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RESEARCH ARTICLE OPEN ACCESS

A.I. Based SMART ELECTRIC VEHICLE

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Abstract:
This research focuses on the design and development of a smart electric vehicle (EV) capable of automatically transferring power transmission between the internal system and the wheels using a gyroscopic sensor and microcontroller in a controlled manner. As the era of electric vehicles is gaining momentum, it is expected to revolutionize the automobile industry, rendering traditional fossil fuel vehicles obsolete in the foreseeable future. The key advantage of electric vehicles lies in their environmentally friendly nature, significantly reducing harmful emissions.

The main objective of this project is to develop a smart car with an automatic power transmission shifting mechanism. To achieve this, SOLIDWORKS software (CAD) was employed to design the mechanical components of the system. The project utilizes a 12-volt regulated power supply circuit, a wiper motor, a fan, and an ATmega-328P microcontroller. Following the design and implementation phases, a comparative analysis will be conducted between the experimental and analytical results, culminating in a comprehensive conclusion.

Keywords: AI-powered electric vehicle, Smart electric car, Autonomous driving, Machine learning in EVs, Electric vehicle automation.

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1.INTRODUCTION

An electric vehicle (EV) utilizes one or more electric or traction motors for propulsion. These vehicles can either draw power from off-vehicle sources through a collector system or be self-sustained with batteries, solar panels, or electric generators that convert fuel into electricity. EVs encompass a wide range of vehicles, including road and rail vehicles, surface and underwater vessels, electric aircraft, and electric spacecraft. Specifically, an electric car is an automobile powered by electric motors using energy stored in rechargeable batteries. The first practical electric cars were produced in the 1880s, gaining popularity in the late 19th and early 20th centuries. However, advancements in internal combustion engines, particularly electric starters, and the mass production of cheaper gasoline vehicles led to their decline.

A resurgence in electric vehicle manufacturing began in 2008 due to improvements in battery technology, health concerns from air pollution, and efforts to reduce greenhouse gas emissions. Various national and local governments have introduced incentives, such as tax credits and subsidies, to promote the adoption of electric vehicles in the mass market. The US Government currently offers a maximum tax credit of $7,500 per car. Compared to internal combustion engine vehicles, electric cars are quieter, have no tailpipe emissions, and generally produce lower overall emissions. In January 2019, a Reuters analysis of 29 global automakers revealed plans to invest $300 billion in electric vehicles over the next 5 to 10 years, with 45% of the investment focused on China. Charging options for electric cars include a variety of charging stations that can be installed at homes and public locations. Leading electric cars like the Nissan Leaf and the Tesla Model S have EPA-rated ranges of up to 243 km (151 miles) and 600 km (370 miles), respectively.

Electric cars offer several benefits over conventional internal combustion engine vehicles, primarily through significantly reducing local air pollution, as they do not emit pollutants such as particulates, volatile organic compounds, hydrocarbons, carbon monoxide, ozone, lead, and nitrogen oxides directly. However, the overall emissions depend on the electricity source and vehicle efficiency, with grid electricity emissions varying based on the region's renewable energy availability and fossil fuel-based generation efficiency.

A gyroscope is a device used to measure or maintain orientation and angular velocity. It typically consists of a spinning wheel or disc, where the axis of rotation can freely orient itself. The conservation of angular momentum ensures the axis remains stable, regardless of the mounting's tilting or rotation. Gyroscopes come in various forms, including microchip-packaged MEMS gyroscopes found in electronic devices, solid-state ring lasers, fiber optic gyroscopes, and highly sensitive quantum gyroscopes. They are used in applications requiring precise navigation and orientation, such as inertial navigation systems in the Hubble Telescope, submarines, gyro theodolites for tunnel mining, and gyrocompasses in ships, aircraft, and spacecraft.

A microcontroller (MCU) is a compact computer on a single metal-oxide-semiconductor (MOS) integrated circuit chip. It is similar to, but less complex than, a system on a chip (SoC), which may include a microcontroller as one of its components. A microcontroller includes one or more CPUs (processor cores), memory, and programmable input/output peripherals. On-chip program memory can be in the form of ferroelectric RAM, NOR flash, or OTP ROM, alongside a small amount of RAM. Microcontrollers are designed for embedded applications, unlike microprocessors used in general-purpose applications like personal computers. They are commonly used in automatically controlled products and devices, such as automobile engine control systems, implantable medical devices, remote controls, office machines, appliances, power tools, toys, and other embedded systems.

2. Body of Paper

Article 1: "Electric passenger vehicles sales and carbon dioxide emission reduction potential in China's leading markets" by Jihu Zheng, Xin Sun, Lijie Jia, Yan Zhou
This study investigates the trends in annual sales and market dynamics of plug-in electric vehicles (PEVs) in China from 2011 to 2017, examining both national and regional levels. It highlights the performance characteristics of the top-selling PEV models and explores provincial-level incentive policies promoting PEV adoption. In the top five provinces with the highest PEV sales, approximately 70% of models have lower electric ranges and battery capacities than the national average. The study estimates regional electricity consumption, gasoline replacement, and CO2 emission reductions based on sales data. Between 2011 and 2017, 682,047 PEVs were sold in these provinces, traveling 18.3 billion kilometers electrically, consuming 3.0 TWh of electricity, replacing 1.6 billion liters of gasoline, and reducing CO2 emissions by 611,824 tons. The majority of these reductions were contributed by battery electric vehicles (BEVs). The study underscores the importance of understanding PEV market trends, incentive policies, and the aggregate impacts of PEVs on energy consumption and emissions.

Article 2: "Impact of the electric vehicles on the air pollution from a highway" by Enrico Ferrero, Stefano Alessandrini, Alessia Balanzino.
This research employs numerical simulations and air pollutant measurements to assess the impact of introducing electric vehicles (EVs) on urban air quality, specifically focusing on NO and NO2 emissions. Conducted near a highway in Milan, Italy, the study uses a Lagrangian Stochastic Dispersion Model to simulate pollutant dispersion and chemical reactions. The results indicate that a significant reduction in air pollutants requires replacing at least 50% of non-electric vehicles with EVs. Even lower rates of EV adoption can improve air quality during high pollution episodes. The findings provide valuable insights for policymakers on planning measures to increase the proportion of EVs in the car fleet to enhance urban air quality.

Article 3: "Balancing fast flexible gyroscopic systems at low speed using parametric excitation" by Shachar Tresser, Izhak Bucher
This paper presents a method to identify imbalance forces in high-speed gyroscopic systems using data measured at low speeds. The method involves using two actuators and multiple sensors to gather data not typically available in rotating structures. The challenges addressed include detecting small responses at low speeds, isolating contributions of individual modes, and developing suitable formulations for dynamics involving gyroscopic and imbalance forces. A new formulation for parametrically excited gyroscopic systems and an amplification scheme for imbalance forces is introduced. The method is validated through finite element simulations and real-time digital processing, enhancing the ability to balance high-frequency flexible modes without rotating to high speeds.

Article 4: "Effects of gyroscopic moment on the damage of a tapered roller bearing" by Jing-Shan Zhao, Wentao Liu, Yun Zhang, Zhi-Jing Feng, Jun Ye, Qing-Bo Niu
This study investigates how gyroscopic moments contribute to damage in tapered roller bearings. Excessive wear and damage often occur due to fatigue cracking under heavy loads in Hertzian contact zones. The study shows that gyroscopic moments induce side damage on raceways and rollers by causing overbearing eccentric stresses when rollers perturb due to load release. Theoretical analysis and computer simulations indicate that while gyroscopic moments do not directly cause abrasion, they create conditions that lead to damage such as cracks, pits, and spalls. The research

provides design criteria to mitigate these effects, enhancing the durability and reliability of tapered roller bearings.

Article 5: "Parametric topology optimization of a MEMS gyroscope for automotive applications" by Mohammad Reza Solouk, Mohammad Hassan Shojaeefard, Masoud Dahmardeh
This article details the parametric topology optimization of a MEMS gyroscope for automotive applications. The optimization focuses on a translational dual-mass Coriolis vibratory gyroscope (CVG) with electrostatic sensing and excitation mechanisms. The study addresses application uncertainties in the optimization process, leading to more reliable designs. The proposed method optimizes the geometry parameters of the gyroscope to enhance performance in automotive applications, including stability and rollover prevention. Finite element analysis is used to ensure the mechanical feasibility and structural integrity of the gyroscope. The study concludes that the optimized gyroscope design improves its suitability for various automotive applications.

3.METHODOLOGY

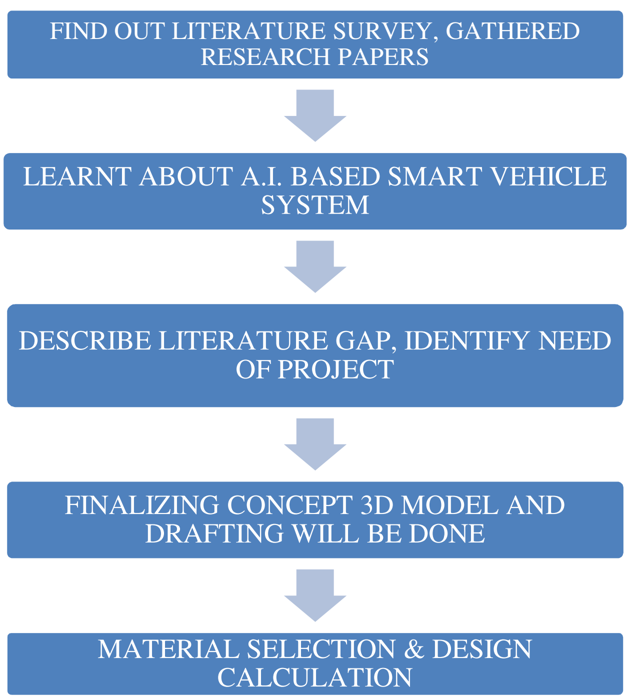

Fig -1:Methodology

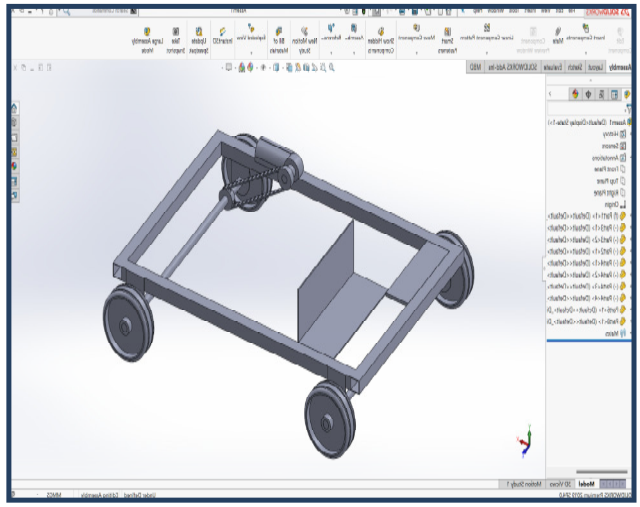

Fig -2: 3D Model

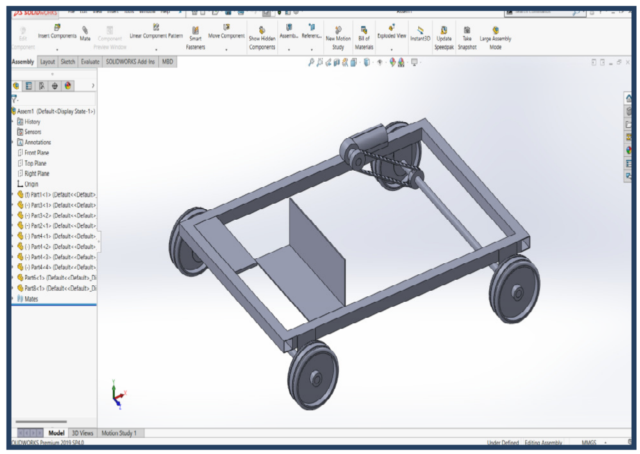

Fig -3: 3D Model

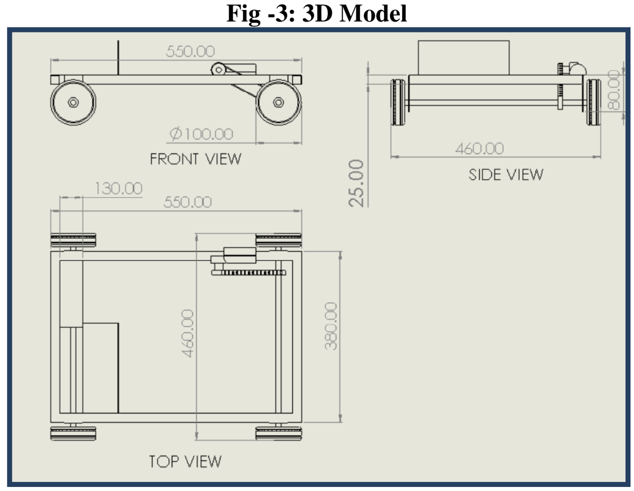

Fig -4: 2D Model

4. CONCLUSIONS

This semester, we successfully completed a research paper on smart electric vehicles (EVs) with the assistance of various research studies. The design and 3D modeling of the smart EVs were carried out using SolidWorks software. Calculations were performed based on the SolidWorks model. After manufacturing the model, it was tested, and the mechanism's functionality was successfully demonstrated.

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