Design Criteria and Target Specifications

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INTRODUCTION:

After we turn customer statements into a list of interpreted needs, in this deliverable, we will define a list of prioritized design criteria which includes functional, non-functional, and constraints parts. Then, we will perform benchmarking to illustrate our solution which satisfies one of the interpreted needs of customer. Finally, we will set marginal and ideal values of the criteria for target specification base on the information gathered from customers' needs and benchmarking. Furthermore, we will also explain how client meeting affect our choice of decisions.

DESIGN CRITERIA:

- Translate needs into design criteria:

#	Needs	Design Criteria	Importance (5-1)
1	Reduce the amount of intaking soft sand.	Shaking frequency (Hz), Motor capacity (Kg-cm), Size of storage tank (mm), Weight (Kg)	3
2	Short battery runtime	Battery capacity (mAh), Charging voltage (V & A), Amount of charging platforms	4
3	**Better wildlife monitoring** and remote surveillance.	**Number of Cameras & Sensors,** GPS & GPRS,	2
4	Have the ability to works in certain weather.	Configuration/Size of robot platform (mm), Operation Temperature (Celsius),	4
5	**Undependable Breaks.**	**Weight (Kg),** **Stopping distance (mm),** **Performance of Sensors,** **Response time (s)**	5
6	The Robot is low cost.	Cost ($)	2

- Choose of solution & Reason:

  During first client meeting, Erin mentioned that there is still not a way yet for robot to deal with the situation of roll-over. When this situation happens to robot, it will return back to work only if people find it and flip it back. Thus, we rank it as most important one. Furthermore, if people not discover the situation quickly, the efficiency of robot to help the restoration of environment (currently location is beach) will reduce more and more as the time passed by. However, the process of ensure robots work properly and help it to go back to work when flipping happens will definitely involve extra works and reduce the efficiency of robot. Therefore, our team's consensus is focusing on helping robot to avoid flipping by using detective sensors and improve robots' breaking system. In addition, it will also help the robot to monitoring wildlife in some extent.

- Revised problem statement for choice of solution:
  A need exists for Robot Missions to improve functionalities and efficiency of Bowie robot for environmental restoration by create and set up valid detective sensors to solve the problems of dependable break, flipping of robot, and wildlife monitoring.
- **NOTE:** Although our team has chosen the particular aspect to solve the problem, we will still perform all the related design criteria and target specification, because these may become useful information for our design as well as to better satisfy our client's needs in the future. However, we will focus on the sensors for the benchmarking part.

BENCHMARKING:

Sensor Device **Specifications**	**Kuman Ultrasonic Distance Measuring Sensor**	**Smraza Ultrasonic Distance Measuring Sensor**	**Elegoo Ultrasonic Distance Measuring Sensor**
Company	Kuman	Smraza	Elegoo
Cost	$13.19	$13.29	$12.54 CAD
Voltage	5V	5V	5V
Static Current	Less than 2mA	Less than 2mA	-
Sensor Angle	Less than 15°	Less than 15°	Less than 15°
Detection Distance	2cm-450cm	2cm-500cm	2cm-500cm
Date released	Feb 23, 2016	May 24, 2017	June 11, 2016

TARGET SPECIFICATIONS:

- Functional Requirements:

#	**Imp**	**Design Specifications**	**Relation (=, < or >)**	**Value**	**Units**	**Verification Method**
1	3	Shaking frequency for storage tank	=	5 ~10	Hz	Test & Analysis
2	3	Charging voltage for robot	=	3.3V at 0.5A, 5V at 3A, 6V at 8A	V & A	Background information
3	5	Breaking/stopping distance	<=	0.3	m	Test
4	5	Time of detect and response	<	1	s	Test
5	2	GPS & GPRS	=	Yes	N/A	Test
6	4	Breaking Speed for breaks/sensor	>	0.4	m/s	Test & Analysis
7	**5**	**Sensor Angle**	**<**	**15**	**degree**	**Test**
8	**5**	**Sensor Current**	**<**	**2**	**mAh**	**Test**
9	**5**	**Sensor detective distance**	**=**	**2~500**	**cm**	**Test**
10	**5**	**Sensor voltage**	**=**	**5**	**A**	**Test**

- Non-functional Requirements:

#	Imp	Design Specifications	Relation (=, < or >)	Value	Units	Verification Method
1	2	Number of cameras & sensors	>=	2	N/A	Test
2	1	Aesthetics	=	Yes	N/A	Test
3	2	Product life	>	5	Years	Test
4	2	Number of charging platforms	>	2	N/A	Test

- Constraints:

#	Imp	Design Specifications	Relation (=, < or >)	Value	Units	Verification Method
1	3	Weight	=	3	Kg	Test
2	4	Motor capacity	>=	6.8	Kg-cm	Test
3	3	Size of storage tank	=	30 x 10 x 60	mm	Analysis
4	3	Specialized outfits size for different weather (Platform)	=	100x100x60	mm	Analysis
5	4	Operation Temperature	=	-5 ~ 30	deg C	Test
6	4	Battery Capacity	>=	5000	mAh	Test
7	2	Cost of sensors and other related accessories	<=	100	$	Estimate, final check
8	2	Maximum Payload	>=	0.8	Kg	Test

HOW CLIENT MEETING AFFECTS OUR DECISION FOR DESIGN CRITERIA AND GIVING RELATIVE IMPORTANCE:

Meeting with our client allowed our design criteria and specifications to develop furthermore. We were able to take in first-hand information from the client which was very beneficial. Empathizing with our client was very important as it allowed us to truly understand the main user needs and focuses that should be put on our design criteria. The meeting gave us the creativity to come up with a couple excellent ideas for the project. Using the notes, we took from the meeting, our group put together a set amount of needs, and we organized them for important to least important based on what our client said and the empathizing. Furthermore, we were able to agree on some reasonable specifications including cost, materials, etc. We based the choices of specifications for our project on what we saw from Bowie on the day of the client meeting. Seeing Bowie’s functionality first hand gave us the impression that the robot was working as intended and our goal was to add something extra to Bowie but obviously not something crucially important (hence, all those things have already been implemented). Thus, we decided to stay on a budget, but still have a good quality of work being done through this project and in the specifications.

Furthermore, when we asked Erin about was there any measure to deal with the emergency of filliping of the robot, it took a while for her to think about it and answered it compare to other questions. Thus, our team think this may be the aspect that did not get fully considered and develop on the robot, which means it is the aspect that need more attention for improvement. And it is the reason for our team to focuse on sensor to improve robot’s undependable break system in order to avoid flips.

CONCLUSION:

In order to help our client to achieve their goal of environmental restoration with the helps of robots, our team consensus decision is designing a detective sensor to help robot to predict the barriers and give response in an ideal range of time to avoid flipping or crashing. This design will not only improve the efficiency of the break system as well as the overall efficiency of the robot, but also will stratify the interpreted need of wildlife monitoring in some extend. As the above tables illustrate, our team has already set up a list of prioritized design criteria, and assign them with range of values between acceptable and ideal base on our benchmarking and research. The next steps for us is to ideate for more solutions and create several prototypes to achieve or modify these design criteria as well as the target specification in order to fully satisfy our client’s needs.