FABRICATION OF VERTICAL CAR PARKING SYSTEM- A PROTOTYPE

Mandeep Kaur, J L Prasad, G Chandrasekhar
Student, Avanthi Institute of Engineering and Technology

***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. This total prototype is powered by a D.C motor. 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.**

***Index Terms*—automated parking, mechanism prototype, space scarce, automobile.**

I. INTRODUCTION

ROTARY CAR PARKING SYSTEM

The Rotary Automated Car Parking System (RACPS) belongs to the class of rotary smart car parking systems. The traditional parking systems such as multilevel or multi-storey car parking systems (non-automated), robot car parking systems, automated multilevel car parking systems etc have been implemented on a huge scale. But these systems have a major disadvantage of large space consumption which is successfully eliminated with the use of a rotary car parking system [2].

Moreover, the latter provides the added benefits of flexible operation without the need of an attendant and added security and least chances of vehicle damage. Since the model makes use of composite parts, it is easy to assemble and dismantle and is thus more convenient than the traditional car parking systems. The rotary model is specifically designed to accommodate multiple cars in the horizontal space of two. The structure can accommodate six cars in the space of two and can even be customized to hold a greater number depending upon the requirements of the user and can be efficiently put to use in much space crunched areas. Parking spaces cannot cope with the growth of the number of vehicles. In many urban housing societies, the parking space ratio is 1:1. The vehicles parked randomly, cause the major problem faced in most of the metropolitan cities. The idea is to park and move cars with no disturbance to the already parked cars in RACPS.

II. HARDWARE SETUP

Chassis:

A chassis is the part of an automobile that the suspension mounts to. Most vehicles manufactured since the 1970s use a uni-body construction method. In this type of design, the chassis is not separate from the body, as it is in a vehicle that uses a separate frame. With uni-body vehicles, the chassis is attached to reinforced sheet metal mounting points designed into the body of the vehicle. Some vehicles, such as pick-up trucks and heavy-duty vehicles continue to use a separate frame and the chassis, for these types of vehicles mounts directly to the frame.

Figure: CHASSIS

Shaft:

It is the shaft which runs at the vehicle speed. It carries power form the counter shaft by use of gears and according to the gear ratio, it runs at different speed and torque compares to counter shaft. One end of this shaft is connects with the universal shaft.

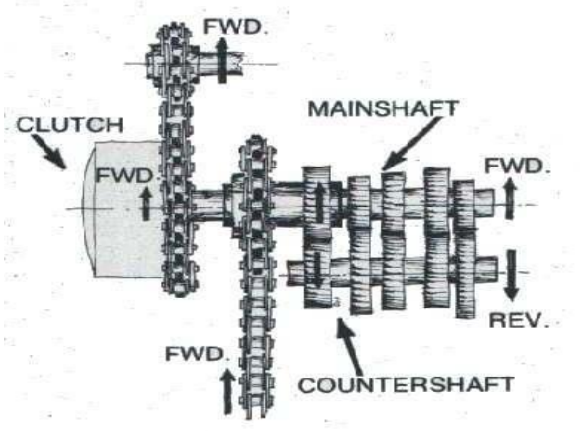

Figure: MAIN SHAFT AND COUNTER SHAFT

Sprockets:

A **sprocket** or **sprocket-wheel** is a profiled wheel with teeth, cogs, or even sprockets that mesh with a chain, track or other perforated or indented material. The name 'sprocket' applies generally to any wheel upon which radial projections engage a chain passing over it. It is distinguished from a gear in that sprockets are never meshed together directly, and differs from a pulley in that sprockets have teeth and pulleys are smooth.

Figure: SPROCKET

Gear wheels:

A **gear** or **cogwheel** is a rotating machine part having cut *teeth*, or cogs, which mesh with another toothed part to transmit torque. Geared devices can change the speed, torque, and direction of a power source; Gears almost always produce a change in torque, creating a mechanical advantage, through their gear ratio, and thus may be considered a simple machine. The teeth on the two meshing gears all have the same shape. Two or more meshing gears, working in a sequence, are called a gear train or a ***transmission*****.** A gear can mesh with a linear toothed part, called a rack, thereby producing translation instead of rotation.

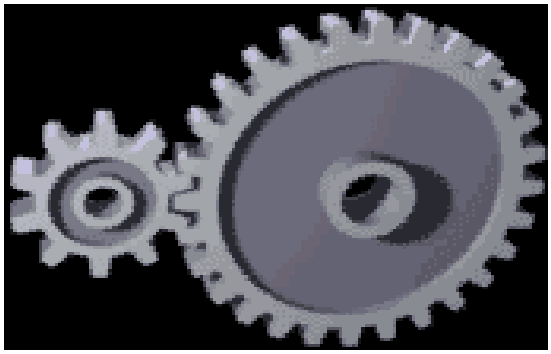

Figure: GEAR WHEELS

Ball Bearings:

Ball bearings, also known as anti-friction bearings, are small metallic or ceramic spheres used to reduce friction between shafts and axles in a number of applications. They are often used in a series to absorb the weight placed on a moving part, or in individual cages to reduce friction in axle assemblies. Most are manufactured to meet very

exacting standards of roundness, since any deformation can cause the moving parts to fail unexpectedly.

Figure: Ball Bearings

Chain drives:

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

Figure: CHAIN DRIVE

Roller chain:

Roller chain or **bush roller chain** is the type of chain drive most commonly used for transmission of mechanical power on many kinds of domestic, industrial and agricultural machinery, including conveyors, wire and tube drawing machines, printing presses, cars, motorcycles, and bicycles. It consists of a series of short cylindrical rollers held together by side links. It is driven by a toothed wheel called a sprocket. It is a simple, reliable, and efficient means of power transmission.

Figure: ROLLER CHAIN

Metal Rod (Iron):

An iron rod is a length of iron that is mainly used in heavy construction projects. Reinforced concrete is intertwined with iron rods, also called rebar, to strengthen the tension of the build. An iron rod can be purchased with or without a ribbed design. Construction-grade iron rods are primarily used in construction or building projects, but a wrought-iron rod can be used in various types of decorative art projects.

Figure: IRON RODS

III. ELECTRICAL SETUP:

D C Motor:

A **DC motor** is any of a class of electrical machines that converts direct current electrical power into mechanical power. The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic; to periodically change the direction of current flow in part of the motor. Most types produce rotary motion; a linear motor directly produces force and motion in a straight line.

DC motors were the first type widely used, since they could be powered from existing direct-current lighting power distribution systems. A DC motor's speed can be controlled over a wide range, using

either a variable supply voltage or by changing the strength of current in its field windings. Small DC motors are used in tools, toys, and appliances.

The universal motor can operate on direct current but is a lightweight motor used for portable power tools and appliances. Larger DC motors are used in propulsion of electric vehicles, elevator and hoists, or in drives for steel rolling mills. The advent of power electronics has made replacement of DC motors with AC motors possible in many applications. DC motors are also the basic motor used in a servo-motor.

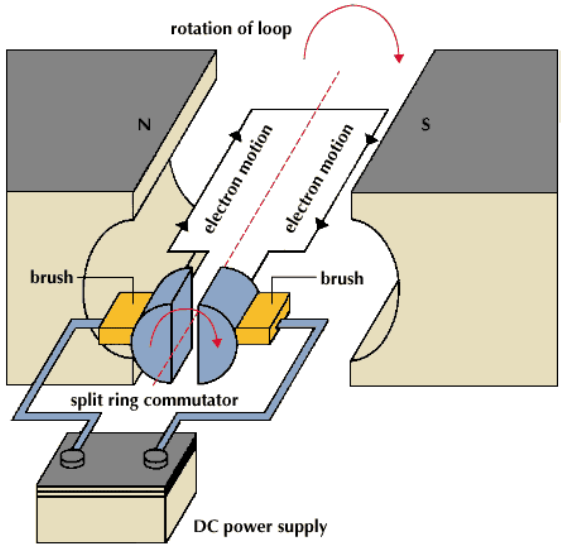

Figure: D C MOTOR

Transformer:

A **transformer** is an electrical device that transfers electrical energy between two or more circuits through electromagnetic induction. Electromagnetic induction produces an electromotive force within a conductor which is exposed to time varying magnetic fields. Transformers are used to increase or decrease the alternating voltages in electric power applications.

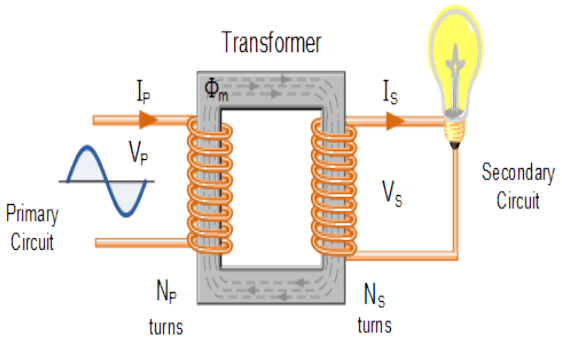

Figure: TRANSFORMER

IV. WORKING

It is simple to operate with the driver parking and leaving the vehicle in the system at the ground level. Once the driver leaves the incorporated safety zone the vehicle is automatically parked by the system rotating to lift the parked car away from the bottom central position. This leaves an empty parking space available at the ground level for the next car to be parked on. The parked car is easily retrieved by pushing the button for the relevant position number the car is parked on. This causes the required car to rotate down to ground level ready for the driver to enter the safety zone and reverse the car out of the system. Except vertical car parking system all other systems use a large ground area, vertical car parking system is developed to utilize maximum vertical area in the available minimum ground area. It is quite successful when installed in busy areas which are well established and are suffering with shortage of area for parking. Although the construction of this system seems to be easy, it will be par from understanding without the knowledge of materials, chains, sprockets, bearings, and machining operations, kinematic and dynamic mechanisms.

V. STEPS TO COMPLETE THE PROJECT

(A). Modeling in AUTOCAD:

Putting the ideas on the modeling software for visualization of the prototype and making it more and more compatible so that there will be less complexity in designing.

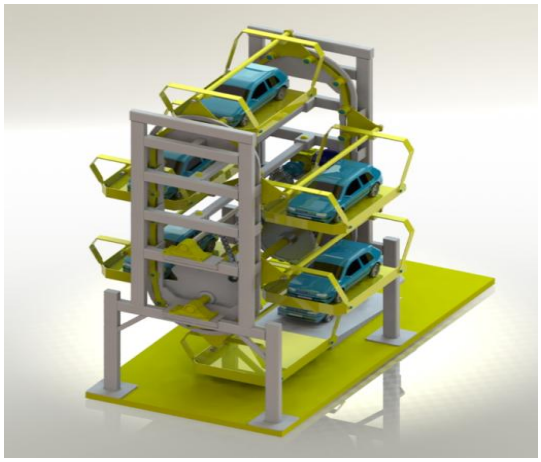

Figure: MODELING IN AUTOCAD

(B).Material Selection and Procurement

In this phase material selection is done and also its procurement as per need the dimensions are taken from AUTOCAD model.

(C). Fabrication

This phase includes fabrication of prototype in the workshop from the procured material and preparing the Prototype model from the software model.

(D). Assembly & Testing

This phase include Assembly of all the sub parts, also the arrangement of the motor and its wiring is done, all finishing operations like grinding, trimming, painting is done here. Testing phase includes testing of the Prototype-model under real environment.

VI. CALCULATIONS AND MODELING

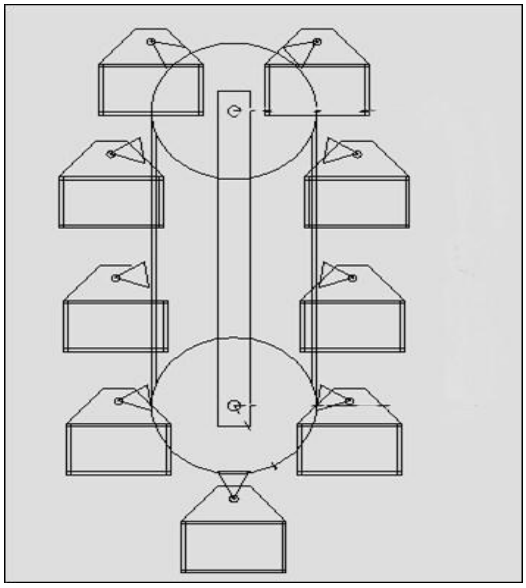

Figure: MODEL ASSEMBLY

(A). Calculated value of shaft diameter

By using Power Equation, P = 0.0462 KW
By using Average Velocity Equation,
V = 1.532 * 10-6 m/s
By using Maximum Bending Moment Equation,
Ma = 121.61 * 103 N.mm
By using Maximum Shear Stress Theory Equation,
Te = 129.37 N.m Ƭmax = 195.23 N/mm2
From above equations, shaft diameter,
D = 14.53mm ≈ 15 mm
By using Maximum Principle Stress Theory Equation,
Me = 125.49 * 103 N.mm
ϭbmax. = 378.746 N/mm2
D = 14.57 mm ≈ 15mm

(B). Chain design

No. of links, Ln = 106 Links
Length of chain, L = 1358.8 mm ≈ 1360 mm

(C). Design of spokes

Maximum Bending Moment, M = 15858.36 N.mm
ϭb = 96585.86 N/mm2
Spoke Diameter, D = 2 mm.

VII. CONCLUSION

Vertical Car Parking model has been designed; all the parts in it were manufactured and assembled and tested successfully. Analysis of the model has been done and developed with the scaling of 1:9 for life size model Such as SUV's like Fortuner. As the life cycle model involves proper design and advanced methods are to be used to meet the requirements of the customers.

VIII. ACKNOWLEDGMENT

Behind every achievement lies an unfathomable sea of gratitude to those who energized it, without whom it would never come into existence. We were pleased to thank our Project Guide Mr. V HARI KIRAN, M. TECH, ASST.PROFESSOR, H.O.D .Department of Mechanical Engineering for his whole hearted Cooperation, unfailing inspiration and valuable Suggestions. We thank him valuable time at odd Hours and his patience and his encouragement at every step in completing this project successfully.

REFERENCE

Text References:

[1] S S RATTAN, Theory of Machines, 4th Edition, Mcgraw Hill Education (India) Private Limited.
[2] R. K. Jain, Production Technology, 17th Edition, Khanna Publications Private Limited.

[3] V B Bhandari, Design of Machine Element, Mcgraw Hill Education (India) Private Limited.

Web References:
[1]http://www.parkingsystemsolutions.com/rotary/Dated 15/11/2014
[2]http://www.tksmy.com/activities_parking_system.html Dated 17/11/2014