PROJECT THREE: MILESTONE 2 – COVER PAGE

Team Number: Tues-24

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

Full Name:	MacID:
Ehsaan Khan	khane16
Zhenyu Zhao	zhaoz154
Borna Sadeghi	sadegb1
Amir Rayyan Khan	khana344

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

Team Number: Tues-24

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-24

Name: Borna	MacID: sadegb1

Sensor Type	Description	Attributes
Hall Sensor	• Measures the magnitude of a magnetic field • Converts magnetic or magnetically encoded information into electrical signals for processing by electronic circuits (think of how a DC motor works) • Allows for the sensing of position, distance and speed of magnetic materials,	• Magnetic field • Position and movement (of magnetic parts)
Light-dependent resistor	• Also known as a photoresistor • Is passive (doesn't consume energy to work) • In brighter light, the resistance is lower	• Light level
Retro-reflective Photoelectric sensorsor	• Senses reflector or reflective materials at a long range • Consists of an emitter and a sensor • Emits directed light (e.g. laser) and detects the reflection back from the object	• Reflectivity • Transparency

Team Number: Tues-24

Name: Amir Rayyan Khan	MacID: khana344

Sensor Type	Description	Attribute(s)
Ultrasonic Sensor	• Consists of an emitter and detector • Detects distance to a target object by detecting reflections of emitted ultrasonic sound waves	• Proximity/Distance through air (doesn't work in a vacuum
Color Sensor	• Consists of an emitter and detector • Are very similar to cameras • Red, blue and green light are casted by the emitters to test for the colour of an object	• Detecting colour (even in the dark)
Active infrared (IR) sensor	• Both emit and detect infrared radiation (unlike passive IR sensors which only detect light from other sources (e.g. on a TV remote))	• Detecting heat and obstacles

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

Team Number: Tues-24

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

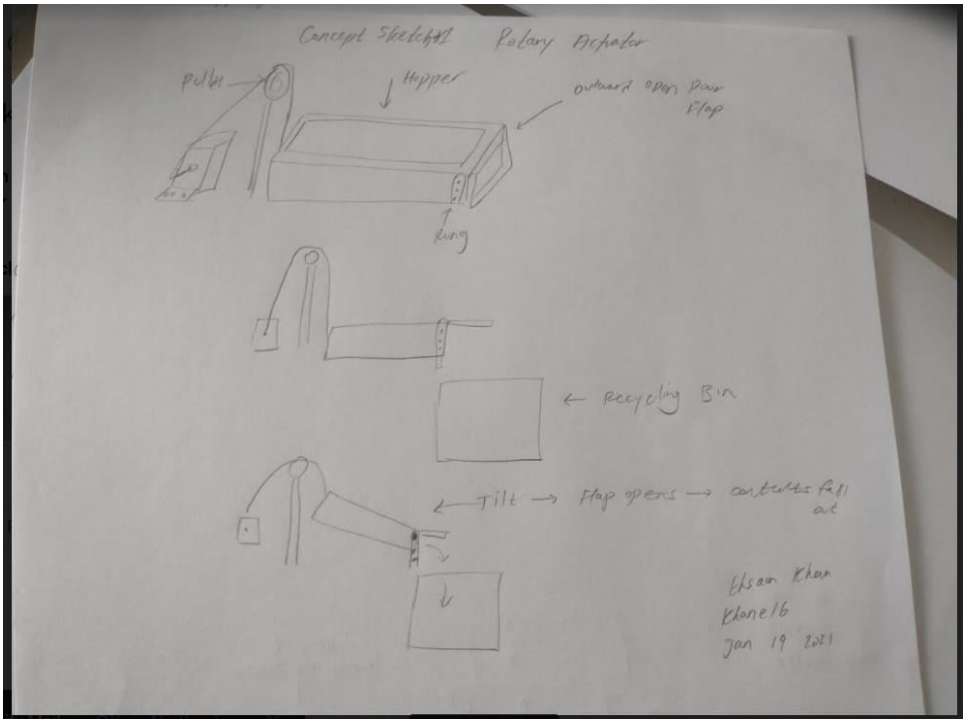
We are asking that you submit your work on both worksheets. It does seem redundant, but there are valid reasons for this:

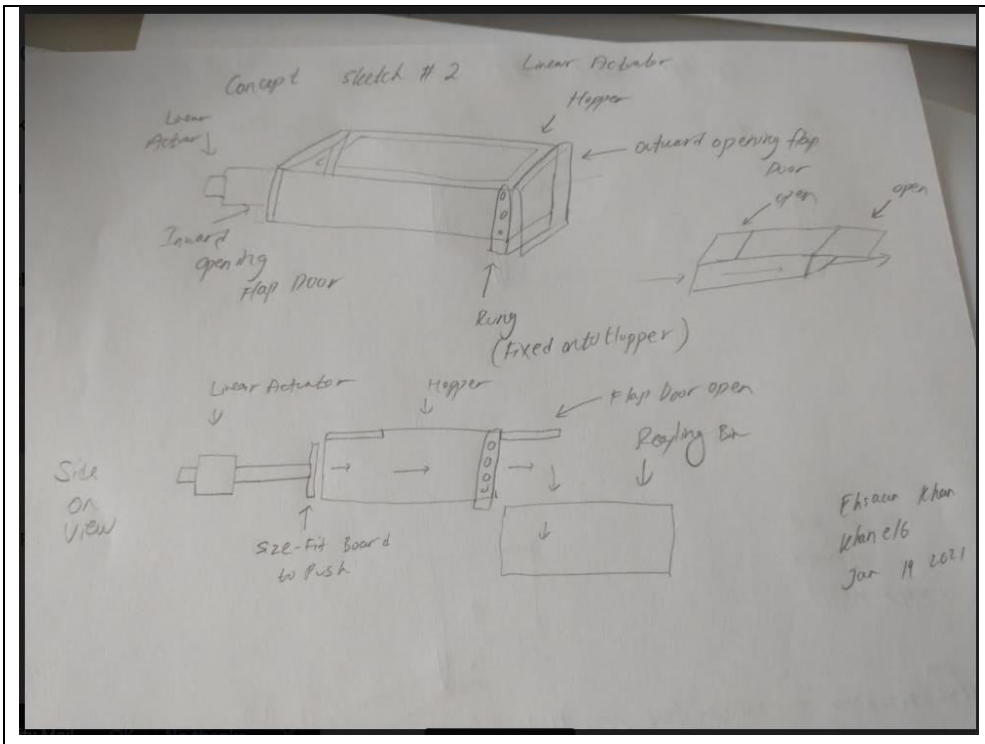
- Each team member needs to submit their concept sketches with the **Milestone Two Individual Worksheets** document so that it can be ***graded***
- Compiling your individual work into this **Milestone Two Team Worksheets** document allows you to readily access your team member's work
  - This will be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

Team Number: Tues-24

Name: Ehsaan Khan	MacID: khane16

Insert screenshot(s) of your concept sketches below

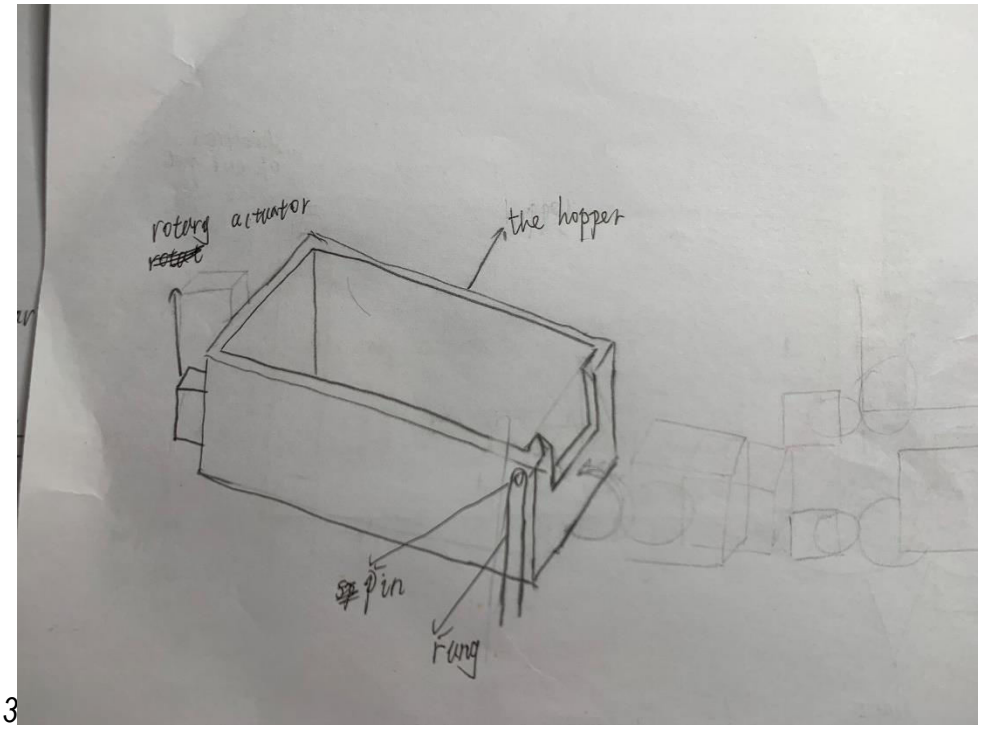



Concept Sketch # 2
Linear Actuator
Hopper
Linear Actuator
outward opening flap Door
open
open
Inward opening Flap Door
Ring (fixed onto Hopper)
Linear Actuator
Hopper
Flap Door open
Recycling Bin
Side on View
Size-Fit Board to Push
Ehsaan Khan
Khan e16
Jan 19 2021

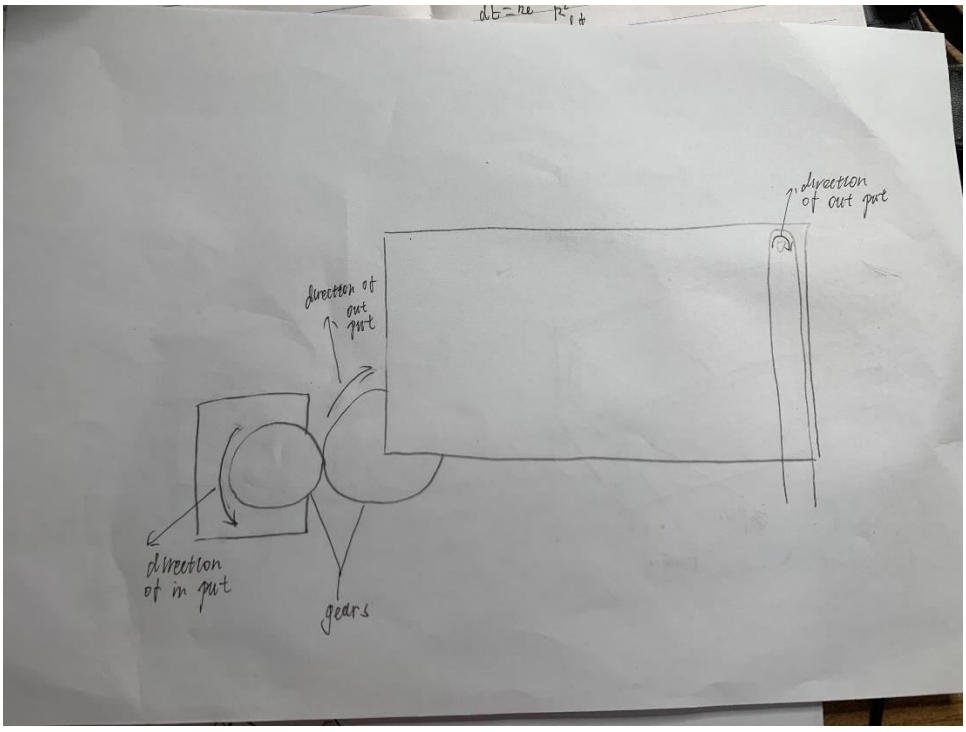
Team Number: Tues-24

Name: Zhenyu Zhao	MacID: zhaoz154

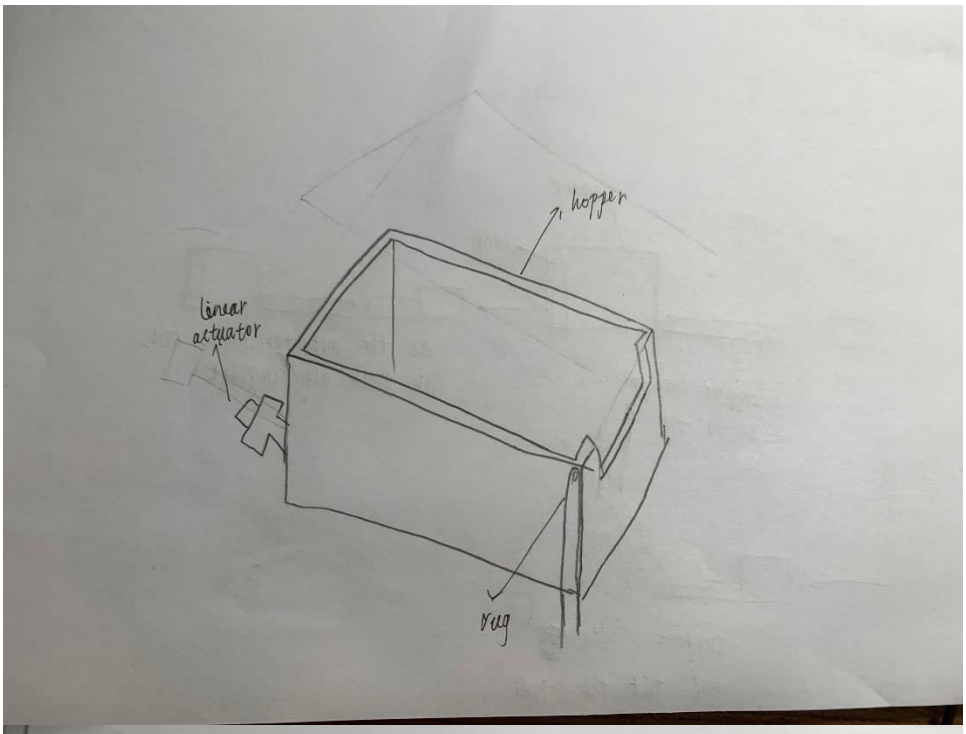
Insert screenshot(s) of your concept sketches below

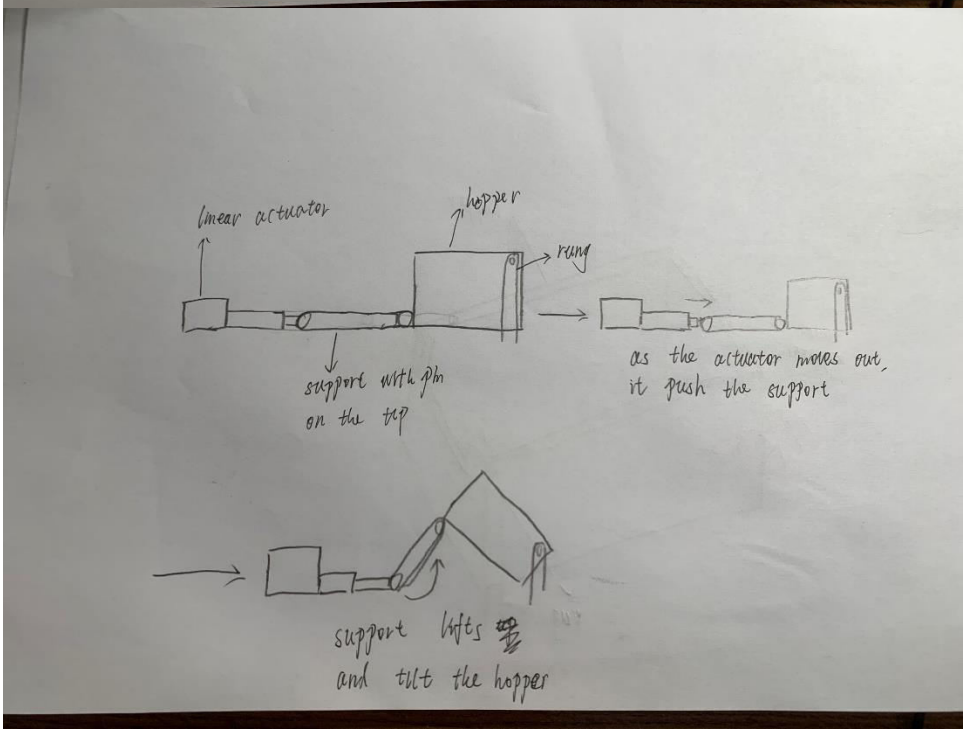


3



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-24

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
Hall sensor	• Measures the magnitude of a magnetic field • Used for the sensing of position, distance and speed of magnetic materials. E.g. Found in wheel speed sensors • For application (classifying bins by an attribute), this might not be ideal because there is only the option to make a bin metallic, but even with all bins metallic and made of magnetic metal, it would be very difficult
Light-dependent resistor (light level sensor)	• A passive light-sensitive resistor that has a lower resistance in brighter light • Can be used to detect light level • Not ideal for bin classification because the light level must be kept constant, and must find a way to reflect a light source off of bins of varying reflectiveness
Retro-reflective photoelectric sensor	• Senses reflectivity of materials at a long range using an emitter and receiver of directed light (e.g. laser) • Potentially could vary the reflectivity, although this may require that the bins stay clean and reflective on the surface
Ultrasonic sensor	• Senses proximity/distance of objects through the air, by emitting and receiving ultrasonic sound • The bins can be offset by a certain distance from the yellow line for identification • Probably most cost-effective way to classify by distance, but this requires the bins to be farther, which means more travel, which means less efficiency (more time spent, more energy used)
Color sensor	• Similar to cameras, emit and detect visible red, blue and green light to test • A very effective way to classify bins, assuming the colour stays

	somewhat the same. Even for a washed out and worn down blue container, it's still easy to distinguish it from a red container. Also great longevity, reliability, production
Active infrared (IR) sensor	• Both emit and detect infrared radiation (unlike passive IR sensors which only detect light from other sources (e.g. on a TV remote)) • Can be used to detect heat, obstacles, motion • Using IR to classify bins can be difficult, their main unique properties are the ability to detect heat. This part isn't a very useful feature in this case since there's no way to vary the heat, but they can also detect obstacles and distances like some of the other sensors, and unlike the ultrasonic sensor, it will work in a vacuum or moving air conditions

2. Identify one sensor to incorporate into your computer program

Colour sensor, because it is easy to make the bins distinguishable in this way, and since colour is less prone to being read incorrectly. Also, we know for sure that there is the option to change the colour of the bins in the Quanser environment.

3. Identify an attribute value for each bin

Bin ID	**Attribute Value (colour, RGB)**
Bin01: Metal Bin	Red
Bin02: Paper Bin	Green
Bin03: Plastic Bin	Blue
Bin04: Garbage Bin	White

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

Team Number: Tues-24

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

	Weight	*Size*	*Cost*	Stability	Compatibility(w/ actuator)		**Score**
Weight	1	1	1	0	0		3
Size	0	1	1	0	0		2
Cost	0	0	1	0	0		1
Stability	1	1	1	1	0		4
Compatibility(w/ actuator)	1	1	1	1	1		5

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
Weight	3	3	9	4	12	3	9	2	6
Size	2	2	4	2	4	4	8	3	6
Cost	1	3	3	4	3	3	3	4	4
Stability	4	4	16	4	16	2	8	4	16
Compatibility (w/ actuator)	5	4	20	3	15	3	15	4	20
TOTAL	15	16	**52**	17	**50**	15	**43**	17	**52**

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

Concept 4, had the highest(tied) score in the decision matrix chart. We believe it taking everything into consideration, like the criterion, is the best concept, and we will go ahead with this one. We find this is both a simple, yet effective and importantly, practical design. It also scored highest in the two most important criterion of Stability and Compatibility(with the actuator). If fulfills the condition, of rotating about the rung. This design can also be repeated

many times, as needed in a recycling facility. This design needs some work and we believe, it will result in a very good design. The design is drawn out and described in detail in the sketches above.