

# **DESIGN AND ANALYSIS FOR WASTE SEGREGATION AND COLLECTION ROBOT WITH CMOS SENSOR**

Submitted in partial fulfilment of the requirements for the award of

Bachelor of Engineering degree in

Mechanical Engineering

By

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**DEPARTMENT OF MECHANICAL ENGINEERING**

**SCHOOL OF MECHANICAL ENGINEERING**

## **SATHYABAMA**

**INSTITUTE OF SCIENCE AND TECHNOLOGY**

**(DEEMED TO BE UNIVERSITY)**

**Accredited with Grade “A” by NAAC JEPPIAR NAGAR, RAJIV GANDHI**

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**MARCH - 2021**



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### DEPARTMENT OF MECHANICAL ENGINEERING

### BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of G. SAI ESHWAR (37150160) and P. RABBI DOSS (37150146) who carried out the project entitled **“DESIGN AND ANALYSIS FOR WASTE SEGREGATION AND COLLECTION ROBOT WITH CMOS SENSOR”** under my supervision from \_\_\_\_\_ to \_\_\_\_\_.

Internal Guide

DURAI RAJ

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Submitted for Viva voce Examination held on \_\_\_\_\_

Internal Examiner

External Examiner

## **DECLARATION**

I, P. RABBI DOSS (37150146), hereby declare that the Project Report entitled **“DESIGN AND ANALYSIS FOR WASTE SEGREGATION AND COLLECTION ROBOT WITH CMOS SENSOR”** done by me under the guidance of **DURAI RAJ.**, at Sathyabama Institute of Science and Technology is submitted in partial fulfillment of the requirements for the award of Bachelor of Technology degree in Mechanical Engineering.

**DATE:**

**PLACE: CHENNAI**

**SIGNATURE OF THE CANDIDATE**

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## **ABSTRACT**

The quick expansion in the populace has prompted ill-advised waste administration in metro urban communities and metropolitan zones which has brought about the spreading of infections. It is assessed that 6.06 billion tons of civil strong waste were created generally in 2019. The isolation, transport, taking care of, and removal of waste should be overseen appropriately to limit the dangers to people in general and the climate. Ultrasonic sensors are added for checking the waste assortment measure. The sensors would be set on the whole the trash receptacles. At the point when the trash arrives at the level of the sensor, at that point, the sign will be given to a microcontroller. Strong waste is the futile, undesirable, and disposed of material coming about because of everyday exercises locally. Strong waste administration might be characterized as the order related to the control of age, stockpiling, assortment, move, preparing, and removal of strong waste.

This project is focused on Human waste connection in the decrease and lessening of Manual work. A robot is intended to give an answer to the issues referenced previously. Where it has highlights like cleaning time is observed, Complementary metal-oxide-semiconductor (CMOS) sensor( cameras) is set, IR sensor for cross-reference, microcontroller sign is an extra component which helps in checking the robot and supersonic sensor is utilized estimating the distance and furthermore to recognize human way and any item.

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## CHAPTER 1

### INTRODUCTION

Advanced mechanics is the designing and innovation which makes machines called robots, the crossing point of science, it substitutes for human activities. Mainstream society has in every case reliably intrigued with robots, R2-D2, Optimus Prime, WALL-E. These over-misrepresented, humanoid hypothesis of robots for the most part says like a personification of the genuine article. Robots are acquiring scholarly and mechanical capacities that don't put the likelihood of a R2-D2-like machine far off in the last mentioned.

In the year 2005, 90%, all things considered, can be discovered gathering vehicles in car manufacturing plants. These robots include for the most part of mechanical arms stunted with welding or screwing on chosen portions of a vehicle. Nowadays, an advanced and extended meaning of mechanical technology that includes the turn of events, creation, and utilization of bots that investigate Earth's harshest conditions, robots that help law authorization, and even robots that aid near each aspect of medical care.

While the general universe of advanced mechanics is expanding, a robot has some viable attributes, for example,

1. Robots all viable with different kinds of mechanical development. The mechanical part of a robot upholds every one of the errands in the climate for which it's planned. For instance, the Mars 2020 Rover's wheels are independently mechanized and work of titanium tubing which upholds it immovably grasp the brutal landscape of the red planet.
2. Robots require electrical segments which control and force the apparatus. Fundamentally, an electric flow is expected to control an immense dominant part of robots.
3. Robots convey probably some degree of PC programming. Without a bunch of codes instructing it, a robot would simply be important for straightforward apparatus. Introducing a program into a robot enables it to realize when and how to complete an assignment.

The advanced mechanics industry is still nearly youthful however has effectively taken astounding steps. From the enormous profundities of our seas to the most extreme statures of space, robots can be set up performing assignments that people were not equipped for the fantasy about accomplishing.

## 1.1 Types of Robots

Mechanical bots gather all shapes and sizes to proficiently pass on out the assignment for which they are planned. Starting with 0.2 millimeter-long "RoboBee" to the 200 meter-long automated transportation vessel "Vindskip," robots are arising to pass on out errands that people can't ready to do. Essentially, there are five kinds of robots they are:

### 1.1.1 Pre-Programmed Robots

Pre-customized robots work in an administered climate where they do effectively, tedious undertakings. An illustration of a pre-customized robot is an auto sequential construction system which is a mechanical arm. The arm serves one capacity — to weld a door on, to walled in area a specific part into the motor, and so forth — and its work is to play out that task longer, quicker, and more effectively and productively than a human.

### 1.1.2 Humanoid Robots

Humanoid robots will be robots that appear as though they emulate human propensities. These robots by and large perform human-like exercises (like running, playing and conveying articles), and it is intended to appear as though us, having human faces and looks. Two of the main instances of humanoid robots are Hanson Robotics' Sophia and Boston Dynamics' Atlas.

### 1.1.3 Autonomous Robots

Self-ruling robots work independently from human administrators. These robots are for the most part intended to complete errands in open conditions which needn't bother with human management. An illustration of a self-ruling robot is the Roomba vacuum cleaner, which utilizes sensors to wander around a home unreservedly.

### 1.1.4 Teleoperated Robots

Teleoperated robots are mechanical bots that are constrained by people. These robots by and large work in most extreme geological conditions, climate, conditions, and so

on Instances of teleoperated robots are the human-controlled submarines which are utilized to fix submerged line spills throughout the BP oil slick or robots used to distinguish landmines on a war zone.

#### 1.1.5 Augmenting Robots

Enlarging robots further upgrades current human capacities or reestablish the abilities a human may have disappeared. Instances of expanding robots are automated prosthetic appendages or exoskeletons which are utilized to lift heavyweights.

#### 1.2 Applications of Robotics

- Helping battle woods fires
- operating at the edge of people in assembling plants (known as co-bots)
- Robots that offer friendship to older people
- Surgical aides
- Last-mile bundle and food request conveyance
- Autonomous family robots which pass on out errands like vacuuming and taking care of the lawn
- Assisting with discovering things and moving them all through distribution centers
- Used during search-and-salvage missions after catastrophic events
- Landmine finders in combat areas

#### 1.3 Uses of Robots

- Manufacturing

The assembling business is likely the most seasoned and most renowned client of robots. These robots and co-bots work to productively test and collect items, similar to vehicles and mechanical gear. It's assessed that there are expanded than 3,000,000 mechanical robots being used as of now.

- Logistics

Transportation, taking care of, and quality control robots are turning into immeasurably significant for most retailers and co-ordinations organizations. Since we expect our bundles happens at bursting speeds, co-ordinations organizations enlist robots in stockrooms, and furthermore out and about, to help increment time productivity. As of now, robots are taking your things off the racks, shipping them

over the distribution center floor, and bundling them. In addition, an ascent in last-mile robots ensures that you'll have a face-to-metal-face experience with a coordinations bot in the forthcoming future.

- Home

Robots can be seen wherever in our homes, assisting with tasks, helping us to remember our arrangement or plan, and furthermore engaging our kids. It's not sci-fi any longer. The most natural illustration of home robots is the self-governing vacuum cleaner Roomba. Additionally, robots are currently evolved to do everything from self-sufficiently taking care of lawn to cleaning pools.

- Travel

Is there anything further sci-fi like than independent vehicles? These self-driving vehicles are not, at this point just creative mind. A combination of information science and advanced mechanics, self-driving vehicles are assuming control over the world by storm. Automakers, similar to Tesla, Ford, Volkswagen, and BMW are largely working on the following influx of movement that will allow us to sit back, unwind and appreciate the drive. Rideshare organizations Uber and Lyft are likewise in the advancement of self-governing rideshare vehicles that don't expect people to drive the vehicle.

- Healthcare

Robots have taken tremendous steps in medical care creation. These mechanical wonders have utilized in pretty much all parts of medical services, from robot-helped medical procedures to bots that help people to recuperate from injury in non-intrusive treatment. Instances of robots at work in medical services are Toyota's medical care colleagues, which help individuals to recover the capacity to walk, and "Pull," a robot intended to self-rulingly voyage all through a clinic and convey all from meds to clean cloths.

A self-ruling robot is additionally called an auto robot or Autobot, which is a robot that performs propensities or accuses of a serious level of self-sufficiency. Self-ruling advanced mechanics is for the most part viewed as a limit of man-made consciousness, mechanical technology, and data designing. The underlying model was proposed and shown by creator/designer David L. Heiserman.

Independent robots are explicitly useful in fields like spaceflight, family upkeep, wastewater treatment, and conveying merchandise and ventures.

Some most recent production line robots are "independent" inside the severe subfield of their immediate climate. It can't be that all level of opportunity exists in their general climate, however the production line robot's working environment is requesting and can as often as possible contain tumultuous unpredicted factors. The expand and position of the following things of work and furthermore the sort of item and the necessary undertaking should be determined to. This can shift capriciously.

One primary territory of advanced mechanics study is to allow the robot to adapt to its current circumstance whether this is ashore, submerged, noticeable all around, underground, or in space.

A completely independent robot can:

- collect insights concerning the climate
- Work for a grow period without human obstruction
- Proceed further all or part of itself all through its working climate without human help
- keep away from the situation that is hurtful to individuals, property, or itself without those are important for its plan particulars

A self-governing robot other than study or gain new information like adapting to another procedure of achieving its undertakings or adjusting to evolving environmental factors. Like different machines, self-governing robots actually need customary support.

## 1.4 Autonomous route

### 1.4.1 Indoor route

For a robot to connect practices with a spot needs it to acknowledge where it is and it tends to have the option to explore highlight point. Such route set about with wire direction in the year 1970s and advanced in the year 2000s to reference point based triangulation. Present business robots self-rulingly explore dependent on detecting normal highlights. The principal business robots to achieve this were Pyxus' HelpMate emergency clinic robot and the Cyber Motion watch robot, both planned by mechanical technology pioneers in the year 1980s. These robots initially utilized physically created CAD floor plans, sonar detecting, and divider following varieties to explore structures. The future, like Mobile Robot's Patrol Bot and self-sufficient wheelchair, both dispatched in 2004, have the ability to create their own laser-based guides of a structure and to explore open regions likewise hallways. Their control framework turns its way on the fly if something blocks the way.

At first, self-sufficient route depended on planar sensors, similar to laser range-locaters, which can just detect at one level. The main frameworks presently intertwine specifics from various sensors for both restriction and route. Frameworks like Motivity can depend on different sensors in different regions, contingent on which permit the most solid information at that point, and can re-map a structure independently.

In inclination of climb steps, which needs profoundly particular equipment, most indoor robots explore incapacitated available territories, controlling lifts, and electronic entryways. With these like electronic access-control interfaces, robots can now effectively and openly explore inside. Self-rulingly climbing steps and opening entryways physically are subjects of examination right now.

As these indoor strategies keep on growing, vacuuming robots will get the ability to tidy up a particular client indicated room or a full floor. Security robots will be equipped for helping out nearby interlopers and cut off exits. These advances likewise bring associative insurances: robot inward guides essentially grant "prohibited regions" to be characterized to keep robots from independently entering unmistakable districts.

#### 1.4.2 Outdoor route

Outside independence is all the more just accomplished noticeable all around in light of the fact that deterrents are uncommon. Journey rockets are very hazardous exceptionally self-sufficient robots. Pilotless robot airplane are increasingly more utilized for surveillance. A portion of these automated ethereal vehicles (UAVs) are capable of flying their entire mission with no human cooperation at all aside from maybe for the arrival where an individual mediate utilizing radio controller. A few robots are equipped for protected, programmed arrivals, at any rate a self-governing boat was accounted for in the year 2014—the Autonomous spaceport drone transport—and is orchestrated to make its underlying operational test in December 2014.

Open air self-rule is more enthusiastically for ground vehicles, due to:

- Three-dimensional landscape
- Great aberrations in surface thickness
- Weather exigencies
- Instability of the detected climate

Metropolitan Solid Waste Management requires the utilization of the rule of Integrated Solid Waste Management (ISWM) to city squander. ISWM is the utilization of reasonable procedures, innovations, and the executives programs covering a wide range of strong squanders from all sources to achieve the twin destinations of (a) squander decrease and (b) powerful administration of waste actually makes after squander decrease.

Squander taking care of and arranging require the exercises related with the administration of squanders up to they are stored down holders for assortment. Taking care of likewise incorporates the development of filled holders to the place of assortment. Arranging waste segments is a significant advance in the taking care of and capacity of strong waste at the source. For instance, the best spot to isolate squander materials for reuse and reusing is at the wellspring of age. Families are getting more mindful of the substance of split paper and cardboard, bottles/glass, kitchen squanders, and ferrous and non-ferrous materials. On location stockpiling is of high need due to general wellbeing concerns and tasteful contemplations. Ugly shoddy holders and furthermore open ground stockpiling, these two of which are bothersome, are normally seen at numerous private and business destinations. The

benefit of giving stockpiling to strong squanders at the source is by and large borne by the family on account of people, or by the administration of business and modern properties. Preparing at the source incorporates exercises, for example, patio squander treating the soil.

Squanders are the material that isn't needed and isn't working financially with seriously handling. It is likely as strong, fluid, and gas. They emerge from human exercises like farming, industry, homegrown exercises, and so forth As indicated by the cause, squander is characterized as homegrown, mechanical, business, clinical, development, atomic, and horticultural. As indicated by properties squander is characterized as latent, harmful, and inflammable. On the off chance that these squanders stay natural, it prompts air, water, soil, or strong waste contamination. Subsequently, strong waste administration is more fundamental.

The precision of an expectation of the impending CMOS innovation is consequently may not probably be extraordinary. In any case, the key standards fundamental the development of CMOS innovation can give us some instinct into the accompanying. A new report by Taur et al. brought up that the particular semiconductors in prevailing utilize this day will before long have a modest pace of impact increment as their size is diminished. Taur upheld an attention on exploratory gadgets, low-temperature employable, and broaden practical incorporation as methods for supporting the business pattern of framework execution improvement. This report considers these and other, more extensive, issues identified with the forthcoming development of CMOS innovation. It results that the current pace of semiconductor show improvement can be supported for another 10 to 15 years, yet just through the advancement of the most recent materials and semiconductor structures. Additionally, a significant change in lithography will be expected to proceed with size decrease. Memory innovation for DRAM materials is similarly arriving at a significant obstacle and necessities the furthest down the line design to move past 1 GB levels.

## CHAPTER-2

### LITERATURE SURVEY:

Eric R. Fossum, A Review of the Pinned Photodiode for CCD and CMOS Image Sensors, The pinned photodiode is the main photo detector assembly used in most CCD and CMOS image sensors. This paper analyses the development, physics, and technology of the pinned photodiode.

R. D. Isaac, The future of CMOS technology, in this report the performance of integrated circuits has been refining exponentially for more than thirty years. In the following decade, the industry needs to overcome numerous technological challenges to tolerate this remarkable pace of development. Experiments in lithography, transistor scaling, interconnections, circuit families, computer memory, and circuit design are sketched. Possible solutions are briefly discussed. The ways in which these challenges will distress upcoming growth in the industry are measured.

L. Giusti, A review of waste management practices and their impact on human health, this report studies the main focus is mainly on municipal solid waste (MSW), exposure to bioaerosols from composting facilities and to pathogens from sewage management plants are measured. The reported properties of radioactive waste are also briefly swotted.

Todd Litman, Autonomous Vehicle Implementation Predictions, this report explores the effects of autonomous motor vehicles, and their consequences for transportation planning. It explores how rapidly such motor vehicles are likely to develop and be deployed established on experience with earlier motor vehicle technologies; their likely benefits and costs; how they will disturb travel movement; and their effects on planning conclusions such as optimal road, parking and public transit supply.

Alan Hamlet, The Autonomous Garbage Truck, this paper details the design of Robot Dumpster, The Separate Garbage Truck, an autonomous mobile robot that examines for complete garbage cans, clears them into its' on board receptacle, and then dumps the contents of the on board receptacle addicted to a designated garbage space when it is filled.

Sunil M P, Waste Segregation Robot -A Swachh Bharat Initiation, in this report it targets at professionally sorting out wastes so that it would be informal for the group to separate them on a enormous scale base. The hardware contains core segment Raspberry Pi combined with the pi camera, dc motor, pick and place robotic arm,

sensors such as IR, moisture, inductive proximity, wet sensor and also use of image arrangement algorithm for performing object finding based on the haar-cascade classifier with exposed CV.

Ran LIANG, Design, Modeling and Analysis of a Climbing Robot Used for Inspection of Glass Curtain Walls, A wall climbing robot established on negative pressure suction is intended, modeled and analyzed for check inspection of glass walls. Statics and kinetics analysis are accompanied in order to pledge the rational design.

Rani Rokade, Smart Garbage Separation Robot with Image Processing Technique, in this the aim of the paper is to present a smart robot which is accomplished of splitting degradable and non- degradable waste using appearance processing techniques. The future robot is in random motion when it senses any object it stops and camera takes image of the things, later processing and segmentation is completed, it splits waste into degradable and non-degradable waste.

Jie Chen, Whole-Body Motion Planning for a Six-Legged Robot Walking on Rugged Terrain, this paper addresses the dispute of terrain geometry created whole-body motion scheduling for a six-legged robot over a uneven terrain. The whole-body planning is disintegrated into two sub-tasks leg support and swing.

Yubin Liu, Biomimetic Design and Optimal Swing of a Hexapod Robot Leg, This paper presents a acquiescent leg mechanism for a small six-legged robot, HITCR-II, created on abstracted anatomy from insect legs. Kinematic structure, comparative proportion of leg segment lengths and actuation system were analyzed in attention of anatomical structure in addition to muscle system of insect legs and preferred mobility.

## **CHAPTER 3**

### **AIM & SCOPE**

#### **3.1 AIM:**

The designed robot must be assisted by image processing to pick and place waste will minimize human effort of segregating. Hence it will increase hygiene in the society and help in keeping environment clean. The use of image processing to segregate waste as plastic, wet and dry has to give us more accurate and reliable output than the use of sensors to detect them as used in most of the previous studies. The advantage of this work is its contribution in making a Smart city. Among the many challenges that a city faces, waste management is of utmost importance. The discarded waste can be then processed to recover materials in an effective way and convert them to energy as usable fuels. This can be further advance by making use of machine learning and artificial intelligence to make it humanoid waste segregation robot.

#### **3.2 OBJECTIVE:**

- The robot system should follow the 5s principle: Sort, Set in order, Shine, Standardize, Sustain.
- To check the parameters like (survey, coverage area, robot dimensions, robot travel, power consumption).
- Selection of mechanism and material selection.
- Movement and number of access of the robot.
- Parts used in robot.
- Placement of sensors.
- To design the parts of the robot.
- To simulate the robot system

## CHAPTER 4

### MATERIAL AND METHODOLOGY

#### 4.1 ALUMINIUM FOR FRAME:

Aluminum is a flexible, lightweight, strong, and malleable metal. It is regularly picked over different metals for different applications since it performs adequately and proficiently in a wide exhibit of conditions. The advantages of aluminum versus steel are many. Contrasted with different metals, including steel, aluminum weighs less by volume. Aluminum is 33% of the heaviness of different metals, including steel, metal, and copper. As per the Aluminum Association, aluminum auto constructions are savvier than steel auto designs: utilizing aluminum has a weight investment fund of up to 55 percent contrasted with steel structures. In the marine transportation industry, aluminum structures are additionally more savvy contrasted with steel. Aluminum bodies have a weight reserve fund of 35 to 45 percent. On the off chance that aluminum is utilized rather than steel to build marine superstructures, there is a weight investment fund of 55 to 65 percent. Fuel and battery utilization is savvier in aluminum than steel structures since lightweight vehicles utilize less energy. As indicated by Drive Aluminum, electrical vehicles that have progressed aluminum body structures utilize fewer batteries than those with steel body structures, which brings about weight reserve funds of up to 3,000 (US) dollars per unit. Contrasted with steel crossbreed vehicles, aluminum half breed vehicles experience fuel reserve funds of 5 to 7 percent. In contrast to steel, aluminum is normally non-destructive. As indicated by Future Industries, aluminum shapes an oxide film that normally shields the metal from erosion. How Stuff Works clarifies that this common consumption insurance happens when aluminum responds with oxygen. The subsequent obstruction shields the metal from different mixtures, including water and further contact with oxygen. This regular obstruction is one explanation that aluminum is more gainful in certain conditions than carbon steel and some hardened steels. The British Stainless-Steel Association clarifies that hardened steel can consume in "forceful conditions." Steel should go through painting or different medicines to shield it from consumption. Aluminum outperforms steel in heat conductivity. Ask any gourmet specialist and they will disclose to you that aluminum-based cookware is more productive for preparing food than steel-based cookware. Aluminum pots bubble water more rapidly than spotless pots since aluminum conducts heat more rapidly than steel. With regards to warm conductivity, aluminum has a fourfold

increment contrasted with steel. As per Secret, an exploration research center that reviews aluminum items and cycles, aluminum's warm conductivity decreases cooling cycles more proficiently than steel in trim activities. Aluminum additionally has a higher electrical conductivity rate than steel. This high electrical conductivity joined with aluminum's low softening point contrasted with that of steel, implies that aluminum can increment electrical release machining rates fivefold contrasted with steel. Steel isn't truly moldable, which is the reason numerous producers decide to utilize aluminum. Steel is limited to specific shapes and arrangements, though aluminum's flexibility implies that architects and creators have more opportunities to make complex constructions. As indicated by Wenzel Metal Spinning, the turning interaction can break or rip steel, despite the fact that it is solid metal. Genuinely, aluminum's pliability produces more secure and more effective designs than steel.

#### 4.2 Polylactic Acid (PLA) For 3d Printing the Frame:

Polylactic corrosive or PLA is a thermoplastic polyester that is being utilized monetarily from one side of the planet to the other for 3D printing and as bioplastic which is being produced using sustainable biomass as it produced using corn starch. The softening mark of PLA goes from 130-180 degrees Celsius which makes it simple for assembling through the melded store shaping procedure. For expanding the strength of the material a few advancements like toughening, adding nucleating specialists, shaping a composite grid, chain broadening, and presenting crosslink structures.  $\text{CH}_3)_2\text{CO}$  is utilized for mollifies the outside of polylactic corrosive during dissolvable welding, it assists with staying with another polylactic corrosive surface without dissolving them. PLA can be corrupted effectively by three techniques they are:

- Hydrolysis
- Thermal debasement
- Photo-degradation

Polylactic corrosive can be 100% reused by either mechanical or compound strategies. In the compound strategy, the material is exposed to pollutions dependent on its use. The PLA can be utilized as a composite by utilizing compound hydrolysis since it is a bio-plastic it very well may be unloaded into the climate without having trepidation of delivering harmful gasses it just delivers water and carbon dioxide during debasing. It can even be burned.

#### 4.3 Calculations:

The following are all the calculations that are done for the robot.

##### 4.3.1 Calculations and Studies Table:

###### 4.3.1.1 Design Details of Robot Body.

Design Consideration Specifications of the frame: 0.21\*0.185 m

Thickness of the base: 0.003 m

Height of the total body: 0.22 m

Ground clearance: 0.065

Thickness of the wall: 0.002 m

Material used for base Aluminum Composite Panel Material used for wall Fiber-Reinforced and 3D printed using Polylactic Acid (PLA) a type of plastic.

###### 4.3.1.2. List of Components Used.

Wheel 2

Caster wheel 2

Battery 2

Arduino Uno 1

Motor Driving Module 2

DC Motor 2

Limit Switch 4

Ultrasonic Sensor

###### 4.3.1.3 Calculating Time Required to Clean an Empty Room

Room dimensions :

- Length of room (Assumption) = 4.8 m (L)
- Breadth of room (Assumption) = 4.5 m (B) 4.4

Calculating the Speed of Robot :

- Number of drive motors = 2
- Radius of drive wheel (R) = 0.056 m
- RPM of each drive motor (N) = 60 RPM
- Width of the robot (W) = 0.33 m
- Speed (V) =  $R \cdot \omega$
- $\omega = (2 \cdot \pi \cdot N) / 60$

- $\omega = 6.28318 \approx 6.28$  radians/second
- $V = 0.35$  m/s
- Considering efficiency of power delivered to motor = 90%
- Speed delivered or Speed of Robot ( $V_r$ ) =  $V \cdot 0.9 = 0.315$  m/s
- Time taken by the robot to cover the room length once ( $t$ ) =  $L / V_r = 4.8 / 0.315 = 15.238$  seconds
- Number of passes required for robot to cover the entire room = Breadth of the room ( $B$ ) / Width of the robot ( $W$ ) =  $4.5 / 0.33 = 13.63$  passes  $\approx 14$  passes
- Total time taken by the robot to cover the entire room =  $14 \cdot 15.238 = 213.332$  seconds  $\approx 3.56$  minutes  $\approx 3$  minutes 34 seconds (Max).

#### 4.3.1.4 Calculating Distance that can be Cleaned with Fully Charged Batteries:

Considering

- Maximum load condition on motors, current drawn by each motor = 1000 mA = 1A.
- Operating temperature = 25 °C.
- Discharge rate of the battery = Discharge rate of lead acid battery at 1-hour rate = 0.78 Ah.

As the motor draws 1A current according to our consideration, total time required for the battery to get completely discharged = 46.8 minutes.

Since lead acid battery shouldn't run past 80% of its charge, leaving 20% left in the battery in order to use it for multiple cycles,

time taken by the battery to discharge 80% of initial charge =  $46.8 \cdot 0.8 = 37.44$  minutes.

Since number of motors is equal to number of batteries which is equal to 2, considering each motor draws equal current of 1A from different batteries,

Total runtime of robot with fully charged batteries = 37 minutes 26 seconds = 2246 seconds.

Distance covered by robot = Velocity of robot ( $V_r$ ) x Total runtime of robot  
 $\geq 0.315 \cdot 2246 = 707.5$  m

#### 4.4 METHODOLOGY:

Design of Automatic Cleaning and Mopping Robot begins with the plan of straightforward and best undercarriage for the robot which is a vital part as it needs to convey all the load on the robot then hardware segments which are to be utilized on the robot are chosen which incorporate the kind of engine and its particular that are to be utilized to run the bot, the sensors to be utilized, the microcontroller, the engine drivers, the haggles electronic segments to be utilized on the robot. All things considered, parts are secured gathering the segments lastly testing and adjusting the gadget are finished.

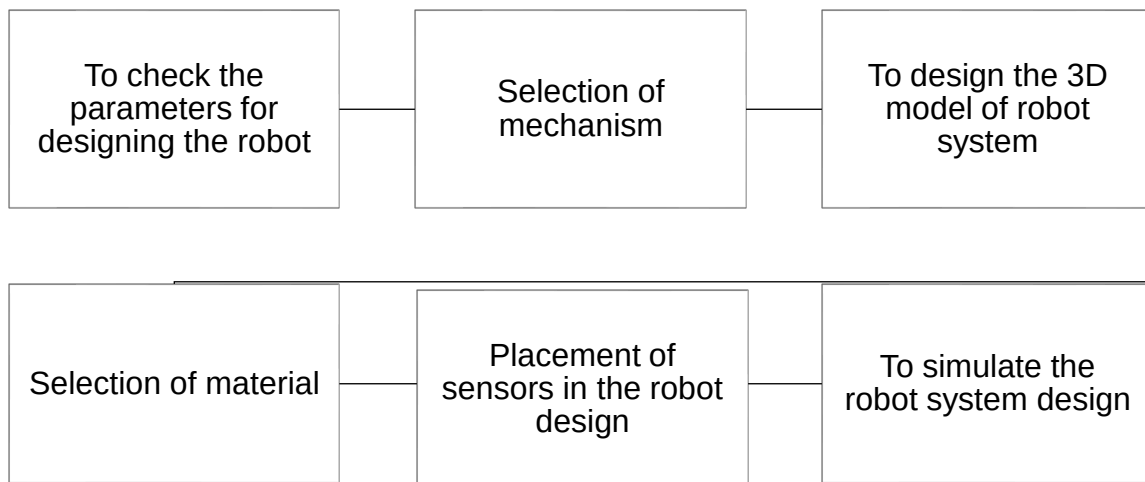


Figure 4.1: Objectives of the project

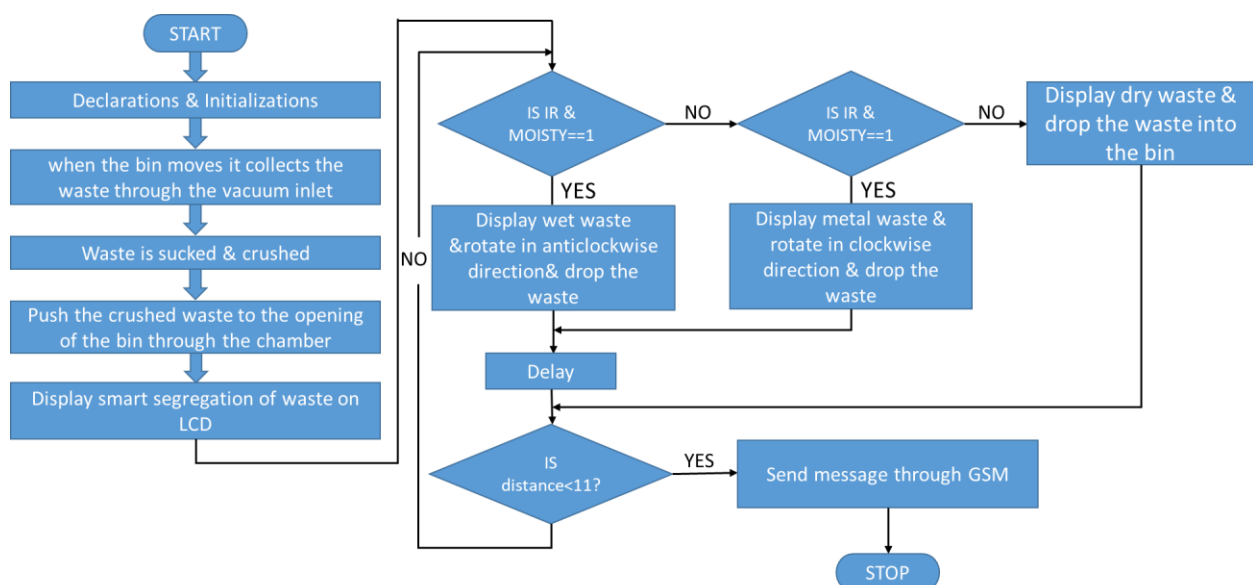


Figure 4.2 : Flowchart of open source code for the robot

Figure 4.2 shows, the working of Automatic Cleaning and Mopping Robot begins by turning on the gadget, the robots push ahead of my checking for obstructions and evades them assuming any. When the robot is turned on it begins cleaning and wiping at the same time and if any hindrance is there in its way it digresses from that and cleans the whole space.

#### 4.4.1 CAD MODEL:

The robot begins by enacting a straightforward switch. It all the while begins cleaning and wiping the floor. It follows per set way beginning from one finish of the room lastly finishes the whole room cleaning. In the wake of arriving at the opposite finish of the room, the robot alters its course and follows the way opposite to the past way. The robot changes the way in the event that it experiences an impediment. The way that the robot follows is a basic snake design as shown in Figure 4.3.

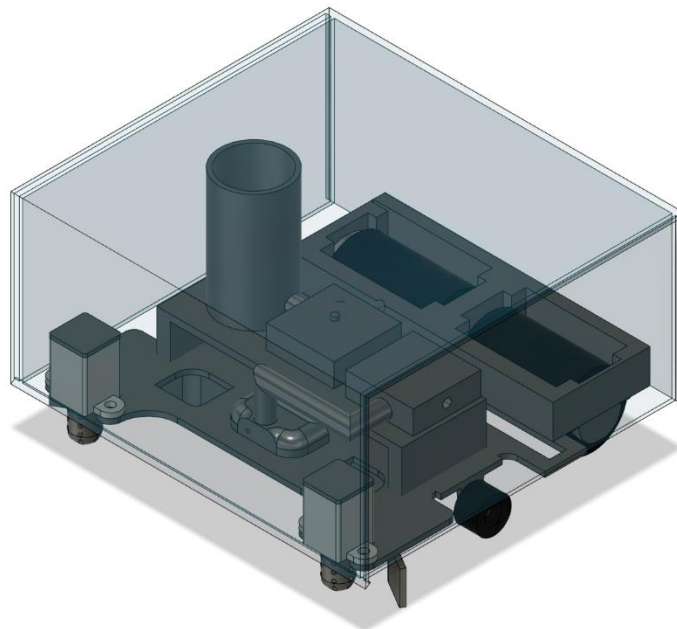


Figure 4.3 : shows the CAD model of the robot designed in Autodesk Fusion 360 software

The development strategy utilized for the robot is a straightforward snake development. The robot begins at a point An of the room as it arrives along the edge B of the room. It alters its course and starts moving toward the path opposite to the past development.



The robot begins to push ahead when it is turned on if there is any obstruction in its manners the supersonic sensor the robot goes astray. On the off chance that the robot hits something, it initiates the breaking point switches behind the guard and it strays from the way. In the event that the furthest switch is initiated, it strays 300 from the current way, and assuming the robot hits an article and the internal switch actuates, the robot digresses 150 from the current way. On the off chance that the robot hits an obstruction, it returns a similar heading and afterward, it turns into another way, this made conceivable because of the utilization of L293D Motor Drive.



Figure 4.6: Sprayer 3D model inbuilt in the frame

At the point when the bot is turned on the pull and cleaning instrument turns on, at that point the ultrasonic sensor checks for the presence of any head-on impediments. In the event of any head-on hindrances it takes a clockwise or an enemy of clockwise turn, if there should arise an occurrence of the shortfall of obstructions, it checks for any effect on the guards. In the event that any effect is recognized, the robot moves from the affected item and without sway it pushes ahead and checks for any head-on obstructions and the circle proceeds.

#### 4.4.2 SYSTEM ARCHITECTURE:

- ATmega-2560 microcontroller :

The ATmega2560 is a low-power CMOS 8-cycle microcontroller subject to the AVR improved RISC designing. By executing astounding rules in a singular clock cycle, the ATmega2560 achieves throughputs advancing toward 1 MIPS for every MHz allowing the structure organizer to smooth out power use rather than planning speed.

The device is burning through the Atmel high-thickness non-unpredictable memory development. By uniting an 8-cycle RISC CPU with In-System Self-Programmable Flash on a strong chip, the Atmel ATmega2560 is a mind-boggling microcontroller

that offers an especially versatile and monetarily insightful response for some embedded control applications.

The ATmega2560 AVR is maintained with a full set-up of program and structure improvement instruments including C compilers, huge scope developing specialists, program debugger/test frameworks, in-circuit emulators, and appraisal units

- Arduino

The Arduino Nano is somewhat, finished, and breadboard-obliging board subject to the ATmega328 (Arduino Nano 3.x). It has essentially comparative convenience to the Arduino Duemilanove, yet in a substitute group. It needs a DC power jack and works with a Mini-B USB interface as opposed to a standard one. Arduino Nano is one sort of microcontroller board, and it is arranged by Arduino. cc. It will in general be worked with a microcontroller like Atmega328. This microcontroller is similarly used in Arduino UNO. It is a little size board and moreover versatile with a wide collection of usages. It doesn't have any DC jack so the power supply can be given using a little USB port regardless straightly connected with the pins like VCC and GND. This board can be given 6 to 20volts using a little USB port on the board.

- DC engine

A DC motor is any class of turning electrical motors that converts direct stream electrical energy into mechanical energy. The most notable sorts rely upon the forces made by appealing fields. Essentially a wide scope of DC motors has some inside instrument, either electromechanical or electronic, to periodically modify the course of current in a piece of the motor.

DC motors were the chief kind of motor extensively used, as they could be filled from existing direct-current lighting power scattering structures. A DC motor's speed can be controlled over a wide reach, using either a variable reserve voltage or by changing the strength of the current in its field windings. Little DC motors are used in instruments, toys, and mechanical assemblies. The boundless motor can deal with direct current yet is a lightweight brushed motor used for advantageous power instruments and machines. Greater DC motors are as of now used in the stimulus of electric vehicles, lifts and raise, and in drives for steel moving plants. The presence of power contraptions has made the superseding of DC motors with AC motors possible in various applications.

- Rtos

A steady working system (RTOS) is a working structure (OS) intended to serve progressing applications that communicate data as it comes in, ordinarily without pad delays. Dealing with time necessities (tallying any OS delay) are assessed in tenths of seconds or more restricted expansions of time. A progressing system is a period-bound structure that has all-around described, fixed time impediments. Dealing with ought to be done inside the described constraints or the system will crash and burn. They either are event-driven or time-sharing. Event-driven systems switch between endeavors subject to their necessities, while time-sharing structures switch the task reliant on clock meddles. Most RTOSs use a pre-emptive booking figuring.

All around valuable working systems ordinarily don't allow customer ventures to cloak (hinder) meddles, considering the way that the customer program could deal with the CPU anyway long it wishes. Some bleeding-edge CPUs don't allow customer mode code to weaken obstructs as such control is seen as a key working system resource. Many embedded systems and RTOSs, in any case, grant the real application to run in piece mode for more significant structure call capability and besides to permit the application to have more conspicuous control of the working environment without requiring OS intercession.

Inspiration to keep an essential separation from dynamic memory task is memory crack. With standard designation and conveyance of little bits of memory, a situation may happen where open memory is separated into a couple of portions and the RTOS is unequipped for allocating a tremendous enough consistent square of memory, disregarding the way that there is adequate free memory. Moreover, the speed of the segment is huge. A standard memory apportioning plan checks an associated summary of unclear length to find a fitting free memory block.

- L293D Dual H-Bridge Motor DriverL293D

It is, for the most part, utilized H-Bridge Driver IC.H-Bridge can likewise be made with the assistance of semiconductors and MOSFETs and so on L293D is a double H-Bridge engine driver, so with one IC, we can interface two DC engines which can be controlled in both clockwise and hostile to clockwise headings.

- Dc-Dc Converter :

- a. DC-DC converter is generally utilized to change over unregulated DC contribution to a controlled DC yield.
- b. 6. CC2500 RF ModuleCC2500:
  - c. RF Module is a trans-beneficiary module that gives simple to-utilize RF correspondence at 2.4 GHz. It tends to be utilized to communicate and get information at 9600 baud rates. It requires no additional equipment and no additional coding to works in Half Duplex mode for example it gives correspondence in the two ways, yet just a single heading simultaneously.

## CHAPTER 5

### Results and Discussions

The robot that was manufactured facilitates both mopping and vacuuming mechanism. It works in both manual and automatic modes. The entire project started after approximating weight of the robot. Based on the weight, the torque required for the robot to move was estimated and the market survey was done to get to the final motor which was high Torque Metal Geared DC motor had been used in the robot.

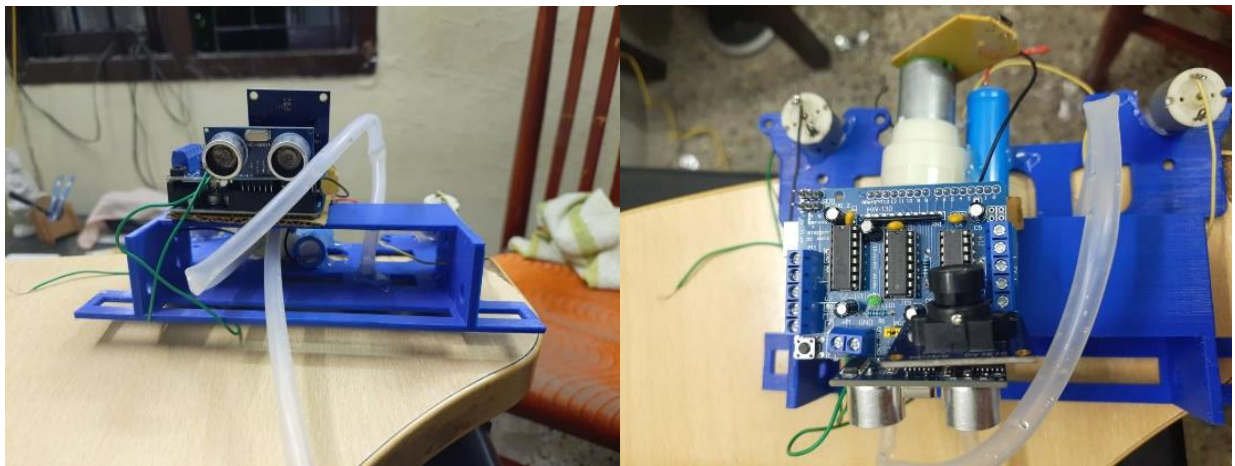


Figure 5.1: Prototype Model

The shape and size of the robot were decided to keep in mind the ease of navigation and programming. With the motor in hand the power supply to the robot is to be selected, keeping in mind the voltage supply and the current capacity the market availability was narrowed down and the Lead Acid Batteries were chosen to reduce the cost of the robot. The IR Sensors which were in use by most of the existing Cleaning robots were replaced by the Ultrasonic sensors which were more accurate. The bumper switches i.e., the limit switches were preferred over other non-contact sensors to increase the efficiency of the robot.

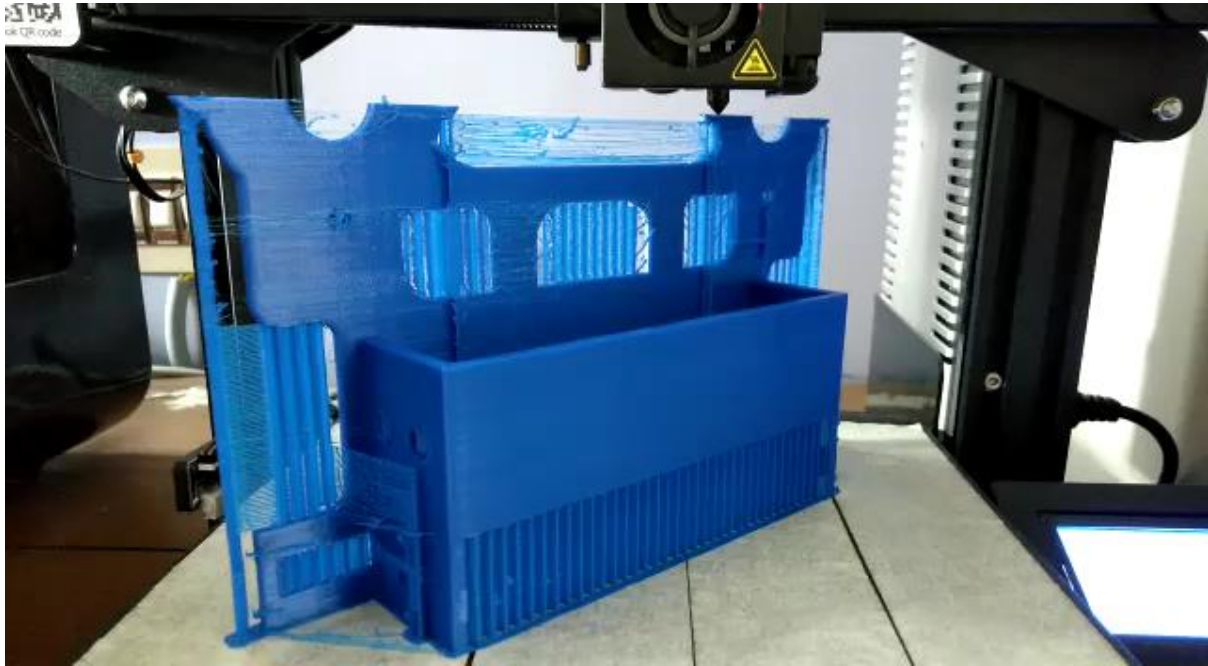
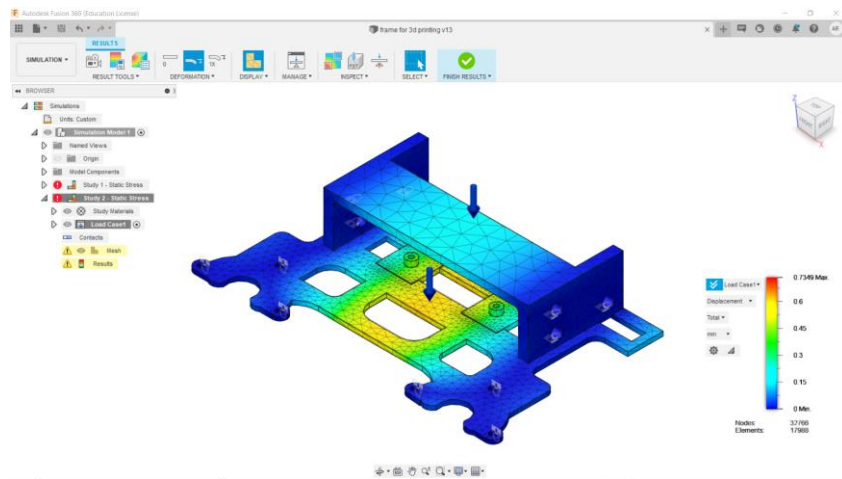


Figure 5.2 : 3D printing the Frame using PLA material

Many challenges had to be addressed during every stage of the development of the robot. These include Positioning of the Components, Wheel Alignment, Vacuum Chamber, Sensor Positioning, Motor Drive Overheating, and Navigation. The robot was able to cover 90% to 92% of the area by following the patterns shown in the figures. In automatic mode, the robot took approximately 10 to 15 minutes to clean a room with the dimensions of 6m\*5m. The robot runs for a total time of 35 minutes on full charge. It is able to simultaneously vacuum and wet mop the floor.

### 5.1 Finite Element Analysis Results:

FEA or finite element analysis is a commonly used method for physical problems using numerical techniques, since crankshaft is a complex mechanism it is difficult to solve in a theoretical manner. It is used to solve very difficult real-time propagation or fluid flow. Any continuous object in space has multiple degrees of freedom which makes it difficult to solve in conventional ways, the outcome of the solution is very far from the real-time study.



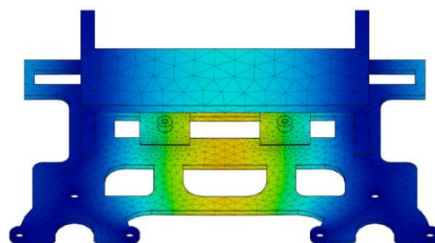
**Figure 5.3: Analysis Study for frame used in the robot which is 3D printed**

### Result Summary:

**Table 5.1: Static Study Results on frame**

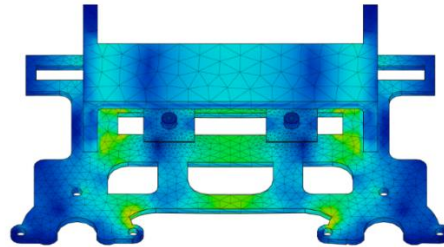
| Name                     | Minimum       | Maximum   |
|--------------------------|---------------|-----------|
| Safety Factor            |               |           |
| Safety Factor (Per Body) | 2             | 4         |
| Stress                   |               |           |
| Von Mises                | 2.193E-04 MPa | 1.325 MPa |
| Displacement             |               |           |
| Total                    | 0 mm          | 0.7349 mm |
| Reaction Force           |               |           |
| Total                    | 0 N           | 1.668 N   |
| Strain                   |               |           |
| Equivalent               | 4.523E-07     | 0.002486  |

Displacement:



**Figure 5.4: Displacement on frame used in the robot which is 3D printed**

## Stress



**Figure 5.5: Stress on frame used in the robot which is 3D printed**

In FEA, the object is needed to be solved can be splatted the surface body into a discrete number of elements for which the solution can be calculated and solved. The element can be spread its boundary condition throughout the whole domine. FEA adds substitutional value to the product design process.it provides significant insight and design that helps to create better products. Some of the specific benefits and outcome of using FEA include the following:

- It can predict the performance of the plan to be used
- It can predict the failure accusation for the case study
- It is used to evaluate and correct observed failures
- It is used to evaluate the design and improve the performance and safety
- Improvises the cost for manufacturing
- Improvises the weight of the known design with optimal performance
- To develop new innovative concepts with high savings on development
- Gains insight into the design concepts or directions
- Modeling decisions a be driven through the goals
  - a. Meshing

It is an important process to obtain results accurately in finite element analysis. The smaller the mesh size the more resolution of the design solutions as samples across the physical domains for higher accuracy the mesh size to be very fine result in an increase in time taken for processing.

Mesh:

Table 5.1: Mesh Details on frame

|                                          |              |                 |
|------------------------------------------|--------------|-----------------|
| Average Element Size (% of model size)   |              |                 |
| Scale Mesh Size Per Part                 |              | No              |
| Average Element Size (absolute value)    |              | 10 mm           |
| Element Order                            |              | Parabolic       |
| Max. Turn Angle on Curves (Deg.)         |              | 60              |
| Max. Adjacent Mesh Size Ratio            |              | 1.5             |
| Max. Aspect Ratio                        |              | 10              |
| Minimum Element Size (% of average size) |              | 20              |
| <b>Type</b>                              | <b>Nodes</b> | <b>Elements</b> |
| Solids                                   | 32766        | 17988           |

Table 5.2: Mesh Details for the FEA model of the frame

A finite element mesh includes both nodes and elements

- Nodes are points in 3d space
- Elements are area or volume defined by nodes

The geometry provided by the element poses the template for meshing. Based on the area defined in a domain the element types are wildly classified into four types they are

- Shell elements
- Solid elements
- Line elements

The shell elements are usually used in modal structures in which one dimension, the thickness, is significantly smaller than the other dimensions. Conventional shell elements use the condition to discretize the body of 3d model by defining the geometry at a reference surface of the model. Conventional shell elements have both displacement and rotational degrees of freedom but in the continuum, shell element discretizes an entire three-dimensional body only. The thickness is decided from the element nodal geometry. while the Continuum shell elements have transposition degrees of freedom only in the thickness property of the material. From a modelling point of view, continuum shell elements appear as if 3d

continuous solid, but their kinetic and constitutive behavior is analogous to standard shell elements.

In Solid elements, the entire geometry is been described by the cad model geometry. The tetrahedrons are the element type for three-dimensional, solid meshes. There are two types of tetrahedrons;

- Linear tetrahedrons
- Parabolic tetrahedrons

In linear tetrahedral element is defined by four corner nodes connected by straight edges. In parabolic tetrahedral element is described by four corner nodes, six mid-side nodes, four corner nodes, and six edges. For the same mesh density for a number of elements, parabolic tetrahedral elements possess improved results than linear elements because they denote curved boundaries more accurately and they make better mathematical approximations. The parabolic tetrahedral elements require more computational resources than linear elements.

## **CHAPTER 6**

### **Conclusion**

There are so many cleaning and wiping robots present in the market yet just some of them are reasonable and monetary. There are exceptionally fewer robots that incorporate both cleaning and wiping. With this work, we attempted to decrease the expense of the robot and make it more viable with the Indian Users and the Industries. To additional improve the route execution of the robot, input sensors, for example, optical encoders can be coordinated. Cleaner brushes can be added to the vacuum cleaning instrument to build the effectiveness of residue gathering. Lithium polymer batteries can be utilized to diminish the heaviness of the robot which can additionally prompt the decrease of force utilization.

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## APPENDICES

### Open Source Code:

#### **For Obstacle Detection:**

```
#include "AFMotor.h"

#include <Servo.h>

#define echopin A4 // echo pin
#define trigpin A5 // Trigger pin

Servo myservo;

const int MOTOR_1 = 1;
const int MOTOR_2 = 2;
const int MOTOR_3 = 3;
const int MOTOR_4 = 4;

AF_DCMotor motor1(MOTOR_1, MOTOR12_64KHZ); // create motor object, 64KHz
pwm

AF_DCMotor motor2(MOTOR_2, MOTOR12_64KHZ); // create motor object, 64KHz
pwm

AF_DCMotor motor3(MOTOR_3, MOTOR12_64KHZ); // create motor object, 64KHz
pwm

AF_DCMotor motor4(MOTOR_4, MOTOR12_64KHZ); // create motor object, 64KHz
pwm

int distance_L, distance_F, distance_R;

long distance;

int set = 20;

void setup() {
    Serial.begin(9600);          // Initialize serial port
    Serial.println("Start");
    myservo.attach(10);
    myservo.write(90);
    pinMode (trigpin, OUTPUT);
    pinMode (echopin, INPUT );
    motor1.setSpeed(180);        // set the motor speed to 0-255
    motor2.setSpeed(180);
    motor3.setSpeed(180);
```

```

    motor4.setSpeed(180); }

void loop() {
    distance_F = data();
    Serial.print("S=");
    Serial.println(distance_F);
    if (distance_F > set){
        Serial.println("Forward");
        motor1.run(FORWARD);    // turn it on going forward
        motor2.run(FORWARD);
        motor3.run(FORWARD);
        motor4.run(FORWARD);

        }
        else{hc_sr4();}
    }
}

long data(){
    digitalWrite(trigpin, LOW);
    delayMicroseconds(2);
    digitalWrite(trigpin, HIGH);
    delayMicroseconds(10);
    distance = pulseIn (echopin, HIGH);
    return distance / 29 / 2;
}

void compareDistance(){
    if (distance_L > distance_R){
        motor1.run(BACKWARD); // turn it on going left
        motor2.run(BACKWARD);
        motor3.run(FORWARD);
        motor4.run(FORWARD);
        delay(350);
    }
    else if (distance_R > distance_L){
        motor1.run(FORWARD); // the other right

```

```

motor2.run(FORWARD);
motor3.run(BACKWARD);
motor4.run(BACKWARD);
    delay(350);
}
else{
motor1.run(BACKWARD); // the other way
motor2.run(BACKWARD);
motor3.run(BACKWARD);
motor4.run(BACKWARD);
    delay(300);
motor1.run(BACKWARD); // turn it on going left
motor2.run(BACKWARD);
motor3.run(FORWARD);
motor4.run(FORWARD);
    delay(500);
}
}
void hc_sr4(){
    Serial.println("Stop");
    motor1.run(RELEASE);    // stopped
    motor2.run(RELEASE);
    motor3.run(RELEASE);
    motor4.run(RELEASE);
    myservo.write(0);
    delay(300);
    distance_R = data();
    delay(100);
    myservo.write(170);
    delay(500);
    distance_L = data();
    delay(100);
}

```

```
myservo.write(90);  
delay(300);  
compareDistance(); }
```

### **Motor Program :**

```
#if (ARDUINO >= 100)
```

```
    #include "Arduino.h"
```

```
#else
```

```
    #if defined(__AVR__)
```

```
        #include <avr/io.h>
```

```
    #endif
```

```
    #include "WProgram.h"
```

```
#endif
```

```
#include "AFMotor.h"
```

```
static uint8_t latch_state;
```

```
#if (MICROSTEPS == 8)
```

```
uint8_t microstepcurve[] = {0, 50, 98, 142, 180, 212, 236, 250, 255};
```

```
#elif (MICROSTEPS == 16)
```

```
uint8_t microstepcurve[] = {0, 25, 50, 74, 98, 120, 141, 162, 180, 197, 212, 225, 236,  
244, 250, 253, 255};
```

```
#endif
```

```
AFMotorController::AFMotorController(void) {
```

```
    TimerInitalized = false;
```

```
}
```

```
void AFMotorController::enable(void) {
```

```

// setup the latch
/*
LATCH_DDR |= _BV(LATCH);
ENABLE_DDR |= _BV(ENABLE);
CLK_DDR |= _BV(CLK);
SER_DDR |= _BV(SER);
*/

pinMode(MOTORLATCH, OUTPUT);
pinMode(MOTORENABLE, OUTPUT);
pinMode(MOTORDATA, OUTPUT);
pinMode(MOTORCLK, OUTPUT);

latch_state = 0;

latch_tx(); // "reset"

//ENABLE_PORT &= ~_BV(ENABLE); // enable the chip outputs!
digitalWrite(MOTORENABLE, LOW);
}

void AFMotorController::latch_tx(void) {
    uint8_t i;

    //LATCH_PORT &= ~_BV(LATCH);
    digitalWrite(MOTORLATCH, LOW);

    //SER_PORT &= ~_BV(SER);
    digitalWrite(MOTORDATA, LOW);

    for (i=0; i<8; i++) {
        //CLK_PORT &= ~_BV(CLK);

```

```

digitalWrite(MOTORCLK, LOW);

if (latch_state & _BV(7-i)) {
    //SER_PORT |= _BV(SER);
    digitalWrite(MOTORDATA, HIGH);
} else {
    //SER_PORT &= ~_BV(SER);
    digitalWrite(MOTORDATA, LOW);
}
//CLK_PORT |= _BV(CLK);
digitalWrite(MOTORCLK, HIGH);
}
//LATCH_PORT |= _BV(LATCH);
digitalWrite(MOTORLATCH, HIGH);
}

static AFMotorController MC;

/*****
MOTORS
*****/

inline void initPWM1(uint8_t freq) {
#ifdef __AVR_ATmega8__ || \
    defined(__AVR_ATmega48__) || \
    defined(__AVR_ATmega88__) || \
    defined(__AVR_ATmega168__) || \
    defined(__AVR_ATmega328P__)
    // use PWM from timer2A on PB3 (Arduino pin #11)
    TCCR2A |= _BV(COM2A1) | _BV(WGM20) | _BV(WGM21); // fast PWM, turn on
oc2a
    TCCR2B = freq & 0x7;
    OCR2A = 0;

```

```

#elif defined(__AVR_ATmega1280__) || defined(__AVR_ATmega2560__)
    // on arduino mega, pin 11 is now PB5 (OC1A)
    TCCR1A |= _BV(COM1A1) | _BV(WGM10); // fast PWM, turn on oc1a
    TCCR1B = (freq & 0x7) | _BV(WGM12);
    OCR1A = 0;
#elif defined(__PIC32MX__)
    #if defined(PIC32_USE_PIN9_FOR_M1_PWM)
        // Make sure that pin 11 is an input, since we have tied together 9 and 11
        pinMode(9, OUTPUT);
        pinMode(11, INPUT);
        if (!MC.TimerInitalized)
        { // Set up Timer2 for 80MHz counting fro 0 to 256
            T2CON = 0x8000 | ((freq & 0x07) << 4); // ON=1, FRZ=0, SIDL=0, TGATE=0,
            TCKPS=<freq>, T32=0, TCS=0; // ON=1, FRZ=0, SIDL=0, TGATE=0, TCKPS=0,
            T32=0, TCS=0
            TMR2 = 0x0000;
            PR2 = 0x0100;
            MC.TimerInitalized = true;
        }
        // Setup OC4 (pin 9) in PWM mode, with Timer2 as timebase
        OC4CON = 0x8006; // OC32 = 0, OCTSEL=0, OCM=6
        OC4RS = 0x0000;
        OC4R = 0x0000;
    #elif defined(PIC32_USE_PIN10_FOR_M1_PWM)
        // Make sure that pin 11 is an input, since we have tied together 9 and 11
        pinMode(10, OUTPUT);
        pinMode(11, INPUT);
        if (!MC.TimerInitalized)
        { // Set up Timer2 for 80MHz counting fro 0 to 256
            T2CON = 0x8000 | ((freq & 0x07) << 4); // ON=1, FRZ=0, SIDL=0, TGATE=0,
            TCKPS=<freq>, T32=0, TCS=0; // ON=1, FRZ=0, SIDL=0, TGATE=0, TCKPS=0,
            T32=0, TCS=0
            TMR2 = 0x0000;

```

```

    PR2 = 0x0100;

    MC.TimerInitalized = true;
}

// Setup OC5 (pin 10) in PWM mode, with Timer2 as timebase
OC5CON = 0x8006; // OC32 = 0, OCTSEL=0, OCM=6
OC5RS = 0x0000;
OC5R = 0x0000;

#else

    // If we are not using PWM for pin 11, then just do digital
    digitalWrite(11, LOW);

#endif

#else

    #error "This chip is not supported!"

#endif

    #if !defined(PIC32_USE_PIN9_FOR_M1_PWM) &&
    !defined(PIC32_USE_PIN10_FOR_M1_PWM)

        pinMode(11, OUTPUT);

    #endif

}

inline void setPWM1(uint8_t s) {
    #if defined(__AVR_ATmega8__) || \
        defined(__AVR_ATmega48__) || \
        defined(__AVR_ATmega88__) || \
        defined(__AVR_ATmega168__) || \
        defined(__AVR_ATmega328P__)

        // use PWM from timer2A on PB3 (Arduino pin #11)
        OCR2A = s;

    #elif defined(__AVR_ATmega1280__) || defined(__AVR_ATmega2560__)

        // on arduino mega, pin 11 is now PB5 (OC1A)
        OCR1A = s;

    #elif defined(__PIC32MX__)

```

```

#if defined(PIC32_USE_PIN9_FOR_M1_PWM)
    // Set the OC4 (pin 9) PMW duty cycle from 0 to 255
    OC4RS = s;
#elif defined(PIC32_USE_PIN10_FOR_M1_PWM)
    // Set the OC5 (pin 10) PMW duty cycle from 0 to 255
    OC5RS = s;
#else
    // If we are not doing PWM output for M1, then just use on/off
    if (s > 127)
    {
        digitalWrite(11, HIGH);
    }
    else
    {
        digitalWrite(11, LOW);
    }
#endif
#else
    #error "This chip is not supported!"
#endif
}

inline void initPWM2(uint8_t freq) {
#if defined(__AVR_ATmega8__) || \
    defined(__AVR_ATmega48__) || \
    defined(__AVR_ATmega88__) || \
    defined(__AVR_ATmega168__) || \
    defined(__AVR_ATmega328P__)
    // use PWM from timer2B (pin 3)
    TCCR2A |= _BV(COM2B1) | _BV(WGM20) | _BV(WGM21); // fast PWM, turn on
oc2b
    TCCR2B = freq & 0x7;

```

```

OCR2B = 0;

#elif defined(__AVR_ATmega1280__) || defined(__AVR_ATmega2560__)
    // on arduino mega, pin 3 is now PE5 (OC3C)
    TCCR3A |= _BV(COM1C1) | _BV(WGM10); // fast PWM, turn on oc3c
    TCCR3B = (freq & 0x7) | _BV(WGM12);
    OCR3C = 0;
#elif defined(__PIC32MX__)
    if (!MC.TimerInitalized)
    { // Set up Timer2 for 80MHz counting fro 0 to 256
        T2CON = 0x8000 | ((freq & 0x07) << 4); // ON=1, FRZ=0, SIDL=0, TGATE=0,
        TCKPS=<freq>, T32=0, TCS=0; // ON=1, FRZ=0, SIDL=0, TGATE=0, TCKPS=0,
        T32=0, TCS=0
        TMR2 = 0x0000;
        PR2 = 0x0100;
        MC.TimerInitalized = true;
    }
    // Setup OC1 (pin3) in PWM mode, with Timer2 as timebase
    OC1CON = 0x8006; // OC32 = 0, OCTSEL=0, OCM=6
    OC1RS = 0x0000;
    OC1R = 0x0000;
#else
    #error "This chip is not supported!"
#endif

    pinMode(3, OUTPUT);
}

inline void setPWM2(uint8_t s) {
#if defined(__AVR_ATmega8__) || \
    defined(__AVR_ATmega48__) || \
    defined(__AVR_ATmega88__) || \
    defined(__AVR_ATmega168__) || \
    defined(__AVR_ATmega328P__)

```

```

    // use PWM from timer2A on PB3 (Arduino pin #11)
    OCR2B = s;
#elif defined(__AVR_ATmega1280__) || defined(__AVR_ATmega2560__)
    // on arduino mega, pin 11 is now PB5 (OC1A)
    OCR3C = s;
#elif defined(__PIC32MX__)
    // Set the OC1 (pin3) PMW duty cycle from 0 to 255
    OC1RS = s;
#else
    #error "This chip is not supported!"
#endif
}

inline void initPWM3(uint8_t freq) {
#if defined(__AVR_ATmega8__) || \
    defined(__AVR_ATmega48__) || \
    defined(__AVR_ATmega88__) || \
    defined(__AVR_ATmega168__) || \
    defined(__AVR_ATmega328P__)
    // use PWM from timer0A / PD6 (pin 6)
    TCCR0A |= _BV(COM0A1) | _BV(WGM00) | _BV(WGM01); // fast PWM, turn on
    OC0A
    //TCCR0B = freq & 0x7;
    OCR0A = 0;
#elif defined(__AVR_ATmega1280__) || defined(__AVR_ATmega2560__)
    // on arduino mega, pin 6 is now PH3 (OC4A)
    TCCR4A |= _BV(COM1A1) | _BV(WGM10); // fast PWM, turn on oc4a
    TCCR4B = (freq & 0x7) | _BV(WGM12);
    //TCCR4B = 1 | _BV(WGM12);
    OCR4A = 0;
#elif defined(__PIC32MX__)
    if (!MC.TimerInitalized)

```

```

{ // Set up Timer2 for 80MHz counting fro 0 to 256

    T2CON = 0x8000 | ((freq & 0x07) << 4); // ON=1, FRZ=0, SIDL=0, TGATE=0,
    TCKPS=<freq>, T32=0, TCS=0; // ON=1, FRZ=0, SIDL=0, TGATE=0, TCKPS=0,
    T32=0, TCS=0

    TMR2 = 0x0000;

    PR2 = 0x0100;

    MC.TimerInitalized = true;

}

// Setup OC3 (pin 6) in PWM mode, with Timer2 as timebase
OC3CON = 0x8006; // OC32 = 0, OCTSEL=0, OCM=6
OC3RS = 0x0000;
OC3R = 0x0000;

#else

    #error "This chip is not supported!"

#endif

    pinMode(6, OUTPUT);
}

```

```

inline void setPWM3(uint8_t s) {
#if defined(__AVR_ATmega8__) || \
    defined(__AVR_ATmega48__) || \
    defined(__AVR_ATmega88__) || \
    defined(__AVR_ATmega168__) || \
    defined(__AVR_ATmega328P__)
    // use PWM from timer0A on PB3 (Arduino pin #6)
    OCR0A = s;
#elif defined(__AVR_ATmega1280__) || defined(__AVR_ATmega2560__)
    // on arduino mega, pin 6 is now PH3 (OC4A)
    OCR4A = s;
#elif defined(__PIC32MX__)
    // Set the OC3 (pin 6) PMW duty cycle from 0 to 255
    OC3RS = s;
#else

```

```

    #error "This chip is not supported!"
#endif
}

inline void initPWM4(uint8_t freq) {
#if defined(__AVR_ATmega8__) || \
    defined(__AVR_ATmega48__) || \
    defined(__AVR_ATmega88__) || \
    defined(__AVR_ATmega168__) || \
    defined(__AVR_ATmega328P__)
    // use PWM from timer0B / PD5 (pin 5)
    TCCR0A |= _BV(COM0B1) | _BV(WGM00) | _BV(WGM01); // fast PWM, turn on
oc0a
    //TCCR0B = freq & 0x7;
    OCR0B = 0;
#elif defined(__AVR_ATmega1280__) || defined(__AVR_ATmega2560__)
    // on arduino mega, pin 5 is now PE3 (OC3A)
    TCCR3A |= _BV(COM1A1) | _BV(WGM10); // fast PWM, turn on oc3a
    TCCR3B = (freq & 0x7) | _BV(WGM12);
    //TCCR4B = 1 | _BV(WGM12);
    OCR3A = 0;
#elif defined(__PIC32MX__)
    if (!MC.TimerInitalized)
    { // Set up Timer2 for 80MHz counting fro 0 to 256
        T2CON = 0x8000 | ((freq & 0x07) << 4); // ON=1, FRZ=0, SIDL=0, TGATE=0,
TCKPS=<freq>, T32=0, TCS=0; // ON=1, FRZ=0, SIDL=0, TGATE=0, TCKPS=0,
T32=0, TCS=0
        TMR2 = 0x0000;
        PR2 = 0x0100;
        MC.TimerInitalized = true;
    }
}

```

```

    // Setup OC2 (pin 5) in PWM mode, with Timer2 as timebase
    OC2CON = 0x8006; // OC32 = 0, OCTSEL=0, OCM=6
    OC2RS = 0x0000;
    OC2R = 0x0000;
#else
    #error "This chip is not supported!"
#endif

    pinMode(5, OUTPUT);
}

inline void setPWM4(uint8_t s) {
#if defined(__AVR_ATmega8__) || \
    defined(__AVR_ATmega48__) || \
    defined(__AVR_ATmega88__) || \
    defined(__AVR_ATmega168__) || \
    defined(__AVR_ATmega328P__)
    // use PWM from timer0A on PB3 (Arduino pin #6)
    OCR0B = s;
#elif defined(__AVR_ATmega1280__) || defined(__AVR_ATmega2560__)
    // on arduino mega, pin 6 is now PH3 (OC4A)
    OCR3A = s;
#elif defined(__PIC32MX__)
    // Set the OC2 (pin 5) PMW duty cycle from 0 to 255
    OC2RS = s;
#else
    #error "This chip is not supported!"
#endif
}

AF_DCMotor::AF_DCMotor(uint8_t num, uint8_t freq) {
    motornum = num;
    pwmfreq = freq;
}

```

```

MC.enable();

switch (num) {
case 1:
    latch_state &= ~_BV(MOTOR1_A) & ~_BV(MOTOR1_B); // set both motor pins to
0
    MC.latch_tx();
    initPWM1(freq);
    break;
case 2:
    latch_state &= ~_BV(MOTOR2_A) & ~_BV(MOTOR2_B); // set both motor pins to
0
    MC.latch_tx();
    initPWM2(freq);
    break;
case 3:
    latch_state &= ~_BV(MOTOR3_A) & ~_BV(MOTOR3_B); // set both motor pins to
0
    MC.latch_tx();
    initPWM3(freq);
    break;
case 4:
    latch_state &= ~_BV(MOTOR4_A) & ~_BV(MOTOR4_B); // set both motor pins to
0
    MC.latch_tx();
    initPWM4(freq);
    break;
}
}

void AF_DCMotor::run(uint8_t cmd) {
    uint8_t a, b;

```

```

switch (motornum) {
case 1:
    a = MOTOR1_A; b = MOTOR1_B; break;
case 2:
    a = MOTOR2_A; b = MOTOR2_B; break;
case 3:
    a = MOTOR3_A; b = MOTOR3_B; break;
case 4:
    a = MOTOR4_A; b = MOTOR4_B; break;
default:
    return;
}

```

```

switch (cmd) {
case BACKWARD:
    latch_state |= _BV(a);
    latch_state &= ~_BV(b);
    MC.latch_tx();
    break;
case FORWARD:
    latch_state &= ~_BV(a);
    latch_state |= _BV(b);
    MC.latch_tx();
    break;
case RELEASE:
    latch_state &= ~_BV(a);    // A and B both low
    latch_state &= ~_BV(b);
    MC.latch_tx();
    break;
}
}

```

```

void AF_DCMotor::setSpeed(uint8_t speed) {
    switch (motornum) {
    case 1:
        setPWM1(speed); break;
    case 2:
        setPWM2(speed); break;
    case 3:
        setPWM3(speed); break;
    case 4:
        setPWM4(speed); break;
    }
}

```

```

/*****

```

## STEPPERS

```

*****/

```

```

AF_Stepper::AF_Stepper(uint16_t steps, uint8_t num) {
    MC.enable();

    revsteps = steps;
    steppernum = num;
    currentstep = 0;

    if (steppernum == 1) {
        latch_state &= ~_BV(MOTOR1_A) & ~_BV(MOTOR1_B) &
            ~_BV(MOTOR2_A) & ~_BV(MOTOR2_B); // all motor pins to 0
        MC.latch_tx();

        // enable both H bridges
        pinMode(11, OUTPUT);
        pinMode(3, OUTPUT);
    }
}

```

```

digitalWrite(11, HIGH);
digitalWrite(3, HIGH);

// use PWM for microstepping support
initPWM1(STEPPER1_PWM_RATE);
initPWM2(STEPPER1_PWM_RATE);
setPWM1(255);
setPWM2(255);

} else if (steppernum == 2) {
    latch_state &= ~_BV(MOTOR3_A) & ~_BV(MOTOR3_B) &
        ~_BV(MOTOR4_A) & ~_BV(MOTOR4_B); // all motor pins to 0
    MC.latch_tx();

    // enable both H bridges
    pinMode(5, OUTPUT);
    pinMode(6, OUTPUT);
    digitalWrite(5, HIGH);
    digitalWrite(6, HIGH);

    // use PWM for microstepping support
    // use PWM for microstepping support
    initPWM3(STEPPER2_PWM_RATE);
    initPWM4(STEPPER2_PWM_RATE);
    setPWM3(255);
    setPWM4(255);
}
}

void AF_Stepper::setSpeed(uint16_t rpm) {
    usperstep = 60000000 / ((uint32_t)revsteps * (uint32_t)rpm);
    steppingcounter = 0;

```

```

}

void AF_Stepper::release(void) {
  if (steppernum == 1) {
    latch_state &= ~_BV(MOTOR1_A) & ~_BV(MOTOR1_B) &
      ~_BV(MOTOR2_A) & ~_BV(MOTOR2_B); // all motor pins to 0
    MC.latch_tx();
  } else if (steppernum == 2) {
    latch_state &= ~_BV(MOTOR3_A) & ~_BV(MOTOR3_B) &
      ~_BV(MOTOR4_A) & ~_BV(MOTOR4_B); // all motor pins to 0
    MC.latch_tx();
  }
}

void AF_Stepper::step(uint16_t steps, uint8_t dir, uint8_t style) {
  uint32_t uspers = usperstep;
  uint8_t ret = 0;

  if (style == INTERLEAVE) {
    uspers /= 2;
  }
  else if (style == MICROSTEP) {
    uspers /= MICROSTEPS;
    steps *= MICROSTEPS;
#ifdef MOTORDEBUG
    Serial.print("steps = "); Serial.println(steps, DEC);
#endif
  }

  while (steps--) {
    ret = onestep(dir, style);
    delay(uspers/1000); // in ms
  }
}

```

```

steppingcounter += (uspers % 1000);
if (steppingcounter >= 1000) {
    delay(1);
    steppingcounter -= 1000;
}
}
if (style == MICROSTEP) {
    while ((ret != 0) && (ret != MICROSTEPS)) {
        ret = onestep(dir, style);
        delay(uspers/1000); // in ms
        steppingcounter += (uspers % 1000);
        if (steppingcounter >= 1000) {
            delay(1);
            steppingcounter -= 1000;
        }
    }
}
}
}

uint8_t AF_Stepper::onestep(uint8_t dir, uint8_t style) {
    uint8_t a, b, c, d;
    uint8_t ocrb, ocra;

    ocra = ocrb = 255;

    if (steppernum == 1) {
        a = _BV(MOTOR1_A);
        b = _BV(MOTOR2_A);
        c = _BV(MOTOR1_B);
        d = _BV(MOTOR2_B);
    } else if (steppernum == 2) {
        a = _BV(MOTOR3_A);

```

```

b = _BV(MOTOR4_A);
c = _BV(MOTOR3_B);
d = _BV(MOTOR4_B);
} else {
    return 0;
}

// next determine what sort of stepping procedure we're up to
if (style == SINGLE) {
    if ((currentstep/(MICROSTEPS/2)) % 2) { // we're at an odd step, weird
        if (dir == FORWARD) {
            currentstep += MICROSTEPS/2;
        }
        else {
            currentstep -= MICROSTEPS/2;
        }
    } else { // go to the next even step
        if (dir == FORWARD) {
            currentstep += MICROSTEPS;
        }
        else {
            currentstep -= MICROSTEPS;
        }
    }
} else if (style == DOUBLE) {
    if (! (currentstep/(MICROSTEPS/2) % 2)) { // we're at an even step, weird
        if (dir == FORWARD) {
            currentstep += MICROSTEPS/2;
        } else {
            currentstep -= MICROSTEPS/2;
        }
    } else { // go to the next odd step

```

```

    if (dir == FORWARD) {
        currentstep += MICROSTEPS;
    } else {
        currentstep -= MICROSTEPS;
    }
}
} else if (style == INTERLEAVE) {
    if (dir == FORWARD) {
        currentstep += MICROSTEPS/2;
    } else {
        currentstep -= MICROSTEPS/2;
    }
}

if (style == MICROSTEP) {
    if (dir == FORWARD) {
        currentstep++;
    } else {
        // BACKWARDS
        currentstep--;
    }
}

currentstep += MICROSTEPS*4;
currentstep %= MICROSTEPS*4;

ocra = ocrb = 0;
if ( (currentstep >= 0) && (currentstep < MICROSTEPS)) {
    ocra = microstepcurve[MICROSTEPS - currentstep];
    ocrb = microstepcurve[currentstep];
} else if ( (currentstep >= MICROSTEPS) && (currentstep < MICROSTEPS*2)) {
    ocra = microstepcurve[currentstep - MICROSTEPS];
    ocrb = microstepcurve[MICROSTEPS*2 - currentstep];
}

```

```

    } else if ( (currentstep >= MICROSTEPS*2) && (currentstep < MICROSTEPS*3))
    {
        ocra = microstepcurve[MICROSTEPS*3 - currentstep];
        ocrb = microstepcurve[currentstep - MICROSTEPS*2];
    } else if ( (currentstep >= MICROSTEPS*3) && (currentstep < MICROSTEPS*4))
    {
        ocra = microstepcurve[currentstep - MICROSTEPS*3];
        ocrb = microstepcurve[MICROSTEPS*4 - currentstep];
    }
}

```

```

currentstep += MICROSTEPS*4;
currentstep %= MICROSTEPS*4;

```

```

#ifdef MOTORDEBUG

```

```

    Serial.print("current step: "); Serial.println(currentstep, DEC);
    Serial.print(" pwmA = "); Serial.print(ocra, DEC);
    Serial.print(" pwmB = "); Serial.println(ocrb, DEC);

```

```

#endif

```

```

if (steppernum == 1) {
    setPWM1(ocra);
    setPWM2(ocrb);
} else if (steppernum == 2) {
    setPWM3(ocra);
    setPWM4(ocrb);
}

```

```

// release all

```

```

latch_state &= ~a & ~b & ~c & ~d; // all motor pins to 0

```

```

//Serial.println(step, DEC);

```

```

if (style == MICROSTEP) {
    if ((currentstep >= 0) && (currentstep < MICROSTEPS))
        latch_state |= a | b;
    if ((currentstep >= MICROSTEPS) && (currentstep < MICROSTEPS*2))
        latch_state |= b | c;
    if ((currentstep >= MICROSTEPS*2) && (currentstep < MICROSTEPS*3))
        latch_state |= c | d;
    if ((currentstep >= MICROSTEPS*3) && (currentstep < MICROSTEPS*4))
        latch_state |= d | a;
} else {
    switch (currentstep/(MICROSTEPS/2)) {
    case 0:
        latch_state |= a; // energize coil 1 only
        break;
    case 1:
        latch_state |= a | b; // energize coil 1+2
        break;
    case 2:
        latch_state |= b; // energize coil 2 only
        break;
    case 3:
        latch_state |= b | c; // energize coil 2+3
        break;
    case 4:
        latch_state |= c; // energize coil 3 only
        break;
    case 5:
        latch_state |= c | d; // energize coil 3+4
        break;
    case 6:
        latch_state |= d; // energize coil 4 only
        break;
    }
}

```

```
case 7:  
    latch_state |= d | a; // energize coil 1+4  
    break;  
}  
}  
MC.latch_tx();  
return currentstep;  
}
```

# Plagiarism Originality Report



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DESIGN AND ANALYSIS FOR WASTE SEGREGATION AND COLLECTION  
ROBOT WITH CMOS SENSOR Submitted in partial fulfilment of the requirements  
for the award of

Bachelor of Engineering degree in Mechanical Engineering By G. SAI ESHWAR  
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is to certify that this Project Report is the bonafide work of G. SAI ESHWAR  
(37150160) and P.

RABBI DOSS (37150146) who carried out the project entitled "DESIGN AND  
ANALYSIS FOR WASTE SEGREGATION AND COLLECTION ROBOT WITH  
CMOS SENSOR" under my supervision from to . Internal Guide DURAI RAJ

Submitted for Viva voce Examination held on \_\_\_\_\_ Internal  
Examiner External Examiner DECLARATION I, P. RABBI DOSS (37150146), hereby  
declare that the Project Report entitled "DESIGN AND ANALYSIS FOR WASTE  
SEGREGATION AND COLLECTION ROBOT WITH CMOS SENSOR" done by me  
under the guidance of DURAI RAJ.,

at Sathyabama Institute of Science and Technology is submitted in partial fulfillment  
of the requirements for the award of Bachelor of Technology degree in Mechanical  
Engineering. DATE: \_\_ PLACE: CHENNAI SIGNATURE OF THE CANDIDATE \_\_  
ACKNOWLEDGEMENT I am pleased to acknowledge my sincere thanks to Board  
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Strong waste is the futile, undesirable, and disposed of material coming about because of everyday exercises locally. Strong waste administration might be characterized as the order related to the control of age, stockpiling, assortment, move, preparing, and removal of strong waste. This project is focused on Human waste connection in the decrease and lessening of Manual work. A robot is intended to give an answer to the issues referenced previously.

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CHAPTER 1 INTRODUCTION Advanced mechanics is the designing and innovation which makes machines called robots, the crossing point of science, it substitutes for human activities. Mainstream society has in every case reliably intrigued with robots, R2-D2, Optimus Prime, WALL-E. These over-misrepresented, humanoid hypothesis of robots for the most part says like a personification of the genuine article. Robots are acquiring scholarly and mechanical capacities that don't put the likelihood of a R2-D2-like machine far off in the last mentioned. In the year 2005, 90%, all things considered, can be discovered gathering vehicles in car manufacturing plants.

These robots include for the most part of mechanical arms stunted with welding or screwing on chosen portions of a vehicle. Nowadays, an advanced and extended meaning of mechanical technology that includes the turn of events, creation, and utilization of bots that investigate Earth's harshest conditions, robots that help law authorization, and even robots that aid near each aspect of medical care. While the general universe of advanced mechanics is expanding, a robot has some viable attributes, for example, 1. Robots all viable with different kinds of mechanical development.

The mechanical part of a robot upholds every one of the errands in the climate for which it's planned. For instance, the Mars 2020 Rover's wheels are independently mechanized and work of titanium tubing which upholds it immovably grasp the brutal landscape of the red planet. 2. Robots require electrical segments which control and force the apparatus. Fundamentally, an electric flow is expected to control an immense dominant part of robots. 3. Robots convey probably some degree of PC programming. Without a bunch of codes instructing it, a robot would simply be important for straightforward apparatus.

Introducing a program into a robot enables it to realize when and how to complete an assignment. The advanced mechanics industry is still nearly youthful however has effectively taken astounding steps. From the enormous profundities of our seas to the most extreme statures of space, robots can be set up performing assignments that people were not equipped for the fantasy about accomplishing. 1.1 Types of Robots Mechanical bots gather all shapes and sizes to proficiently pass on out the assignment for which they are planned. Starting with 0.2

millimeter-long "RoboBee" to the 200 meter-long automated transportation vessel "Vindskip," robots are arising to pass on out errands that people can't ready to do. Essentially, there are five kinds of robots they are: 1.1.1 Pre-Programmed Robots Pre-customized robots work in an administered climate where they do effectively,

tedious undertakings. An illustration of a pre-customized robot is an auto sequential construction system which is a mechanical arm. The arm serves one capacity — to weld a door on, to walled in area a specific part into the motor, and so forth — and its work is to play out that task longer, quicker, and more effectively and productively than a human. 1.1.2

Humanoid Robots Humanoid robots will be robots that appear as though they emulate human propensities. These robots by and large perform human-like exercises (like running, playing and conveying articles), and it is intended to appear as though us, having human faces and looks. Two of the main instances of humanoid robots are Hanson Robotics' Sophia and Boston Dynamics' Atlas. 1.1.3 Autonomous Robots Self-ruling robots work independently from human administrators.

These robots are for the most part intended to complete errands in open conditions which needn't bother with human management. An illustration of a self-ruling robot is the Roomba vacuum cleaner, which utilizes sensors to wander around a home unreservedly. 1.1.4 Teleoperated Robots Teleoperated robots are mechanical bots that are constrained by people. These robots by and large work in most extreme geological conditions, climate, conditions, and so on Instances of teleoperated robots are the human-controlled submarines which are utilized to fix submerged line spills throughout the BP oil slick or robots used to distinguish landmines on a war zone. 1.1.5 Augmenting Robots Enlarging robots further upgrades current human capacities or reestablish the abilities a human may have disappeared.

Instances of expanding robots are automated prosthetic appendages or exoskeletons which are utilized to lift heavyweights. 1.2 Applications of Robotics Helping battle woods fires operating at the edge of people in assembling plants (known as co-bots) Robots that offer friendship to older people Surgical aides Last-mile bundle and food request conveyance Autonomous family robots which pass on out errands like vacuuming and taking care of the lawn Assisting with discovering things and moving them all through distribution centers Used during search-and-salvage missions after catastrophic events Landmine finders in combat areas 1.3 Uses of Robots Manufacturing The assembling business is likely the most seasoned and most renowned client of robots. These robots and co-bots work to productively test and collect items, similar to vehicles and mechanical gear.

It's assessed that there are expanded than 3,000,000 mechanical robots being used as of now. Logistics Transportation, taking care of, and quality control robots are turning into immeasurably significant for most retailers and co-ordinations organizations. Since we expect our bundles happens at bursting speeds, co-ordinations organizations enlist robots in stockrooms, and furthermore out and about, to help increment time productivity. As of now, robots are taking your things off the racks, shipping them over the distribution center floor, and bundling them.

In addition, an ascent in last-mile robots ensures that you'll have a face-to-metal-face experience with a co-ordinations bot in the forthcoming future. Home Robots can be seen wherever in our homes, assisting with tasks, helping us to remember our arrangement or plan, and furthermore engaging our kids. It's not sci-fi any longer. The most natural illustration of home robots is the self-governing vacuum cleaner Roomba. Additionally, robots are currently evolved to do everything from self-sufficiently taking care of lawn to cleaning pools.

•Travel Is there anything further sci-fi like than independent vehicles? These self-driving vehicles are not, at this point just creative mind. A combination of information science and advanced mechanics, self-driving vehicles are assuming control over the world by storm. Automakers, similar to Tesla, Ford, Volkswagen, and BMW are largely working on the following influx of movement that will allow us to sit back, unwind and appreciate the drive.

Rideshare organizations Uber and Lyft are likewise in the advancement of self-governing rideshare vehicles that don't expect people to drive the vehicle. Healthcare Robots have taken tremendous steps in medical care creation. These mechanical wonders have utilized in pretty much all parts of medical services, from robot-helped medical procedures to bots that help people to recuperate from injury in non-intrusive treatment. Instances of robots at work in medical services are Toyota's medical care colleagues, which help individuals to recover the capacity to walk, and "Pull," a robot intended to self-rulingly voyage all through a clinic and convey all from meds to clean cloths.

A self-ruling robot is additionally called an auto robot or Autobot, which is a robot that performs propensities or accuses of a serious level of self-sufficiency. Self-ruling advanced mechanics is for the most part viewed as a limit of man-made consciousness, mechanical technology, and data designing. The underlying model was proposed and shown by creator/designer David L. Heiserman. Independent robots are explicitly useful in fields like spaceflight, family upkeep, wastewater treatment, and conveying merchandise and ventures. Some most recent production line robots are "independent" inside the severe subfield of their immediate climate.

It can't be that all level of opportunity exists in their general climate, however the production line robot's working environment is requesting and can as often as possible contain tumultuous unpredicted factors. The expand and position of the following things of work and furthermore the sort of item and the necessary undertaking should be determined to. This can shift capriciously. One primary territory of advanced mechanics study is to allow the robot to adapt to its current circumstance whether this is ashore, submerged, noticeable all around, underground, or in space.

A completely independent robot can: collect insights concerning the climate Work for a grow period without human obstruction Proceed further all or part of itself all through its working climate without human help keep away from the situation that is hurtful to individuals, property, or itself without those are important for its plan particulars A self-governing robot other than study or gain new information like adapting to another procedure of achieving its undertakings or adjusting to evolving environmental factors. Like different machines, self-governing robots actually need customary support. 1.4 Autonomous route 1.4.1

Indoor route For a robot to connect practices with a spot needs it to acknowledge where it is and it tends to have the option to explore highlight point. Such route set about with wire direction in the year 1970s and advanced in the year 2000s to reference point based triangulation. Present business robots self-rulingly explore dependent on detecting normal highlights. The principal business robots to achieve this were Pyxus' HelpMate emergency clinic robot and the Cyber Motion watch robot, both planned by mechanical technology pioneers in the year 1980s.

These robots initially utilized physically created CAD floor plans, sonar detecting,

and divider following varieties to explore structures. The future, like Mobile Robot's Patrol Bot and self-sufficient wheelchair, both dispatched in 2004, have the ability to create their own laser-based guides of a structure and to explore open regions likewise hallways. Their control framework turns its way on the fly if something blocks the way. At first, self-sufficient route depended on planar sensors, similar to laser range-locaters, which can just detect at one level.

The main frameworks presently intertwine specifics from various sensors for both restriction and route. Frameworks like Motivity can depend on different sensors in different regions, contingent on which permit the most solid information at that point, and can re-map a structure independently. In inclination of climb steps, which needs profoundly particular equipment, most indoor robots explore incapacitated available territories, controlling lifts, and electronic entryways.

With these like electronic access-control interfaces, robots can now effectively and openly explore inside. Self-rulingly climbing steps and opening entryways physically are subjects of examination right now. As these indoor strategies keep on growing, vacuuming robots will get the ability to tidy up a particular client indicated room or a full floor. Security robots will be equipped for helping out nearby interlopers and cut off exits. These advances likewise bring associative insurances: robot inward guides essentially grant "prohibited regions" to be characterized to keep robots from independently entering unmistakable districts. 1.4.2

Outdoor route Outside independence **is all the more** just accomplished noticeable all around **in light of the** fact that deterrents are uncommon. Journey rockets are very hazardous exceptionally self-sufficient robots. Pilotless robot airplane are increasingly more utilized for surveillance. A portion of these automated ethereal vehicles (UAVs) are capable of flying their entire mission with no human cooperation at all aside from maybe for the arrival where an individual mediate utilizing radio controller.

A few robots are equipped for protected, programmed arrivals, at any rate a self-governing boat was accounted for in the year 2014—the Autonomous spaceport drone transport—and is orchestrated to make its underlying operational test in December 2014. Open air self-rule is more enthusiastically for ground vehicles, due to: Three-dimensional landscape Great aberrations in surface thickness Weather exigencies Instability of the detected climate Metropolitan Solid Waste Management requires the utilization of the rule of **Integrated Solid Waste Management (ISWM)** to city squander.

ISWM is the utilization of reasonable procedures, innovations, and the executives programs covering **a wide range of** strong squanders from all sources to achieve the twin destinations of (a) squander decrease and (b) powerful administration of waste actually makes after squander decrease. Squander taking care of and arranging require the exercises related with the administration of squanders up to they are stored down holders for assortment. Taking care of likewise incorporates the development of filled holders to the place of assortment. Arranging waste segments is a significant advance in the taking care of and capacity of strong waste at the source.

For instance, the best spot to isolate squander materials for reuse and reusing is at the wellspring of age. Families are getting more mindful of the substance of split paper and cardboard, bottles/glass, kitchen squanders, and ferrous and non-ferrous

materials. On location stockpiling is of high need due to general wellbeing concerns and tasteful contemplations. Ugly shoddy holders and furthermore open ground stockpiling, these two of which are bothersome, are normally seen at numerous private and business destinations.

The benefit of giving stockpiling to strong squanders at the source is by and large borne by the family on account of people, or by the administration of business and modern properties. Preparing at the source incorporates exercises, for example, patio squander treating the soil. Squanders are the material that isn't needed and isn't working financially with seriously handling. It is likely as strong, fluid, and gas. They emerge from human exercises like farming, industry, homegrown exercises, and so forth As indicated by the cause, squander is characterized as homegrown, mechanical, business, clinical, development, atomic, and horticultural.

As indicated by properties squander is characterized as latent, harmful, and inflammable. On the off chance that these squanders stay natural, it prompts air, water, soil, or strong waste contamination. Subsequently, strong waste administration is more fundamental. The precision of an expectation of the impending CMOS innovation is consequently may not probably be extraordinary. In any case, the key standards fundamental the development of CMOS innovation can give us some instinct into the accompanying. A new report by Taur et al.

brought up that the particular semiconductors in prevailing utilize this day will before long have a modest pace of impact increment as their size is diminished. Taur upheld an attention on exploratory gadgets, low-temperature employable, and broaden practical incorporation as methods for supporting the business pattern of framework execution improvement. This report considers these and other, more extensive, issues identified with the forthcoming development of CMOS innovation.

It results that the current pace of semiconductor show improvement can be supported for another 10 to 15 years, yet just through the advancement of the most recent materials and semiconductor structures. Additionally, a significant change in lithography will be expected to proceed with size decrease. Memory innovation for DRAM materials is similarly arriving at a significant obstacle and necessities the furthest down the line design to move past 1 GB levels. CHAPTER-2 LITERATURE SURVEY: Eric R.

Fossum, A Review of the Pinned Photodiode for CCD and CMOS Image Sensors, The pinned photodiode is the main photo detector assembly used in most CCD and CMOS image sensors. This paper analyses the development, physics, and technology of the pinned photodiode. R. D. Isaac, The future of CMOS technology, in this report the performance of integrated circuits has been refining exponentially for more that of thirty years. In the following decade, the industry need to overcome numerous technological challenges to tolerate this remarkable pace of development.

Experiments in lithography, transistor scaling, interconnections, circuit families, computer memory, and circuit design are sketched. Possible solutions are briefly discussed. The ways in which these challenges will distress upcoming growth in the industry are measured. L. Giusti, A review of waste management practices and their impact on human health, this report studies the main focus is mainly on municipal solid waste (MSW), exposure to bioaerosols from composting abilities and to pathogens from sewage management plants are measured. The reported properties of radioactive waste are also briefly swotted. Todd Litman, Autonomous Vehicle

Implementation Predictions, this report explores the effects of autonomous motor vehicles, and their consequences for transportation planning.

It explores how rapidly such motor vehicles are likely to develop and be deployed established on experience with earlier motor vehicle technologies; their likely benefits and costs; how they will disturb travel movement; and their effects on planning conclusions such as optimal road, parking and public transit supply. Alan Hamlet, The Autonomous Garbage Truck, this paper details the design of Robot Dumpster, The Separate Garbage Truck, an autonomous mobile robot that examines for complete garbage cans, clears them into its' on board receptacle, and then dumps the contents of the on board receptacle addicted to a designated garbage space when it is filled.

Sunil M P, Waste Segregation Robot -A Swachh Bharat Initiation, in this report it targets at professionally sorting out wastes so that it would be informal for the group to separate them on a enormous scale base. The hardware contains core segment Raspberry Pi combined with the pi camera, dc motor, pick and place robotic arm, sensors such as IR, moisture, inductive proximity, wet sensor and also use of image arrangement algorithm for performing object finding based on the haar-cascade classifier with exposed CV.

Ran LIANG, Design, Modeling and Analysis of a Climbing Robot Used for Inspection of Glass Curtain Walls, A wall climbing robot established on negative pressure suction is intended, modeled and analyzed for check inspection of glass walls. Statics and kinetics analysis are accompanied in order to pledge the rational design. Rani Rokade, Smart Garbage Separation Robot with Image Processing Technique, in this the aim of the paper is to present a smart robot which is accomplished of splitting degradable and non- degradable waste using appearance processing techniques.

The future robot is in random motion when it senses any object it stops and camera takes image of the things, later processing and segmentation is completed, it splits waste into degradable and non-degradable waste. Jie Chen, Whole-Body Motion Planning for a Six-Legged Robot Walking on Rugged Terrain, this paper addresses the dispute of terrain geometry created whole-body motion scheduling for a six-legged robot over a uneven terrain. The whole-body planning is disintegrated into two sub-tasks leg support and swing.

Yubin Liu, Biomimetic Design and Optimal Swing of a Hexapod Robot Leg, This paper presents a acquiescent leg mechanism for a small six-legged robot, HITCR-II, created on abstracted anatomy from insect legs. Kinematic structure, comparative proportion of leg segment lengths and actuation system were analyzed in attention of anatomical structure in addition to muscle system of insect legs and preferred mobility. CHAPTER 3 AIM & SCOPE 3.1 AIM: The designed robot must be assisted by image processing to pick and place waste will minimize human effort of segregating. Hence it will increase hygiene in the society and help in keeping environment clean.

The use of image processing to segregate waste as plastic, wet and dry has to give us more accurate and reliable output than the use of sensors to detect them as used in most of the previous studies. The advantage of this work is its contribution in making a Smart city. Among the many challenges that a city faces, waste management is of utmost importance. The discarded waste can be then processed

to recover materials in an effective way and **convert them to energy** as usable fuels.

This can be further advance by making use of machine learning and artificial intelligence to make it humanoid waste segregation robot. 3.2 OBJECTIVE: The robot system should follow the 5s principle: Sort, Set in order, Shine, Standardize, Sustain. To check the parameters like (survey, coverage area, robot dimensions, robot travel, power consumption). Selection of mechanism and material selection. Movement and number of access of the robot. Parts used in robot. Placement of sensors. To design the parts of the robot. To simulate the robot system CHAPTER 4 MATERIAL AND METHODOLOGY 4.1 ALUMINIUM FOR FRAME: Aluminum is a flexible, lightweight, strong, and malleable metal.

It is regularly picked over different metals for different applications since it performs adequately and proficiently in a wide exhibit of conditions. The advantages of aluminum versus steel are many. Contrasted with different metals, including steel, aluminum weighs less by volume. Aluminum is 33% of the heaviness of different metals, including steel, metal, and copper. As per the Aluminum Association, aluminum auto constructions are savvier than steel auto designs: utilizing aluminum has a weight investment fund of up to 55 percent contrasted with steel structures.

In the marine transportation industry, aluminum structures are additionally more savvy contrasted with steel. Aluminum bodies have a weight reserve fund of 35 to 45 percent. **On the off chance that** aluminum is utilized rather than steel to build marine superstructures, there is a weight investment fund of 55 to 65 percent. Fuel and battery utilization is savvier in aluminum than steel structures since lightweight vehicles utilize less energy.

As indicated by Drive Aluminum, electrical vehicles that have progressed aluminum body structures utilize fewer batteries than those with steel body structures, which brings about weight reserve funds of up to 3,000 (US) dollars per unit. Contrasted with steel crossbreed vehicles, aluminum half breed vehicles experience fuel reserve funds of 5 to 7 percent. In contrast to steel, aluminum is normally non-destructive. As indicated by Future Industries, aluminum shapes an oxide film that normally shields the metal from erosion. How Stuff Works clarifies that this common consumption insurance happens when aluminum responds with oxygen.

The subsequent obstruction shields the metal from different mixtures, including water and further contact with oxygen. This regular obstruction is one explanation that aluminum is more gainful in certain conditions than carbon steel and some hardened steels. The British Stainless-Steel Association clarifies that hardened steel can consume in "forceful conditions." Steel should go through painting or different medicines to shield it from consumption. Aluminum outperforms steel in heat conductivity.

Ask any gourmet specialist and they will disclose to you that aluminum-based cookware is more productive for preparing food than steel-based cookware. Aluminum pots bubble water more rapidly than spotless pots since aluminum conducts heat more rapidly than steel. With regards to warm conductivity, aluminum has a fourfold increment contrasted with steel. As per Secret, an exploration research center that reviews aluminum items and cycles, aluminum's warm conductivity decreases cooling cycles more proficiently than steel in trim activities.

Aluminum additionally **has a higher electrical conductivity** rate than steel. This high

electrical conductivity joined with aluminum's low softening point contrasted with that of steel, implies that aluminum can increment electrical release machining rates fivefold contrasted with steel. Steel isn't truly moldable, which is the reason numerous producers decide to utilize aluminum.

Steel is limited to specific shapes and arrangements, though aluminum's flexibility implies that architects and creators have more opportunities to make complex constructions. As indicated by Wenzel Metal Spinning, the turning interaction can break or rip steel, despite the fact that it is solid metal. Genuinely, aluminum's pliability produces more secure and more effective designs than steel.

#### 4.2 Polylactic Acid (PLA) For 3d Printing the Frame:

Polylactic corrosive or PLA is a thermoplastic polyester that is being utilized monetarily from one side of the planet to the other for 3D printing and as bioplastic which is being produced using sustainable biomass as it produced using corn starch. The softening mark of PLA goes from 130-180 degrees Celsius which makes it simple for assembling through the melded store shaping procedure.

For expanding the strength of the material a few advancements like toughening, adding nucleating specialists, shaping a composite grid, chain broadening, and presenting crosslink structures. CH<sub>3</sub>)<sub>2</sub>CO is utilized for mollifies the outside of polylactic corrosive during dissolvable welding, it assists with staying with another polylactic corrosive surface without dissolving them. PLA can be corrupted effectively by three techniques they are: • Hydrolysis • Thermal debasement • Photo-degradation Polylactic corrosive can be 100% reused by either mechanical or compound strategies.

In the compound strategy, the material is exposed to pollutions dependent on its use. The PLA can be utilized as a composite by utilizing compound hydrolysis since it is a bio-plastic it very well may be unloaded into the climate without having trepidation of delivering harmful gasses it just delivers water and carbon dioxide during debasing. It can even be burned. Calculations: The following are all the calculations that are done for the robot.

#### 4.3.1 Calculations and Studies Table: 4.3.1.1 Design Details of Robot Body.

| Design Consideration     | Specifications |
|--------------------------|----------------|
| Thickness of the base    | 0.003 m        |
| Height of the total body | 0.22 m         |
| Ground clearance         | 0.065 m        |
| Thickness of the wall    | 0.002 m        |
| Material used for base   | Aluminum       |
| Material used for wall   | Composite      |

Panel Material used for wall Fiber-Reinforced and 3D printed using Polylactic Acid (PLA) a type of plastic.

#### 4.4

**METHODOLOGY:** Design of Automatic Cleaning and Mopping Robot begins with the plan of straightforward and best undercarriage for the robot which is a vital part as it needs to convey all the load on the robot then hardware segments which are to be utilized on the robot are chosen which incorporate the kind of engine and its particular that are to be utilized to run the bot, the sensors to be utilized, the microcontroller, the engine drivers, the haggles electronic segments to be utilized on the robot. All things considered, parts are secured gathering the segments lastly testing and adjusting the gadget are finished. / Figure 4.1: Objectives of the project / Figure 4.2 : Flowchart of open source code for the robot Figure 4.2

shows, the working of Automatic Cleaning and Mopping Robot begins by turning on the gadget, the robots push ahead of my checking for obstructions and evades them assuming any. When the robot is turned on it begins cleaning and wiping at the same time and if any hindrance is there in its way it digresses from that and cleans the whole space.

#### 4.4.1 CAD MODEL:

The robot begins by enacting a straightforward

switch. It all the while begins cleaning and wiping the floor. It follows per set way beginning from one finish of the room lastly finishes the whole room cleaning.

In the wake of arriving at the opposite finish of the room, the robot alters its course and follows the way opposite to the past way. The robot changes the way **in the event that** it experiences an impediment. The way that the robot follows is a basic snake design as shown in Figure 4.3. / Figure 4.3 : shows the CAD model of the robot designed **in Autodesk Fusion 360** software The development strategy utilized for the robot is a straightforward snake development. The robot begins at a point A of the room as it arrives along the edge B of the room. It alters its course and starts moving toward the path opposite to the past development. / Figure 4.4: Shows the CAD model of the robot frame designed **in Autodesk Fusion 360** software Figure 4.5: shows the CAD model of the robot brush motor **in Autodesk Fusion 360** software DESIGN SPECIFICATION: VOLUME : 210\*183.52\*120.592 FRAME THICKNESS : 3 mm CLEANING FLUID : 68 mL The robot begins to push ahead when it is turned on if there is any obstruction in its manners the supersonic sensor the robot goes astray.

On **the off chance that the** robot hits something, it initiates the breaking point switches behind the guard and it strays from the way. **In the event that** the furthest switch is initiated, it strays 300 from the current way, and assuming the robot hits an article and the internal switch actuates, the robot digresses 150 from the current way. **On the off chance that the** robot hits an obstruction, it returns a similar heading and afterward, it turns into another way, this made conceivable because of the utilization of L293D Motor Drive. / Figure 4.6: Sprayer 3D model inbuilt in the frame At the point when the bot is turned on the pull and cleaning instrument turns on, at that point the ultrasonic sensor checks for the presence of any head-on impediments.

In the event of any head-on hindrances it takes a clockwise or an enemy of clockwise turn, **if there should arise an occurrence of** the shortfall of obstructions, it checks for any effect on the guards. **In the event that** any effect is recognized, the robot moves from the affected item and without sway it pushes ahead and checks for any head-on obstructions and the circle proceeds. 4.4.2 SYSTEM ARCHITECTURE: ATmega-2560 microcontroller : The ATmega2560 **is a low-power CMOS** 8-cycle microcontroller subject to the AVR improved RISC designing.

By executing astounding rules in a singular clock cycle, the ATmega2560 achieves throughputs advancing toward 1 MIPS for every MHz allowing the structure organizer to smooth out power use rather than planning speed. The device is burning through the Atmel high-thickness non-unpredictable memory development. By uniting an 8-cycle RISC CPU with In-System Self-Programmable Flash on a strong chip, the Atmel ATmega2560 is a mind-boggling microcontroller that offers an especially versatile and monetarily insightful response for some embedded control applications.

The ATmega2560 AVR is maintained with a full set-up of program and structure improvement instruments including C compilers, huge scope developing specialists, program debugger/test frameworks, in-circuit emulators, and appraisal units • Arduino The Arduino Nano is somewhat, finished, and breadboard-obliging board subject to the ATmega328 (Arduino Nano 3.x). It has essentially comparative convenience to the Arduino Duemilanove, yet in a substitute group. It needs a **DC power jack and** works with a Mini-B USB interface as opposed to a standard one.

Arduino Nano is one sort of microcontroller board, and it is arranged by Arduino. cc. It will in general be worked with a microcontroller like Atmega328.

This microcontroller is similarly used in Arduino UNO. It is a little size board and moreover versatile with a wide collection of usages. It doesn't have any DC jack so the power supply can be given using a little USB port regardless straightly connected with the pins like VCC and GND. This board can be given 6 to 20volts using a little USB port on the board. • DC engine A DC motor is any class of turning electrical motors that converts direct stream electrical energy into mechanical energy. The most notable sorts rely upon the forces made by appealing fields.

Essentially a wide scope of DC motors has some inside instrument, either electromechanical or electronic, to periodically modify the course of current in a piece of the motor. DC motors were the chief kind of motor extensively used, as they could be filled from existing direct-current lighting power scattering structures. A DC motor's speed can be controlled over a wide reach, using either a variable reserve voltage or by changing the strength of the current in its field windings. Little DC motors are used in instruments, toys, and mechanical assemblies.

The boundless motor can deal with direct current yet is a lightweight brushed motor used for advantageous power instruments and machines. Greater DC motors are as of now used in the stimulus of electric vehicles, lifts and raise, and in drives for steel moving plants. The presence of power contraptions has made the superseding of DC motors with AC motors possible in various applications. • Rtos A steady working system (RTOS) is a working structure (OS) intended to serve progressing applications that communicate data as it comes in, ordinarily without pad delays.

Dealing with time necessities (tallying any OS delay) are assessed in tenths of seconds or more restricted expansions of time. A progressing system is a period-bound structure that has all-around described, fixed time impediments. Dealing with ought to be done inside the described constraints or the system will crash and burn. They either are event-driven or time-sharing. Event-driven systems switch between endeavors subject to their necessities, while time-sharing structures switch the task reliant on clock meddles. Most RTOSs use a pre-emptive booking figuring.

All around valuable working systems ordinarily don't allow customer ventures to cloak (hinder) meddles, considering the way that the customer program could deal with the CPU anyway long it wishes. Some bleeding-edge CPUs don't allow customer mode code to weaken obstructs as such control is seen as a key working system resource. Many embedded systems and RTOSs, in any case, grant the real application to run in piece mode for more significant structure call capability and besides to permit the application to have more conspicuous control of the working environment without requiring OS intercession. Inspiration to keep an essential separation from dynamic memory task is memory crack.

With standard designation and conveyance of little bits of memory, a situation may happen where open memory is separated into a couple of portions and the RTOS is unequipped for allocating a tremendous enough consistent square of memory, disregarding the way that there is adequate free memory. Moreover, the speed of the segment is huge. A standard memory apportioning plan checks an associated summary of unclear length to find a fitting free memory block. • L293D Dual H-Bridge Motor DriverL293D It is, for the most part, utilized H-Bridge Driver IC.H-Bridge can likewise be made with the assistance of semiconductors and MOSFETs and so on

L293D is a double H-Bridge engine driver, so with one IC, we can interface two DC engines which can be controlled in both clockwise and hostile to clockwise headings.

- Dc-Dc Converter : DC-DC converter is generally utilized to change over unregulated DC contribution to a controlled DC yield.

6. CC2500 RF Module CC2500: RF Module is a trans-beneficiary module that gives simple to-utilize RF correspondence at 2.4 GHz. It tends to be utilized to communicate and get information at 9600 baud rates. It requires no additional equipment and no additional coding to works in Half Duplex mode for example it gives correspondence in the two ways, yet just a single heading simultaneously. CHAPTER 5 Results and Discussions The robot that was manufactured facilitates both mopping and vacuuming mechanism. It works in both manual and automatic modes. The entire project started after approximating weight of the robot.

Based on the weight, the torque required for the robot to move was estimated and the market survey was done to get to the final motor which was high Torque Metal Geared DC motor had been used in the robot. Figure 5.1: Prototype Model The shape and size of the robot were decided to keep in mind the ease of navigation and programming. With the motor in hand the power supply to the robot is to be selected, keeping in mind the voltage supply and the current capacity the market availability was narrowed down and the Lead Acid Batteries were chosen to reduce the cost of the robot.

The IR Sensors which were in use by most of the existing Cleaning robots were replaced by the Ultrasonic sensors which were more accurate. The bumper switches i.e., the limit switches were preferred over other non-contact sensors to increase the efficiency of the robot. / Figure 5.2 : 3D printing the Frame using PLA material Many challenges had to be addressed during every stage of the development of the robot. These include Positioning of the Components, Wheel Alignment, Vacuum Chamber, Sensor Positioning, Motor Drive Overheating, and Navigation. The robot was able to cover 90% to 92% of the area by following the patterns shown in the figures.

In automatic mode, the robot took approximately 10 to 15 minutes to clean a room with the dimensions of 6m\*5m. The robot runs for a total time of 35 minutes on full charge. It is able to simultaneously vacuum and wet mop the floor. 5.1 Finite Element Analysis Results: FEA or finite element analysis is a commonly used method for physical problems using numerical techniques, since crankshaft is a complex mechanism it is difficult to solve in a theoretical manner. It is used to solve very difficult real-time propagation or fluid flow. Any continuous object in space has multiple degrees of freedom which makes it difficult to solve in conventional ways, the outcome of the solution is very far from the real-time study.

/ Figure 5.3: Analysis Study for frame used in the robot which is 3D printed Result Summary: Table 5.1: Static Study Results on frame

| Name                     | Minimum       | Maximum   |
|--------------------------|---------------|-----------|
| Safety Factor            |               |           |
| Safety Factor (Per Body) | 2             | 4         |
| Stress                   |               |           |
| Von Mises                | 2.193E-04 MPa | 1.325 MPa |
| Displacement             |               |           |
| Total                    | 0 mm          | 0.7349 mm |
| Reaction Force           |               |           |
| Total                    | 0 N           | 1.668 N   |
| Strain                   |               |           |
| Equivalent               | 4.523E-07     | 0.002486  |
| Displacement:            |               |           |

/ Figure 5.4: Displacement on frame used in the robot which is 3D printed Stress / Figure 5.5: Stress on frame used in the robot which is 3D printed In FEA, the object is needed to be solved can be splatted the surface body into a discrete number of elements for which the solution can be calculated and solved.

The element can be spread its boundary condition throughout the whole domine.

FEA adds substitutional value to the product design process. It provides significant insight and design that helps to create better products. Some of the specific benefits and outcome of using FEA include the following: It can predict the performance of the plan to be used. It can predict the failure accusation for the case study. It is used to evaluate and correct observed failures. It is used to evaluate the design and improve the performance and safety. Improvises the cost for manufacturing. Improvises the weight of the known design with optimal performance. To develop new innovative concepts with high savings on development. Gains insight into the design concepts or directions. Modeling decisions can be driven through the goals. Meshing. It is an important process to obtain results accurately in finite element analysis.

The smaller the mesh size the more resolution of the design solutions as samples across the physical domains for higher accuracy the mesh size to be very fine result in an increase in time taken for processing. Mesh: Table 5.1: Mesh Details on frame

|                                        |       |                                          |             |
|----------------------------------------|-------|------------------------------------------|-------------|
| Average Element Size (% of model size) | Scale | Mesh Size Per Part                       | No          |
| Average Element Size (absolute value)  | 10 mm | Element Order                            | Parabolic   |
| Max. Turn Angle on Curves (Deg.)       | 60    | Max. Adjacent Mesh Size Ratio            | 1.5         |
| Max. Aspect Ratio                      | 10    | Minimum Element Size (% of average size) | 20          |
| Type                                   | Nodes | Elements                                 | Solids      |
|                                        |       |                                          | 32766 17988 |

Table 5.2: Mesh Details for the FEA model of the frame. A finite element mesh includes both nodes and elements. Nodes are points in 3d space. Elements are area or volume defined by nodes. The geometry provided by the element poses the template for meshing.

Based on the area defined in a domain the element types are widely classified into four types they are Shell elements Solid elements Line elements. The shell elements are usually used in modal. The thickness is decided from the element nodal geometry. while the Continuum shell elements have transposition degrees of freedom only in the thickness property of the material. From a modelling point of view, continuum shell elements appear as if 3d continuous solid, but their kinetic and constitutive behavior is analogous to standard shell elements. In Solid elements, the entire geometry is been described by the cad model geometry.

The tetrahedrons are the element type for three-dimensional, solid meshes. There are two types of tetrahedrons; Linear tetrahedrons Parabolic tetrahedrons. In linear tetrahedral element is defined by four corner nodes connected by straight edges. In parabolic tetrahedral element is described by four corner nodes, six mid-side nodes, four corner nodes, and six edges. For the same mesh density for a number of elements, parabolic tetrahedral elements possess improved results than linear elements because they denote curved boundaries more accurately and they make better mathematical approximations.

The parabolic tetrahedral elements require more computational resources than linear elements. CHAPTER 6 Conclusion. There are so many cleaning and wiping robots present in the market yet just some of them are reasonable and monetary. There are exceptionally fewer robots that incorporate both cleaning and wiping. With this work, we attempted to decrease the expense of the robot and make it more viable with the Indian Users and the Industries. To additional improve the route execution of the robot, input sensors, for example, optical encoders can be coordinated. Cleaner brushes can be added to the vacuum cleaning instrument to build the effectiveness of residue gathering.

Lithium polymer batteries can be utilized to diminish the heaviness of the robot which

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