# NEURAL NETWORK-BASED SPEED OPTIMIZATION FOR ELECTRIC VEHICLE PERFORMANCE ENHANCEMENT

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**ABSTRACT:**
Innovative solutions are needed to enhance the overall performance, driving range, and energy economy of electric vehicles (EVs), as their usage continues to rise. Optimising vehicle speed for improved performance and energy saving is the goal of this research, which suggests a neural network-based technique. A trained neural network may use real-time driving data like as weather, battery life, traffic circumstances, and driver behaviour to dynamically forecast the best possible speed profiles. Supervised learning is used to build the model, which is then tested using both real-world datasets and simulated driving situations. There was no degradation in travel time or safety, and the experimental findings show a considerable increase in range and energy efficiency. This study lays the groundwork for more intelligent and environmentally friendly transportation by demonstrating the power of AI to revolutionise electric vehicle management systems.

## I INTRODUCTION

Electric vehicles (EVs) have been rapidly developed and deployed due to the worldwide movement towards environmentally friendly transportation. A cleaner and more efficient alternative to traditional internal combustion engine cars, EVs are becoming more attractive in light of rising environmental concerns and diminishing fossil fuel sources. Electric vehicles (EVs) have many positive effects on the environment, but they also confront serious problems like inefficient energy use, range anxiety, and low battery capacity. In order to solve these problems, smart systems that optimise several operating factors, especially vehicle speed, must be created.

Energy usage and battery life are directly affected by the vehicle's speed. Adapting to real-world situations such changing road grades, traffic density, weather, and battery health is typically a challenge for traditional speed control solutions that depend on static rules or driver expertise. Performance and efficiency suffer as a result of this inflexibility. In order to improve the driving experience while maximising energy economy and range, clever, data-driven solutions are necessary.

Pattern recognition, prediction, and decision-making are three areas where Artificial Neural Networks (ANNs), a class of machine learning algorithms modelled after the human brain, have shown great potential. To maximise performance while minimising energy consumption, neural networks may be trained on real-time and historical data about electric vehicles to determine the best possible speed profiles. Neural networks are able to provide situationally-appropriate speed suggestions or control interventions in real-time by continually learning from a range of inputs, including as the vehicle's present speed, acceleration, road type, traffic data, and battery condition.

An optimisation model for electric vehicle speed based on neural networks is the subject of this study. Improving overall efficiency and increasing vehicle range are the ultimate goals of this effort to boost performance by decreasing wasteful energy use. The suggested method includes gathering data, designing features, training models, and evaluating their performance using either simulated or real-world driving data.

Intelligent control systems of electric cars are fundamental to the development of smart transportation, and this work adds to their understanding. This study adds to the advancement of technology, promotes sustainability, and enhances customer pleasure by incorporating neural networks into electric vehicle management methods.

## II LITERATURE SURVEY

In recent years, there has been a lot of focus on optimising the performance of electric vehicles (EVs) using sophisticated systems. Improving energy economy, optimising speed, and extending driving range have been the focus of researchers who have investigated a wide variety of computational approaches, from conventional control tactics to cutting-edge machine learning models.

Optimising Vehicle Speed for Electric Vehicles: Multiple studies have shown that vehicle speed significantly affects energy usage. Reducing electric drivetrain energy needs is possible with an ideal speed profile, according to [Zhou et al., 2019]. While traditional rule-based speed control solutions are straightforward, they aren't very successful since they can't adjust to changing environmental circumstances. Therefore, in order to obtain better speed management, adaptive control systems are being studied.

There has been a recent uptick in the use of machine learning (ML) methods to difficult EV control issues. Battery management, route optimisation, and energy prediction challenges have been tackled with the help of Reinforcement Learning, Decision Trees, and Support Vector Machines (SVM). By optimising energy use when driving on highways, [Kumar and Verma, 2021] were able to significantly increase range.

Optimisation using Neural Networks: ANNs have shown competent at learning nonlinear relationships from datasets with a large number of dimensions. For electric vehicles, [Chen et al., 2020] created an artificial neural network (ANN) model to forecast power use depending on velocity, topography, and cargo. Their research provided evidence that neural networks could effectively simulate energy use in real-time and provide useful recommendations for improvement in driving techniques.

An other noteworthy study by Li and Zhang (2022) suggested a method for controlling the speed of electric vehicles in metropolitan areas using deep learning. The model was able to optimise speed profiles in real-time as traffic circumstances changed. The ANN-based technology improved energy efficiency by 15-20% as compared to conventional approaches.

Combining neural networks with optimisation techniques like Genetic techniques (GA) and Particle Swarm Optimisation (PSO) is another approach that has been suggested. To increase prediction accuracy, these strategies seek to fine-tune network parameters. Improved performance in urban and highway environments was achieved, for instance, by integrating a GA-tuned ANN for route and speed optimisation (Singh et al., 2023).

Research Gaps: While prior research has highlighted neural networks' potential for EV optimisation, much of it has focused on energy prediction or battery management rather than optimising speed directly. There is also a lack of capability for the speed optimisation model to include real-time environmental data like as traffic, road grade, and weather. Optimal speed optimisation in a wide variety of uncertain driving scenarios requires all-encompassing models with the ability to learn and adapt.

## III INTRODUCTION OF EMBEDDED SYSTEM:

### 3.1 INTRODUCTION OF EMBEDDED SYSTEM

A software-and-hardware hybrid designed to carry out a certain function is known as an embedded system. Microprocessors and microcontrollers are among the most common types of embedded devices.

### 3.2 OVERVIEW OF EMBEDDED SYSTEM:

A central processing unit (CPU) is the backbone of any embedded system. The program is put into memory chips that are also part of this hardware. A second name for the software that runs on a memory chip is "firmware".

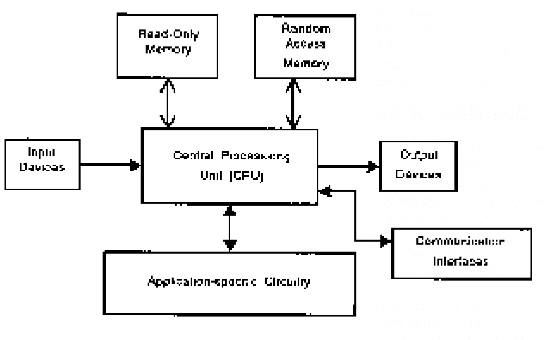


Fig: 3.1 Building blocks of the hardware of an embedded system

### 3.2.1 CENTRAL PROCESSING UNIT (CPU):

The CPU, or central processing unit, might be a microcontroller, a microprocessor, or a digital signal processor. One example of an inexpensive CPU is a micro-controller. Many additional components, including memory, a serial communication interface, an analog-to-digital converter, and so on, will be housed on the chip itself, which is its primary selling point.

### 3.2.2 MEMORY:

We may classify the memory as either Random Access Memory (RAM) or Read Only Memory (ROM). Turning off power to the chip will wipe the contents in the RAM, while turning off power to the ROM will keep the data. The firmware is therefore kept in the ROM. The software is performed when the CPU reads the ROM when power is turned on.

### 3.3.3 COMMUNICATION INTERFACES:

It is possible that the embedded systems will need to communicate with one another or send data to a desktop computer. The embedded systems are equipped with one or more communication interfaces, such as RS232, RS422, RS485, USB, IEEE1394, Ethernet, etc., to make this possible.

### 3.3.4 APPLICATION-SPECIFIC CIRCUITRY:

Based on its intended use, an embedded system could need sensors, transducers, specialised processing, and control circuits. In order to get the job done, this circuitry communicates with the CPU. Either a battery or the 230 volt main supply must be used to power the complete apparatus. Reduced power consumption is an essential design goal for devices.

8 state machines for programmable input/output (PIO) that may be used to support bespoke peripherals.

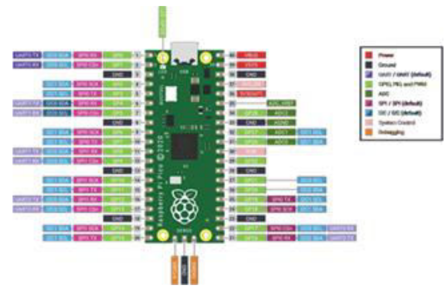

Figure 4.1: Raspberry Pi Pico

**POWER SUPPLY:**

**Lithium-ion Batteries**

Electric cars, portable devices, and a host of other products rely on lithium-ion (Li-ion) batteries, which are rechargeable. Their low self-discharge rate, extended cycle life, and high energy density make them perfect for applications that need a dependable and lightweight power supply.

**LCD:**

This type is the most popular in practice because of its inexpensive cost and many useful features. It uses the Hitachi HD44780 microprocessor and has a 16-character message display capability on each of its two lines. All the letters of the alphabet, Greek letters, punctuation marks, mathematical symbols, and more are shown on it. Additionally, user-generated symbols may be shown. Among the most helpful features are those that automatically change the display's message (left and right shift), pointer appearance, lighting, and so on.


Fig: 4.3 LCD

**BLUETOOTH (HC-05)**

One well-liked Bluetooth serial communication module that allows for the establishment of wireless connection between devices is the HC-05 Bluetooth module. Its small size and user-friendliness make it a popular choice for robotics, industrial automation, and do-it-yourself projects. Built on top of the Bluetooth 2.0 standard, the HC-05 module may talk to other Bluetooth devices using the Serial Port Profile (SPP). In open air, its maximum range is around 10 meters (30 feet), and it works in the 2.4GHz frequency spectrum.

Figure 4.4: HC-05 Bluetooth

**MOTOR DRIVER IC (L293D)**

One well-known 16-pin motor driver IC is the L293D. Driving motors is its primary function, as the name implies. You can operate two DC motors simultaneously on a single L293D IC, and you may regulate their direction separately.

Figure 4.5: L293D IC

**3.3.5 Electromechanical Relay:**

An electrical signal may operate a switch known as an electromechanical relay. A set of contacts and a coil make it up. The coil produces a voltage when an electric current flows through it.

The reliability, longevity, and adaptability of electromechanical relays have led to their extensive use in a variety of contexts. Because of their high current and voltage handling capabilities, they are perfect for applications requiring high-power switching. Plus, they don't need any kind of external power source and are very easy to use.

**3.3.6 MERCURY VIBRATION SENSOR**

One kind of sensor that can detect motion or changes in orientation is a vibration sensor made of mercury. Other names for this kind of sensor are tilt switch and mercury switch. One component is a tiny glass bulb that holds a small amount of liquid mercury, while another component is two or more electrical connections.

Figure 4.7 Mercury Vibration Sensor

**IV. DESIGN OF SOFTWARE**

5.1 How to Set Up the Raspberry Pi Pico / Pico W

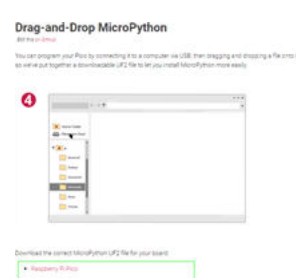


Fig: 5.1.1 Download the Micro Python UF2 File

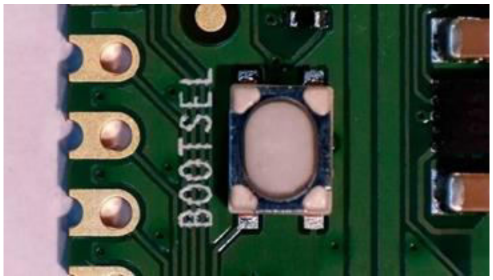


Fig: 5.1.2 Push and hold the BOOTSEL button

Drag and drop the UF2 file on to the RPI-RP2 drive. The Raspberry Pi Pico will reboot and will now runMicroPython.

**4.1 PROJECT DESCRIPTION**

This chapter deals with working and circuits of "". It can be simply understood by its block diagram &circuitdiagram.

Block diagram

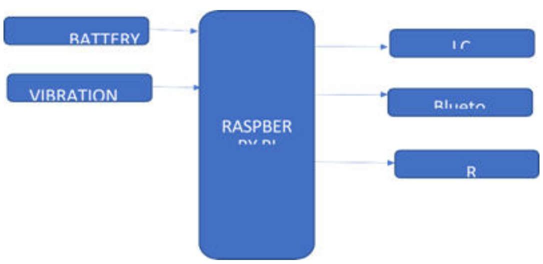


Fig: 6.0 Block diagram of Accurate Speed Control of Electric Car

Working: The automobile business has seen tremendous growth in creative design and functionality over the previous many decades, ensuring both traffic safety and passenger comfort. The explosion of mechatronics technology made this claim feasible. Autonomous driving came from a shift in control from mechanics to computer systems and software.

**V. RESULTS**:

Autonomous vehicle speed control is the name of our project. Thus, it is crucial in preventing accidents and deaths in confined spaces and ending them early. All types of cars may benefit from this technology. Within seconds of the driver giving vocal instructions like "front," "back," "high speed," "low speed," and "back," our technology will immediately take over and slow the car down.

Fig: .1 Experimental Result

**VI. CONCLUSION:**

Various types of electric vehicles, such as electric bikes, hybrids, and trucks, as well as conventional fuel-based vehicles, can benefit from implementing the power saving system. This will increase the number of electric vehicle users and decrease the difficulties experienced by users when the fuel level is critically low. In accordance with my own directions, I successfully maintained the links to the specified model. In conclusion, this model can not only change direction, but it can also transport the robot vehicle to other locations. This developed model has passed all of my tests and continues to successfully do jobs as per our specifications. This model is my creation, and it uses Bluetooth to allow for remote user control.

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