Advanced car parking system using a forklift

A Thesis Report Submitted to the Department of Mechanical Engineering for Partial Fulfillment of the Requirement for the Degree of Bachelor of Science in Mechanical Engineering

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APPROVAL

This is to certify that the project on " Advanced car parking system by using forklift By (Antora Naznin ID No. BME1602009441, Ruhul Amin ID No. BME1602009446 , Al Mamun ID No. BME 1602009439, Shah Sabbir Ahmed Hiron ID No BME1602009438) has been carried out under our supervision. The project has been carried out in partial fulfillment of the requirements for the degree of Bachelor of Science (B.Sc.) in Mechanical Engineering of years of 2020 and has been approved as to its style and contents.

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DECLARATION

We, hereby, declare that the work presented in this project is the outcome of the investigation and research work performed by us under the supervision of Md. Ahatashamul Haque Khan Shuvo, Lecturer, Department of Mechanical Engineering, Sonargaon University (SU). We also declare that no part of this project and thesis has been or is being submitted elsewhere for the award of any degree.

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Abstract

In today's life, there is a wide variety of forklifts, from the large heavy loading truck to the one that works among narrow aisles. Forklifts have become one of the basic transportation tools we use in our lives. With all the forklifts in existence, we find that there are some improvements that can be made to bring the forklift to a better performance. Existing forklift design has its limitation in rotation and the structure has potential safety risk. Now a day’s advanced car parking system is an important issue and day by day its necessity is increasing. In Bangladesh we are still using the manual vehicle parking system and that is why we are facing problems like wastage of time and fuel finding free space around the parking lot when we need to park our car which requires a good amount of lighting. Another issue is chaos that happens while parking because there is no particular system anyone can park anywhere that sometimes causes damage to the vehicles while moving out or in the parking lot. Security is also an issue there.

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Chapter 1
Introduction

1.1 General

With the sharp increase in the number of cars, looking for a parking lot is a major problem nowadays. As a result, people use two different types of parking management systems, namely: the automatic parking system and the Marshaling parking system.
While a multi-story parking is similar to multiple parking lots stacked vertically, a parking system is more similar to a storage and retrieval system for cars [2]. As it is known, the land is becoming less but the population of humans is growing day by day. This scenario is very obvious in modern developed cities. Therefore, land is very limited and spaces need to be saved in every aspect of life. By building an automated or semi-automated parking system which allows high space utilization, less space is needed compared to the conventional car parking system because, in an automated car parking system, the parking space can be more compact by having vehicles parked nearer to each other and also less space is required for runways or paths in the parking space as vehicles are transferred to parking spaces using elevators and conveyors. Thus, optimized usage of spaces can be achieved [3].

Smart parking can be defined as the use of advanced technologies for the efficient operation, monitoring and management of parking as part of an urban mobility strategy. The global market for advanced parking systems reached $ 93.5 million, with the United States representing a 46% market share and providing a strong growth opportunity for companies offering services in the United States and the United States. [5]. A number of technologies form the basis of intelligent parking solutions, including vehicle sensors, wireless communications and data analytics. Parking in advance has also become viable through innovation in areas such as smartphone apps for customer service, mobile payments and onboard navigation systems.

1.2. Research aim:

The purpose of this study is to set up an advanced parking management system in a public place so that the public can easily park their car and also reserve a parking lot before arriving at their destination. The motivation of the project is, we want to digitize our daily life as well as our country. In many countries this advanced car parking system is available and popular.

1.3 Objectives:

The objectives of this thesis are:

- To study, design and construct an automated car parking system
- To develop an intelligent and user-friendly automated parking system to reduce the number of people and traffic jams.
- To ensure safe and secure parking spaces in a limited area.

Chapter 2
Literature Review

2.1 Forklift:

A forklift is a powered industrial truck used to lift and move materials over short distances. The forklift was developed in the early 20th century by various companies, including Clark, which made transmissions, and Yale & Towne Manufacturing, which made hoists.

Fig 2.0: forklift

2.2 Working principle of Forklifts

In today's life, there is a wide variety of forklifts, from the large heavy loading truck to the one that works among narrow aisles. Forklifts have become one of the basic transportation tools we use in our lives. With all the forklifts in existence, we find that there are some improvements that can be made to bring the forklift to a better performance. Existing forklift design has its limitation in rotation and the structure has potential safety risk. Our new design has 180 degrees rotating forks attached to truck body on both ends. Also, it has a scissor lift under the operator’s cabin which improves the stability. There are two subassemblies: scissor lift and lifting fork; there is a total of 37 parts in the new design. Once the design is conceived, we calculate the mass properties of parts and subassemblies to ensure the stability of the forklift. Results show that the truck is safe to use: its center of gravity remains in the safety triangle and we use this to get the maximum loading capacity. Then we run stress analysis on important parts and subassemblies using finite element method (FEM). Results show that the new design is safe to use under working conditions.[7]

2.3 Types of forklifts

1.Industrial Reach Forklift Trucks.
2.Industrial Counterbalance Forklifts.
3.Rough Terrain Forklifts.
4.Industrial Side Loader Forklifts.

2.3.1 Industrial Reach Forklift Trucks

Industrial reach forklift trucks are renowned for their extended lift height, making them ideal in any warehousing situation with high rise storage pallet racking. There are different types of reach forklift truck that are best suited to a range of scenarios:[7]
Stand-up trucks are the most common and are often used where there's only one load per bay. The two forks on the front of the truck slide underneath palletized loads, to lift and transport safely.

2.3.2 Industrial Counterbalance Forklifts

Industrial counterbalance forklifts are the most common trucks used in indoor warehouses and stores, although they can be used outdoors, on stable, even surfaces. They offer straightforward operation and have dual forks at the front of the truck that lift and transport the loads.
There are different types available, including three-wheel models that provide better maneuverability, making them perfect for narrow aisles.

2.3.3 Rough Terrain Forklifts

For outdoor construction and with difficult terrain, a rough terrain forklift is ideal. It has inflatable tires with thicker threads, allowing stability on uneven ground, as well as a more powerful engine so it can reach higher speeds, and better maneuverability, making them more robust and durable.
This means that they are perfect for transporting heavy loads across rugged terrain, with some models handling up to 3 tons per load. The carefully calibrated counterbalance at the back of the truck prevents overbalancing, with it being easily operated in mud, ice or even snow.

2.4 Types of car parking system:

- AGV systems
- Crane systems
- Puzzle systems
- Silo systems
- Tower systems

2.4.1 AVG Systems:

Automated Guided Vehicle known as AGV technology has been introduced in automated parking system most recently though AGVs has been used in automated warehousing for decades.

Fig 2.1: AVG car parking system

2.4.2 Crane Systems:

This system is used utilizing a single mechanism that is to simultaneously perform the horizontal and vertical movements of the vehicle to be parked or retrieved in the parking system. This mechanism allows the vehicle platform to move to and from one parking spot to another very quickly.

Fig 2.2: Crane car parking system

2.4.3 Puzzle Systems:

Puzzle systems offer the densest form of automated parking as it utilizes around 95% of the floor area and often used in smaller systems. A grid of pallets covers a solid floor or steel frame, and each pallet is supported by a set of rollers and belts that are driven by motors fitted to the support frames underneath each pallet location in a horizontal puzzle system.

Fig 2.3: Puzzle car parking system

2.4.7 Tower Systems:

This system is typically consisting of a vehicle elevator with a parking space either side of the elevator shaft. To complete a parking tower, this configuration is repeated over a number of levels. The vehicle elevator simply rises to one of the parking levels of the tower and deposits the vehicles sideways into a parking space. A vehicle is retrieved in the same way. System redundancy is an issue with tower system as there is a single mechanism to park and retrieve vehicles.

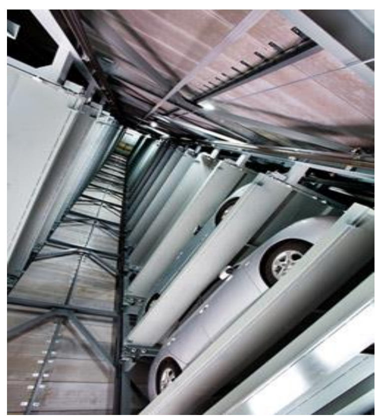

Fig 2.4: Tower car parking system

2.5 Application:

- It is very useful in the high population density in urban areas.
- This whole arrangement will be used as an exercise equipment.
- Easy to operate and less effect of electricity by manual using.

In the decades that followed the development of our country, we came to a situation in which the manual parking system in commercial spaces must be replaced. The manual car parking system creates obstacles and chaos in parking spaces, resulting in lost time and economic losses.

2.5.1 Office buildings:

This will help the staff to park their car without hindrance or loss of time. This will also relieve them of the unnecessary parking obstacle. In addition, if someone is already late, he would not be late if he had to look for a parking space and park his car. It will also ensure the safety of their cars against theft.

2.5.2 Shopping centers:

This will help customers to park their car without hindrance, which will give them time to look for more products. This will benefit both customers and sellers, who will have more time to explore their options and sellers will have more product options to sell. This will increase the number of customers coming to the malls.

2.5.3 Hospitals:

At the hospital, when there are a lot of emergencies, there are a lot of cars and ambulances coming into the car park. This creates a traffic jam that delays patients' receipt of medical care, which can often be fatal. If we install the automated system, it will take less time to park the car and allow patients to reach medical services.

2.6 More places are car parking system by using forklift:

If we install automated car parking systems in amusement parks and railway station or any other places it will attract more people to come to these places. The more the people will come the more revenue will be earned. Moreover, these amusement parks relieve us from our dull and monotonous lives, refreshes our mind.

CHAPTER 3
METHODOLOGY

3.1 Component of our project:

The components needed to complete the project are:

- DC Motor
- Control panel
- Controller Regulator
- Stepper motor (3 types of motor)
- Auto stopper switch

3.1.1 DC Motor

A DC motor is any of a class of rotary electrical machines that converts direct current electrical energy into mechanical energy. 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.

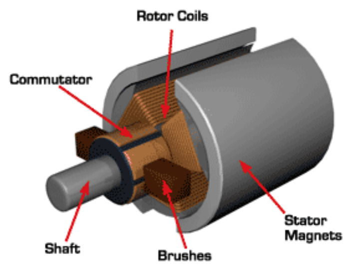

Fig 3.1: DC motor

3.1.2 DC Power Supply Unit:

A DC power supply is one that supplies a constant DC voltage to its load. Depending on its design. Generally, it is consisting of battery, DPDT (Dipole-Through) switch etc.

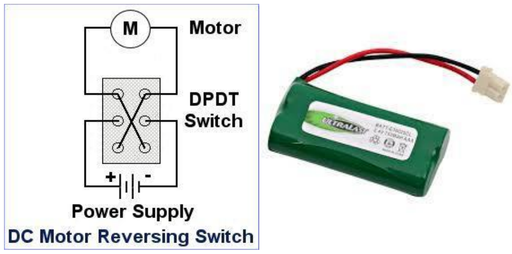

Fig 3.2: DC power supply

3.1.3 Control panel

The two types of ladder control circuits commonly used are the three-wire control regulator and the three-wire motor control circuit. The three-regulator wire control circuit uses maintained contact devices to control the up-down and left right or frontside backside. The three-motor control circuit uses momentary contact devices that control the magnetic motor starter.

3.1.4 Stepper motor

The stepper motor is an electromagnetic device that converts digital pulses into mechanical shaft rotation. The shaft or spindle of a stepper motor rotates in discrete step increments when electrical command pulses are applied to it in the proper sequence. Stepper motors are used in precision applications where a high rotational speed is not required.

- Stepper motor is a digital device
- It follows the instruction as the computer does do
- It is used for the movement of lift

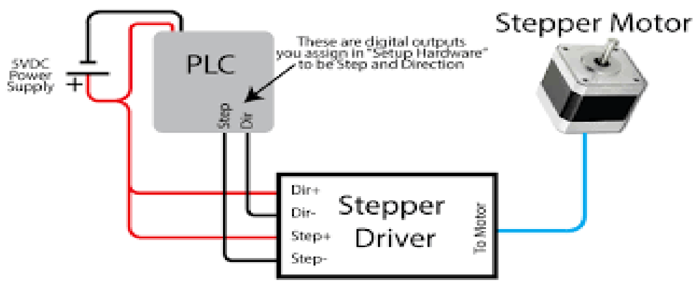

Fig 3.3: Stepper motor

3.1.5 Regulator

A voltage regulator is a system designed to automatically maintain a constant voltage level. A voltage regulator may use a simple feed-forward design or may include negative feedback. It may use an electromechanical mechanism, or electronic components.

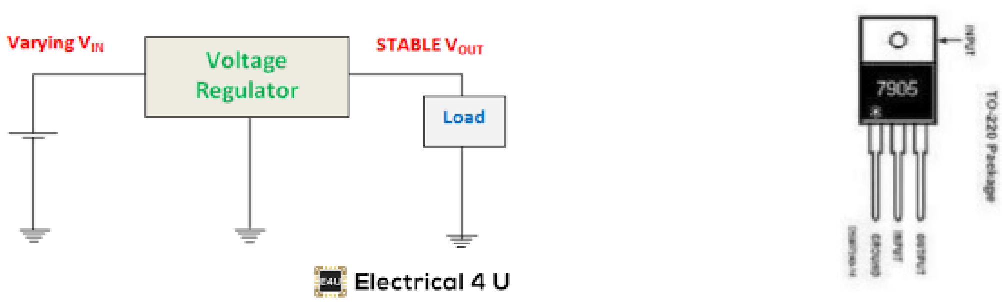

Fig 3.4: Regulator

Chapter 4

4.1 Design and Working principle of our project:

The parameters which will be calculated are-

- Mass of the Forklift.
- Designed Torque of the motors to be used.
- Designed RPM of the motors.

4.2 How This Process Work

At first, we need AC Electrical source. Then we need an adapter for converting electrical power from AC to DC. Now we connected DC to control unit. Control unit is the unit from where we operate all the system in this process. Control unit attached with Power indication light, Control unit on/Off Switch (Main switch), Three Regulator & three knob(switch) for Three Motors RPM Regulating & amp; Power indication respectively.

- Motor Helps to moves the basement left and right to support whole forklift
- Motor Works to lift up forklift with car or without car and down it
- Motor works to place the car to the parking area or take the car from parking area with forward and reverse direction.

[N.B: -operator should have acknowledgement about the right place and direction of those motors]
We Also use handmade auto stopper switch which help to stop the forklift in right position and that cannot make any accident.

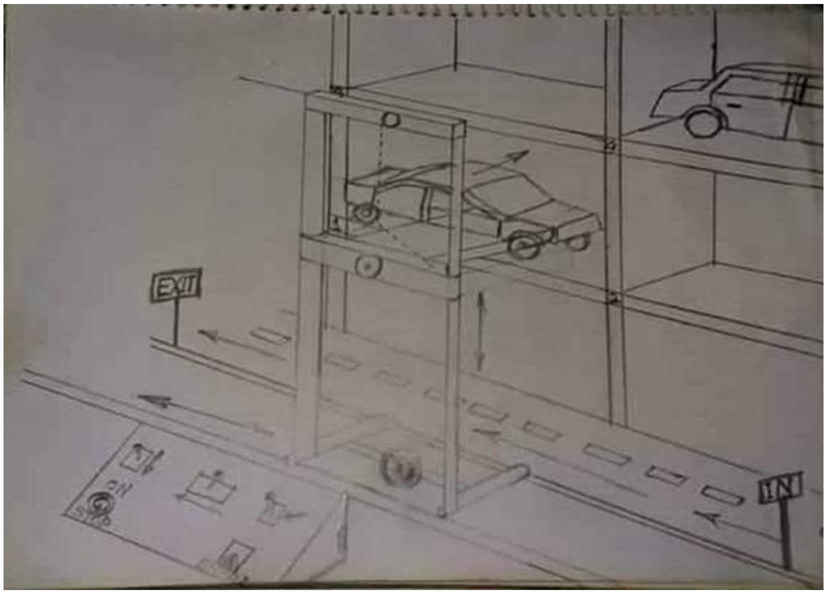

Fig 4.1: Design and Working principle

4.3 Final Assembly:

The CAD design of the final assembly has been done from the part drawing of the parts of the project. In Fig 4.2 an isometric view of the final assembly is shown. All the dimensions shown here are in meter unit.

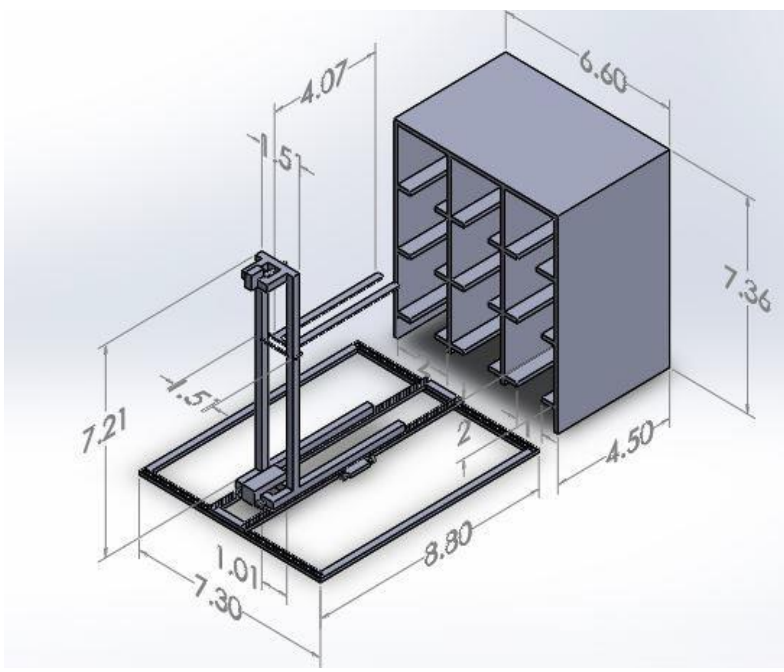

Fig 4.2: view of the final assembly.

4.4 Mass Calculation of the Components:

Using tool measuring command of SolidWorks software from the final assembled CAD design of the forklift parts which have been done according to the assumed dimensions we get,

Volume of the designed Fork, V_{fork} = 0.141732 m^3.

Volume of the designed Frame, V_{frame} = 0.36056 m^3.

So, Mass of the designed Fork, M_{fork} = V_{fork} * Density of stainless steel.

= (0.141732 * 7800) kg.

= 1105.51 kg.

And, Mass of the designed total Frame, M_{fork} = V_{fork} * Density of stainless steel.

= (0.36056 * 7800) kg.

= 2812.37 kg.

4.5 Torque Calculation of the Motors:

Here, factor of safety in all the calculation of torque is taken as 2.

4.5.1 Torque to Lift Up and Down:

Perpendicular distance of C.G. from the Y-axis of forklift stand, r1 = 0.5 * 1.5 m.

= 0.75 m.

Mass to be lifted (in loaded condition), M_{lift} = Mcar + M_{fork} = 2050 + 1105.51 = 3155.51 kg.

Weight to be lifted (in loaded condition), W_{lift} = M_{lift} * g

= (3155.51 * 9.81) N = 30955.55 N.

Frictional force induced due to the weight, Fk = W_{lift} * Dynamic Frictional co-efficient.

= 30955.55 * 0.15 = 4643.33 N.

So, the total torque induced in lifting operation, T_{lift} = (W_{lift} + Fk) * r1.

= (30955.55 + 4643.33) * 0.75 Nm.

= 26699.16 Nm = 26.7 kNm.

Therefore, Designed Torque, T designed = T_{lift} * Factor of safety = (23.57 * 2) kNm.

= 53.4 kNm.

4.5.2 Torque to Move Right and Left:

Perpendicular distance of C.G. from the Y-axis of rail path edge, r2 = 0.5 * 3.8 m = 1.9 m.

Mass to be moved right-left (in loaded condition), $M_{move} = M_{car} + M_{fork} + M_{frame}$.

= (2050 + 1105.51 + 2812.37) kg.

= 5967.87 kg.

Weight to be moved right-left (in loaded condition), $W_{move} = M_{move} * g$.

= 5967.87 * 9.81 N

= 58544.81 N.

Frictional force induced due to the weight, Fk = W_{move} * Dynamic Frictional co-efficient.

= 58544.81 * 0.15 N = 8781.72 N.

So, the total torque induced to move right-left operation, Tmove = (W_{move} + Fk) * r2.

= (58544.81 + 8781.72) * 1.9 Nm.

= 127920.41 Nm = 127.92 kNm.

Therefore, Designed Torque, Tdesigned = T_{move} * Factor of safety.

= (127.92 * 2) kNm = 255.84 kNm.

4.5.3 Torque to Move Forward and Backward:

Perpendicular distance of C.G. from the Y-axis of forklift stand, r3 = 0.5 * 1.5 m.

= 0.75 m.

Mass to be moved forward and backward (in loaded condition),

M_{move} = Mcar + M_{fork} +M_{frame}.

= (2050 + 1105.51 + 2812.37) kg = 5967.87 kg.

Weight to be moved forward and backward (in loaded condition),

$W_{move} = M_{move} * g$.

= 5967.87 * 9.81 N = 58544.81 N.

Frictional force induced due to the weight, Fk = W_{move} * Dynamic Frictional co-efficient.

= 58544.81 * 0.15 N = 8781.72 N.

So, the total torque induced to move backward-forward operation,

T_{move} = (W_{move} + Fk) * r3.

= (58544.81 + 8781.72) * 0.75 Nm.

= 50494.9 Nm = 50.5 kNm.

Therefore, Designed Torque, Tdesigned = Tmove * Factor of safety.

= (50.5 * 2) kNm = 101 kNm.

4.6 RPM Calculation of the Motors:

All the shaft diameter of the motor used here is assumed, d = 0.75 m.

or, r = .375 m.

4.6.1 RPM to Lift Up and Down:

Moment of inertia induced in lifting operation (in loaded condition),

$I_{lift} = M_{lift}$ *(r1)2.

= 3155.51 * (0.75)2.

= 1774.97 kg-m2.

We know, $T_{lift} = I_{lift}$ *angular acceleration.

Angular acceleration = T_{lift} / I_{lift} = 26699.16 / 1774.97 = 15.04 rad/s2.

or, w2r = 15.04

or, w = (15.04 / 0.375)0.5 = 6.33 rad / s.

or, 2πN = 6.33

So, required rpm in lifting, N = 6.33 *(60/2π) rpm = 60.48 rpm ≈ 61 rpm.

4.6.2 RPM to Move Right and Left:

Moment of inertia induced to move left-right (in loaded condition),

$I_{move} = M_{move}$ *(r2)2.

= 5967.87 * (1.9)2.

= 21544.011 kg-m2.

We know, Tmove = I_{move} *angular acceleration.

Angular acceleration = Tmove / I_{move} = 127920.41 / 21544.011 = 5.94 rad/s2.

or, w2r = 5.94

or, w = (5.94 / 0.375)0.5 = 3.98 rad / s.

or, 2πN = 3.98

So, required rpm in moving left-right, N = 3.98 *(60/2π) rpm = 38.006 rpm ≈ 38 rpm.

4.6.3 RPM to Move Forward and Backward:

Moment of inertia induced to move forward-backward (in load condition),

I_{move} = M_{move}*(r3)2.

= 5967.87 * (0.75)2.

= 4475.90 kg-m2.

We know, T_{move} = I_{move} *angular acceleration.

Angular acceleration = T_{move} / I_{move} = 50494.9 / 4475.90 = 11.28 rad/s2.

or, w2r = 11.28

or, w = (11.28 / 0.375)0.5 = 5.48 rad / s.

or, 2πN = 5.48

So, required rpm in moving left-right, N = 5.48 * (60/2π) rpm = 52.33 rpm ≈ 52 rpm.

4.7 Summary of Calculation:

Table 4.1: Summary of calculation

Operation	Induced Torque, T (kNm)	Designed Torque, T (kNm)	Designed rpm of the shaft, N
1. Lifting the car up and down.	26.7	53.4	61
2. Moving the car left and right.	112.92	225.84	38
3. Moving the car forward and backward.	50.5	101	52

CHAPTER 5
EXPERIMENTAL SETUP AND PERFORMANCE TEST

5.1Experimental Setup:

Experimental setup consists of-

- Block Diagram of our project:
- Circuit design of power supply from the battery to motor.
- Final setup of the parts of the project on a wooden surface.

5.2 Block Diagram:

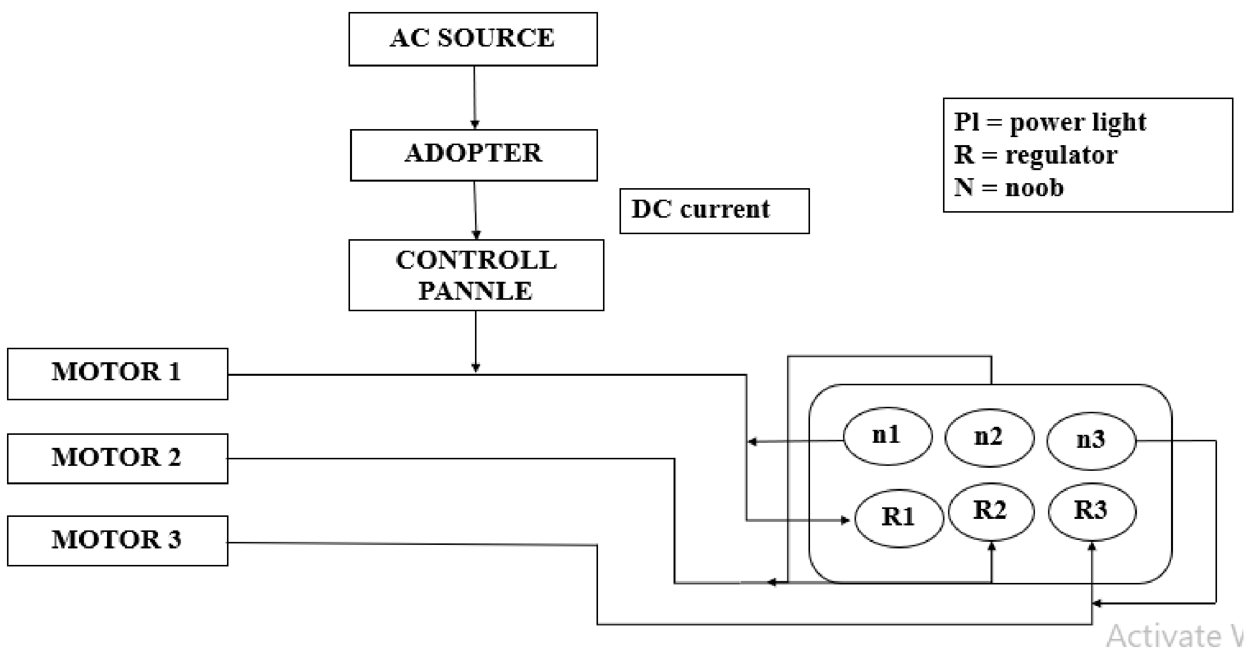

Fig 5.1: BLOCK DIAGRAM

The different levels are accessed through interior forklift system. An automated car parking has mechanized lifts which transport the car to the different levels at a certain position. Therefore, these car parks require less building volume and less ground space and thus being cost effective. This system saves a lot of space where more than 100 cars need to be parked as compared to other systems. This system enables the parking of vehicles, floor after floor and thus will reduce the space used. Here any number of cars can be parked according to the requirement. [8]

5.3 CIRCUIT DIAGRAM:

This section consists of the overall description of the hardware of the Automated Car Parking system and details of the circuits used in the project. It also discusses the mathematical formulas or any other calculations involved in the project.

- A Li-polymer battery of 5-6 volts has been used as the power supply.
- A power switch and two DPDT switch have been used to regulate the motors.
- The DPDT switch is used to invert the connection of the motors with the power switch to rotate the motor both clockwise and anticlockwise.

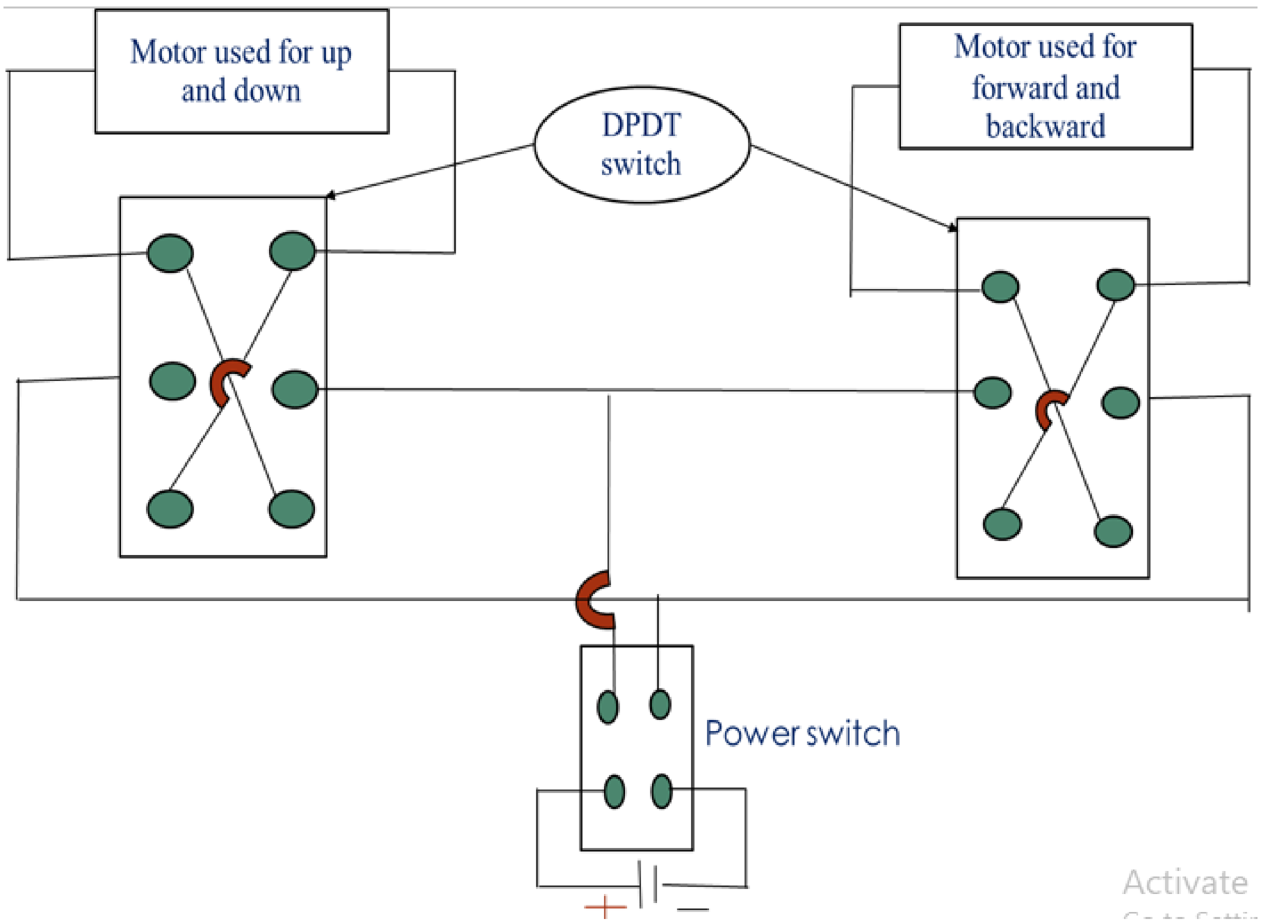

FIG 5.2: CIRCUIT DIAGRAM

5.4 FINAL SETUP:

According to the circuit design shown in Fig 4.10 connection of power supply has been done into the controlling board.

Fig 5.3: FINAL SETUP

Finally, all the components and parts of the project have been mounted on a wooden surface shown in

5.5 Performance Test:

Performance test of the forklift consists of-
The estimation of the maximum load it carries.
Average speed at which it can move in different motion.
Required time for storing and retrieving operation.
Area of the space in the stacker for each car.

5.6 Maximum Load Estimation:

The maximum mass of the Car, Fork, Forklift stand which can easily be lifted by the forklift have been measured by a mass balancing scale. These data are given in Table 4.
Overall maximum load estimations are given below-

Table 5.1: Maximum Load Estimation

Name of part	Mass, m (kg)	Mass $= \frac{m}{Total\ mass} * 100$ (%)	Weight, W (N)
1. Car	0.2	11.43	1.962
2. Fork	0.5	28.57	4.91
3. Forklift stand including two motors	1.05	60	10.3
Total =	1.75	100	17.17

5.7 Average Speed of the Forklift:

To calculate the average speed of the Forklift, time has been calculated using stopwatch for a certain distance. Then, dividing the distance by the time the average speed of the Forklift has been calculated.

Table 5.2: Average speed at no loading condition

Operations	Distance, S (cm)	Time, t (s)	Average speed, V = $\frac{s}{t}$ (cm/s)
1. Lifting up	44	24.41	1.802
2. Falling down	44	24.39	1.804
3. Moving forward when the forks are on base.	17	6.95	2.452
4. Moving backward when the forks are on base.	17	8.07	2.107
5. Moving forward when the forks are on 0.1 m height from the base.	17	6.81	2.496

6. Moving backward when the forks are on 0.1 m height from the base	17	8.23	2.065
7. Moving forward when the forks are on 0.26 m height from the base.	17	6.99	2.432
8. Moving backward when the forks are on 0.26 m height from the base.	17	7.82	2.174

Table 5.3: Average speed at loading condition

Operations	Distance, S (cm)	Time, t (s)	Average speed, V = st (cm/s)
1. Lifting up	44	26.72	1.652
2. Falling down	44	22.94	1.918
3. Moving forward when the forks are on base.	14	6.11	2.292
4. Moving backward when the forks are on base.	14	8.82	2.053
5. Moving forward when the forks are on 0.1 m height from the base. .	14	5.71	2.500
6. Moving backward when the forks are on 0.1 m height from the base	14	7.14	1.961
7. Moving forward when the forks are on 0.26 m height from the base.	14	5.97	2.417
8. Moving backward when the forks are on 0.26 m height from the base.	14	6.35	2.205

Required Time for Storing and Retrieving:

Required time for storing and retrieving operations is estimated using stopwatch typically. The required time to store and retrieve is shown in Table: time required in storing and retrieving operation-

Table 5.4: Required Time for Storing and Retrieving

Operation	Required time (s)
1. Storing the car on first floor	58.20
2. Retrieving the car from first floor	55.35
3. Storing the car on second floor	72.79
4. Retrieving the car from second floor	63.83

Chapter 6
Result & Discussion

6.1 RESULT:

The lifting up-down and moving forward-backward operations have been working properly at the average speed shown in Table 5.2 and Table 5.3. From the tables it is observed that the lifting operation takes more time than that of falling down in case of both load and no-load condition. In case of moving forward takes less time than that of moving backward. On the other hand, the relative time of moving forward while the load is on base is more than while the load is on 0.1 m height from the base. But gradually it decreases with increasing height from the base. Generally, in this parking system the approximate time required to store and retrieving in first and second floor are given in Table 5.4. Besides, the overall capacity of the stacker can be observed from Table 5.5.

6.2 DISCUSSION:

From the following time tabulation, it can be said that there is some variation in time between the storing and retrieving operation. These variation in time is because of the misalignment of the wheel attached to the motor which increases the tendency of increasing the friction as well as decreasing gripping property of the tire used in the wheel. Besides, a tilting effect to on the forklift stand is induced due to the gravity which affects the movement of the forklift. Using lubricating oil this limitation can be reduced effectively. Parking systems should be serviced at least once a year and up to four times a year for high traffic areas or for valet parking. In addition, regular cleaning is mandatory to keep the car parking system in great working order, especially with the problems posed by weather (salt on the road can spread to lifter platforms and cause severe damage if not removed).

6.3 Economical Benefits of Automated Car Parking System

6.3.1 Efficiency:

It is much more efficient to wash clothes using the design and fabrication of car parking than to use the manual car parking. The parking slot whereas each car must be parked individually in the parking slot. It also requires less area when compared to normal parking space. The operator does not need well skilled worker for operate controller. The manual parking is also more comfortable to use than the automated car parking. This leaves traffic free to urban area keeps them out of the harmful effect of car. [8]

6.3.2 Affordability:

A natural location to install a Parking spot is at the public area can park anyone. The urban people already use the parking area and they will be able to understand whole thing that is car parking system share the parking space among the entire community.

6.3.3 Easy to Build and Maintain:

Unlike any of the other alternatives, the car parking uses locally available no. of car. It can be produced in any area that has prevalent packaging technology and things like wood, cast iron and belt. Since the parts are widely available, the parking slot can serve as a basis for local entrepreneurs to start micro enterprises which would stimulate the local economy.

6.3.4 Wastage of time:

As manual car parking systems are not planned properly it takes a lot of time for finding a parking space, parking in and retrieving the vehicles. Insurance premium often heavily influenced by the probability of accidents or other events occurring, using manual car parking system may maximize the potential for property damage, theft, personal injury or death.

6.4 DISADVANTAGES

There are several other disadvantages of manual car parking systems, Such as:

- Need a lot of human effort.
- It is heavy in weight.
- Structure is complex.
- Children can’t use it.
- Normal car parking systems are not sustainable.
- Normal car parking systems sometimes block air and sunlight.
- Normal car parking systems can hardly be recycled.

CHAPTER 7

7.1 CONCLUSION

- This project is based on the way a forklift works. Forklift is used generally in industrial purposes. For the first time the forklift is being used in this project. As the uses of forklift is popular throughout the world, this semi-automated car parking system based on forklift would be an effective and successful way of car parking.

- The multi-level automatic parking system is a good replacement for parking. The design is obviously effective because it can handle more cars in a limited space than other existing designs. The lifting system is also simpler and more economical. This is a versatile project with almost an app All regions, residential or industrial whatever. We want to finish this project as a great and evolving experience. The machine must be made low and easy if it is accepted into the community.

- We recognized this need and designed the machine from scratch keeping in mind the low cost. The machine will only have parts available in urban areas. This simply eliminates the need to order or import components for parking. The machine also uses lifting and regulatory instruments for all precision parts.

7.2 Recommendation:

1. This project is semi-automated i.e. controlled by an attendant. It would be fully automated which would make the system more sophisticated and secured.
2. Installation of the system in underground would also make it possible to minimize more land uses.

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