

Remote Controlled Garage Shutter

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Bachelor of Technology

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Industrial Design

By

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CERTIFICATE

This is to certify that the thesis titled “**Remote Controlled Garage Door**” is submitted by **Pranshu** (Roll No. 110ID0545) and **Sarit Sourav Parida** (Roll No. 110ID0271) in partial fulfilment of the requirements for the award of Bachelor of Technology degree in Industrial Design at the National Institute of Technology, Rourkela is an authentic work carried out by them under my supervision and guidance.

To the best of my knowledge, the matter embodied in the thesis has not been submitted to any other University/Institute for the award of any Degree or Diploma.

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Date – 9th May 2014

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Abstract

In today's world, security, wellbeing and accommodation has gotten exceptionally imperative than before. As the reliance on innovation increments, individuals require the capability to contemplate trivial errands and need to focus on other pertinent issues. This sort of interest must be met by a framework equipped for rapidly, exactly, and dependably translating the needs of the client and actualizing suitable movements independently. The Remote Controlled Garage Door exploit the utilization of current innovations to give such a framework. The general idea driving is to actualize a framework where the client is no more fundamentally answerable for deciding the activity, yet rather an order module screens the movement, the garage door needs to be performing and makes the fitting modification.

In an age where no one has much time for things like coming out of the car and opening garage door, a remote control garage door steps up for the solution of their problem. The research project for a garage door that can be opened with a mere touch of a remote control button is studied, reviewed and its prototype has been developed.

For the development purpose the problems faced by the users are identified, detailed specifications of the product parts are done and a working prototype has been fabricated.

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1. Introduction

1.1 Background

The uses of garage doors can go back to 450 BC when chariots were kept in it, its uses increased extensively around 20th century when expensive motorised vehicles came into existence and its safety became a concern for its users. Evidences suggests that upward lifting garage door was invented in 1906 and the developments in these doors progressed since then, like ease in its uses and in its working mechanisms. They also got motorised in later years.

After the huge progress made in the field of electronics that touched everything of our basic necessities, garage doors was not an exception. Several garage doors are available that can be opened with remote control and they come with various safety measures for the users. So the advantages and disadvantages of various existing types of garage doors are observed and one model is selected for further development in the project.

The various types of existing garage doors are:

- **Sectional Doors**
- **Flex-A-Door**
- **Rolling Doors**

1.1.1 Sectional Door

They are created out of various inflexible segments/boards that are pivoted together and move vertically in the opening, then evenly along the roof, guided by tracks and balanced springs.

The Sectional garage door offers the best level of stylish flexibility. It includes various vast segments or boards.

Advantages of Sectional Garage Door:

- They open upwards and run parallel to the roof.
- Unlike the customary "tilt" doors, they don't swing outwards to open.
- Vehicles could be stopped straight up to the front of the garage door without blocking its opening.
- In instance of any harm, areas or boards could be supplanted independently.
- Require little headroom.

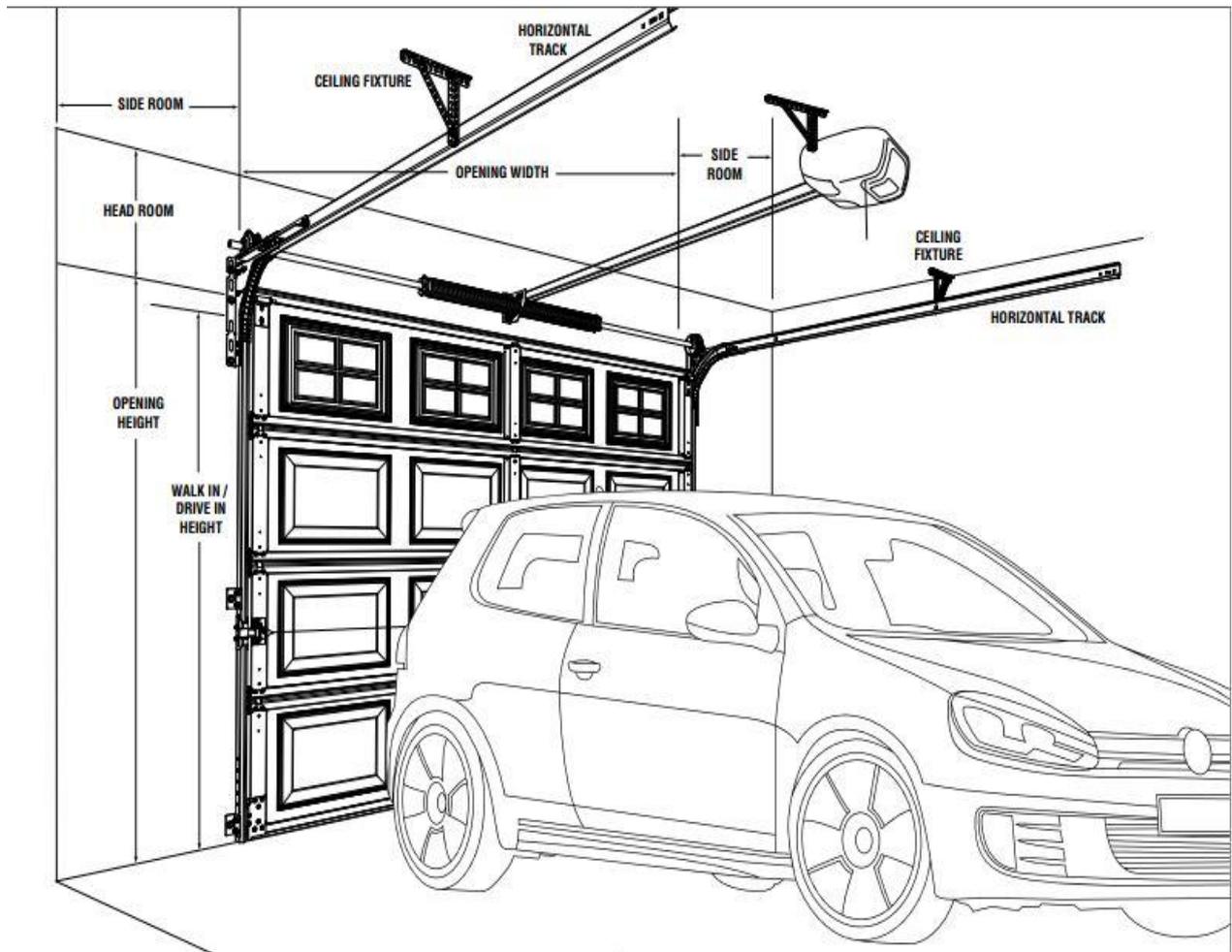


Fig.- 1.1: Image shows the view of a Sectional Door from inside of the Garage [1].

1.1.2 Flex-A-Door

They are made from a durable Roll-A-door curtain which is fitted on a curving track – that slides from a vertical position up into a horizontal position, close to the ceiling.

It is especially suited to applications where there is not the headroom for a rolling door, or where a smoother, easier to use solution is required to replace an existing tilt door.

Advantages of Flex-A-Door:

- Suitable for low headroom.
- Great for accommodating vehicles that require extra height.
- They open upwards and parallel to the ceiling.
- Vehicles can be parked right in front of the garage door.
- Robust & striking Roll-A-Door curtain.

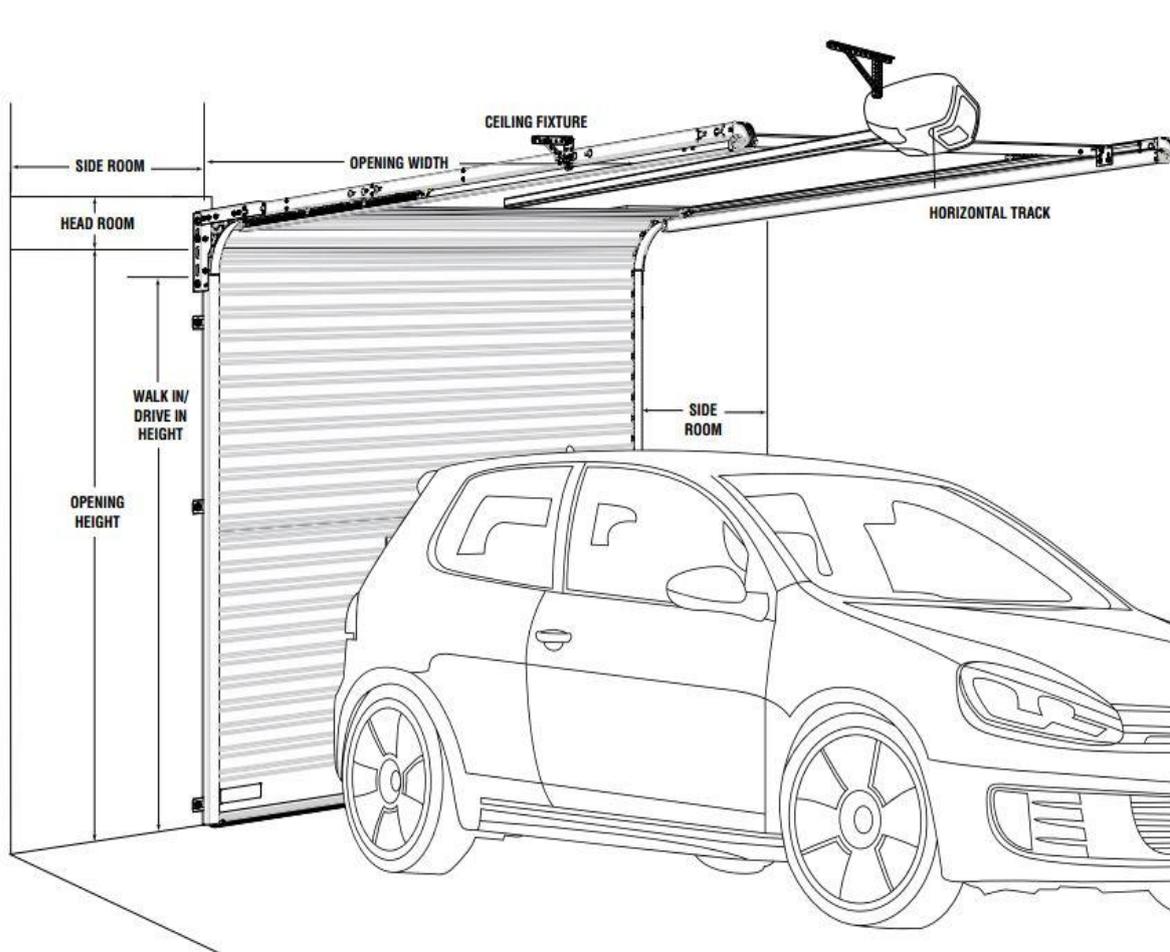


Fig.-1.2: Image shows the view of a flex-a-door from inside of the Garage [3].

1.1.3 Rolling Door

They consist of a ribbed steel shutter that moves vertically while opening and rolls up and around the drum, guided by tracks and counterbalanced with springs.

They are particularly suitable for garages where there is plenty of headroom above the opening and where an old-fashioned look is required.

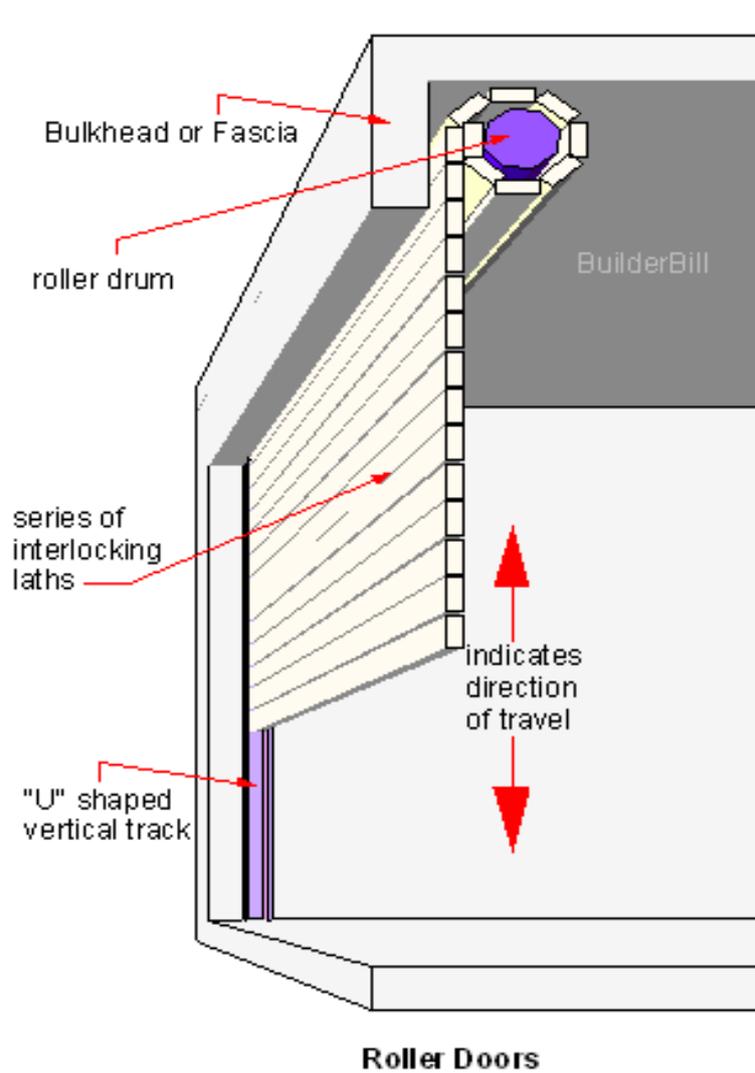


Fig.-1.3: Image shows the view of a rolling garage shutter [4].

1.2 Motivation

- Safety of the vehicles.
- Ease in handling the system.
- Ease in uses.
- Opening the garage door while sitting in the car.
- Making the existing mechanisms less complicated.
- Safety of the users.
- Making these doors automatic.
- Affordable price.

1.3 Problem Statement

The current issue burdening most users as they leave their homes is the inquiry, "Did I close my garage door?" As an immediate consequence of this puzzlement, the user is frequently compelled to return over to their home to wiretap the status of their garage door. This kind of issue expenses the users a migraine, as well as amazingly valuable time they could have set somewhere else.

The second issue confronted by Indian sub-landmass individuals is opening the garage door physically. Pushing and pulling the garage door physically is a monotonous undertaking that devours both vitality and time.

This task is focused for taking care of both the issues and giving an idea to remote controlled garage door that is reasonable by the clients.

This task is focused around a framework that might figure out whether the garage door ought to be shut naturally after leaving the home. This will be achieved using a few gadgets observed by an expert summon module. These gadgets incorporate an door sensor, light sensor, a micro-controller, an impediment sensor, a four-catch principle controller, a four-catch remote control, and attractive sensors.

The mounting of these gadgets will introduce straightforwardly upon the current garage door framework and ought to not the slightest bit meddle with the best possible working of the garage door.

General Dimensional Requirements for the garage door are:

The accompanying measurements are to be dealt with while introducing a computerized garage door

- Measurement of door opening width and height. This determines the size of door needed, and the rough opening should be the same size as the door.
- Measurement of the clearance (side room) on the left and right side of the garage door opening. There needs to be at least 3-3/4" clearance on either side to accommodate the installation of the vertical track for standard extension spring and standard torsion spring systems. Specialized extension and torsion spring systems may require more side room.
- Measurement of the headroom - distance between the top of the door opening (jamb header) and the ceiling (or floor joist). Standard extension and torsion spring systems

generally require 10" to 12" of headroom. Additional headroom is required for installation of an automatic garage door opener.

- Measurement of the backroom - distance is measured from the garage door opening toward the back wall of the garage. Door height plus 18" is required. Additional backroom may be required for installation of an automatic garage door opener.

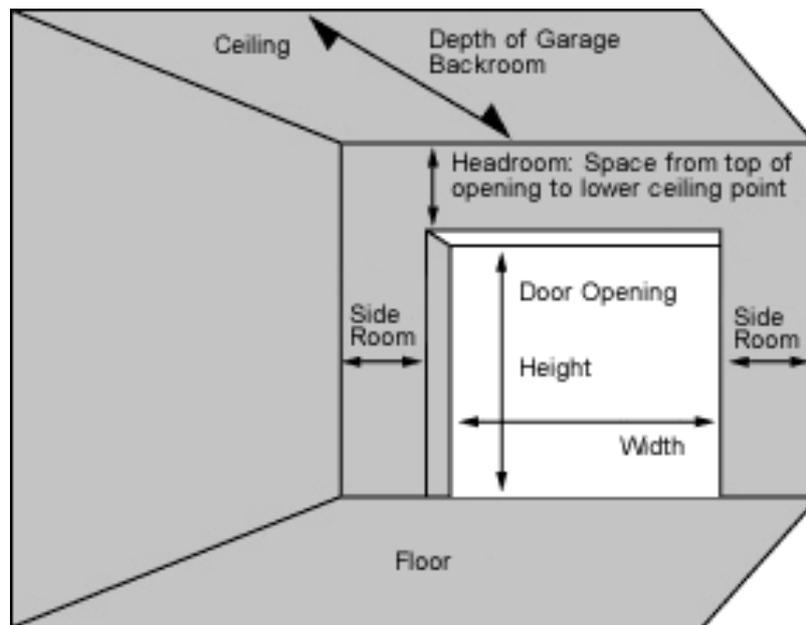


Fig.-1.4: Image shows the dimensional requirements needed for a Garage Door [2].

The least space required among the three garage doors is by Sectional Door and the least amount of power required for automatically lifting the garage door by motor is taken by Sectional Garage Door.

1.4 Literature Review

The creation is all the more especially concerned with instrument for working doors for garages and so forth which are mounted for development from a shut vertical position to an open overhead level position, and the other way around.

An essential object of the creation is to give door working instrument of the general character above alluded to which is generally straightforward in development, promptly versatile for utilization with existing doors and which is profoundly productive and tried and true in operation.

The enhanced component is generally basic in development, exceptionally productive in operation, and offers least infringement upon the typical space inside the building having an door gave the instrument.

A sectional door embodying a majority of areas urgently associated at contiguous edges for relative development of the segments in the development of the door between vertical shut and level open positions. The door is given rollers at each of its inverse side edges for go in a channel track including a vertical segment and an overhead level area united with the vertical area through a bended area. The roller captivating tracks are arranged at inverse sides of the door opening which is characterized by a casing. An engine supporting plate is settled to the bars halfway their closures and on which is suitably secured an electric engine. A channel iron is arranged transversely of the point bars middle their inverse closures and the engine 14 and is inflexibly secured to the more level countenances of the bars. An apparatus lessening lodging is underpinned on the divert iron and in which is rotatable journalled the transitional part of a drive shaft which broadens transversely of the casing. Secured to shaft inside the lodging is a Worm equip in lattice with a Worm on the engine shaft which stretches out into the lodging at right points to the drive shaft.

The drive shaft is given at each one end thereof with a sprocket adapt whose teeth are locked in inside openings in a longitudinally expanding punctured track. The punctured tracks are arranged at inverse sides of the casing and parallel therewith and such tracks are underpinned from roof pillars as by method for suitable grapple parts. The engine is of the reversible sort and in the establishment of the instrument suitable stop and switching switches are given, the switches in essence shaping no some piece of the creation.

In operation; with the door shut, upon empowerment of the engine, the edge will be brought about to go from the full line to the dabbed line position with ability to turn about the hub of the drive shaft and the door will be moved to the vacant position. The door in its vacant position is arranged over the highest point of the door opening whereby affect therewith is significantly completely dodged.

In a complete establishment, the punctured tracks are arranged nearly nearby inverse sides of the casing. Where the door roller engageable tracks are now mounted, the punctured tracks may be mounted on the roller tracks through interceding separating components. With this plan, on the other hand, longer drive shafts are obliged and such more drive shafts ideally have their inverse closures rotatably backed in heading underpinned by suitable parallel expansions of the edge.

1.5 Methodology

Sectional doors are so designated in light of the fact that they are made of segments. Private doors regularly have four or five segments.

These garage door segments are stacked vertically. They are held together with pivots along the length of the areas. The pivots at each one end hold the segments together, as well as they serve an extra motivation behind holding the rollers set up. Rollers are required to permit the door to be opened and shut in tracks. These tracks are connected with track sections to the sides of the opening called the pillar. These sections are likewise called frame sections.

The end pivots additionally serve a third reason - to permit the door to close into a wedge. The end pivots take after a movement - 1, 2, 3, 4, 5, 6, and so forth, with every higher number dispersing the roller further far from the pivot. The vertical track aids in this wedge activity by utilizing graduated track sections, with easier-numbered support sections holding the bottom of the track closer to the frame while the higher-numbered sections keep the highest point of the vertical track further far from the pillar. The net effect is a garage door that seals firmly against the opening. This fittings was initially protected by Overhead Door Corporation, and for a few decades a considerable measure of creativity went into getting garage doors to seal against the openings.

Pivots permit the segments to rotate as the garage door opens, however no pivots are required at the lowest part of the base segment or at the highest point of the top area. Thus other fittings is utilized. At each one end of the top area is a top apparatus or top section that holds the roller in position in the track. At each one end of the bottom area is a comparative section that holds the lowest part rollers set up. This bottom section, or lowest part installation, likewise holds the link utilized within counterbalancing the door.



Fig.-1.5: Image shows a sectional garage door with frame [3].

Sectional doors fit to the rear surface of the front frame of the garage, and as such need a small amount of clear brickwork to the sides and top of opening. The door rises vertically up and then back into the ceiling space. No door frame is required which means the maximum garage opening width can be exploited for drive-through.

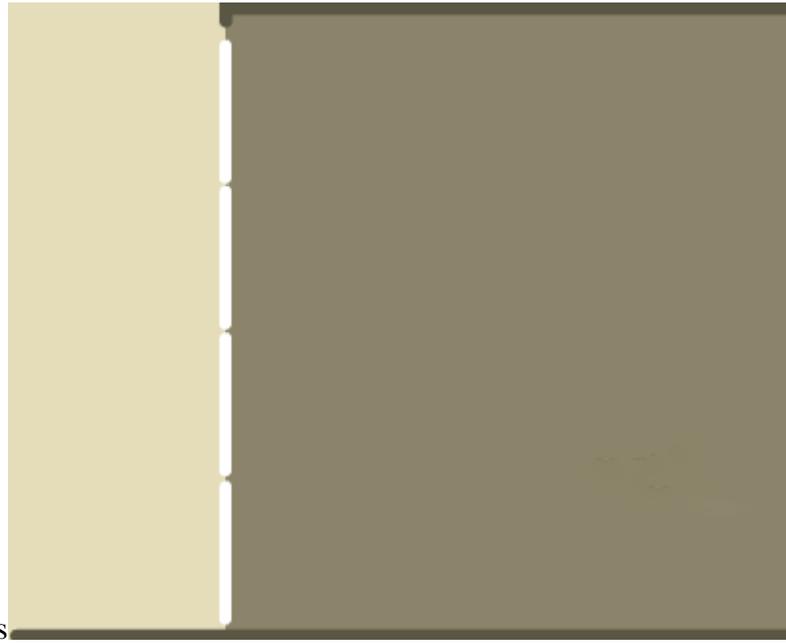


Fig.-1.6: Image shows the sectional door as closed [4].

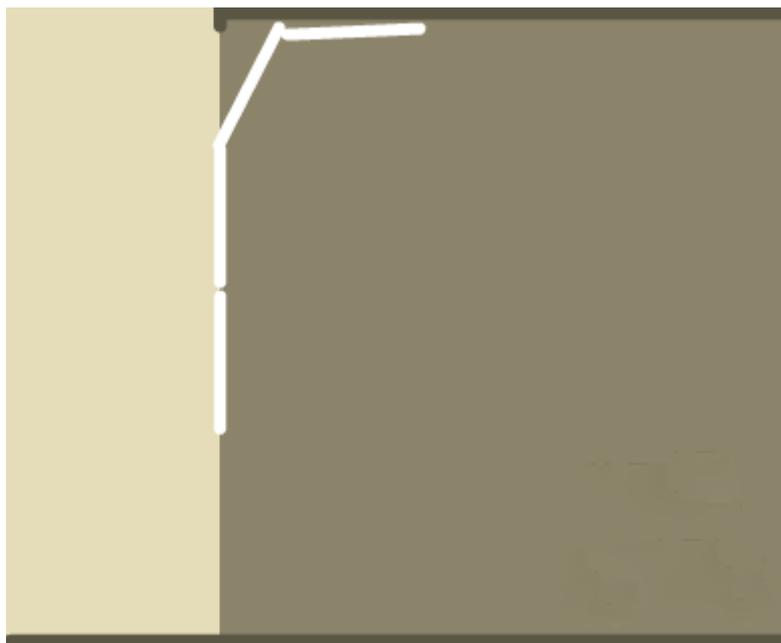


Fig.-1.7: Image shows the sectional door while opening [4].

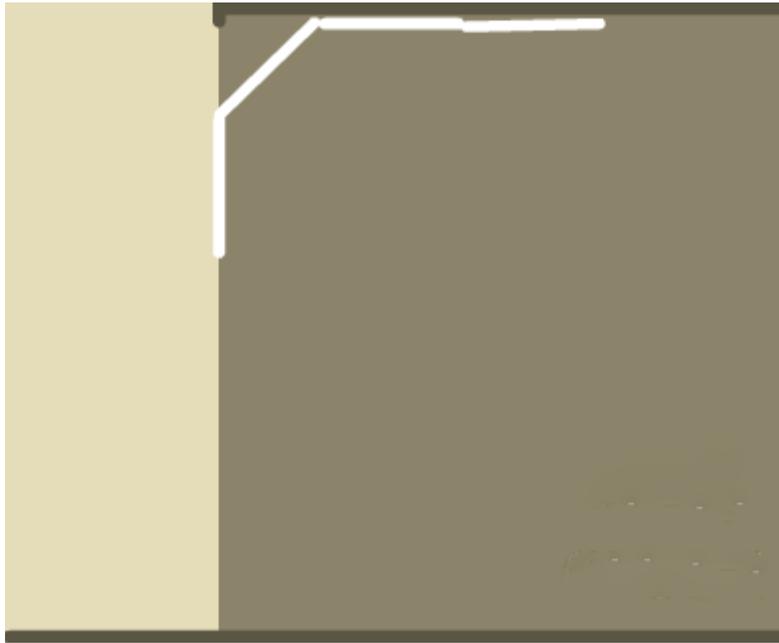


Fig.-1.8: Image shows the sectional door while opening [4].

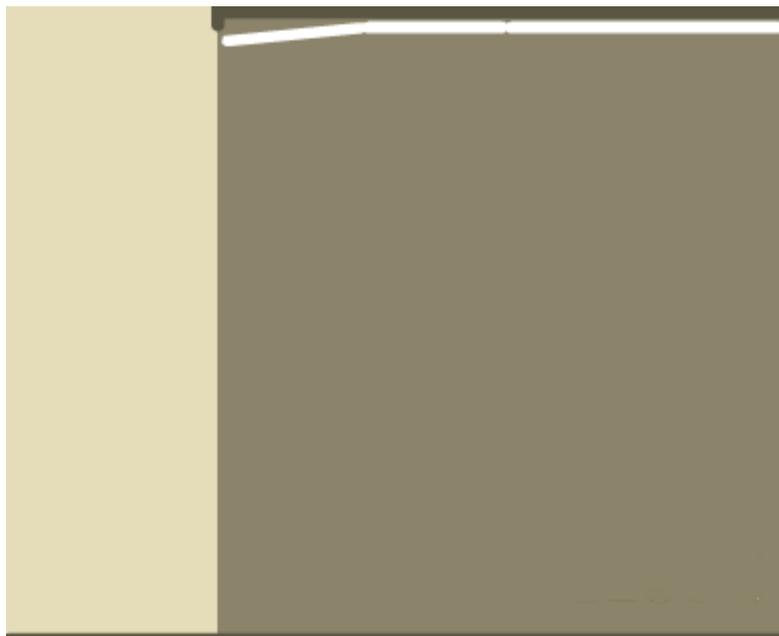


Fig.-1.9: Image shows garage door as opened [4].



Fig.-1.10: Image shows the automated arrangement of Sectional Garage Door [1].

1.5.1 Dimension Details needed for a garage door

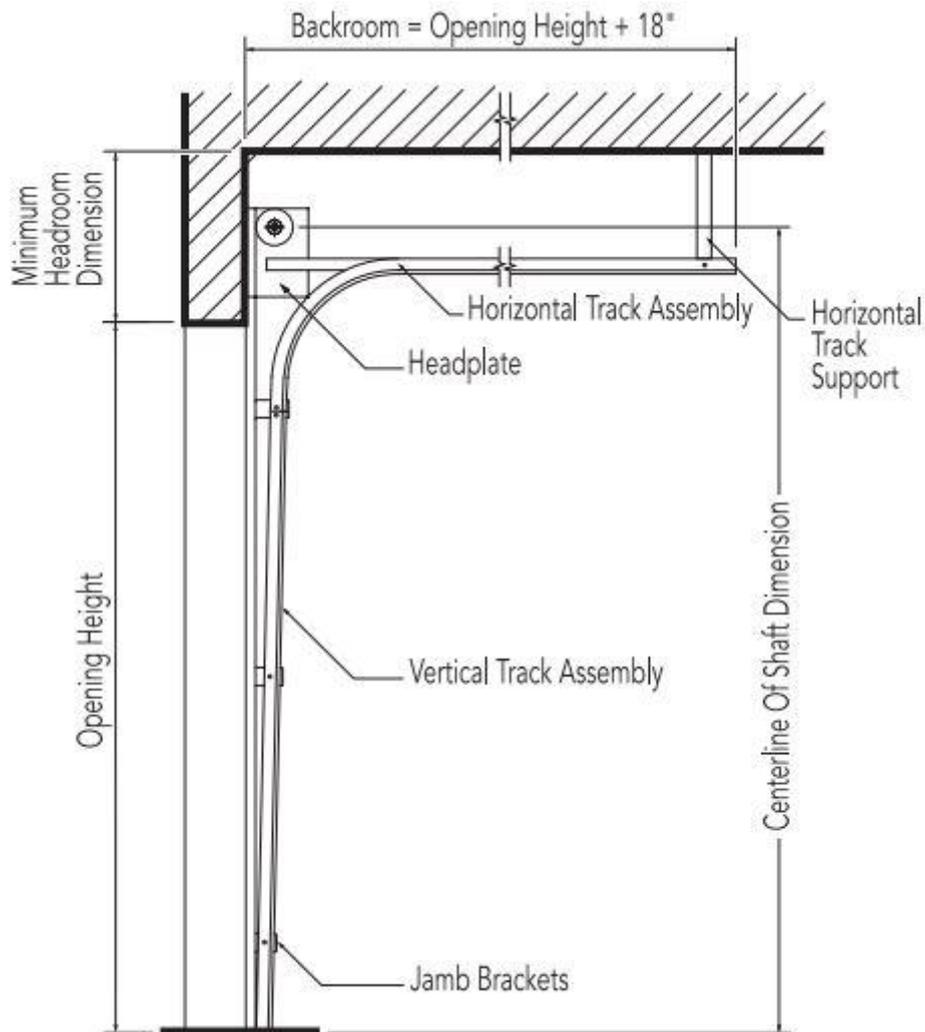


Fig.-1.11: It shows the dimensional requirements of Sectional Door [2].

Table 1, It shows the different Dimensional needs of a Standard Sectional Door.

Door Height	Centre line of shaft	Minimum Headroom	Backroom
12 foot	O.H. + 11 5/8 inches	14 ¼ inches	O.H. + 18 inches

2. Design of Garage Shutter

2.1 Sectional Garage Door

Sectional doors are usually constructed of 3 to 8 panels and slide up and goes overhead. Sectional doors occupy exactly the same amount of internal garage space as a monolithic door. Sectional doors have some distinct advantages over single panel monolithic doors, which are:

- Wider Space

Sectional doors require very little space outside the garage to open. A vehicle may park very close to the garage before opening the door.

- Reliability

Each section of a sectional door has its own link to the door track. This increases consistency and robustness as compared to monolithic doors, which have only a 2 track links for the whole section.

- Space Saving

Sectional garage doors open vertically and they are suspended under the ceiling to sustain any additional space. This constructional method means one can take full advantage of the space inside and outside of the garage for parking.

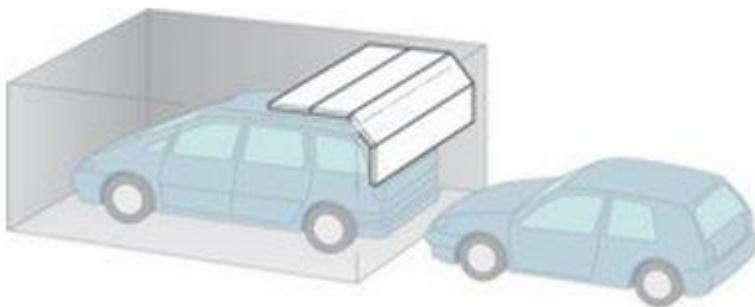


Fig.-2.1: Image shows that space is saved in a sectional garage door [3].

- Variable Fitting

The shape of the garage opening is of very less importance. Whether the shape is square or angled with segmental or full centred arch.

2.1.2 Materials Used

Garage doors can be made out of many materials, steel, aluminium, wood, copper, glass and vinyl (polyethylene) are the most popular ones. A few manufacturers make garage doors by putting foamed-in-place polyurethane insulation in panels and sectional garage doors.

2.1.3 Main Parts

- **Lead Screw-** It is a screw used as a link into the machine, to convert rotational motion into linear motion. Because of the large area of sliding contact between their male and female members, screw threads have larger frictional energy losses compared to other linkages. They are not typically used to carry high power, but more for intermittent use in low power actuator and positioner mechanisms.
- **A Stepper Motor -** It is a brushless DC electric motor that divides a full rotation into a number of equal steps. The position of the motor can be commanded to move and hold at one of the steps without any feedback sensor, as long as the motor is carefully sized for the requirement.

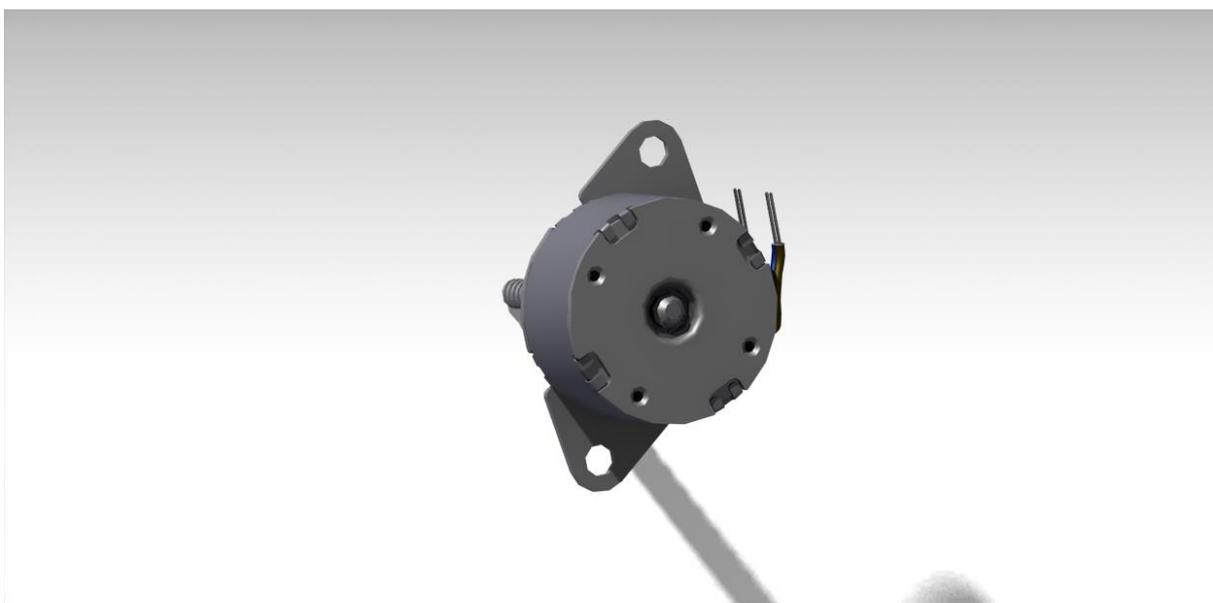


Fig. - 2.2: Image shows a rendered model in catia of a stepper motor with lead screw.

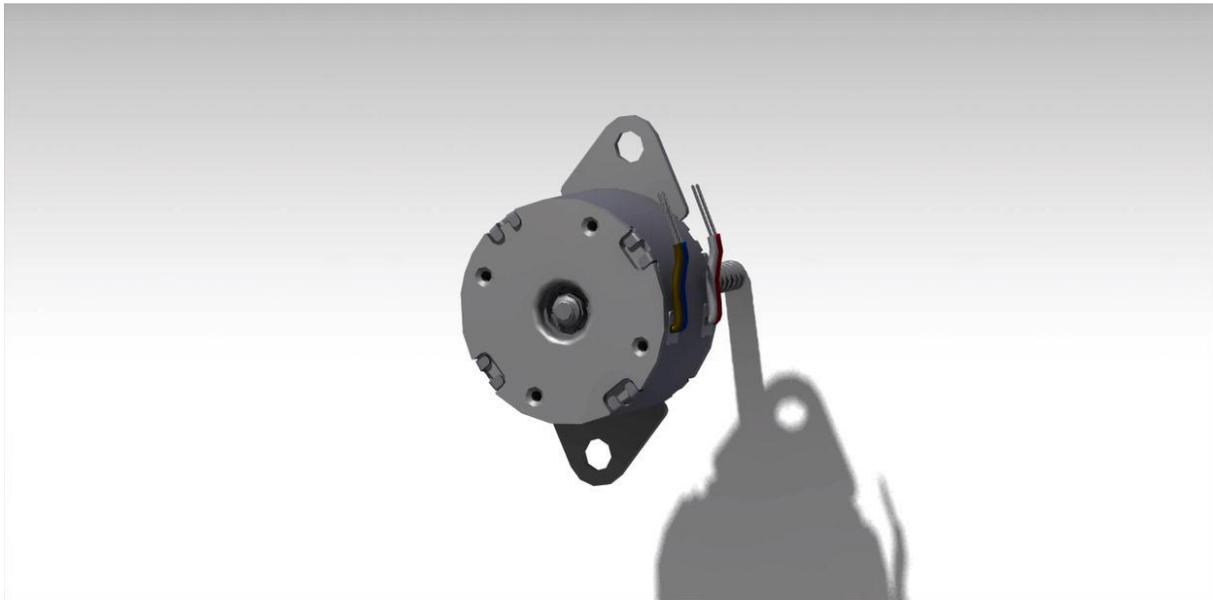


Fig.- 2.3: Image shows a rendered model in catia of a stepper motor with lead screw.

- **Torsion Spring** - A torsion spring is a spring that works by torsion or twisting; which means, a flexible elastic object storing mechanical energy when twisted then it exerts a force (actually torque) in the opposite direction, proportional to the amount (angle) it is twisted.



Fig.- 2.4: Image shows a rendered model in catia of a torsion spring.

2.1.4 Assembled Product

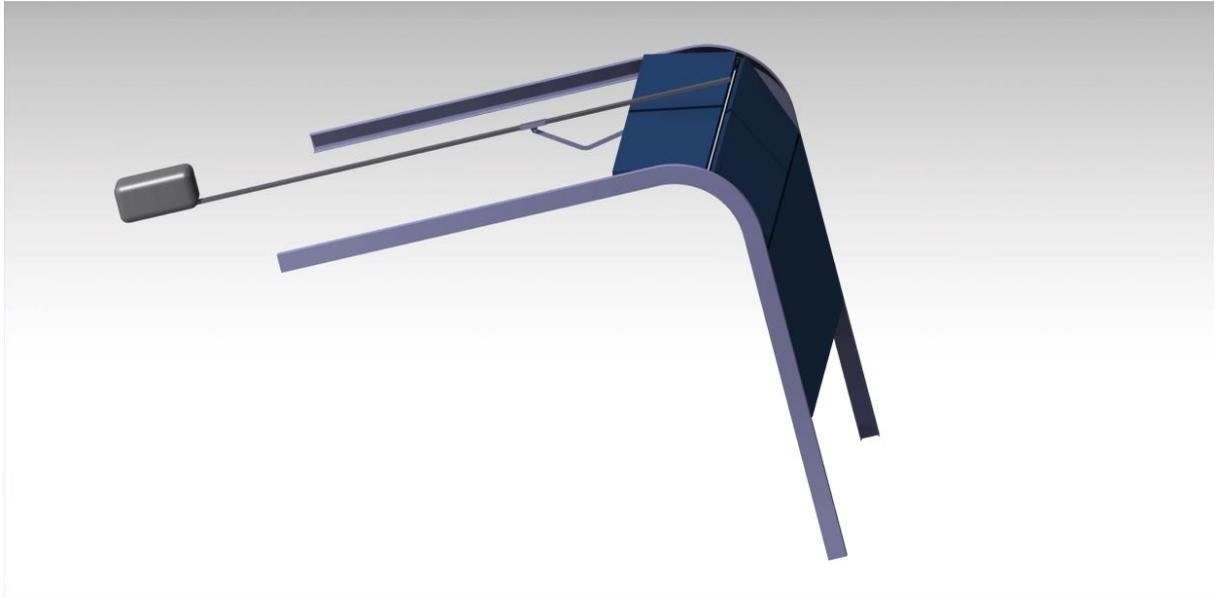


Fig.- 2.5: Image shows a rendered model in catia of assembled sectional garage door.

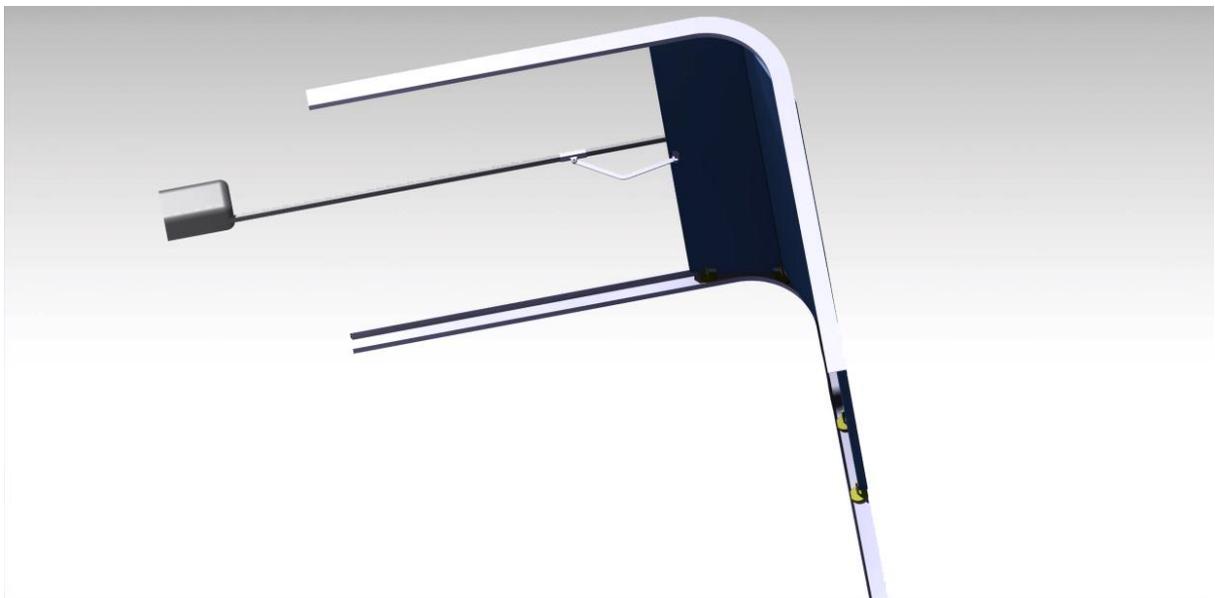


Fig.- 2.6: Image shows a rendered model in catia of assembled sectional garage door.

2.2 Operation

An electric drive is exceptionally valuable in client accommodation, they are controlled by remote controls. The electric drive follows up on a toothed sash which opens and shuts the door without any exertion from the client. The drive framework opens and shuts the door at a palatable rate. The electric engine is secured to the ceiling. One can drive in as well as out with the door without any issue.

At the point when the button of remote control is pressed then it offers signal to the receiver which is inside the garage and the recipient on getting the sign reactions bringing about exchanging on the engine. The engine thus pivots and the lead screw begins turning which either pulls or opens the door or pushes or shuts the door.

2.2.1 Remote Control

The sectional garage door opens and closes consequently at a solitary press of the catch of the remote control. One does not have to leave the car to open the garage door. The electrically determined garage door is worked utilizing a remote gadget.

3. Fabrication of Garage Shutter

3.1 Detailed Design

3.1.1 Parts and Specifications

- Planks– 3 pieces of planks are required for the support purpose and basic structure of the garage door.



Fig. – 3.1: Above picture shows a wooden plank.

Dimension – 18 cm x 20 cm

Quantity – 3

- Panels– 4 wooden panels are needed for the construction of the door.

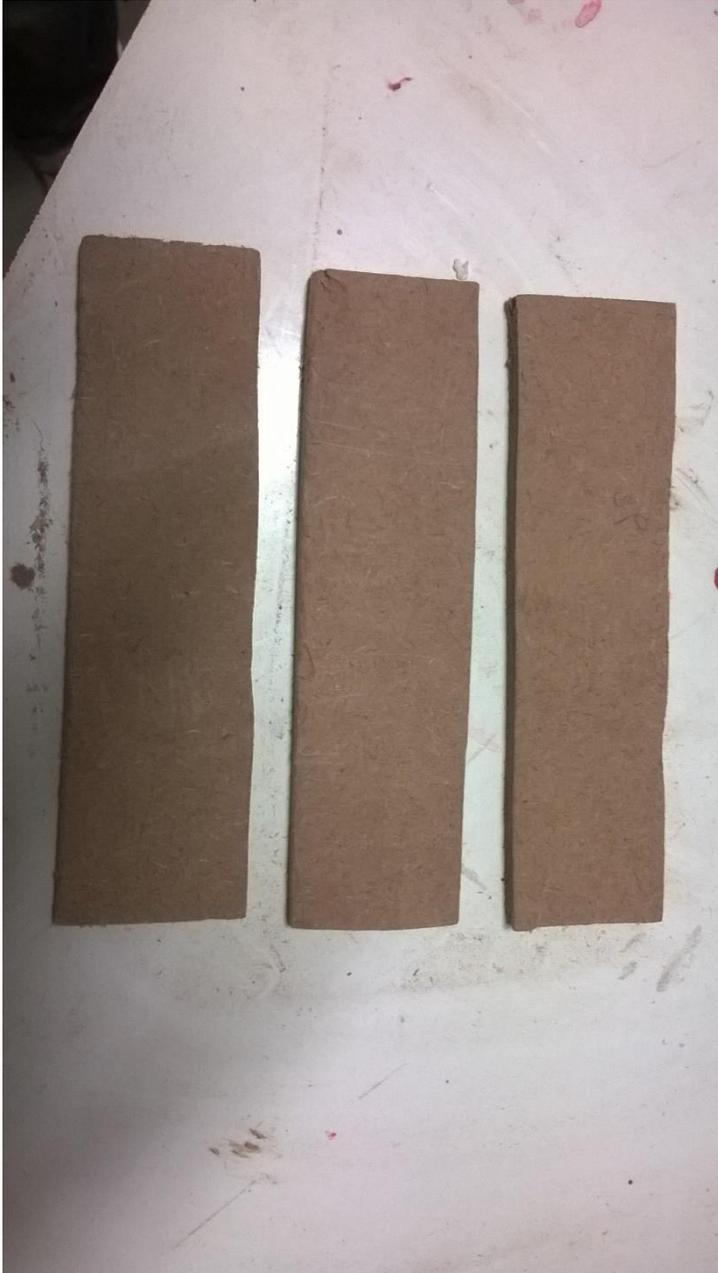


Fig. – 3.2: Above picture shows the panels of the door.

Dimension – 4 cm x 15 cm

Quantity – 4

- Lead Screw – A lead screw is used to be coupled with motor.



Fig. – 3.3: Above picture shows a lead screw.

Dimensions

Length – 15 cm

Diameter – .25cm

Quantity - 1

- Nut–A nut is needed with the lead screw for movement purpose.



Fig. – 3.4: Above picture shows 3 nuts fastened in lead screw.

Dimension

Diameter - .25cm

Quantity – 1

- DC Motor – A DC Motor is required to give rotational movement to lead screw.
- Coupler – Couplers are needed for coupling motor and lead screw.

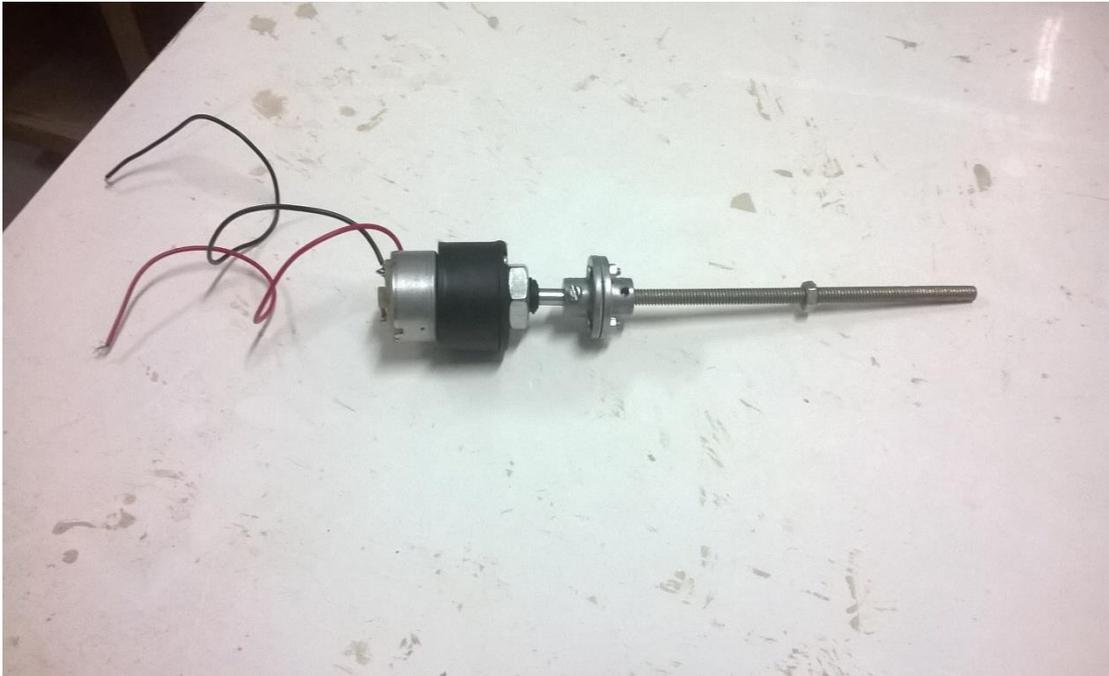


Fig –3.5: Above picture shows a DC Motor with couplers.

Specifications

RPM – 60

Voltage – 12V

Quantity

Motor – 1

Coupler – 2

3.2 Working Principle

In this prototype the working principle used is different and easier in functioning from the one contemporarily used for the Garage.

Here, a lead screw is coupled with the motor and the motor is attached to the roof of the planks. Lead screw has a nut whose rotational movement is fixed i.e. it will not show any rotational movement when motor will rotate. So there will be a lateral movement of the bolt along with the lead screw and the top section of the sectional garage door is attached with the bolt, so the bolt will pull to open or push to close the door.

Therefore, when power is supplied to the motor, it will rotate together with the coupled screw and nut meshed with the screw will make translational motion and the door will open or close depending on the direction of motion of the motor.

3.3 Assembly

Step 1 – All wooden planks are assembled to give them a structure of garage.



Fig. – 3.6: Above picture shows assembled planks in a garage shape structure.

Step 2 – All panels are hinged together.



Fig. – 3.7: Above picture shows the hinged panels of the garage door.

Step 3 – Motor and lead screw with nut are coupled with the help of coupler.

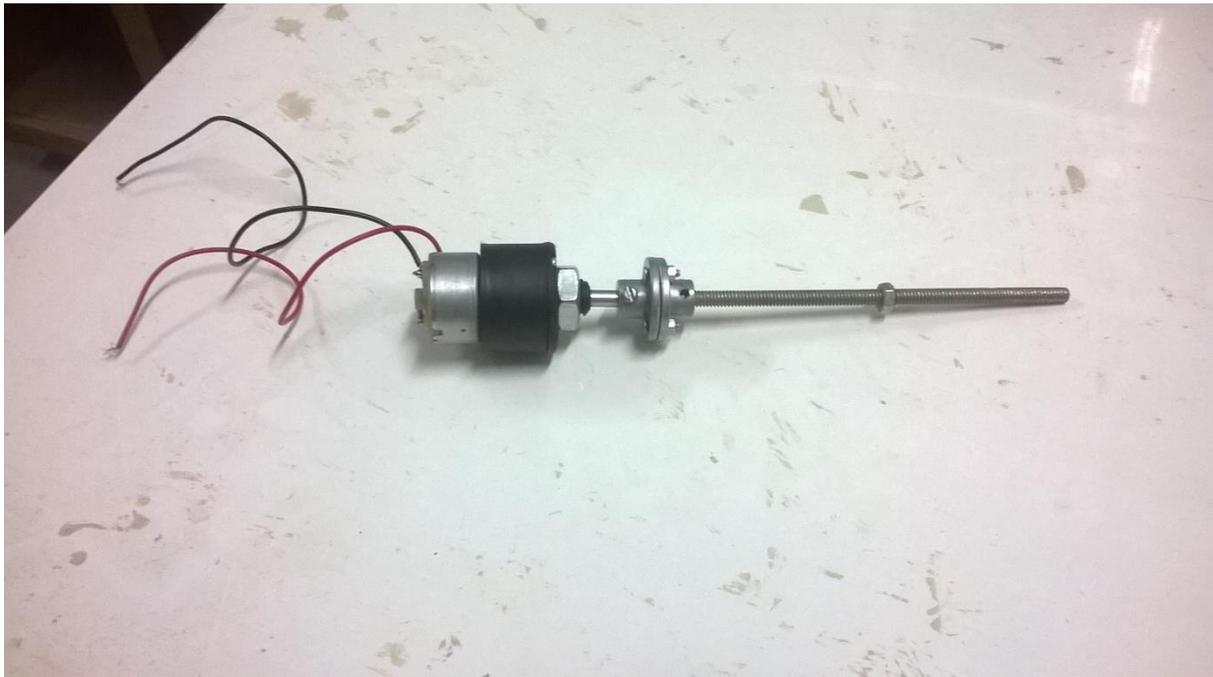


Fig. – 3.8: Above figure shows the coupled motor and lead screw.

Step 4 – Motor is attached to the ceiling of the plank structure.



Fig. – 3.9: Above figure shows a motor attached to the top plank.

Step 5 – Now nut and the top panel are attached together with the help of gas welding and the prototype is ready.



Fig.- 3.10: Garage Door assembled model.

A working model of the garage door is fabricated.

4. Conclusion and Future Work

After working on this project, it can be concluded that among various garage shutters available, sectional garage door is the most efficient, convenient, useful and requires minimum space for installation.

Various mechanisms for the operation of Sectional Garage Door are studied. One of them is selected for prototype development purpose. CAD model of various parts of the Sectional Garage Door is designed and also the parts are assembled to form the final product.

Finally, a prototype of the motorised sectional garage door in working condition is developed.

4.1 Scope of Future work :

- Controlling the opening and closing of the door with remote control which involved integration of signal receivers which will actuate the motor and give instruction to open or to close.
- Light sensor can be used for detecting the lighting condition of the garage.
- Magnetic sensor can be used in the door for detecting whether there is any obstacle in between the floor and the door when the door is in open condition. If there is any obstacle then the door will be prevented from closing.
- Stepper motor can be used for controlling the motions of the garage door.

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