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An Intensive Approach to Reduce Range Anxiety of Electric Vehicle by Calibrating Weight Factor

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Abstract: **Electric vehicles (EVs) are gaining popularity thanks to advancements in green energy technology. However, a major concern for potential users is range anxiety—the fear that an EV might run out of power before reaching a destination. A key factor contributing to this concern is the impact of passenger weight on the vehicle's range. Extra weight from passengers increases energy consumption, particularly in stop-and-go traffic, leading to reduced driving range. To address this issue, we developed a method to improve range prediction by considering the effect of passenger weight. Our approach uses real-world data to understand how passenger load impacts energy consumption, especially when battery levels and vehicle speed are constant. By fine-tuning the range prediction model based on passenger weight, we aim to reduce range anxiety while ensuring optimal vehicle performance. This research offers a practical solution to range anxiety by providing more accurate range estimates, helping EV drivers feel more confident about their vehicle's capabilities. This improvement could encourage wider adoption of electric vehicles, benefiting both the environment and drivers.**

1. INTRODUCTION

Electric vehicles (EVs) are becoming very popular because they are better for the environment compared to gasoline powered vehicles. Regulations are increasingly limiting fossil-fuelled vehicles to promote cleaner energy solutions [1]. This change toward cleaner technology is driven by the need to cut down on pollution and support a healthier planet.In [2], Author evaluated the cost of EVs and compared with conventional vehicles and found that EVs will be a cheaper option in a few years of time. Despite this, people are hesitant to switch to EVs due to the issue of range anxiety.

Range anxiety is anapprehension that an EV might not have enough battery charge to finish a trip, which could leave drivers stranded.Electric vehicles (EVs) often have limited range, and the scarcity of recharging stations leads to 'range anxiety', which makes potential users hesitant to adopt EVs [3,4]. This worry can get worse depending upon different things such as driving style, weather, and the type of roadthat affect how far an EV can travel. This range anxiety is greatly determined by the driving behavior of EV users. As driving patterns vary on an individual basis, energy consumption for the same distance and environmental conditions could be extremely different [5]. In [6], the author discussed V2V (vehicle-to-vehicle) charging as a fundamental component of the EV ecosystem. In [7], the author applied different states of charges to minimize range anxiety in electric vehicles (EVs). To improve the accuracy of range anxiety analysis, L. Xia et al. [8] presented a method based on new energy vehicle monitoring big data. In [9], machine learning is used to predict and display energy consumption, which can reduce range anxiety.

D. Pevec et al. [10] conducted a survey which emphasized on potential electric vehicle (EV) owners to gauge their perception of range anxiety by focusing on two main factors: the state of charge (the battery's current energy level) and the remaining range. Another significant but often overlooked factor is passenger weight.

The weight of passengers can impact an EV's range in a few ways. Heavier vehicles need more energy to accelerate and might have trouble braking, especially in stop-and-go traffic. This means heavier EVs use more power, leading to shorter distances on a full charge.

Our research is focused on solving range anxiety by analysing, how passenger weight affects an EV's range by predicting range more accurately with the proposed methodology. With better predictions, drivers can feel more confident about using electric vehicle, encouraging more people to adopt them.

In this article, we have used real-time data to understand how energy used in EVs has a corelation with the passenger weight. By researching, how load of different passengers affect range, we aim to create better prediction models to reduce range anxiety. Our research would be beneficial forindustries aiming production of electric vehicles and reduce anxiety of potential customersby providing a practical way to improve the reliability and dependability of EVs. The Figure 1 illustrates a block diagram for calibration of range considering weight of passenger.

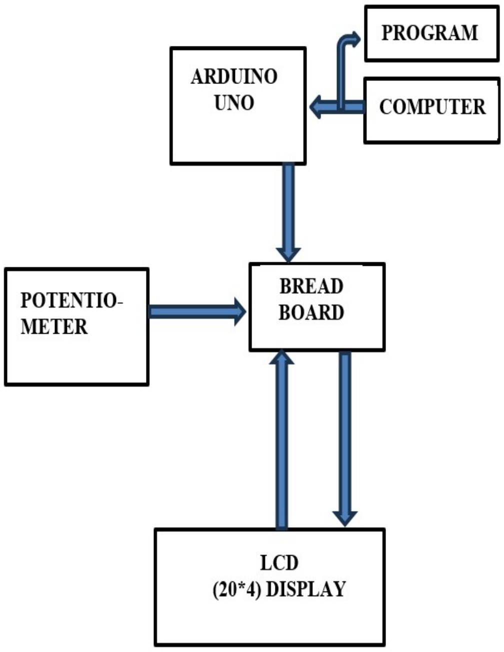

Figure 1:Block Diagram for Calibration of Range Considering Passenger Weight

2. COMPONENTS

2.1 Arduino UNO: The Arduino UNO is a microcontroller board that is built around the ATmega328 [11]. Microcontrollers are tiny computers that can be programmed to perform specific tasks. The Arduino Uno compiles user-written code (called sketches) and translates it into instructions compatible to ATmega328P. These instructions control the various electronic components connected to the board.

The Arduino IDE (Integrated Development Environment) is a free software application used to write, compile, and upload code to the Arduino Uno [12]. It provides a user-friendly interface and simplifies the programming process.

The Arduino Uno features the ATmega328P, an 8-bit AVR microcontroller. It operates at 5V with a recommended input voltage range of 7-12V, though it can handle inputs from 6 to 20V. The board has 14 digital I/O pins, six of which support Pulse Width Modulation (PWM) output, along with six analog input pins. Each I/O pin can handle up to 20 mA, and the 3.3V pin supports up to 50 mA. The board includes 32 KB of flash memory, with 0.5 KB used by the bootloader, 2 KB of SRAM, and 1 KB of EEPROM. The clock speed is set at 16 MHz, and the board communicates through USB, SPI, I2C, and UART.Figure 2 shows the snapshot of Arduino Uno board.

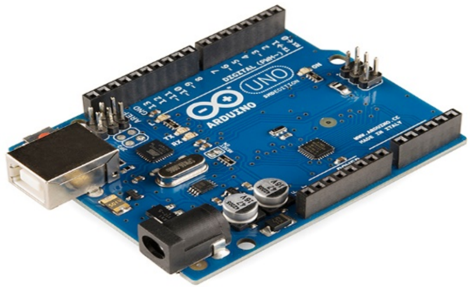

Figure 2: Arduino UNO (ATmega-328P)

2.2 LCD display 20*4: An LCD 20x4 display consists of four rows, with each row capable of displaying up to 20 characters. When setting up a 20x4 LCD display, proper wiring, initialization using the Liquid Crystal library, attention to contrast settings and power supply voltage are crucial for optimal performance. It works with any microcontroller, for instance Arduino operating at 3.3 V to 5V [13]. LCD display (20x4) is shown in Figure 3.

Figure 3: 20*4 LCD display

2.3 Potentiometer: A potentiometer is a variable resistor with three terminals, where a sliding or rotating contact allows you to adjust the resistance, effectively creating a customizable voltage divider [14]. Connecting a 10kΩ potentiometer to a 20*4 LCD display serves the purpose of adjusting the contrast of the display. By adjusting the potentiometer, users can control the contrast of the LCD screen, ensuring optimal visibility of text and graphics displayed on screen. A 10kΩ potentiometer is shown in Figure 4.

Figure 4: 10kΩ potentiometer

3 METHODOLOGY

Hardware Setup: An Arduino Uno microcontroller collects and processes data in real-time. A 20x4 LCD display shows information to the driver. We have used a breadboard to connect components and a potentiometer to adjust settings.

Data Collection: Real-time data has been collected on the EV's passenger weight through potentiometer and sentit to an Arduino uno. To keep the data consistent, speed is set to constant and battery level to 100 percentages during the tests.

Testing the Impact of Passenger Weight: Experiments have been conducted to see how extra weight affects the EV's range. By adding known weights to the vehicle, we have observed how the range changes. It has been found that for every 10-kg increase in passenger weight, the range is decreased by 5%.

Software Development: Our software for the Arduino Uno calculated the estimated range based on the collected data. The software used algorithms to adjust the range prediction depending on passenger weight and speed, which has been maintained constant with battery level being 100 percent.

Real-time Display: The LCD display indicated the estimated range in real-time, allowing drivers to know how far they could go before recharging. It also indicates if and where they might need to stop to recharge.

Validation and Testing: We are testing the system for different passenger load conditions to ensure that the predictions are accurate. By keeping the battery level and speed constant, we ensured the consistency of results.

In the below table, the range of EVs has been predicted through a software algorithm by conducting 10 structured test cases with varying passenger weights with constant speed while keeping the battery level at 100 percent.

Table 1: Experimental Data for Range Prediction of Electric Vehicle (Two- wheeler)

S.NO.	Weight (KG)	Speed (KM/H)	Battery (%)	Range (KM)
1.	50-60	40-50	100	100
2.	61-70	40-50	100	95
3.	71-80	40-50	100	90
4.	81-90	40-50	100	85
5.	91-100	40-50	100	80
6.	101-110	40-50	100	75
7.	111-120	40-50	100	70
8.	121-130	40-50	100	65
9.	131-140	40-50	100	60
10.	141-150	40-50	100	55
11.	151-160	40-50	100	50

4 RESULT

This paper presents the results of a development project designed to help EV riders understand how their battery will perform during a trip, allowing them to plan places to stop for recharging if needed. This way, drivers can know in advance whether they need to stop and where they can do so. In this article, we have evaluated the real-time range of an electric vehicle based on the weight of its passengers. We used various components such as the Arduino Uno, a 20x4 LCD display, a breadboard, and a potentiometer. Our results proposed that every 10 kg increment in the weight of the passengers resulted decrement of 5 percent in the range.

The project addresses a common concern that prevents people from buying EVs—the fear of running out of power on long trips.

5 CONCLUSION

Our research tackles the issue of range anxiety in electric vehicles (EVs) by examining how passenger weight affects driving range. Using real-time data, we have developed a method to predict range more accurately, considering the increased energy consumption caused by heavier passenger loads, especially in stop-and-go traffic. Our refined prediction model provides EV drivers with better estimates, allowing them to plan trips with greater confidence. This way, accuracy is improved, and henceforth, range anxiety is reduced, which encourages wider adoption of EVs among customers, contributing to a more sustainable future. By offering a practical solution to range anxiety, we aim to support both drivers and the environment, promoting a greener transportation model.

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