A
Project Report on

“Design & Fabrication of Solar Operated Road Cleaning Machine”

Submitted By

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CERTIFICATE

This is to certify that,

Mr. Prasad Pandurang Londhe

has successfully completed the Project Stage – II entitled "**Design & Fabrication of Solar Operated Road Cleaning Machine"** under my supervision, in the partial fulfillment of Bachelor of Engineering – Mechanical Engineering of Savitribai Phule Pune University.

Guide **Examiner**

HOD **Principal**

ACKNOWLEDGEMENT

We take this opportunity to express our gratitude and to thank all those who have helped us in accomplishing this project. We would like to begin thanking our beloved **Principal Mr. Prof. P. G. Vispute Sir** who has always been an inspiration to us and our HOD, **Mr. Prof. S. D. Ratanakar Sir** who has always motivated us to work hard..

We would like to thank our project guide, **Mrs. Prof. D. J. Ganore Maam** who oversaw the Project work right from its inspection to its completion and showed a great amount of patience, listened to the problems we faced and constantly encouraged us. Thank you sir, we could not have completed this project without your help.

We also wish to thank all teaching and non-teaching staff and parents who have been supportive to us during the process of completing this project. We also thank our friends for giving us valuable suggestions.

To the people above all the other people who have done their bit in helping us, thanks to all.

Mr. Prasad Londhe

ABSTRACT

Cleaning is the main basic need for all human beings and it is necessary for daily routine process. The conventional road and floor cleaning machine is most widely used in many applications such as example roads, railway stations, airports, Hospitals, Bus stands, in multi buildings, colleges etc. also this machine uses human energy for its working operation. It is a user friendly as well as eco- friendly. In our project we are aimed to use easily available materials with low cost and it can be easily fabricated and easy to use and control. It is the better alternative for conventional machine. The manually operated eco - friendly road and floor cleaner can work very efficiently with respect to covering area, time and cost of road cleaning process compared with the existing machineries. Also it is economical to use.

The main aim of our project is to design and develop road cleaning. To draw 3D model. All the parts will manufacture and then assemble together and then the testing of model will carried out.

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ABRIVATIONS

Sut =.Brinal Hardness

Zp = Number Of Teeth Of Pinion

Zg = Number Of Teeth Of Gear

Np = SpeedOfPinion

Ng = Speed Of Gear

Y = Lewis From Factor

Бbp = Bending Stress Pinion

Fb = Bending Force

Q = Operating Pitch Diameter

Fw = Wear Strength

m = Module

dp = Diameter Of Pinion

a = Mounting Distance

ha = Addendum

hf = Root Diameter

hk = Working Depth

Ln = Number Of Links

C = Tip And Root Clearance

V = Effective Load

h = Tooth Depth

1 INTRODUCTION

Effective cleaning and sanitizing help and protect the health of the human beings directly and indirectly. Also, cleaning and sanitizing prevents the pest infestations by reducing residues that can attract and support bees, pests etc. It also improves the shelf life of the floor, walls etc. due to regular cleaning and maintenance.

In recent years, most of the people prefer to use trains or buses for commuting and hence these places are littered with biscuits covers, cold drink bottles etc. Hence, it is necessary to clean the bus stands and railways stations at regular interval. There is no one single cleaning method that is suitable for all locations and occasions and effective cleaning depends upon type of cleaning device, cleaning technique and also the equipment should be user friendly.

Cleaning work can be physically demanding and a need has been identified to developed methods for systematic ergonomic evaluation of new products. In recent years, floor cleaning robots are getting more popular for busy and aging populations due to lack of workers. However in India, unemployment is more and hence there is a need to develop less labour oriented cleaning machine.

Environment is a place where humans as well as plants and animals live. Keeping it clean and neat is our responsibility. It is necessary to keep our environment clean because we get fresh air, reduce pollution etc. An unclean environment leads to a bad condition of a society, arrival of diseases and many more.

In recent years cleanliness is becoming an important factor for the betterment of the nation and so, to support the cause we have conducted a study, prepared a design and working of a Semiautomatic Road Cleaning Machine. The cleaning machine is an approach to deliver easy and time efficient cleaning of roads, by reducing human efforts. There are in numerous functions of the road cleaning machine mainly,

1) Remove the dust from road by the use of scrubber which is operated by using engine.

2) Cleaning of dust and dirt by use of brush.

3) Collecting the dust into the collector tank

This cleanliness can be achieved by utilizing all the functions of the road cleaner to the optimum level. The basic idea is to generate a machine which works on basic principles of physics, using mechanical, automobile components and devices. Making an assembly of the components and ultimately creating a machine which can be the answer to various cleaning issues in a single unit.

Background of Present Road Cleaning:

The manual operated machines are time consuming and laborious, on other side of the flip, the diesel operated machines are very costlier. These problems actually instigate to think an alternative arrangement which would nullify the limitations of former said processes. Further its initial cost is also less. The new evolved concept is a road cleaning machine is operated by human power. To accomplish this new idea, the present work is well carried out which is as under.

1. Firstly, the complete market review and literature survey based on the Road Cleaning processes been done.
2. On the basis of the demand power the machine component are designed.
3. On the basis of obtained designed dimensions the fabrication work of the proposed manually operated road cleaning machine is carried out.
4. At last, the testing and trails have been taken to ascertain the load capacity of the machine.

Objective of Manually Operated Eco-Friendly Road Cleaner:

• To provide the alternative method for road cleaning

• To reduce human efforts

• To save the time

• To reduce the cost

• To avoid noise pollution

Cleaning has become a basic need for all human beings and it is unavoidable daily routine process. The conventional road cleaning machine is most widely used in railway stations, airports, hospitals, Bus stands, etc. also this machine needs electrical energy for its operation. It is not user friendly as well as eco-friendly. In summer time there is power crisis and most of the roads cleaning machines are not used effectively due to this problem particularly.

2 LITERATURE SURVEY

2.1 Design & analysis of manually Operated eco-friendly road Cleaner by Prof. Dr. A. Muniaraj, Aravind, K, Kadamban, T, Thirumalai Balaji.

Cleaning has become a basic need for all human beings and it is unavoidable daily routine process. The conventional road cleaning machine is most widely used in railway stations, airports, hospitals, Bus stands, etc. also this machine needs electrical energy for its operation. It is not user friendly as well as eco-friendly. In summer time there is power crisis and most of the roads cleaning machines are not used effectively due to this problem particularly. In our project we are using easily available materials with low cost. It is the better alternative for conventional machine.

In recent years, most of the people prefer to use trains or buses for commuting and hence these places are littered with biscuits covers, cold drink bottles etc. Hence, it is necessary to clean the bus stands and railways stations at regular interval. There is no one single cleaning method that is suitable for all locations and occasions and effective cleaning depends upon type of cleaning device, cleaning technique and also the equipment should be user friendly.

2.2 Design of Dust Collector for Rear Wheel of Four-Wheeler by Abhishek Chakraborty, Ashutosh Bansal

Vehicle traffic is responsible for the suspended road dust. Substantial fraction of PM10 in urban air is mainly due to non-exhaust traffic emissions and re-suspension from street surfaces. These road non-exhaust emissions are often uncontrolled and information about the effectiveness of mitigation measures on paved roads is still scarce. The present work is aimed to design a dust collector system for high clearance four-wheelers to minimize the level of non-exhaust emissions to some extent. The model consists of a centrifugal fan to absorb dust before it spreads and pollutes the air, which is to be placed on and above the rear side of a wheel. Calculation is performed to determine the accuracy of the model by using the reference concentrations of fugitive dust generated by a vehicle travelling on road. This system will help in controlling or decreasing the dust concentration behind a vehicle. The modeling and designing of the system is done on CatiaV5 to get better results.

The most significant donor of fugitive road dust to the total suspended particulate burden is vehicle traveling on paved and unpaved' surfaces. Dust is rarely considered as a cause of road accidents on police reports. 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. Around 40% of the total dust emission emits from the vehicle activities on road.

2.3 Design & Development of Road Side Cleaning Machine by Ashish Patil, Pranav Patil, Jaywant Patil, Rohit Ingawale, Sanket Nalawade, Amar Patil.

Our study shows that dirt besides the road causes uncleanness and accident problems. We had developed a semiautomatic road side cleaning machine that insures that dust and dirt in sides of road should be clean. Our design proposes and successfully implemented the use of scrubber and brush that will remove the dust and collect it into the storage box in which the scrubber is

driven by engine which removes the dust and throws it into the path of brush. This brush is driven by speed amplification mechanism which consists of chain and gear drive separately. The motion of brush allows pushing the removed dust into the storage box. This is the best alternative method for cleaning road side dust.

2.4 Design and Fabrication of Multipurpose Eco- Friendly Cleaning Machine by Praveen H, Harish Gowda GR, Anil G Ramageri, Arunkumar Kallammanavar, Prasanna P Kulkarni, Girish B Kallihal

In our project we are aimed to use easily available materials with low cost and it can be easily fabricated and easy to use and control. It is the better alternative for conventional machine. The manually operated eco-friendly road and floor cleaner can work very efficiently with respect to covering area, time and cost of road cleaning process compared with the existing machineries. Also it is economical to use.

Hence, it is necessary to clean the bus stands and railways stations at regular interval. There is no one single cleaning method that is suitable for all locations and occasions and effective cleaning depends upon type of cleaning device, cleaning technique and also the equipment should be user friendly. Cleaning work can be physically demanding and a need has been identified to developed methods for systematic ergonomic evaluation of new products. In recent years, floor cleaning robots are getting more popular for busy and aging populations due to lack of workers.

2.5 Design and development of tricycle operated street cleaning machine by sandeep j. Meshram, dr.g.d.mehta.

This paper presents the design and fabrication of Tricycle operated street cleaning machine with the related search. At present we have few automated machines which are foreign made and can be used in our country. But the fact is that those machine are designed keeping in mind that their road condition. Here, in Indian market, the conditions are very different. On other hand in ruler area the road cleaning is done by an manual operation which renders fatigue hazards like asthma, bronchitis etc. to the worker. This basically instigates to thing for an alternative mechanism called Street cleaning process.

A tricycle operated street cleaning machine seems an alternative concept for avoiding such problems enlisted in first point. The tricycle operated machine can work very efficiently with respect to covering area, time and cost of street cleaning process compared with the existing machineries. Also it is economical. It was seen while testing of machine, that the cleaning is less effective where the street seems to be very rough and damaged.

A proposed solution over the present state of art is being explained through this article. A solution is the evolution of a unique machine, which would run with the help of human power

3.1 PROBLEM STATEMENT

It is found that the existing street cleaning machines uses petrol and diesel. It can cause pollution and also the vibration produced in the machine causes noise pollution. While manual cleaning may cause health problem as the person directly comes in contact with dust. Also, the shoulder problem due to continuously sweeping occurs.

Now, workers are hired to do this stuff but it is impossible to work continuously for workers. So this is time consuming and also costly process because of workers salary. The important factor is eliminating traffic problem because of less manpower as well as accident.

Solar operated street cleaning machine seems an alternative concept for avoiding such problems enlisted in first point

The running cost of machine is low and initial cost of machine is covered by saving of workers salary.

3.2 OBJECTIVES

1) Remove the dust from road by the use of scrubber which is rotate by using wheel motion.

2) Cleaning of dust and dirt by use of brush.

3) Collecting the dust into the collector tank.

4) Develop eco-friendly road cleaning technique.

5) Reduce the road cleaning cost.

6) To reduce human efforts.

7) To avoid noise pollution

8) Cleaning of dust and dirt by use of brush.

9) To support “SWACH BHARAT ABHIYAN”

4 Methodology

Phase I

Work on project concept

We started our work with literature survey.

↓

Search many research papers from various articles and published journal papers.

↓

Then we collected all the topic related data from these research papers and studied them in detailed manner along with the standard reference books and academic books.

↓

Reference sites:

1. http://explore.ijert.org/
2. http://www.ijetcse.com/
3. http://industrialscience.org/
4. http://www.ijist.net/

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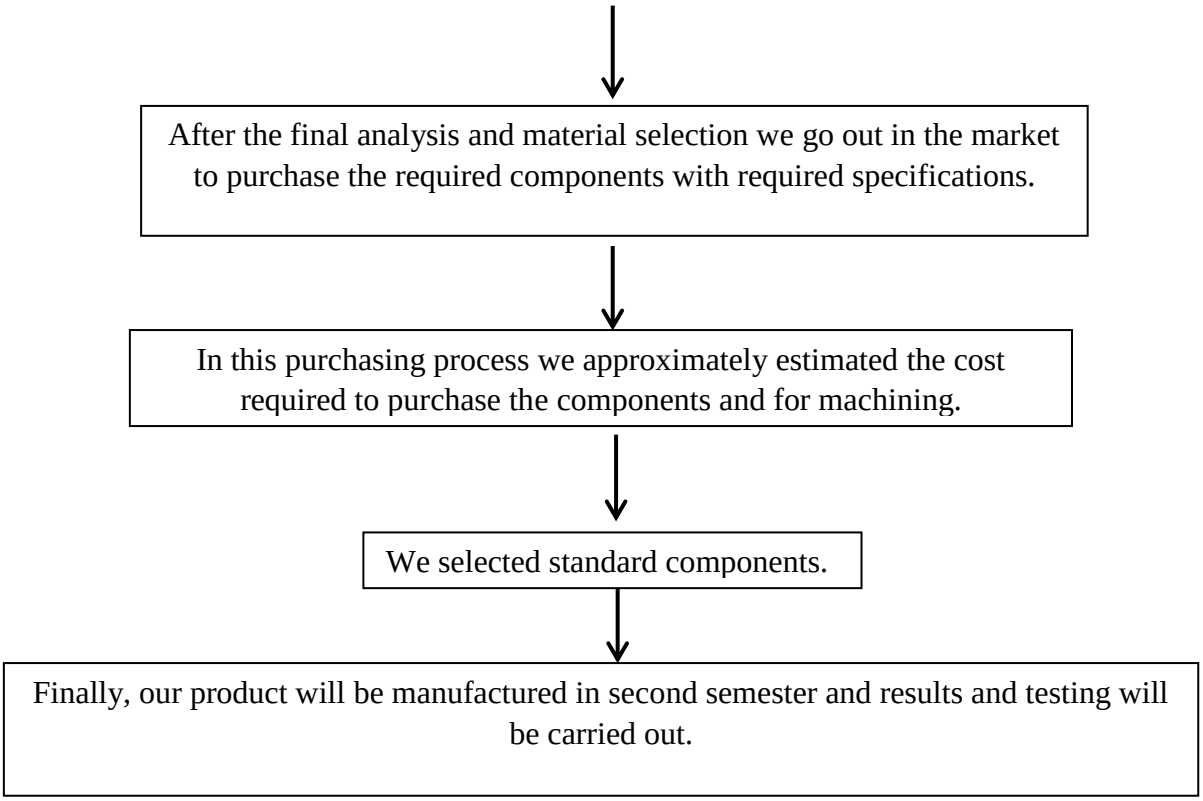
Worked on diff. Mechanisms that can be useful for our project.

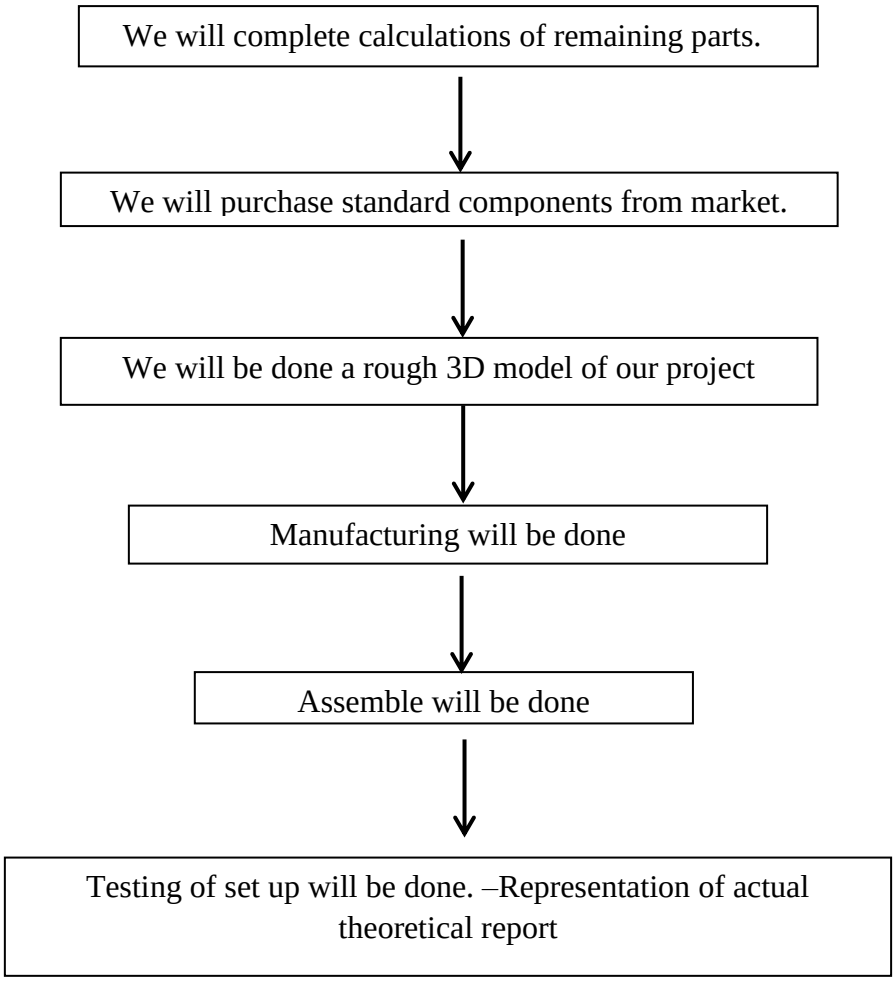
↓

We have done a rough 2D sketch of model in Auto-CAD.


After the final analysis and material selection we go out in the market to purchase the required components with required specifications.
In this purchasing process we approximately estimated the cost required to purchase the components and for machining.
We selected standard components.
Finally, our product will be manufactured in second semester and results and testing will be carried out.

PHASE II

Actual preparation of project:



5.1 DESIGN OF THE BASIC COMPONENTS

Computer-aided design (CAD) is the use of computers to aid in the creation, modification, analysis, or optimization of a design. CAD software is used to increase the productivity of the designer, improve the quality of design, improve communications through documentation, and to create a database for manufacturing. CAD output is often in the form of electronic files for print, machining, or other manufacturing operations.

CAD is used as follows:

1. To produce detailed engineering designs through 3-D and 2-D drawings of the physical components of manufactured products.
2. To create conceptual design, product layout, strength and dynamic analysis of assembly and the manufacturing processes themselves.
3. To prepare environmental impact reports, in which computer-aided designs are used in photographs to produce a rendering of the appearance when the new structures are built.

CAD systems exist today for all of the major computer platforms, including Windows, Linux, UNIX and Mac OS X. The user interface generally centers around a computer mouse, but a pen and digitizing graphic tablet can also be used. View manipulation can be accomplished with a space mouse (or space ball). Some systems allow stereoscopic glasses for viewing 3-D models. In our olden days, engineers, designers and draughts men were struggling to produce and submit engineering drawings in their scheduled times. It was mainly due to tremendous efforts they had taken to produce both new drawings and edited/updated drawings. Every lines, shapes, measurements, scaling of the drawings - all made them headache to the design / drafting field. All these difficulties and pressures over-ridden by **Computer Aided Design Drafting (CAD Drafting)** technology.

The advantages of CAD include: the ability to producing very accurate designs; drawings can be created in 2D or 3D and rotated; other computer programs can be linked to the design software. With manual drafting, you must determine the scale of a view before you start drawing. This scale compares the size of the actual object to the size of the model drawn on paper. With CAD, you first decide what units of measurement you will use, and then draw your model at 1:1 scale, should one of the main benefits of CAD. When you draft manually, you first select a sheet, which usually includes a pre-printed border and title block. Then you determine the location for views' plans, elevations, sections, and details. Finally, you start to draw. With CAD, you first draw your design, or model, in a working environment called model space. You can then create a layout for that model in an environment called paper space.

A layout represents a drawing sheet. It typically contains a border, title block, dimensions, general notes, and one or more views of the model displayed in layout viewports.

Layout viewports are areas, similar to picture frames or windows, through which you can see your model. You scale the views in viewports by zooming in or out. Manual drafting requires meticulous accuracy in drawing line-types, line-weights, text, dimensions, and more. Standards must be established in the beginning and applied consistently. With CAD, you can ensure conformity to industry or company standards by creating styles that you can apply consistently. You can create styles for text, dimensions, and line-types.

With manual drafting, you use drawing tools that include pencils, scales, compasses, parallel rules, templates, and erasers. Repetitive drawing and editing tasks must be done manually .In CAD, you can choose from a variety of drawing tools that create lines, circles, spline curves, and more. You can easily move, copy, offset, rotate, and mirror objects. You can also copy objects between open drawings. With manual drafting, you must draw objects carefully to ensure correct size and alignment. Objects drawn to scale must be manually verified and dimensioned. With CAD, you can use several methods to obtain exact dimensions. The simplest method is to locate points by snapping to an interval on a rectangular grid. Another method is to specify exact coordinates. Coordinates specify a drawing location by indicating a point along an X and Y axis or a distance and angle from another point. With object snaps, you can snap to locations on existing objects, such as an endpoint of an arc, the midpoint of a line, or the centre point of a circle. With polar tracking, you can snap to previously set angles and specify distances along those angles. Revisions are a part of any drawing project. Whether you work on paper or with CAD, you will need to modify your drawing in some way. On paper, you must erase and redraw to make revisions to your drawing manually. CAD eliminates tedious manual editing by providing a variety of editing tools. If you need to copy all or part of an object, you don't have to redraw it. If you need to remove an object, you can erase it with a few clicks of the mouse. And if you make an error, you can quickly undo your actions. Once you draw an object, you never need to redraw it.

To work efficiently using the cad the organisation must focus on the following areas where it needs to be on upper side.

1. Most popular CAD software like AutoCAD, ProgeCAD, and Micro station are high priced for individuals. Alternatively, individuals can try free open source CAD drafting software QCAD, LibreCAD and Opens CAD.

2. Every new release of the CAD software, operator has to update their skills.

3. Improper use of blocks and layers make updating and modification of the drawings a cumbersome task for another person.

The user interface generally centers on a computer mouse, but a pen and digitizing graphic tablet can also be used. View manipulation can be accomplished with a space mouse (or space ball). Some systems allow stereoscopic glasses for viewing 3-D models. In our olden days, engineers, designers and draughts men were struggling to produce and submit engineering drawings in their scheduled times. It was mainly due to tremendous efforts they had taken to produce both new drawings and edited/updated drawings.

You can easily move, copy, offset, rotate, and mirror objects. You can also copy objects between open drawings. With manual drafting, you must draw objects carefully to ensure correct size and alignment. Objects drawn to scale must be manually verified and dimensioned. With CAD, you can use several methods to obtain exact dimensions. The simplest method is to locate points by snapping to an interval on a rectangular grid. Another method is to specify exact coordinates. Coordinates specify a drawing location by indicating a point along an X and Y axis or a distance and angle from another point. With object snaps, you can snap to locations on existing objects, such as an endpoint of an arc, the midpoint of a line, or the centre point of a circle. With polar tracking, you can snap to previously set angles and specify distances along those angles. Revisions are a part of any drawing project. Whether you work on paper or with CAD, you will need to modify your drawing in some way.

CAD is also used for the accurate creation of photo simulations that are often required in the preparation of environmental impact reports, in which computer-aided designs of intended buildings are superimposed into photographs of existing environments to represent what that locale will be like, where the proposed facilities are allowed to be built. Potential blockage of view corridors and shadow studies are also frequently analysed through the use of CAD.[9]

CAD has been proven to be useful to engineers as well. Using four properties which are history, features, parameterization, and high-level constraints. The construction history can be used to look back into the model's personal features and work on the single area rather than the whole model. Parameters and constraints can be used to determine the size, shape, and other properties of the different modelling elements. The features in the CAD system can be used for the variety of tools for measurement such as tensile strength, yield strength, electrical, or electromagnetic properties. Also its stress, strain, timing, or how the element gets affected in certain temperatures, etc.

There are several different types of CAD. Each requiring the operator to think differently about how to use them and design their virtual components in a different manner for each.

There are many producers of the lower-end 2D systems, including a number of free and open source programs. These provide an approach to the drawing process without all the fuss over scale and placement on the drawing sheet that accompanied hand drafting since these can be adjusted as required during the creation of the final draft. 3D wireframe is basically an extension

of 2D drafting (not often used today). Each line has to be manually inserted into the drawing. The final product has no mass properties associated with it and cannot have features directly add to it, such as holes. The operator approaches these in a similar fashion to the 2D systems, although many 3D systems allow using the wireframe model to make the final engineering drawing views.

3D "dumb" solids are created in a way analogous to manipulations of real-world objects (not often used today). Basic three-dimensional geometric forms (prisms, cylinders, spheres, and rectangle) have solid volumes added or subtracted from them as if assembling or cutting real-world objects. Two-dimensional projected views can easily be generated from the models. Basic 3D solids don't usually include tools to easily allow the motion of the components, set their limits to their motion, or identify interference between components.

There are two types of 3D solid modelling

Parametric modelling allows the operator to use what is referred to as "design intent". The objects and features are created modifiable. Any future modifications can be made by changing on how the original part was created. If a feature was intended to be located from the center of the part, the operator should locate it from the center of the model. The feature could be located using any geometric object already available in the part, but this random placement would defeat the design intent. If the operator designs the part as it functions the parametric modeller is able to make changes to the part while maintaining geometric and functional relationships.

Direct or explicit modelling provide the ability to edit geometry without a history tree With direct modelling, once a sketch is used to create geometry the sketch is incorporated into the new geometry and the designer just modifies the geometry without needing the original sketch. As with parametric modelling, direct modelling has the ability to include the relationships between selected geometry (e.g., tangency, concentricity).

The top-end systems offer the capabilities to incorporate more organic, aesthetic and ergonomic features into the designs. Freeform surface modelling is often combined with solids to allow the designer to create products that fit the human form and visual requirements as well as they interface with the machine.

5.2 GEOMETRIC DIAMENSIONS AND TOLARANCES

GD&T is a system for defining and communicating engineering tolerances. It uses a symbolic language on engineering drawings and computer-generated three-dimensional solid models that explicitly describe nominal geometry and its allowable variation. It tells the manufacturing staff and machines what degree of accuracy and precision is needed on each controlled feature of the part. GD&T is used to define the nominal (theoretically perfect) geometry of parts and assemblies, to define the allowable variation in form and possible size of individual features, and to define the allowable variation between features.

There are several standards available worldwide that describe the symbols and define the rules used in GD&T. One such standard is American Society of Mechanical Engineers (ASME) Y14.5. This article is based on that standard, but other standards, such as those from the International Organization for Standardization (ISO), may vary slightly. The Y14.5 standard has the advantage of providing a fairly complete set of standards for GD&T in one document. The ISO standards, in comparison, typically only address a single topic at a time. There are separate standards that provide the details for each of the major symbols and topics below (e.g. position, flatness, profile, etc.).

Exchange of geometric dimensioning and tolerancing (GD&T) information between CAD systems is available on different levels of fidelity for different purposes:

- In the early days of CAD, exchange-only lines, texts and symbols were written into the exchange file. A receiving system could display them on the screen or print them out, but only a human could interpret them.

- GD&T presentation: On a next higher level the presentation information is enhanced by grouping them together into callouts for a particular purpose, e.g. a datum feature callout

  and a datum reference frame. And there is also the information which of the curves in the file are leader, projection or dimension curves and which are used to form the shape of a product.

- An enhancement of GD&T representation is defining a formal language for GD&T (similar to a programming language) which also has built-in rules and restrictions for the proper GD&T usage. This is still a research area (see below reference to McCaleb and ISO 10303-1666).
- GD&T validation: Based on GD&T representation data (but not on GD&T presentation) and the shape of a product in some useful format (e.g. a boundary representation), it is possible to validate the completeness and consistency of the GD&T information. The software tool FBTol from the Kansas City Plant is probably the first one in this area.

- GD&T representation information can also be used for the software assisted manufacturing planning and cost calculation of parts. See ISO 10303-224 and 238 below.

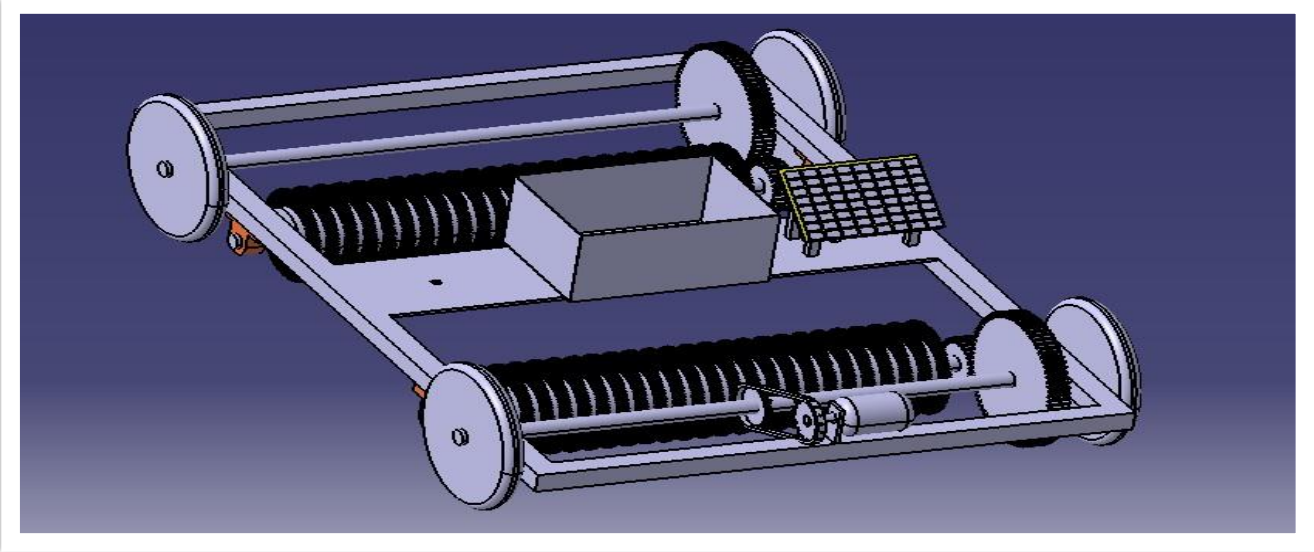


Fig.1 CATIA model

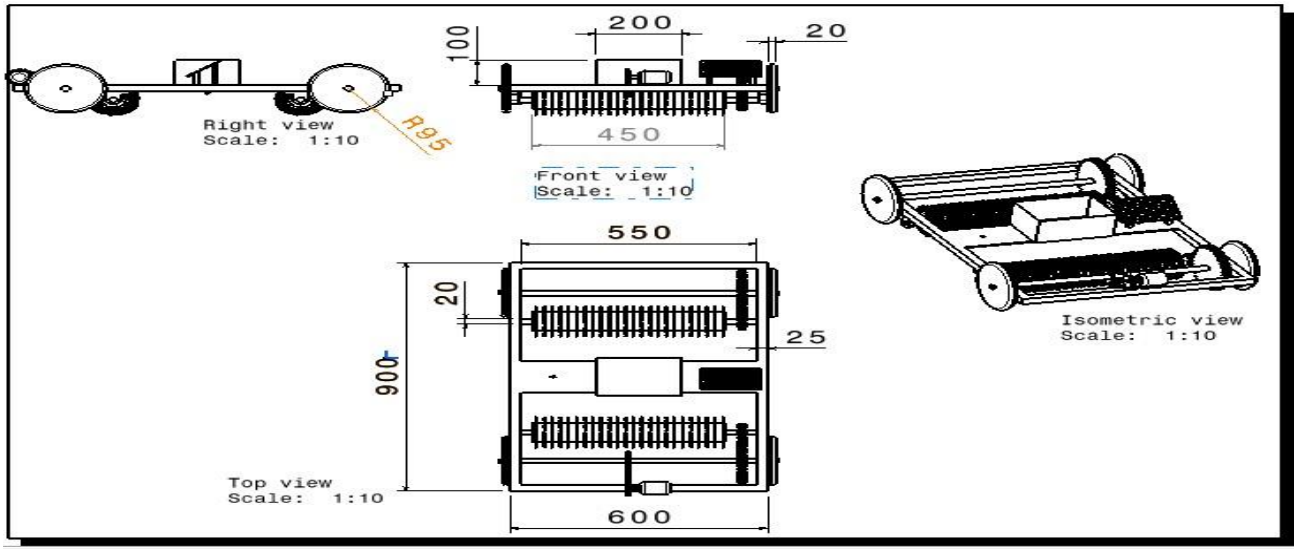


Fig.2 CAD model

6 COMPONENTS

1) Brush
2) Chain drive
3) Gear pair
4) wheel
5) Solar Panel
6) Motor

6.1 Brush

Fig.3 Brush

The cleaning brush is located at outside of the machine and it is mounted on the shaft which is rotated with the help of chain and sprocket unit. The main work of the brush is to push the Garbage into storage tank.

A brush is a common tool with bristles, wire or other filaments. It generally consists of a handle or block to which filaments are affixed in either a parallel or perpendicular orientation, depending on the way the brush is to be gripped during use. The material of both the block and

bristles or filaments is chosen to withstand hazards of its intended use, such as corrosive chemicals, heat or abrasion. It is used for cleaning, grooming hair, make up, painting, surface finishing and for many other purposes.

It is one of the most basic and versatile tools in use today, and the average household may contain several dozen varieties. A common way of setting the bristles, brush filaments, in the brush is the staple or anchor set brush in which the filament is forced with a staple by the middle into a hole with a special driver and held there by the pressure against all of the walls of the hole and the portions of the staple nailed to the bottom of the hole.

The staple can be replaced with a kind of anchor, which is a piece of rectangular profile wire that is anchored to the wall of the hole, like in most toothbrushes. Another way to attach the bristles to the surface can be found in a fused brush, in which instead of being inserted into a hole, a plastic fibre is welded to another plastic surface, giving the option to use different diameters of bristles in the same brush.

6.2 Chain drive

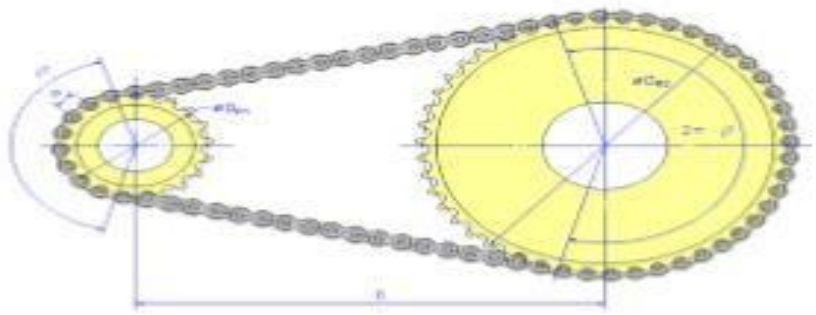


Fig.4 Chain drive

The main disadvantage of the belt drives and the rope drives is that the velocity ratio does not remain constant, but varies on account of slip. Since chain drives are positive drives there is no slip, hence the velocity ratio will remain constant.

Chain drive is a way of transmitting mechanical power from one place to another. It is often used to convey power to the wheels of a vehicle, particularly bicycles and motorcycles. It is also used in a wide variety of machines besides vehicles.

Most often, the power is conveyed by a roller chain, known as the drive chain or transmission

chain, passing over a sprocket gear, with the teeth of the gear meshing with the holes in the links of the chain. The gear is turned, and this pulls the chain putting mechanical force into the system.

Another type of drive chain is the Morse chain, invented by the Morse Chain Company of Ithaca, New York, United States. This has inverted teeth.

Sometimes the power is output by simply rotating the chain, which can be used to lift or drag objects. In other situations, a second gear is placed and the power is recovered by attaching shafts or hubs to this gear. Though drive chains are often simple oval loops, they can also go around corners by placing more than two gears along the chain; gears that do not put power into the system or transmit it out are generally known as idler-wheels. By varying the diameter of the input and output gears with respect to each other, the gear ratio can be altered. For example, when the bicycle pedals' gear rotate once, it causes the gear that drives the wheels to rotate more than one revolution.

The chains are made up of rigid links which are hinged together in order to provide the necessity flexibility for wrapping around the driving and driven wheel. The wheels have projecting teeth and fit into corresponding recesses. The wheels and the chains are thus constrained to move together without slipping and ensure the perfect velocity ratio. The toothed wheels are known as sprocket wheel.

The main difference between the two drives is that a chain drive is powered by a chain loop, while a belt drive is powered by a belt. 2. Another notable difference is the material of the drive. Chain drives are made of metal, which makes them more durable and stronger compared to a belt.

Highly efficient, chain drives gives the advantage of more power compared to belts. It can be used for both small and large center distances. Chain drives have low maintenance cost. They give a high transmission efficiency of up to 98 percent.

Types of chain drive:

There’s a wide variety of different chain drive designs developed due to finding use in many different mechanical applications. They can be classified into various categories depending on what we choose as a yardstick. When classifying based on their function, chain drives can be divided into three main types.

1. Power transmission chain drive

2. Conveyor chain drive

3. Hoisting and hauling chain drive

4. Power transmission chain drive

This type of chain drive is specifically used for transmitting power between two shafts. Most machines that produce power cannot consume it at the same place, e.g. pumps with attached motors. Transmission systems convey power to the consumer through different methods. When chains are used for this process, they are known as power transmission chains.

Common examples are bikes, agricultural machinery, compressors, engine camshafts, etc. All these applications use chain drives for power transmission.

- Conveyor chain drive

Another common application for chain drives is conveyor chains. Conveyors use chain drives that are crafted especially for material transportation. They come in hundreds of different designs and sport features such as low friction, high temperature- and chemical resistance. They can also be anti-static and magnetic.

Conveyor chain drives find use in industries such as packaging, automotive, food and beverage production, pharmaceuticals and textiles. Attachments can be fitted to conveyor chains to adapt them for various uses.

- Hoisting and hauling chain drive

Chain hoists are probably the most common piece of machinery used to lift and lower equipment. They can lift massive weights with very little effort using pulleys.

Hand chain hoists or chain blocks are a common sight in garages, workshops, construction sites, ship engine rooms and in many factories. They can lift/lower heavy loads going up to 20 tonnes. Hoisting chains can be pneumatic, electrical or manual.

We will be focusing on the different types of chains in the next section but since hoisting chains are rather straightforward in their design and field of application, we'll be covering them here. Hoist chains can be divided into two categories:

- Oval link chains
- Stud link chains

Types of Chains in Use

There are many types of chains used in chain drives, each with its own advantages and disadvantages. The five most common types in use are as follows:

- Roller chain (bush roller chain)
- Silent chain or inverted tooth chain
- Leaf chain

- Flat-top chain
- Engineering steel chain

6.3 Gear pair

A gear or cogwheel is a rotating machine part having cut teeth or, in the case of a cogwheel, inserted teeth (called cogs), which mesh with another toothed part to transmit torque. Geared devices can change the speed, torque, and direction of a power source. Gears almost always produce a change in torque, creating a mechanical advantage, through their gear ratio, and thus may be considered a simple machine.

Fig.5 Gear drive

The teeth on the two meshing gears all have the same shape. Two or more meshing gears, working in a sequence, are called a gear train or a transmission. A gear can mesh with a linear toothed part, called a rack, producing translation instead of rotation. The gears in a transmission are analogous to the wheels in a crossed, belt pulley system. An advantage of gears is that the teeth of a gear prevent slippage.

When two gears mesh, if one gear is bigger than the other, a mechanical advantage is produced, with the rotational speeds, and the torques, of the two gears differing in proportion to their diameters. In transmissions with multiple gear ratios—such as bicycles, motorcycles, and cars the term "gear" as in "first gear" refers to a gear ratio rather than an actual physical gear. The term describes similar devices, even when the gear ratio is continuous rather than discrete, or

when the device does not actually contain gears, as in a continuously variable transmission. Spur gears or straight-cut gears are the simplest type of gear. They consist of a cylinder or disk with teeth projecting radically.

6.4 wheels

The invention of the solid wooden disk wheel falls into the late Neolithic, and may be seen in conjunction with other technological advances that gave rise to the early Bronze Age. This implies the passage of several wheel-less millennia even after the invention of agriculture and of pottery, during the A ceramic Neolithic.

In its primitive form, a wheel is a circular block of a hard and durable material at whose center has been bored a circular hole through which is placed an axle bearing about which the wheel rotates when a moment is applied by gravity or torque to the wheel about its axis, thereby making together one of the six simple machines. When placed vertically under a load-bearing platform or case, the wheel turning on the horizontal axle makes it possible to transport heavy loads; when placed horizontally, the wheel turning on its vertical axle makes it possible to control the spinning motion used to shape materials (e.g. a potter's wheel); when mounted on a column connected to a rudder or a chassis mounted on other wheels, one can control the direction of a vessel or vehicle (e.g. a ship's wheel or steering wheel); when connected to a crank or engine, a wheel can store, release, or transmit energy

Fig. 6 Wheels

6.5 Solar panel

Solar panels are those devices which are used to absorb the sun’s rays and convert them into electricity or heat. A solar panel actually a collection of 9or photovoltaic0 cells, which can be used to generate electricity through photovoltaic effect. These cells are arranged in a grid-like

pattern on the surface of solar panels. Thus it may also be described as a set of photovoltaic modulus, mounted on a structure supporting it. A photovoltaic module is a packaged and connected assembly of solar cells. Installation of solar panels in homes helps in combating the harmful emissions of greenhouse gases and thus helps reduce global warming. Solar panels do not lead to any form of pollution and are clean. They also decrease our reliance on fossil fuels (which are limited) and traditional power sources.

Solar panels collect clean renewable energy in the form of sunlight and convert that light into electricity which can then be used to provide power for electrical loads. Solar panels are comprised of several individual solar cells which are themselves composed of layers of silicon, phosphorous (which provides the negative charge), and boron (which provides the positive charge). Solar panels absorb the photons and in doing so initiate an electric current. The resulting energy generated from photons striking the surface of the solar panel allows electrons to be knocked out of their atomic orbits and released into the electric field generated by the solar cells which then pull these free electrons into a directional current. This entire process is known as the Photovoltaic Effect. An average home has more than enough roof area for the necessary number of solar panels to produce enough solar electricity to supply all of its power needs excess electricity generated goes onto the main power grid, paying off in electricity use at night.

Fig.7 Solar panel

The major types of solar panels

There are three major types of solar panels: monocrystalline, polycrystalline, and thin-film. Each

type has its own unique advantages and disadvantages, and the solar panel type best suited for your installation will depend on factors specific to your own property and desired system characteristics.

What type of solar panel is best?

Crystalline solar panels have the highest efficiency out of all panels.

Monocrystalline panels are between 15-20% efficient, making them the most efficient of all crystalline panels

Polycrystalline panels are between 15-17% efficient and can be the most cost effective option.

Thin film solar panels are best for unorthodox roof styles and are the most resilient.

What are different solar panels made of?

To produce electricity, solar cells are made from a semiconducting material that converts light into electricity. The most common material used as a semiconductor during the solar cell manufacturing process is silicon.

Monocrystalline and polycrystalline solar panels

Both monocrystalline and polycrystalline solar panels have cells made of silicon wafers. To build a monocrystalline or polycrystalline panel, wafers are assembled into rows and columns to form a rectangle, covered with a glass sheet, and framed together.

While both of these types of solar panels have cells made from silicon, monocrystalline and polycrystalline panels vary in the composition of the silicon itself. Monocrystalline solar cells are cut from a single, pure crystal of silicon. Alternatively, polycrystalline solar cells are composed of fragments of silicon crystals that are melted together in a mold before being cut into wafers.

Thin-film solar panels

Unlike monocrystalline and polycrystalline solar panels, thin-film panels are made from a variety of materials. The most prevalent type of thin-film solar panel is made from cadmium telluride (CdTe). To make this type of thin-film panel, manufacturers place a layer of CdTe between transparent conducting layers that help capture sunlight. This type of thin-film technology also has a glass layer on the top for protection.

Lastly, Copper Indium Gallium Selenide (CIGS) panels are another popular type of thin-film technology. CIGS panels have all four elements placed between two conductive layers (i.e. glass,

plastic, aluminium, or steel), and electrodes are placed on the front and the back of the material to capture electrical currents.

What do different solar panel types look like?

The differences in materials and production cause differences in appearance between each type of solar panel:

Monocrystalline solar panels: the most efficient option

If you see a solar panel with black cells, it's most likely a monocrystalline panel. These cells appear black because of how light interacts with the pure silicon crystal.

While the solar cells themselves are black, monocrystalline solar panels have a variety of colours for their back sheets and frames. The back sheet of the solar panel will most often be black, silver or white, while the metal frames are typically black or silver.

Polycrystalline solar panels: can be a more cost effective option

Unlike monocrystalline solar cells, polycrystalline solar cells tend to have a bluish hue to them due to the light reflecting off the silicon fragments in the cell in a different way than it reflects off a pure monocrystalline silicon wafer.

Similar to monocrystalline, polycrystalline panels have different colors for back sheets and frames. Most often, the frames of polycrystalline panels are silver, and the back sheets are either silver or white.

Thin-film solar panels

The biggest differentiating aesthetic factor when it comes to thin-film solar panels is how thin and low-profile the technology is. As their name suggests, thin-film panels are often slimmer than other panel ty[es. This is because the cells within the panels are roughly 350 times thinner than the crystalline wafers used in monocrystalline and polycrystalline solar panels.

It's important to keep in mind that while the thin-film cells themselves may be much thinner than traditional solar cells, an entire thin-film panel may be similar in thickness to a monocrystalline or polycrystalline solar panel if it includes a thick frame. There are adhesive thin-film solar panels that lie as-close-as-possible to the surface of a roof, but there are more durable thin-film panels that have frames up to 50 millimetres thick.

As far as colour goes, thin-film solar panels can come in both blue and black hues, depending on what they're made from.

Solar panel power and efficiency ratings

Each type of solar panel varies in the amount of power it can produce.

Monocrystalline and polycrystalline solar panels

Of all panel types, monocrystalline panels typically have the highest efficiencies and power capacity. Monocrystalline solar panels can reach efficiencies higher than 20 percent, while polycrystalline solar panels usually have efficiencies between 15 to 17 percent.

Monocrystalline solar panels tend to generate more power than other types of panels not only because of their efficiency but because they have come in higher wattage modules as well. Most monocrystalline solar panels come with more than 300 watts (W) of power capacity, some now even exceeding 400 W. Polycrystalline solar panels, on the other hand, tend to have lower wattages.

This doesn't mean that monocrystalline and polycrystalline solar panels aren't physically the same size – in fact, both types of solar panels tend to come with 60 silicon cells each, with 72 or 96 cell variants (usually for large-scale installations). But even with the same number of cells, monocrystalline panels are capable of producing more electricity.

Thin-film solar panels

Thin-film solar panels tend to have lower efficiencies and power capacities than monocrystalline or polycrystalline varieties. Efficiencies will vary based on the specific material used in the cells, but they usually have efficiencies closer to 11 percent.

Unlike monocrystalline and polycrystalline solar panels that come in standardized 60, 72 and 96 cell variants, thin-film technology does not come in uniform sizes. As such, the power capacity from one thin-film panel to another to another will largely depend on its physical size. Generally speaking, the power capacity per square foot of monocrystalline or polycrystalline solar panel will exceed thin-film panel technology.

Different types of solar panels have varying costs

The manufacturing processes differ between monocrystalline, polycrystalline, and thin-film; as such, each type of panel comes with a different price tag.

Monocrystalline solar panels: the highest cost option

Of all types of solar panels, monocrystalline panels are likely to be the most expensive option. This is largely due to the manufacturing process – because the solar cells are made from a single silicon crystal, manufacturers have to absorb the costs of creating these crystals. This process,

known as the Czochralski process, is energy-intensive and results in wasted silicon (that can later be used to manufacture polycrystalline solar cells).

Polycrystalline solar panels: middle of the road

Polycrystalline solar panels are typically cheaper than monocrystalline solar panels. This is because the cells are produced from silicon fragments rather than a single, pure silicon crystal. This allows for a much simpler cell manufacturing process, thus costing less for manufacturers and eventually end-users.

6.6 Motor

Fig.8 Motor

An electric motor is an electrical machine that converts electrical energy into mechanical energy. Most electric motors operate through the interaction between the motor's magnetic field and winding currents to generate force in the form of rotation. Electric motors can be powered by direct current (DC) sources, such as from batteries, motor vehicles or rectifiers, or by alternating current (AC) sources, such as a power grid, inverters or electrical generators. An electric generator is mechanically identical to an electric motor, but operates in the reverse direction, accepting mechanical energy (such as from flowing water) and converting this mechanical energy into electrical energy. Electric motors may be classified by considerations such as power source type, internal construction, application and type of motion output. In addition to AC versus DC types, motors may be brushed or brushless, may be of various phase (see single-phase, two-phase,

or three- phase), and may be either air-cooled or liquid-cooled General-purpose motors with standard dimensions and characteristics provide convenient mechanical power for industrial use. The largest electric motors are used for ship propulsion, pipeline compression and pumped-storage applications with ratings reaching 100 megawatts.

Electric motors are found in industrial fans, blowers and pumps, machine tools, household appliances, power tools and disk drives. Small motors may be found in electric watches. In certain applications, such as in regenerative braking with traction motors, electric motors can be used in reverse as generators to recover energy that might otherwise be lost as heat and friction. Electric motors produce linear or rotary force (torque) and can be distinguished from devices such as magnetic solenoids and loudspeakers that convert electricity into motion but do not generate usable mechanical force, which are respectively referred to as actuators and transducers.

Sr. no.	**Particulars**	**Details**
1	Current rating	2A
2	Voltage rating	12V
3	Power consumption	24 watts
4	Torque	7630Nmm (7.63 Nm)

Table no. 1: Specification of motor

6.7 Battery Datasheet

Fig.9 Battery

Common specifications 12 V 8Ah Sealed Lead Acid Rechargeable Battery Model –TLV1280F1

Terminals –F1-0.187
Length-150mm
Widht-65mm
Height- 94mm
High Performance
Features of the TLV1280F1 - 12V 8Ah Sealed Lead Acid Battery with F1 Terminals
• Absorbent Glass Mat (AGM) technology for efficient gas recombination of up to 99% and freedom from electrolyte maintenance or water adding
• Not restricted for air transport-complies with IATA/ICAO Special Provision A67
• UL-recognized component
• Can be mounted in any orientation
• Computer designed lead, calcium tin alloy grid for high power density
• Long service life in float or cyclic applications
• Maintenance-free operation
• Low self-discharge

Common Applications
• Commonly used in home and office alarm systems
• Fire panel battery backup
• Select models of children's ride on toys
• Medical devices
• Fish finders and outdoor GPS gear
• Emergency Lighting
• Power packs

Product Specification:
Dimensions:
Terminal Type: F1
Length (mm/inch): 151/5.94
Width (mm/inch): 65/2.56
Height (mm/inch): 94/3.70
Total Height (mm/inch): 100/3.94
Approx. Weight (kg/lbs.): 2.45/5.40
Performance Characteristics Nominal Voltage: 12V
Nominal Capacity 77ºF (25ºC)
20HR (10.5V): 8Ah
10HR (10.5V): 7.9Ah
1HR (9.60V): 5.53Ah
Internal Resistance
Fully Charged battery 77ºF (25ºC): Approx. 20mΩ
Capacity Affected by Temperature (20 Hour)

40°C: 102%
25°C: 100
0°C: 85%
-15°C: 65%
Self-Discharge (25°C)
3 Month: Remaining Capacity: 91%
6 Month: Remaining Capacity: 82%
12 Month: Remaining Capacity: 65%
Nominal Operating Temperature: 25°C±3°C (77°F±5°F)
Operating Temperature Range Discharge: -15°C – 50°C (5°F – 122°F)
Charge: -10°C – 50°C (14°F – 122°F)
Storage: -20°C – 50°C (-4°F – 122°F)
Float Charging Voltage (25°C):
13.60 to 13.80V Temperature compensation: -18mV/°C
Cyclic Charging Voltage (25°C): 14.50 to 14.90V
Temperature compensation: -30mV/°C
Maximum Charging Current: 2.55A
Maximum Discharge Current: 127.5A (5 sec)
Terminal Material: Copper

7 WORKING PRINCIPLE OF ROAD CLEANING MACHINE

Eco friendly road cleaning machine is an advanced type of machine used for the roads or streets. The detail working of the Eco friendly road cleaning machine is explained below Eco friendly road cleaning machine we are making without using any power supply, fuels and engines .The machine is run by a human effort or a man power. The system is fixed with pair of wheels which are connected with the help of shaft.

The shaft makes the wheels connected to one and other .The wheels are moved for a desired position with a help of manual force which can handle is provided to move .The handle can be adjusted for a required height and provided three adjusting holes for it. A chain drive is connected to the wheels and gear at both sides.

The chain is moved according to the wheel and gear .the brush moving opposite direction of the wheels move and the brush brooms the waste present on the road also it dumps the waste into the waste collecting box. The waste collecting box is removed to dump the waste into desired places.

Fig.10 Project Model

8 BASIC DESIGN OF ROAD CLRANING

Selection of motor

Given data:

Estimated weight: - 17.5 KG

Time required to achieve speed (Acceleration time) - 15 sec

Coefficient of friction (ur):- 0.15

Desired speed of machine (final speed):- 1.8 KMPH

Total Wheel Force Required = Rolling Resistance + Acceleration Resistance

Acceleration Resistance Force = mass (kg) X Acceleration (m/s^2)

= mass X ((Final velocity –Initial velocity)/acceleration time)

= 17.5 ((1.8 X 1000)/ 3600 X 15)

= 0.5833 N

Rolling Resistance Force = mass X Gravity X coefficient of friction

= 17.5 X 9.8 X 0.15

= 25.725 N

Total Wheel Force Required = 0.5833 + 25.725

= 26.4 (Considering air drag also)

Distance Travelled for acceleration from 0 – 1.8 Kmph in 15 sec = s=ut + (½) x at^2

=0+ (0.5 x 0.12 x 15 x 15)

= 13.5

Required Wheel Power = Force (N) x Distance travelled (m) = 26.4 N x 13.5 m

= 356.4 J

Now 356.4 J Energy has been spent for 15 seconds

Then Power delivered = 23.76 J/sec = 23.76 watt

Power required for acceleration is 23.76 watt

Vehicle speed 1.8 Kmph = 0.5 m/s

Force required = 26.4 N

Time required = 1 hr. = 3600 sec

Distance travelled = speed x Time

= 0.5 m/s x 3600

= 1800 m

Required Energy = force x distance

= 26.4 x 1800

= 47520 J (13 watt)

Spur gear design:

Given data:

For 12V & 2A motor

Power = 24 watt

For w = 30, P = $2\pi NT/60$

T = 7.63 Nm
T = 7630Nmm
n_p = 30rpm
n_g = 60rpm
Power transmission = 24 watt (For 12V & 2A DC motor)

As the power transmission is very low & load is also low we select grey cast iron material for both gear and pinion.

Hence,

$(S_{ut})_p$ = 260 N/mm^2 = 197min ……. Brinell hardness

$(S_{ut})_g$ = 260 N/mm^2 = 197min ……. Brinell hardness

Let us consider N_f = 1 ……. (Factor of safety)

Also design by considering 20^0 full depth involve system

$\Phi = 20^0$ ……..…….. (DDB, page no. 17.3)

Face width of gear % pinion tooth b = 10m … (optimal value) (DDB, page no. 17.14)

Its range is 8m<b<12m

[A] Now no. of teeth is given as,

$G = n_p / n_g$

$= 30/60$

$= 0.5$

We know that,

$G = Z_p / Z_g$

$0.5 = Z_p / Z_g$

$0.5\ Z_p = Z_g$

For $\Phi = 20^0$, minimum no. of teeth is 17 it interference will occur

$Z_g = 17, Z_p = 34$ …….. (theroticaly)

$Z_p = 17, Z_p = 35$ …….. (practicaly)

[B] Now, beam strength is calculated as, $б_{bp} = (S_{ut})_p/3$

$= 260/3$

$= 86.66\ N/mm^2$

$б_{bg} = (S_{ut})_g/3$

$= 260/3$

$= 86.66\ N/mm^2$

Lewis form factor is given as,

$Y_p = 0.484 – (2.87/ Z_p)$

$= 0.484 – (2.87/ 35)$

$= 0.402$

$Y_g = 0.484 – (2.87/ Z_g)$

$= 0.484 – (2.87/ 17)$

$= 0.315$

So,

i. $б_{bp} \times Y_p = (86.66) * (0.402) = 34.837\ N/mm^2$
ii. $б_{bg} \times Y_g = (86.66) * (0.315) = 27.297\ N/mm^2$
As, ii < i gear is weaker than pinion in bending hence it is necessary to design gear for bending

$F_b = б_{bg} \times Y_g \times m \times b$

$= 27.297 \times 10m \times m$

$F_b = 272.97 \times m^2\ N$

[C] wear strength is calculated as,
$d_p = m \times Z_p$ $d_p = 35\ m$
$Q = 2\ Z_g/ (Z_g + Z_p)$

$= (2 \times 17)/(17 + 35)$

$Q = 0.653$

$K = 0.16\ [BHN/100]^2$

$= 0.16\ [197/100]^2$

$K = 0.620 N/mm^2$ Now,
$F_w = d_p \times b \times Q \times K$

$= 35m \times 10m \times 0.653 \times 0.620$

$F_w = 141.70 \times m^2\ N$

As $F_b < F_{w,}$ hence gear pair is weaker in pitting & hence it should be designed for safety against pitting failure.

[D] Effective load:

$V = \pi\ d_p\ n_p\ /60 \times 1000$

$= \pi\ 35m * 30/60 \times 1000$

$V = 0.054m\ m/s$

$F_t = P/V$

=24/0.054m

F_t = 444.45 s/m

$K_v = 3/(3 + V)$

$K_v = 3/ (3 + 0.054m)$

For very low accuracy V < 10 m/s

$F_{eff} = (K_a K_m F_t)/ K_v$ ……. (R. B. Patil table no. 1-13)

Here, $K_a = 1$, $K_m = 1.5$ (low power transmission system)

$F_{eff} = [1 \times 1.5]/ [3/(3 + 0.054)] \times [444.45/m]$

$F_{eff} = [(3 + 0.054)0.5 \times 444.45]/m$

$F_{eff} = [(3 + 0.054) \times 222.25]/m$

But, $F_w = N_f \times F_{eff}$

$141.70 \times m^2 = [1 \times (3 + 0.054m) 222.25]/m$

$m^3 = [(3 + 0.054m) 222.25]/141.70$

$= (3 + 0.054m) \times 1.5682$

$= 4.704 + 0.084m$ $m^3 - 0.084m - 4.704 = 0$

m = 1.692 & m = -0.846

m = 1.692

m = 2 ……..selecting std. available

Hence dimension of gear pair given as,

m = 2

$d_p = 35 \times 2 = 70$ mm

$d_g = 17 \times 2 = 35$ mm

$Z_g = 17$

$Z_p = 35$

a =52mm

$h_a = m = 2$

$h_f = 1.25m = 2.5$

$h_k = 2m = 4$

C = 0.25m = 0.5
h = 2.25m = 4.5
s = 1.5768m = 3.1536
Tooth space = 1.5708m = 3.1416

Fillet radius = 0.4m = 0.8

M_t (torque transmitted by gears) = 7630 Nmm

Tangential component resultant tooth face,

$P_{r=2}$ M_t/ d_p

$P_{r=}$ N

Radial component resultant tooth face,

$P_{r=}$ P_t tan α

$P_{r=79.345}$ N

Chain design:

Given, P =
24 watt n_1
= 30rpm n_2
= 30rpm
[A] Refer (8.26 section of R.B.Patil book transmission system design)

The no. of teeth for smaller speeds is at least 17 teeth will give a better life expecting with less chain noise.

But as our power transmission is very low, at very low speed we can select minimum no. of teeth less than 17.

So we have select 15 no of teeth on sprocket pinion.

$Z_{p=}$ 15 & Z_g = 15 as G = 1

[B] = now service factor (K_s) =1

Design power (P_d) = K_s x P

= 1 x 24

[C] Tooth correction factor (K_1) = 0.85 ……..(for 15 no. of teeth)

Multiple std. factor (K_2) = 1 …….(for simple single std roller chain)

Required power rating of chain is,

$K_w = P_d / (K_1 \times K_2)$

$= 0.024 / (0.85 \times 1)$

$K_w = 0.028$

CHAIN DESIGN:

Selecting standard chain used in cycle as Chain - 06 B

Pitch -9.525mm

1. Roller diameter, d1=6.35 mm
   Width' b1=5.72 mm
   Transverse pitch pt=54.85 mm
   z1= 15
   z2= 15
2. Approximate centre distance, a = 40*P ----------nominal
   a = 40*9.525
   a = 381 mm
3. No of links
   Ln=2(a/p) + (z1+z2/2) + (z2- z1/2 □)2 x (p/a)
   = 2(381/9.525) + (15+15/2) + (15-15/2 □)2 x (9.525/381)
   = 95
4. Corrected centre distance
   a= p/4 {[L_n- (z_1+z_2/2)] + ([L_n- (z_1+z_2/2)]^2 -8(z_2- z_1/2 π)^2)$^{1/2}$
   a= 380.96mm
   a=381 mm
5. Length of the chain
   L= L_n*p = 95 x 9.525 = 904.875mm

Design of sprocket

Used chain no.06B
For Z=15
From table no 14.3

Pitch, P = 9.525 mm

Width between inner plates, b1= 5.72 mm

Roller diameter, d1= 6.35 mm

1. Pitch circle diameter

$D_1 = \frac{p}{\sin(180/z1)}$ $D_2 = \frac{p}{\sin(180/z2)}$

$= \frac{9.525}{\sin(180/15)}$ $= \frac{9.525}{\sin(180/15)}$

D_1= 45.812 mm D_2 = 45.812mm

2. Roller seating radius (r_i)
   $r_{imax} = 0.505d_1 + 0.069 \times (d_1)^{1/3}$
   r_{imax} = 3.33mm
   r_{imin}=0.505 d_1 = 3.2mm
3. Tooth Flank Radius (r_e)
   $r_{emax} = 0.008(z^2+180)$ =3.24mm
   $r_{emin} = 0.12 \times d_1(z+2)$ = 12.954mm
4. Root Diameter (D_f)
   $D_f = D - 2 \times r_i$ = 39.152m

   … $(D = \frac{p}{\sin(180/z1)})$
5. Tooth height above pitch polygon (h_a)
   $h_{amax} = 0.625 \times p - 0.5 \times d_1 + 0.8*p/z$
   = 3.268mm
   $h_{amin} = 0.5(p-d_1)$
   = 1.5875mm
6. Tooth Width (b_f)

   $b_f = 0.93 \times b_1$ = 5.3196mm

Shaft calculations:

We select M.S material for shaft,

ϱ = 7860 kg/ m^3

L = 0.3 m (we consider this length for given value of oil tank)

M_t = torsional moment (torque) acting on the shaft i.e. torque supplied to shaft from motor

M_t = 7.63Nm

G = Modulus of rigidity (N/ m^2) for M.S. material

G = 79300 N/ m^2 = 79300 x 10^6 N/ m^2

For line shaft $\Theta = 3^0$ per meter length

[Design date book, table no. 9.8, V.B. Bhandari]

Now we know that,

$\Theta = (584 \times M_t \times l)/ (G \times d^4)$

$d^4 = (584 \times 7.63 \times 0.3)/ 79300 \times 10^6 \times 3^0$

$d^4 = 8.65 \times 10^{-3}$

Hence d = 8.65 mm

From Design date book, table no. 9.3, V.B. Bhandari we select std. Dimension of shaft.

d= 10 mm & designation of shaft as ISRO 10

9 COST ESTIMATION

Cost estimation may be defined as the process of forecasting the expenses that must be incurred to manufacture a product. These expenses take into a consideration all expenditure involved in a design and manufacturing with all related services facilities such as pattern making, tool, making as well as a portion of the general administrative and selling costs.

PURPOSE OF COST ESTIMATION:

1. To determine the selling price of a product for a quotation or contract so as to ensure a reasonable profit to the company.
2. Check the quotation supplied by vendors.
3. Determine the most economical process or material to manufacture the product.
4. To determine standards of production performance that may be used to control the cost.

TYPES OF COST ESTIMATION:

1. Material cost
2. Machining cost

Material Cost Estimation

Material cost estimation gives the total amount required to collect the raw material which has to be processed or fabricated to desired size and functioning of the components.

These materials are divided into two categories.

1. Material for fabrication:

   In this the material in obtained in raw condition and is manufactured or processed to finished size for proper functioning of the component.

2. Standard purchased parts:

   This includes the parts which was readily available in the market like allen screws etc. A list is forecast by the estimation stating the quality, size and

Standard parts, the weight of raw material and cost per kg. For the fabricated parts.

Machining Cost Estimation

This cost estimation is an attempt to forecast the total expenses that may include manufacturing apart from material cost. Cost estimation of manufactured parts can be considered as judgment on and after careful consideration which includes labor, material and factory services required to produce the required part.

9.1 PROCEDURE FOR CALCULATION OF MATERIAL COST

The general procedure for calculation of material cost estimation is after designing a project,

1. A bill of material is prepared which is divided into two categories.
    a. Fabricated components
    b. Standard purchased components
2. The rates of all standard items are taken and added up.
3. Cost of raw material purchased taken and added up.

SR.NO.	COMPONENTS	COST
1.	Brush	500
2.	Chain drive	1500
3.	Gear pair	1500
4.	wheel	1500
5.	Motor	1200
6.	Solar panel	2000
7.	Battery	2500

Table. 2 Cost Estimation

Total Cost = Cost of Components + Machining Cost+ labour cost = 14500/-

9.2 PROCESS SHEET

Following operations were while fabricate the project

Cutting: -

Cutting is the separation or opening of a physical object, into two or more portions, through the application of an acutely directed force.

Implements commonly used for cutting are the knife and saw, or in medicine and science the scalpel and microtome. However, any sufficiently sharp object is capable of cutting if it has a hardness sufficiently larger than the object being cut, and if it is applied with sufficient force. Even liquids can be used to cut things when applied with sufficient force (see water jet cutter).

The material as our required size. The machine used for this operation is power chop saw. A power chop saw, also known as a drop saw, is a power tool used to make a quick, accurate crosscut in a work piece at a selected angle. Common uses include framing operations and the cutting of moulding. Most chop saws are relatively small and portable, with common blade sizes ranging from eight to twelve inches.

Fig.11 Cutting Operation

The chop saw makes cuts by pulling a spinning circular saw blade down onto a work piece in a short, controlled motion. The work piece is typically held against a fence, which provides a precise cutting angle between the plane of the blade and the plane of the longest work piece edge. In standard position, this angle is fixed at 90°. A primary distinguishing feature of the mitre

saw is the mitre index that allows the angle of the blade to be changed relative to the fence. While most mitre saws enable precise one-degree incremental changes to the mitre index, many also provide "stops" that allow the meter index to be quickly set to common angles (such as 15°, 22.5°, 30°, and 45°). The time required for this operation is 50 minutes.

Cutting Types

1. Milling 2. Lathe Processing

Cutting is a technique where the operator moves a material (work piece) such as metal and the tool in relation to each other in order to shape the work piece into the desired form through shaving, drilling, etc. Cutting can be broadly divided into two methods: rolling, where the work piece is restrained while the tools turn, and turning, where the work piece is turned instead.

1. Milling

Milling is performed by rotating a cutting tool called a milling machine mounted on a spindle. Because the tool comes into contact with the secured work piece intermittently for cutting, a wide variety of machining is possible, including cutting flat planes or curves into the work piece surface, or boring or grooving the work piece.

Different types of milling machines are available according to the orientation of the spindle: horizontal machines, vertical machines, and gantry machines, which feature a main body shaped like a gate. Using tools such as face mills, end mills, and slot cutters, these machines cut materials into the desired shape.

Various milling cutters

- Face mill
- End mill
- Slot cutter

General-purpose milling involves the milling operation being performed by an operator. Moving the tool and work piece in relation to each other, the operator determines and sets the cutting conditions, including the tool position and the feed, speed, and cut amounts. This manual method ensures a refined, high-quality finish.

1.NC milling (CNC milling)

NC milling involves milling under cutting conditions controlled by a computer. Before numerical control (NC), punch cards were used for milling program control. Today, computer numerical control (CNC) has become mainstream, and the term “NC milling” now often also includes CNC

milling. The automated operation reduces the labour involved in the process, and enables more complex shapes to be cut through programmed control using 3D CAD or CAM software.

2. Lathe Processing

In lathe processing, cutting is performed by pushing a rotating cylindrical work piece against a cutting tool called a tool bit, which is attached to a spindle. Using a lathe, the periphery of a cylindrical work piece can be made circular, tapered, drilled, bored to enlarge a hole, threaded, or parted by grooving.

Various lathe machining processes

- Round-nose cutting
- Drilling
- Parting

1. General-purpose lathe

With general-purpose lathe machines, the operator manually performs feed operations and exchanges tools. The work piece is held in place by a holder called a chuck, and is rapidly rotated for cutting. With a table top bench lathe, small parts can be machined on a workbench.

2. NC lathe (CNC lathe)

Controlling the machining conditions of lathe processing using a computer makes it possible even for beginners to create products at a certain level of quality. Some models also support automatic changeover of multiple tools for improved work efficiency.

Cam-operated automatic lathes were conventionally used to manufacture same-shaped products from a long rod material—just like sliced hard candies. In recent years, however, cams have been replaced by programmed control in NC automatic lathes

Welding: -

Welding is a fabrication or sculptural process that joins materials, usually metals or thermoplastics, by using high heat to melt the parts together and allowing them to cool causing fusion. Welding is distinct from lower temperature metal-joining techniques such as brazing and soldering, which do not melt the base metal.

In addition to melting the base metal, a filler material is typically added to the joint to form a pool of molten material (the weld pool) that cools to form a joint that, based on weld configuration (butt, full penetration, fillet, etc.), can be stronger than the base material (parent metal). Pressure may also be used in conjunction with heat, or by itself, to produce a weld.

Welding also requires a form of shield to protect the filler metals or melted metals from being contaminated or oxidized.

Square pipes of different lengths to make frame. The machine used for this operation is electric arc welding. Electrical arc welding is the procedure used to join two metal parts, taking advantage of the heat developed by the electric arc that forms between an electrode (metal filler) and the material to be welded. The welding arc may be powered by an alternating current generator machine (welder). This welding machine is basically a single-phase static transformer Suitable for melting RUTILE (sliding) acid electrodes. Alkaline electrodes may also be melted by alternating current if the secondary open-circuit voltage is greater than 70 V.

Fig.12 Welding Operation

The welding current is continuously regulated (magnetic dispersion) by turning the hand wheel on the outside of the machine, which makes it possible to select the current value, indicated on a special graded scale, with the utmost precision. To prevent the service capacities from being exceeded, all of our machines are fitted with an automatic overload protection which cuts of the power supply (intermittent use) in the event of an overload. The operator must then wait for a few minutes before returning to work. This welding machine must be used only for the purpose described in this manual. Read the entire contents of this manual before installing, using or servicing the equipment, paying special attention to the chapter on safety precautions. Contact your distributor if you do not fully understand these instructions. The time required for this operation is 120 minutes.

- Types of Welding Processes

The four main types of welding are: Gas Metal Arc Welding (GMAW/MIG), Gas Tungsten Arc Welding (GTAW/TIG), Shielded Metal Arc Welding (SMAW), and Flux Cored 1

1. Arc Welding (FCAW).

In this post, we'll detail the specifics assigned to each process and highlight the differences among them. Keep reading to learn all you need to know about the four main types of welding and what they're used for arc welding

2. Gas Metal Arc Welding (GMAW/MIG)

Also known as Metal Inert Gas or MIG welding, this process uses a thin wire as an electrode. The wire heats up as it is fed through the welding instrument and towards the welding site.

Shielding gas must be used to protect the weld from contaminants in the air. Typically, this comes in the form of carbon dioxide, oxygen, argon or helium. This method is often used to work on metals such as stainless steel, copper, nickel, carbon steel, aluminium, and more. Of all the welding processes, this one is most popular across the construction and automotive industries.

Gas metal arc welding is believed to be one of the easier welding techniques to learn, which makes it a great area of focus for beginning welders. It also calls for minimal clean-up, offers high welding speeds and better control over thinner materials.

Some downsides associated with this type of welding process revolve around the costs of getting shielding gas along with an inability to weld thicker metals or perform vertical or overhead welding.

3. Gas Tungsten Arc Welding (GTAW/TIG) gas tungsten arc welding

This type of welding process, also known as Tungsten Inert Gas or TIG welding, is commonly used to weld together thin and non-ferrous materials like aluminium, copper, lead, or nickel. It's commonly applied to bicycle or aircraft manufacturing.

Unlike other types of welding processes, TIG welding uses a non-consumable tungsten electrode to produce the weld. You will still need an external gas supply, usually argon or a mix of argon and helium.

This is considered one of the most difficult welding methods to master, and one that produces the most high-quality welds. Because there is only a tiny area between the arc and the area being welded, it takes an enormous amount of precision and skill to complete. Welds born of this method are known to be extremely strong.

4. Shielded Metal Arc Welding (SMAW)

This type of welding process relies on a manual technique using a consumable electrode coated in flux. This method tends to be most popular among home-shop welders. This process is also

more informally known as stick welding.

The nickname references the electrode used to weld the metal, which comes in the form of a

"Stick." Because shielded metal arc welding requires minimal equipment, it's one of the most low-cost processes around.

This type of welding does not require shielding gas and can be performed outdoors in the wind or rain. It also works well on dirt and rusty materials. That said, downsides do exist.

Stick welds don't typically produce the best quality products. They are prone to porosity, cracks, and shallow penetration. In general, stick welds are less durable than what other types of welding will produce.

Flux Cored Arc Welding (FCAW) flux
cored arc welding
Similar to MIG welding, flux cored arc welding revolves around a continuous wire feed process.

There are two separate processes associated with flux cored arc welding.

One involves the use of shielding gas while the other relies on self-shielding agents produced when fluxing agents decompose within the wire.

This type of welding is known for being inexpensive and easy to learn. Much like the MIG welding process, it's a great way for beginning welders to kick off their careers in the field.

It also allows welders to perform their work outdoors (windy conditions won't affect the weld). The semi-automatic arc provides high welding speed and portability, making it a popular process to employ on construction projects.

Drilling: -

Drilling is a cutting process that uses a drill bit to cut a hole of circular cross-section in solid materials. The drill bit is usually a rotary cutting tool, often multi-point. The bit is pressed against the work-piece and rotated at rates from hundreds to thousands of revolutions per minute. This forces the cutting edge against the work-piece, cutting off chips (swarf) from the hole as it is drilled.

In rock drilling, the hole is usually not made through a circular cutting motion, though the bit is usually rotated. Instead, the hole is usually made by hammering a drill bit into the hole with quickly repeated short movements. The hammering action can be performed from outside the hole (top-hammer drill) or within the hole (down-the-hole drill, DTH). Drills used for horizontal drilling are called drifter drills. In rare cases, specially-shaped bits are used to cut holes of non-circular cross-section; a square cross-section is possible.

Fig.13 Drilling Operation

Drilled holes are characterized by their sharp edge on the entrance side and the presence of burrs on the exit side (unless they have been removed). Also, the inside of the hole usually has helical feed marks.

Drilling may affect the mechanical properties of the work piece by creating low residual stresses around the hole opening and a very thin layer of highly stressed and disturbed material on the newly formed surface. This causes the work piece to become more susceptible to corrosion and crack propagation at the stressed surface. A finish operation may be done to avoid these detrimental conditions.

For fluted drill bits, any chips are removed via the flutes. Chips may form long spirals or small flakes, depending on the material, and process parameters. The type of chips formed can be an indicator of the machinability of the material, with long chips suggesting good material machinability.

Fig.14 Drill Bit

A drill is a tool used for making round holes or driving fasteners. It is fitted with a bit, either a drill or driver chuck. with hand-operated types dramatically decreasing in popularity and cordless battery-powered ones proliferating

A drilling machine, also called a drill press, is a powerful tool used to cut a round hole into or through metal, plastic, wood, or other solid materials by turning and advancing rotary drill bits into a work piece.

This drilling cutting tool (Drill Bit) is held in the drill press by a chuck and fed into the work at variable speeds. The speed and feed should be set properly and coolant needs to be provided for the desired finished part. The drilling machine can not only be applied in the drilling process but is also useful for many other machining operations

Finishing: -

Finishing is a broad range of industrial processes that alter the surface of a manufactured item to achieve a certain property. Finishing processes may be employed to: improve appearance, adhesion or wettability, solder ability, corrosion resistance, tarnish resistance, chemical resistance, wear resistance, hardness, modify electrical conductivity, remove burrs and other surface flaws, and control the surface friction. In limited cases some of these techniques can be used to restore original dimensions to salvage or repair an item.

The edges with grinder using grinding wheel. The machine used for this operation is hand grinder. An angle grinder, also known as a side grinder or disc grinder, is a handheld power tool used for cutting, grinding and polishing. Angle grinders can be powered by an electric motor, petrol engine or compressed air.

The motor drives a geared head at a right-angle on which is mounted an abrasive disc or a thinner cut-off disc, either of which can be replaced when worn. Angle grinders typically have an adjustable guard and a side-handle for two-handed operation. Certain angle grinders, depending on their speed range, can be use*d* as sanders, employing a sanding disc with a backing pad or disc. The backing system is typically made of hard plastic, phenolic resin, or medium hard rubber depending on the amount of flexibility desired. The time required for this operation is 20 minutes.

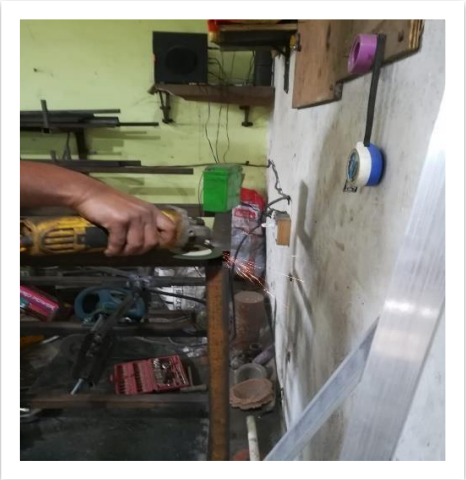


Fig.14 Finishing Operation

Polishing: -

Polishing is the process of creating a smooth and shiny surface by rubbing it or using a chemical action, leaving a surface with a significant specular reflection (still limited by the index of refraction of the material according to the Fresnel equations.) In some materials (such as metals,

glasses, black or transparent stones), polishing is also able to reduce diffuse reflection to minimal values. When an unpolished surface is magnified thousands of times, it usually looks like mountains and valleys. By repeated abrasion, those "mountains" are worn down until they are flat or just small "hills." The process of polishing with abrasives starts with coarse ones and graduates to fine ones.

The welded joints with hand grinder using grinding wheel. The machine used for this operation is hand grinder. With refinement, grinding becomes polishing, either in preparing metal surfaces for subsequent buffing or in the actual preparation of a surface finish, such as a No. 4 polish in which the grit lines are clearly visible. Generally speaking, those operations which serve mainly to remove metal rapidly are considered as grinding, while those in which the emphasis is centred on attaining smoothness are classified as polishing. Grinding employs the coarser grits as a rule while most polishing operations are conducted with grits of 80 and finer. If polishing is required, start with as fine a grit as possible to reduce finishing steps. There is a wide range of grinding and polishing tools on the market and advice is available from ASSDA members to assist in particular applications.

Fig.15 Polishing Operation

The Polishing Machine (also called the Buffing Machine) is used to polish soft metals including copper and brass as well as plastics such as Perspex. The two ‘mops’ spin at high speed when the ‘on’ switch is pressed.

If the material is carefully pressed against the mop and moved backwards and forwards it will be polished.

The material must be filed to remove scratches and then wet and dry paper or emery cloth is used to further smooth the surfaces. Only then can it be polished on the buffing machine.

10 PROPOSED WORK

Sr. No	Activity/month	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb & March	April
1	Search of topic									
2	Selection of topic and research papers									
3	Finalising of sponsored project									
4	Literature review									
5	Basic diagram and study of components									
6	Cad diagram and starting the calculation of components									
7	Calculations									
8	Finalizing the calculations and preparing the final cad diagram with dimensions									

9	Starting manufacturing									
10	Buying the standard components from market									
11	Testing of model									
12	Rough draft of report									
13	Final report									

Table No.03 PLAN OF PROPOSED WORK

11 SAFETY PRECAUTIONS

The following points should be considered for the safe operation of machine and to avoid accidents: -

- All the parts of the machine should be checked to be in perfect alignment.
- All the nuts and bolts should be perfectly tightened.
- The operating switch should be located at convenient distance from the operator so as to control the machine easily.
- The inspection and maintenance of the machine should be done from time to time.
- All the nuts and bolts should be perfectly tightened.
- The operating switch should be located at convenient distance from the operator so as to control the machine easily.
- The inspection and maintenance of the machine should be done from time to time.

12 Advantages

- Eco friendly road cleaning machine.
- Eco friendly road cleaning machine is an advanced type of machine used for the roads or streets.
- Cost of machine is low.
- Maintenance of machine is less.

13 Performance Table for Motor

Final Speed (KMPH)	**Acceleration time** (Sec)	**Power Required** (Watt)
3	15	40
1.8	10	24.2
2.5	10	34.32
2.5	15	50.10
1.8	15	23.76

Table no: 04 Performance table

14 Future Scope

Existing road clean methods are two types

i) Fuel operated

ii) Manually operated.

Manual cleaning may causes shoulder problem due to continuous sweeping. Fuel operated road cleaner's uses fuel energy for cleaning & causes pollution. Both required more cost. In our project solar operated road cleaning machine is alternative concept for avoiding such problems. It works very efficiently with respect to covering area. It is very economical to use. In future we can add container to it to collect the dust. Automate the machine using AIML we can automate with the help of various sensors, Program, logic diagram and improve its performance by reducing losses.

15 Conclusion

The Solar operated eco-friendly road cleaner is successfully designed, analyzed and fabricated. This project works implements the solar operated eco-friendly road cleaner for road cleaning that reducing the cost, human efforts as well as time. It is the best alternative for automated road cleaning machine during power crisis. It is found that the existing road cleaning machines uses petrol and diesel. It can cause pollution and also the vibration produced in the machine causes noise pollution.While manual cleaning may cause healthy problem as the person directly comes in contact with dust. Also, the shoulder problem due to continuously sweeping occurs. A solar operated eco-friendly road cleaner is an alternative concept for avoiding such problems. The solar operated eco-friendly road cleaner can work very efficiently with respect to covering area, time and cost of road cleaning process compared with the existing machineries. Also it is economical. It was seen while testing of machine, that the cleaning is less effective where the road seems to be very rough and damaged.

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