

PEDAL-OPERATED GARBAGE CLEANER

A Design Project

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Bachelor of Science of Mechanical Engineering

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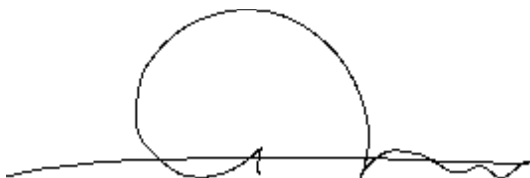
APPROVAL SHEET

This thesis entitled “**PEDAL-OPERATED GARBAGE CLEANER**” prepared and submitted by the group of **NUERA, R.J., LAURON, M., and LANGUIDO, J.M.**, in partial fulfillment of the requirements for the degree of **Bachelor of Science in Mechanical Engineering** has been **APPROVED** by the Examiners.



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Researchers

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CHAPTER I

THE PROBLEM AND ITS SCOPE

RATIONALE

In today's current times, adapting to the changes around world makes the humankind survive on its environment. The recent coronavirus disease or COVID-19 pandemic affects the living of every individual in every aspect and definitely changes the usual life use to be. As this crisis continues, the problem about maintaining the cleanliness especially in tourist spots remains because despite the increasing cases, there are still people going on those places.

Having a clean environment is important nowadays knowing the current situation the world faces. Effective cleaning and sanitizing protect the health of every human and helps maintain the cleanliness in the surroundings. Producing a manually operated machine that can clean the garbage in the road like those plastic wrappers, fallen leaves, dusts and other light materials is done with various designs. One of those designs is the mechanical road cleaner machine which as an alternative for conventional electric cleaning machine. That machine works by pushing through it manually by the user then enables it to collect the mentioned garbage. The fact that in this modern era of technology, road cleaning machines are powered with diesel engines, electric motors and even using robots creates more pollution, using a manually operated machine will provide benefits in saving energy and the ecosystem.

Inspired by mechanical road cleaner machine, the researchers propose a pedal operated garbage cleaner, an innovation from the said machine which will help both the environment in maintaining its cleanliness will also help the people to keep the fitness of their physical health to a good level since driving a bicycle is a form of exercise.

Instead of pushing through it manually, the user will be driving a bicycle with garbage cleaner to achieve those benefits.

THEORETICAL BACKGROUND

One significant theory is relevant to the current study. The Diffusion of Innovation Theory (DOI) the process by which people follow a new idea, product, practice, theory, or another similar concept [1]. The researchers provide a rundown of the Diffusion of Innovation Theory, which explains how, where, and how rapidly new ideas and innovations spread.

Diffusion of Innovation Theory

The conjectures in this study are supported by the diffusion of innovation theory by Everett M. Rogers. This theory was originated in communication to explain how, over time, an idea or product gains momentum and diffuses through a specific population or social system. The end result of this diffusion is that people, as part of a social system, adopt a new idea, behavior, or product. Adoption means that a person does something differently than what they had previously (.i.e, purchase or use another product, acquire and perform a new behavior, etc.). The key to adoption is that the person must receive an idea, behavior, or product as new or innovative.

The adoption of a new idea is caused by human interaction through interpersonal networks [1]. If the initial adopter of an innovation discusses it with two members of a given social system, and these two become adopters who pass the innovation along to two peers, and so on, the resulting distribution follows a binomial expansion Everett Rogers." According to this theory, innovation has allowed people to materialize the ideas that they have learned through the years of encountering or engaging innovated appliances. But innovation never stops. Innovation is everywhere and occurs every possible time. People will unconsciously get the idea that a certain

object can be innovated. Just like an Iphone was being innovated to its latest version. As observed by the researchers, we decided to modify an existing innovation that will help society in general.

Nevertheless, all of these are assumptions especially on Everett's diffusion of innovation theory that states that the ideas of innovation can be acquired just by using certain appliances that can be innovated.

The researchers apply this theory to the creation of a pedal-operated garbage cleaner, where the researcher comes up with a new concept. It was motivated by the researcher's personal encounters in which they perceived a new idea that could be used to improve a mechanism. Creating this project design will help the environment of the cemented road maintain its cleanliness and in some way generate a form of exercise to the rider when it is set into motion.

Lateral Motion Theory

The researchers also provide an overview of the Lateral Motion Theory, which describes how bicycles move in different directions and is closely related to our study into how our project design manages to slightly change direction, particularly over a short distance.

Although its equations of motion can be linearized, a bike is a nonlinear system. The variable(s) to be solved for cannot be written as a linear sum of independent components, i.e. its behavior is not expressible as a sum of the behaviors of its descriptors [2]. Generally, nonlinear systems are difficult to solve and are much less understandable than linear systems. In the idealized case, in which friction and any flexing is ignored, a bike is a conservative system. Damping, however, can still be demonstrated: under the right circumstances, side-to-side oscillations will decrease with time. Energy added with a sideways

jolt to a bike running straight and upright (demonstrating self-stability) is converted into increased forward speed, not lost, as the oscillations die out [2].

A bike is a nonholonomic system because its outcome is path-dependent. In order to know its exact configuration, especially location, it is necessary to know not only the configuration of its parts, but also their histories: how they have moved over time. This complicates mathematical analysis [3]. Finally, in the language of control theory, a bike exhibits non-minimum phase behavior [4]. It turns in the direction opposite of how it is initially steered, as described to the countersteering. In order to initiate a turn and the necessary lean in the direction of that turn, a bike must momentarily steer in the opposite direction. This is often referred to as countersteering. With the front wheel now at a finite angle to the direction of motion, a lateral force is developed at the contact patch of the tire. This force creates a torque around the longitudinal (roll) axis of the bike, and this torque causes the bike to lean away from the initially steered direction and toward the direction of the desired turn. Where there is no external influence, such as an opportune side wind to create the force necessary to lean the bike, countersteering is necessary to initiate a rapid turn [3].

Basically this theory supports our innovation of the extension of garbage cleaner in front of the bicycle. This means that the motion of the bicycle directly proportional when it is about to be steer with respect of this concept, we will incorporate it with our innovative garbage cleaner design wherein it has fabricated flat bar or ball joint and dowel on it. These specific mechanical parts are integral of the extension of garbage cleaner because it will also define the movement of the bicycle alongside with the attachment of garbage cleaner. Fabricated flat bar or ball joints are a flexible ball and socket joint that will connect the bicycle fork control arms to the steering knuckles and act as a pivot point. It allows a bicycle's suspension to move up and down, while also allowing the wheels to steer left or right. The application of dowel utilized to reinforce joints and support shafting to operate it with stability. This explicitly states that the following unit's combination will be feasible and operational as the process progresses.

REVIEW OF RELATED LITERATURE

Many years had passed, and a number of road garbage cleaner designs had already been created for various uses in the area. The researchers will use the findings from similar studies in this section of the study to create a much better design of their own. Other studies of road garbage cleaner designs are included in the discussion. Previous studies are often explored to help and enrich the research topic's anchorage.

This research is backed up by the contributions of these brilliant inventors: Manivannan R., Rajasekar R., NithishVetrivel S., Praveen Kumar A., and Nithesh Kumar K. S. the “Design and Development of Roadside Waste Collector” [5]. Cleaning is a must for this generation. The number of users in each tourist spot is typically higher, necessitating daily floor sweeping. The majority of waste produced is dumped along the roadside, with only human resources being used to retrieve it. The present approach employs a vacuum cleaner to gather discarded products such as plastics, glass, and dust particles. This procedure is much more expensive, takes much longer, and has an ergonomic impact on human workers. Gastrointestinal infections, respiratory infections, and skin diseases may all affect staff.

As a result, in our project, brushes (roller brush) have taken the place of the vacuum system. This approach aids in the elimination of waste [dry leaves, vegetable wastes], cellophane (such as plastic wastes), and dirt. It decreases human labor, time, and energy, and it's also effective form of exercise because it has garbage cleaner attach to the front of the bicycle. With the help of this study we researchers decided to develop a product based on the same concepts but in a problem-free environment with the aid of this current analysis.

With regards to the importance of road cleaning machine, carried out a technical analysis of residential floor cleaning robots based on US granted patents [6]. They observed that the macroscopic analysis of patents and patent bibliometrics or patent maps, is useful tools to make an overview for designated technical topics and they observed that the Samsung is the top one patentee in cleaning robot after macroscopic of view. On the report of evaluation has shown how the use of multiple assessment techniques can provide a comprehensive appraisal of the design, usability and musculoskeletal loading upon the operator [7]. They suggested that the trials with a larger number of subjects would certainly strengthen the conclusions.

The most significant cause of road dust to the total suspended particulate burden is vehicle traveling on paved and unpaved' surfaces. Consequently data directly relating dust to road accidents are rare, but in a study if dust is the cause of 10% of these accidents casualties then the cost could amount to as much as 0.02% of GDP in some developing countries and total about \$800 million annually [8].

Thus, this related study shows that vehicles drive over paved and unpaved surfaces, which are vulnerable to dirt and wastes along the road, which is possibly related to our study because it focuses on how to aid dirt and wastes specifically in a cemented road. Our study does not stop by merely determining considerable dirt and waste is present in a given area of the road; it also looks into removing the dirt and waste from the cemented road and testing the garbage cleaner's load capability.

In addition, litters in public places like markets, garages, parks and gardens and streets usually comprises of leaves, nylons, papers, small and medium size polluted particles from

vehicles and different kinds of rubbish deposited by pedestrians and vehicle occupants. It is imperative to clear the road on standard premise because of open public

hygiene and aesthetic purposes. Street sweeping is usually carried out by lorry driven type vehicle which include a twin gutter brushes that sweep the debris that litters the street nooks and crannies and then vacuumed the debris into refuse collector, taking into account that about 80% street wastes are located on the sides of the road [9].

This clearly states the necessity of cleaning the roads which the Pedal-Operated Garbage Cleaner will help. It is clearly stated in the related study that a lorry-driven vehicle is typically the sort of collector that removes a large amount of street waste from the sides of the road and helps to keep the road clean. In our project design we will develop manually pedal-operated garbage cleaner wherein its purpose; to achieve simultaneous collect dirt and waste along the run of the cemented road, develop a cost effective garbage cleaner and effective in terms of exercise at the same time in cleaning as it has garbage cleaner in front of the bicycle, and to pull off the shifting motion of the bicycle mounted with garbage cleaner.

STATEMENT OF THE PROBLEM

Most cleaning tools can't completely clean a large area, and doing it manually, particularly with a large area, is exhausting. As a result, the aim of this research is to improve society's cleaning resources by developing an enhanced pedal operated garbage cleaner machine that is both time and hassle-free.

Specifically, this study aims to undertake the following:

- I. Identify the shortcomings of the manually operated garbage collector machine and create a more innovative machine design with the use of a bicycle.
- II. Develop a more efficient machine based on the shortcomings of the manually operated garbage collector machine.
- III. Design a machine that it is physically commodious, particularly for the elderly, and that it saves time, especially when cleaning a larger area, such as a complex or tourist attraction.
- IV. Evaluate the performance of the machine.
- V. Test the machine whether it conforms the design criteria:
 - Mobility
 - Stability
 - Safety
 - Functionality

SCOPE AND LIMITATIONS

The following scope and limitations are observed due to the ample amount of time and limited resources available for the project's production:

1. The expenses for the project must not exceed ₱15,000.00.
2. The pedal operated cleaner machine shall be steel based approach. The mechanism shall utilize steel shafting, chain and sprockets, pedal steel bike and wheels, supporting frame and base frame, mounts and joints, nuts and bolts, roller brush, caster wheel, dowel, ball joints and collector bin.
3. The pedal operated cleaner machine must collect and store an ample amount of wastes and dirt based on its allowable load capacity.
4. The pedal operated cleaner machine can travel around a distant cemented road in moderate operation of the pedals.
5. Its usage ranges in a remote area of cemented road.

SIGNIFICANCE OF THE STUDY

The study contributes to a new and creative approach to waste reduction in the Cordova-Roro Port Road sector. The prototype has the potential to make a difference in the collection of waste on cemented roads. People can use the Pedal-Operated Garbage Cleaner to expand the forms in which they can collect waste. The design can be use on cemented road areas where wastes are visible and need to be collected. The main significance of this project is to keep our surroundings especially roads clean with the aid of the pedal-operated garbage cleaner, so that we can stroll down the roads feeling revitalize.

This project design will be beneficial to the dedicated cyclist as well as the residents within the community of the road because it will not just generate a form of exercise to the cyclist itself but can also minimize the wastes and dirt around within the said road.

This project design will also be beneficial to the environment and government because as known preserving environment is one of the most important things to do. Getting rid of all wastes can help the people within environment secure cleanliness and feel revitalize. To the government, the government can use this prototype to have a technological advancement in collecting wastes in different areas of Cordova. They can distribute the prototype to every place that requires the need of waste reduction.

RESEARCH METHODOLOGY

RESEARCH DESIGNS AND METHODS

This section discusses the research design (approach, form, and method/s), the environment, the study's respondents, and the research instrument, as well as providing solutions to the specific problems. The researchers used a quantitative approach in this study because they used a questionnaire to collect data and statistical methods to validate and provide the relevant data.

RESEARCH ENVIRONMENT

The study will be conducted at Roro Port Road, Cordova Cebu.

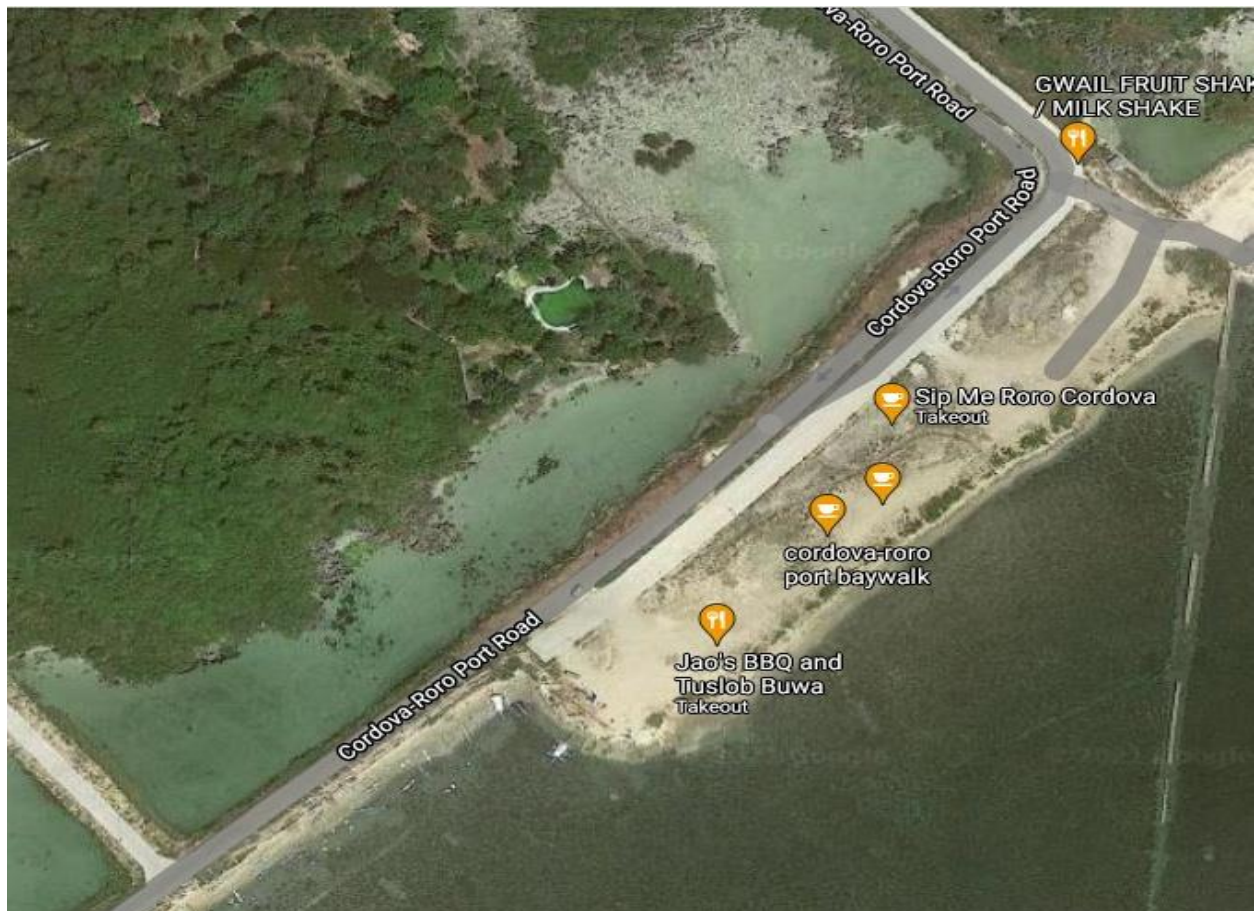


Figure 1.1 Cordova-Roro Port Road sector

The specific location was chosen because it is a popular tourist attraction with a large number of visitors, it has a large amount of space, and the required garbage is located near the plain cemented lane, making it suitable for the pedal-operated garbage cleaner to perform its purpose.

RESEARCH INSTRUMENT

The data will be acquired using a survey questionnaire, and the data will be checked using statistical methods. MS Excel, MS Word, MS Power Point, and Auto CAD were among the software applications used.

RESEARCH RESPONDENTS

The researchers will use stratified sampling to choose respondents from the Roro Port Road Cordova neighborhood. A particular subject will be selected to evaluate our actual project design, and their responses will be collected as soon as they are able to manipulate it.

DEFINITION OF TERMS

The following terms as defined are used in this study:

Garbage – It refers to the collected wastes from the roller brush to the garbage bin. It usually consists of plastic wrappers, fallen leaves, dusts, papers and other light materials.

Garbage Cleaner – This part is mainly consisting of the garbage bin, roller brush, caster wheel, frames and the other two bigger wheels. It is attached in the front wheel of the bicycle.

Pedal Operated – The primary source to function the prototype design is to drive the bicycle with its pedal hence it is called pedal operated.

CHAPTER II

PRESENTATION, ANALYSIS AND INTERPRETATION OF DATA

CONCEPTUAL FRAMEWORK

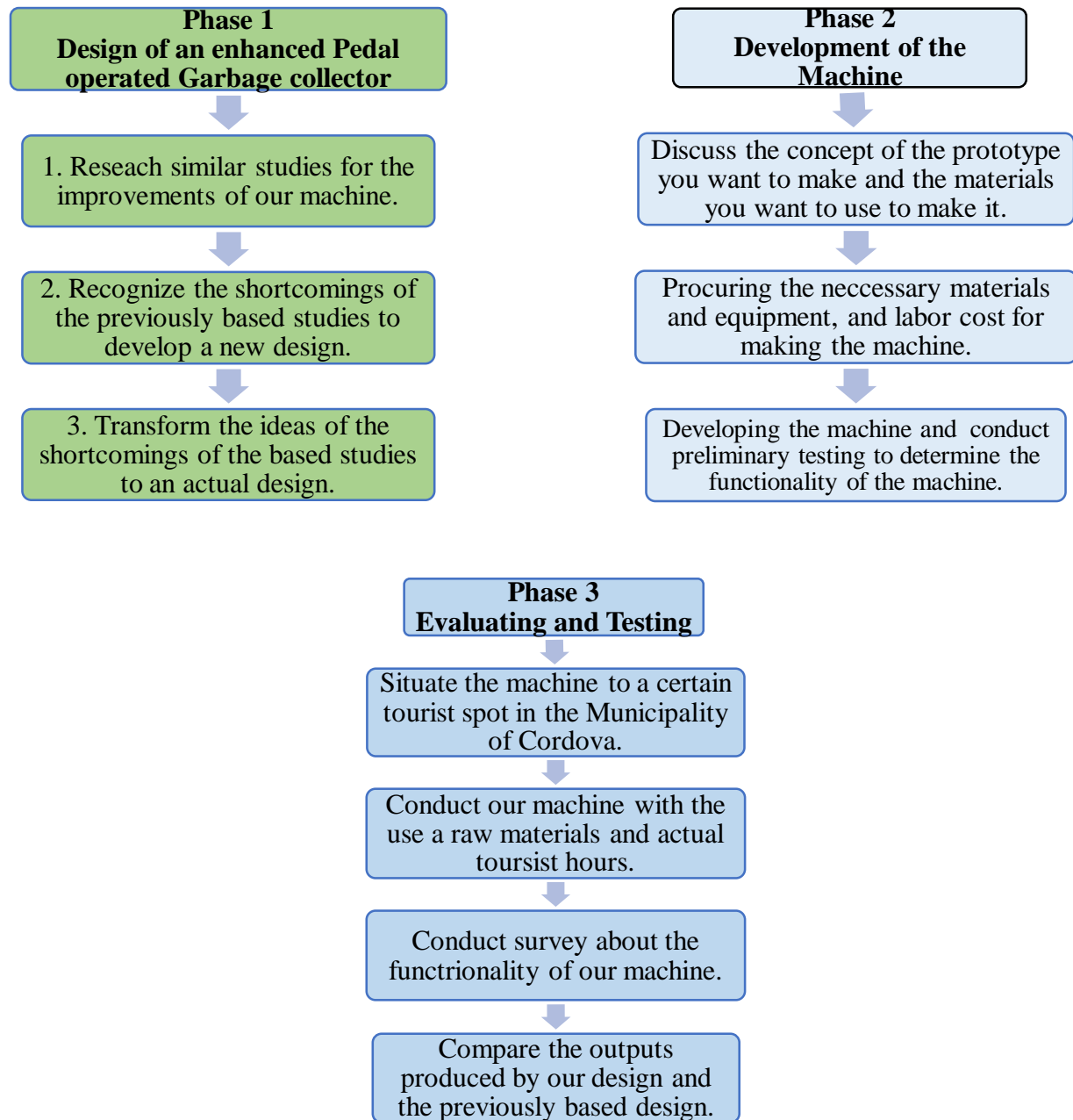


Figure 2.1 Conceptual Framework

Figure 2.1 Conceptual Framework

The details provided in the project's theoretical context convinced the researchers to create a Pedal Operated Garbage Cleaner Machine. The flow chart above depicts the working principles of the collection of garbage into the chamber trash bin and dissipate when it's full.

In general, the first phase entails gathering ideas from a variety of existing or old output connected to our project. Identify the flaws in the prior studies' designs and improve on them to create a better one. So, in essence, this is the improved and modified version that resulted from a discussion and planning of several concepts arising from the flaws in the prior design.

After developing the improved design, talk about the materials that will be utilized to make the idea a reality. Gather the supplies and talk about the overall cost of the product. When the product is ready, test it somewhat to ensure that it works properly.

Once you've determined that your product works well, put it to the test in a tourist-friendly region of our municipality of Cordova, using raw materials or rubbish such as leaves, plastics, and plastic bottles. Collect data by running a survey among all users who used our product to evaluate and compare it to the prior design.

PROPOSED PROTOTYPE DESIGN

In this work, three-dimensional 3D modeling using AutoCAD drawing software was driven. For manual operation, pedal operated body is selected as the rider machine, to which garbage cleaner with fabricated roller brush attachment is made to the front wheel of the body. A frame is constructed for waste cleaning purpose, for an instance front side of the frame is made of shaft, to which fabricated roller brush are meandered and the shaft rotates by driven chain mechanism thereby pushing the waste into the waste chamber attached to the frame. At the same time, when the wheel is steered, the integral mechanical part which are the lockable gas spring and ball joint will play its respective role to proportionally make the bicycle and garbage cleaner itself to operate along the way. This pedal operated-road footpath cleaning machine is specifically designed to clean the roads which are plane and smooth, such like cemented road.

PROPOSED PROTOTYPE DESIGN PEDAL-OPERATED GARBAGE CLEANER

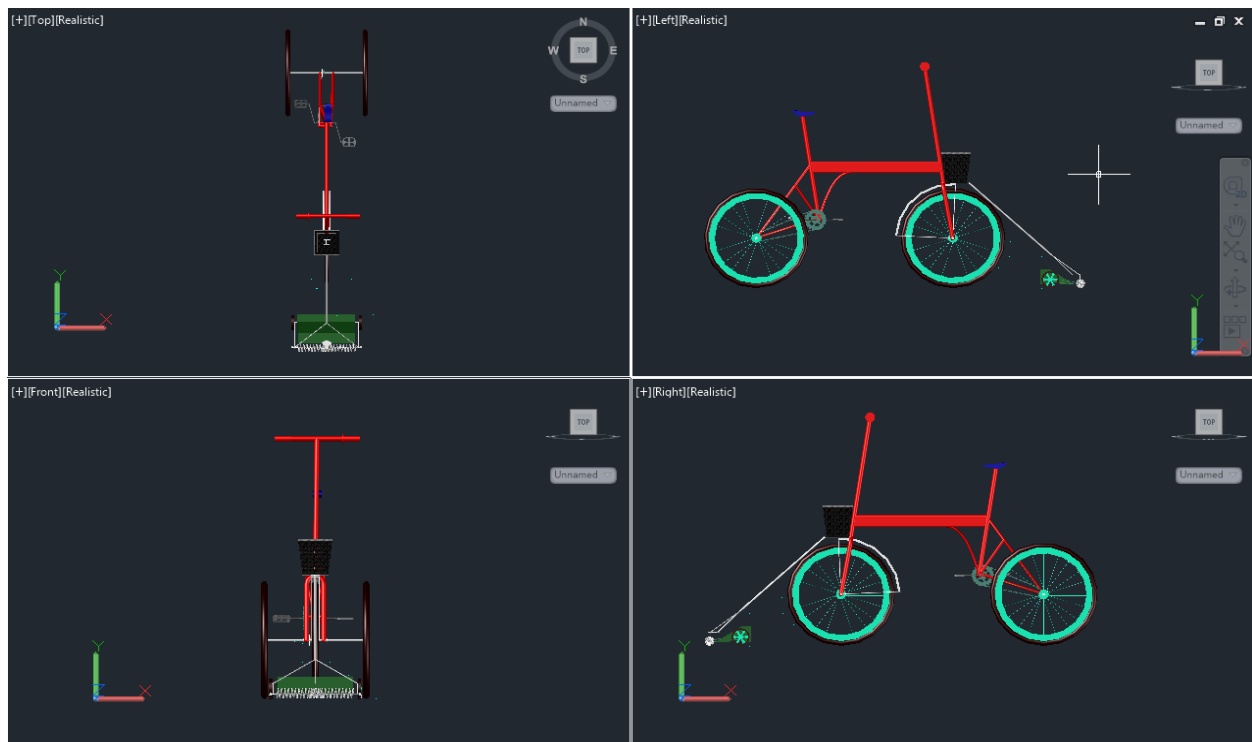


Figure 2.2 (Four distinct viewpoints)

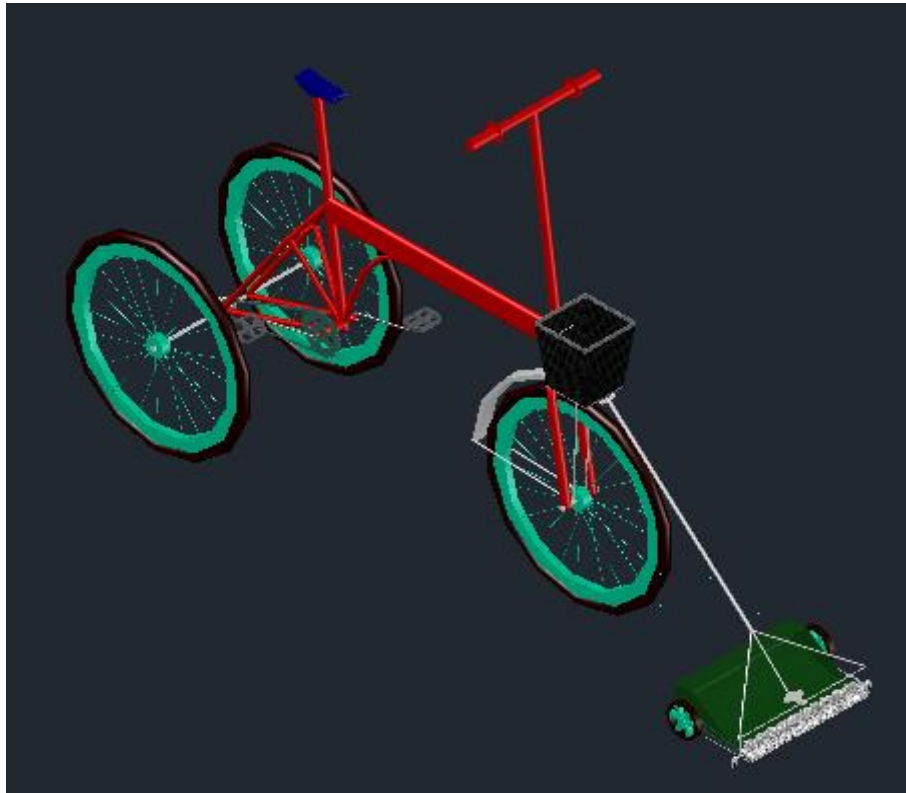


Figure 2.3 SOUTHWEST ISOMETRIC

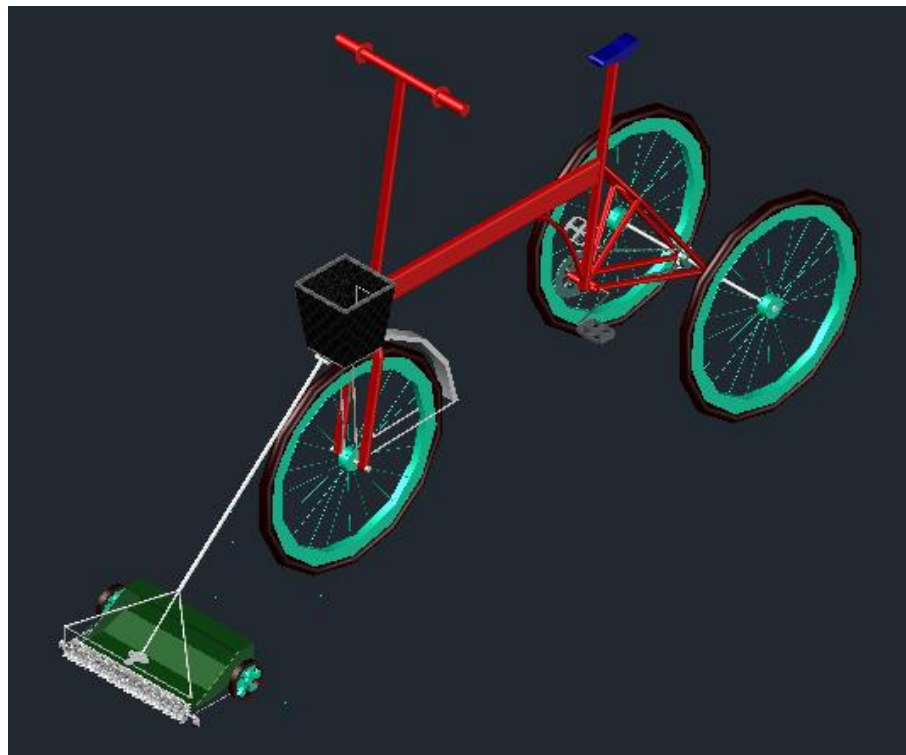


Figure 2.4 SOUTHEAST ISOMETRIC



Figure 2.5 NORTHWEST ISOMETRIC



Figure 2.6 NORTHEAST ISOMETRIC

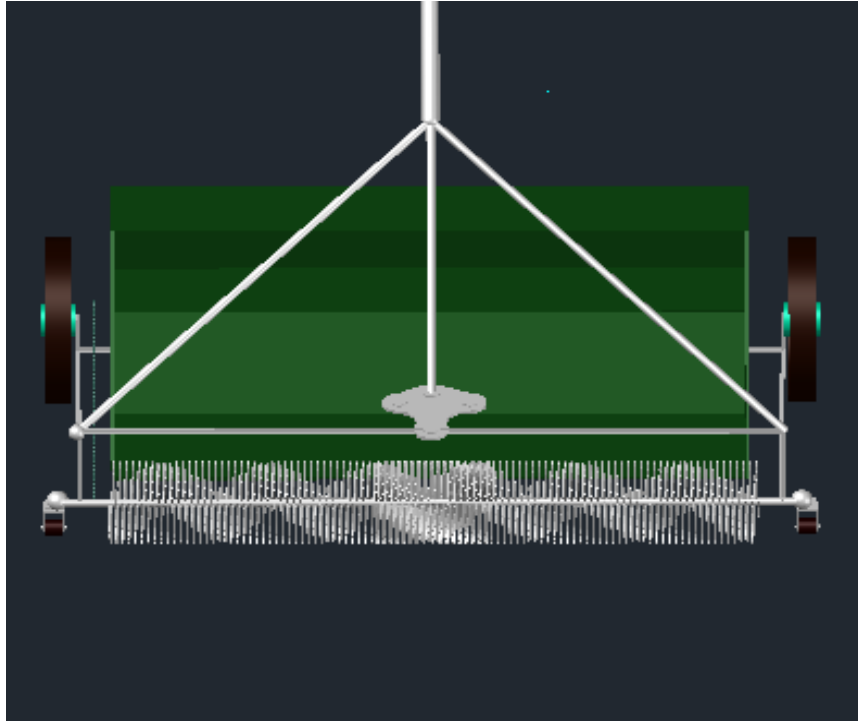


Figure 2.7 CUSTOM VIEW

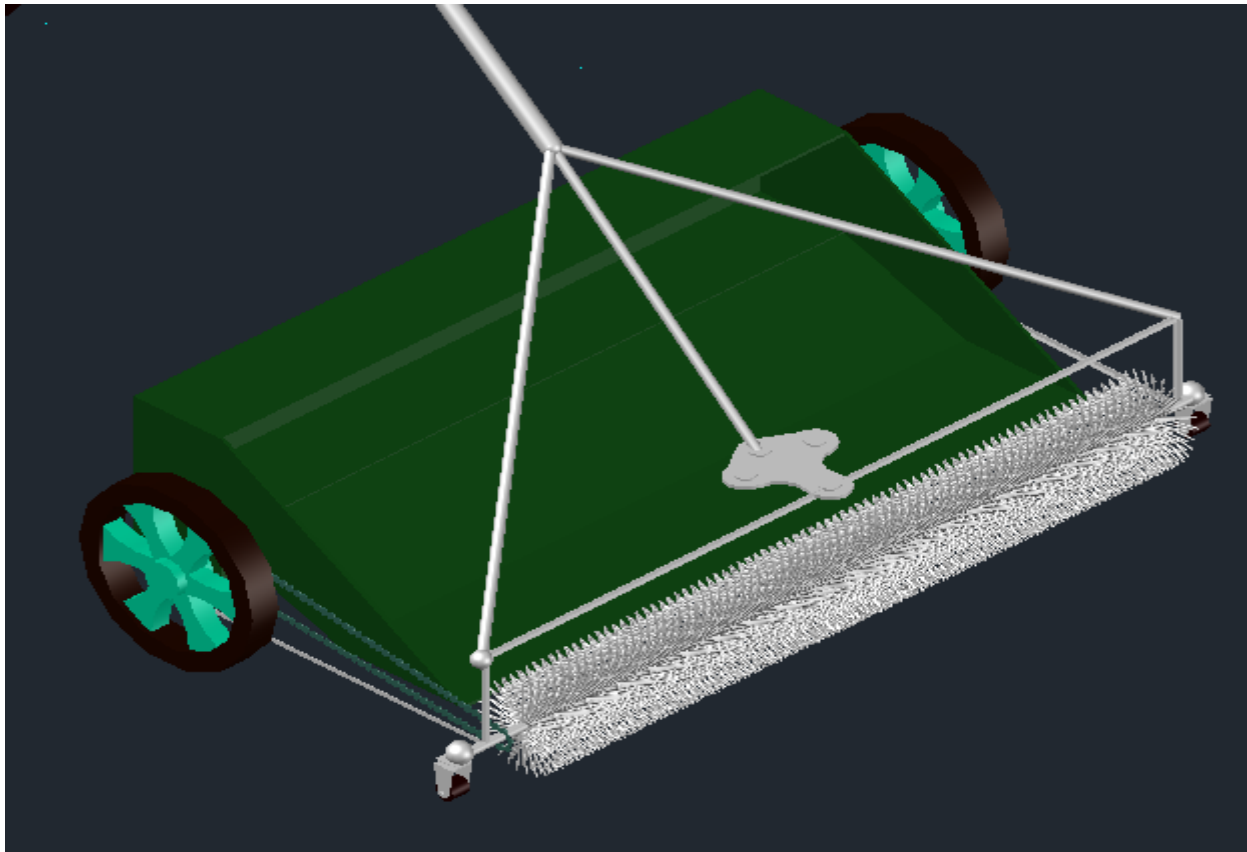


Figure 2.8 MOUNTED GARBAGE CLEANER (SW ISOMETRIC)

PARTS OF THE MACHINES

The Pedal Operated Garbage Cleaner is composed of the following major components:

Shafting, wheels, chain drive, collector bin, steel frame, pedal steel bike, roller brush, caster wheel, dowel and ball joint.



Figure 2.9 - Shafting

It is a component of both a bicycle and a garbage cleaner, a rotating machine element with a circular cross section which is utilized to transmit power from one component to another.



Figure 2.10 - Wheels

It is a component of both a bicycle and a garbage cleaner which serve two primary purposes: they minimize pressure and provide leverage.



Figure 2.11 - Chain drive

It is a component of both a bicycle and a garbage collector that transmits the power of a drive sprocket through a chain, allowing the bicycle and garbage collector to travel.

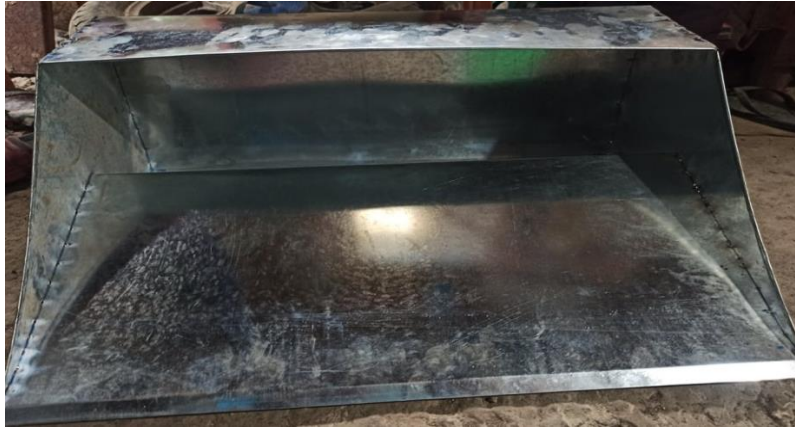


Figure 2.12 - Collector Chamber

It is a component of the garbage cleaner that serves as a container for the garbage collected by the roller brush to be transported to. A second collector bin is placed in front of the bicycle's handlebars.



Figure 2.13 - Steel Frame

It is a component of the bicycle that provides a smoother riding experience as well as safety. This serves as the body of the bicycle on which the rider will be riding.



Figure 2.14 - Pedal steel bike

It is the portion of a bicycle that the rider uses to propel the bike with their foot. It connects the rider's foot or shoe to the crank, allowing the leg to rotate the bottom bracket spindle and propel the bicycle's wheels.



Figure 2.15 - Roller brush

It is a part of the garbage cleaner which function is to collect the garbage as its shaft rotates together with the chain drive from the mechanical energy source in the pedal.



Figure 2.16 - Caster wheel

It is a wheel attached in front of the garbage cleaner that enables it to move from all direction. It guides the movement of the garbage cleaner proportional to the bicycle.



Figure 2.17 - Ball bearing

It is a portion of the garbage cleaner roller brush as well as the bike that allows the rear section of the main wheels to move and the roller brush to rotate.



Figure 2.18 - Lockable gas spring

It is a component of the garbage cleaner which aid the ergonomics and comfort for conveniently safely changing direction and lying positions.



Figure 2.19 - Ball joint

It is located between the shafts that link the bicycle and the garbage cleaner, and its purpose is to allow the bicycle and garbage cleaner to move sideways together. It is dowelled in the garbage cleaner and fixed to the bicycle wheel.

PRESENTATION ANALYSIS AND INTERPRETATION OF DATA

PART I

The graph is based on the data obtained in the survey questionnaires.

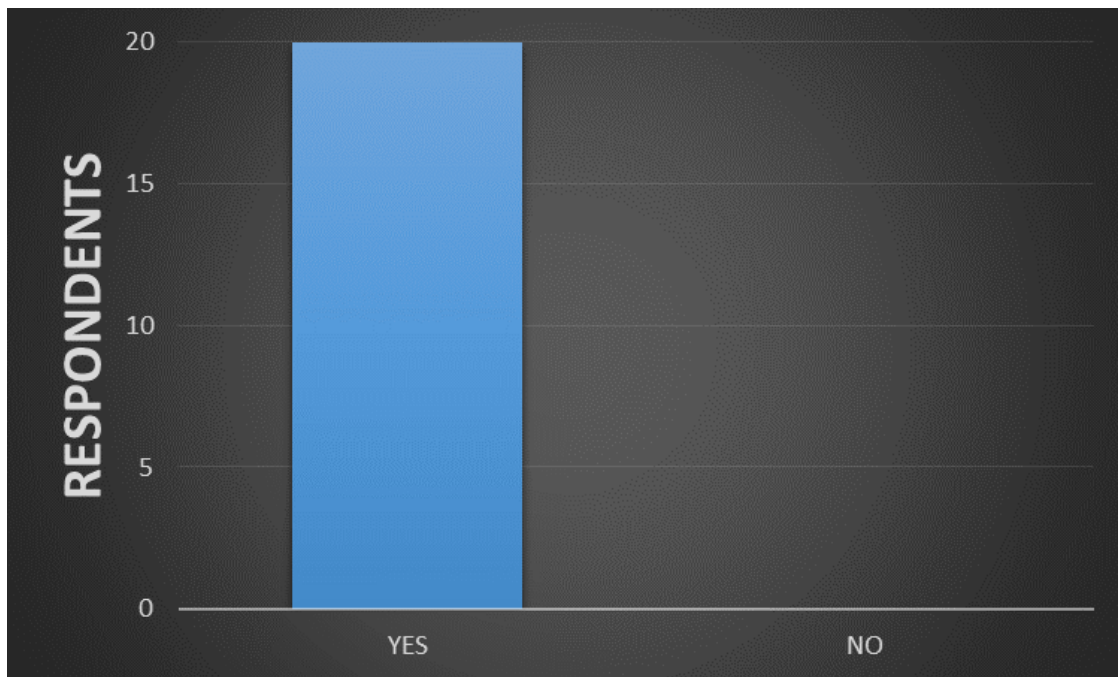


Figure 2.20: The number of respondents who said they used to notice garbage at the Cordova-Roro Road Port.

This figure shows that of the 20 respondents, 100% claimed that they had noticed garbage at the Cordova-Roro Road Port. This signifies that there is garbage present at the Cordova-Roro Road Port.

The graph is based on the data obtained in the survey questionnaires.

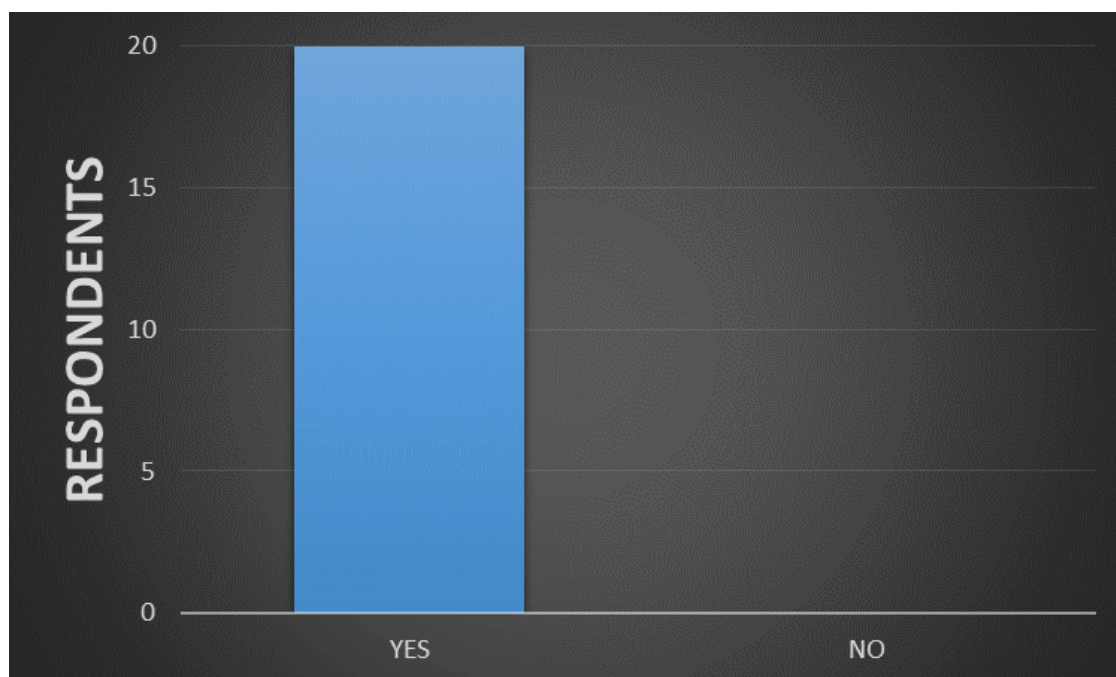


Figure 2.21: Number of respondents who said they find someone or a resident near the Cordova-Roro Road Port who collects garbage and disposes of it.

This figure shows that of the 20 respondents, 100% claimed that they used to find someone or a resident near the Cordova-Roro Road Port who collects garbage and disposes of it. This indicates that the residents are also able to gather garbage and dispose of it properly.

The graph is based on the data obtained in the survey questionnaires.

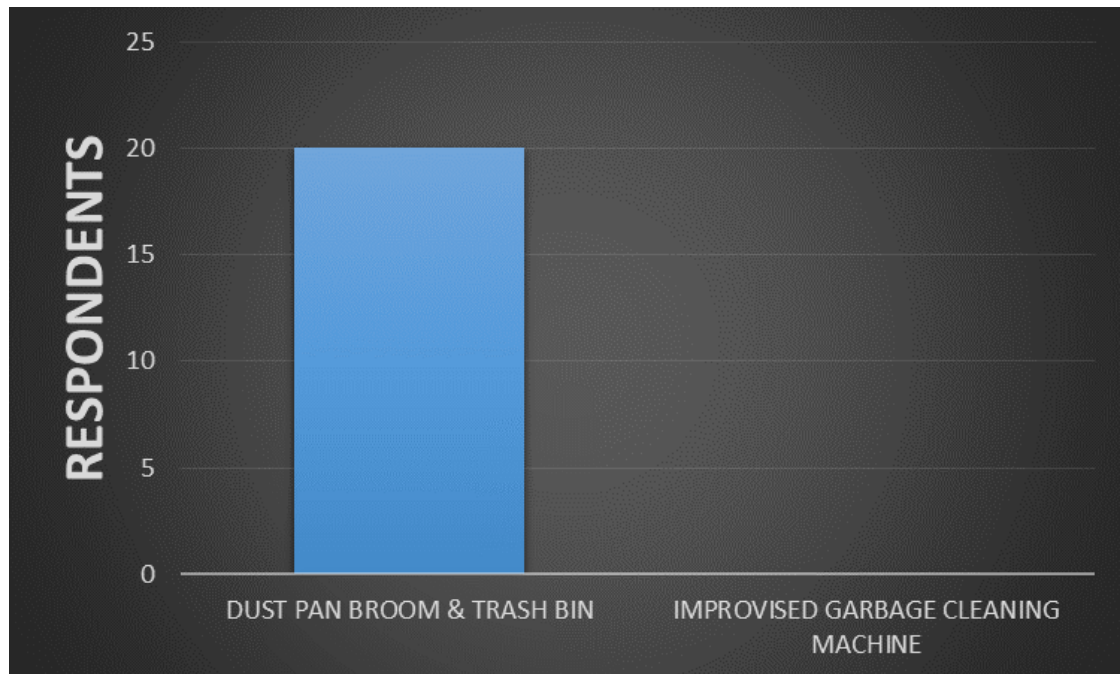


Figure 2.22: Types of tools utilized by the resident/s

This figure shows that of the 20 respondents, 100% claimed that they had noticed most of the residents near the Cordova-Roro Road Port utilized dustpan, broom, and trash bin to collect garbage and none of them are utilized improvised garbage cleaning machine. This signifies that most of the residents near of the Cordova-Roro Road Port simply utilized the fundamental tools in cleaning garbage. Researchers then introduced this Pedal-Operated Garbage Cleaner to assist them to work much better.

The graph is based on the data obtained in the survey questionnaires.

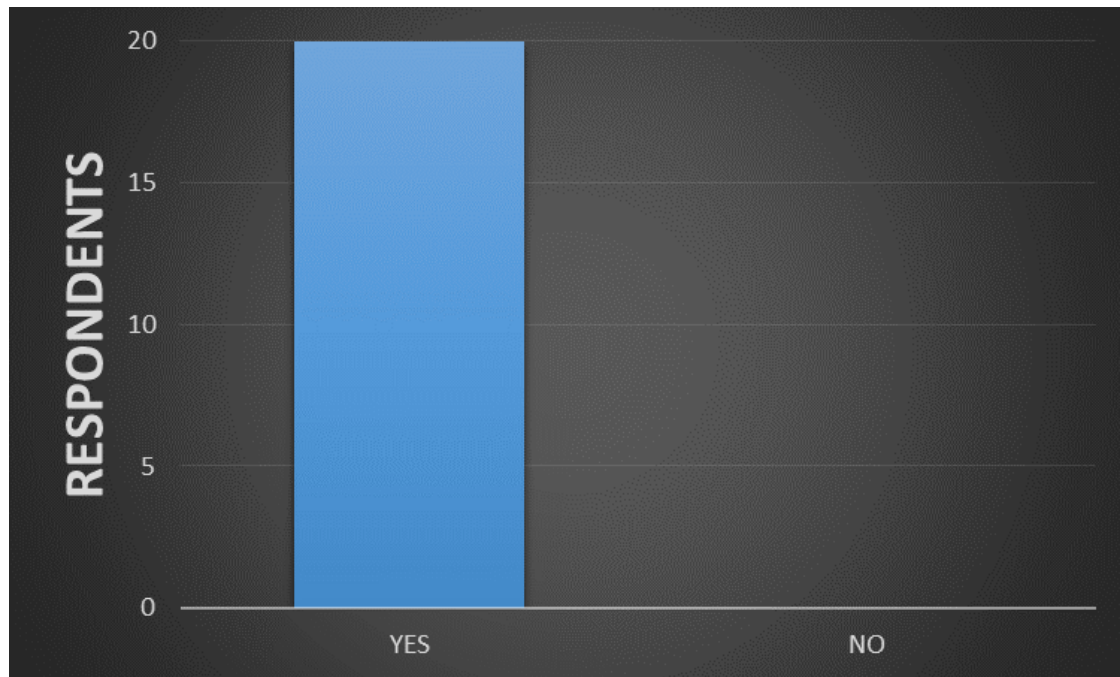


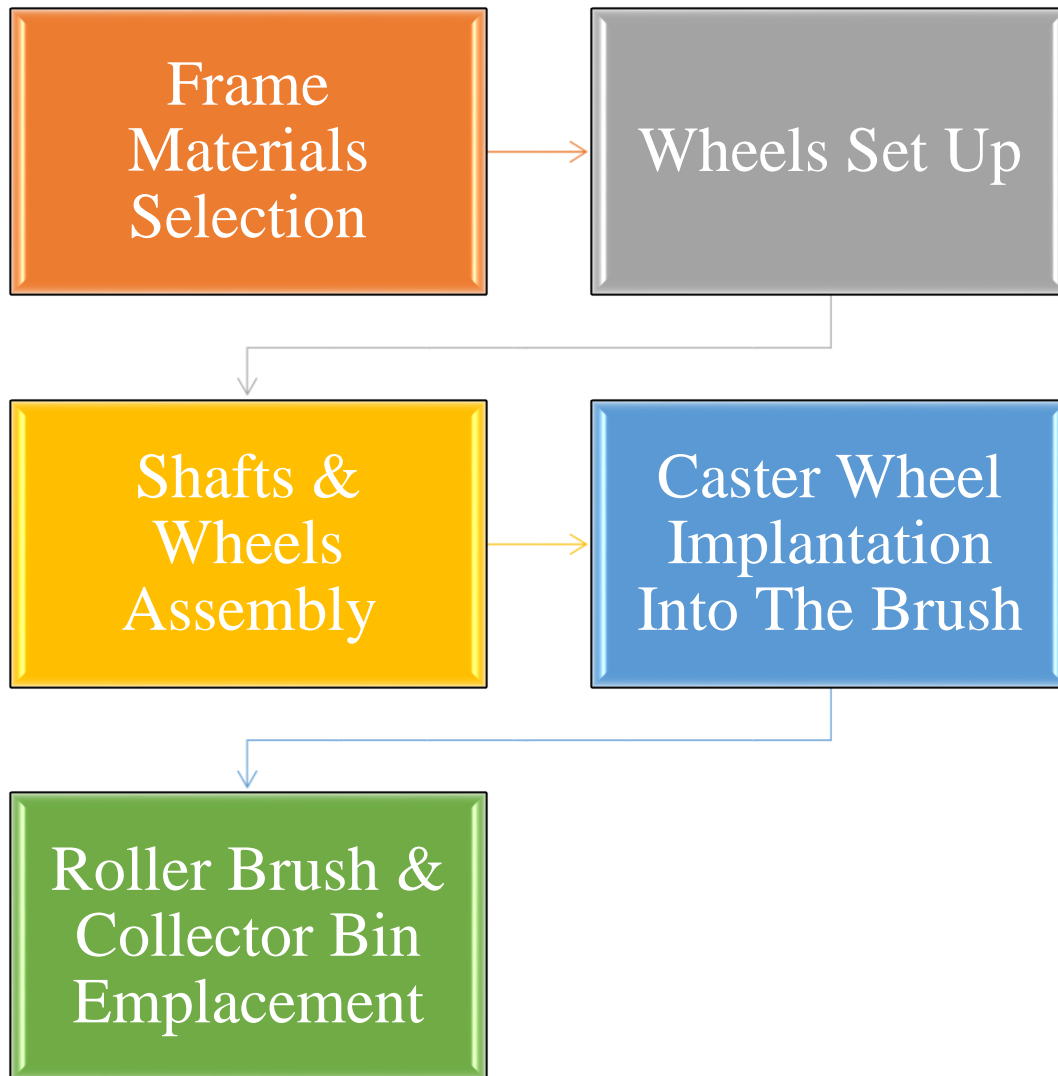
Figure 2.23: Number of respondents who said Pedal-Operated Garbage Cleaner would be beneficial

This figure shows that of the 20 respondents, 100% claimed that Pedal-Operated Garbage Cleaner would be beneficial for them and to the community. This implies that all of the respondents agreed that this design will benefit for them and the residents within the community.

PART II**Table 2.1: Satisfactory Survey**

PEDAL- OPERATED GARBAGE CLEANER	Very Dissatisfied	Dissatisfied	Neutral	Satisfied	Very Satisfied
1. Project Mobility				40%	60%
2. Project Stability				35%	65%
3. Project Safety				55%	45%
4. Project Functionality				45%	55%

Regarding category number one which is project mobility, 65% of the respondents answered very satisfied and 40% answered satisfied. The results indicated that the thesis prototype made is easy to use without needing much effort. In the second category, project stability, 65% of the respondents answered very satisfied and 35% answered satisfied. The responses implied that the thesis prototype is stable and when tested there is no sign of failure. In third category which is the project safety, 45% of the respondents answered very satisfied and 55% answered satisfied. The results implied that the thesis prototype is indeed safe to use. Lastly, the project functionality, with 55% of the respondents answered very satisfied and 45% answered satisfied. The results implied that the thesis prototype is working and operational.

DESIGN FRAMEWORK**Figure 2.24: Design Framework****1. FRAME MATERIALS SELECTION**

Materials selection is the most important part of our project since obviously those selected materials are the foundation of our project. The most evident material we'll be using is a bicycle. We will be using this material as the foundation of our project since it will be the one to manipulate

the entire machine. And considering it's durability and sturdiness. We also selected Tonkita Push Brush, we improvised it into propeller-like brush as it will be the one to sweep the surface considering its length and flexibility.

2. WHEELS SET UP

The entire project is made up of five wheels of various sizes and proportions. The bicycle itself has three wheels, two of which are on the back side of the bicycle to ensure that it maintains its stability, since this might cause machine malfunction, particularly while it is on standby. It was created mainly for the purpose of maintaining equilibrium while in motion. The bicycle's front wheel is utilized to control the entire machine that was positioned in front of it. In the machine itself, two small wheels were attached to it for it will be the one to lift the brush and the collector bin, this was designed for the purpose of being able to move with the bicycle's motion.

3. SHAFTS AND WHEELS ASSEMBLY

The two wheels at the back side of the bicycle were attached by a hollow and sturdy shaft with a long and high strength low alloy steel. At the end of the long and high strength low alloy steel it was locked with a flange nut. And in the middle of the alloy steel, bearing was attached to it so it will allow the wheels to revolve. The bicycle is propelled forward by the use of chains, sprockets, cranks, and pedals. The same working principles apply to the two machine wheels in front.

4. CASTER WHEEL IMPLANTATION INTO THE BRUSH

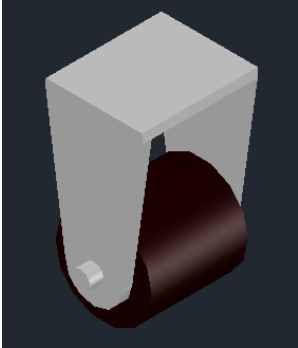
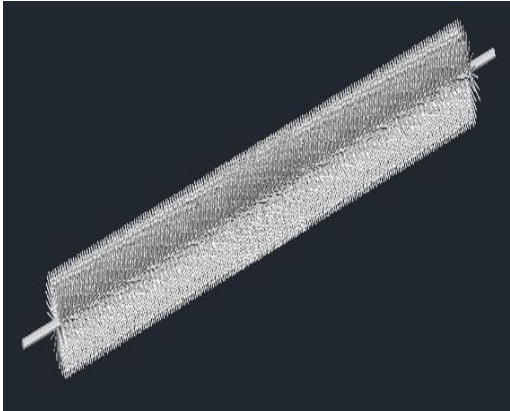
A Caster wheel is injected to the brush so that it will be manipulated with the motion of the bicycle. With the help of the caster wheel the machine will be able to rotate at approximately 180°.




5. ROLLER BRUSH AND COLLECTOR BIN EMPLACEMENT

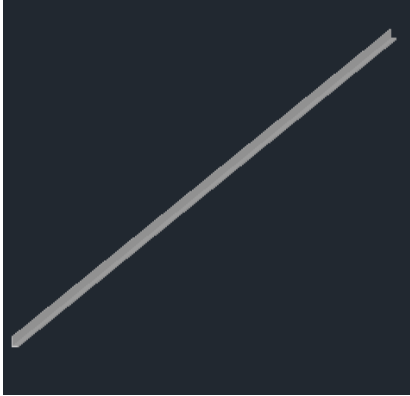

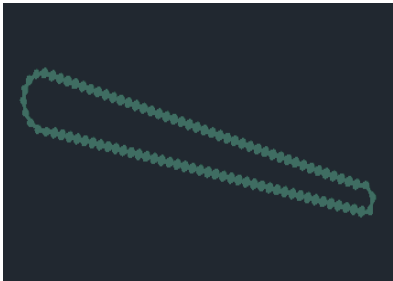
This is the point at which the project is finished, and the job may be done with a garbage cleaner, which can do for a level surface, especially in a congested location.

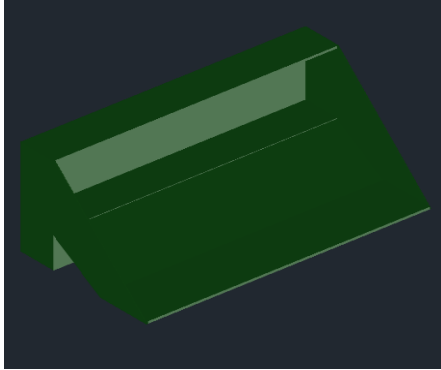
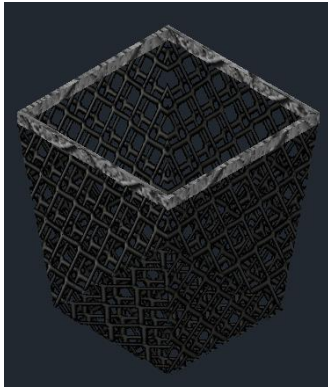

PROPOSED DESIGN SPECIFICATIONS

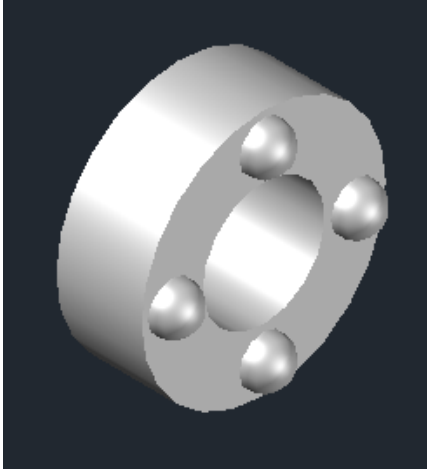

Table 2.2: Proposed Design and Specifications

Name & Picture	Specifications	Description
<p data-bbox="370 426 544 457">Caster Wheel</p> 	<p data-bbox="737 426 1019 457">Dimensions: 2.5" OD</p> <p data-bbox="737 499 1003 569">Material: Plastic and Rubber</p>	<p data-bbox="1081 426 1417 972">It is a wheel attached in front of the garbage cleaner that enables it to move from all direction. It guides the movement of the garbage cleaner proportional to the bicycle.</p>
<p data-bbox="375 1249 539 1281">Roller Brush</p> 	<p data-bbox="737 1249 1052 1318">Dimension: 22" L & 8" OD</p> <p data-bbox="737 1360 1029 1430">Material: Nylon Brush and Plastic</p>	<p data-bbox="1081 1249 1417 1724">It is a part of the garbage cleaner which function is to collect the garbage as its shaft rotates together with the chain drive from the mechanical energy source in the pedal.</p>

<p>Main Wheels</p> 	<p>Dimension: 19.25" OD and 2" W</p> <p>Material: Steel and Rubber</p>	<p>It is a component of bicycle which serve two primary purposes: they minimize pressure and provide leverage.</p>
<p>Secondary Wheels</p> 	<p>Dimension: 11.81" OD and 2.5" W</p> <p>Material: Steel and Rubber</p>	<p>It is a component of the garbage cleaner which serve two primary purposes: they minimize pressure and provide leverage.</p>
<p>Shafting</p> 	<p>Dimension: 16"</p> <p>Material: Mild Steel</p>	<p>It is a component of both a bicycle and a garbage cleaner, a rotating machine element with a circular cross section which is utilized to</p>

		transmit power from one component to another.
<p>Angle Bar</p> 	<p>Dimension: 3 x 16 x 1.5</p> <p>Material: Black Iron</p>	<p>This protects any edges and corners that must maintain their form, as well as providing support for the connecting steel shafts.</p>
<p>Sprocket</p> 	<p>Dimension: 3" OD</p> <p>Material: Mild Steel</p>	<p>It is a component of both a bicycle and a garbage collector that transmits the power of a drive sprocket through a chain, allowing the bicycle and garbage collector to travel.</p>
<p>Chain</p> 	<p>Dimension: 11.5" L</p> <p>Material: Mild Steel</p>	<p>It is a component of both a bicycle and a garbage collector that transmits the power of a drive sprocket through a chain, allowing</p>


		the bicycle and garbage collector to travel.
<p>Collector Chamber</p> 	<p>Dimension: 15" L x 19.75" W, 8" H</p> <p>Material: Galvanized Iron</p>	<p>It is a component of the garbage cleaner that serves as a container for the garbage collected by the roller brush to be transported to the collector bin.</p>
<p>Collector Bin</p> 	<p>Dimension: 7.25" L x 5" W</p> <p>Material: Plastic</p>	<p>This is placed in front of the bicycle's handlebars to store the accumulated garbage.</p>
<p>Ball Joint</p> 	<p>Dimension: 14 mm</p> <p>Material: Mild Steel</p>	<p>It is located between the shafts that link the bicycle and the garbage cleaner, and its purpose is to allow the bicycle and garbage cleaner to move sideways together. It is dowelled in</p>




		the garbage cleaner and fixed to the bicycle wheel.
<p>Ball Bearing</p> 	<p>Dimension: 6202 bearing</p> <p>Material: Mild Steel</p>	<p>It is a portion of the garbage cleaner roller brush as well as the bike that allows the rear section of the main wheels to move and the roller brush to rotate.</p>
<p>Lockable Gas Spring</p> 	<p>Dimension: 10" L</p> <p>Material: Mild Steel</p>	<p>It is a component of the garbage cleaner which aid the ergonomics and comfort for conveniently safely changing direction and lying positions.</p>

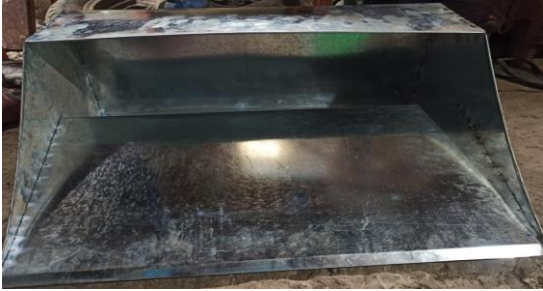


ACTUAL DESIGN SPECIFICATIONS



Table 2.3: Actual Design and Specifications

Name & Picture	Specifications	Description
<p>Caster Wheel</p> 	<p>Dimensions: 2.5" OD</p> <p>Material: Plastic</p>	<p>It is a wheel attached in front of the garbage cleaner that enables it to move from all direction. It guides the movement of the garbage cleaner proportional to the bicycle.</p>
<p>Roller Brush</p> 	<p>Dimension: 22" L & 8" OD</p> <p>Material: Nylon Brush and Plastic</p>	<p>It is a part of the garbage cleaner which function is to collect the garbage as its shaft rotates together with the chain drive from the mechanical energy source in the pedal.</p>

<p>Main Wheels</p> 	<p>Dimension: 19.25" OD and 2" W</p> <p>Material: Steel and Rubber</p>	<p>It is a component of bicycle which serve two primary purposes: they minimize pressure and provide leverage.</p>
<p>Secondary Wheels</p> 	<p>Dimension: 11.81" OD and 2.5" W</p> <p>Material: Steel and Rubber</p>	<p>It is a component of the garbage cleaner which serve two primary purposes: they minimize pressure and provide leverage.</p>
<p>Shafting</p> 	<p>Dimension: 16"</p> <p>Material: Mild Steel</p>	<p>It is a component of both a bicycle and a garbage cleaner, a rotating machine element with a circular cross section which is utilized to transmit power from one component to another.</p>

<p>Angle Bar</p> 	<p>Dimension: 3 x 16 x 1.5</p> <p>Material: Black Iron</p>	<p>This protects any edges and corners that must maintain their form, as well as providing support for the connecting steel shafts.</p>
<p>Sprocket</p> 	<p>Dimension: 1st gear 2.25" OD 2nd gear 2.5" OD 3rd gear 3" OD 4th gear 3.5" OD 5th gear 4" OD 6th gear 4.5" OD</p> <p>3" OD (secondary sprocket)</p> <p>Material: Mild Steel</p>	<p>It is a component of both a bicycle and a garbage collector that transmits the power of a drive sprocket through a chain, allowing the bicycle and garbage collector to travel.</p>
<p>Chain</p> 	<p>Dimension: 11.5" L</p> <p>Material: Mild Steel</p>	<p>It is a component of both a bicycle and a garbage collector that transmits the power of a drive sprocket through a chain, allowing the bicycle and garbage collector to travel.</p>

<p>Collector Chamber</p> 	<p>Dimension: 15" L x 19.75" W, 8" H</p> <p>Material: Galvanized Iron</p>	<p>It is a component of the garbage cleaner that serves as a container for the garbage collected by the roller brush to be transported to the collector bin.</p>
<p>Collector Bin</p> 	<p>Dimension: 7.25" L x 5" W</p> <p>Material: Plastic</p>	<p>This is placed in front of the bicycle's handlebars to store the accumulated garbage.</p>
<p>Ball Joint</p> 	<p>Dimension: 14 mm</p> <p>Material: Mild Steel</p>	<p>It is located between the shafts that link the bicycle and the garbage cleaner, and its purpose is to allow the bicycle and garbage cleaner to move sideways together. It is dowelled in the garbage cleaner</p>

		and fixed to the bicycle wheel.
<p>Ball Bearing</p> 	<p>Dimension: 6202 bearing</p> <p>Material: Mild Steel</p>	<p>It is a portion of the garbage cleaner roller brush as well as the bike that allows the rear section of the main wheels to move and the roller brush to rotate.</p>
<p>Lockable Gas Spring</p> 	<p>Dimension: 10" L</p> <p>Material: Mild Steel</p>	<p>It is a component of the garbage cleaner which aid the ergonomics and comfort for conveniently safely changing direction and lying positions.</p>

OLD, CURRENT AND FULL ACTUAL DESIGN

The old proposed design of the project

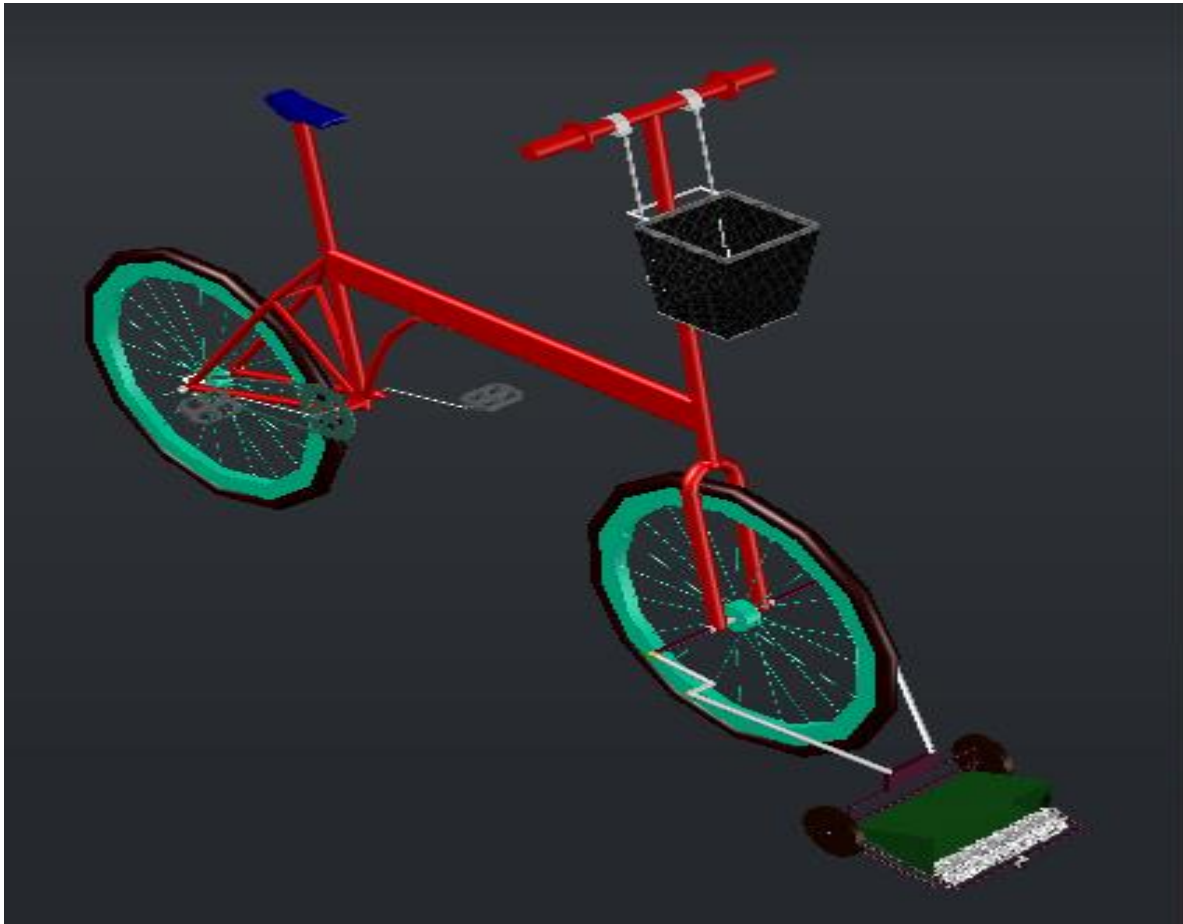


Figure 2.25: Previous Proposed Design

Initially, this is the proponent's prior design that aims to satisfy the following design criteria. These integral mechanical parts includes the ball joint, swivel, caster wheel, industrial roller brush, dowel, trash bin and chain drive.

The current proposed design of the project

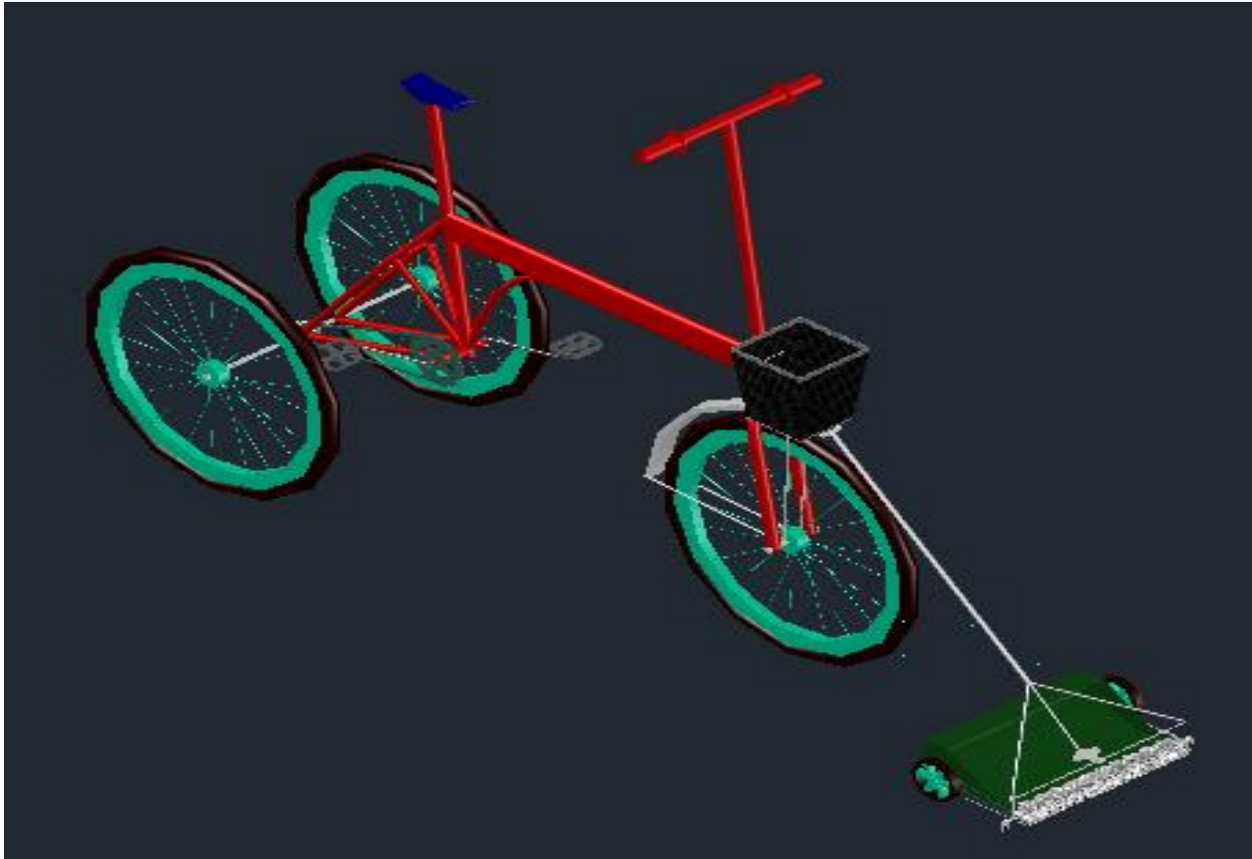


Figure 2.26: Current Proposed Design

As the progress of realizing the proposed design and actual design, the researchers have adapted and adjusted the necessary changes to improve the product by including new materials which provides better functionality, safety, stability and mobility of the product. It includes double back wheel, two caster wheels, two lockable gas spring, fabricated industrial roller brush, ball bearing, and angle bar. Also swivel, and dowel were removed from the design. The double back wheel were installed as the researchers found out that it improves the stability and its safety of the bike and the user itself compared to a single back wheel where balance problems occur. The two caster wheels were injected to provide better mobility especially in steering the lateral directions of the machine unlike the single caster wheel, the researchers observed it is having a hard time

tilting which will require much effort of steering from the rider. Then two lockable gas spring were reinforced to support the functionality of the caster wheel for conveniently safely changing direction and lying positions, this was used to aid the replacement of dowel and swivel. Lastly, proponents encountered procuring the industrial roller brush because it's not available in the Philippines instead its market availability is only found in international market. Hence, the researchers fabricate an alternative roller brush in order to replace the unattainable material.

The full actual design of the project



Figure 2.27: Actual Pedal-Operated Garbage Cleaner

BILL OF MATERIALS**Table 2.4: Bill of Materials**

Serial No.	Name of Product	Quantity	Price Php	Total Amount
1.	Bicycle	1	3,000	3,000
2.	Caster Wheel	2	150	300
3.	Spokes	15	3	45
4.	Tire Set	1	800	800
5.	Brush	8	230	1,840
6.	Trash Bin	1	50	50
7.	Transportation	984		984
8.	Food Expenses	2,317		2,317
9.	Labor Machine	3,000		3,000
10.	Labor Tires	150		150
TOTAL AMOUNT SPENT				Php 12,306.00

The table above shows the different materials and its respective prices that are needed to build the Pedal – Operated Garbage Cleaner along with its quantity.

CHAPTER III

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

SUMMARY OF FINDINGS

Tourist locations are certain to attract a large number of visitors. The majority of the issues that occur in any tourist destination are obviously rubbish. Sweeping the entire area takes a long time, especially if done manually with a broom and dustpan. These kinds of issues may be seen in any busy environment, including schools and apartments. Some places, like as hotels and restaurants, will rely heavily on vacuums, which is not cost effective. Vacuum cleaners can't do everything and aren't always feasible. Vacuums should not be used in certain situations, particularly on uneven surfaces. Furthermore, vacuums are not recommended for use in open areas such as food parks, etc. The idea of developing the " Pedal – Operated Garbage Cleaner " sprang from these thoughts and limitations in vacuums, with the goal of providing a leisurely and efficient means of cleaning an open space.

In Cordova-Roro Port Road, which is our research environment, the proponents seen countless cleaners (BHW Workers) sweeping the massive area of the road. The proponents have seen their struggles of working under the heat of the sun perhaps the whole day. The proponents chose to construct something that will undoubtedly benefit the workers in this specific location. After witnessing the results of many trials, the project's proponents produced the prototype and tested it on the selected respondents along with the circulated questionnaire, and the outcome was good. After using it for almost three days the proponents found out that the caster wheel isn't time friendly because of the material used to make the caster wheel, it will ultimately be ruined if

utilized for an extended period of time, therefore use a rubber-based caster wheel instead. While testing our prototype in our selected environment the proponents found out that our material used are easily blown away by the wind because of its weight. Also, the researchers found out that due to windy environment and when the riders speed up the movement of the bike the garbage inside the trash bin suddenly falling given the fact that it has no cover.

The Pedal-Operated Garbage Cleaner contributes to a new and creative approach to waste reduction in the Cordova-Roro Port Road sector. The majority of residents or respondents were satisfied with the product capacity in terms of mobility, safety, stability, and functionality. Based on the findings of the operation, it is capable of cleaning garbage such as plastic bottles, dried leaves, and plastics.

CONCLUSIONS

- The design and analysis of the “Pedal – Operated Garbage Cleaner” have been brought into practical model successfully.
- People will be able to leisurely clean the massive and long road of Roro Centennial Road and somehow being able to exercise at the same time.
- Based on the satisfactory rates given by the respondents, the Pedal – Operated Garbage Cleaner is efficient and feasible for cleaning the area.
- The machine is easily manipulated by the respondents especially in a curvy road.
- As the operation conducted, the machine has a good satisfactory rating from the users who conducted the test drives.

RECOMMENDATIONS

The results of the study showed a promising result. However, certain features were not implemented. Thus, the researchers recommended the following for future research:

- Use a rubber-based caster wheel for long-term durability, as the one we used could break down after a long and tedious scenic drive.
- Make sure to use the product in approximately 7 days to assess its durability and efficiency.
- Use aluminum-based steel to make use of its density.
- Change or replace of research environment that is not windy enough that could swept away the garbage's such as light weight leaves and plastics.
- Put a cover in the trash bin to reduce spoilage of garbage.

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APPENDIX A
RESEARCH INSTRUMENT
Survey Questionnaire

TITLE OF THE STUDY: Pedal-Operated Garbage Cleaner

RESEARCHERS: Nuera, Russel Jay, Lauron, Menjude, and Languido, John Mark

NAME (Optional):

AGE:

DATE:

PURPOSE OF STUDY:

The 3rd BSME Engineering students of University of Cebu Lapu Lapu and Mandaue is currently having their thesis entitled **Pedal-Operated Garbage Cleaner**. As part of this thesis, the proponents will conduct survey in relation to their proposed prototype design.

PROCEDURE:

The survey should only take a few minutes of your time.

RISKS AND DISCOMFORTS:

We do not expect this discussion to cause you any harm. But if you feel uncomfortable with some of the questions, you may choose not to answer them but can decide to continue with the discussion.

BENEFITS:

The results of the study will inform the researchers and possible project implementers on the importance of using Pedal-Operated Garbage Cleaner in cemented road sector.

CONFIDENTIALITY:

Your responses will be private and confidential. They will not be shared with anyone other than the members of the team research team.

Part I

Instruction: Fill up the following questions honestly. Put a check mark on the box provided with each statement for your answer.

1. Do you see any garbage in the Cordova-Roro Road Port?

☐ Yes

☐ No

2. If you say Yes, do you find someone who collects the garbage and dispose it properly?

☐ Yes

☐ No

• What kind of tool they utilized?

☐ Dust pan, broom, and trash bin

☐ Improvised garbage cleaning machine

3. Would it be beneficial to the community to have a Pedal-Operated Garbage Cleaner?

☐ Yes

☐ No

Part II

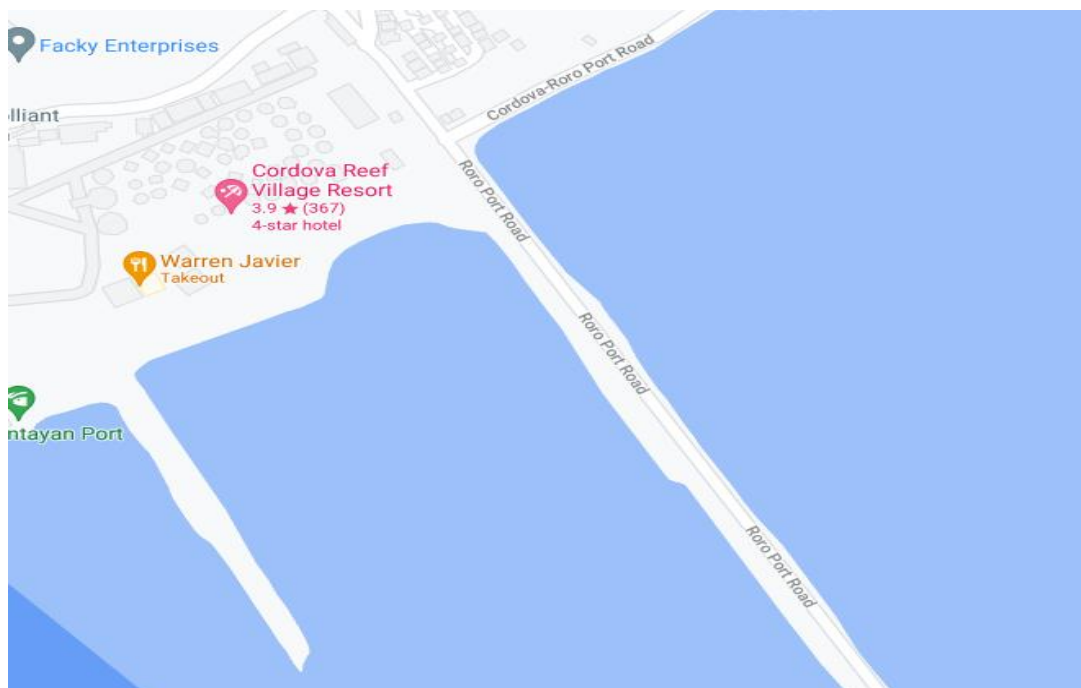
Prototype Satisfactory Survey

How would you rate the following?

PEDAL- OPERATED GARBAGE CLEANER	Very Dissatisfied	Dissatisfied	Neutral	Satisfied	Very Satisfied
1. Project Mobility					
2. Project Stability					
3. Project Safety					
4. Project Functionality					

APPENDIX B

RESEARCH ENVIRONMENT MAP



APPENDIX C

DOCUMENTATION



APPENDIX D

CURRICULUM VITAE



Name: John Mark Y. Languido

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Contact Number: 09158246780

E-mail address: johnmarklanguido22@gmail.com

EDUCATIONAL BACKGROUND

Tertiary: University of Cebu Lapu-Lapu and Mandaue

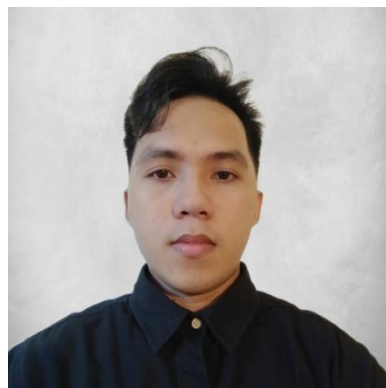
Secondary (SHS): Cordova Catholic Cooperative School

Secondary (JHS): Cordova Catholic Cooperative School

Primary: Ibabo Elementary School

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2018 – Present



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Secondary (JHS): Cordova Catholic Cooperative School

Primary: Cordova Central School

Affiliations

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2018 – Present



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Secondary (JHS): Cordova Catholic Cooperative School

Primary: Cordova Central School

Affiliations

- Member, Junior Philippine Institute of Mechanical Engineers (JPSME)
2018 – Present