INTRODUCTION TO ENGINEERING DESIGN AND COMMUNICATION

Group 05

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Initial objective list

- Time saving
- Automation
- Managing waste properly
- Diminish bad odor
- Controlling spill level
- Easy to service
- Easy to use
- Easy to assemble / replace
- Marketability
- Automated sealing

Objective	Constraints	Limitations
Time saving (automated lid)	• Low quality sensor	• Low accuracy
Automation (automated lid, automatic level measure, automatic zip tying)	• Government rules and regulations	• Low budget • Unable to find parts
Properly managing waste (automated lid, rubber seal, automatic level measure)	• Government tax	• Unable to find parts
Reduction of bad odor (Rubber seal, automated lid)	• Low quality rubber seals	• rubber seal damaging in a period due to excessive use
Spill level controlling (automatic level measure, automatic zip tying)	• Negligence of people	• Cannot be placed practically everywhere
Easy to service	• Lack of skill labors	• Lack of technical knowledge
Easy to use (readily available parts)	• Low quality and low capacity in the battery	• Have to charge the battery frequently • The polythene bag may tear
Easy to assemble/ replace	• Relatively expensive	• Unable to find parts
Marketability	• Competitors	• Shrinking the customer base
Automated sealing	• Low quality of a zip tie	• Zip tie can break

Intended objective list

★ Waste should manage properly

- Should reduce pollution
  - Low impact on surrounding
    - Increase garbage capacity of a dustbin
  - Diminish bad odor

- Should reduce getting infected
  - Prevent contamination from Medi waste
    - Infectious waste

  - Provide hygienic conditions

★ Should be automated

- Spill level should be measured
- Lid should work automatically
  - Time saving
  - Accuracy
    - Specific angle and distance to detect a person by a sensor
- Trash bag should seal automatically
  - Prevent trash spilling out

★ Should be marketable

- Should be portable
  - Should be light weight
    - Useful for indoors
    - Useful for outdoors

★ Should be easy to use

Low impact on surrounding

Overflowing waste bins are ideal breeding ground for breeding for bacteria, insects, besides and other animals that thrive from garbage in and around the dustbin include rats, stray cats, and dogs. And sometimes stray dogs and cats drag the litter and dump them in everywhere. Nowadays we can see open lid trash bins in many public places, and they are overflowing when the trash bins are full. It adversely affects the environment. As a solution to this problem we choose 1200 leters sized dustbin. But the limitation we have is not produce that size and constraint is, not available that size in the market. By concerning this fact, we are going to increase the garbage capacity of the dustbin. It solves the problem cause by garbage overflow, and it reduces the amount of unwanted waste in the environment.

Diminish bad odor

Overflowing waste cause air pollution resulting various respiratory diseases and other adverse health effects as contaminants are absorbed from lungs into other parts of the body. To solve this, we are planning to seal the dustbin with a rubber seal. But due to our low budget we must use a low-quality rubber seal, resulting a reduce our initially predicted durability from three years (3) to one (1) year.

Prevent contamination from Medi waste

Improper disposal of Medi waste can lead to infections. These infections can be transmitted even by even touching Medi waste. There 3 main types of Medi waste. Such as

- Infectious waste – waste suspected to contain pathogens and other viruses poses a risk of disease transmission.
- Chemical waste – waste containing chemical substances ex: - lab reagents disinfectants that are expired or no longer needed pose a threat.
- Sharp's waste – used or unused sharps ex: - knives, syringes, blades and broken glasses can transmit diseases.

But due to several laws and regulations and our limited knowledge of dealing with above mentioned chemical waste and sharp's waste, we decided to focus on infectious waste.

Provide hygienic conditions

Odor is almost synonymous with government hospitals. Waste materials strewn all around crowded wards and waiting rooms are grim reminder of unhygienic condition of our health instructions.

Spill level should be measured

Overflowing garbage when its full is a major problem to the waste management. We can find a solution to this problem by knowing the maximum capacity of the trash bin and stop filling garbage after coming to that level. So, what we are going to do as a solution for this problem is, to detect the amount of garbage reaches the maximum level by using a sensor. But negligence of people is a limitation and unable to place the dustbin everywhere is a constraint. So, we hope to solve this by raising the public awareness as much as we can.

Time saving

We currently have trash bins that can be manually operated by hand or foot. We must spend extra time to do these things and it is difficult to do them manually. Therefore, we must use several sensors for time saving. But we have a constraint that budget is limited. According to our low budget we must buy low quality sensors and in that case accuracy of the sensor signals may be low.

Accuracy

Sensor with high accuracy precision help the dustbin work at any given time and with any situation. Accuracy is the most important specification while using indoor and outdoor and **working to people** with different heights without any errors. High accurate sensor can detect 2 cm -400 cm and has a coverage angle of 15 degrees. But due to our low budget using a high accurate sensor is not possible. Using a low-quality sensor will reduce accurately detecting distance and covering angle. As we suggested 180-degree coverage earlier it is not possible. Therefore, we decided to use a single sensor which can work a person is detected from one direction. In the metrics the mentioned accuracy of 90% will reduce accordingly due to the sensor selection.

Prevent trash spilling out

When the leakage from container is a major problem faced near trash bin. The main case is poorly tied trash bag and weakly tied knot. Also poorly tied trash bag will cause trash spill in the truck. This can be solved by using a zip tie that can seal the trash bag automatically. When researching about this solution we have identified that the zip ties imported to Sri Lanka are from China and lacks the quality and resulting zip tie to break when tightening. And this can be solved by using extra heavy duty cable ties with 15 inches and that can handle 250 LB

Portability

Portability and light weight are major factors when choosing a smart dustbin presently. And according to the changes in the market, competitors also make their smart dustbins lighter and user friendly resulting a relative shrink in our customer base due to our dustbins being heavy relatively.

In the metrics, the mentioned proposed weight should be reduced to adopt to the present market decreasing a final weight of dustbin from 3kg to 1kg.

Justifications

Easy to service and easy to assemble

Although our objective is to design a dustbin that is easy for people to service, by considering the declining technical knowledge and skill labor of the people, we decide to remove that objective (easy to service). As well as we removed the objective easy to assemble / replace because it is difficult for people to find the parts needed for the maintenance and they are relatively expensive.

We think the product we offer may cause more inconvenience to people in the future.

Revised problem statement

In the present days garbage has become a significant problem due to the increase of population. Many countries in the world face to this problem. Many people throw away garbage without any responsibility, carelessly or without any hesitation. Nowadays, people have become selfish and unwilling to throw away trash appropriately. It is common to see people discard trash out of everywhere. Carelessness has also made people just throw rubbish in anywhere without even thinking about it. And we can find garbage bins overflowing at various public places. So that breeding various animals near the trash bins and it creates unhygienic surroundings, lousy odor which leads to the spread of deadly diseases and human illness. Smart dustbins help to create a cleaner, safer, more hygienic environment and enhanced operational efficiency while reducing management cost, resources, and roadsides emissions. The smart bin is ideal for busy locations such as campuses, airports etc. And nowadays dustbins are usually used in hospitals.

According to statistical data, "Sri Lanka generates 7000 MT of solid waste per day with the western province accounting for nearly 60% of waste generation. Each person generates an average of 1-0.4 kg of waste per day. According to the Waste Management Authority and the Central Environmental Authority, only half of the waste generated is collected."

Presently there are several available solutions for dustbins such as swing dustbins, manually operated dustbins (in which lid must be opened by hand), dustbins which opens with the help of leg also smart dustbins. All of them have their own draw backs. Currently manually operated dustbins are not a suitable choice for the elderly who are suffering from skeletal and neurological disorders. This was also experienced by a grandparent of our group member who suffered from arthritis and found it difficult to operate dustbins manually. Smart dustbin is another solution available these days. But the prices and lack of several features and being highly technical, reason people not to choose those. Another problem we have identify is the fact that trash bags must be tied down manually which result in spreading diseases to the cleaning staff. And also if the tie knot is not secure it can lead to trash spilling out. Also currently trash bin has a lid that does not seal completely resulting a bad odor spreading near the trash bin leading to unhygienic conditions. Traditional trash bins also have a higher capability of overflowing if unattended for a longer period by the cleaning staff. This can be seen in almost every public trash bins these days. When considering above identified problems in the current existing dustbins we propose our own dustbins addresses each identified problem.

By considering all these facts we need develop a trash bin for solving these problems. Firstly, we should manage waste properly. Therefore, we can reduce the impact on surrounding and diminish the bad odor. Nowadays we can see open lid trash bins in many public places, and they are overflowing when the trash bins are full. This is a major problem to the environmental impurity, and it causes for breeding various animals like insects, rats etc. And sometimes stray dogs and cats drag the litter and dump them in everywhere. It adversely affects the environment. By concerning this fact, we are going to increase the garbage capacity of the dustbin. Not only that we are introducing an automatic sealing system to diminish bad odor. From that, we can minimize the risk of human health because bad odor of the garbage causes various respiratory diseases and other adverse health effects. Medi waste can also be considered as another way in which people can be

infected. There are three main types of Medi waste. They are infectious waste, chemical waste and sharp's waste. But under the undergraduate level constraints and limitations we can provide a solution only to the infectious waste. Disposal of chemical waste and sharp's waste are dangerous processes. There is constraint that we do not currently have the knowledge of how to dispose the chemical waste. And also, we have to use a different process for the disposal of sharp waste due to the sharpness of the equipments. But even though the skill labors are available from outside for this, there is a constraint that we can't do it under the limited budget. So we removed create solutions for those chemical waste and sharp's waste.

Garbage bins spilling out is a major cause of many problems. If we can know the amount of garbage in the bin before it overflows, it will make our day easier. Therefore, we thought to add a sensor to measure the garbage level when it filled to the limit. But due to the carelessness and laziness of people, even though the garbage bins are filled to the maximum level, people still dump trash without any hesitation. As the designing team we could not get any action for this matter.

In this project we are looking forward to making a dustbin which has a lid with an automatic opening and closing. The bin will automatically open when you approach with trash. We will include a sensor to identify a man who is coming closer near the bin and then it will open, after the man moves away the lid will automatically close. If we could use an ultrasonic sensor, we could make this approach more successful. If this project becomes a success people could save some sort of time while opening and closing bins. Because of the budget limitation we must use a low-quality ultrasonic sensor to this product.

There are smart dustbins, there are already light weight dustbins in the market. So this competitors are the constraints we have and the weight of the dustbin is about 3kg, so we have to create less than 3 kg weight to conflict with the current market, and the limitation is shrinking the customer base. So, we have to create best output according to the customer need.

When the leakage from container is a major problem faced near trash bin. The main case is poorly tied trash bag and weakly tied knot. Also poorly tied trash bag will cause trash spill in the truck. This can be solved by using a zip tie that can seal the trash bag automatically. When researching about this solution we have identified that the zip ties imported to Sri Lanka are from China and lacks the quality and resulting zip tie to break when tightening. And this can be solved by using extra heavy duty cable ties with 15 inches and that can handle 250 LB.

Current available automated solutions average prices range in between $50 to $500. So, we are planning to develop a smart dustbin addressing the above identified weaknesses within the budget 15,000 LKR. So, the smart bin designing by us is an innovative solution to the waste management problem that our nation faces and we believe this smart communal bin to be answer of some of the questions posed by our garbage collection system.

References

1) About the status of waste management in Sri Lanka
https://efl.lk/status-waste-management-sri-lanka/

2) Types of Medi waste
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7152398/

3) Capacities of dustbins
https://www.whitehorse.vic.gov.au/waste-environment/rubbish-recycling/bin-services/find-your-bin-size

4) Qualities of sensors
https://www.sensorpartners.com/en/knowledge-base/sensors-resolution-and-accuracy/
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7152398/

5) Qualities of zip ties
https://www.advancedcableties.com/categories/cable-ties/

6) Qualities of rubber seals
https://www.baumer.com/cn/en/quality-control-of-rubber-seals-on-the-basis-of-height-measurements-/n/News_PosCon-_r_bHM

7) Prices of garbage bins
https://www.amazon.com/s?k=smart+trash&adgrpid=81952170632&gclid=Cj0KCQjwl_SHBhCQARIsAFIFRVUwKM8R56tuyaJiZtJL9tCkekWIiYeoBbI2nbHNd7NS0JRXskLfsQkaAiyREALw_wcB&hvadid=393644800775&hvdev=c&hvlocphy=1009919&hvnetw=g&hvqmt=b&hvrand=14794326369680645767&hvtargid=kwd-303276730246&hydadcr=22333_10729128&tag=hydglogoo-20&ref=pd_sl_3ihw3paulr_b

8) Unhygienic conditions raise sting in hospitals
https://timesofindia.indiatimes.com/city/chandigarh/unhygienic-conditions-raise-a-stink-in-hospitals/articleshow/5717479.cms