RESEARCH ARTICLE OPEN ACCESS

Intertia Intermittent Triggering System For Electric Vehicles To Boost Battery Backup Using Ai

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ABSTRACT:
In an effort to transition as quickly as possible to electric vehicles, the Indian government has launched "MISSION EV." However, the obstacle is the primary obstacle that automobile manufacturers and the government face. The paper discusses the development of model of electric vehicle drive train with intelligent inertial control unit. The inertia is controlled using the on board inertial measurement units, and if the system is capable of sustaining the motion at present speed, the intelligent system becomes active. The intelligent system controls the battery consumption by breaking the battery circuit from time to time thereby saving diagram. When the inertia drops below self-sustenance level the system deactivates giving continuous supply from battery. The system uses the artificial intelligence to determine the activation of the intermittent triggering system by continuously monitoring the vehicle speed, acceleration, inclination and other parameters responsible to sustain the vehicle using inertia. A trained supervised machine learning model is deployed on the system to get the vehicle data regarding the speed and acceleration to calculate inertial sustenance and cut the battery supply intermittently to boost battery backup using machine learning and AI.

***Keywords* -** Mission EV, battery life, inertia, battery circuit, self-sustenance, parameters, Supervised machine learning, AI etc.

Date of Submission: 07-11-2023 Date of acceptance: 21-11-2023

I. INTRODUCTION

Expanding in the quantity of voyaging vehicles has expanding the issues like air contamination and to the utilization of oil. The human sensibility for the issue of energy and the environment is encouraging research into alternative automotive industry solutions like hybridization, electrification, and multiple fueling. In parallel, the systems are altered in light of the current issues. The electric bikes are the answer to this problem. The electrically helped bicycles are typically fueled by battery-powered battery, and their driving presentation is impacted by battery limit, engine power, street types, activity weight, control, and, especially, by the administration of the helped power.

However the biggest problem with the wide scale implementation of the electric vehicles is the battery backup and the requirement to charge the electric vehicle. Though the ongoing research is on the smart battery technology to improve the battery backup and the battery life of the electric vehicle, the proposed paper discusses with the innovative approach of inertial intermittent triggering system which monitors vehicles inertia capable of sustenance and then cuts of the supply intermittently to boost the battery backup. Machine learning and AI approach is used to determine the intermittent trigger cycle and frequency based on the predictions derived from the supervised machine learning model.

The paper discusses the concept of intermittent triggering to boost battery backup in electric vehicles. The inertia monitoring system is implemented along with the proposed setup to develop an smart intermittent triggering unit which uses machine learning to activate the appropriate triggering time to save the battery in the electric vehicles when the system is capable of self-sustenance due to inertia.

II. LITERATURE REVIEW

The literature search primarily focused on topics related to electric vehicles (EV), hybrid electric vehicles (HEV), and fuel cell-powered hybrid electric vehicles (FCHEV). Through our study of various papers, we have identified relevant literature that addresses the issue of battery backup in electric vehicles. Overall, these research findings contribute to the understanding of battery backup challenges in electric vehicles.

C. Abagnalea et al. [1] presented a novel approach to the positioning of the electric motor in a pedelec prototype. Unlike the conventional method of placing the motor on one of the bicycle's three hubs, their concept involves placing the motor centrally and transmitting torque to the central hub through a bevel gear. They also introduced a low-cost driving torque measurement system and a unique test apparatus.

Mr. Mragank Sharma [2] and his team conducted research on regenerative braking. They developed a process where the storage system temporarily stores kinetic energy from the bike. By assembling a brushed DC motor, an L-clamp iron bar, and a frictional pulley clamp above the hub of the front pulley, they harnessed power. When the rider applies the brake, the system activates the frictional pulley, causing it to rotate in the opposite direction of the wheel. This rotation drives the armature of the DC motor, converting mechanical work into useful electrical energy (charge) stored in the battery. This additional energy enhances the battery's charging capacity, allowing the electric bicycle to cover a significant distance.

Soniya K. Malode et al. [3] proposed a simple and practical method for regenerative braking in electric vehicles, with a specific emphasis on its impact on the generation of usable brake energy.

Nitipong Somchaiwong [4] introduced a method in which an electric bike is powered by a PM brushless DC motor. Additionally, they developed a regenerative power system.

P. Spagnol et al. conducted research on utilizing energy exchanges between a cyclist and a motor to enhance the efficiency of the primary engine, which is the human body. They borrowed an idea from the extensively studied realm of four-wheeled vehicles to create a self-sustaining and grid-independent system, distinct from other Electrically Power-Assisted Cycles (EPACs). The paper provides a detailed explanation of the algorithm's design, with a particular focus on measuring human metabolic efficiency using collected biometric data.

P Khatun et al. [9] have presented an experimental test bench designed for the Antilock Braking System (ABS) and Traction Control System (TCS) of an electric vehicle. The research paper discusses both the preliminary investigation and the implementation of the test bench. Fuzzy control algorithms are developed and deployed on this cost-effective test bench. The test bench features a DSP controller responsible for controlling a brushless permanent magnet motor, which is powered by a power inverter. To simulate real road conditions, a three-phase induction motor is connected to the PM motor, acting as a representation of the road load. Through simulation studies, an initial rule base is derived and then tested on the experimental setup, which replicates the dynamics of a braking system. Fuzzy logic membership functions are defined for various parameters such as observed load torque and slip.

The output torque demand function is determined based on the fuzzy rule set. Specifically, the fuzzy rules limit the slip ratio to 0.1 for dry surfaces. By identifying unstable regions on the torque-slip graph and following the fuzzy rules, the algorithm effectively reduces slip. On dry road surfaces, the control region extends up to 0.35, and eventually, the slip stabilizes around 0.25. The results demonstrate that ABS significantly improves performance and has the potential for optimal wheel control in challenging driving conditions. The findings highlight the effectiveness of the fuzzy control algorithms implemented on the test bench..

Dixon J et al. [10] present a Buck-Boost converter and Ultracapacitor bank system designed for energy recovery during braking. The buck-boost converter utilizes IGBTs and has been successfully tested on an electric Chevrolet truck. The control strategy of the system sets the minimum and maximum voltages of the Ultracapacitor bank, as well as the maximum current flowing to the battery. The control strategy relies on a reference table and takes inputs such as vehicle speed, load current, and other variables into account. Additionally, a methodology is provided that employs sensors to determine wheel decelerations, enabling the optimal utilization of the converter to recover the maximum amount of energy. The results are illustrated through graphs displaying voltage, current, and the capacitor bank voltage of the battery. These graphs demonstrate the proper functioning of the buck-boost converter. The designed system offers several benefits, including minimal energy loss and battery pack degradation. It enables higher acceleration capabilities and ensures appropriate deceleration during braking.

Chuanwei Z et al. [11] present a control scheme for regenerative braking based on an analysis of various regenerative braking approaches. The paper discusses three primary control strategies: maximum regenerative power control, constant regenerative current control, and maximum regenerative efficiency control. Two modes, continuous current mode and discrete current mode, are analyzed in detail. Through the analysis, a formula for regenerative efficiency in a control scheme is derived. The study focuses on two aspects during the analysis of the braking system: electric loop efficiency and regenerative energy efficiency. Based on the analysis, the paper concludes that the control scheme with constant regenerative current outperforms the control schemes based on maximum regenerative power and efficiency.
Furthermore, the paper asserts that the proposed method offers superior control performance and achieves higher regenerative braking efficiency.

From the literature review carried out it can be concluded that the project has wide scope. Energy regeneration and battery backup issue in electrical vehicles is an ongoing research topic and problem still exists. The following literature gap has been detected after studying the literature review in detail.

1. The current literature review focuses on the energy regeneration and majority of the research scholars have suggested the generator coupling approach
2. The Regenerative braking is suggested in most of the literature work studied .
3. The current literature work doesn’t account for all the energy that can be harvested or saved to boost the battery backup.
4. The research also focuses on battery technology and development of batteries

with larger range. This is an ongoing research and the current research work nor the existing electric vehicles do not focus on the energy that is wasted in driving the electric vehicle

5. The regenerative braking is in existence in many hybrid cars, thus the existing research just suggest the implementation of regenerative braking for electric vehicles

The current research work does not suggest the use of machine learning for decision making. With the proliferation of AI based systems and AI being implemented in most of the automobiles today, there needs to be an innovative approach for proper prediction of the energy regeneration while driving using machine learning to predict the maximum possibility of energy regeneration based on vehicle monitoring in real time. None of the literature work studied suggested the use of machine learning in the field of battery backup enhancement

III. METHODLOGY

The entire project is carried out in different steps so that the errors can be minimized throught the approach of the project. The Brief methodology to carry out the project is given below:

- Literature review
- Problem Definition
- Material survey and selection
- Development of mechanical structure
- Setting up the data collection system by development of inertial measurement unit coupled with the vehicle
- Collection of data points on real-time road driving conditions
- Data preprocessing
- Training the machine learning model for detection of the battery cutoff point based on inertia sustained
- Hardware development with sensors nodes interfaced to deploy the trained machine learning model
- Development of inertia monitoring system
- Development of Intelligent battery accelerator system
- Program
- Assembly
- Tests and Experiments
- Results Analysis
- Optimization
- Conclusion

IV. WORKING PRINCIPLE

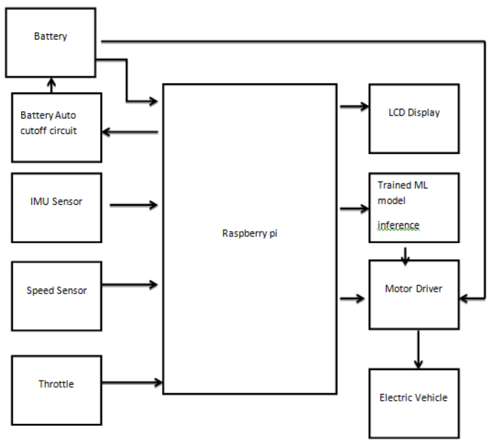

Fig 1.Working Principle

The figure below shows the block diagram of the project. The proposed project involves development of smart system for electric vehicles which will continuously monitor the speed of the vehicle and the inertia at which it has the capability to sustain some distance without using the power from the battery. A trained machine learning model is deployed on raspberry which collects the real-time data regarding the speed, acceleration, inclination and other riding conditios of the vehicle to determine the self sustenance state. When this stage is reached the vehicle automatically disconnects from the battery intermittently to save the battery and boost the battery backup. As shown in the illustrative diagram below the project consists of development of smart inertial control unit of the vehicle . The throttle is used to drive the vehicle once the vehicle is started inertial measurement system comes into picture. The speed and inertia are measured using MEMS IMU and if the system is capable of sustaining itself, the system cutoff the battery for short period of time . These small cutoffs can contribute towards a major boost in battery backup, thereby promoting National Electric Vehicle mobility mission.

V. HARDWARE AND SOFTWARE ASSEMBLY

The following hardware is used for the implementation of the selected test bench.

- Raspberry Pi 3 B+
- Inductive Proximity Sensor
- Accelerometer
- Gyroscope sensor
- IMU sensor
- Throttle
- Battery
- Electric Drive Train
- LCD Display

The system consists of smart inertial measurement system which will continuously monitor the inertia, speed and acceleration of the system. If the system reaches a stage where it has got inertia capable of self-sustenance, the smart intermittent battery triggering circuit will be activated which will break the battery circuit intelligently from time to time saving or boosting the battery backup in electric vehicles. The proposed system is demonstrated on the frame using all the drive components of an electric vehicle.

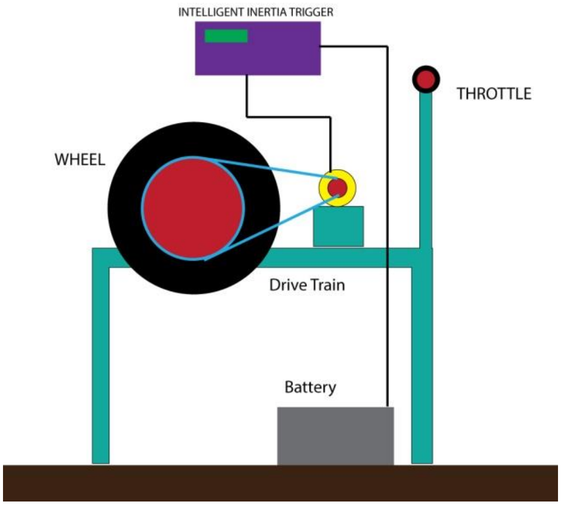

Fig.2 The Implemented System

VI. DESIGN CALCULATIONS

Battery Calculation:

The selected batteries in the project are 2 12V 9AH batteries. We are connecting 2 batteries in series to make a 24V system which will power the motor

Considering the power rating:

P=VxI

P=24*9

P=216 Watt

Motor Selected: 350 Watt

Therefore the range or backup of the battery nominal is given by:

216/350

Battery backup = 0.6 Hours=36 minutes

Consider a constant speed of 25km/hr

The test bench has a working range of approx.

Range in kms: 90 Kms on single charge

When the intertia triggering system is active:

When the inertia triggering system is active. For example assume the inertia system gets triggered at 25km speed.

The system will trigger for 70 percent of the time and stay off of 30 percent.

Considering total battery backup of 0.6 hours,

Off time or time saving for inertia intermittent triggering:

.3x0.6

=0.18 hours

So the total battery backup due to inertia intermittent triggering system 0.78 hours.

Thus in this way the system is going to give more backup using inertia intermittent triggering system.

Motor Selection Calculation:

The mass of the vehicle including person: 150 kg

Considering the datasheet of the motor the 350 watt motor was choses as it provided a great balance between the speed and torque.

VII. IMPLEMENTATION

The hardware schematic of the system developed is as shown below.

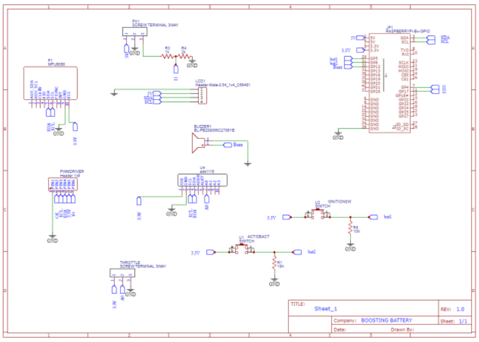

Fig.3 Hardware schematic

The PCB layout for the proposed system is given below.

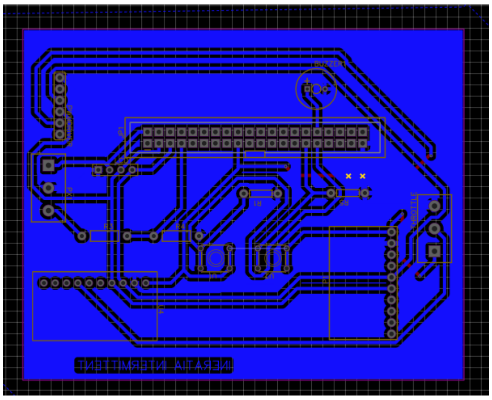

Fig.4 PCB Layout

The figure below shows the mechanical dimensions of the test bench to be fabricated for the system.

ISSN: 2248-9622, Vol. 13, Issue 11, November 2023, pp 114-122

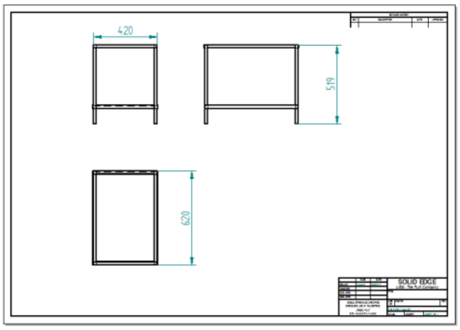

Fig.5 Chassis frame with dimensions

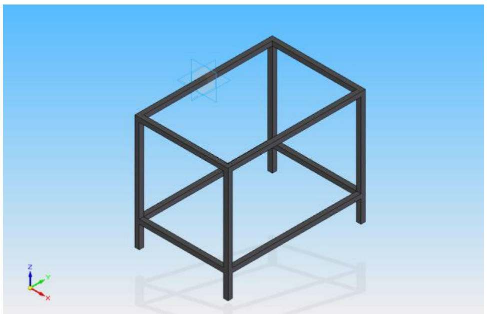

Fig.6 Chassis 3d

Fig.7 Sprocket

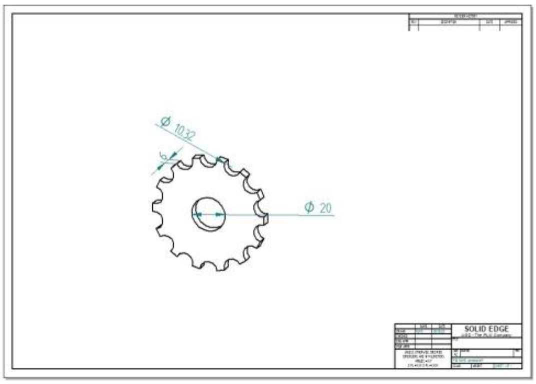

Fig.8 Sprocket Drawing

Fig.9 Wheel

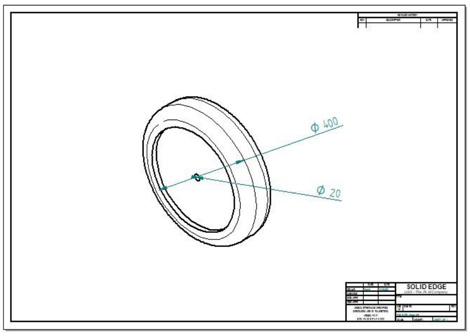

Fig.10 Wheel drawing

The figure below shows the flow chart of the working logic of the system.

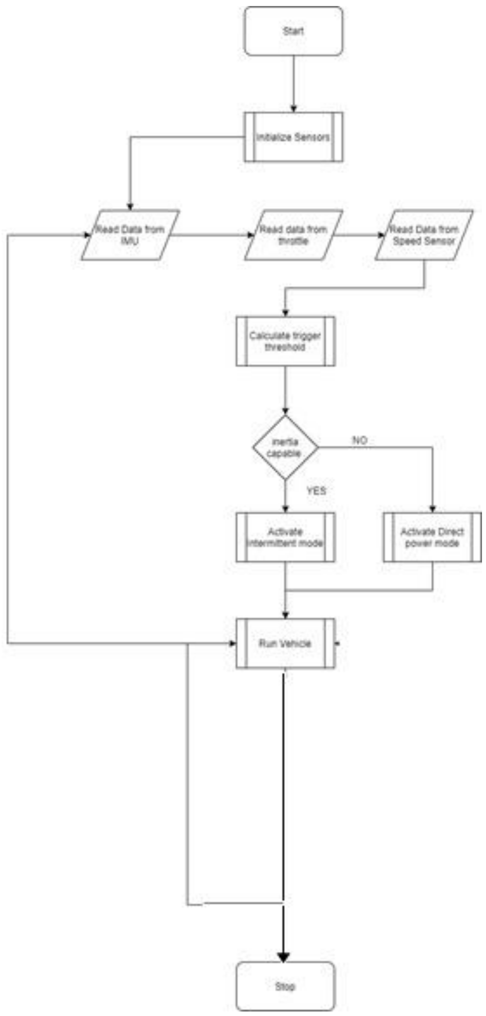

Fig.10 Flow Chart

VIII. CONCLUSION

The paper discusses with the inertia intermittent triggering to boost battery backup in electric vehicles. The proposed project is expected to solve the problems faced by electric vehicles by development of system which can boost the backup of the electric vehicle battery. The present problem with the wide scale implementation of the electric vehicles is the battery backup which is yet to improve. This makes it difficult to completely replace the petrol and diesel vehicles with the electric vehicles. The proposed system is expected to save the small amount of energy at every different intervals of time which will cumulatively boost the battery back up by cutting the battery supply at regular intervals of time . The system implements smart MEMS and Machine learning based system system which will measure the speed of the vehicle and if the inertia of the vehicle is sufficient enough to carry the vehicle forward, the system automatically cuts the battery supply saving the amount of energy .

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