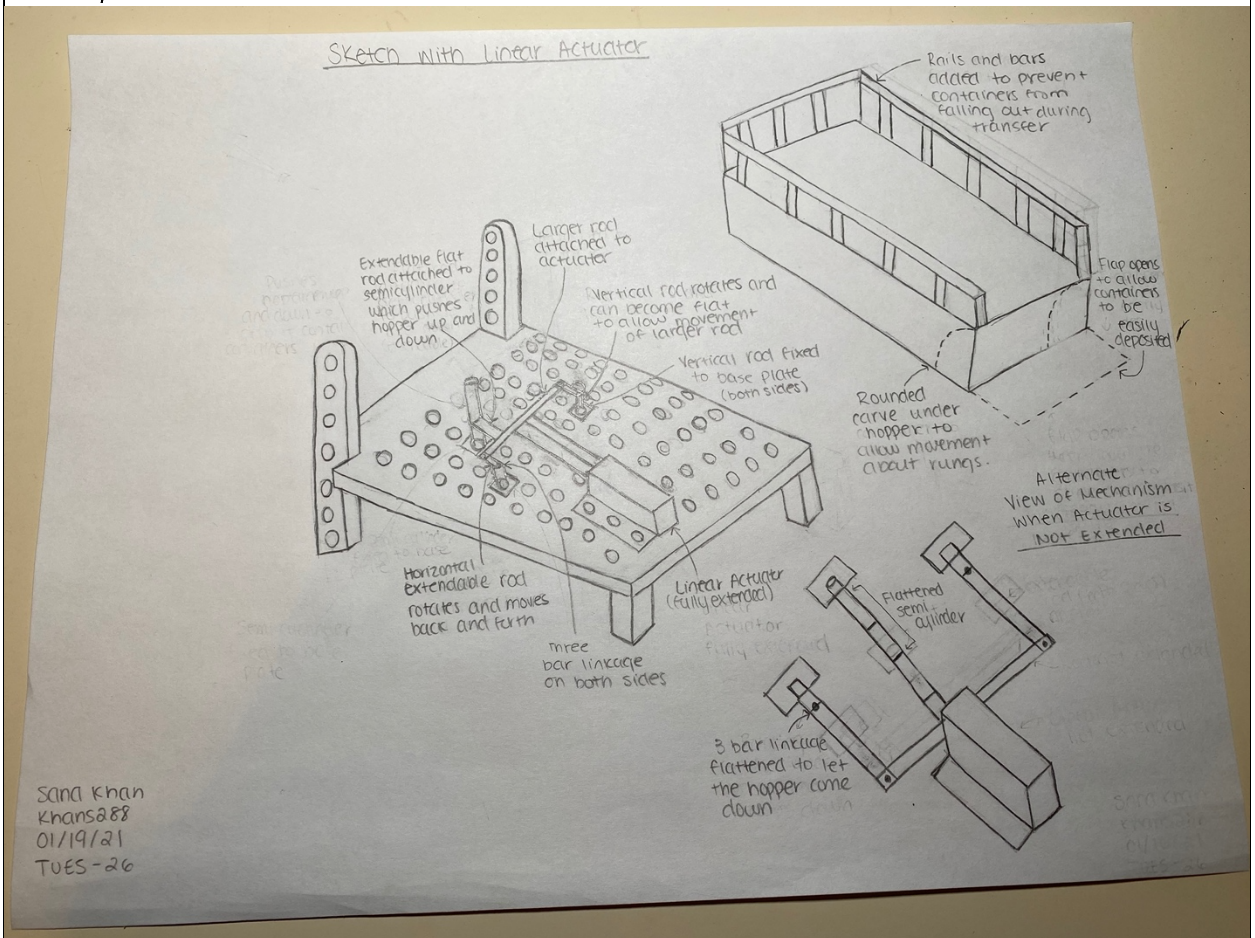
Name: Sana Khan	MacID: khans288

Insert screenshot(s) of your concept sketches below

Concept 1



Concept 2



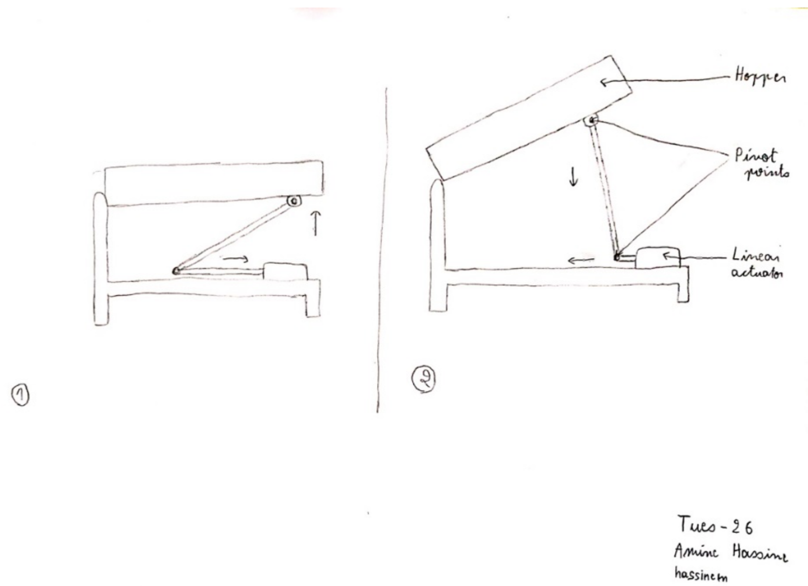
Sketch with Linear Actuater
Rails and bars added to prevent containers from falling out during transfer
Larger rod attached to actuater
Extendable flat rod attached to semicylinder which pushes hopper up and down
Vertical rod rotates and can become flat to allow movement of larger rod
Vertical rod fixed to base plate (both sides)
Flap opens to allow containers to be easily deposited
Rounded carve under hopper to allow movement about rungs.
Alternate View of Mechanism When Actuater is Not Extended
Horizontal extendable rod rotates and moves back and forth
Linear Actuater (fully extended)
Three bar linkage on both sides
Flattened semi-cylinder
3 bar linkage flattened to let the hopper come down
Sana Khan
Khans288
01/19/21
TUES-26

Team Number: Tues-26

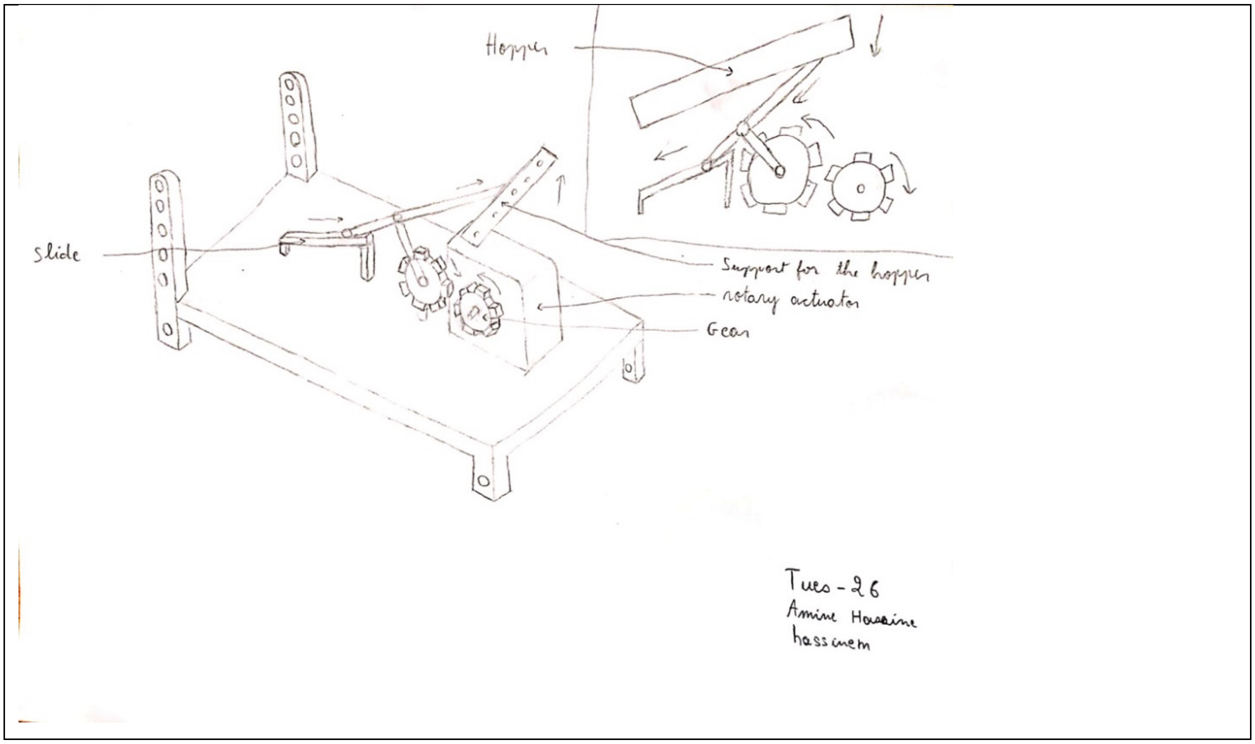
Name: Hassine Amine	MacID: hassinem

Insert screenshot(s) of your concept sketches below

Concept 3:



Concept 4:



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

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

Team Number: Tues-26

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 (3 Discussion points per sensor)**
Ultrasonic Sensor	• Proximity Sensor that detects the distance of an object from it • Could offset different bins to different lengths to distinguish between bins • Could run into configuration errors if the ultrasonic sensor locks onto another surface besides the bin
Hall Sensor	• Uses electromagnetic laws to detect the proximity of a metal object and strength of electromagnetic field • Determines if object in proximity is metal or not • Could set the distance to staggered and the strength of the electromagnetic field of the metal bins would change, helping individualize the bins
Active Infrared Sensor	• Uses infrared radiation waves that aren't visible to detect proximity of an object • Active infrared sensor uses led light to bounce off bin surface and detect proximity • Using staggering bin position alike the ultrasonic sensor, bins can be detected based on the change in proximity
Light Dependent Resistor	• Detects presence of the level of light depending on proximity • Depending on the color of the bin and its absorption of light, the LDR will calculate a resistance value unique to the color • Results can be impacted by the ambience of the room and slower than the color sensor
Color Sensor	• Detects the color of the material in the RGB scale • Bin can be assigned a specific color to be detected by the color sensor either, Red, Yellow, or Blue

	• Can distinguish the bins individually by color, decreasing the chance of error
Retro-reflective Photoelectric Sensor	• Detects an object coming into proximity • Light emit onto object is reflected and caught on the receiver were depending on the color's absorptance, a different voltage would be read a lot like light dependent resistor • Slower than color sensor and can struggle with the ambience of the room

2. Identify one sensor to incorporate into your computer program

Color Sensor

3. Identify an attribute value for each bin

Bin ID	**Attribute Value (What we are changing about the bin)**
Bin01: Metal Bin	Red Bin Color
Bin02: Paper Bin	Green Bin Color
Bin03: Plastic Bin	Blue Bin Color
Bin04: Garbage Bin	White Bin Color

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

Team Number:	Tues-26

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

	Simplicity	Cost Effective	*Efficient*	Size	Durability	Accuracy of Depositing	**Score**
Simplicity	0	0	0	1	0	1	3

Cost Effective	1	0	0	1	0	1	4
Efficient	1	1	0	1	1	1	6
Size	0	0	0	0	0	1	2
Durability	1	1	0	1	0	1	5
Accuracy of Depositing	0	0	0	0	0	0	1

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*	
		Rating	Weighted Rating	Rating	Weighted Rating	Rating	Weighted Rating	Rating	Weighted Rating
Simplicity	3	2	6	1	3	4	12	3	9
Cost Effective	4	3	12	2	8	4	16	3	12
Efficient	6	4	24	2	12	3	18	4	24
Size	2	2	4	4	8	1	2	2	4
Durability	5	4	20	3	15	2	10	4	20
Accuracy of Depositing	1	4	4	4	4	2	2	2	2
TOTAL	21	19	70	16	50	16	60	18	71

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

Based off the weighted matrix, we have decided that concept 4 is the optimal choice of design for our mechanism. However, we will still add some components of concept 1 such as the sliding panel and a railing on the hopper, as it was the second optimal choice. Concept 2 was too complicated and had not met our requirements. It was also confusing and did not seem realistic. In terms of size, concept 3 was not optimal since the linear actuator would have to move far out. It would take more space and more time which makes it inefficient. Using only 1 component with the actuator would be too much stress on the mechanism meaning it is not durable and could fail.