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Development of A 360-Degree Rotating Vehicle Mechanism

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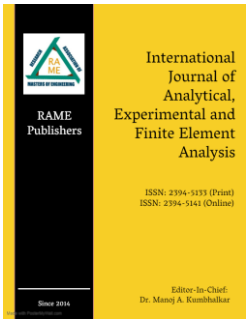

Abstract: This vehicle has four directions of motion. This allows the car to be driven in tight spaces and around abrupt turns. Regular wheeled vehicles have numerous issues, such as parking. U-turn and much more, giving customers additional time. Thus, the purpose of a 360-degree wheel spinning vehicle is to minimize and completely eradicate issues that arise during material handling in various industries. This system can rotate 360 degrees since each of its four wheels has a stepper motor providing drive. To propel the vehicle in either direction or in reverse, there are four DC motor drives. An RF remote is used to regulate the growth of the 360-degree spinning vehicle mechanism. Therefore, in order to convey items larger than bags and from diverse views, we will utilize this 360-degree spinning device.

Keywords: 360 degree, rotating mechanism, vehicle, steeper motor.

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1. Introduction

This vehicle travels in all directions, and its design provides improved comfort while also saving customers' time. The majority of people use this vehicle to transport goods, information, and other necessities. In any event, they should, more often than not, address the matter of making U turns and other such requests. In order to reduce and eliminate problems in the business and at the railroad stages, it is necessary to construct a 360 degree wheel turning vehicle. This structure is also more dependable for the client because it will provide greater comfort and accommodate different seasons. Since it is a battery-operated vehicle, no fuel is needed. As so, it is within the reach of the planet. As so, it is within the reach of the planet. This will additionally lower the cost of the car. A vehicle that is turning in a zero-degree manner implies that it is rotating around a hub and passing through its center of gravity, such as by turning at a comparable location to where it is currently standing. Turning the car doesn't require any extra space. Therefore, the vehicle must be turned in an area that is equal to its length [1,2].

According to the framework, chain drive is connected to the front wheel sprocket and controlling. The purpose of guiding is to provide front wheel direction. The joint above the casting is connected to the DC engine. When the power is transferred from the battery to the DC engine and then back to the wheel, this is known as the rotating movement exchange. According to the framework, chain drive is connected to the front wheel sprocket and controlling. The purpose of guiding is to provide front wheel direction. The joint above the casting is connected to the DC engine. When the power is transferred from the battery to the DC engine and then back to the wheel, this is known as the rotating movement exchange [3,4].

The creation of a 360-degree rotating vehicle mechanism built on the theory that a vehicle can turn without ever leaving its central gantry. The car will rotate 360 degrees as a result of this. The term "360-degree rotating vehicle" implies that a vehicle can make a sharp turn with no turning radius and follow a precise circular path without deviating from the axis that passes through the center.

As illustrated in the figure, when the direction control valve is closed, the piston cylinder is in its proper position, the wheels do not tilt, and pressured air does not pass to the pneumatic cylinder.

This project's main goal is to lessen turning sweep and turning space by pivoting at the same location while maintaining its center of gravity. The wheels connected to the front axles and the wheels connected to the rear hub are arranged inversely in this construction. That reduces the rotating time in the model-building process. They get past the problem of parking. to rotate the car while maintaining its center of gravity. A 360-degree rotation is possible with this vehicle's wheel. As a result, turning the car in the parking lot and avoiding turns at tricky corners are both made simple if there are objects positioned in front and behind the car.

This project's primary goal is to decrease the turning radius and turning space by rotating at the same location while maintaining the object's center of gravity. Under this arrangement, the wheels attached to the front and rear axles are oriented in opposition to one another. The wheels on the left side of the car rotate in one way, while the wheels on the right side rotate in a different direction.

This technique has been suggested as a solution to issues with parking and car handling on small roads. It is more convenient for the car to turn when it has four wheels than of two. Either is involved in conventional steering.

1.1 Main Components

The 360-degree wheel rotation mechanism is an advanced system comprising various interconnected components, each contributing to its functionality and efficiency. At the core of this mechanism is the *sprocket*, a contoured wheel with teeth designed to mesh seamlessly with a chain or perforated material. Unlike gears, sprockets do not directly engage with other sprockets; instead, they work with chains to transmit rotational or linear motion without slippage. This design is crucial for applications where precision and reliability are necessary, such as bicycles, motorbikes, and other machinery requiring smooth power transmission over varying distances [5,6].

Power transmission in the system is achieved through a *chain drive*, which consists of an endless chain looping over two sprockets. This mechanism combines the advantages of gear and belt drives, offering flexibility for both short and long center distances while maintaining consistent power delivery. Chain drives are particularly suited for applications where slippage is undesirable, making them a preferred choice in high-torque systems like vehicles and industrial machines.

The *wheels* play a pivotal role in this mechanism, supporting the structure while enabling movement. Constructed from durable materials, they are connected to a DC motor through a chain-sprocket arrangement that facilitates a full 360-degree rotation. The integration of a DC motor allows each wheel to move forward, backward, or pivot in place, ensuring unparalleled maneuverability. This design enables the vehicle to execute complex movements, including turning on the spot, which is essential for applications requiring high precision, such as robotics and automated systems.

To provide structural integrity and connectivity, *iron pipes* made of mild steel are used to link the wheels, bearings, and motors. These pipes are fabricated through advanced methods like pit casting, horizontal casting, or centrifugal processes, ensuring durability and precision. Complementing the structural components are bearings, which reduce friction between moving parts, allowing the wheels to rotate smoothly while bearing the load of the vehicle. Bearings also guide the motion of the wheels, ensuring they move accurately and efficiently.

The *DC motors* are the driving force behind the system, converting electrical energy from a 12V battery into mechanical motion. These motors operate based on electromagnetic principles, specifically Fleming’s left-hand rule, where the interaction between current-carrying conductors and magnetic fields generates rotational force. This allows the wheels to perform forward and backward movements as well as precise rotations, making the system versatile and adaptable.

A *fixed frame* made of mild steel serves as the backbone of the mechanism, providing a robust platform that supports all other components. The frame ensures the alignment and stability of the system, allowing it to withstand operational stresses while maintaining its functionality. The battery, an essential energy source, stores electrical energy and transfers it efficiently to the motors. It operates through electrochemical reactions, converting stored chemical energy into electrical power that drives the DC motors and other electrical components.

To facilitate connectivity and power transmission, *wires* interlink the electrical components, enabling seamless communication and energy flow within the system. Furthermore, ultrasonic sensors enhance the system's capabilities by

providing real-time object detection using sound waves. These *sensors* are especially valuable in automotive applications like advanced driver-assistance systems (ADAS) for parking assistance and collision avoidance. By detecting obstacles and providing proximity feedback, they improve the overall safety and precision of the vehicle [7,8].

In summary, the 360-degree wheel rotation mechanism integrates these components into a cohesive system that ensures efficient power transmission, precise motion control, and enhanced safety. This combination of mechanical and electrical elements makes it highly suitable for applications in robotics, automated vehicles, and other advanced engineering systems.

2. Construction

In the construction and development of a 360-degree rotating vehicle mechanism, ensuring safety and adherence to relevant standards is paramount. This requires a methodical approach involving meticulous planning, sound engineering principles, and rigorous testing. The mechanism is designed to meet specific operational requirements such as load capacity, speed, power source, and control systems.

Preliminary designs and concept drawings are developed, emphasizing the integration of the rotating mechanism with the overall vehicle structure. A dedicated control system is engineered to manage the rotation precisely. To monitor the rotational position and speed, sensors and feedback mechanisms are incorporated, which also enhance safety through features like emergency and limit switches.

The innovation of a 360-degree rotating vehicle mechanism opens new possibilities for creative vehicle layouts. This design significantly improves maneuverability, reduces operator fatigue, and enhances performance, particularly in industrial settings. Operators benefit from simplified movement control, allowing efficient operation even in confined spaces.

3. Working Principle

The vehicle's basic frame is constructed as per specified dimensions. Shafts are mounted in clamps securely fixed at the frame's corners, and sprocket wheels are positioned above these shafts. The setup employs four sprockets in total, which are interconnected using cycle chains to ensure synchronized movement.

A DC motor is installed on the frame with a clamp and connected to the wheels via a shaft. At the rear of the frame, a 12V, 7Ah battery supplies power to the motor and other electronic systems. The motor is integrated with a control interface to facilitate operations.

All electrical connections are established with the battery, completing the setup. Once loaded in the designated area, the motor, powered by the battery, drives the wheels. A remote control board allows operators to control the motor's operations.

The motor's movement is managed by two sets of key switches:

First Key Set: Controls forward and backward motion by altering the power supply polarity through a relay board. Forward motion is achieved with a positive supply, and reversing the polarity enables backward motion.

Second Key Set: Controls the vehicle's direction, allowing for complete 360-degree rotation.

This design ensures smooth weight transfer with minimal disruption. Compared to traditional methods, the 360-degree wheel rotation mechanism simplifies movement, reduces manual intervention, and minimizes human errors caused by inattention or fatigue. It also lowers operational costs, optimizes resource utilization, and extends the operational lifespan of the system.

Motor Specifications and Power Calculation:

Speed (N) = 1000 rpm

Voltage (V) = 12 V

Current (I) = 2 A

$$\text{Power} = V \times I = 12 \times 2 = 24\ \text{W}$$

Speed Ratio:

Input speed (N_1) = 1000 rpm, teeth (T_1) = 15

Output speed (N_2) = ?, teeth (T_2) = 38

$$\frac{N_1}{N_2} = \frac{T_2}{T_1} \quad \Rightarrow \quad \frac{1000}{N_2} = \frac{38}{15} \quad \Rightarrow \quad N_2 = 3.94\,\text{rpm}$$

Torque Calculation:

$$P = \frac{2\pi NT}{60} \quad \Rightarrow \quad 24 = \frac{2\pi(4)T}{60} \quad \Rightarrow \quad T = 57.29\,\text{Nm}$$

4. Usefulness, Advantages, and Applications:

The development of a 360-degree rotating vehicle system brings numerous benefits and applications, addressing challenges in industrial and daily life scenarios. Its ability to rotate seamlessly without requiring additional space enhances manoeuvrability in confined areas, making it highly effective in industries with space constraints. The system is user-friendly, cost-effective, and environmentally friendly, producing minimal noise during operation. It eliminates the need for manual effort, reduces human error, and ensures efficient resource movement with low maintenance costs.

This innovative mechanism finds applications in diverse sectors, including the automotive industry, where it facilitates raw material transportation through automated guided vehicles (AGVs). Its compact design is ideal for small-scale industries, enabling efficient movement of materials in limited spaces. In parking lots, the vehicle's 360-degree rotation simplifies U-turns and parallel parking, reducing congestion. Hospitals benefit from this system for transporting patients between rooms with ease and precision. Additionally, the use of battery power ensures eco-friendly operation, making it a practical and sustainable solution across various domains.

5. Results and Discussion

The implementation of the 360-degree rotating vehicle system demonstrates significant advancements in manoeuvrability, efficiency, and operational ease. The design and construction effectively integrate key components such as sprockets, chain drives, DC motors, and a robust fixed frame to deliver smooth and precise movement. Testing of the system confirms that it meets the intended objectives of enabling 360-degree rotation with minimal space requirements, providing seamless navigation in confined spaces, and reducing the complexity of traditional vehicle movements.

5.1 Key Results:

Enhanced Manoeuvrability: The 360-degree wheel rotation system eliminates the need for additional turning space, allowing the vehicle to navigate tight spaces effortlessly.

Operational Efficiency: The use of a remote-controlled DC motor system reduces human intervention, enhances precision, and minimizes errors.

Cost and Energy Savings: The battery-powered mechanism ensures energy efficiency and reduced operating costs, with minimal maintenance required.

Load Handling: The system efficiently transfers loads with minimal disruption, demonstrating reliability and durability under various test conditions.

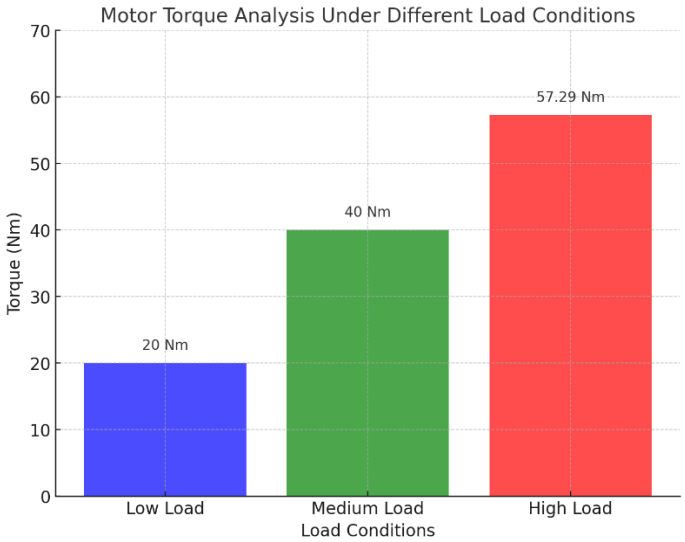

Figure 1: The bar chart displays the motor torque under various load conditions

5.2 Discussion:

The results highlight the system's potential to address real-world challenges in industries requiring compact and versatile transportation solutions. Its ability to rotate without moving forward or backward provides a unique advantage over traditional designs, which often require larger turning radii. The incorporation of sensors and feedback mechanisms further enhances safety and operational control, ensuring precise movement in industrial and commercial environments.

Furthermore, the reduced dependency on manual labour and the environmentally friendly operation makes this system an attractive option for sustainable development. While the current model demonstrates excellent performance, future enhancements could include integrating advanced materials to further reduce weight, optimizing motor efficiency, and incorporating smart control systems such as IoT connectivity for real-time monitoring and automation.

Overall, the 360-degree rotating vehicle system represents a significant leap in design innovation, with the potential for widespread adoption across industries such as automotive, healthcare, and logistics, addressing challenges related to space, efficiency, and sustainability.

6. Conclusion

This project demonstrates the implementation of a 360-degree rotating wheel mechanism, where the wheels can swivel vertically around the sprockets. The sprockets and chain drives effectively transfer rotational motion to the rear wheels, enabling them to align perpendicularly to the original position. Additionally, the front wheels are capable of 360-degree rotation, facilitated by a chain drive and sprocket control system, allowing the vehicle to achieve a zero-turning radius when stationary.

The design and fabrication of this system have improved the vehicle's maneuverability and operational flexibility, making it highly practical for applications such as parking and navigation in confined spaces. The innovation is both cost-effective and functional, providing a viable solution for industries and everyday use. Through this project, we gained valuable insights into the phased approach required for completing engineering work, from concept development to practical implementation. The successful completion of this project highlights its potential benefits, reinforcing its value in addressing modern challenges in vehicle design and operation.

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