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Mono Electrical Vehicle

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Abstract: The monowheel electric vehicle (MEV) is an innovative, single-wheeled, self-balancing personal transportation device powered by electric propulsion. Designed for individual users, the MEV combines the agility and compactness of traditional unicycles with modern electric motor technology. These vehicles rely on a combination of gyroscopes, accelerometers, and tilt sensors to maintain dynamic balance, allowing riders to intuitively control speed, acceleration, and direction through subtle body movements and leaning.

Keywords: Urban micro-mobility, Zero-emission transportation, Lightweight electric vehicle, Self-balancing vehicle

I. INTRODUCTION

The increasing demand for efficient, eco-friendly, and space-saving transportation solutions has driven the development of innovative personal mobility devices such as the Mono Wheel Electric Vehicle (MEV). Combining the traditional design of a unicycle with advanced electric motor technology, the MEV is a single-wheeled, self-balancing vehicle that offers a unique, agile, and highly compact mode of travel. By employing gyroscopes, accelerometers, and intelligent control systems, the MEV enables riders to navigate urban environments with ease, simply by shifting their body weight for intuitive and responsive movement. Powered by high-performance lithium-ion batteries, the MEV boasts impressive capabilities, including a travel range of up to 50 miles and top speeds of approximately 30 mph, depending on the specific model. Its lightweight structure and portability make it an ideal choice for urban residents seeking a convenient, sustainable alternative to conventional cars, scooters, and public transportation. Furthermore, the MEV's zero-emission operation contributes to environmental conservation efforts by lowering carbon emissions and helping to alleviate traffic congestion in densely populated areas. As urbanization continues to reshape global cities, the Mono Wheel Electric Vehicle stands out as a forward-thinking solution, redefining personal transportation through its fusion of innovation, efficiency, and environmental responsibility.

II. LITERATURE REVIEW

The emergence of Mono Wheel Electric Vehicles (MEVs) represents a significant innovation in the field of personal transportation. Research into self-balancing vehicles began with early work on dynamic stabilization, notably with the development of the Segway, which demonstrated the viability of gyroscope-based balance control (Zhou et al., 2007). Building on these principles, MEVs evolved to offer a more compact, single-wheel design aimed at urban mobility Several studies highlight the core technologies that underpin MEV operation, including the use of gyroscopes, accelerometers, and advanced sensor fusion algorithms (Kim & Lee, 2012). These components allow the vehicle to maintain stability and respond to the rider's body movements, creating an intuitive control system. Further research by Sun et al. (2015) emphasizes the importance of real-time feedback loops in ensuring rider safety and improving vehicle responsiveness under different load and terrain conditions.

Advancements in battery technology have also played a critical role in MEV development. The adoption of high-capacity lithium-ion batteries has enabled greater travel ranges and reduced charging times (Chen et al., 2016). Moreover, innovations in regenerative braking systems, which recover kinetic energy during deceleration, have improved overall energy efficiency and extended battery life.

From a design perspective, the use of lightweight materials such as carbon fiber composites and aerospace-grade aluminum has enhanced MEV portability without compromising durability (Wang & Zhang, 2018). Some researchers have also explored ergonomic designs to improve rider comfort and reduce fatigue during longer journeys (Patel & Kumar, 2019).

In terms of environmental impact, numerous studies advocate for electric personal mobility devices like the MEV as sustainable alternatives to traditional gas-powered vehicles. According to Johnson (2020), widespread adoption of electric micro-mobility solutions could significantly reduce urban air pollution and traffic congestion, contributing to smarter and cleaner cities.

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Despite these advancements, challenges remain. Research by Li et al. (2021) identifies concerns regarding rider safety, especially at higher speeds and in complex traffic environments. Furthermore, the high cost of production and limited infrastructure support (such as charging stations) are seen as barriers to widespread adoption.

III. CONSTRUCTION

ELECTRIC MOTOR:

The Brushless DC (BLDC) motor consists of two key components: the stator and the rotor. The stator, which is the stationary part of the motor, is made from multiple layers of laminated silicon steel and is wound with copper coils. These windings create electromagnetic poles when energized, generating a rotating magnetic field. This rotating field interacts with the rotor, causing it to spin and produce mechanical motion.Unlike brushed motors that rely on mechanical commutation, BLDC motors use electronic commutation for smoother and more efficient operation. The rotor, which is the moving part of the motor, is equipped with permanent magnets. These magnets can either be mounted on the surface or embedded within the rotor core, depending on whether it is a surface-mounted or interior permanent magnet design. The number of magnetic poles on the rotor affects the motor's torque output and speed performance.

To ensure precise control, BLDC motors are equipped with position sensors—commonly Hall-effect sensors or rotor encoders. These sensors continuously monitor the rotor's position and send real-time data to the electronic controller. Based on this feedback, the controller accurately switches current through the stator windings to maintain optimal rotation and performance

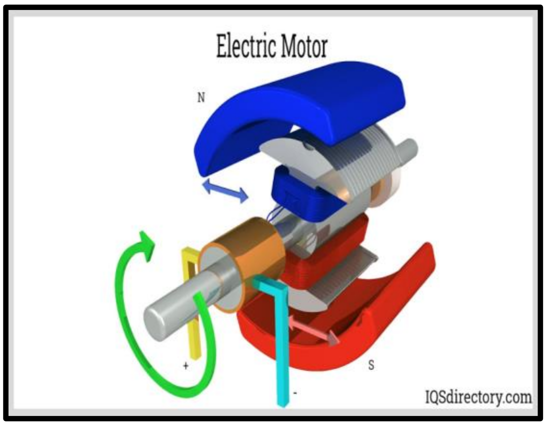

fig. a) Electric motor

12 AH battery

A 12V AH lithium battery in a one-wheel electric vehicle serves as the primary power source. It supplies the electrical energy required to run the brushless DC motor (BLDC), which drives the wheel and propels the vehicle forward. The battery stores energy in chemical form and releases it as direct current (DC) when needed. Its Ampere-Hour (AH) rating indicates how much current it can supply over a specific time period—for example, a 12V 10AH battery can theoretically deliver 10 amps for 1 hour or 5 amps for 2 hours. In addition to powering the motor, the battery also supplies electricity to the electronic control system, including gyroscopes, sensors, and the control board that manages balance and movement. Some systems may also use battery power for lighting, indicators, or connectivity features. The battery can be recharged through a compatible charger, and in some designs, regenerative braking helps recover energy back into the battery during deceleration.

fig.b) Battery

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IV. WORKING

A monowheel is a unique single-wheel vehicle in which the rider sits inside the wheel's circumference, rather than on top or outside of it like in a traditional unicycle. This fundamental design difference gives the monowheel its distinctive structure and behavior.The monowheel generally consists of a circular frame surrounded by a large outer track—usually made of rubber—that acts as a giant tire enabling movement.Inside the outer wheel is a fixed inner frame, which houses the engine, rider seat, and controls. The inner frame remains relatively stationary while the outer wheel rotates around it—similar in concept to a giant ball bearing.

The engine (or sometimes pedals) powers the rotation of the outer ring, propelling the entire vehicle forward. The inner structure (with the rider) is connected to the outer wheel using rollers or bearings, allowing it to stay upright while the outer wheel moves. This mechanism is somewhat similar to the action of a gyroscope—as long as the vehicle is in motion, it maintains balance and directional stability.

Turning a monowheel is difficult due to its lack of lateral support and unconventional balance dynamics. Riders must often shift their weight or use small steering mechanisms to change direction. Feet are typically kept close to the ground for additional support to prevent tipping.

Without motion, a monowheel becomes unstable and prone to tipping over. Sudden stops are difficult, as the center of mass may rotate forward inside the wheel (a phenomenon called "gerbiling"). High-powered engines are inefficient in monowheels due to their unusual load distribution and control limitations.

Though once envisioned as a futuristic alternative to cars and bikes, monowheels never became widely adopted due to poor stability at low speeds or when stationary, awkward handling and difficult braking, and safety concerns, especially at high speeds.

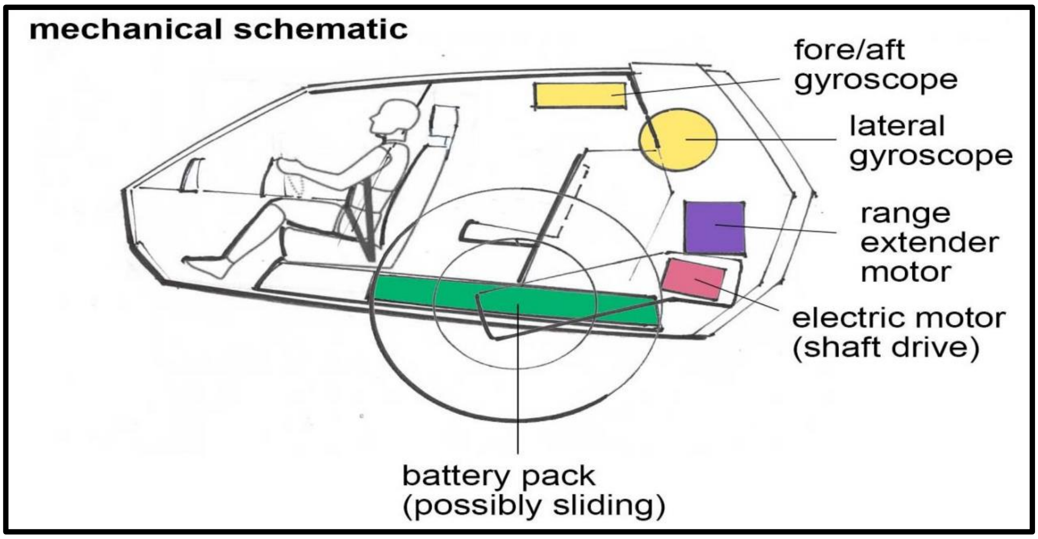

Fig. c) Working Diagram

V. COMPONENTS

1 Metal rod:
A shaft is a rotating mechanical component, typically circular in shape, designed to transmit power between different parts or from a power-generating machine to one that absorbs power.

2 Shaft:
The shaft in a one-wheel electric vehicle acts as a central mechanical element that supports the rotor of the motor and may also serve as a mounting point for the inner frame or rider's platform. It transmits torque generated by the brushless DC motor to the wheel, enabling rotation and forward movement. In some designs, the shaft may also help guide rotational movement between the stationary inner frame and the rotating outer wheel, functioning like an axle.

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Additionally, the shaft must withstand dynamic loads from the rider, vibrations, and uneven terrain while maintaining alignment and balance. In advanced models, it may incorporate bearings or serve as a channel for wiring between the control board and the motor.

3 Coupling:
A coupling is a mechanical component used to link two rotating shafts at their ends, allowing the transfer of torque and motion from one shaft to another. Its core function is to maintain a mechanical connection between rotating equipment, even when there is slight misalignment, axial movement, or vibration between the connected shafts. While standard couplings are designed to keep the connection intact during operation, certain specialized types—such as torque-limiting couplings—can slip or disengage automatically if a predefined torque threshold is exceeded, thereby preventing equipment damage. The proper selection, installation, and regular maintenance of couplings not only ensures optimal performance but also contributes to reduced machine downtime and lower overall maintenance costs.

VI. ADVANTAGES

1. Portability
- **Compact & Lightweight**: Easily carried or stored indoors, on public transport, or in small living spaces.
- **Ideal for Urban Life**: Navigates tight environments where bikes or scooters are cumbersome.

2. Energy Efficiency
- **Low Power Usage**: Consumes far less electricity than cars or even e-bikes.
- **Environmentally Friendly**: Zero emissions during operation.

3. Maneuverability
- **High Agility**: Can weave through crowds, narrow sidewalks, and between cars in traffic.
- **Tight Turning Radius**: More flexible than two-wheeled options.

4. Cost-Effective
- **Affordable Options**: Entry-level models are cheaper than e-bikes or premium scooters.
- **Low Maintenance**: Fewer mechanical parts mean fewer repairs and lower long-term costs.

5. Minimal Parking Needs
- **Carry Indoors**: No need for locks or finding a rack—just bring it inside.
- **No Parking Fees**: Avoids costs associated with car or scooter parking.

6. Unique Riding Experience
- **Fun Factor**: Challenging and satisfying to master.
- **Skill Development**: Improves balance, reflexes, and coordination.

7. Quiet Operation
- **Silent Motor**: No noise pollution; great for residential areas or night rides.

8. Tech Integration
- **App-Connected**: Adjust ride settings, track speed, distance, and diagnostics.
- **Smart Features**: Some models include lights, alarms, or anti-theft functions.

9. Fast Charging (on Some Models)
- **Quick Recharge**: Certain monowheels can be fully charged in 1.5–2 hours

VII. CONCLUSION

In conclusion, monowheel electric vehicles (EUCs) represent a highly innovative solution to modern urban mobility, offering a unique and efficient mode of transport. Their compact size makes them ideal for navigating crowded city streets, tight spaces, and public transport systems, while their portability and low maintenance make them a practical choice for commuters. With zero emissions and low energy consumption, they are also an eco-friendly alternative to traditional vehicles, contributing to a cleaner environment.However, mastering a monowheel requires some skill, as balancing and maneuvering can be challenging, particularly for beginners. Though they are fun and engaging once learned, they may not be suitable for those with limited balance or physical abilities. Additionally, their limited range

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and inability to handle rough terrain can be a drawback for longer commutes or off-road use.Despite these limitations, monowheels provide a cost-effective, agile, and futuristic transport option, making them an attractive choice for tech enthusiasts and those seeking a convenient last-mile solution. As urban mobility continues to evolve, monowheel electric vehicles will likely remain a valuable tool for personal transportation, especially in densely populated areas where space and efficiency are paramount.

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