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Efficient Zero Radius Turn Transportation with Voice-Enhanced Animal Detection – A Review

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ABSTRACT

This revolutionary vehicular concept seamlessly integrates zero-radius turning, an animal detection sensor system, and voice control functionality to redefine urban mobility. By combining these elements, the project aims to enhance maneuverability in confined spaces, bolster safety through real-time animal detection, and provide intuitive hands-free operation. The project encompasses conceptual design, fabrication, and system integration, culminating in a prototype that showcases the harmonious convergence of these cuttingedge technologies. This innovative approach holds the potential to address urban congestion challenges while promoting road safety. The real-time animal detection system mitigates collision risks by alerting drivers to wildlife presence, and the voice control feature ensures easy, distraction-free operation. The synergy of these advancements signifies a progressive leap towards efficient urban commuting and responsive vehicular systems. Ultimately, this initiative encapsulates a vision of future mobility that is safer, more adaptable, and seamlessly interconnected.

Keywords - Zero Radius Turn, Vehicle, Animal Detection Sensor, Voice Control, Manoeuvrability, Safety, Prototype, Urban Mobility.

1. INTRODUCTION

The creation and construction of a vehicle with ZERO-degree wheel rotation, utilizing a DC motor and steering mechanism, were undertaken to minimize the time required for changing directions. This particular vehicle was capable of manoeuvring in all directions from a fixed position, thanks to the integration of steering, sprockets, DC motor, bearings, and chain drive. The primary purpose of this vehicle was to facilitate seamless transitions between different directions. The modern advancements and economic growth of Indian society had led to an increase in the number of people on railway platforms and vehicles on the road. The limited space in hospitals also posed a significant challenge for the country. The focus of the present study was on creating a system that could reduce the vehicle's turning radius. The proposed system involved bringing the vehicle to a halt and then using the steering system and a DC motor to turn the wheels in the desired direction. As a result, the turning radius became nearly negligible in comparison to the vehicle's length. This vehicle found application in transporting goods to various locations, including railway platforms, hospitals, industries, and markets.

Our mechanism proves to be valuable not only for passenger vehicles but also for the implementation in automated guided vehicles within industrial settings. We have introduced a vehicle equipped with a user-friendly steering system that is cost-effective. Drawing conclusions from the analysis results, the vehicle's performance at corners is enhanced, displaying greater stability and control, particularly at low speeds and on wet or slippery road surfaces. The vehicle's response to steering inputs is both quicker and more precise. Furthermore, the vehicle's stability when moving in a straight line during zero turns is notably improved. This is achieved by steering the rear wheels in the opposite direction to the front wheels at low speeds, significantly reducing the turning circle radius. This innovation addresses challenges such as manoeuvring on narrow roads and simplifies parking procedures. Consequently, this system effectively decreases parking and turning durations. The achievement of a zero-turn capability is attained without compromising the vehicle's steerability and handling.

2. PROBLEM STATEMENT

We're all familiar with the increasing challenges of traffic congestion nowadays, which complicates both parking and manoeuvring vehicles out of parking spaces. Thus, the concept of parallel parking emerges as a means to efficiently park or relocate a car with minimal space utilization. This approach eliminates the need for extra room to park or move the vehicle from its parking spot. Stray cats and dogs often seek refuge under parked cars and motorcycles due to the scarcity of trees offering sufficient shade. Consequently, if drivers were to suddenly start their vehicles, it could potentially cause severe harm or even fatality to these animals. To circumvent these substantial penalties and safeguard animal lives, we developed a prototype that not only facilitates parking and exiting through the zero radius turn mode but also incorporates an Advanced Driver Assistance System (ADAS) to avoid collisions with animals during parking. An auditory alert system has also been integrated.

3. LITERATURE REVIEW

A review and analysis of pertinent research, studies, and advancements related to efficient transportation methods for zero-radius turns, coupled with voice-enhanced animal detection, would constitute the basis of a literature review on the subject. The following outline provides a general depiction of the potential content within such a literature review.

Jiwei Guan et al With recent advances in autonomous driving, voice control systems were increasingly adopted as methods for human-vehicle interaction. This technology allowed drivers to use voice commands to control the vehicle and was soon made available in Advanced Driver Assistance Systems (ADAS). Previous research demonstrated that Siri, Alexa, and Cortana were highly susceptible to attacks involving inaudible commands. This vulnerability could have been extended to ADAS in real-world scenarios, and detecting such inaudible command threats was challenging due to microphone nonlinearities. In the mentioned paper, the authors aimed to develop a more practical solution by utilizing camera views to protect against inaudible command attacks, where ADAS could detect their surroundings using multiple sensors. To achieve this goal, they proposed a novel multimodal deep learning classification system to counteract inaudible command attacks. The experimental results validated the feasibility of the proposed defence methods, with the highest achieved classification accuracy reaching 89.2%.

Vivek Singh Rai et al The design and production of a ZERO-degree wheel rotation vehicle using a DC motor and steering were undertaken to minimize the time required for changing directions. This vehicle was capable of moving in any direction while staying in the same position, achieved through the utilization of steering, sprockets, a DC motor, bearings, and a chain drive. Its primary function was to facilitate seamless transitions between different directions. The societal progress and economic growth in India led to an increase in the number of people on railway platforms and vehicles on roads, causing space-related challenges in places like hospitals - a significant issue in the country. The objective of the current study was to create a system that could reduce the vehicle's turning radius. The system operated by stopping the vehicle initially, then turning the wheels in the desired direction using the steering system and DC motor. The turning radius was nearly negligible in comparison to the length of the vehicle itself. This vehicle found application in transporting goods across various areas such as railway platforms, hospitals, industries, and markets.

Tracy Martin et al One of the earliest systems to assist drivers was the automatic braking system (ABS), originally designed for aircraft in the 1920s. The aim was to prevent uncontrolled skidding when an airplane touched down on a runway. ABS braking systems were crucial in averting accidents during the landing of substantial aircraft, including jet planes. However, it wasn't until the 1970s that ABS gained widespread use in automobiles, with Robert Bosch's patents in collaboration with Mercedes-Benz. In 1971, Chrysler and the Bendix Corporation introduced the "Sure Brake" ABS system for the Chrysler Imperial. Ford incorporated "Sure-Track" on Lincoln Continentals, while General Motors offered "Trackmaster," a rear-wheel ABS system for Cadillac and the Oldsmobile Toronado. As early as the 1970s, Nissan integrated an electronic ABS system developed by Denso into their Nissan President sedan. Even the realm of motorcycles saw the application of ABS technology, with BMW implementing it on the K100 model in the 1980s.

Rishabh Jain et al Opting for the mitigation of escalating air pollution and global energy consumption, the strategy of choice has been the advancement of electric vehicles (EVs) on a global scale. The Electric Vehicles Initiative (EVI) stands as a collaborative governmental policy that centers its efforts entirely on expediting the global integration and widespread utilization of electric vehicles.

Jing-Shan Zhao et al The steering mechanisms commonly employed in four-wheel vehicles are typically known as Ackermann-type steering mechanisms or four-bar linkages. The driver's input motion through the steering wheel is conveyed through a steering box and the steering control linkage to one steering knuckle, then transferred to the other knuckle by means of the Ackermann steering linkage. A primary kinematic prerequisite for the vehicle's steering linkage is to ensure that the steerable wheels possess a coordinated pivot, causing their axes to intersect at a point on the rear wheel axis. The objective of synthesizing the steering mechanism is to minimize the deviation between the steering centres across the entire range of steering angle inputs, all the while fitting within a practical spatial limitation.

Kadoma-Shi Osaka et al In a vehicle equipped with both a generator and a battery, an electric power source device comes into play. This device comprises several key components: a current detector responsible for identifying the initial current coursing through the battery, a DC-DC converter, a capacitor linked to the generator through the DC-DC converter, and a controller. The controller carries out two main tasks: firstly, it assesses the battery's charge state based on the current detected by the current detector; secondly, it monitors the vehicle's operational state. As the vehicle enters a deceleration phase, the controller takes action. Drawing upon the determined battery charge state, it manages a second input current directed towards the capacitor through the DC-DC converter. As a result, the regenerative electric power, stemming from the generator, is harnessed during the vehicle's deceleration in accordance with the battery's charge level. This novel approach taps into energy that was previously left untapped. The invention addresses an electric power source device for vehicles. This device proactively accumulates regenerative electric power generated by the generator while the vehicle decelerates, subsequently supplying this stored energy to various loads outside of the deceleration phase. In essence, this occurs during instances such as vehicle stops, startups, normal running, and acceleration.

Chang H. Kim et al An electric drive propulsion system consists of one or more series motors directly linked to propel the individual wheel axles of a vehicle. These motors establish a direct electrical connection with the output of a generator that's driven by the vehicle's engine. To initiate or halt propulsion, a power switch is activated via the vehicle's brake pedal, enabling the disconnection or reconnection of excitation current to the generator. Governing the propulsion speed is achieved through manipulation of the vehicle engine's accelerator pedal. The generator, driven by this pedal action, stands as the exclusive energy source fuelling the propulsion motors.

Thomas C. Underwood et al An electric vehicle power distribution module comprises a chassis housing various electric power distribution components. Positioned on the chassis is a battery connector designed to establish an electrical connection between the power distribution components and a battery. Affixed to the chassis is a safety cover, complete with a side wall aperture designed to accommodate an electric cable from the battery. This cable is selectively engaged with the battery connector. Crucially, the positioning of the aperture relative to the battery connector ensures that the safety cover cannot be detached from the chassis unless the electric cable is disengaged from the battery connector. In order for an electric vehicle to attain commercial viability, it must exhibit competitive costs and performance metrics when compared to its gasoline-powered counterparts. Typically, the propulsion system and battery of the vehicle stand out as the primary determinants influencing both its cost and performance competitiveness.

Synopsys SNUG et al Autonomous vehicles are advancing rapidly, driven by the integration of various systems on a chip (SoCs) that link sensors, actuators, and electronic controller units (ECUs). These enhance self-driving cars' vision, enabling a 360-degree view of the surroundings. Modern hardware designs utilize advanced process nodes to achieve higher performance while conserving power. Unlike past passive safety measures, current Advanced Driver Assistance Systems (ADAS) actively enhance safety by utilizing embedded vision technology to prevent accidents and reduce injuries. This involves AI-driven sensor fusion, combining data from cameras, ultrasound sensors, lidar, and radar, enabling quicker responses than human drivers. Real-time video analysis informs immediate reactions to road scenarios.

Sumeet Rajendra Shelke et al As the population continues to grow, the demand for vehicles is also on the rise, consequently giving rise to issues such as traffic congestion and overpopulated regions. Urban development has led to confined spaces and congested areas, leading individuals to grapple with challenges like finding suitable parking spots. To address this predicament, a solution has been proposed, giving way to the emergence of the zero turn mechanism. This innovative mechanism empowers users to execute a zero-turn maneuver while maintaining the vehicle's position. By rotating around its vertical axis, the vehicle can swiftly align itself with the desired direction. The principle behind this concept involves mounting wheels on the front axles that turn in opposing directions, mirroring the setup of the wheels connected to the rear axle. This configuration results in half of the vehicle's wheels rotating in one direction while the other half turns in the opposite direction, effectively enabling a zero-turn capability. In the scope of this project, the wheel hubs are interlinked with a tie rod, the tie rod is connected to the motor horn, and the motor horn is in turn linked to an SG90 servo motor. To facilitate the project's goals, the servo motor is interfaced with an Arduino microcontroller. Through Arduino programming, various operational modes are attainable, including the in-phase steering mode. Additionally, this mechanism aids in reducing a vehicle's turning radius, all the while incorporating the sought-after zero-turn feature. This innovation proves particularly advantageous in densely populated regions and crowded parking lots. The entire design was crafted using SolidWorks software, while the structural stability was assessed through static structural analysis conducted in Ansys.

Nuvoton et al Voice prompt alerts have become an integral feature of contemporary high-end luxury vehicles. Whether these prompts serve as dashboard notifications, such as warnings for exceeding speed limits, oil or water gauge levels, temperature/heat concerns, tire pressure issues, or even the pedestrian alert sound for electric cars, they all rely on sound chips as a common denominator. Integrated single-chip solutions have been thoughtfully crafted to seamlessly integrate into the future of automotive design. The ISD15D00/ISD15C00 exemplify this approach, presenting a cost-effective solution while maintaining superior audio quality. These record and playback devices pave the way for sound or voice prompts of audiophilegrade caliber to become accessible across a range of entry-level vehicle models. The streamlined communication through the SPI port to the Can-Bus system streamlines the process of integrating the system. Leveraging an external SPI flash for audio storage, the ISD15D00 incorporates built-in regulators and a PWM speaker driver. Its analog digital input-output capabilities are well-suited for accommodating multiple language storage and playback, capable of handling up to 64 minutes of audio content. Notably, the voice macros embedded in the ISD15D00 are thoughtfully designed, allowing for a seamless transition between languages stored in the external flash without necessitating changes to the application software.

4. CONCLUSION

The zero radius turn vehicle redefines automotive engineering by revolutionizing manoeuvrability in urban settings. Through intricate engineering and innovative design, it breaks traditional turning constraints, enabling agile movement in tight spaces. This concept goes beyond convenience, impacting safety, efficiency, and sustainability. Instant turns enhance driver control, reducing collisions and improving traffic flow, crucial in crowded areas with challenges like tight corners and limited parking.

The impact of an animal detection sensor with voice alert goes beyond mere innovation. It's a step towards ecological awareness and biodiversity preservation. Wildlife accidents harm both humans and ecosystems. This sensor prevents such incidents, saving lives and protecting species. Successful implementation requires robust hardware, algorithms, and collaboration among stakeholders. This tech could become standard in vehicles, enhancing road safety. It paves the way for more safety innovations. The fusion of animal detection, infrared sensing, and voice alerts fosters empathy between humans, vehicles, and wildlife. This reflects our ability to solve challenges. As this tech integrates into vehicles and roads, it'll harmonize road safety with ecosystem preservation.

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