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Electric Vehicle Overload Detection and Alert System using Arduino

H Vinay Kumar[1], Shivakumar S M[2], P Nikhil[3], Basavaraj[4], T Sai Mani[5]
Assistant Professor, Electrical and Electronics Engineering[1]
Students, Electrical and Electronics Engineering, Ballari[2-5]
Rao Bahadur Y Mahabaleshwarappa Engineering College, Ballari

Abstract: *The increasing adoption of electric vehicles (EVs) has promoted sustainable and eco-friendly transportation. However, overloading remains a major issue in lightweight EVs such as e-bikes and tricycles, leading to reduced battery efficiency, increased power consumption, mechanical stress, and safety risks. Most existing EVs lack a real-time system to detect and alert users about overload conditions.*

This project, "Electric Vehicle Overload Detection and Alert System Using Arduino" proposes a low-cost and reliable solution to monitor vehicle load and enhance safety. The system employs a strain gauge load cell to measure the applied load, and an HX711 amplifier to amplify and digitize the sensor output. An Arduino UNO microcontroller processes the data and continuously compares it with a predefined threshold. When an overload condition is detected, the system alerts the user through a buzzer and displays real-time load and mileage information on a 16×2 LCD display.Additionally, the system calculates mileage before and after overload, allowing users to analyze the impact of excess load on vehicle efficiency. A two-stage power regulation circuit using LM2596 and LM7805 ensures a stable 5V supply from the vehicle's 24V battery. Experimental results confirm accurate overload detection and reliable operation. The proposed system improves safety, efficiency monitoring, and vehicle reliability, making it suitable for low-speed and lightweight electric vehicles.

Keywords*:* Electric Vehicle (EV) Overload Detection, Arduino UNO, Load Cell (Strain Gauge), Buzzer Alert System

I. INTRODUCTION

In recent years, the demand for electric vehicles (EVs) has increased significantly due to their environmental benefits, lower operating costs, and contribution to sustainable transportation. As the EV industry grows, the focus has shifted not only to performance but also to safety and reliability. One of the challenges that EV users often face is vehicle overloading, which can lead to a number of issues such as reduced battery efficiency, increased power consumption, and mechanical stress on various components. Overloading not only compromises vehicle performance but also poses safety risks for passengers and the vehicle itself. To address this problem, this project introduces a system titled "Electric Vehicle Overload Detection and Alert System Using Arduino". The objective of the system is to detect overload conditions in an electric vehicle using a load cell sensor, and immediately alert the driver through a buzzer when the weight exceeds a predefined threshold. This helps in taking timely action to prevent damage or performance loss. In addition to overload detection, the system is also capable of calculating the real-time mileage of the electric vehicle, both before and after the overload occurs. By monitoring these values, users can understand how excess load affects the vehicle's efficiency, thus promoting safer and more responsible usage. This project offers a cost-effective, scalable, and easy-toimplement solution using Arduino and basic electronic components. It aims to enhance the performance, safety, and sustainability of electric vehicles, making them smarter and more reliable for everyday use.

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II. PROBLEM STATEMENT

Overloading in electric vehicles is a serious issue that can lead to decreased performance, reduced battery life, and increased safety risks. Despite the growing adoption of electric vehicles, most EVs lack a built-in system to detect and alert drivers when the vehicle is overloaded. This can result in inefficient power consumption, increased wear and tear, and even mechanical failure over time. There is a pressing need for a cost-effective, real-time overload detection and alert system that can not only notify the driver immediately but also provide insights into how overloading affects the vehicle's efficiency, such as mileage. Existing solutions either target traditional vehicles or are too complex and expensive for practical implementation in low- to mid-range EVs. This project aims to solve this problem by designing a smart, Arduino-based system that detects overload conditions using a load cell, alerts the driver through a buzzer, and calculates real-time mileage to monitor the vehicle's performance before and after overload conditions.

III. LITERATURE REVIEW

Several studies have addressed the issue of vehicle overloading using sensor-based embedded systems. An Arduino-based overload detection system reported in IRJET highlights the use of load sensors to detect excess weight and alert the driver through audio and visual indicators, thereby improving vehicle safety. Some systems also restrict vehicle operation during overload conditions to prevent damage.

IoT-based approaches using platforms like Raspberry Pi enable real-time monitoring and remote access to load data, improving efficiency in transport management. However, such systems are often complex and costly for small-scale electric vehicles.

Advanced real-time monitoring systems integrate multiple sensors and image processing for regulatory enforcement, but their complexity limits their application in lightweight EVs. IEEE-based research emphasizes that overload detection using load sensors and alert mechanisms significantly reduces accident risks and vehicle wear.

From the literature survey, it is evident that there is a need for a simple, low-cost, Arduino-based overload detection system for electric vehicles, which forms the basis of the proposed project.

IV. RESEARCH METHODOLOGY

The proposed Electric Vehicle Overload Detection and Alert System is implemented on an electric tricycle to monitor load conditions and analyze performance variations. A strain-gauge load cell is mounted on the vehicle to measure the applied load in real time. Since the output signal from the load cell is very small, it is amplified and converted into digital form using an HX711 amplifier module. The processed signal is then fed to an Arduino UNO, which acts as the central control unit of the system.

The electric vehicle operates on a 24V battery system, which is stepped down using an LM2596 buck converter and further regulated by an LM7805 voltage regulator to obtain a stable 5V supply for all electronic components. The Arduino continuously compares the measured load with a predefined threshold value. When the load exceeds the safe limit, the system activates a buzzer to alert the user and displays real-time load and mileage information on a 16×2 LCD display. Mileage values before and after overload conditions are calculated to study the effect of excess load on vehicle efficiency.

V. WORKING PRINCIPLE

The working principle of the Electric Vehicle Overload Detection and Alert System is based on **strain-gauge load sensing and microcontroller-based processing**. When load is applied to the vehicle, the load cell experiences mechanical strain, which causes a proportional change in electrical resistance. This produces a very small analog voltage signal. The HX711 amplifier amplifies and converts this signal into digital form. The Arduino UNO processes the data, compares it with a predefined load limit, and determines overload conditions. If the load exceeds the threshold, an alert is generated using a buzzer, and relevant information is displayed on an LCD.

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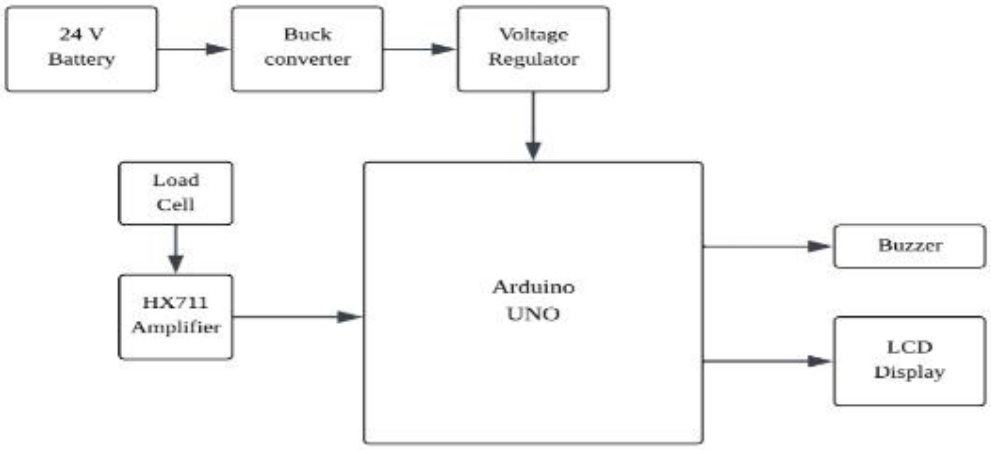
WORKING

The electric vehicle supplies 24V DC power from its battery system.
This voltage is stepped down using an LM2596 buck converter and regulated to 5V using an LM7805 voltage regulator to safely power all electronic components.
A strain-gauge load cell mounted on the electric tricycle senses the applied load on the vehicle.
The load cell produces a very small analog signal proportional to the weight applied.
This weak signal is amplified and converted into digital form using the HX711 amplifier module.
The digital load data is sent to the Arduino UNO, which acts as the central controller.
The Arduino continuously compares the measured load with a predefined safe load limit.
If the load exceeds the threshold value, the Arduino activates a buzzer to alert the user.
Simultaneously, real-time load and mileage information is displayed on a 16×2 LCD display.
Mileage values before and after overload are calculated to analyze the effect of excess load on vehicle performance.

VI. BLOCK DIAGRAM



COMPENTS USED

1. 24V Battery
2. Buck Converter
3. Voltage Regulator
4. Arduino UNO
5. Load Cell
6. HX711 Amplifier
7. LCD Display
8. Buzzer

VII. COMPONENTS DESCRIPTION

24V Battery

The 24V battery serves as the primary power source for the electric vehicle and the overload detection system. It supplies energy to the motor and electronic components. The battery output is later stepped down to suitable voltage levels for safe operation of the Arduino, sensors, and display modules.

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Buck Converter
The buck converter (LM2596) is used to step down the 24V battery voltage to a lower intermediate level. It ensures efficient voltage reduction with minimal power loss and heat generation. This protects sensitive electronic components and improves overall system efficiency.

Voltage Regulator
The voltage regulator (LM7805) provides a stable 5V DC output required by the Arduino UNO, HX711 amplifier, and LCD display. It ensures consistent voltage supply, prevents fluctuations, and protects components from damage due to overvoltage.

Arduino UNO
Arduino UNO acts as the central control unit of the system. It receives load data from the HX711 module, processes the information, compares it with preset limits, and controls output devices such as the LCD and buzzer. It also performs mileage calculations and decision-making operations.

Load Cell
The load cell is a strain-gauge based sensor used to measure the applied load on the electric vehicle. When weight is applied, it produces a small electrical signal proportional to the load. This signal is used to detect overload conditions accurately.

HX711 Amplifier
The HX711 is a high-precision amplifier and analog-to-digital converter designed for weight measurement. It amplifies the weak signal from the load cell and converts it into digital form, enabling accurate load measurement by the Arduino UNO.

LCD Display
The 16×2 LCD display provides a visual interface between the system and the user. It displays real-time information such as load values, mileage, and system status, allowing the driver to monitor vehicle conditions easily.

Buzzer
The buzzer acts as an alert device in the system. When the measured load exceeds the predefined safe limit, the Arduino activates the buzzer to provide an immediate audible warning to the user, ensuring timely corrective action.

VIII. ADVANTAGES

- **Improves Safety:** By detecting overload conditions in real-time and alerting the driver, the system helps prevent accidents and damage to the vehicle, ensuring safer transportation.
- **Enhances Efficiency Monitoring:** The ability to calculate and compare mileage before and after overloading gives valuable insights into how excess weight affects the performance of an electric vehicle.
- **Protects Vehicle Components:** Prevents unnecessary strain on the motor, battery, and suspension systems by alerting users to reduce the load, thereby extending the vehicle's lifespan.
- **Cost-Effective solution:** Uses affordable components like Arduino, load cells, and buzzers - making it suitable for integration in low-budget or small-scale EVs.
- **Simple and Scalable Design:** The system is easy to implement and can be scaled or modified for different types of electric vehicles and load capacities.
- **Promotes Responsible Usage:** Educates drivers and users about the impact of overloading and encourages responsible and optimal vehicle loading practices.

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IX. LIMITATIONS

- The system provides only an alert during overload conditions and does not automatically control or limit the vehicle operation.
- Accuracy of load measurement depends on proper calibration of the load cell and may vary with temperature and mechanical mounting.
- The system is designed for low-speed, lightweight electric vehicles and may not be suitable for heavy or high-speed EVs without modification.
- Mileage calculation is based on sensor inputs and assumptions, which may not reflect exact real-world driving conditions.
- The system does not include wireless or IoT connectivity for remote monitoring or data logging.
- Environmental factors such as vibration, dust, and moisture may affect sensor performance if proper enclosures are not used.
- The system requires a stable power supply; fluctuations in battery voltage may affect performance if not regulated properly.

X. CONCLUSION

The Electric Vehicle Overload Detection and Alert System using Arduino presents a practical, low-cost, and scalable solution to a critical safety issue in modern electric mobility. By integrating a strain gauge load cell, HX711 amplifier, Arduino UNO, and alert mechanisms like an LCD and buzzer, the system effectively detects overload conditions in real time and informs the driver immediately. This proactive approach helps prevent mechanical damage, battery strain, and potential accidents caused by excessive loading. The system also calculates mileage before and after overload, offering valuable insights into how weight impacts vehicle efficiency. The dual-stage voltage regulation using LM2596 and LM7805 ensures stable power delivery to all components, while the modular design allows easy expansion and customization. Overall, the project enhances safety, promotes responsible usage, and supports the long-term reliability of electric vehicles, especially in low-speed, lightweight applications like e-bikes and tricycles

XI. FUTURE SCOPE

Future improvements may include IoT integration for remote monitoring, SD card logging, Bluetooth connectivity, multiple load-cell configurations, and weatherproof mechanical enclosures.

REFERENCES

[1]. A Study on Sensors for Measuring Load of Railway Vehicle Wheels in Motion. Department of Transport Equipment and Technology, VTU T. Kableshkov, Sofia, Bulgaria and Department of Electronic Engineering, TU of Sofia, Bulgaria.

[2]. Strain gauges and Wheatstone bridges –basic instrumentation and new applications for electrical measurement of non-electrical quantities.

[3]. A.A. Mulla, Z. A. Mulla, Microcontroller based weighing machine.

[4]. R.K. Rajput, “Strength of Materials”, Laxmi Publications.

[5]. Open Source AI Platforms.

[6]. International Research Journal of Engineering and Technology (IRJET), Volume: 07 Issue: 05 | May 2020. “Arduino based Vehicle Overload Detection and Prevention System” Neeli Sreekeerthan, Shaik Maqsood, Tirunahari Sri Sharan, Gummadi Prashanth Sai UG students, Dept of Mechatronics Engineering, Mahatma Gandhi Institute of Technology, Telangana, India

[7]. International Journal of Innovative Research in Science, Engineering and Technology, Vol. 8, Issue 10, October 2019. “Vehicle Overloading Detection and Protection using Raspberry Pi and IOT Application” Mr. Shardul Singh Gurjar, Dr. Ravi Mishra, Department of Communication System, Shri Shankaracharya

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Technical Campus (SSGI), Bhilai, CG, India Associate Professor, Department of Electrical & Electronics Engineering, Shri Shankaracharya Technical Campus (SSGI), Bhilai, CG, India.

[8]. YMER || ISSN: 0044-0477 "Real-Time Vehicle Overload Detection System" P. Devi, N. Ragavendran, V. Praveenkumar, R. Durkeshwaran. Department of Electronics and Communication Engineering, Sri Ramakrishna Institute of Technology, Coimbatore - 641108, Tamil Nadu, India.

[9]. IEEE Xplore Part Number: CFP23N67-ART; ISBN: 979-8-3503-2142-5 || "Arduino based Vehicle Overload Detection System for Prevention of Accidents using ADC" Shraddha Dahatonde, Nishigandha Jape, Ram.N. Hajare, D. B. Pardeshi, P William Department of Electrical Engineering Sanjivani College of Engineering Savitribai Phule Pune University, Pune, India.

ABOUT AUTHORS

	Name–Mr. H Vinay Kumar Designation-Assistant professor B.E(ElectricalandElectronicsEngineering) RaoBahadurYMahabaleshwarappaEngineeringcollege Email ID- vinayhavinal@rymec.in
	Name – Shivakumar S MDesignation-Student USN– 3VC22EE056 PhoneNumber– 9686327426 E-mail id –shivaeee056.rymec@gmail.com
	Name – P Nikhil Designation-Student USN –3VC22EE048 PhoneNumber–9113949593 E-mail id –pnikhil048.eee.rymec@gmail.com
	Name- Basavaraj Designation- Student USN – 3VC22EE011 PhoneNumber–9353162578 E-mail id – basavaraj011eee.rymec@gmail.com
	Name– T Sai Mani Designation- Student USN – 3VC22EE064 PhoneNumber– 9591432888 E-mail id- rsai84484@gmail.com