

DESIGN AND FABRICATON OF ROBOTIC MANHOLE CLEANER FOR SANITARY WORKERS USING DESIGN THINKING APPROACH

Submitted in partial fulfilment of the requirements for the award of
Bachelor of Engineering degree in Mechanical department

By

JOE ROZZARIO DOSS (Reg. No. 39150056)
KEVIN JOHN MOOLAYIL (Reg. No. 39150066)



**DEPARTMENT OF MECHANICAL ENGINEERING
SCHOOL OF MECHANICAL ENGINEERING**

SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

Accredited with grade "A" by NAAC | 12B Status by UGC | Approved by AICTE

**JEPPIAAR NAGAR, RAJIV GANDHI SALAI,
CHENNAI – 600119**

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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **JOE ROZZARIO (REG NO: 39150056)** and **KEVIN JOHN MOOLAYIL (REG NO: 39150066)**, who carried out the Project entitled "**DESIGN AND FABRICATION OF ROBOTIC MANHOLE CLEANER USING DESIGN THINKING APPROACH**" under our supervision from Dec 2022 to Apr 2023.

Internal Guide

Dr. J. JEYA JEEVAHAN, M.E., Ph.D.

Head of the Department

Dr. G. ARUNKUMAR, M.E., Ph.D.

Submitted for Viva voce Examination held on 10-05-2023

Internal Examiner

External Examiner

DECLARATION

We, **KEVIN JOHN MOOLAYIL (39150066)** and **JOE ROZZARIO DOSS (39150056)**, hereby declare that the project Report entitled “**DESIGN AND FABRICATION OF ROBOTIC MANHOLE CLEANER USING DESIGN THINKING APPROACH**” done by us under the guidance of **Dr. JEYA JEEVAHAN** is submitted in partial fulfilment of the requirements for the award of Bachelor of Engineering in Mechanical Engineering.



1. KEVIN JOHN MOOLAYIL



2. JOE ROZZARIO DOSS

DATE: 10-05-2023

PLACE: CHENNAI

SIGNATURE OF THE CANDIDATES

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ABSTRACT

According to a report (1993-2022), Tamil Nadu tops with 218 deaths in India during manual scavenging. The Prohibition of Employment as Manual Scavengers and their Rehabilitation Act bans manual scavenging, and insists to use only the mechanized scavenging. Thus, the development of automatic or semi-automatic machines for cleaning the sewer holes are an important and urgent requirement in India. However, the manual scavenging is still continuing in India, which lead to adverse health effects on the sanitary workers in India. The current sewage cleaning machines are not efficient to drain the sand and solid particles completely, and they do not cover the full area of the sewer hole. In this project work, the design and simulation of a novel sewer hole cleaning robot is carried out using Solid works robotic simulator package. In our proposal, the robot is modelled with an all-inclusive cylindrical barrel with slidable plate, 360° rotatable barrel setup, and a sewage collecting tank. The simulation results shows that the proposed sewer hole cleaning robot can access more area with higher stability in collecting the sewage efficiently. This innovation will lead to the improved lifestyle of the sanitary workers.

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CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Our study region is within Alleppy metropolis in Kerela, a water metropolis bordered by the Pama River and Manimala River on several sides, all of which contribute to the city's benevolent urban expansion. The majority of Alleppy's drainage systems are now in poor shape. This is most evident during the rainy season, when barely one hour of rain may submerge entire districts. The garbage, which includes polythene, bottles, paper, and other materials, runs down the sewers and clogs up small openings. This stops the water from flowing freely. The cleaner men's current methods of drain cleaning are by no means very effective. Here, the Punnapra, Cherthala, and Haripad Area has been chosen as a case study for drainage and waterlogging issues. The goal of the study is to determine the guiding principles for effectively incorporating a drainage network into Alleppy town's land use plans. The goal of the study is to identify a reliable solution called "Robotic Manhole cleaner" in this process. Various drain cleaning methods, including robots with four wheels, caterpillar tracks, and suction pumps mounted on robots, were also explored. The four-wheeled robot with two wheels on either side of the drain is the design we chose. The vehicle's front features a chain-sprocket-based grabber that revolves while picking up trash with its connected claws. This makes it simple to transfer the garbage into the robot's central collecting box. After some time, the garbage is eventually disposed of via a conveyor belt that is under the waste box. This design is as straightforward as it can be, reducing the possibility of mechanical or electrical components failing.

The purpose of this study is to quantify and evaluate the current sewage cleaner issues. in order to protect the wellbeing of those who do such dangerous employment. The project uses a design-thinking methodology. As a result, the design scope is determined. After the empathy step, the real problem statement will be chosen.

Sewage treatment facilities in India can barely handle one-third of the sewage produced each day, according to reports from the Central Pollution Control Board.

The number of sewage treatment plants (STPs) in the country more than doubled in 2015 due to the construction or proposal of 815 brand-new STPs, which also had a significant impact on the proportion of sewage treated during the previous ten years. Compared to 37% in 2015 and 30% in 2009, more than 50% of the sewage produced in metropolitan areas was treated in 2021. The government's desire to carefully regulate sewage outflow from the country is demonstrated by the rate at which fresh sewage is generated. Sedimentation, coagulation, flocculation, screening, grit removal, and effluent discharge are some of the technologies utilised in sewage treatment facilities. Additionally, processes like chlorination and filtration are performed. The therapies covered include primary, secondary, and tertiary.

Manual scavenging was outlawed in India in 1993, and rehabilitation was emphasised in 2013. This Act imposes penalties on anyone who employ anybody to clean septic tanks and sewers in a dangerous manner. The 2013 Act is enhanced by the new law that is being presented. In addition to considering total mechanisation, it also establishes a legal foundation for compensation in the case of fatalities through manual scavenging and increases district-level responsibility.

Today, water is consumed at a rapid rate. In our way of life, water is mostly utilised for drinking, cooking, and cleaning. The water utilised in the industry and the home originates in the sewers and eventually makes its way into the rivers, ponds, and seas. where water and other more substantial components (polythene, bottles, etc.) also reach. With the primary objective of clearing drains of these solid objects, we designed an automated drain cleaning system. This machine is very simple to install at any drain point. It is constructed such that it allows water to pass through while gathering all solids and depositing them in a pile in the trash can. This equipment has the ability to simultaneously clean and move debris from gutters and drains. To address problems in real time, an automatic drainage water cleaning and control system is presented. Due to the growing sewage issues from nearby companies and the continuous industrial expansion, it is urgently necessary to find a solution to the sewage water problem. Both humans and the environment are seriously harmed by the garbage and pollutants that come from industry. The drainage level will be cleaned and controlled by our suggested method employing an automatic mechanism. The primary regulating component is an auto mechanism, and

municipal drainage level monitoring. We employed a motor, chain, driver, bucket, and frame in this system.

All living things, including humans, have a basic need for water. Water is abundant on Earth, yet it cannot be used by humans. Clean water is more crucial for a number of reasons. The water's pollutants can be dangerous and sickening. The purpose of the drainage system is to collect, transport, and dispose of water through an outfall or outlet as long as the drainage system is taken into account. Bottles, plastic bags, papers, and other pollutants are included in the evacuation water. The Swatch Bharat Mission is at its height in our day, and everyone is working to make their community and nation clean. Our crew contributes to this aim by figuring up a means to remove solid trash from the drainage there. In contrast to modern society, the drainage system built by members of the Harappan civilisation is mostly based on scientific principles. House drains discharge into the main drains that are located beneath numerous roads and major thoroughfares.

1.2 PROBLEM STATEMENT

According to a study of sanitation personnel who operate in septic tanks, sewage treatment facilities, and manholes, no mechanised equipment is presently utilised to clean manholes. The workers' lives are at danger since they must clean inside the manhole. They reject to buy these items in favour of purchasing older, more expensive, manually operated products instead.

1.3 MOTIVE OF THE PRODUCT

Because it has automatic controls, workers can move it up and down and rotate the devices inside the manhole to scrape out all of the waste. This product's main goal is to provide a method for effectively cleaning manholes without requiring them to be entered. It also has the best, most affordable price so that everyone can afford to buy it. Thus, the robotic manhole cleaner is suggested as a solution to the issues raised above. It offers an appropriate and hygienic method of cleaning manholes without endangering life. It provides sanitary staff with a secure means to clean. The primary component of this robotic cleaner, which is located in the centre and is lowered into the manhole to clean it from the inside, is moved from one location to another using the four wheels mounted at each corner.

1.4 FORMER PRODUCTS

There are some former products that are available in the market that have different specifications with a variety of working processes and functions.

- Sewer Jetting Cum Suction Machine
- Sewer Suction Machine
- Twin D P Systems
- High pressure Jetting cum Suction Pressure
- Hydraulic Hose
- Robotic Scavenger Bandicoot
- Desilting Machine
- Rodding Machine

CHAPTER 2

LITERATURE SURVEY

Ankita B. Padwal suggested using manual labour rather than machinery to clean the drainage system. When drainage is neglected, solid wastes that eventually solidify into blocks are carried by it. The flow of waste water has been hampered by this obstruction, and there is a potential for overflow in public areas. The wastes are being manually cleaned with sticks, which might cause a serious illness. To get around this, they created a mechanical, semi-automatic drain cleaner to take the role of labor-intensive workers.

Dr. K. Kumaresan described how manual labour was mechanised. Drainage pipelines are used for disposal, and clearing blockages in them might result in the loss of human life. They created the Auto-Matic Sewage Cleaning System to solve this issue. They developed their idea in a unique approach, treating each gaseous ingredient independently to ensure that the water flowed effectively. It is possible to develop this project using all available resources, including labour, equipment, materials, and funding. They used the resources at hand to complete their project in an inexpensive and effective manner. To run and manage production, they applied automation technologies connected to the usage of mechanical, electrical, and computer-based systems.

Dr. Mhael Okpara (2014) reviewed drainage cleaning to replace manual work with an automated system because it is dangerous for human life and cleaning time. To address this issue, they implemented a design automatic drainage water pump monitoring and control system using PLC and SCADA. In this project, effective methods for managing waste disposal and routinely treating waste disposal in both harmful and nontoxic ways are used.

Ganesh U. L. showed the usage of a mechanised drainage cleaner to replace the manual effort required for the drainage cleaning system. pipes that drain poorly. There are times when cleaning the drainage system might be hazardous to human life. To address this problem, they built a mechanical, semi-automatic drainage

water cleaner. As a consequence of the project's frequent waste filtration, the water flow is now efficient. There are several environmental dangers that may be reduced by using the drainage system machine.

Gregor Burger discussed the idea and software architecture of a novel general-purpose platform for the creation of network-based models and examined several significant difficulties in computational design. When connecting city drain as a sub-model into bigger software projects, they introduced features like the hot-start mechanism and the extension interfaces that have proven to be quite helpful. presented the idea and software architecture of a novel general-purpose platform for the creation of network-based models and took a close look at several significant computational design difficulties.

Elangovan K., et al. evaluated the topic of replacing manual labour with automated systems for drainage cleaning since manual cleaning systems are dangerous for human life. This project effectively disposes of garbage that has been put into the drainage that is poisonous or contains harmful gases. To accomplish automated control of sewage waste water treatment, a Siemens PLC controller was utilised in the drainage wastewater treatment system to regulate the stepper motor, compressor, gas exhauster, pressure valve, liquid level, flow, and other analogue variables.

N. Prabhushankar and others The primary objective of the planned work was to remove drainage water using a spring return reciprocating pump that was pneumatically controlled. centrifugal pumps are typically used to dewater drainage systems, but they are not very good at completely removing suspended and heavy materials, and they also need a lot of electricity to operate. Cleaning can lessen the need for manual labour.

CHAPTER 3

AIM AND SCOPE

3.1 AIM AND SCOPE OF THE PROJECT

Our main aim working on this project is to develop a robotic manhole cleaner for sanitary employees.

3.2 OBJECTIVE

- To make it easier for sanitation employees to clean manholes without going down into them.
- The survey taken from the people about the former products found some minor problems that do not satisfy them to use it always.
- The majority of items are not very efficient since they cannot totally remove the trash because the earlier products have drawbacks with their use.

3.3 SCOPE OF THE PROJECT

- From Assumption Mapping we found the problem statement, that till now what are the problems people facing. How they are suffering by pains and why they are not comfortable with former products.
- Then survey taken from both elderly and working professionals with our problem assumption question we known well about their problems.
 - With the efficient need of the elderly people and working professional we are gone through the better design to give the best pain relief mechanism

CHAPTER 4

MATERIALS AND METHODOLOGY

4.1 MATERIALS

To produce a machine part, the type of material must be carefully chosen while taking design and safety into account. The following elements influence the material choice:

- Mechanical Strength
- Stability
- Ductility
- Availability
- Design

4.1.1. Mechanical Strength

The main criterion for choosing appropriate materials for any engineering application or product is mechanical strength. The capacity of a substance to withstand loads or forces is known as mechanical strength. Materials chosen for engineering applications should have the necessary mechanical strength to sustain any loads or forces created during operation in the engineering product's structure.

4.1.2 Stability

Engineering products made with a certain material must be able to withstand the following operating conditions in order to be considered stable.

4.1.3 Ductility

Engineering materials' ductility is a feature that makes them appropriate for manufacture using mechanical processes such as rolling, drawing, extrusion, and others. Essentially, it refers to how far a material can be stretched plastically before failing or breaking. The strength of a substance is correlated with its ductility. Significant strength can be gained at the expense of ductility, or the other way around.

4.1.4 Availability

Materials should be readily available in the desired form and at a reasonable price when used to create engineering products. so that the product may be manufactured affordably and have a competitive price on the market. Any kind of material, including casting, forging, rolled sheets, etc., may be accessible. But in order to make it easier to manufacture the product with the specified quality, the material must be available in the appropriate form.

4.1.5 Design

The design of the product also influences the choice of material for every technical product. The strength and ductility needed in the materials chosen for an engineering product are determined by its design. Therefore, engineering product design should take into account the characteristics of engineering material.

4.2 MATERIALS USED

- 1-inch square hollow base
- 1-inch 5mm steel flat
- 6-inch sheet metal
- 12-volt dc motor 1amp
- Screw rod 18mm
- Pneumatic cylinder
- Spur gear pinion
- Battery 12v 7.5amp
- Hand lever valve 5/2
- Toggle switch 12v
- Mild steel material
- Arc welding

4.2.1 1-Inch Square Hollow Base

A hollow tube with a square cross-section of 1 inch on all sides at the base is known as a 1-inch square hollow base. This kind of tubing is frequently used for a variety

of purposes, including support beams, frames, and other load-bearing structures, in building, engineering, and manufacturing operations.

In comparison to solid material of the same dimension, the tubing's hollow base design offers increased strength and stability while lowering total weight. As a result, it is a well-liked option for applications where weight is an issue but strength is still needed.

Steel, aluminium, and other metals, as well as plastic and composite materials, are just a few of the materials that may be used to create 1-inch square hollow base tube. The particular use, as well as elements like cost, strength, and durability, all influence the material choice.

It is crucial to take the project's load requirements, the type of material required, and any other unique needs into account when choosing 1-inch square hollow base tube. Additionally, it is crucial to confirm that the tubing was made in accordance with the required specifications and complies with all applicable safety regulations.



Fig: 4.1 : 1-inch square hollow base

4.2.2 1inch 5mm Steel Flat

Typically, a rectangular piece of steel having a thickness of 5mm and a width of 1 inch (25.4mm) is referred to as a 1-inch-5mm steel flat. Depending on the particular use it is meant for, the length of the steel flat may change.

Steel flats are frequently employed in industrial, engineering, and building applications because of their strength, adaptability, and durability. They have a wide range of uses, including sustaining large weights, offering structural support, and serving as a part of machinery and equipment.

Mild steel or low carbon steel, which is very inexpensive and has acceptable mechanical qualities, is frequently used to make steel flats. However, depending on the particular application and specifications, a different type of steel may be employed. To increase corrosion resistance, durability, or aesthetics, steel flats can also be coated or polished with a number of materials.

The general use and qualities of a 1-inch-5-mm steel flat will vary on the demands of the individual application, although they are a rather typical component in many industrial and manufacturing contexts.



Fig: 4.2 : 1-inch 5mm steel flat

4.2.3. 6-Inch Sheet Metal

A flat piece of metal that is 6 inches wide (or around 152.4 mm) is referred to as 6-inch sheet metal. The automotive and aerospace industries, as well as the construction and industrial sectors, may all benefit from the versatility of sheet metal. Metals such as aluminium, copper, brass, steel, and stainless steel are frequently used to make sheet metal. Depending on the project's use and needs, such as

strength, durability, and corrosion resistance, a certain type of metal will be employed.

Using a number of fabrication processes, including cutting, bending, and welding, sheet metal may be moulded and worked into a wide range of forms and sizes. It is frequently utilised in roofing, ducts, gutters, and body panels for automobiles. Numerous consumer goods, including electronics, furniture, and appliances, are made from sheet metal as well.

Typically measured in gauges, the thickness of sheet metal can vary greatly depending on the particular purpose. The gauge number indicates how much thinner the sheet metal is. For instance, a sheet of metal with a gauge of 24 is thinner than one with a gauge of 18.

In general, 6-inch sheet metal is a widely utilised and adaptable material for usage in a variety of industrial, commercial, and consumer applications.



Fig :4.3: 6-inch sheet metal

4.2.4. 12v Dc Motor 1a

An electrical motor that runs on a DC (direct current) power source with a voltage rating of 12 volts and a current rating of 1 ampere (A) is known as a 12-volt DC motor.

Applications for DC motors include robotics, industrial automation, and the automobile industry. To power mechanical systems and gadgets, they transform electrical energy into mechanical energy.

A motor's voltage and current ratings are multiplied to determine its power rating, expressed in watts. In this instance, the 12-volt DC motor would have a power rating of 12 watts and a current rating of 1 amp.

The motor's design, which takes into account elements like the motor's size and form, the quantity and orientation of its coils, and the kind of bearings it employs, will determine the motor's torque and speed. The motor's appropriateness for a given application will depend on its specific torque and speed.

In general, a 12-volt DC motor with a current rating of 1 amp is a very popular type of motor that may be utilised in a number of low-power applications where moderate torque and speed are required.



Fig :4.4 :12v dc motor 1a

4.2.5 Screw Rod 18mm

An 18mm screw rod is a form of threaded rod that is frequently used in structural and mechanical applications. A long, straight metal rod having threads on both ends is referred to as a "threaded rod" and is used as a fastener to keep things together or generate tension in a system.

The type of metal utilised and the thread pitch will determine the precise qualities and features of a screw rod with an 18mm diameter. Stainless steel, carbon steel, and alloy steel are often used materials for threaded rods; each has special qualities including strength, corrosion resistance, and flexibility.

A screw rod's thread pitch is the separation between adjacent threads, and it is commonly expressed in millimetres per thread (mm/rev). A threaded rod's strength, holding power, and simplicity of installation can all be impacted by its pitch.

There are several uses for screw rods having a diameter of 18mm, including keeping structural pieces together in construction and transferring motion and force in mechanical systems. When great tensile strength is necessary, they can also be utilised as anchor bolts or tie rods.

An 18mm screw rod is a rather substantial threaded rod that may be utilised in a variety of applications where strength and longevity are key considerations.



Fig: 4.5: Screw rod 18mm

4.2.6 Pneumatic Cylinder

A mechanical device known as a pneumatic cylinder uses compressed air to generate force in a linear motion. It has a cylinder inside of which is a piston that travels back and forth when pressurised air is delivered into the cylinder and expelled from it.

Automation, robotics, and equipment are just a few examples of the industrial and manufacturing applications where pneumatic cylinders are frequently utilised. They are frequently employed to move and position things or to exert force under control. Various types and sizes of pneumatic cylinders are available, depending on the needs of the individual application. They can be single-acting or double-acting, moving the piston in one or both directions using compressed air, respectively. Depending on the needs of the particular application, pneumatic cylinders can also differ in stroke length, diameter, and force output.

Due to their generally higher cost-effectiveness and simplicity of maintenance, pneumatic cylinders are frequently favoured over hydraulic cylinders. However, they might not be appropriate for applications that need for strong force output or exact motion control.

Pneumatic cylinders, in general, are a flexible and widely utilised class of mechanical equipment that are frequently seen in industrial and manufacturing settings, and which are frequently used to regulate motion or apply force in a controlled manner.



Fig :4.6: Pneumatic cylinder

4.2.7 Spur Gear Pinion

An example of a mechanical part used in power transmission systems to convey rotational motion and torque between two parallel shafts is a spur gear pinion. It is made up of a smaller gear called the pinion and a bigger gear called the spur gear that mesh together.

Many different types of equipment, such as machinery, automotive systems, and industrial equipment, frequently employ spur gear pinions. They are frequently used to alter the direction of rotation as well as to speed up or slow down the rotational motion between two shafts.

The number of teeth, pitch, and diameter of a spur gear pinion will vary depending on how it is designed. The gear ratio, or the ratio of the number of teeth between the pinion and the spur gear, will be determined by these design elements.

Depending on the needs of the particular application, spur gear pinions can be constructed from a range of materials, including steel, brass, and plastic. To strengthen their toughness and wear resistance, they can also be built with other surface treatments including heat treatment or surface hardening.

To transmit torque and rotational motion between two parallel shafts, spur gear pinions are a typical and significant part of power transmission systems. They may be tailored for certain uses and are available in a range of sizes and designs.

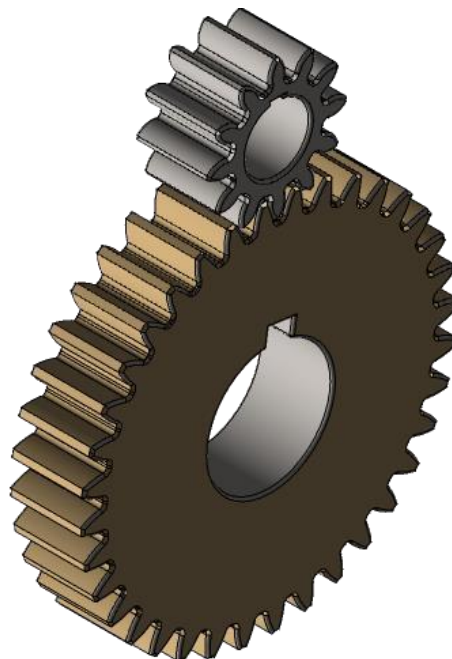


Fig :4.7: Spur gear pinion

4.2.8 Battery 12v 7.5a

A 12V 7.5Ah battery is a type of rechargeable lead-acid battery that is frequently used in a variety of applications, including wheelchairs, electric scooters, emergency lights, backup power systems, and alarm systems.

The "12V" stands for the battery's nominal voltage, which is the voltage at which it is intended to function. The "7.5Ah" stands for the battery's ampere-hour rating, which denotes how much charge the battery can hold and provide over time.

A 12V 7.5Ah battery may, in actuality, deliver 1 amp of current for 7.5 hours or 7.5 amps of current for 1 hour before it has to be recharged. The battery's actual operating time will be influenced by the particular application, temperature, and discharge rate.

Batteries made of lead-acid are renowned for their affordability, dependability, and durability. To maintain their best performance and lifespan, they can be hefty and need routine maintenance.

Overall, a 12V 7.5Ah battery is a typical and adaptable battery type that may be utilised in a variety of applications requiring moderate power output and runtime.



Fig :4.8: Battery 12v 7.5a

4.2.9 Hand Lever Valve 5/2

A typical form of pneumatic valve used in manufacturing and industrial settings to regulate the flow of compressed air in a system is the 5/2 hand lever valve.

The number "5/2" in the name denotes the valve's ports and locations. A 5/2 hand lever valve, in particular, has five ports and two settings. Two exhaust ports, two supply ports, and one control port are among the five ports. The two positions, which are sometimes referred to as "A" and "B" positions, allude to the two potential flow routes that the valve might provide.

The operator moves a lever that controls the position of the valve spool inside the valve body to manually operate the hand lever valve. Depending on where the lever is positioned, the valve spool controls how compressed air is distributed across the various ports.

In pneumatic systems, hand lever valves are frequently employed to regulate the motion of cylinders, actuators, and other pneumatic parts. They are a popular option in a wide range of industrial and manufacturing applications because of their reputation for toughness, dependability, and simplicity of use.

A 5/2 hand lever valve, in general, is a flexible and frequently used kind of pneumatic valve that offers dependable and accurate control over the flow of compressed air in a system.



Fig: 4.9: Hand lever valve 5/2

4.2.10 Toggle Switch 12v

An electrical switch known as a toggle switch is frequently used in a number of systems, including those in automobiles, ships, and factories. To switch a circuit on or off, a mechanical lever or "toggle" can be turned up or down.

A toggle switch that can manage 12 volts of electrical power is known as a 12V toggle switch. This qualifies it for usage in several automotive, maritime, and low-voltage industrial applications.

Usually, a toggle switch is wired up to a circuit using two or more wires. The switch completes the circuit when it is in the "on" position, enabling electricity to flow through it and power the system or device it is attached to. There is no electricity flowing through the switch while the toggle is in the "off" position, breaking the circuit. There are many different sizes, styles, and configurations of toggle switches, including single-pole, double-pole, and multi-pole variations. They can also be made with a variety of features, including locking mechanisms, lighted toggles, and waterproofing.

In general, a 12V toggle switch is a flexible and dependable electrical switch type that is often utilised in a variety of applications. A toggle switch may offer a quick and efficient way to turn circuits on and off, whether you need to operate lights, fans, motors, or other electrical equipment.



Fig :4.10 :Toggle switch 12v

4.2.11 Mild Steel Material

Low carbon and other components are found in mild steel, a form of carbon steel. It is additionally referred to as plain-carbon steel or low carbon steel. Mild steel is more malleable and ductile than other varieties of steel due to its low carbon content, making it simpler to shape and work with.

Mild steel is frequently utilised in a variety of applications, including the manufacturing, automotive, and construction sectors. It is frequently used to create wire, sheet metal, tubing, and structural elements including beams, columns, and bars. Tools, machinery parts, and other industrial components are also made with it.

The cost of mild steel is one of its benefits when compared to other forms of steel. Additionally, it is simple to work with and accessible when utilising standard metalworking equipment and methods. In addition, mild steel is simple to weld, making it a popular option for industrial and construction operations.

Mild steel, however, has several drawbacks. If not adequately protected, it is susceptible to rust and corrosion and is not as robust or durable as other varieties of steel. Other types of steel or other materials could be better appropriate for

particular applications, such as those in severe environments or high-stress applications.

Mild steel provides an excellent blend of strength, ductility, and affordability and is a versatile and widely used material. It is a well-liked option in several sectors and applications because to its accessibility and simplicity of usage.

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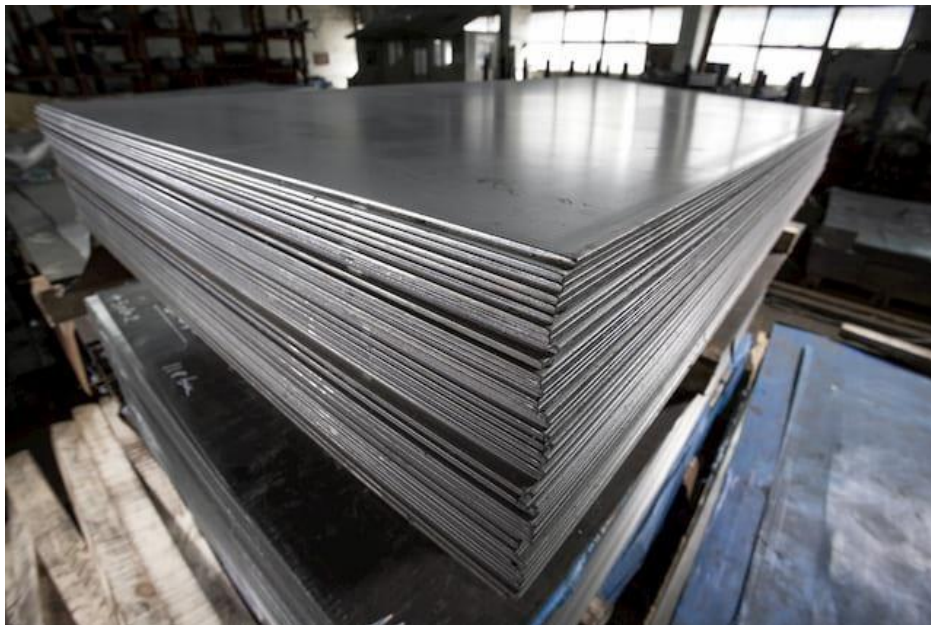


Fig :4.11 Mild steel material

4.2.12 Arc Welding

An electric arc is used in the welding process known as "arc welding" to melt and fuse metals together. In the construction, manufacturing, and maintenance sectors, it is one of the most extensively utilised welding procedures.

Arc welding is the process of joining two metals together by passing an electric current via an electrode, which sparks an electric arc. Metal is melted by the arc's heat, and the joint may be filled with filler material to fortify the metal's bond.

Arc welding can take many different forms, including gas metal arc welding (GMAW), gas tungsten arc welding (GTAW), and shielded metal arc welding (SMAW). Each style of arc welding has its own benefits and drawbacks and employs a unique electrode and shielding gas.

A wide range of metals, including steel, stainless steel, aluminium, and copper, may be joined by arc welding. It is a flexible welding technique that may be used to combine metals of various thicknesses and forms. It can also be carried out in a number of different locations.

Arc welding has the benefit of being a reasonably quick and affordable welding procedure that requires little expertise and equipment. High-quality welds do, however, need a certain amount of expertise and training.

Arc welding, as a whole, is a popular and adaptable welding technique that may be used to connect a wide range of metals in a number of applications.

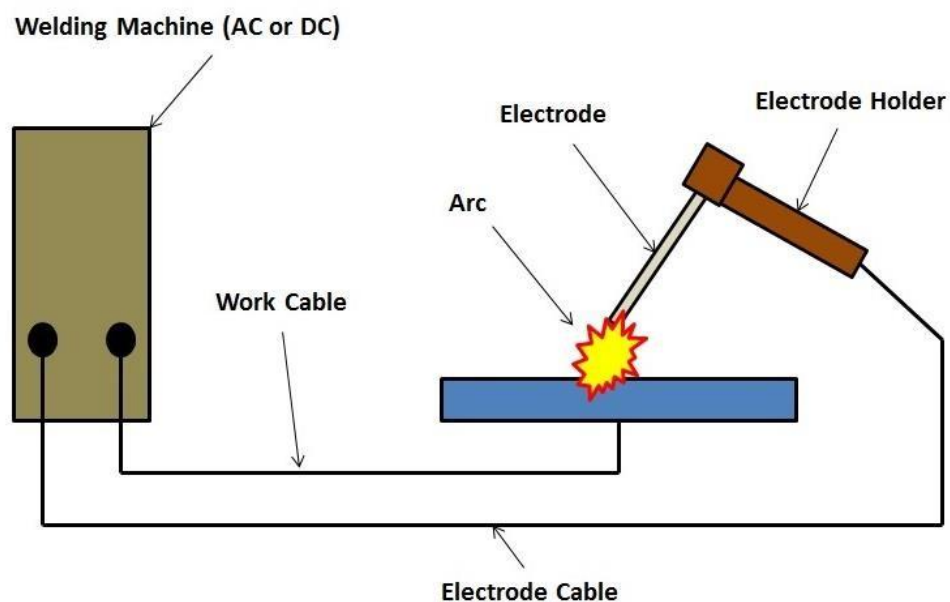


Fig: 4.12: Arc welding

4.3 METHODOLOGY

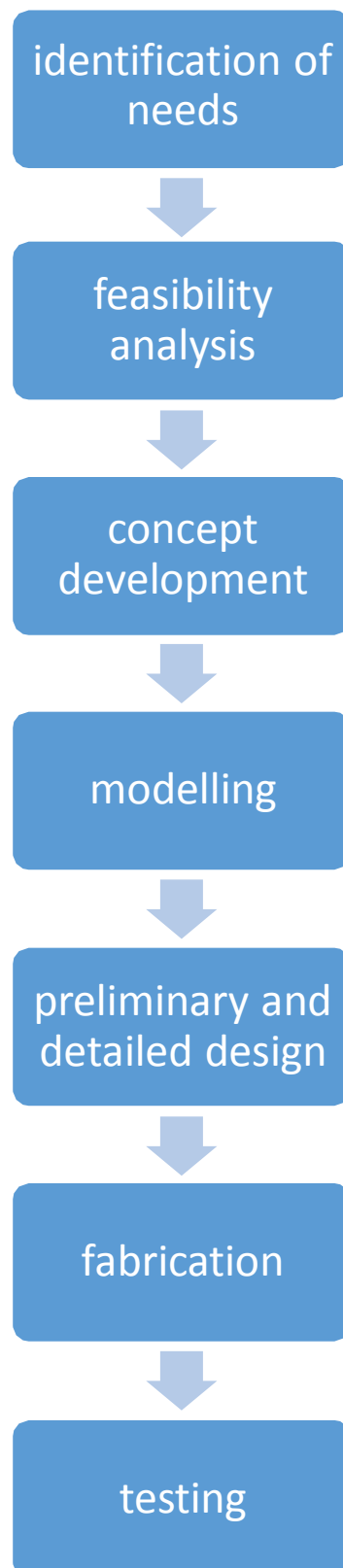


Fig 4.13 Methodology

4.2.1 Identification Of Need

Sewage cleaners were surveyed on the difficulties they encountered at work. Numerous health issues and, in extreme situations, even death are brought on by this employment. By devising a robotic device that can complete the task without endangering the lives of the workers, this problem can be resolved.

Survey taken from sanitary workers

Survey Details

1. Name: Nishad

Address: Cherthala, Kerala

Work Experience: 6 years full time

About the work: Faced lots of difficulties during the start. Was doing it as a part time. Doing this for the past 6 years. It has its own difficulty but with time you get used to it .

Problems faced during the work: The smell is the major issue faced during the process.

Skin diseases and itching is caused , while getting in hole and working

People with breathing problems will find it difficult to work in such conditions.

2. Name: Benny

Address: Haripad , Kerala

Work Experience: 3 years

About the work: Not happy with the work. Find it very difficult. Works mainly as support staff.

Problems faced during the work: It take a lot of time to clean one hole.

During rainy seasons the holes will be wet which makes it difficult to work.

Collecting the waste is a hassle.

3. Name: Georgekutty

Address: Punnapra ,Kerala

Work Experience: 15 years

About the work: The work is alright. There are a few machines that are currently being used, but none of them are very efficient. At the end a person has to get down and get it done.

4.2.3 Feasibility Analysis

Assumption Mapping

As we gone through assumption mapping with four categories

- Known – important
- Unknown –important
- Known – unimportant
- Unknown –unimportant

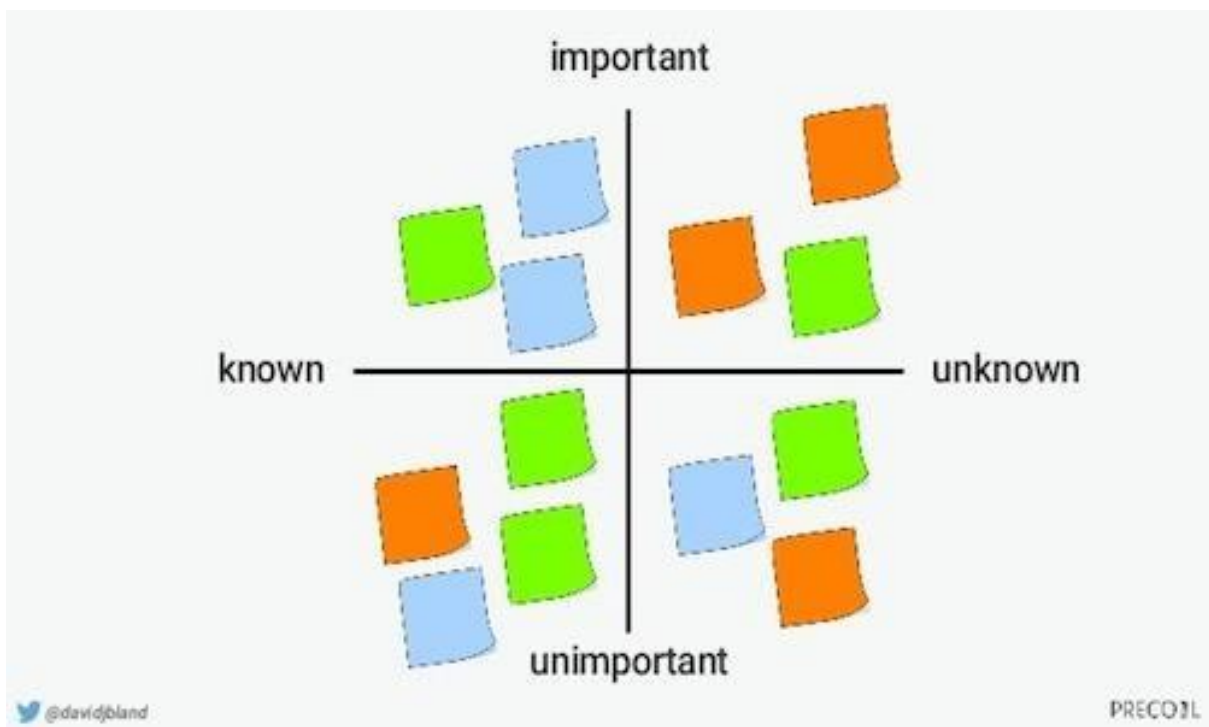


Fig :4.14: Assumption mapping

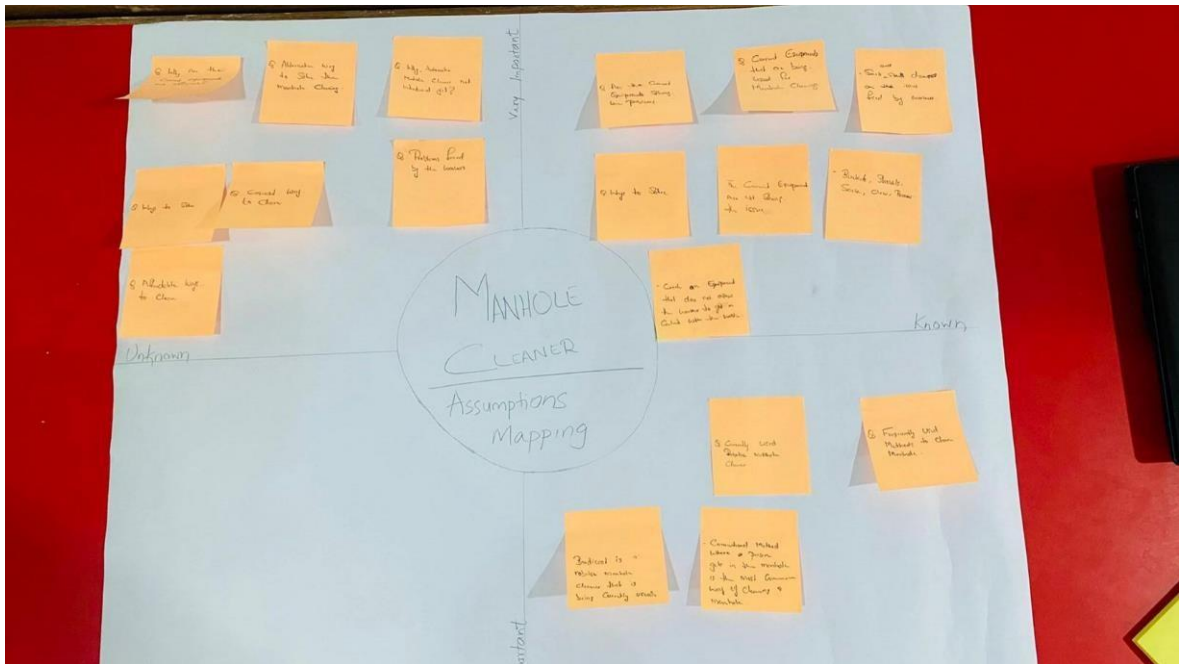


Fig :4.15: Our assumption Mapping



Fig :4.16: Working on assumption mapping

4.2.4 Design

In order to develop a robotic manhole cleaner, three to four designs were sketched out on paper with approximate dimensions. One design that felt comfortable and efficient was chosen, and some more functions were added to it. The concept has now been accurately modelled in solid Works.

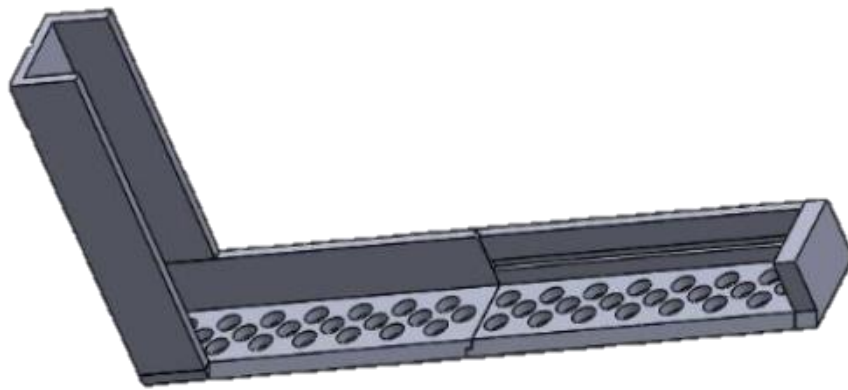


Fig: 4.17: First proposed design

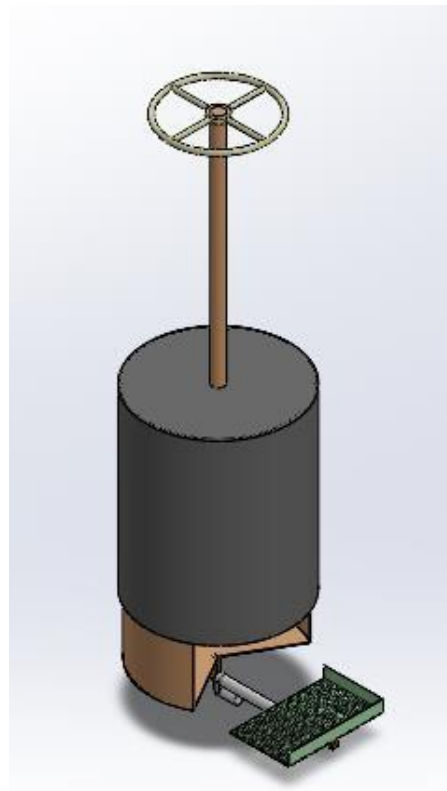


Fig :4.18:Second proposed design

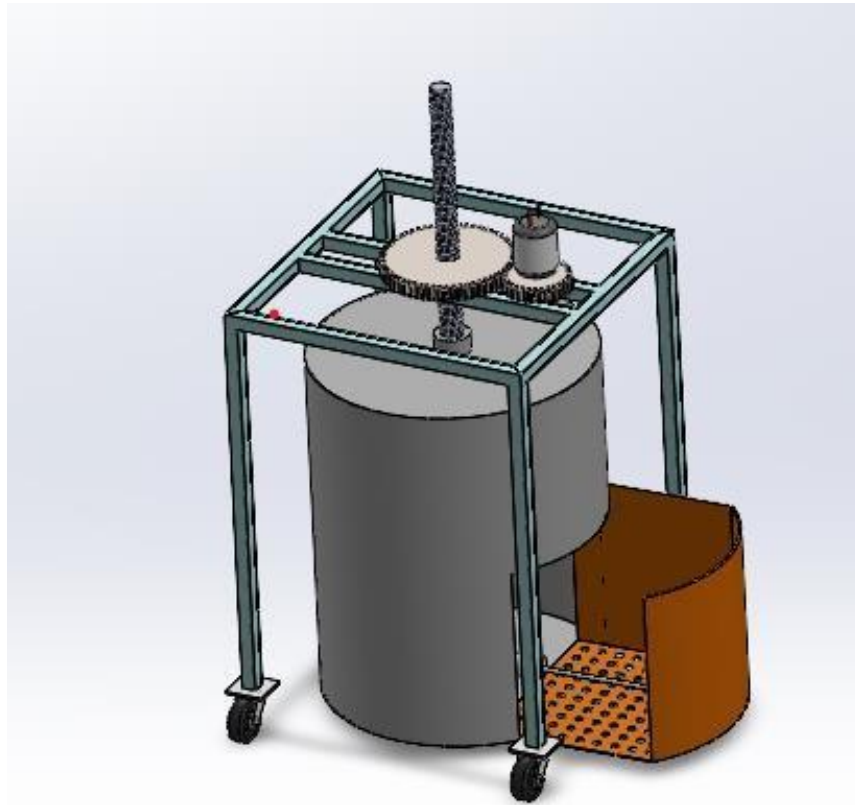


Fig :4.19: Final design opened

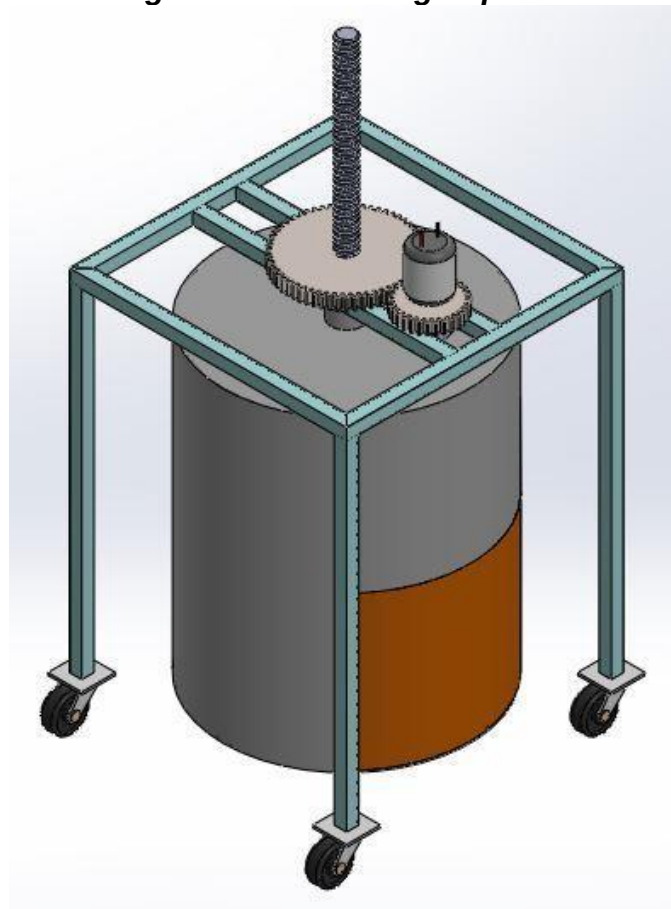


Fig: 4.20: Final design closed



Fig:4.21: Prototype

CHAPTER 5

CONCLUSION

Cleaning the gutters and drains has always been a hassle. Because there are so many toxic waste compounds in gutters and drains, cleaning them appears immoral and puts workers at a great danger of being sick or poisoned. Throwing bottles, plastics and other similar items into the gutter can also cause it to narrow and finally get blocked. This gadget was successfully built since its main purpose is to remove solid waste from drainage systems to prevent drainage water from clotting and causing gutter jamming problems. It allows fluid to pass through it while catching and storing big solid waste. Therefore, rather of cleaning the whole gutter floors, it must be fitted at the designated locations. The device rotates up to a few extents every day to deposit the solid trash, making it an effective gutter cleaning method that also uses very little electricity.

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