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Simplified Model on Principle of 360 Degree Rotational Vehicle

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ABSTRACT: This paper explores a simplified theoretical model underlying the design and operation of a 360-degree rotational vehicle, focusing on its mechanical structure, motion dynamics, and control principles. The model is primarily centered around the use of omnidirectional wheel systems—such as Mecanum wheels or omni-wheels—that allow the vehicle to move in any direction and rotate around its center without the need for traditional steering mechanisms. Each wheel is independently powered and controlled, enabling precise vector-based movement including lateral shifts, diagonal paths, and full rotational spins on the spot. The integration of a centralized control algorithm allows for the real-time coordination of wheel velocities and orientations, facilitating smooth, responsive navigation. This design greatly enhances maneuverability, especially in constrained or complex environments such as warehouses, urban streets, and robotic platforms. The proposed model also considers factors such as friction, load distribution, and energy efficiency to ensure practical implementation. This study contributes to the ongoing development of agile, compact, and highly mobile vehicle systems with potential applications in robotics, autonomous vehicles, industrial automation, and smart transportation.

KEYWORDS: Omnidirectional Wheels, Kinematics, Degree of Freedom (DoF).

I. INTRODUCTION

The layout of the vehicle chassis is another critical consideration. The vehicle's frame typically needs to be rigid yet lightweight to support the system and provide stability. A common design approach is to use a four-wheel layout, with wheels placed at the four corners of a square or rectangular chassis. However, some designs opt for a three-wheel configuration, where the wheels are arranged in a triangular pattern for more compact designs. In either case, the position and alignment of each wheel are key factors that ensure the vehicle can perform rotational movements and translation with precision.

The vehicle's layout also includes motor drivers and controllers that manage the independent control of each wheel's speed and direction. These components communicate with the vehicle's central control unit, usually a microcontroller or embedded system, which coordinates the motions of the individual wheels to achieve smooth and accurate movement.

At the heart of the layout are omnidirectional wheels, which play a pivotal role in enabling 360-degree movement. These wheels are typically mounted at specific angles (often 45° for Mecanum wheels or 90° for omni-wheels) and are connected to individual motors. This unique wheel design eliminates the need for traditional steering mechanisms, allowing the vehicle to navigate smoothly in multiple directions with minimal friction and without altering the vehicle's orientation.

360 DEGREE ROTATIONAL VEHICLE

The layout of a 360-degree rotational vehicle is a critical aspect that defines its ability to move freely in all directions and rotate on the spot. Unlike traditional vehicles that rely on steering systems, the key to this vehicle's versatility lies in its wheel arrangement and the independent control of each wheel. The vehicle's layout is designed to allow each wheel to rotate in a manner that facilitates omnidirectional movement, enabling it to move forward, backward, sideways, and even pivot in place without altering the direction of the vehicle body.

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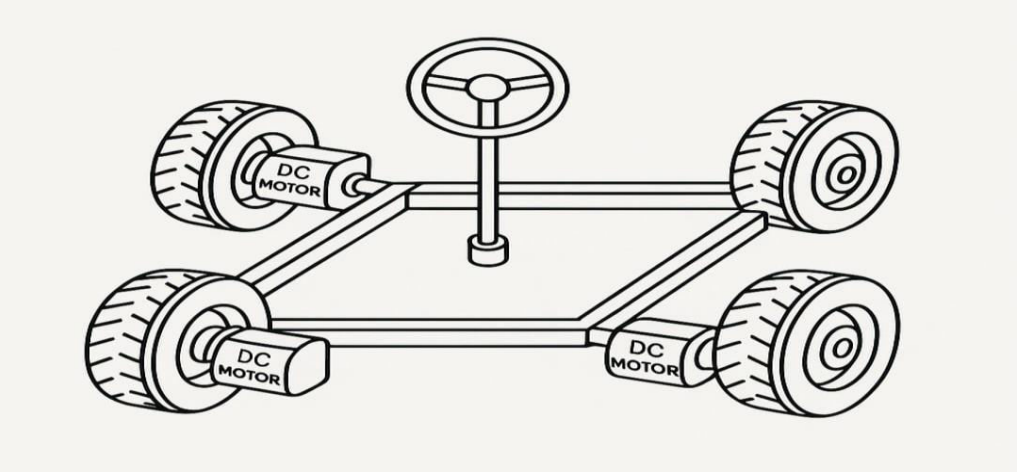

Fig 1. Introduction of vehicle layout.

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II. WORKING SETUP OF 360 DEGREE ROTATIONAL VEHICLE

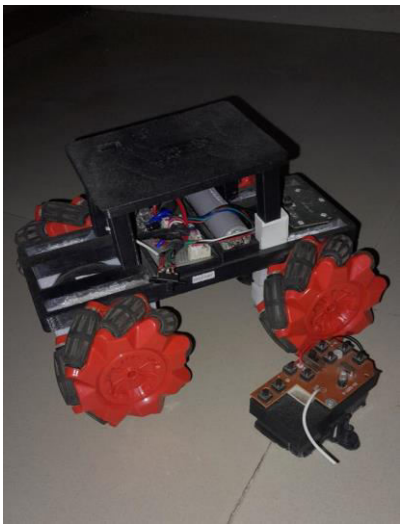

Fig. 2. Working model of 360 degree rotational vehicle.

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III. MATERIAL AND COMPONENTS USED IN REFRIGERATION SYSTEM MODEL

A 360-degree rotational vehicle requires a variety of specialized materials and components that are crucial to its performance and functionality. At the heart of the vehicle's design are the omnidirectional wheels, which enable the vehicle to move in any direction and rotate on the spot. These wheels are typically constructed from durable materials like rubber and plastic, with some models incorporating lightweight aluminum for additional strength. The most commonly used types of omnidirectional wheels are Mecanum wheels and omni-wheels. Mecanum wheels have rollers mounted at a 45-degree angle, which allows them to move the vehicle in multiple directions by varying the speed and direction of each wheel. On the other hand, omni-wheels have rollers positioned at 90-degree intervals, providing similar functionality. The precise alignment of these rollers is crucial to achieving smooth, multidirectional movement with minimal friction.

The next essential component is the motor, which drives each of the wheels independently. DC motors are often used due to their simplicity, reliability, and ease of control. They provide the necessary torque and speed for the vehicle to move smoothly in any direction. Stepper motors are another option, offering greater precision for controlling wheel rotations incrementally. In more advanced systems, brushless DC motors might be used for higher efficiency and smoother operation. These motors are connected to motor drivers, which control the speed and direction of the motors based on signals from the central control.

IV. APPLICATIONS OF 360 DEGREE ROTATIONAL VEHICLE

360 degree rotational vehicles, with their unique ability to move in direction without the need for traditional steering, have a wide range of applications across various industries. One of the most notable uses is in robotics, where these vehicles are used as mobile platform for service robots, drones or autonomous vehicles. In envirnment that require tight maneuvering, such as warehouse or hospitals, 360-degree vehicles are ideal because theycan navigate through narrow Aisles or around obstacles without needing to turn, making them highly efficient for material handling and transport.

In automated warehouse, for instance, robot equipped with omnidirectional wheels can easily move inventory across the floor, even when dealing with complex crowded places.

V. EXPERIMENTAL VALIDATION

The Arduino IDE is an open-source software, which is used to write and upload code to the Arduino boards. The IDE application is suitable for different operating systems such as Windows, Mac OS X, and Linux. It supports the programming languages C and Ct+. Here, IDE stands for Integrated Development Environment. The program or code written in the Arduino IDE is often called sketching, We need to connect the Arduino board with the IDE to upload the sketch written in the Arduino IDE software. The sketch is saved with the extension '.ino.'

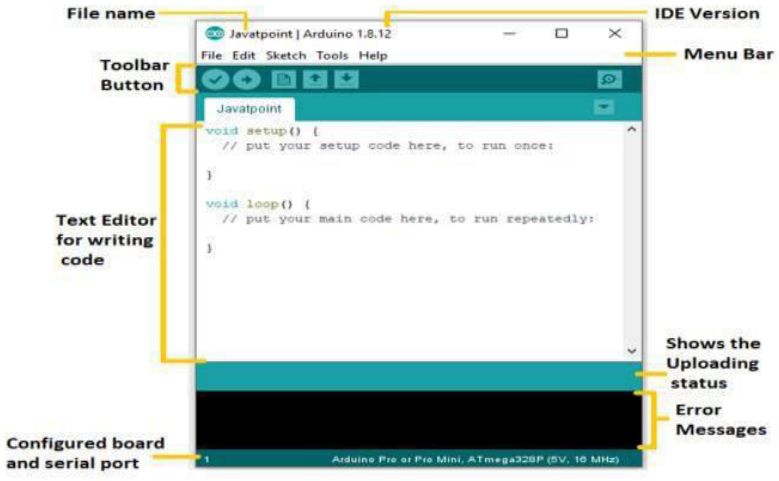

Fig. 3 Arduino Interface

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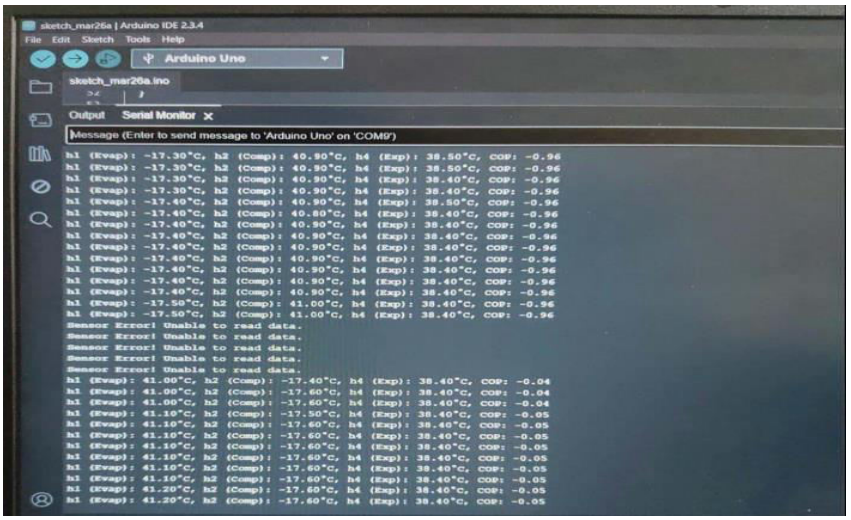

Fig. 4 Arduino Program Output Co-Ordinates

VI. CONCLUSION

The study of 360-degree rotational vehicles provides a fascinating insight into modern mobility solutions that go far beyond the limitations of traditional steering systems. By combining the use of omnidirectional wheels, individual motor control and a well-planned mechanical layout, these vehicles are capable of smooth, precise and highly flexible movement in any direction. This technology not only simplifies the process of navigation in tight or complex environments but also opens up new possibilities in the field of robotics, automation, transport and smart system.

Throught understanding key concepts such as kinematics, degree of freedom and wheel mechanics, learner gains valuable knowledge about how advanced motion systems are designed and operated. Building or studying such a vehicle also encourages the development of practical skills in mechanical design, electronic and programming. The simplicity of core principles, combined with the versatility of real-world applications, makes the 360 degree rotational vehicle a powerful learning tool and a stepping dtop into more complex areas of engineering and robotics.

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