



# ECONOMICS IN DESIGN

Group 05

Vilan Jayawardene EN21466830

Vinal Gamage EN21481130

Kasuni Dissanayake EN21485640

Dulanthi Perera EN21482120

N.A. Thinuri Isaka EN21492716

#### 4.1. Bill of material

	Item number	Quantity	Item name	Item description
<b>Components used for detecting a person and opening of the lid</b>	1	1	IR Infrared Obstacle Avoidance Sensor Module Adjustable (YL-63)	infrared sensor emits and/or detects infrared radiation to sense its surroundings
	2	2	Servo Motor SG90 9G Micro Servo Motor	servos can lift about 3.75lbs that is positioned on an arm 1cm out from the shaft  Servo can rotate approximately 180 degrees (90 in each direction)
<b>Components used to detect garbage level and sealing trash bag</b>	3	1	Zip Ties Heavy Duty 18 Inch	Sealing the trash bag is done from the zip tie
	4	1	Ultrasonic sensor HY-SRF05	An ultrasonic sensor is an instrument that measures the distance to an object using ultrasonic sound waves
	5	1	NEMA 17 17HS4023 Stepper Motor 42x42x2mm D Shaft 5mm	The gear rod is connected to the gear rod which pulls the zip tie sealing the trash bag
	6	1	EasyDriver A3967 V44 Stepper Motor Driver Board	It provides much more flexibility and control over your stepper motor

	7	1	Differential Main Gear 64t Motor Gear 21	Pulling the zip tie from its grooves
<b>Components used for charging device</b>	8	1	12V 3000ma Battery	Rechargeable Li-ion battery that can be used multiple times
	9	1	12.6V 1.3A SMPS Charger	Connects mains power with on board battery system
<b>Other components</b>	10	1	Garbage Bin 100 LTR	
	11	1	LED 3mm Water Clear 20mA	LEDs that will allow displaying information battery level.
	12	2	Push Button Micro Switch 6x6x4mm	for making and breaking of electric current in a circuit
	13	1	Jumper Wire	Wires to connect microcontroller with each electronic component
	14	1	Rubber seal	serve as a static seal between flat surfaces
	15	1	Passive Buzzer Electromagnetic 3V 16Ohm 2KHZ	The buzzer is a sounding device that can convert audio signals into sound signals
	16	1	Arduino Uno R3 Atmega328P Atmega16U2	The board has 14 digital I/O pins, 6 analogue I/O pins

#### 4.2. Cost estimate (Bottom-up approach)

Item name		Cost per 1 (LKR)	Quantity	Total (LKR)
<b>for detecting a person and opening of the lid</b>	IR Infrared Obstacle Avoidance Sensor Module Adjustable (YL-63 )	Rs.130.00	1	Rs.130.00
	Servo Motor SG90 9G Micro Servo Motor	Rs.330.00	2	Rs.660.00
<b>detect garbage level and sealing trash bag</b>	Zip Ties Heavy Duty 18 Inch	Rs.22.00	2	Rs.44.00
	Ultrasonic sensor HY-SRF05	Rs.225.00	1	Rs.225.00
	NEMA 17 17HS4023 Stepper Motor 42x42x2mm D Shaft 5mm	Rs.1,250.00	1	Rs.1,250.00
	EasyDriver A3967 V44 Stepper Motor Driver Board	Rs.380.00	1	Rs.380.00
	Differential Main Gear 64t Motor Gear 21	Rs.50.00	1	Rs.50.00

charging device	12V 3000ma Battery	Rs.2,290.00	1	Rs.2,290.00
	12.6V 1.3A SMPS Charger			
Other components	Garbage Bin 100 LTR	Rs.7,975	1	Rs.6,975
	LED Defused 5mm 3V 20m	Rs.2.5.00	3	Rs.7.5.00
	Push Button Micro Switch 6x6x4mm	Rs.6.00	2	Rs.12.00
	Jumper Wire	Rs.180.00	1	Rs.180.00
	Rubber seal	Rs.200.00	1	Rs.200.00
	Passive Buzzer Electromagnetic 3V 16Ohm 2KHZ	Rs.50.00	1	Rs.50.00
	Arduino Uno R3 Atmega328P Atmega16U2	Rs.1,571.00	1	Rs.1,571.00
Total cost				Rs. 14024.5.00

## 4.3 sunk and opportunity cost

### Sunk cost

A sunk cost is a cost that has already been incurred and cannot be recovered. Sunk costs are contrasted with prospective costs, which are future costs that may be avoided if action is taken.

A sunk cost refers to money that has already been spent and cannot be recovered.

Small scale	Cost (Rs /=) (Per month)
Cost of the software used in the system (Arduino)	1790
Communication cost (One member to another)	400
Buying equipment's for trash can	2000
<b>Total</b>	<b>4190</b>

### Opportunity cost

Opportunity cost is the profit lost when one alternative is selected over another.

The concept is useful simply as a reminder to examine all reasonable alternative before making a decision.

In the previous assessment as we considered that some materials are the best for the designing this trash bin, so the same opportunity costs are there for the both small and large scale.

Opportunity cost	
	Cost (Rs/=) (Cost per month)
Cost of using IR sensor instead of ultrasonic sensors when measuring the trash level	130
Cost of using SG995 servo motor instead of stepper motor when sealing the trash bag	330
<b>Total</b>	<b>460</b>

## 4.4 Fixed and variable costs

### Fixed cost

A fixed cost is a cost that does not change with an increase or decrease in the amount of goods or services produced or sold.

Fixed cost			
Small scale	Cost (Rs/=) (Cost per month)	Large scale	Cost (Rs/=) (per month)
Maintenance of the trash can	5000	Depreciation	500
Advertising	15000	Rental cost	20,000
Cost of developing software used	4000	Property taxes	1800
		Utility payments	4000
		Labour cost (per month)	10,000

<b>Total</b>	<b>24000</b>		<b>36,300</b>
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## Variable cost

A variable cost is an ongoing cost that changes in value according to factors like sales revenue and output.

Variable costs mainly include raw materials and distribution costs of the trash can

Variable cost			
Small scale (per trash bin)	Cost (Rs/=)	Large scale	Cost (Rs/=) (per month )
Cost of raw materials (such as gear rods, red, orange buttons, tires ...)	14,024.5	Cost of raw materials	1402450
Labour cost	400	Wages and commissions	80,000
Cost for the electricity	200	Cost of assembly	50,000
Cost of packaging	200	Cost of packaging	10,000
		Part time staff for designing the trash can	30,000
<b>Total</b>	<b>14,824.5</b>		<b>1572,450</b>



## 4.5 - Recurring and Nonrecurring costs

### **Recurring costs**

- Recurring costs are occurring repeatedly at regular intervals.
- It happens again and again during the from the manufacture process to the disposal.
- Most of the variable costs are recurring costs as they repeat with each unit of output.
- Fixed costs which are paid on a repeatable basis are also recurring costs.

<b>Recurring costs</b>	
<b>Small scale (for one trash bin)</b>	<b>Cost per month (Rs /=)</b>
Costs of direct labor	30000
Depreciation expense	1000
Electricity	1000
Transport costs	1000
<b>Total</b>	<b>40000</b>

### **Nonrecurring costs**

- The costs that not to be repeated are called as nonrecurring costs.
- This type of cost happens only one time during the manufacturing process.

<b>Nonrecurring costs</b>	
<b>Small scale (for one trash bin)</b>	<b>Cost per month (Rs /=)</b>
Costs of materials/equipment	14024.5
Receiving and shipping	2000
Sales commissions	1000
<b>Total</b>	<b>17024.5</b>

#### **4.6 – Direct and Indirect costs**

##### **Direct costs**

- Direct costs are the costs that can be directly related to the products or services being produced.
- They are directly attributable to the object, and it is financially feasible to do so.
- Direct costs are those for activities or services that benefit specific projects.

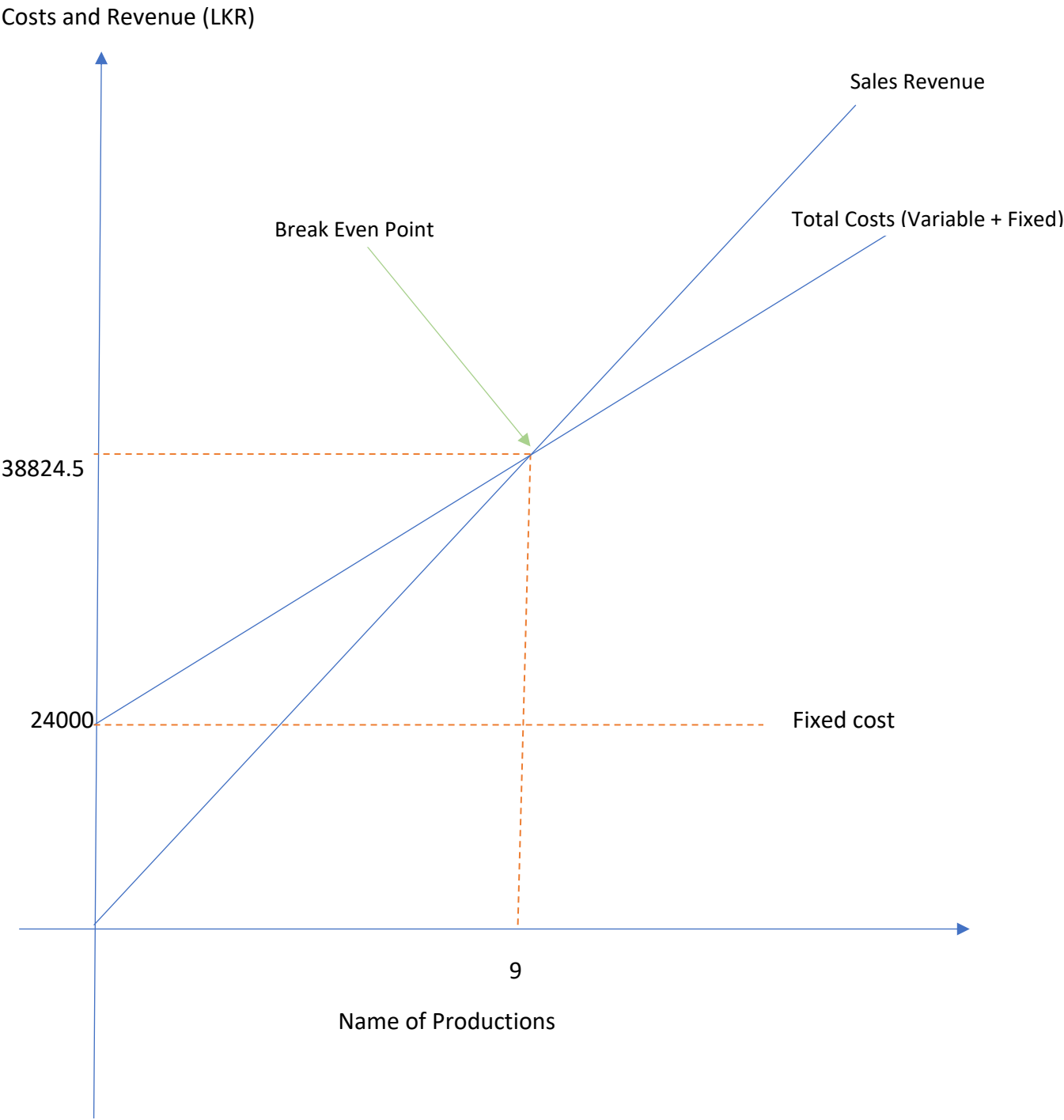
<b>Direct costs</b>	
<b>Small scale (for one trash bin)</b>	<b>Cost per month (Rs /=)</b>
Direct materials	14024.5
Costs of equipment	2000
Costs of direct labor	30000
Sales commissions	1000
Depreciation expense	1000
<b>Total</b>	<b>48024.5</b>

## Indirect costs

- The costs which are not directly accountable to a cost object is called as indirect cost.
- These types of costs are not going to connect directly with the product.
- They are difficult to allocate to a specific output or activity.
- Indirect costs may be either fixed or variable.

Indirect costs	
Small scale (for one trash bin0	Cost per month (Rs /=)
Indirect raw materials	100
Electricity	1000
Rental cost	20000
Production salaries	5000
<b>Total</b>	26100

**Break even analysis**



This estimate was calculated only by considering small scale production.

Revenue per unit – 17500 LKR

Variable cost per unit – 14824.5 LKR

Fixed Cost – 24000 LKR

Break-even Point (units) = Fixed Costs/ (Revenue per unit - Variable cost per unit)

$$= 24000 / (17500 - 14824.5)$$

$$= 8.970 \text{ approximately } 9$$

Profit margin = 17500 - 14824.5

2675.5 LKR

Profit percentage =  $2675.5 / 14824.5 * 100 \%$

= 18.04 %

## 4.7 A proposal to minimize the cost

### ❖ Investment cost

The capital for the manufacturing process must be done within the budget. We need to see and reduce the cost for each step in-manufacturing.

#### 1. Costs when purchasing the components for the device

Gain the advantage of pitching the right demands for a lower cost and acquiring the best materials, researching, and learning the current demand rates, the prices per material from websites. We must try to negotiate the prices with different vendors to obtain the components at a reasonable price.

#### 2. Inventory Optimization

We must check the inventory carefully, in order to take advantage of existing supplies. Make a list of cheapest raw material suppliers and we can start contacting them to elaborate.

#### 3. Optimizing Labor, Tools, and machinery

- Always take qualified employees will save money and time. Though skilled labors demand higher pay rates, unskilled labors make expensive errors that might harm even the customer base.
- When assembling electronic circuits expensive tools and equipment are not needed because it is not much complicated.
- Since the product is not made in batches expensive machines are not required.

## 4. Transportation

This must be done by a guaranteed delivery service. If we can cover one area with one delivery, we can reduce the cost of delivery charges. When ordering the materials, we must take goods by one dealer.

### ❖ Operation & maintenance costs

- This product should be operated according to the instructions given by the instructions in the user manual.
- This device must be inspected by a skilled technician in every 6 months for maintenance purposes.

### ❖ Annual expenses later year

- The rubber seal should change every year for better experience, or it depends according to customer usage.

### ❖ Environmental and social consequences

This device can be used both indoors and outdoors. This device is mostly designed for outdoor usage such as hospitals, main cities.

## 4.8 A proposal for design for the environment

### 1) Unrecyclable components

- Components that take a long-time duration to decay and cannot be reusable. But with research and advancements in technology they could become resources now a days. We have to limit these unrecyclable components because it is harder to dispose.

Goals	The power supply unit of the trash bin	Using a Solar system to gain power when used in outdoors
	The material that is used to make the dustbin.	The structure can be made by recyclable plastic.
	The mechanism of the zip tie	Using an hydraulic system for long lasting usage
	Pollution Prevention	The zip tie which ties automatically should be fully airtight so no hazardous gases pollute the area.

This product is almost an environmentally friendly product and will be more if we could do the necessary changes of the above product.



## 4.9. Making cost equations

$$C = D + \frac{(I + F)}{Q}$$

$$C = (A+B+E+G+H) + \frac{(J+K+L+M+N+P+R)}{Q}$$

**C – Total cost**

**D – Direct cost per unit**

A-Direct materials

B-Costs of equipment

E-Costs of direct labor

G-Sales commissions

H-Depreciation expense

**I - Indirect costs**

J-Indirect raw materials

K-Electricity

L-Rental cost

M-Production salaries

**F – Fixed costs**

N-Regular maintenance of the trash bin

P-Advertising

R-Cost of developing software used

**Q – Quantity**

**D – Direct cost per unit**

Costs	Price per month (Rs)
1) Direct materials	14024.50
2) Costs of equipment	2000
3) Costs of direct labor	30000
4) Sales commissions	1000
5) Depreciation expense	1000
<b>Total</b>	<b>48024.5</b>

**I – Indirect cost per unit**

Costs	Price per month (Rs)
1)Indirect raw materials	100
2)Electricity	1000
3)Rental cost	20000
4)Production salaries	5000
<b>Total</b>	<b>26100</b>

**F- Fixed cost per unit**

Costs	Price per unit (Rs)
1) Regular maintenance of the trash can	5000
2) Advertising	15000
3) Cost of developing software used	4000
<b>Total</b>	<b>24000</b>

#### 4.10. Make/Buy Decisions

Item	Make/Buy	Justification
1) IR sensor(active)	Buy	It is an optoelectronic component and its mechanism is complicated to build. Due to our lack of knowledge to set up that mechanism and limited budget to pay for labor costs, we decided to buy that.
2) Ultrasonic sensor	Buy	
3) Servo Motor SG90	Buy	It is complicated to make and also the motor contributes a lot to the performance of our dustbin. Therefore, it is cheaper to buy a quality one.
4) Stepper Motor	Buy	
5) Zip Ties Heavy Duty 18 Inch	Buy	It is not practical to make a zip tie because we have to spend some time on that. So, it is more advantageous to buy.
6)Easy Driver 44	Buy	We haven't enough knowledge to set up an easy driver. Therefore, we decided to purchase one.
7) Gear rod	Buy	It needs a higher manufacturing cost and a large power plant. Therefore, it is more profitable to buy without making.
8) 12V 3000mA Battery	Buy	We decided to buy it because it is available in standard industry sizes as we required. Also, it has inherently safe chemistry and longest life than we create.
9) 12.6V 1.3A SMPS Charger	Buy	It needs an initial cost to make and we cannot afford that because of the limited budget.
10) Garbage Bin 100 LTR	Buy	The raw materials that need to make the trash bin are not readily available. And also, it makes no sense to make it because our product is small. When we consider the cost of making our bin, it is higher than the price we buy. Therefore, we think to buy it from a shop.
11) LED Defused 5mm 3V 20m	Buy	We buy them because they have an exceptional color range to choose from as we want and they are reliable than making. Also, it takes some time to make.

12) Push Button Micro Switch 6x6x4mm	Buy	Proper plan is needed to set up a switch and it is more expensive compared to network time frames. So, it is cheaper to purchase a one.
13) Jumper Wire	Buy	Manufacturing wires requires high accuracy machinery and it needs a high cost. Therefore, we decided to buy.
14) Rubber seal	Buy	We have to get the skill labors for making a rubber seal. We cannot afford that since the budget is limited.
15) Passive Buzzer Electromagnetic 3V 16Ohm 2KHZ	Buy	Making a buzzer is a little hard and time consuming to build. Therefore, we decided to buy one.
16) Arduino Uno R3 Atmega328P Atmega16U2	Buy	It is not easy to make Arduinos as it needs to be advanced knowledge of sub-component. It also requires the latest equipment to manufacture. So, it is better to purchase.

## **Marketing plan**

### **Current situation**

- Background to sustainable offering

Smart Bin is revolutionizing that is important for managing collection operations using unique container intelligence. The creative problem solving, and situation analysis are effective for new marketing offering. The Smart Bin can be charged by solar power that is cheapest and easily available to everyone. It is the effective revolution to prevent spreading the smell in the surrounding area. The creative problem solving is important in the marketing plan for promoting the new offering in the marketplace. This marketing plan for innovation will be effective to consider the behavior of the people.

- Environmental analysis

The strategic tools are such as PESTE and SWOT analysis are important in the marketing plan for identifying the situations in the context of Smart Bin. It is the innovation and part of technology that will help to improve the environment condition by reducing the waste and will have the positive impact on the society.

- Market and customer analysis

Smart Bin helps to reduce the waste and create the friendly environment. This new offering will be important for companies. For example, hospital as well as hospitality sectors will use this bin that will prevent the bad smell in the environment. This new revolution will increase the market growth in Sri Lanka. The people will throw the waste in the right bin to reduce the environmental pollution.

**The major driving factors of Smart trash bin market are as follows:**

- Touchless trash bins offering convenience and preventing cross-contamination of germs
- Product innovation and technology improvement
- Smart cities and efficient waste management systems

**The challenges factors of Smart trash bin market are as follows:**

- Low and slow adoption of smart solutions in developing countries
- Technology providers that can convert any trash bin into a smart one restricting growth of market

**The trends of Smart trash bin market are as follows:**

- Entering the market with differentiated offerings
- Small and private label players increasing their presence
- The Smart trash bin market is segmented on the lines of its products, end user, retail format and regional. Based on end user segmentation it covers residential segment and commercial segment.

**The target market:**

Our target market consists of Hospitals, Houses, Universities, Restaurants.