FABRICATION OF AUTOMATIC WALL PAINTING ROBOT

Submitted in partial fulfillment of the requirements
Of the degree of

BACHELOR OF TECHNOLOGY
IN
MECHANICAL ENGINEERING

By

ANKUR SINGH (1614101039)
MUKESH KUSHWAHA (1614101208)
RISHI KUMAR SINGH (1614101143)
SUNIL KUMAR SINGH (1614101176)

Supervisor:

Mr. B.N. Agrawal

SCHOOL OF MCHANICAL ENGINEERING
GALGOTIAS UNIVERSITY
GREATER NOIDA
2020

CERTIFICATE

This is to certify that the Research work titled **FABRICATION OF AUTOMATIC WALL PAINTING ROBOT ON** that is being submitted by **Ankur Singh, Mukesh Kushwaha, Rishi Kumar Singh, Sunil Kumar Singh** is in partial fulfillment of the requirements for the award of **Bachelor of Technology**, is a record of bonafide work done under my guidance. The contents of this research work, in full or in parts, have neither been taken from any other source nor have been submitted to any other Institute or University for award of any degree or diploma.

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This thesis/dissertation/project report entitled **Fabrication of Automatic Wall Painting Robot on** by **Ankur Singh, Mukesh Kushwaha, Rishi Kumar Singh, Sunil Kumar Singh** is approved for the degree of bachelor of technology in mechanical engineering.

Examiners

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ACKNOWLEDGEMENT

The contributions of many different people, in their different ways, have made this possible. I would like to extend my gratitude to the following.

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_____

(Ankur Singh)

_____

(Mukesh Kushwaha)

_____

(Rishi Kumar Singh)

_____

(Sunil Kumar Singh)

(Department of Mechanical engineering)

ABSTRACT

The primary aim of the project is to design, develop and implement of Automatic Wall Painting Robot which helps to achieve low cost painting process and equipment. Despite the advance techniques in robotics and it is wide spreading application in wall painting has shared little in research activities. The system performs the painting process by the use of sensors information. The ultrasonic sensor mounted are on the mobile robot in a way so that the first sensor is positioned to give vertical coordinates and the second sensor gives the horizontal coordinates.

The painting chemicals can cause hazards to the human painters such as eye and respiratory system problems, Also the nature of painting procedure that requires repeated work and hand rising makes it boring, time and effort consuming. When construction workers and robots are properly integrated in building tasks, the whole construction process can be better managed and savings in human labour, timing and cost are obtained as a consequence. In addition, It offer to reduce human exposure to difficult and hazardous environments, which would solve the most of the problem related to safety when many activities accurate the same time. All these factors motivate the development of an automatically painting robot.

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List of abbreviations

1. IR	Infrared
2. FCV	Flow Control Valve
3. MGV	Multi Groove Belt
4. IDE	Integrated Development Environment
5. TDPW	Time Duration Painting of Wall
6. SDL	Safety Work Load
7. BMEP	Brake mean effective pressure.
8. IMEP	Indicated mean effective pressure.
9. PMEP	Pumping mean effective pressure.
10. FMEP	Frictional mean effective pressure

1

Introduction

1.1 Aim of the project

The primary aim of the project is to design, develop and implement automatic Wall Painting Machine which helps to achieve low cost painting equipment and safety. The painting chemicals can cause hazards to the human painters such as eye and respiratory system problems. Also the nature of painting procedure that requires repeated work and hand rising makes it boring, time and effort consuming. When construction workers and machine are properly integrated in building tasks, the whole construction process can be better managed and savings in human labour and timing are obtained as a consequence.

In addition, it would offer the opportunity to reduce or eliminate human exposure to difficult and hazardous environments, which would solve most of the problems connected with safety when many activities occur at the same time. These factors motivate the development of an automated painting system.

1.2 Research purpose and meaning

Building and construction is one of the major industries around the world in the fast moving construction industry is also growing rapidly, but the labour in construction industry are not sufficient this insufficient labours in the construction industry is because of the difficulty in the work. In construction industry, during the work in tall buildings or in the sites where there more risky situation like interior area in the city .There are some other reasons for the insufficient labour which may be because of the improvement the education level which cause the people to think that these types of work is not as prestigious as the other jobs, The construction industry is labour intensive and conducted in dangerous situations therefore importance of construction robotics has been realized and is grown rapidly. Applications and activities of robotics and automation in this construction industry started in the early 90"s aiming to optimize equipment operations, improve safety, enhance perception of

workspace and furthermore, ensure quality environment for building occupant. After this, the advances in the robotics and automation in the construction industry has grown rapidly. Fast globalization and interconnectivity create the major driving force in creating and enhancing chance. Therefore society must acquire new trends of innovation to prosper in their ways of life. The community has revolutionized due to the interconnectivity greatly compared to some years back when usage of technology did not exist. Saving human labour number and timings are only the two main advantages besides we must consider the opportunity to reduce human exposure to difficult and hazardous environments, improve the quality of such work which would solve with safety. Despite the advances in the robotics and it is wide spreading applications, painting is also considered to be difficult process as it also must paint the whole building. To make this work easier and safer and to reduce the number of labour automation in pain introduced. The development of service robots became popular recently dur to fact that society needs robots to relax humans from tedious and dangerous jobs in Egypt, as well as other developing countries, the increasing population stimulates the construction-related activities such as interior finishing and painting. Painting is classically done by humans and generally requires exhaustive physical efforts and involves exposure to dangerous chemicals. Chemicals can seriously impair the vision, respiratory system and general health of the human painter. These factors make painting an ideal candidate process for automation. More than 100,000 apartments are built annually in Egypt, with an average painting area of 40million square meters (based on an average 100 m2 apartment area with 400 m2 painting area). The surface area of painting is more due to the renovation work and expected population increase in the future. This demand imposes challenges that will hardly be met using human painters only in the next decade. Therefore development of a Painting machine that can perform the painting task with minimum human intervention is needed and will improve the quality of painting. The need for an autonomous painting robot is both clear and strong. Automated painting had been realized successfully in the automotive industry to paint millions of cars in the assembly lines. This industry uses spray painting and the robotic system is fixed in the assembly line. The domestic painting robots should be different in the sense that robots should have mobility so that it can move to paint the fixed walls. Also, the domestic painter robots should use roller instead of spray which is the common practice in the market to attain customer satisfaction. This automatic wall painting robot is not designed using complicated components. This robot is simple and portable. The robot is designed using few steels, conveyor shaft, chain, rope, spray gun and a controller unit to control the entire operation of the robot the cost of project is less because of simple mechanism. This robot is compact because of high speed and pressure capabilities they have. They also have a very small weight to power output ratio and predictable performance i.e., losses are minimum and so gives expected performance. Due to elegant and simple control system it produces less noise and vibration.

It has longer life, flexibility and it is efficient and dependable, and the installation is simple and the maintenance is easy. In this mechanized word, there is a growing urge of automatic executions of almost all our work. Humans avoid getting physically involved in the task rather than find machines to carry out our designated work. Now taking of autonomous wall painting robot.

1.3 Objective of Study

The actual targets for development of the wall painting machine, in order to solve the aforementioned situation, were set as follows:

1. To make machine structure simple to enable easy mounting as well as for safety.
2. To Avoid Hazard effect of Paint on Human Body
3. To save the human effort and improved throughout
4. To reduce the environment risk on human lives
5. To overall raise the quality of work
6. Accurate and smooth painting
7. To perform only painting in a single colour.
8. The Automated Painting Robot was to be designed with the vision to facilitate easy.
9. Being a Prototype design, The Painting section is limited In height

2

Literature review

2.1 Introduction

Automation can be defined as the technology by which a process or procedure is performed without human assistance. The term was inspired by the earlier word automatic (coming from automaton), was not widely used before 1947, when Ford established an automation department. It was during this time that industry was rapidly adopting feedback controllers, which were introduced in the 1930s.

Automation has been achieved by various means including mechanical, hydraulic, pneumatic, electrical, electronic devices and computers, usually in combination. Complicated systems, such as modern factories, airplanes and ships typically use all these combined techniques. The benefit of automation includes labour savings, savings in electricity costs, savings in material costs, and improvements to quality, accuracy and precision.

Spraying paint with compressed air can be traced back to its use on the Southern Pacific Railway in the early 1880s in 1887 Joseph Binks, the maintenance supervisor at Chicago's Marshall Field's Whole sale Store developed a hand pumped cold-water paint spraying machine to apply whitewash to the subbasement walls of the store. Francis Davis Millet, the decorations director for the World's Columbian Exposition in Chicago in 1893, used Binks and his spray painting system to apply white wash consisting of mix of oil and white lead to the buildings at the Exposition, taking considerably less time than traditional brush painting and turning it into what has been called the White City. In 1949, Edward Seymour developed a type of spray painting, aerosol paint that could be delivered via a compressed aerosol in a cam.

Spray painting is a painting technique where a device sprays a coating (paint, ink, varnish, etc.) through the air on*to a surface. The most common types employ compressed gas—usually air—to atomize and direct the paint particles. Spray guns evolved from airbrushes, and the two are usually distinguished by their size and the size of the spray pattern they produce. Airbrushes are hand-held and used instead of a brush for detailed work such as photo retouching, painting nails or fine art. Air gun spraying use

equipment that is generally larger. It is typically used for covering large surfaces with an even coating of liquid. Spray guns can be either automated or hand-held and have interchangeable heads to allow for different spray patterns. Single colour aerosol paint cans are portable and easy to store.

The process of air gun spraying occurs when paint is applied to an object using an air-pressurized spray gun. The air gun has a nozzle, paint basin, and air compressor. When the trigger is pressed the paint mixes with the compressed air stream and is released in a fine spray. There are two types of air-gun spraying processes. In a manual operation method, the air-gun sprayer is held by a skilled operator, about six to ten inches (15–25 cm) from the object, and moved back and forth over the surface, each stroke overlapping the before ensuring a continuous coat. In an automatic process the gun head is attached to a mounting block and delivers the stream of paint from that position. The object being painted is usually placed on rollers or a turntable to ensure overall equal coverage of all sides.

The spray nozzle is a precision device that facilitates dispersion of liquid into a spray. Nozzles are used for three purposes: to distribute a liquid over an area, to increase liquid surface area, and create impact force on a solid surface. A wide variety of spray nozzle applications use several spray characteristics to describe the spray.

***Spray Patterns:**

Due to a wide range of nozzle shapes and sizes, the consistency of the paint can be varied. The shape of the work piece and the desired paint consistency and pattern are important factors when choosing a nozzle. The three most common nozzles are the full cone, hollow cone, and flat stream. As shown below.

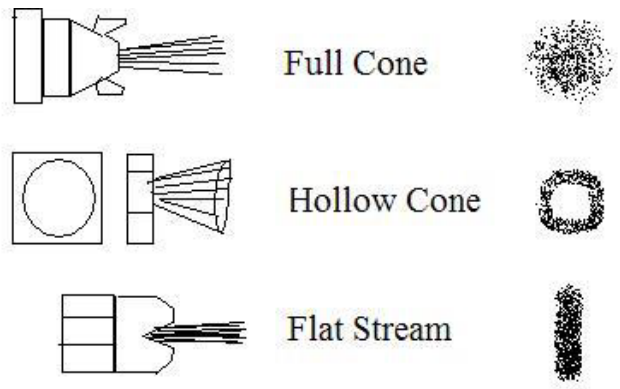


Fig 2.1 spray patterns

2.2 Review

The literature review detailed in this section was conducted to ascertain and understand the successes and failures of wall painting systems that have been designed before.

Padakar and Devi (2019) was developed a wall painting robot. Which is mechanical and electronic base robot, this robot introduce motor and belt drive mechanism to drive the roller on Y axis. It is roller base painting system, this robot has only one degree of freedom. This robot consuming more time to painting a wall.

Madhira and Mehta (2017) was developed a wall painting robotThis robot is introduce the stepper motor and using belt and pully mechanism. Its painting system is generic pneumatic air brush are paint the wall, painting robot had two degree of freedom. In this robot bluetooth module HC05 transceiver are installed to connected with the mobile bluetooth so this robot operate with the mobile. Its weight is little high approx 40 kg.The robot paint the wall 100m*2 per hour.

Mukundan and Sirajuddin (2017) was developed a wall painting robot. This robot introduce screwed sprayer movement stand For Y axis movement. Screw sprayer movement is slow mechanism so robot consume more time t paint the wall. Limitation of the robot is, it is only move in Y axis.

T Suroor and Ramdan (2011) was developed a roller based interior wall painting robot. Which had contain a robotic arm which have 2 degree of freedom robotic arm and three degree of freedom frame wheel. Average duration of this robot for painting a wall is 0.101 h/m2 for two layer of paint which means 10 me wall can painted in 3 hour. Limitation of this painting robot is its only motion in Y axis.

Tamir is the very advance robot which is developed by Warszawsky and Y Rosenfield (1994). Which main objective is painting, tilling and plastering. The robot has six degree of freedom and heavy weight approx 500 kg. the robot can reduce 70% painting timing. The robot has heavy weight so it is not used for residential buildings. Tamir is very costly robot.

Karthik madhira and Sandip Mehta developed a wall painting robot , this robot is introduce the stepper motor and using belt and pully mechanism. Its painting system is generic pnumetic air brush are paint the wall, this painting robot have two degree of freedom. In this robot bluetooth module HC 05 tranciver are installed to connected with the mobile bluetooth so this robot operate with the mobile. its weight is little high approx. 40 kg. The robot paint the wall 100m*2 per hour.

ShvaryaPadakar and ShrustiDevi developed a wall painting robot. Which is mechanical and electronic base robot, this robot introduce motor and belt drive mechanism to drive the roller up and down. Its painting system Is roller base painting system, this robot has only one degree of freedom. This robot taking more time to paint a wall.

3

Working and construction

3.1 Mechanism

In this project we are using multi groove belt mechanism.

For left and right motion (for X axis) there will be two guide shaft and on the opposite side of spray gun block there will be multiple groove cutting, by using this cutting, spray gun block will move anywhere between the guide soft. All this mechanism will work on leaner motion. And by using this mechanism spray gun block will smoothly move to anywhere between the guide soft.

Motion on y axis the same mechanism will be use. Two multi groove cutting block will connect to the last end of mechanism which I s use in the motion on X AXIS. One block is lock with multi groove belt and another block is guide by rack gear.

3.2 Working principle

Robot is operated by mobile. Two motor are installed on the frame and two motor will be install on the guide. When painting robot will do X axis movement spray gun will paint the wall then IR sensor will send a signal to the microcontroller and microcontroller send a signal to the Y axis then Y axis movement are take place .In this robot we will using timer chip which is decide the rotation of the motor. On X axis movement when motor rotate clockwise direction, movement of spray gun block is +ve X direction When motor rotate anticlockwise direction movement of spray gun block is -ve X direction. Similarly for Y axis movement when motor rotate clockwise direction spray gun block move -ve Y direction and when rotate anticlockwise movement of spray gun block is +ve Y direction. All system is controlled by Timer chip and Microcontroller.

3.3 Main components

Components of wall painting robot mainly two part

A. Mobile platform

1. Frame
2. Wheel
3. Microcontroller
4. Battery
5. Motor
6. Timmer chip

B. Spray gun mount

1. Spray gun
2. IR sensor
3. Flow control valve

C. Others Component

1. Shaft
2. Multi groove belt
3. Guider
4. Air compressor
5. Rake gear
6. Bluetooth
7. Android app

Mobile platform

1. Frame

It is a main part of this project in which every function of the machine will work. All the available equipment who is connected to each other, will move anywhere near to the wall. Length of the frame is 1 m and width is 0.75 m.

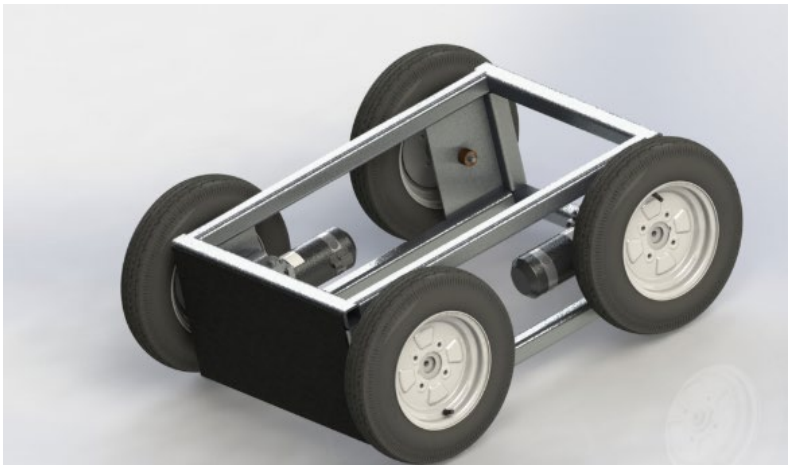


Fig 3.1 Frame of robot

2. Wheel

wheel is the moving part of the project which carry total weight of the project. For the movement of wheel to DC gear motor are installed which is connected with the battery. Wheel are controlled by the microcontroller.

3. Microcontroller

MCU is a small integrated chip which contain one or more CPU and programmable input/output. In this project MCU controlled all movement of the project. MCU connected with the IR sensor, IR sensor sense the wall and give information to the MCU, MCU give the direction for movement to the wheel.

Technical Specifications:

- Microcontroller: Microchip ATmega328P [7]
- Operating Voltage: 5 Volts
- Input Voltage: 7 to 20 Volts
- Digital I/O Pins: 14 (of which 6 can provide PWM output)
- UART: 1
- I2C: 1
- SPPI: 1
- Analog Input Pins: 6
- DC Current per I/O Pin: 20 mA
- DC Current for 3.3V Pin: 50 mA

- Flash Memory: 32 KB of which 0.5 KB used by bootloader
- SRAM: 2 KB
- EEPROM: 1 KB
- Clock Speed: 16 MHz
- Length: 68.6 mm
- Width: 53.4 mm
- Weight: 25 g

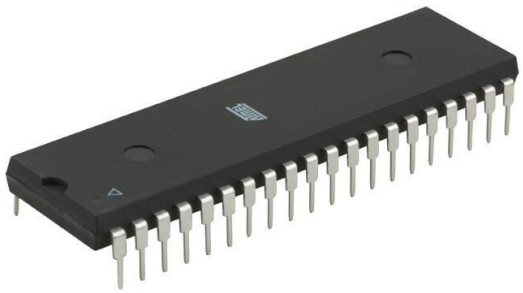


Fig 3.2 Microcontroller

4. Battery

Batter is a device which contain one or more electrochemical cell. Battery giving the power to the project. In this project 3 battery are use which voltage is 12 vol t. 2 battery are installed for the movement of wheel and one battery are installed for rotating the motor.

5. Motor

Motor is a device which converting electrical energy into mechanical energy. In this robot motor is giving power to the shaft (1) by using chain drive then shaft (1) giving power to the shaft (2). On the shaft (2) one wire will rapped and one end of the wire spray gun block which doing liner motion.

Specification

- Power-5watt, 12volt
- Torque-0.24525 Nm

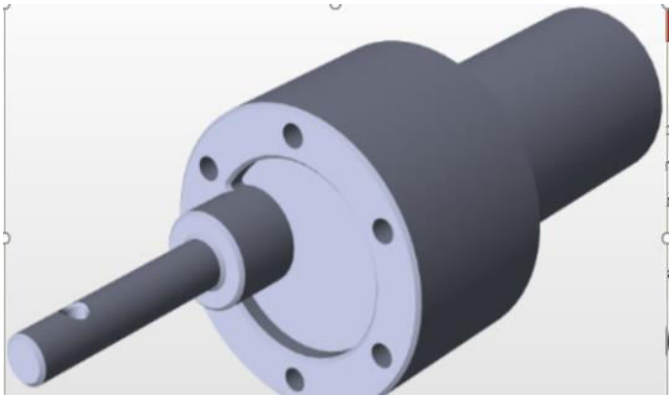


Fig 3.3 Motor

6. **Timmer chip**

   it is the 555 integrated chip which is use for controlling the rotation of the motor. Timer IC used to provide time delay, oscillator and as a flip-flop element. It rotate the motor into clockwise and anticlockwise

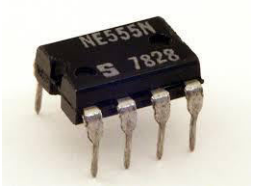


Fig 3.4 Timmer chip

Spray Gun Mount

1. **Spray gun**

   This process occurs when paint is applied to an object through the use of an air-pressurized spray gun. The air gun has a nozzle, paint basin, and air compressor. When the trigger is pressed the paint mixes with the compressed airstream and is released in a fine spray.

   Specification:-

   Air Pressure = 35psi

   Nozzle size = 1 mm

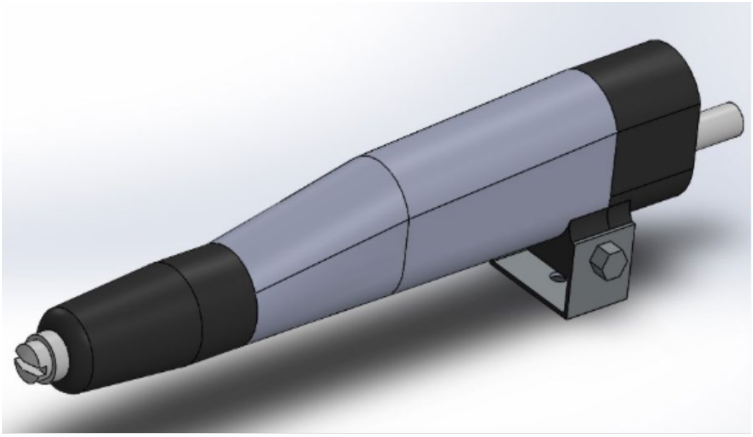


Fig3.5 spray gun

2. IR sensor

IR sensor is used for this project. IR (infrared) is the typical light source being used in the sensor for robot to detect object. Basic principle of IR sensor is based on an IR emitter and an IR receiver.

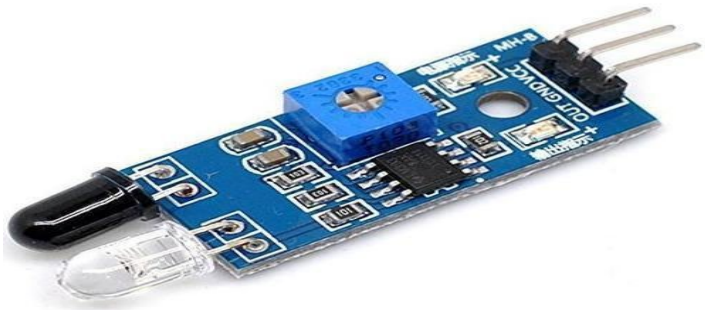


Fig 3.6 IR sensor

3. Flow control valve

flow control valve is a device which is use for controlling pressure of the fluid.

Others component

1. **Shaft**

A shaft is a rotating machine element, usually circular in cross section, which is used to transmit power from one part to another.

In this project we are using 3 circular shaft

Specification

2 Shaft are 0.75 meter and diameter is 0.75mm
1 shaft is0 .5 meter and diameter is .075 mm

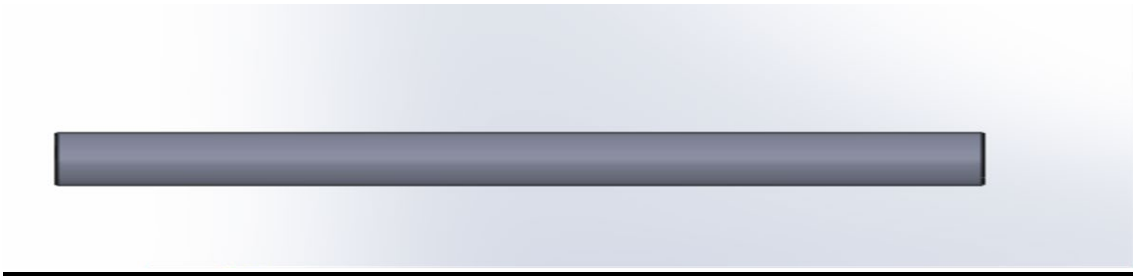


Fig 3.7

2. **Multi groove belt**

A multi-groove, V-Ribbed, or poly groove belt is made up of usually between 3 and 24 “V” shaped sections alongside each other. This gives a thinner belt for the same drive surface, thus it is more flexible, although often wider. The added flexibility offers an improved efficiency, as less energy is wasted in the internal friction of continually bending the belt. In practice this gain of efficiency causes a reduced heating effect on the belt, and a cooler-running belt lasts longer in service. Belts are commercially available in several sizes, with usually a ‘P’ (sometimes omitted) and a single letter identifying the pitch between grooves. The ‘PK’ section with a pitch of 3.56 mm is commonly used for automotive applications

A further advantage of the poly groove belt that makes them popular is that they can run over pulleys on the un grooved back of the belt. Though this is sometimes done with V-belts with a single idler pulley for tensioning, a poly groove belt may be wrapped around a pulley on its back tightly enough to change its direction, or even to provide a light driving force.

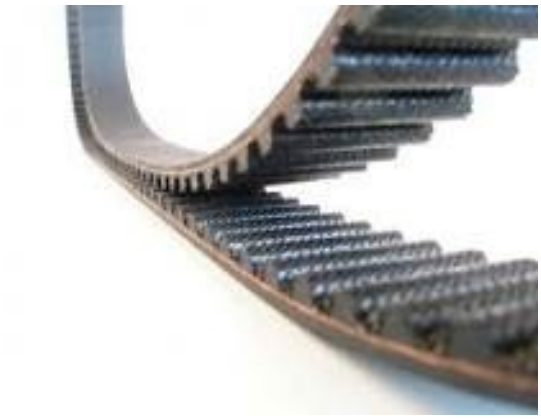


Fig 3.8 Multi groove belt

3. Guider

Guider is guide to the spray gun block

4 Guider are use, which length is 1 meter

4 Additional supporter are use for supporting the shaft, which length is 20cm.

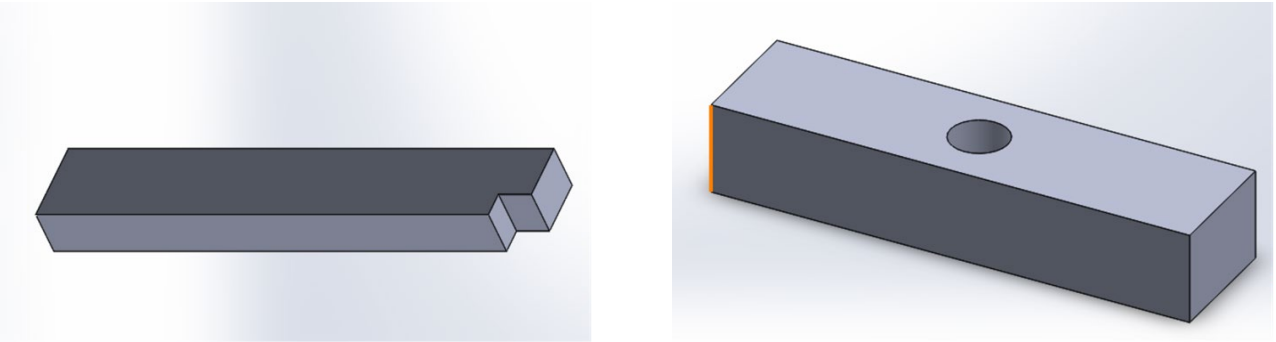


Fig 3.9 Guider

4. Air compressor

An air compressor is a device that converts power (using an electric motor, diesel or gasoline engine, etc.) into potential energy stored in pressurized air (i.e., compressed air). By one of several methods, an air compressor forces more and more air into a storage tank, increasing the pressure. When the tank's pressure reaches its engineered upper limit, the air compressor shuts off. The compressed air, then, is held in the tank until called into use. The energy contained in the

compressed air can be used for a variety of applications, utilizing the kinetic energy of the air as it is released and the tank depressurizes. When tank pressure reaches its lower limit, the air compressor turns on again and re-pressurizes the tank. An air compressor must be differentiated from a pump because it works for any gas/air, while pumps work on a liquid.

Fig 3.10 Air compressor

5. Rake gear

Rack and pinion gears are used to convert rotation into linear motion. A perfect example of this is the steering system on many cars. The steering wheel rotates a gear which engages the rack. As the gear turns, it slides the rack either to the right or left, depending on which way you turn the wheel.

A rack and pinion is a type of linear actuator that comprises a circular gear engaging a linear gear (the *rack*), which operate to translate rotational motion into linear motion. Driving the pinion into rotation causes the rack to be driven linearly. Driving the rack linearly will cause the pinion to be driven into a rotation. A rack and pinion drive can use both straight and helical gears. Helical gears are preferred due to their quieter operation and higher load bearing capacity. The maximum force that can be transmitted in a rack and pinion mechanism is determined by the tooth pitch and the size of the pinion.

For example, in a rack railway, the rotation of a pinion mounted on a locomotive or a railroad car engages a rack placed between the rails and helps to move the train up a steep gradient.

Fig 3.11 Rake and pinion gear

6. Bluetooth

Bluetooth is a wireless technology standard used for exchanging data between fixed and mobile devices over short distances using short-wavelength UHF radio waves in the industrial, scientific and medical radio bands, from 2.402 GHz to 2.480 GHz, and building personal area networks (PANs). It was originally conceived as a wireless alternative to RS-232 data cables.

Bluetooth is managed by the Bluetooth Special Interest Group (SIG), which has more than 35,000 member companies in the areas of telecommunication, computing, networking, and consumer electronics. The IEEE standardized Bluetooth as IEEE 802.15.1, but no longer maintains the standard. The Bluetooth SIG oversees development of the specification, manages the qualification program, and protects the trademarks. A manufacturer must meet Bluetooth SIG standards to market it as a Bluetooth device. A network of patents apply to the technology, which are licensed to individual qualifying devices. As of 2009, Bluetooth integrated circuit chips ship approximately 920 million units annually.

General pin functions:

- **LED**: There is a built-in LED driven by digital pin 13. When the pin is high value, the LED is on, when the pin is low, it is off.
- **VIN**: The input voltage to the Arduino/Genuino board when it is using an external power source (as opposed to 5 volts from the USB connection or other regulated power source). You can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin.

- **5V**: This pin outputs a regulated 5V from the regulator on the board. The board can be supplied with power either from the DC power jack (7 - 20V), the USB connector (5V), or the VIN pin of the board (7-20V). Supplying voltage via the 5V or 3.3V pins bypasses the regulator, and can damage the board.
- **3V3**: A 3.3 volt supply generated by the on-board regulator. Maximum current draw is 50 mA.
- **GND**: Ground pins.
- **IOREF**: This pin on the Arduino/Genuino board provides the voltage reference with which the microcontroller operates. A properly configured shield can read the IOREF pin voltage and select the appropriate power source, or enable voltage translators on the outputs to work with the 5V or 3.3V.
- **Reset**: Typically used to add a rest button to shields that block the one on the board.

7. Android app

An app is designed to control the painting robot manually and automatically this app is connected through the Bluetooth module which is already interfaced with the robot microcontroller.

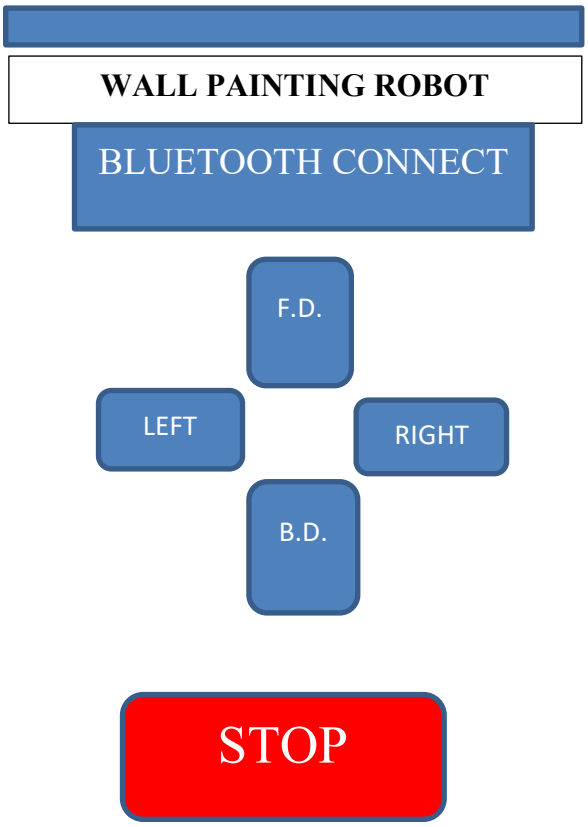


Fig 3.12 Android App

3.4 System block diagram

Components of wall painting robot have manly two part one of the mobile frame and other part is spray gun mount. Mobile frame achieved mobility from motor. On the mobile frame all components like compressor, battery guide frame, container, microcontroller, timer chip will be installed, All components of robot control by microcontroller. Microcontroller will receive signal from the IR sensor and give signal to the robot wheel motor for movement.

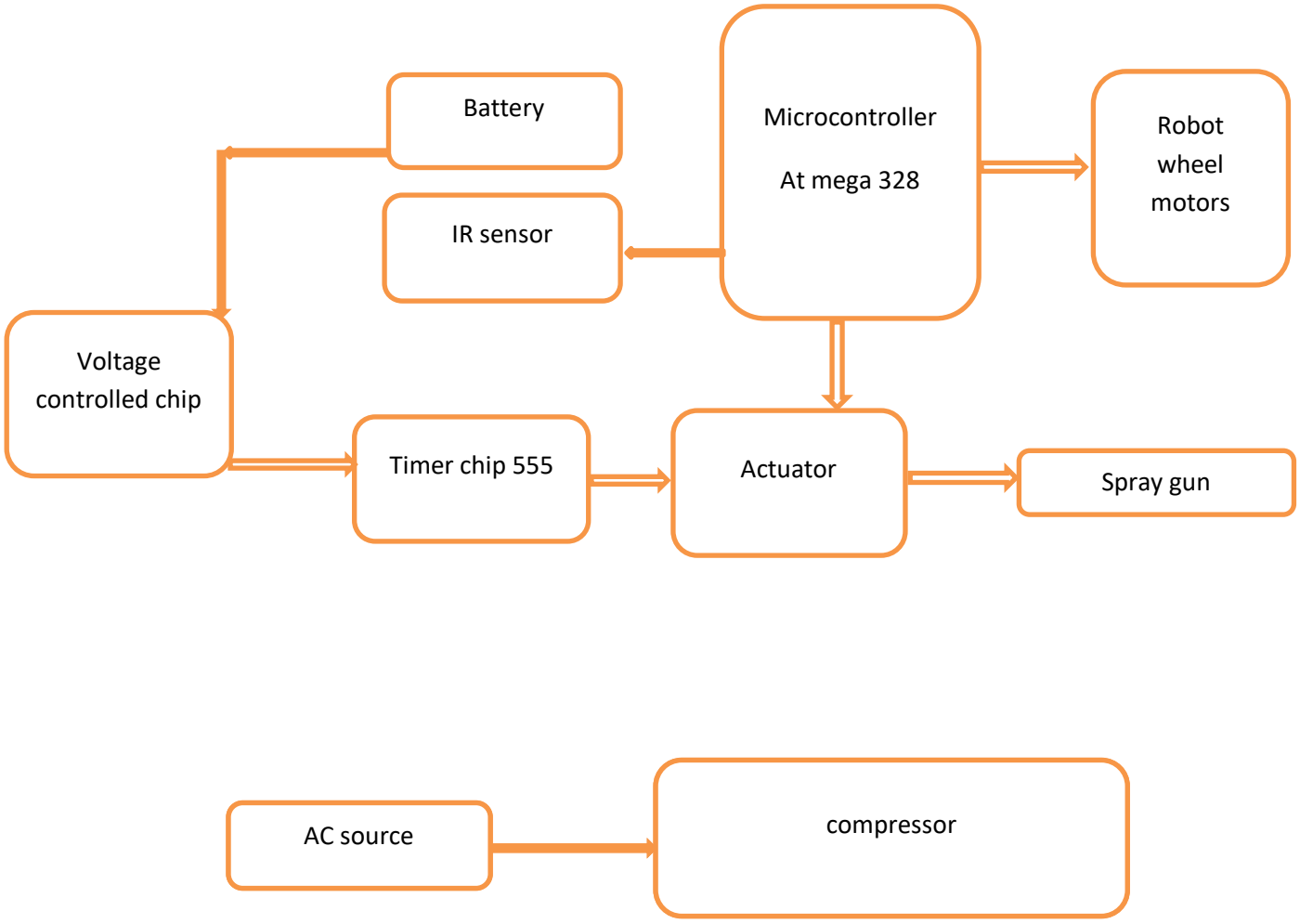


Fig 3.13 System Block Digram

4

Proposed Tools and Design Process

4.1 Proposed tools

There are some tool which is use in the making of automatic wall painting robot

1. Solid works
2. Arduino IDE
3. Welding Machine
4. Screw Driver

1. Solid works

SolidWorks is solid modelling software that allows you to design products in 3 dimensions. The technique is generally to sketch 2D profiles then use methods like extruding and lofting to produce the solid shape. Here are some examples:

To model a paperclip, sketch the profile then sweep the wire diameter along it.

2. Arduino IDE

Arduino IDE comprises of two things – Arduino & IDE. Let's talk about these one by one.

Arduino is a micro-controller development board series – Uno, Mega, Nano, Mini etc. are a few examples. Now, any micro-controller (here it is the Atmega 328 IC on the Arduino Uno or Atmega 1280 on Arduino Mega) that needs to be programmed is basically fed with a hex code version of the code written in high level (English) language. So, Arduino development boards are fed with the code via their Arduino IDE.

Now, IDE (Integrated Development Environment) is basically a software that enables better and assisted code editing, compiling and debugging

3. Welding

Welding is a material joining process which produce coalescence of material by heating them suitable temperature with or without the application of pressure or by the application of pressure alone, with a without filler material.

E.g: Welding is use for making permanent joint**.**

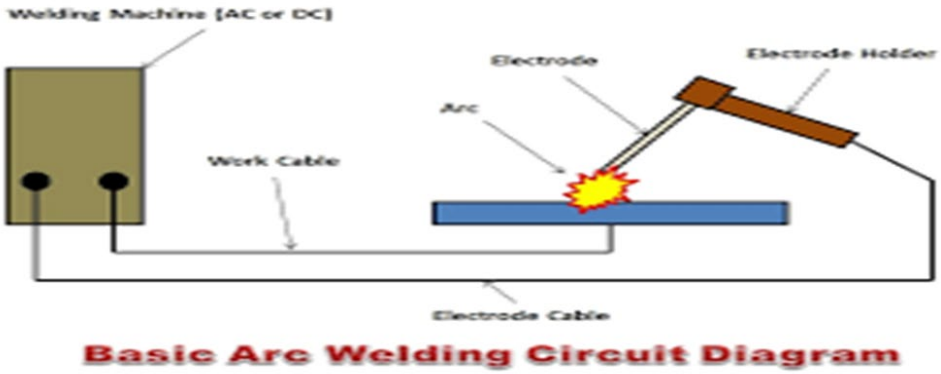


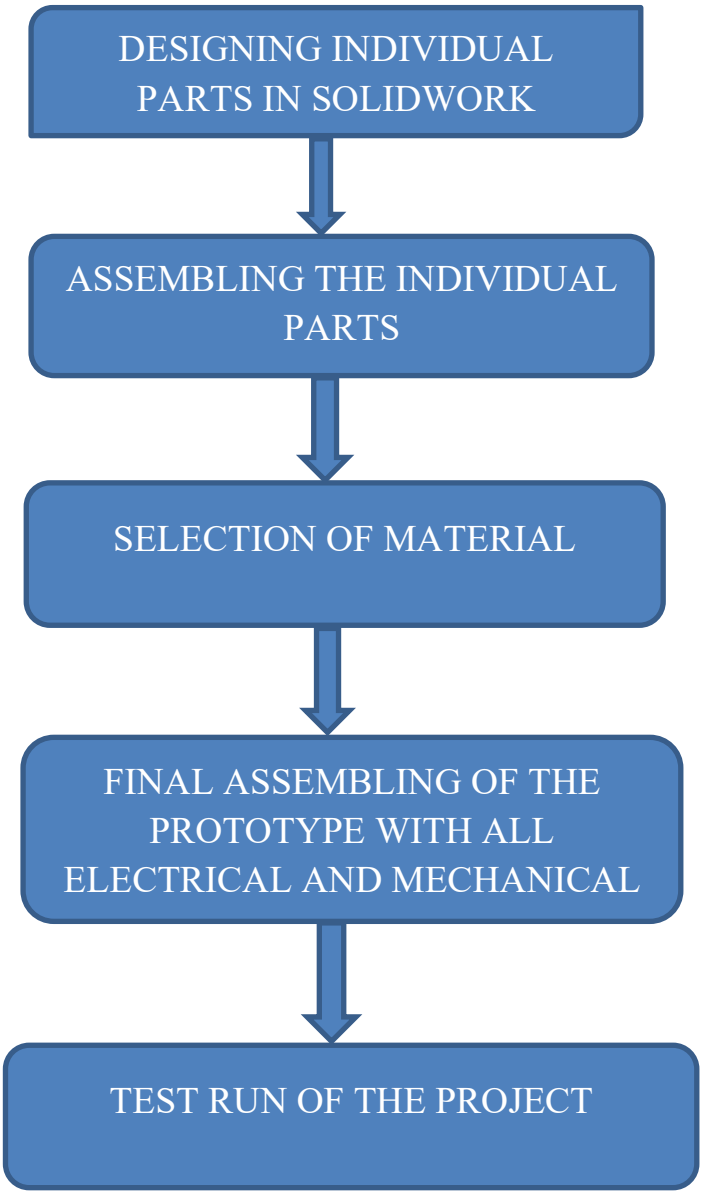
Fig 4.1 Arc welding circuit diagram

4. Screw Driver

You use a screwdriver when you remove or fit screws in anything. The technique of tightening or loosening a screw is pretty simple. Push the screwdriver toward the head of the screw, and then it's righty- tighty, lefty-loosy. In other words, turn clockwise to tighten (the way a clock's hands turn), counter-clockwise (or anti-clockwise) to loosen.

4.2 Design Process

The basic following process are use to design the prototype of Project.



Design of part

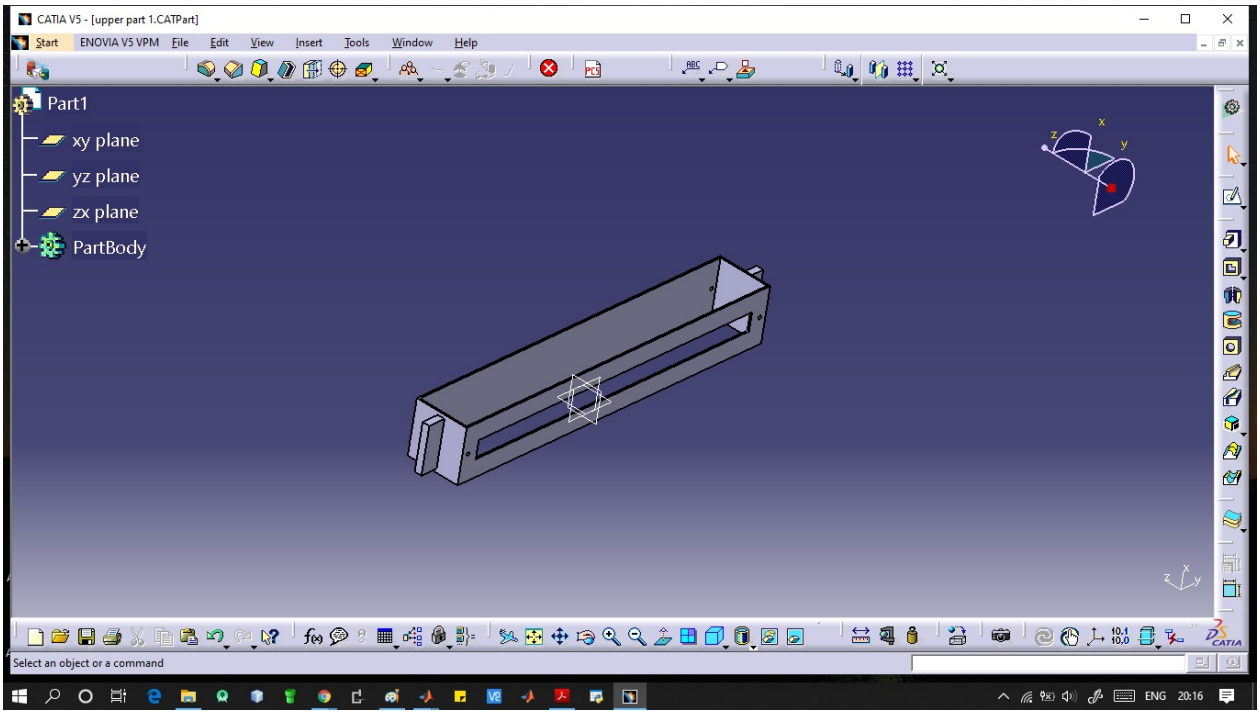


Fig 4.2 Guide frame

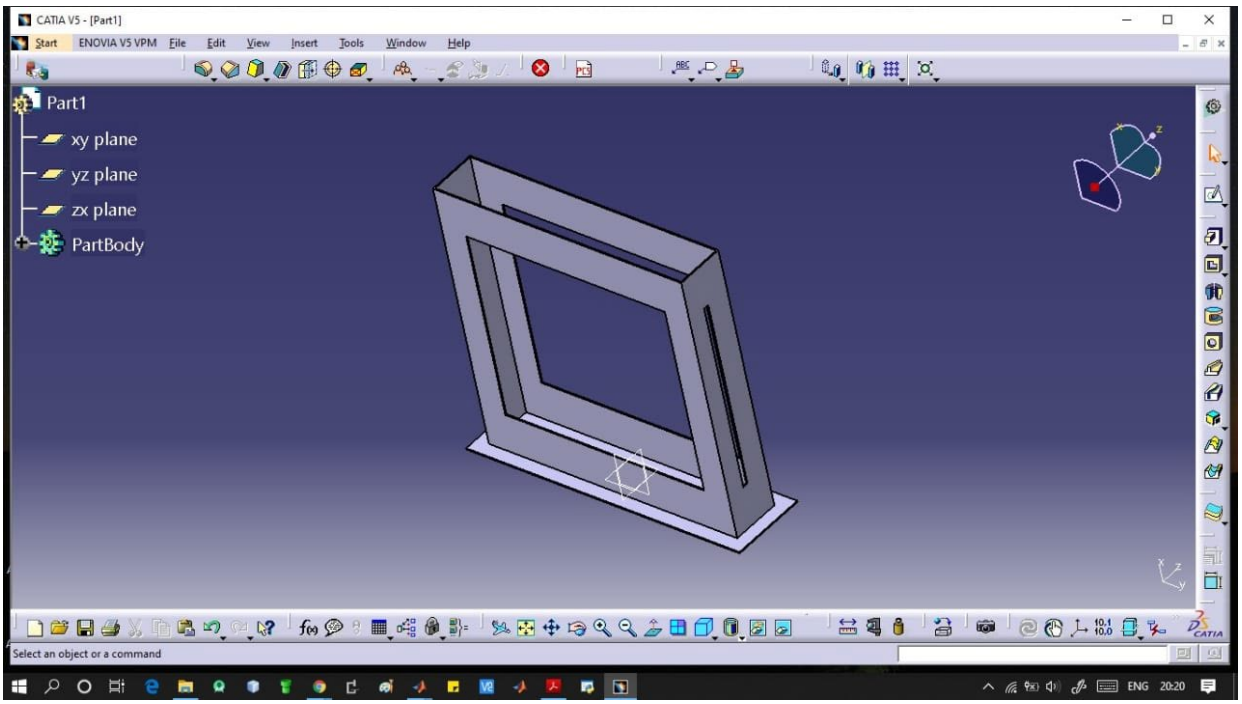


Fig 4.3 Guide frame

Assembling of part

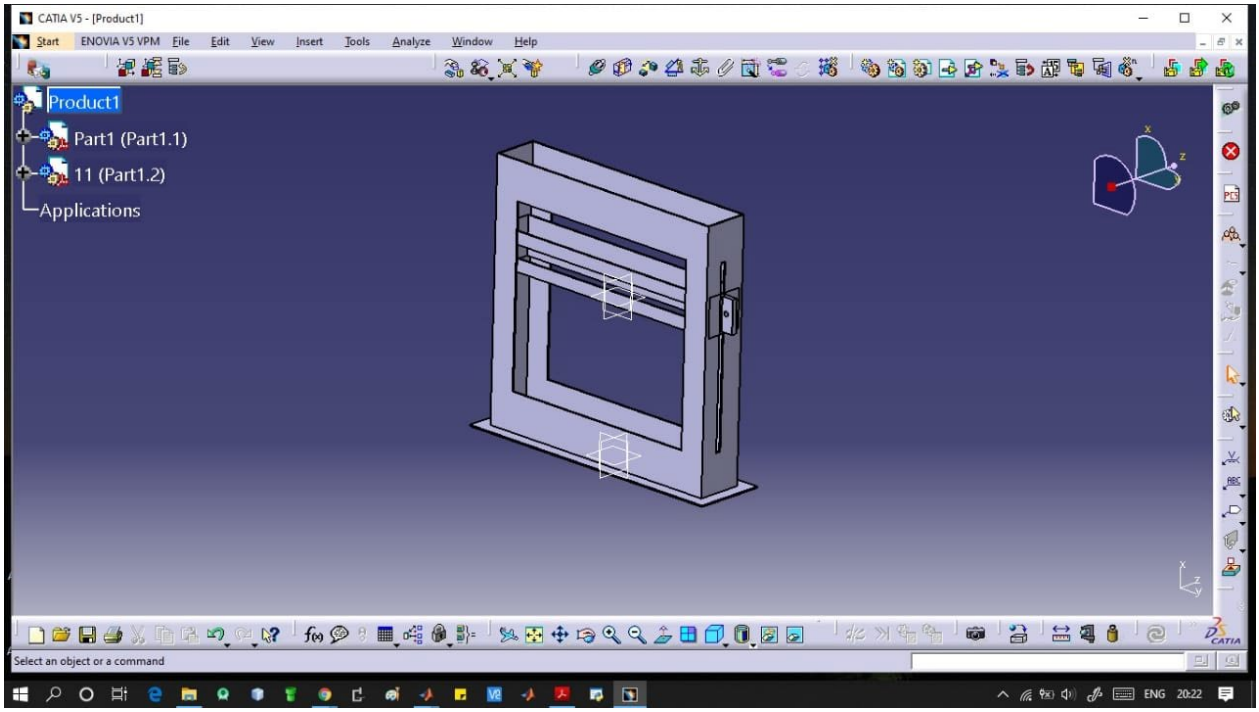


Fig 4.4 Guide frame

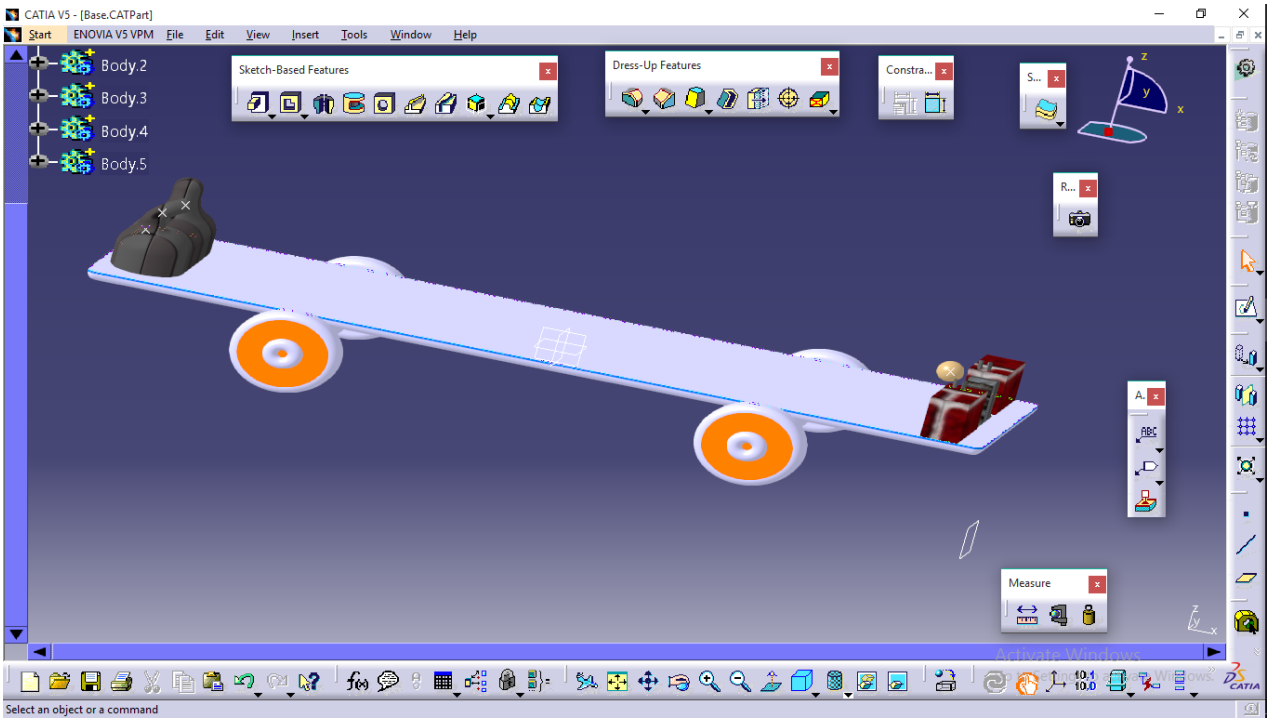


Fig 4.5 Base

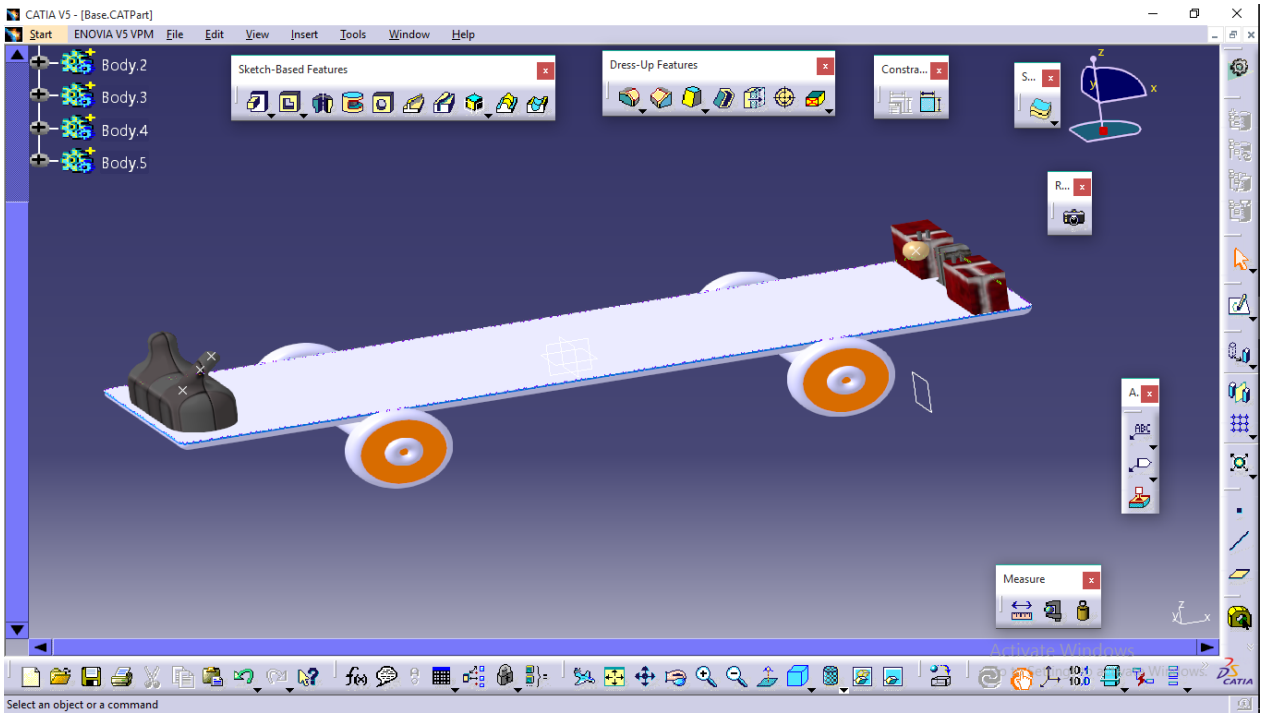


Fig 4.6 Base

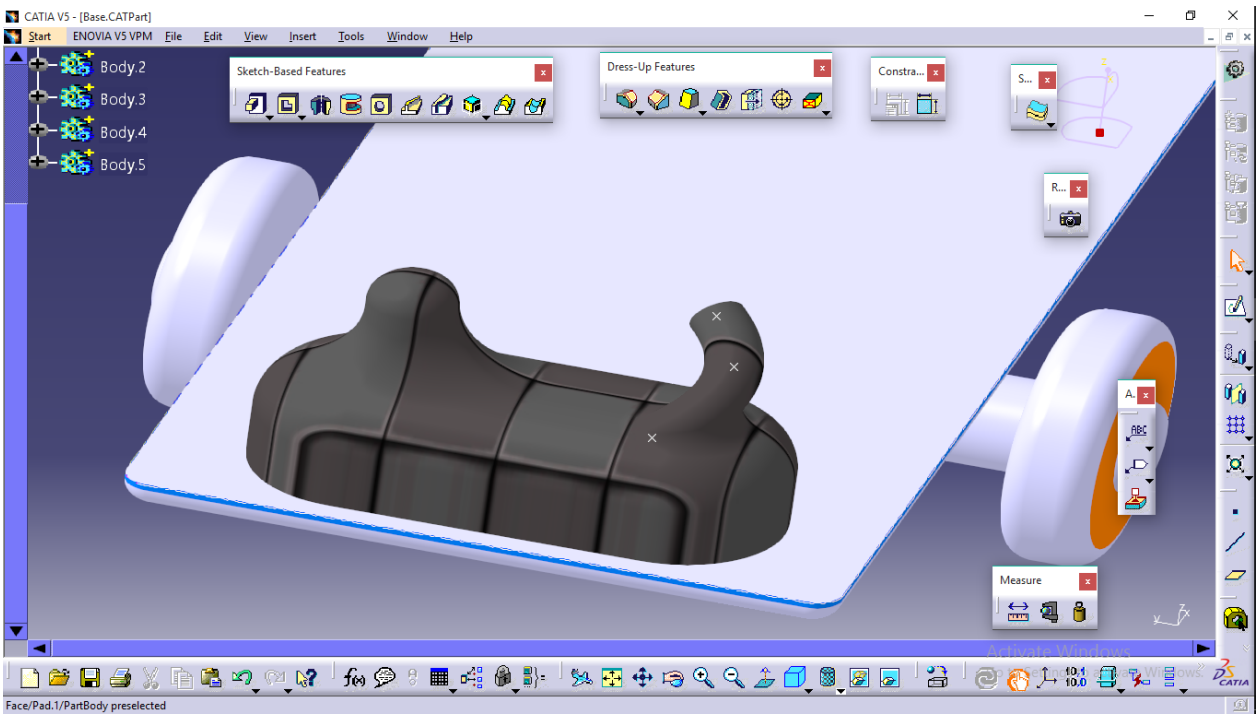


Fig 4.7 Compressor

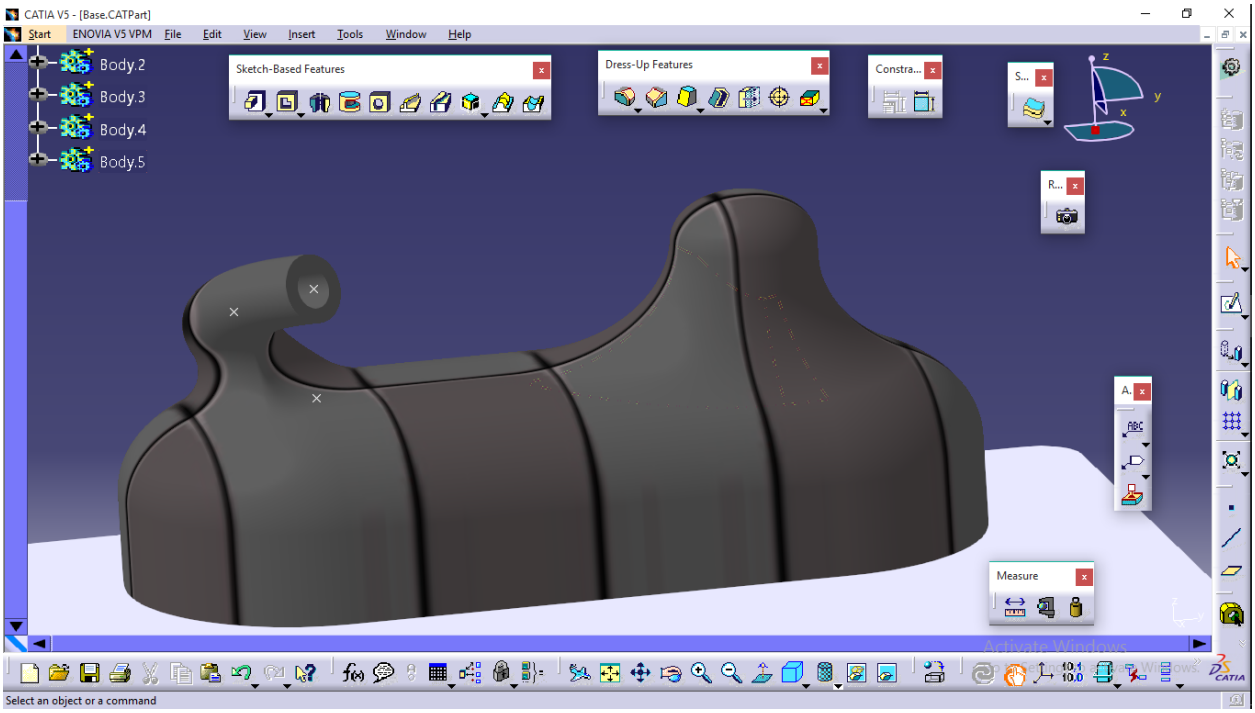


Fig 4.8 Compressor

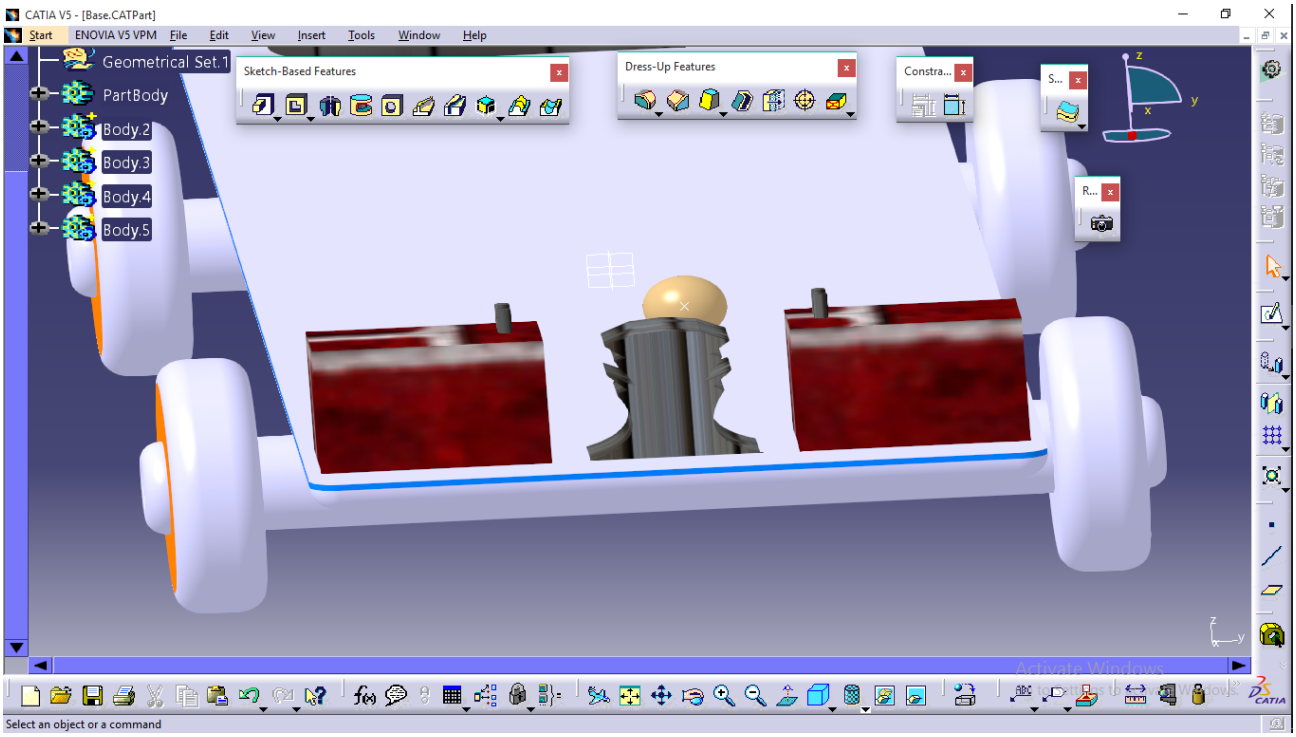


Fig 4.9 Base, Compressor, Timer chip

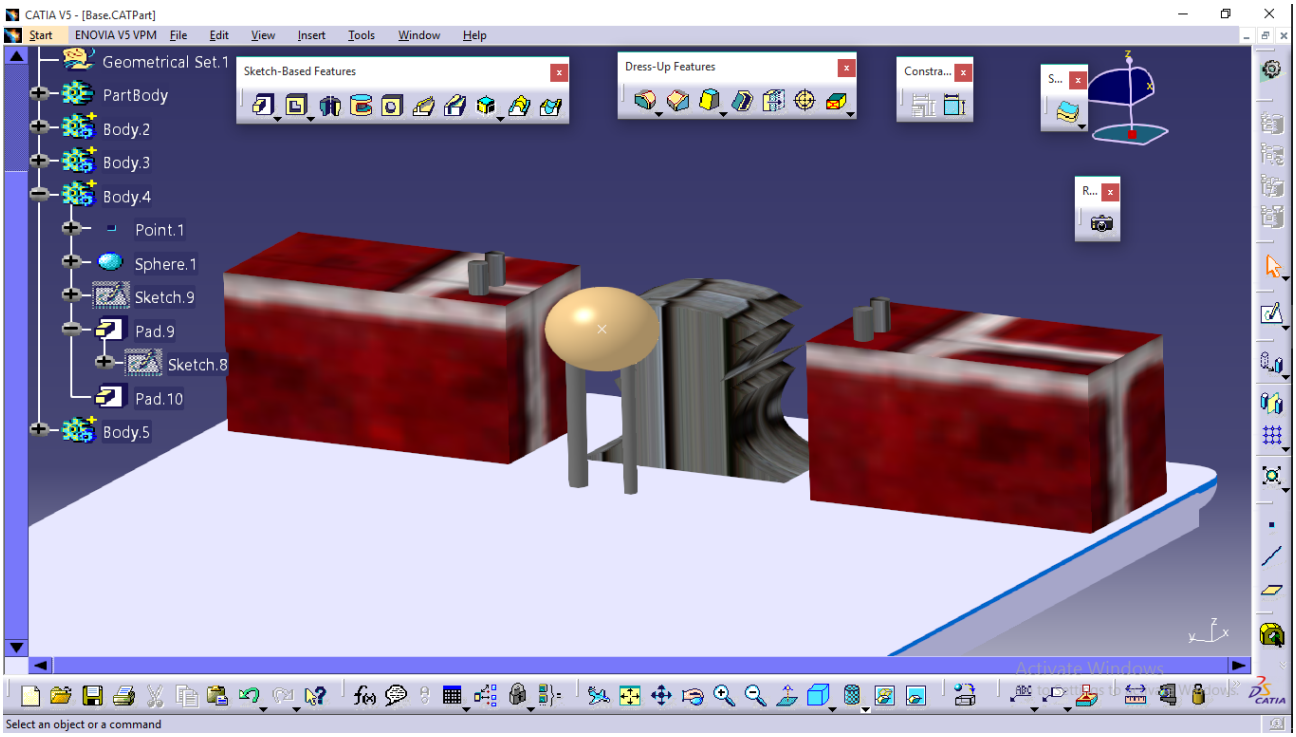


Fig 4.10 Base, compressor Timer chip

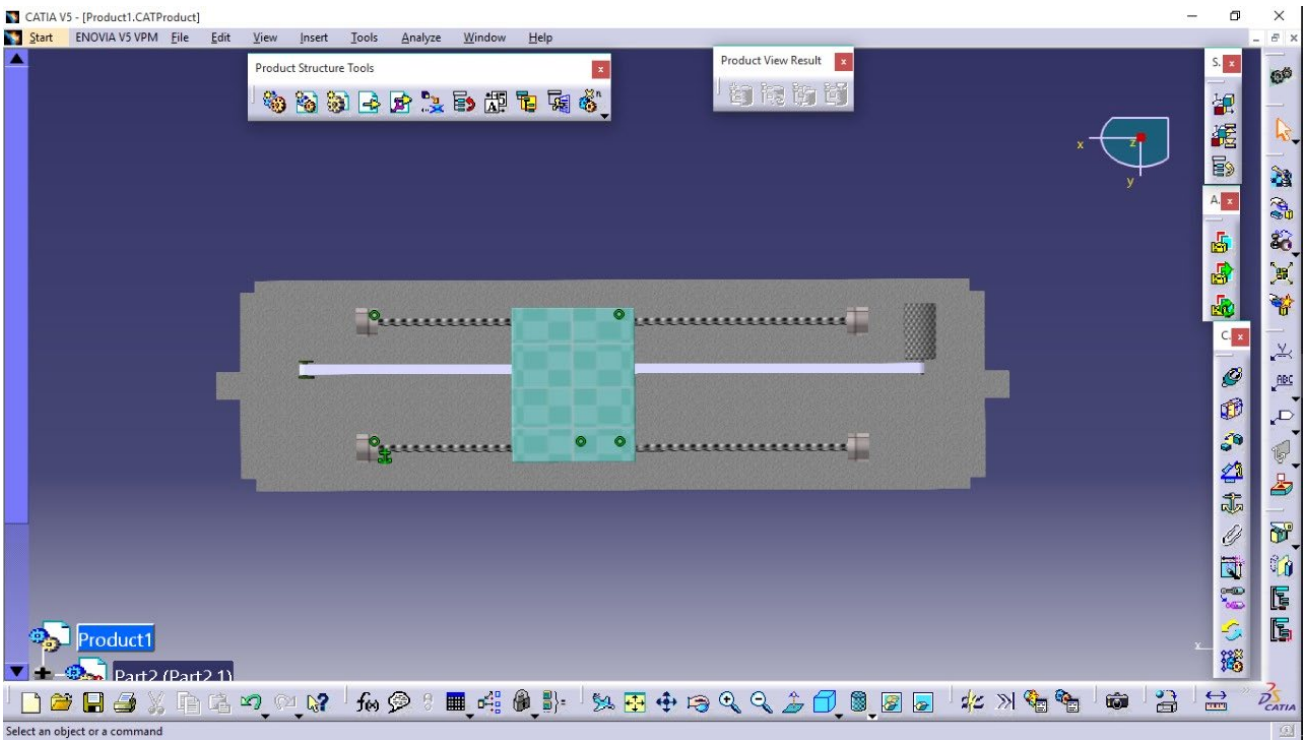


Fig 4.11 Actuator

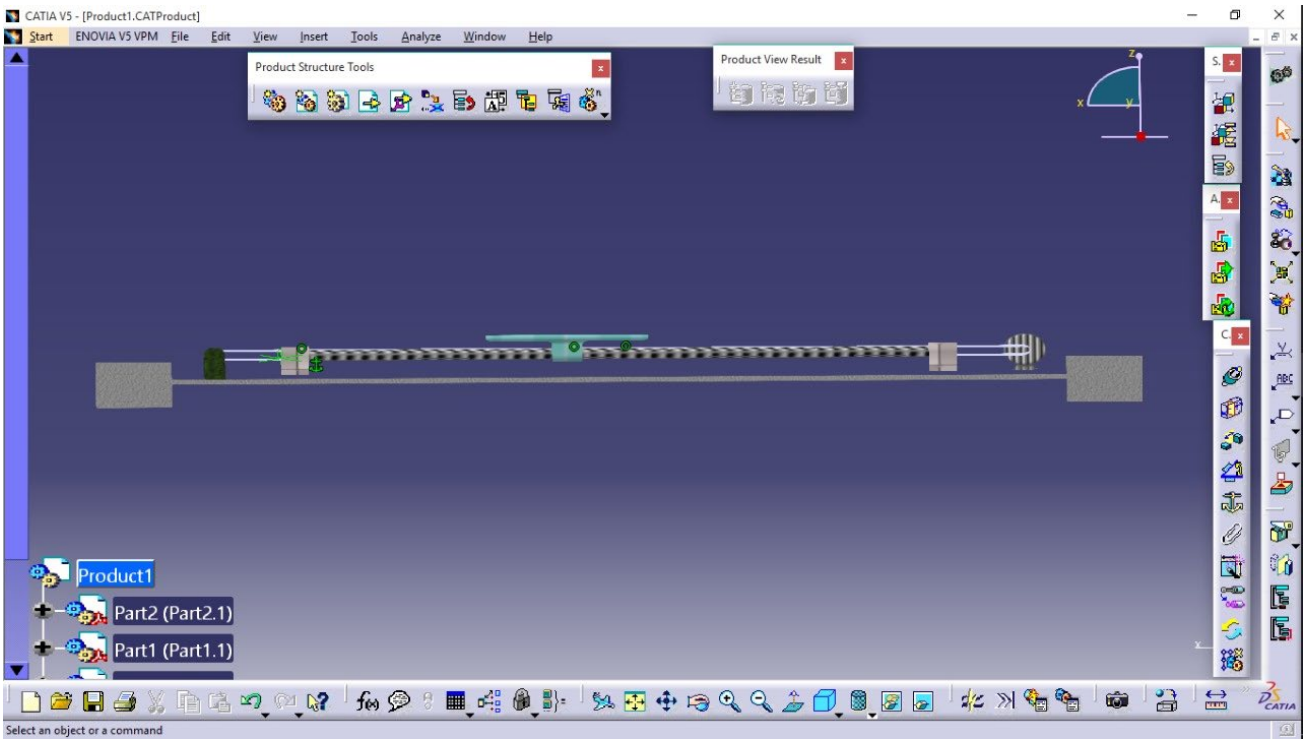


Fig 4.12 Actuator

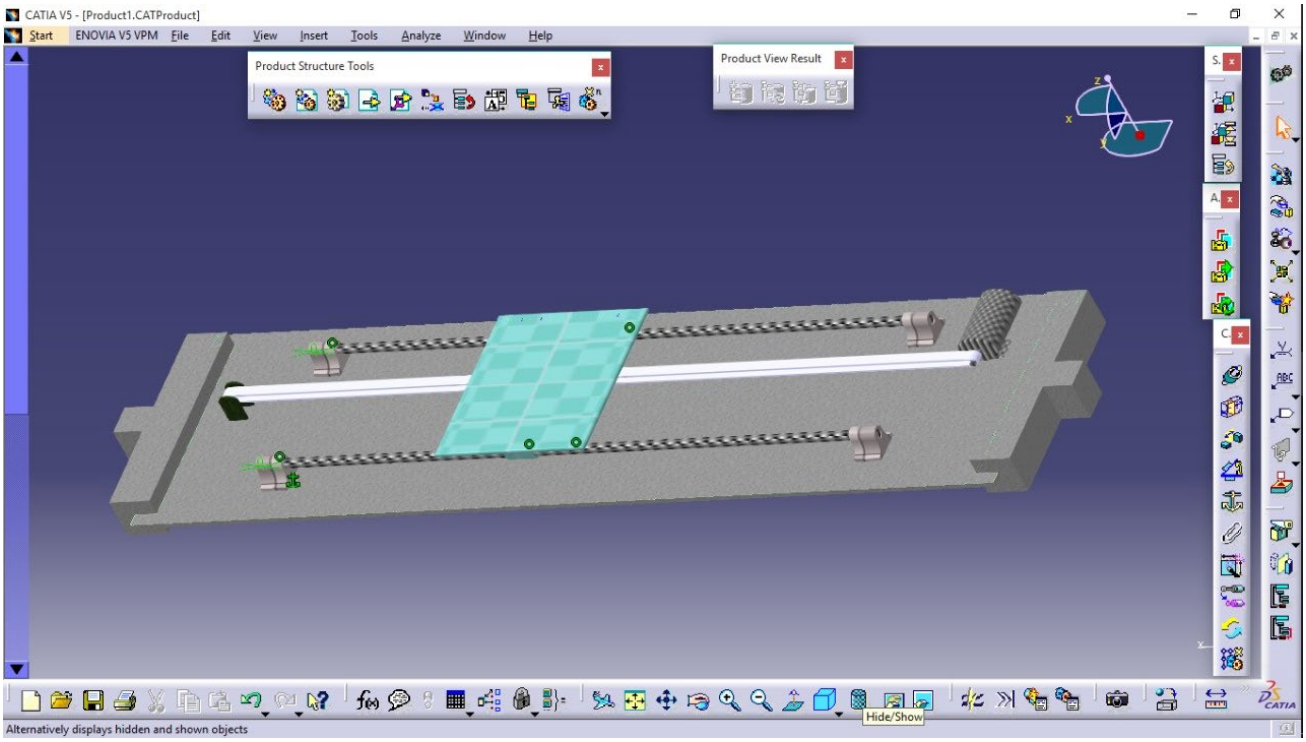


Fig 4.13 Actuator

4.3 Mathematical Analysis

Time duration of wall painting to painting the wall

For x axis Movement

Time taking for painting the wall = 0.75 m width and 0.03 m length

= 0.75m * 0.03m

= 0.025 m^2/per 3sec

In one second Robot point the Wall = 0.225/3 m^2

=0.0075 m^2

Than Y axis movement take place it take 1 second to cover 0.03 m

Total time consuming the Robot = 0.0225/4 m^2/sec

= 0.005025 m^2/sec

= 0.005025*60

= 0.3375 m^2/minutes

= 0.3375*60

= 20.25 m^2/hours

4

Problem description

4.1 Problem description

Painting is often tedious, repetitive work, as well as being time-consuming work which in turn cost money. Also, workers risk exposure to harmful toxins. In addition to the fact that manual painting, paint guns and the like, depend mostly on human precision which -compared to automated spraying- lacks consistency.

The relatively narrow specimen of previously developed interior wall painting robots are found to be focusing rather of the mobility of the mechanical arm or the carrier shaft and its companion wheeled-base, instead of the actual quality of the paint spraying.

4.2 Problem solution

We present the automatic painting robot as a solution to the drawbacks of the traditional system.

Certain important assumptions must be taken into consideration:

That the wall to be painted is assumed to be flat and smooth, free of all obstructions. And a certain distance from side walls, ceiling and floor will not be painted; since it'll be a two DOF robot, can only paint area that require no Roll, Yaw, pitch or movement in the z-axis.

Thus, the proposed solution would be to:
First: the use of a multi groove belt mechanism that provides the vertical movement. And a four-wheeled Base that provides the horizontal movement.
Second: the use of two Arduino boards with two ultrasonic sensors measuring the horizontal distance for one side wall and vertical distance from ground. These boards would, as well, control the direction and speed of the lift and turning the Spray gun ON/OFF.

5

Conclusion and Recommendation

1.1 Conclusion

Our project has described the automatic wall painting robot. The robot is light weight and small size which can easily handled. The robot has contain one spray gun which suck the paint with the help of compressor and spray on the wall. It is smooth functioning robot. The above robot made by us is a prototype of the robot with some further modification we also use the robot in use of water spray on the wall. Further we can also use for glass cleaning robot.

Automatically paint the wall of given dimension has been designed and implemented. The approach uses IR transmitter and IR receiver to detect the presence of wall. The microcontroller unit to control the movement of the DC motor. The robot eliminates the hazards caused due to the painting chemicals to the human painters such as eye and respiratory system problems and also the nature of painting procedure that requires repeated work and hand rising makes it boring, time and effort consuming.

The robot is cost effective, reduces work force for human workers, reduce time consumption. The pitfall of the project is that the robot continues painting even after the end of the wall hence it can be overcome by adding some indicating objects such as buzzers.

The prototype was designed for the purpose of automating the interior walls painting process, making it easier and more efficient. This design is simple in nature and relatively easy to implement in comparison with the reminder of interior wall painting robots. Adding to that, the stability of its structure, and the fact that it can be built using any other material, judging by its availability, affordability and in accordance to the needed specifications.

A interior wall painting robot based on this prototype would be beneficial to the construction field corporations, granting these corporations the ability to provide painting services in addition to the actual construction work, which gives an advantage over other painting and construction corporations, while maintaining a reasonable spending ceil on acquiring the robot and/or building it.

1.2 Recommendation

For future work we recommend the following

- Using multiplexers to reduce the number of Arduinos in the circuit.
- Implementing the final product using microcontrollers from the AVR series instead of Arduino board environment
- Increase the number of sensors to cover more work area.
- Adding a Z-axis movement, gives the capability to paint a 4-walled room with no human interference.
- Increasing its degrees of freedom to include yaw, pitch and roll to reach the edges and margins of the wall to be painted and the ceiling.
- Utilize a liquid level sensor to halt the operation when the paint runs out. And a pressure sensor on the nozzle to alert if the nozzle is blocked by previous dry paint
- Exploit external mix nozzles instead of a spray gun
- Employ omni-wheels.
- In the future the painting robot can be enhanced by using image processing in order to scan the objects and obstacles that are present in the wall so that those objects can be automatically omitted while painting

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