

Modelling and design of e-vehicles integrated with wireless technology with sensors using artificial intelligence and cloud computing

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Abstract—The e-vehicles or electric vehicles (EV) is described as the vehicle that are capable to run through electric motor which attains power from external electrical source and stores in the battery for further usages. It is grounded on electro mechanical system. The enhancement of electric vehicle leads to decrease in the emission of CO₂ in the atmosphere. It helps to increase the use of renewable energy source whenever there is a demand in the electrical supply from the grid. The hybrid electric vehicle helps in versatile ways to conserve fuels. Effective utilization with optimization techniques in the usage of electric supply from the grid with proper charging and discharging helps to maintain the demand side management. The electric vehicle helps to main the greener ecosystem with reduction in contaminated air in the environment. This is done through artificial intelligence techniques. The external physical parameters are sensed through the sensors. The overall performance is monitored with two way communication system adopted through the cloud computing techniques with implementing wireless technology.

Keywords—*Electric Vehicles (EV), electrical source, battery, electric current control, emission of CO₂, demand side management, artificial intelligence, cloud computing*

I. INTRODUCTION

Transportation is an important parameter in everyday life. This is done through diesel and petrol vehicles that leads to various pollution in the environment. To overcome the drawbacks of the existing vehicle, the electric vehicles are implemented [1].

The existence and introduction of electric vehicles came in 19th century. The advancement of power electronics combined with microelectronics leads to the enhancement and development of electric vehicles. The development of electric vehicles are rapidly increased due to the eco-friendly nature. The rise of electric vehicles are due to the reduced amount of fossil fuels that also destructs the environment with various climatic change [2]. The process of attaining clean energy through the electric vehicles is also an important parameter for switching over the electric vehicles. The rise in the petrol and diesel price is also a considering parameter for the switching of electric vehicles than the conventional vehicle. The emissions from the petrol and diesel vehicle cause larger emission of toxic compounds in the environment which adversely affects the health of living organisms. To overcome the constraints of commercial vehicles, the electric vehicles are introduced. This is highly recommended due to the ease of use and coziness level. The electric vehicle is defined as the automotive vehicle that operates through the electrical energy. It adopts the electric motor for propulsion [3].

There are four kinds of electric vehicles based upon the performance and manufacturing. The hybrid electric vehicles play a prominent role in saving the usage of electric energy through adopting renewable energy source. This hybrid electric vehicles includes adopting energy from non-conventional energy source such as solar, tidal and wind energy. This helps in the enhancement of renewable energy source [4], [5].

In hybrid electric vehicles, the artificial intelligence with cloud computing techniques are implemented to enhance the control of power and to maintain the overall performance of the vehicles. This helps to maintain the

battery's State of Charge (SOC) [6]–[8]. This helps to maintain the life span of battery that adversely promotes the performance efficiency of the electric vehicles. Thus they are attained through the optimization techniques that are integrated with wireless technology. In the hybrid electric vehicles, the electrical energy obtained from the grid can be stored when there is larger availability for further usages. This can also help by sending them back to the electrical grid when there is a demand in the supply system. This helps to improve the storage of energy capacity in the electric vehicle. The overall performance is monitored and automated through two way communication system with sensors. The electric vehicles are the efficient alternative for the fossil fuel vehicles. The electric vehicles have zero tailpipe emissions. The absence of tailpipe emission leads to the reduction of carbon footprints in the environment. The electric vehicles have lesser maintenance cost due to the absence of various movable parts inside the vehicles which also reduces the running cost of the vehicle [9]–[11].

Thus the electric vehicles provides higher efficiency with better performance. This is done through the use of lithium ion batteries for storage of electrical power. The electric vehicles are much convenient and easier to operate because it does have any complicated system. They provide lesser noise pollution when compared to the traditional vehicles. This is due to the absence of combustion engines in the electric vehicles. They also provide easier and convenient in charging at any place without any rush at the petrol pump as similar to the conventional vehicles [12]–[14].

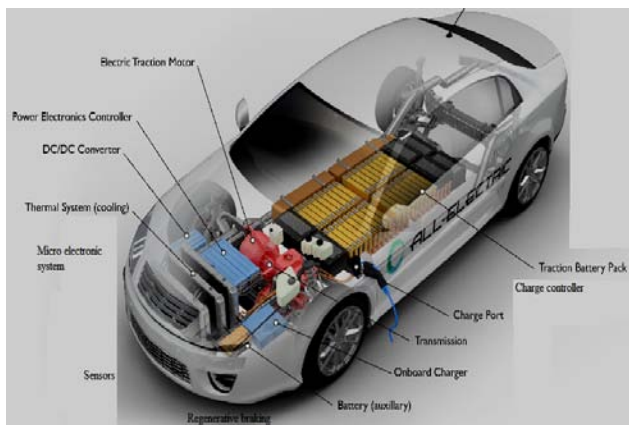


Fig. 1. Electric vehicle (EV)

The figure 1 demonstrates the model of electric vehicles. The advancement of electric vehicles are implemented through the artificial intelligence with cloud computing techniques. The Artificial Intelligence (AI) techniques helps in versatile forms with various task scheduling and source distribution. This helps in numerous automation and sophistications. These electric vehicles are integrated with wireless technology with sensors to adopt automation in the systems. The real time information processing are enhanced through the artificial intelligence and internet of things [15]–[17].

Various mechanism are implemented to control the loss of energy and to improve the efficiency of the system. This

is done with optimization techniques with algorithms with the adoption of artificial intelligence. This helps in the management of congestion control. To improve the functioning of electric vehicles, the integration of smart grid with electrical vehicles plays a prominent role. This helps in the optimization of charging and discharging of electrical vehicles based upon the rush and non-rush hours. This helps to maintain the demand side management. Here the loads are scheduled through the optimization techniques adopting artificial intelligence which helps to schedule the loads based upon the priority of the consumers [18].

The Government has launched the Electric Vehicle Initiative (EVI) to enhance the development of electric vehicles to reduce the usage of fossil fuels and develop a sustainable greener ecosystem. In this initiative sixteen countries are participating including India. There are various financial advantages in the electric vehicles ranging from lower cost of registration fees and road tax when compared to the purchase of the petrol or diesel vehicles. There are numerous policies and benefits offered by the Government. Thus the electric vehicles are the way forward in the transportation sector that helps in versatile benefits. The electric vehicle industry also helps to enhance various employment opportunities as reported by the Ministry of Skill Development and Entrepreneurship. The adoption of electric vehicles leads to the improvement of green energy with economic benefits in the upcoming decades.

II. PROPOSED SYSTEM

The e-vehicle or the electric vehicle is the combination of vehicle with electric propulsion system with battery storage and energy management system. The electric vehicles are differentiated into three categories. They are composed of microelectronics with chemical and automotive applications.

The electric vehicles adopts batteries to store the energy for functioning. These rechargeable batteries helps in proper charging and discharging operations that leads to improve the life span. This is also done by employing the regenerative braking. The electric vehicle can able to extract the kinetic energy at standstill conditions. This also helps to improve the performance of the battery. The traction batteries are the important part in the electric vehicles. This helps to enhance the energy storage process in the vehicles.

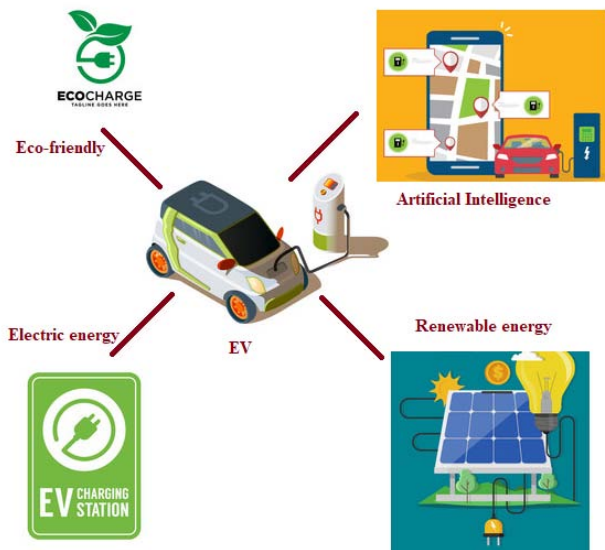


Fig. 2. Components of Electric Vehicle (EV)

The figure 2 demonstrates the electric vehicle with their various functioning parameters.

This includes the artificial intelligence techniques to provide automation with improve performance in the system. The components of electric vehicle includes power supply, electric gear box, inverter, charger, battery, sensors, servo-steering and servo-brake system. The charging of battery are classified into three types namely the current, voltage and pulse charging. These charging properties of batteries helps in the development of electric vehicles.

Thus the energy management system shows a prominent part in the functioning of the electric vehicles. The hybrid electric vehicle includes the extraction of energy for renewable energy source. This includes the solar panel at the roof of the electric vehicle that extracts energy at the day time and stores in the battery for further usages. The source of power for the electric vehicles are adopted through the battery. This helps in the improvement of energy management system in the electric vehicles [19], [20].

III. IMPLEMENTATION OF E-VEHICLES

The e-vehicles are functioned using the electric energy from the grid that are stored in the battery. The control management of the energy in the electric vehicle are maintained and regulated through the batteries inside the electrical vehicles.

To adopt faster energy charging of batteries, the technology of multi-energy system is employed. This helps to charge the batteries in a short span of time. Due to the absence of various ignition engines and motors inside the electric vehicle leads to saves the interior space. The body structure of the electric vehicle is composed of aluminum with plastic over coating to enhance light weight structure. The important parameter is the electric propulsion system that consists of single motor and multi motor drive.

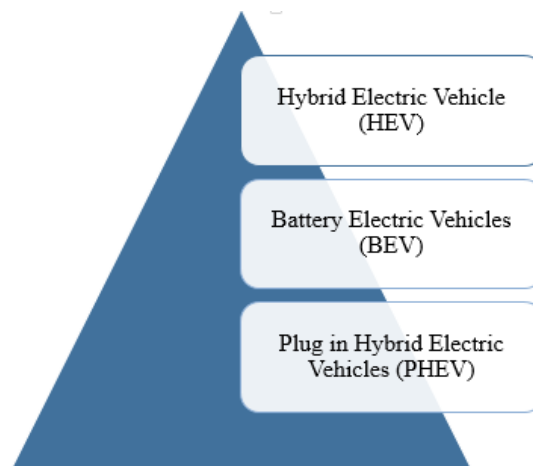


Fig. 3. Classification of EV

The figure 3 represents the classification of electric vehicles. They are differentiated based upon the usage of conventional engine and the type of battery charging and discharging techniques.

1. Hybrid Electric Vehicle (HEV)

The hybrid electric vehicle is a vehicle that integrates with the internal combustion engine with an electric propulsion system.

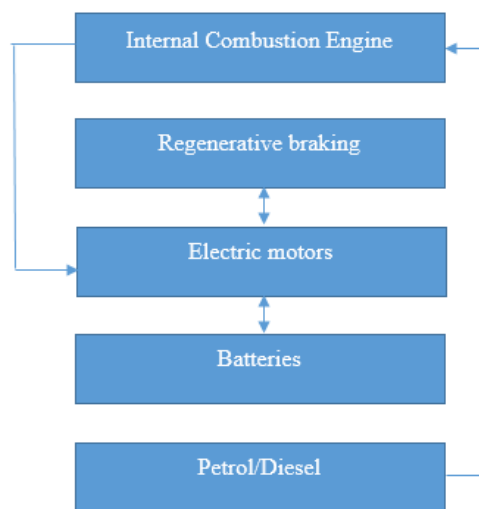


Fig 4: Hybrid Electric Vehicle

The figure 4 represents the functioning of hybrid electric vehicles. It is composed of internal combustion engine, generator and electric motors. The energy storage system includes batteries and supercapacitors [20]. The numerous categories of batteries are lead acid battery, lithium ion battery and nickel-metal hydride batteries. The fuel economization is attained through the hybrid electric vehicles. This enhances various supportable modes of mobility in the system. This involves various techniques such as the regenerative braking system to improve the efficiency of the system.

2. Battery Electric Vehicle (BEV)

The battery electric vehicle is represented as the complete electric vehicle that are operated through the chemical reactions that are takes place inside the battery. This can be charged and discharged based upon the needs of the users. They replaces the internal combustion engines with electric motors and various controllers for functioning the vehicle.

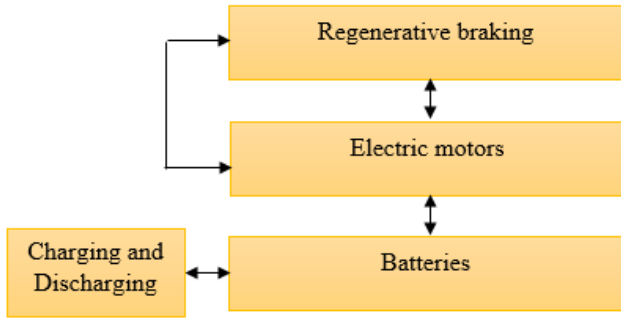


Fig. 5. Battery Electric Vehicle (BEV)

The figure 5 demonstrates the components and functioning of battery electric vehicle. Thus they are formulated through the rechargeable batteries with the absence of fuels in operating the vehicles. There is no another propulsion system in the electric vehicle. They are much efficient in reducing various environmental constraints that are caused by the conventional vehicles. They are inbuilt with artificial intelligence techniques to adopt the optimization of power This helps in charging the vehicle based upon the rush and off rush hours and dependent on the priority of the consumers. This leads to reduce the energy demand and saves the electric energy.

3. Plug in Hybrid Electric Vehicle (PHEV)

The Plug in Hybrid Electric Vehicle is defined as the vehicle which adopts two source for the internal combustion engine in which the battery can be charged and discharged whenever its needed. This can be done through plugging a charge cable with an external source for battery charging. Thus it uses charging elements and regenerative braking system. This includes both the usage of electric power and fossil fuels based upon the availability.

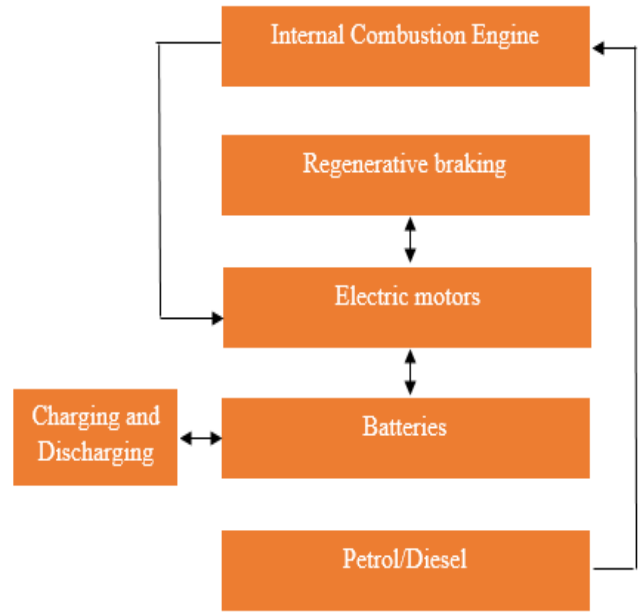


Fig. 6. Plug in Hybrid Electric Vehicle

The figure 6 demonstrates the Plug in Hybrid Electric Vehicle (PHEV).

IV. INTEGRATION OF E-VEHICLES WITH ARTIFICIAL INTELLIGENCE

The integration of e-vehicles with artificial intelligence gets rise with the vehicle to grid technology (V2G). This involves the process of charging and discharging techniques. This helps in implementation of two way communication system interacting with the grid and electric vehicle [23]. This includes various control strategies with sensors and hardware implementation in the electric vehicles. This helps to improve the efficiency through attaining stability in the system.

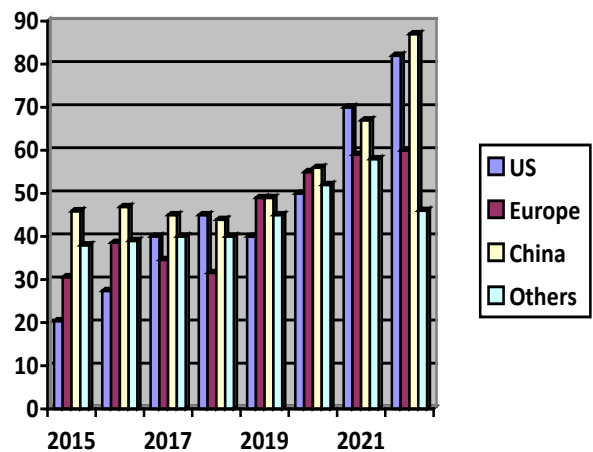


Fig. 7. Evolution of electric vehicle

The figure 7 demonstrates the evolution of electric vehicles across the world.

With the introduction of artificial intelligence in the charging and discharging system, it helps in attaining intelligent trends in upcoming decades. The load balancing

is attained through the introduction of optimization techniques. They are done through deep learning techniques. This helps in the combination of renewable energy for charging and leads in the reduction of greenhouse gas effects and its constraints. This helps in charging the battery through extracting the solar energy from the solar panel that converts the heat energy into electrical energy accompanied with charge controllers. Then it is stored in battery for further usages. They help in management of congestion and promotes voltage regulation.

The deep learning technique is defined as the subcategory of machine learning. It consists of numerous layers that help to process the data to produce the output. This includes extraction of optimum results with numerous layers that process them through optimization techniques.

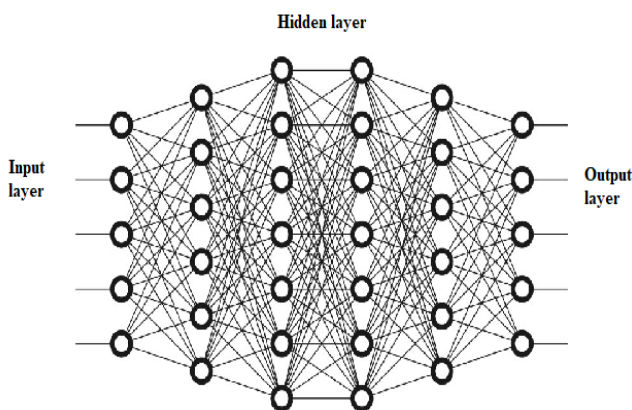


Fig. 8. Deep learning

The figure 8 represents the deep learning with numerous input and hidden layers that process the output. This is implemented to reduce the human interference in the functioning. This is largely used language and speech processing to improve automation with accurate results in the electrical vehicles. The scheduling is done through the optimization techniques. It is composed of input layer, hidden layer and the output layers. This works based upon the functioning of human intelligence. It resembles the neural network of human brain. It includes various data and algorithm to test and train the prototype.

The constraints are solved through the genetic algorithm. The genetic algorithm is a heuristic approach to solve the problems to achieve the optimum results. This is enhanced through the techniques of natural selection.



Fig. 9. Genetic algorithm

The figure 9 demonstrates the genetic algorithm process in obtaining the optimum outcome.

Algorithm

- In step 1, the program starts.
- Step 2 declares three integers x, y and z, which will be used in subsequent steps.
- Step 3 defines the values of x and y.
- Step 4 multiplies the values of x and y using the * operator.
- Step 5 stores the result of step 4 in the z variable using the assignment operator =.
- Step 6 prints the value of z using the cout statement.
- Step 7 stops the program.

the program performs a simple computation and displays the result. It can be easily modified or extended to include additional functionality, such as taking user input or performing more complex operations.

The genetic algorithm is used as an optimization technique to schedule the loads based upon the priority. The electric vehicle's charging is based upon the rush and off rush hours. This reduces the demand of electric power from the grid. This also helps to maintain the balance of power for the domestic and industrial usages.

V. SIMULATION IMPLEMENTATION AND OUTCOME

The implementation of e-vehicles with artificial intelligence and cloud computing techniques with sensors are evaluated and established in matlab Simulink. This helps to obtain the performance efficiency and its outcome.

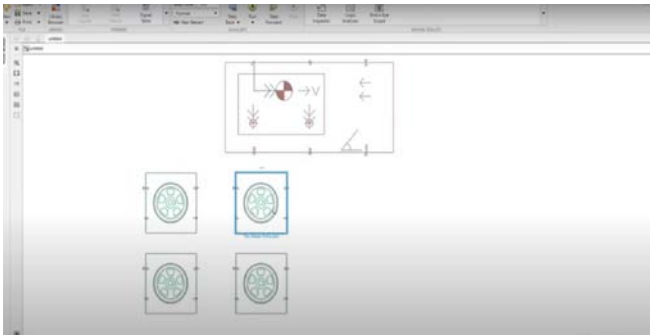


Fig 10: Modelling of e-vehicles

The Fig 10 demonstrates the modelling of e-vehicles in matlab Simulink. This includes various sensors with regenerative braking, motors and batteries.

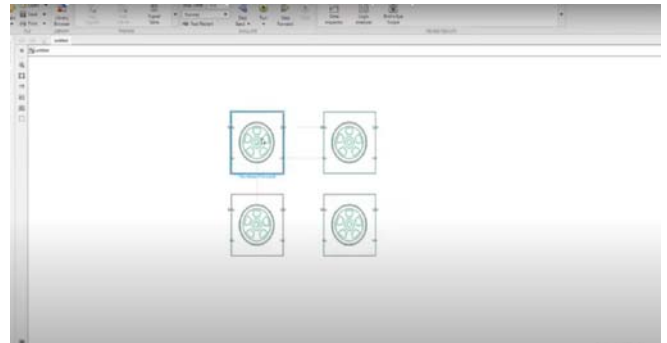


Fig 14: Regenerative braking

The Fig 13 represents the implementation of regenerative braking schemes in the electric vehicles.

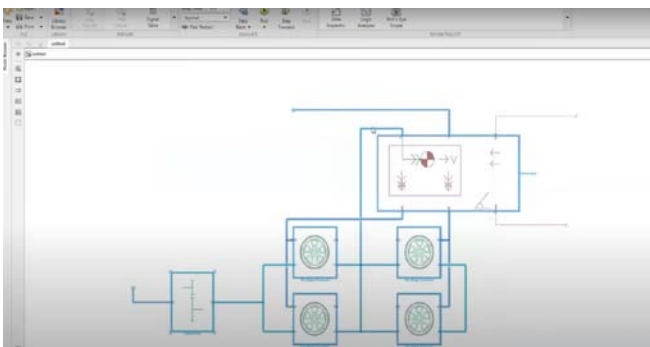


Fig 11: Vehicle body

The Fig 11 represents the modelling of vehicle body with sensors and storage systems.

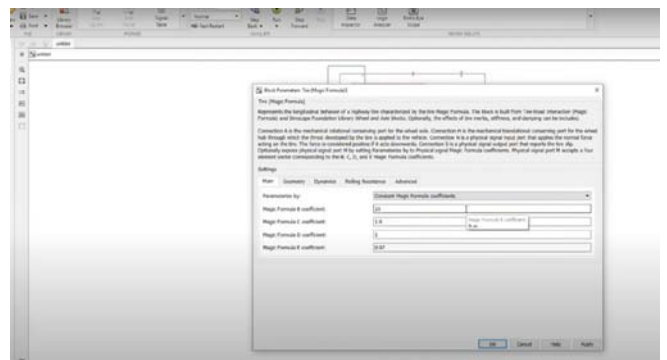


Fig 14: Battery's Performance analysis

The Fig 14 demonstrates the battery's performance parameter analysis. This helps in the calculation of charging and discharging of battery to enhance its life cycle.

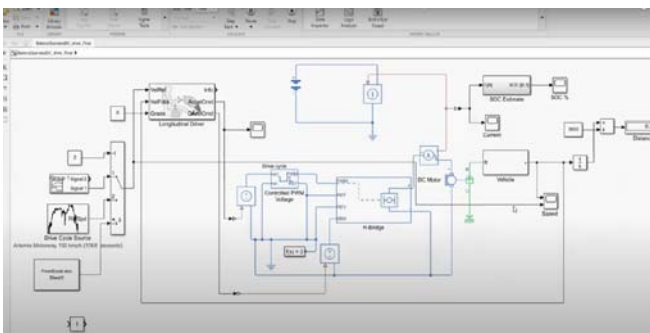


Fig 12: Electric vehicles with RES

The Fig 12 represents the implementation of electric vehicles with renewable energy systems. The renewable energy here utilised is the solar energy source. The solar panel helps in the conversion of energy and saves in the battery for further usages.



Fig 15: Performance efficiency

The Fig 15 demonstrates the performance efficiency of the electrical vehicles. This is calculated through various parameters involving battery's state of charge to regenerative braking.

VI. CONCLUSION

The evolution of electric vehicles are increasing rapidly from the past decades. These are due to the eco-friendly nature and reduction in the usage of fossil fuels. This helps to obtain a greener environment by avoiding the

emission of various toxic pollutant in the environment. The electric vehicles are implemented with the aid of artificial intelligence to boost the complete enactment of the vehicles. This helps in improving the functioning of the electric vehicles enabling two way communication system through cloud computing techniques. The genetic algorithm is used to optimize the usage of electric energy from the grid based upon the priority and rush hours to eliminate the demand. Thus the use of electrical vehicles with artificial intelligence techniques is the way forward measures to enhance various benefits with reducing the constraints caused by the conventional vehicles.

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