IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

DESIGN AND DEVELOPMENT OF VERTICAL/ROTARY CAR PARKING SYSTEM

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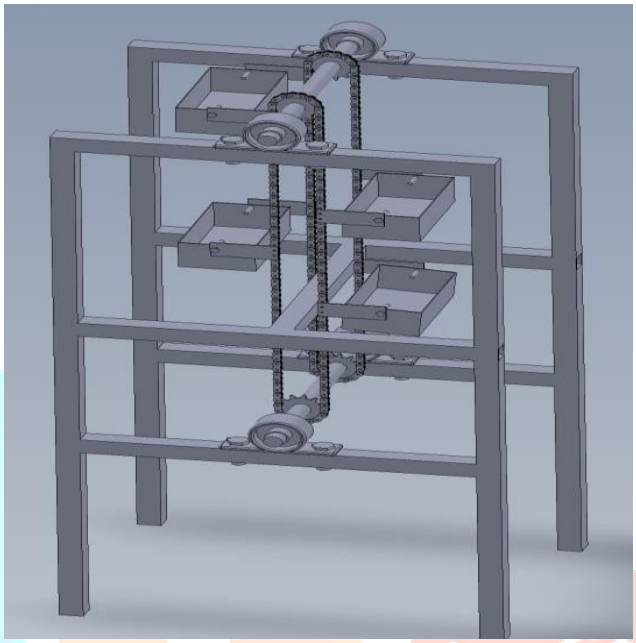
Abstract:

This project deals with manufacture of a Prototype of Vertical Car Parking System. This system has been implemented to reduce the excess use of land space which is already very scarce in metro cities. Different types of vehicle parking are applied worldwide namely Multi-level Automated Car Parking, Automated Car Parking System, and Rotary Parking System. The present project work is aimed to develop a scale down working model of a car parking system for parking cars within a large parking area. The chain and sprocket mechanism is used for driving the parking platform. When the car comes on the ramp the switch will be activated and the bucket comes to carry the vehicle. When the switch will be operated by the operator, sprockets starts to rotate and the new space will be adjusted for new vehicle. Planners, developers, architects are finding out solutions to tackle this problem of parking, so we took this opportunity to bring the technology of automated parking to where it is needed.

Introduction

In 1905, the first multi-level automated car park (APS) was built in Paris, with an elevator that transports cars to the appropriate level, where the employees parked their vehicles. Automated parking garages first appeared in the United States (New York) in the 1920s and have remained popular to this day. The so called car towers are the most well-known car parks of this type in Europe. A car park in the Volkswagen plant in Wolfsburg, Germany, was built from two concrete silos that were once used to store grain, resulting in the TurmFahrt glass towers, which are car parks for cars leaving the production line. Each one can hold 400 cars. They pass through an underground tunnel connecting the factory and the towers on their way to the silo. Both silos are open to the public. Visitors travel up and down through the center of each building in a glass gondola, or elevator. The model is easy to assemble and dismantle due to the use of composite parts, making it more convenient than traditional car parking systems. The rotary model is designed to fit multiple cars in a horizontal space that can

only fit two cars. The structure can hold six cars in the space of two, or it can be customized to hold a larger number depending on the needs of the user, and it can be used effectively in areas where space is limited. Even though automated parking, such as multilevel parking, has improved the situation slightly, there is still room for improvement. This is due to the fact that people still face issues with space, searching time, and waiting time in public places such as malls, multiplexes, railway stations, and shopping streets. The majority of these issues will be resolved thanks to new smart parking technology.



OBJECTIVE:

1. To develop a methodology for advance vertical parking system for cars.
2. Develop a basic 3D conceptual model by using SOLIDWORKS.
3. To make a survey for material selection and components required.
4. To design and develop the prototype model.
5. Successful testing of project.

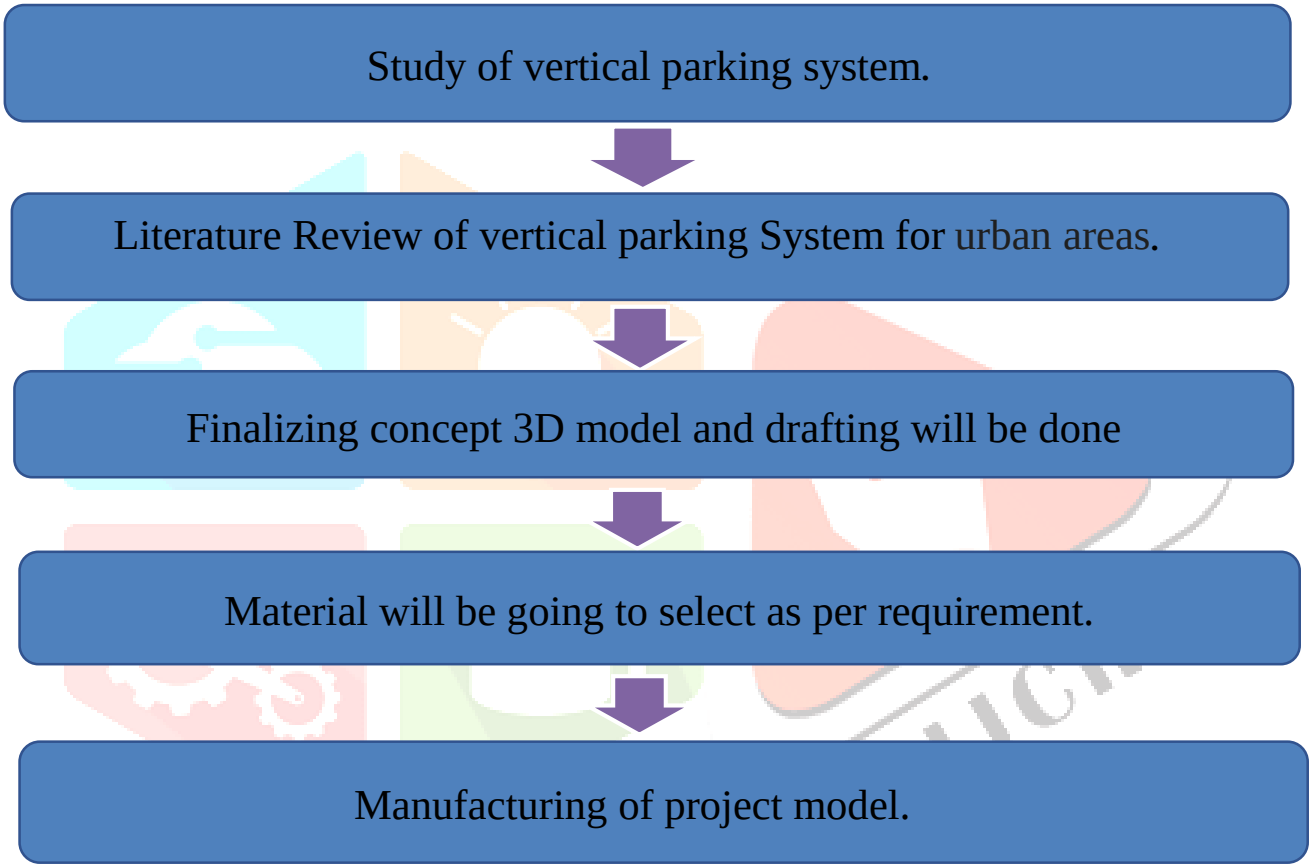
PROBLEM STATEMENT:

Parking is a major problem in urban areas, where space is limited and demand for parking is high. Traditional parking methods, such as parking lots and garages, can be inefficient and take up a lot of space. Vertical/Rotary car parking systems (V/RCPS) have emerged as a potential solution to this problem. V/RCPS are mechanical systems that store cars in multiple levels, using elevators or platforms to move cars vertically. This can significantly increase the amount of parking that can be accommodated in a given area. V/RCPS can also be automated, which can reduce the need for human labor and improve the efficiency of parking operations.

SCOPE :

1. Vertical car parking systems are becoming increasingly automated, which is making them more convenient and user-friendly. In the future, we can expect to see fully automated systems that can park and retrieve cars without any human intervention.
2. Vertical car parking systems are increasingly being integrated with smart city initiatives. This is allowing cities to collect data on parking usage and make better use of parking resources.

METHODOLOGY:



WORKING:

1. Entry Of Vehicle:-

The vehicle owner drives to the parking facility's entry point. The RFID reader scans the RFID card. The systems verifies the card and checks for available parking spots. Once authenticated, the entry gate opens, the vehicle is directed to a lift. The lift transports the vehicle to an assigned parking level.

2. Parking allocation:-

The control system uses algorithms to allocate the nearest available spot, optimizing space and minimizing wait times. The vehicle is moved horizontally on a platform to allocated spot

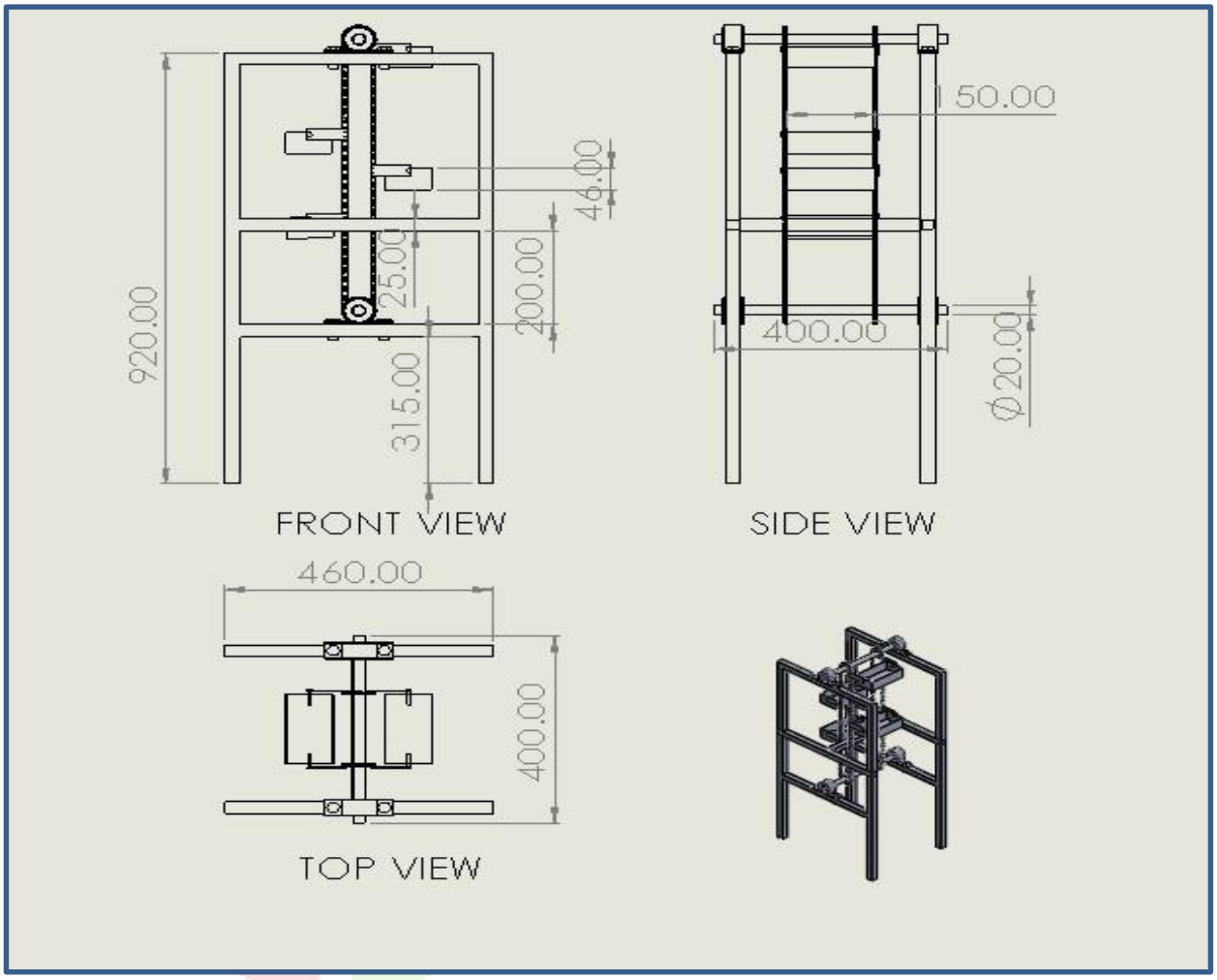
3. Vehicle exit process:-

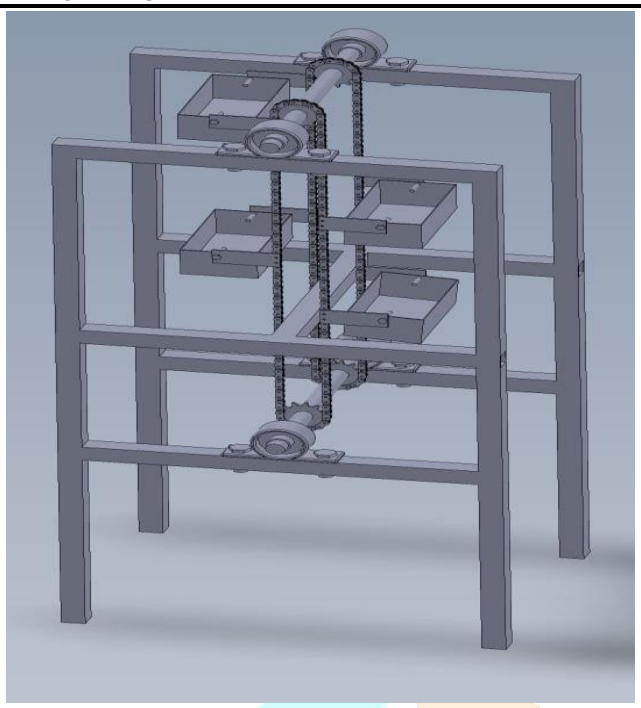
a) Upon returning, the vehicle owner scans their RFID card at the exit the parking area.

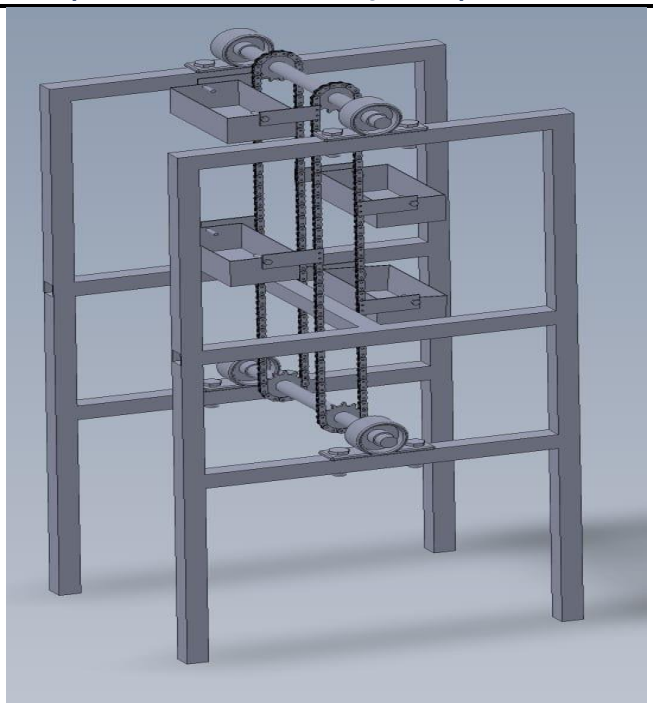
b) The system retrieves the vehicle by moving it form its parking spot to the lift.

c) The vehicle is lowered to the ground level and owner presented its.

MODEL & DESIGN:







CALCULATION

1. Wiper Motor:-

   Speed (rpm) = 55 rpm

   Power (p) = 120 w

   Torque = $60_{*}P\ 2_{*}\pi_{*}RPM$

   Torque = $60_{*}120\ 2_{*}\pi_{*}55 = 7200\ 110_{\pi}$

   Torque = 20.83 nm

2. Frame:-

   Material selected for body is st310 grade square hollow pipe

   Load on frame considered P = 6 kg = 58.86 N

   y = D/2 = 25/2 = 12.5mm

   D = 25 mm B = 25 mm t= 2mm thickness

   Maximum Length of frame is 920 mm

   Moment of inertia in x direction

   DB^3/12 _ db^3/12

   I = 16345.34 mm4

   Mb =WL/4 = $49.05_{*}920$ 4 = 13537.8 N-mm

   Bending stress of pipe

   $Mb/I = \sigma b/y$

   σb = $13537.8_{*}12.5$/16345.34

   = 10.35 N/mm2

   Theoretical bending stress

   $\sigma b(th)$ = Syt/f. s = 310/1

   = 310 N/mm2

   $\sigma b(acutal) < \sigma b(th)$

   Hence design is safe.

• Width: 400 mm

• Length: 920 mm

Total load on the Frame = Weight of vehicle × 4 + Weight of Pallet×4 +Weight of Rod×2 + Weight of Chain×2 + Weight of Joint×12+Weight of Motor + Miscellaneous

= (0.25×9.81*4+ 1.2×9.81*4+ 0.6×9.81*2+ 0.9×9.81*2 + 0.145×9.81*12 + 3*9.81 + 5*9.81)

= 181.86

3. Chain or sprocket:- w = d1*π*n / 60 w = 2.112*3.14*55/60 w

=6.08 m/s Chain force:

Ft = P / w =120/6.08

=19.73 N

BASIC FORMULAS

Torque: T = 30P / πn;

T=30*120/3.141*55=41.66 N-mm^2

Chain pitch:

t = 2,

Number of teeth of the sprocket: z = z1=z2=22

Pitch diameter:

di = t / sin(180 / z)

=2/sin(180/22)

=2.112

Linear speed: w = d1*π*n / 60 w

= 2.112*3.141*55/60

w =6.08 m/s Chain

force:

Ft = P / w =120/6.08 =19.73 N

4. Pallet Specifications:

• Thickness = 2mm…. (Considering the load of vehicle)

• Length = 150 mm

• Height = 80mm

• Mass of a vehicle is 1.5 kg

Total load on pallet = Weight of the vehicle + Weight of pallet screw

= 0.250*9.81+0.02*9.81 =14.91 N

CONCLUSION:

Automated car parking system is a concept which is used to park cars by stacking them in a structure. The structure is mounted on the ground which is fairly enough for parking 2 cars side by side. But this system parks 6-18 cars, depending on the height of the structure. This parking system is designed to solve the problem of parking place. So there is no traffic jam during rush hours. It also utilizes time and space and it is better than the traditional parking system in so many ways. The parking system has its own features such as, it is easy to operate, least trouble, least noise and vibration cheap running cost, and so on.

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