Design and Development of Ingenious Fifth Wheel Drive System

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A B S T R A C T

In the past, parking required more time and caution from the driver because small spaces needed to be avoided to prevent hitting another car while the car was moving. Due to traffic laws and road congestion, parking is a major issue in large cities. If a driver is inexperienced, this can negatively impact other drivers as well. There is a maximum amount of time required for parking. Before modern parking techniques, drivers also had to exercise greater caution to prevent running into their cars when reversing. Consequently, a parking concept for those who park the quickest is developed to prevent these inconveniences. One more wheel, called the fifth wheel, can be used for this kind of parking. The fifth wheel is landed and raised employing a solenoid valve arrangement and a pneumatic cylinder. The motion of the fifth wheel in both directions is made possible by a DC motor. Being aware of issues that arise when the wheel is being lifted or landed is also beneficial. Four-wheeled vehicles are the primary application for this concept. This arrangement causes the vehicle to quickly turn parallel at a large angle concerning the front axle. In situations where there is not enough room, the model allows the driver to park the car between two other vehicles.

Keywords: Parallel Parking, fifth wheel, steering mechanism, automation, turning radius.

1. Introduction:

In practically every city, parking has become a major issue. The researchers are constantly adjusting the current methods or introducing new ones, like an automated parking system, to find a solution. According to the suggested project concept, the fifth wheel has an additional driving mechanism and is attached to the back of the car. The fifth wheel helps with unpacking the car when it is parked in a parallel parking pattern, which makes moving the car extremely difficult. When the fifth wheel is engaged, the car is raised from the back using the front wheel. Next, the drive is engaged to rotate the fifth wheel, which causes the car to roll either clockwise or counterclockwise. After leaving the parking lot, the fifth wheel disengages once more and returns to its initial position, restoring the vehicle to normal and enabling normal driving. The four wheels of the fifth-wheel drive system that this project developed are typically attached to a metal frame via a motor arrangement that powers the vehicle. Furthermore, a separate drive motor that operates in both clockwise and counterclockwise directions is attached to the rear of the vehicle to attach the spare wheel. A unique linkage mechanism is used to raise and lower the fifth wheel as needed. An external 12 V DC supply powers the entire assembly, allowing each motor to be controlled separately using a remote control system.
provided. Figures and tables should be embedded and not supplied separately.

1.1 *Need for Effective Parking System:*

Everyday population growth also means that there is a growing problem with space. With fewer parking spaces available due to the growing number of vehicles in metropolitan areas, parallel parking—which

involves parking cars in a line—is the recommended solution to this problem. The fewer issues a car has, the more sequentially you park the cars. The incompetent driver's inability to parallel park the car in a shorter amount of time is another issue. This driver runs the risk of colliding with the front-side vehicle's rear-end vehicle. When parking in parallel without a mechanism, the vehicle must occupy twice its length of space for the back and front to fit inside the parked position. Fuel waste occurs during parking because it takes longer, which is another issue with the car. Thus, there are significant issues with improper parking, insufficient space, fuel consumption, and time consumption. According to the results of several studies comparing crash and unintentional experiences, parallel parking has crash rates that are 19–71% lower than angle parking. A different mechanism is used to park the car parallelly without risk or effort to avoid all of these issues. To perform parallel parking, a fifth wheel will be added to the back of the car, and various assemblies will be used to drive and raise the car on that side. Certain studies provide a quick overview of the parking mechanism by adjusting the steering mechanism, while other studies provide a brief overview of the parking mechanism by utilizing a sensor and controller.

1.3 Problem Statement, Scope, and Objectives of the Project Work:

The parking structure in cars is difficult to use and takes a long time. When parking, the car must be more cautious to avoid running into the other vehicle when reversing. Thus, fifth-wheel parking is introduced as a way to prevent this. The goal of this proposed project is to create a conceptual model of a fifth-wheeled vehicle that satisfies the following requirements:

1. Simply park and unpark your car using the parallel parking system.
2. to find a solution to the parking issue in metropolitan areas.
3. Reduce time spent parking by using a reliable and secure system.

As a result, through the project work, we offer a creative solution to the parallel parking system that uses the vehicle's fifth wheel to help park and remove the car from the parking array. It also offers long-term fixes for the parking issue that the globe is currently experiencing.

2. 2. Brief Literature Review:

Vaibhav Channewadkar, Ninad Vaidya, and Dhaval Shah presented the “Fifth Wheel Drive System,” describing that in earlier methods of parking, the time taken was 2 minutes, and the driver needed to be more alert while parking to avoid hitting the car during the reverse motion. Therefore, to avoid these inconveniences, a concept of parallel parking is proposed, where the total time will be 50 to 60 seconds. This parking can be done using an additional wheel called the fifth wheel. This concept is mainly used for four-wheeled vehicles. This setup makes the vehicle turn parallel at a significant angle regarding the front axle within a short time. The model enables the driver to park the vehicle between two vehicles, where the space is limited and concluded that it is very useful for a driver while driving the vehicle and parking the vehicle. [1]

Mr. Paresh G. Chaudhary, Mr. Sanket R. Avhad, Mr. Omkar P. Dharpale, Mr. Ganesh R. Dhumal, and Mr. Akshay R. Dhende presented “Auxiliary Drive Wheel Vehicle Parking Mechanism, describing that parking is a big problem in big cities due to congestion of roads and traffic regulation, and if it is an unskilled driver, it will be a big problem for other drivers. Also, maximum time is needed for parking. Therefore, to avoid these inconveniences, a concept of parking is developed for taking the least time to park, and this system aims to fold the auxiliary wheel for better adaptability and also place it in boot space. This parking can be done using an additional wheel (an auxiliary drive); most likely, this will be a stepney wheel. This prototype was found to be able to be maneuvered very easily in tight spaces, making 360-degree steering possible. [2]

Dr. P. Mohammad Ali, A. Sarath, S. Satheesh Kumar, and P. Yuvaraj presented “Design and Fabrication of a 360-Degree Rotating Vehicle” and described that the project is about a 360-degree

rotating vehicle. This vehicle moves in all directions. This makes the vehicle suitable for operation on narrow paths and sharp corners. Normal-wheel vehicles face a lot of problems like parking, U-turns, and much more, which consume more time. So, a 360-degree wheel-rotating vehicle is designed to reduce and eliminate problems that occur when handling material in industries. In this system, each of the four wheels has a stepper motor, so it can rotate 360 degrees. Consequently, we can utilize this 360-degree rotating vehicle for various purposes, like transporting things in overwhelming bags and vehicles, which will help in decreasing rush hour gridlock and spare time. Concluded that the proposed system uses advantages such as low cost, labor, energy, and materials to improve quality, accuracy, and precision, along with easy maintenance. [3]

Mohamed Ajmal Mahasin M, Bharath V, Gowtham P, Karthikeyan E, and Maheswaran N presented "Fabrication of Parallel Car Parking System Using 5th Wheel (Motorized)," describing that in earlier methods of parking, the time taken was approximately 2 minutes to park the vehicle. The driver needs to be more alert while parking to avoid hitting the card during the reverse motion. The unskilled drivers are not able to park the vehicle perfectly. To avoid these inconveniences, a concept of parallel parking is proposed, where the total time will be 50 to 60 seconds. This parking can be done using an additional wheel (the fifth wheel). This concept is mainly used for four-wheeler vehicles and trucks. This setup makes the vehicle turn parallel at a significant angle regarding the front axle within a short period. The model enables the driver to park the vehicle between two vehicles, where space is limited. [4]

Sudip Kachhia presented "Design of a 360-Degree Rotating Car," describing that the main function of a car is to move from one place to another. The car provides a lot of benefits, like protecting us from the sun in the summer and from the rain in the monsoon. Traveling is an inevitable part of a person's life. Cars are the most common thing in today's world. Having a car is a status in society, but having a costly car is a royal status in society. With an increase in several vehicles, people have to face traffic problems like parking, taking the reverse, etc. These problems can be efficiently reduced and eliminated by the use of this application. It operates in a clockwise and anticlockwise direction. A primary objective of the present invention is to provide simple, stable, easy control, smaller space needed, and a more concise movement of the car. It has been concluded that vehicles are allowed to guide in all directions. [5]

Yogendra Kumar, Chandana Yadav, Priya Jatav, Karunakar Singh, and Manisha Singh Chauhan presented "360 Degree Rotating Wheel Vehicle," describing that replacing two-wheel drives with four-wheel drives makes it more advantageous for the vehicle to proceed. Traditional controlling includes either the Ackerman or Davis directing framework, which has the significant weakness that it can't take the least sweep turn. Attempt to take care of the issue of turning span with the new idea of zero-turning vehicles with mechanical linkages and automatic shifting. The primary reason for this venture is to lessen the turning sweep and turning space by pivoting at the same spot without leaving its focal point of gravity. In this framework, the wheels associated with the front axles are inversely related to each other, as are the wheels associated with the back hub. The wheels on the left half of the vehicle pivot in one bearing, and the ones on the right 50% of the vehicle. [6]

Priyadarshini R. et al. did the work on parallel parking of cars using the fifth wheel. According to his study, parallel parking is the method of parking the vehicle parallel between the two vehicles while keeping a safe distance. They developed a system by introducing a fifth wheel on the rear side of the vehicle. The pneumatic system is used as a jack to lower the wheel and lift the vehicle from the rear side. The prime mover is used to provide power to the fifth wheel, and forward and reversed rotation is also done by the motor. Firstly, the driver places the vehicle at an angle from the front. As soon as the driver pushes the button, the wheel goes downward, and the vehicle is lifted from the rear. The prime mover gives the rotation to the wheel as per the requirement (forward or reverse), and the vehicle parks in

between the vehicles. For this system, they implement a digital display to indicate the status of the fifth wheel. Priyadarshini R. et al. did the work on parallel parking of cars using the fifth wheel. For this system, they implement a digital display to indicate the status of the fifth wheel. [7]

2.1 Inferences from Previous Literature Review:

Numerous solutions to parking issues in urban areas and parking in small spaces are provided by the current literature review. Below is a list of the different approaches that have been discussed in various studies:

[1] This system uses two distinct mechanisms to implement the fifth wheel on the back side of the vehicle. A set of triangular hubs, racks, and pinions is used in the second mechanism to raise the vehicle after the wheel comes into contact with the road. In the first mechanism, the vehicle is lifted directly using hydraulic and pneumatic systems for turning.

[2] Reducing the turning radius of the vehicle by altering its steering mechanism can be done in two ways. In the first, the vehicle is parked by rotating only its front two wheels at 900, and in the second, the vehicle is rotated at the designated location with all four wheels rotating at 900 (zero drift concept).

[3] An additional four wheels that are perpendicular to the vehicle's longitudinal axis can also be used to solve this issue. An actuator on the auxiliary wheels raises and parks the car.

[4] Using GPS systems, self-organizing fuzzy logic controllers, controllers, and ultrasonic sensors is an additional method. This system recognizes the vehicle's coordinates and an available parking spot, allowing the vehicle to be automatically parked.

3. System Modeling:

The mechanism employed in this project makes use of chain drives, triangular pivots, and rack and pinion systems. If necessary, chains and sprockets working with the electrical motor can help move the fifth wheel after the rack and pinion mechanism start the motion transfer process and transfer it to a triangular pivot. This invention usually has to do with cars. The current invention poses a significant challenge to vehicle maneuverability in restricted areas. a retractable assembly for furniture that automatically retracts in cars. When activated, it pushes the associated auxiliary wheel into a parking space or other restricted area. Develop a system to display the vehicle's base frame at all angles, from zero to 360. To drive the vehicle model, a DC motor is utilized. Motor power can be transferred to the vehicle axle through chain and sprocket or DC motor arrangements. In the perpendicular plane of the four wheels, we will add a drive wheel to the back side. When folding an auxiliary drive wheel, a triangle pivot principle is employed. One side of the triangle hub will be forced by the rack and pinion. The fifth wheel will be raised by the other side of the triangle because of its pivot point at the top. At the pinion will be a DC motor for the rack's actuation. Therefore, the liner actuator (Rack and Pinion) had to have unfolded the fifth wheel axel whenever it was necessary. While parallel parking, the fifth wheel engages, and the remaining two rear wheels are lifted off the ground. When driving normally, the vehicle will move on its normal four wheels.

DC Motor:

Any member of the class of rotary electrical motors that transforms direct current electrical energy into mechanical energy is known as a DC-geared motor (12 V, 3 AMP, 60 RPM, 6 Nos.). The most widely used kinds depend on the forces generated by magnetic fields. Almost all varieties of DC motors have an internal mechanism—electromechanical or electronic—that allows the motor's portion of the current

to be periodically reversed. The motor mountings consist of right-angled bent metallic frames with multiple mounting holes to attach the mounting to the body. To facilitate the motor shaft, it also features a large diameter hole.

Photograph 1: DC Motor & Mounting

Nylon Wheels:

The wheels are provided to propel the vehicle and to give a firm grip between the road surface and the wheel. It has a frictional surface created by a rubber covering around the periphery of its nylon construction (72 mm outer diameter, 6 mm shaft diameter, 5 nos.). Additionally, a fifth-wheel drive motor is included to rotate and raise the vehicle body so that the entire vehicle can be turned clockwise or counterclockwise. This requires enough friction in the wheel, which is why these particular wheels are included. Picture 3.3 displays the nylon wheel.

Photograph 2: Nylon Wheels and DC Adapter Power Supply

Power Supply:

AC adapters (210-230 V AC, 0.8 Amp, 12 V DC, 2 Amp, 1 No.) are used with electrical devices that require power but do not contain internal components to derive the required voltage and power from mains power. The internal circuitry of an external power supply is very similar to the design that would be used for a built-in or internal supply. External power supplies are used both with equipment with no other source of power and with battery-powered equipment, where the supply, when plugged in, can sometimes charge the battery in addition to powering the equipment. The use of an external power supply allows the portability of equipment powered either by mains or batteries without the added bulk of internal power components and makes it unnecessary to produce equipment for use only with a specified power source; the same device can be powered from 120 VAC or 230 VAC mains, a vehicle or an aircraft battery by using a different adapter.

DPDT Switch and connecting wires:

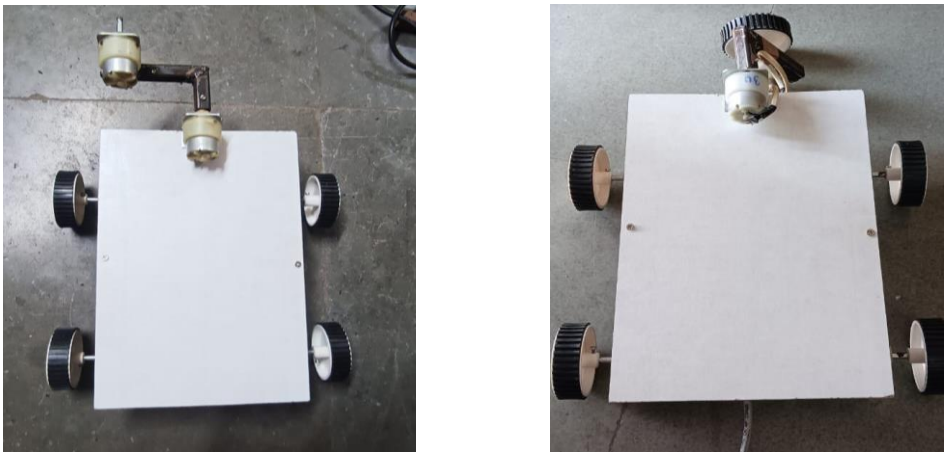
Double-pole, double-throw, or DPDT switches are electromechanical switches that are created by extending the SPDT switch's pole. This requires no nuts, bolts, or screws to install because it comes with a locking system that allows you to lock and unlock the switch in a distant cabinet directly. This switch is very useful for reversing the applied voltage's polarity (12 V DC, 20 Amp, 3 Nos.). In situations where we need different outputs, it is used. This switch has three states: ON, OFF, and ON. The two ON states differ primarily in their polarity, which is opposite from one another.

Photograph 3: The DPDT switch and Connecting Wires

Since electricity requires a medium to flow through, connecting wires (single-core 0.1 sq m copper wire, 12 V DC, 16 Amp, 1 m quantity) enable an electrical current to move from one point on a circuit to another. Aluminum or copper make up the majority of the connecting wires.

4. Working of Fifth Wheel Drive System:

The fifth wheel, which is an additional wheel, is used by the fifth-wheel drive system to raise and lower the car from the rear end onto the front wheel. It is very difficult to move a car that is parked in a parallel parking system; doing so requires more than 20 times the vehicle's to-and-from motion, which is a laborious task. The proposed project model includes a fifth wheel with a separate drive motor attached to the linkage mechanism that is also powered by a DC motor, in addition to the vehicle's four conventional drive wheels.



Photograph 4: Actual Model of 5th Wheel Steering Drive System

When a car gets stuck in the parking system, the electric current supplied to the motor mounted on the car's chassis turns the linkage, lowering it until the fifth wheel raises the car onto its front wheels. To remove the vehicle from the parking array, the fifth wheel motor is allowed to run the wheel while the vehicle is being lifted from the rear side. The linkage motor is then stopped by flipping the switch. Upon raising and exiting the parking array, the vehicle is lowered and returns to its standard position. The fifth wheel is then permitted to return to its initial position by turning the linkage motor in the opposite direction. To remove the vehicle from the parking array, the fifth wheel motor is allowed to run the wheel while the vehicle is being lifted from the rear side. The linkage motor is then stopped by flipping the switch. Following the vehicle's lift and exit from the parking array, the fifth wheel is once more

permitted to return to its initial position by turning the linkage motor in the opposite direction, at which point the vehicle is lowered and resumes its original position.

5. Testing of Fith Wheel Drive System:

Any design and manufacturing process should include testing as a standard practice. Ensuring safety is essential, whether it is clarifying the characteristics of materials or offering proof for completed goods. A cost-effective design, technological advancement, and superiority are all dependent on testing. A DC motor is used to move the fifth wheel forward or backward. The fifth wheel is raised after the car is parked correctly aligned. The status of the procedure is simultaneously shown to the driver on the dashboard display. When there is a three-wheel malfunction, this will assist in diagnosing the issue. The vehicle model is propelled by a DC motor. An arrangement of a DC can transfer power from the motor to the axle of the vehicle. An additional drive wheel on the perpendicular plane of the four wheels will be installed on the backside. An auxiliary drive wheel is folded using a triangular pivot principle. It will exert force on one side of the triangular hub. Thus, the fifth wheel axel must be unfolded by a liner actuator whenever necessary. The car will move on its regular four wheels when driving normally, but when parking in parallel, the fifth wheel engages and the other two rear wheels are off the ground.

6. Conclusions:

The fifth-wheel attachment to the vehicle allows the vehicle to be easily parked and removed from the parallel parking arrangement, or it can be parked in a very small space where there is no need for the vehicle to be in motion, as our capstone project on a fifth-wheel drive system found. Furthermore, any driver can effortlessly engage the fifth wheel and turn the car; therefore, no advanced driving knowledge is needed to get the car out of the parking array. This is another benefit of the fifth-wheel drive system. A more affordable parking system is the goal of this project report on the Fifth Wheel Car Parking Mechanism. When parking in a busy area, defines time savings. Using the linkage mechanism to raise and lower the vehicle, the capstone project model on the fifth-wheel drive system operates flawlessly. Additionally, the vehicle's fifth wheel functions satisfactorily to turn it either clockwise or counterclockwise. Depending on how the wire is connected, the four wheels efficiently propel the car forward or backward. It has been noted that when all motors are permitted to run simultaneously, the power supply that is supplied occasionally becomes suitable. The project model can be fixed by giving it a high-ampere power supply, but doing so could raise project costs. The mechanism effectively resolves the parallel parking problems. The lifting mechanism of this project is simple and can be installed on any of the vehicles. There is no need for professional drivers to unpark the car from the parallel parking system. Besides these, the system added extra cost to the vehicle as the extra drive system is to be added to drive the fifth wheel. When the car gets stuck in the same system, the fifth-wheel drive system is utilized to fix the parallel parking issue. Any car can have the system installed for better parking and unparking.

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