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Multi-Functional Multi-Ability Electric Vehicle

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***Abstract*: A concept of a 'Modular Multi-functional Electric Vehicle (MMEV) is originated, which is a composed system design of 1, 3, 6 or 8 battery modules of 600mm in width and 900mm in length. This concept innovates transportation over a time span of 5, 10 or 20 years applying four types of MMEVs: the MMEV-Chair, -Tatami, -Road and -Room. It makes it possible to climb staircases, to double the capacity of today's traffic or to offer space of 2,400mm in width for the weaker road user while keeping today's road capacity the same and to integrate indoor and outdoor use of a vehicle while managing time and making communication with people more easily. This enhancement contributes in significantly better results. This paper reviews state-of-art on electric vehicle concept giving description for each sub-category, and then details power management strategies and charging techniques highlighting main problems and solutions. In this paper the development process is explained, concept sketches are proposed, models are made and verified and a real first running chassis of an MMEV-Tatami is realized to evaluate its size, floor base and hands-free driving mode.**

***Keywords*: Concept Design, Electric Vehicle, Modelling, Prototype.**

1. Introduction

EVs, with enough penetration in the transportation sector, are expected to reduce that figure, but this is not the only reason bringing this century old and once dead concept back to life, this time as a commercially viable and available product. As a vehicle, an EV is quiet, easy to operate, and does not have the fuel costs associated with conventional vehicles. As an urban transport mode, it is highly useful. It does not use any stored energy or cause any emission while idling, is capable of frequent start-stop driving, provides the total torque from the startup, and does not require trips to the gas station. It does not contribute either to any of the smog making the city air highly polluted. The instant torque makes it highly preferable for motor sports. The quietness and low infrared signature makes it useful in military use as well. The power sector is going through a changing phase where renewable sources are gaining momentum. The next generation power grid, called 'smart grid' is also being developed. EVs are being considered a major contributor to this new power system comprised of renewable generating facilities and advanced grid systems. All these have led to a renewed interest and development in this mode of transport.

There are quite a few configurations and options to build an EV with. EVs can be solely driven with stored electrical power, some can generate this energy from an ICE, and there are also some vehicles that employ both the ICE and the electrical motors together. EVs use different types of energy storage to store their power. Though batteries are the most used ones, ultra-capacitors, flywheels and fuel cells are also up and coming as potential energy storage systems (ESS). Different charging voltages and charger configurations can be used in charging the vehicles. Wireless charging is also being examined and experimented with to increase convenience. These charger standards, configurations and power conversion systems are demonstrated in Sections 6–8 discusses the effects.

EVs create in different sectors. Being a developing technology, EVs still have many limitations that have to be overcome to enable them to penetrate deeper into the market. This paper was created as an effort to sum up all these works to demonstrate the state-of-the art of the system and to position different technologies side by side to find out their merits and demerits, and in some cases, which one of them can make its way to the future EVs.

The system allows a driver to use only light forces to steer a heavy car. The rim of a 15 in. (380 mm) diameter steering wheel moving four turns from full left lock to full right lock travels nearly 16 ft (5 m), while the edge of a road wheel moves a distance of only slightly more than 12 in. (300 mm). If the driver swiveled the road wheel directly, he or she would have to push nearly 16 times as hard. The steering effort passes to the wheels through a system of pivoted joints. These are designed to allow the wheels to move up and down with the suspension without changing the steering angle. They also ensure that when cornering, the inner front wheel - which has to travel round a tighter curve than the outer one - becomes more sharply angled. Zero turn vehicle as the name itself indicates the meaning that a vehicle take the turn with zero turning radius and gives circular path without leaving its vertical axis passing through the center. Zero degree turning radius vehicle implies the vehicle rotating about an axis passing through the center of gravity of vehicle i.e. the vehicle turning at the same place, where it is standing. No extra space is required to turn the

vehicle. So vehicle can be turned in the space equal to the length of the vehicle itself.

2. Components of Electric Vehicle

1) Battery

Battery is the main power source which provides an average voltage current to the vehicle. It is a 12 volts and 0.8 ampere rechargeable battery. A battery is a device for storing chemical energy and converting that chemical energy into electricity. A battery is made up of one or more electrochemical cells, each of which consists of two half-cells or electrodes. One half-cell, called the negative electrode, has an overabundance of the tiny, negatively charged subatomic particles called electrons. The other, called the positive electrode, has a deficit of electrons. When the two halves are connected by a wire or an electrical cable, electrons will flow from the negative electrode to the positive electrode.

2) DC Motor

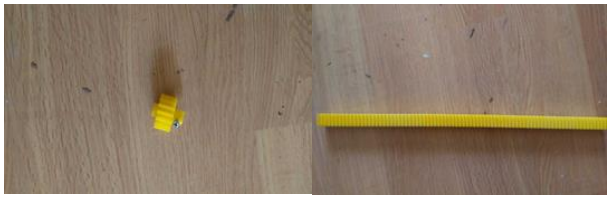
DC motors are classified into three categories namely brushed DC motor, BLDC or brushless DC motor, and stepper. Brushed DC motors are widely used in electric vehicles for retracting, positioning and extending electrically-powered side windows. These motors are suitable for many uses because of their low cost. increases its efficiency and reliability by eliminating the source of power and wear loss. In addition, these motors boast of some significant advantages over induction motors and brush DC motors like higher speed ranges, noiseless operation, faster dynamic response, better speed versus torque characteristics etc. Also, the ratio of torque delivered relative to the size of the motor is higher, which makes it a good choice for electric vehicles, where high power is required but lightness and compactness are critical factors as well. While BLDC motors are mechanically simple relatively, they do require regulated power supplies and sophisticated control electronics.

3) Gear

A gear or cogwheel is a rotating machine part having cut teeth or, in the case of a cogwheel, inserted teeth (called cogs), which mesh with another toothed part to transmit torque. Geared devices can change the speed, torque, and direction of a power source. Gears almost always produce a change in torque, creating a mechanical advantage, through their gear ratio, and thus may be considered a simple machine. The teeth on the two meshing gears all have the same shape. Two or more meshing gears, working in a sequence, are called a gear train or a transmission A gear can mesh with a linear toothed part, called a rack, producing translation instead of rotation.

4) Rack and Pinion

A rack and pinion is a type of linear actuator that comprises a circular gear (the pinion) engaging a linear gear (the rack), which operate to translate rotational motion into linear motion. Driving the pinion into rotation causes the rack to be driven linearly. Driving the rack linearly will cause the pinion to be driven into a rotation. For example, in a rack railway, the rotation of a pinion mounted on a locomotive or a railroad car engages a rack placed between the rails and helps to move the train up a steep gradient.



5) Wheel

In its primitive form, a wheel is a circular block of a hard and durable material at whose center has been bored a circular hole through which is placed an axle bearing about which the wheel rotates when a moment is applied by gravity or torque to the wheel about its axis, thereby making together one of the six simple machines. When placed vertically under a load-bearing platform or case, the wheel turning on the horizontal axle makes it possible to transport heavy loads; when placed horizontally.

6) Angle Clamp

The device allows two items to be held at a 90-degree angle, in order to be attached together. With many types, the items can be of different widths or diameters and the clamp will still hold the two at a perfect 90 degree angle. In terms of a single screw and welding angle clamps, this is due to the function of the jaws, which can pivot to accommodate materials of different thicknesses, while keeping them square to one another.

7) Rectangular Aluminium Bar

Aluminum rectangular bar is an extruded solid aluminum bar that is versatile, easy to work with and has a wide range of applications. Aluminum rectangular bar is made from one of the most widely used heat treatable aluminum alloys in the industry. it has excellent corrosion resistance, good workability and good machinability.

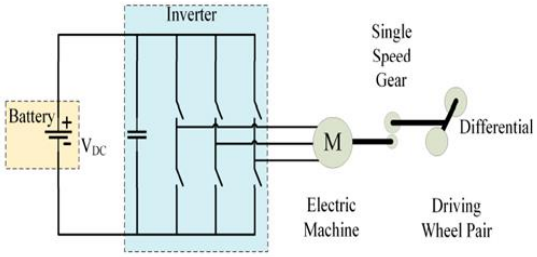
3. Construction of Thermoelectric Refrigerator

EVs can run solely on electric propulsion or they can have an ICE working alongside it. Having only batteries as energy source constitutes the basic kind of EV, but there are kinds that can employ other energy source modes. These can be called hybrid EVs (HEVs). The International Electro technical Commission's Technical Committee 69 (Electric Road Vehicles) proposed that vehicles using two or more types of energy source, storage or converters can be called as an HEV as long as at least one of those provide electrical energy [4]. This definition makes a lot of combinations possible for HEVs like ICE and battery, battery and flywheel, battery and capacitor, battery and fuel cell, etc. Therefore, the common population and specialists both started calling vehicles with an ICE and electric motor combination HEVs, battery and capacitor ones as ultra-capacitor-assisted EVs, and the ones with battery and fuel cell FCEVs [2–4]. These terminologies have become widely accepted and according to this norm, EVs can be categorized as follows:

1. Battery Electric Vehicle (BEV)
2. Hybrid Electric Vehicle (HEV)
3. Plug-in Hybrid Electric Vehicle (PHEV)
4. Fuel Cell Electric Vehicle (FCEV)

1) Battery Electric Vehicle (BEV)

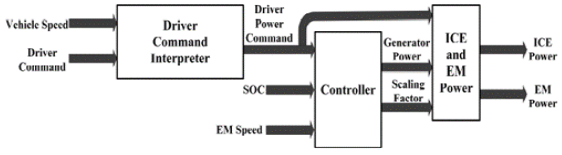
EVs with only batteries to provide power to the drive train are known as BEVs. BEVs have to rely solely on the energy stored in their battery packs; therefore, the range of such vehicles depends directly on the battery capacity. Typically, they can cover 100 km–250 km on one charge [5], whereas the top-tier models can go a lot further, from 300 km to 500 km [5]. These ranges depend on driving condition and style, vehicle configurations, road conditions, climate, battery type and age. Once depleted, charging the battery pack takes quite a lot of time compared to refueling a conventional ICE vehicle.



Circuit diagram of battery electric vehicle

2) Hybrid Electric Vehicle (HEV)

HEVs employ both an ICE and an electrical power train to power the vehicle. The combination of these two can come in different forms which are discussed later. An HEV uses the electric propulsion system when the power demand is low. It is a great advantage in low speed conditions like urban areas; it also reduces the fuel consumption as the engine stays totally off during idling periods, for example, traffic jams. This feature also reduces the GHG emission. When higher speed is needed, the HEV switches to the ICE. The two drive trains can also work together to improve the performance. Hybrid power systems are used extensively to reduce or to completely remove turbo lag in turbocharged cars, like the Acura NSX. It also enhances performance by filling the gaps between gear shifts and providing speed boosts when required. The ICE can charge up the batteries, HEVs can also retrieve energy by means of regenerative braking.

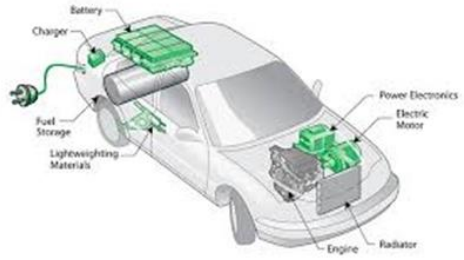


Flow chart of hybrid electric vehicle

3) Plug-In Hybrid Electric Vehicle (PHEV)

The PHEV concept arose to extend the all-electric range of HEVs [9–14]. It uses both an ICE and an electrical power train, like a HEV, but the difference between them is that the PHEV

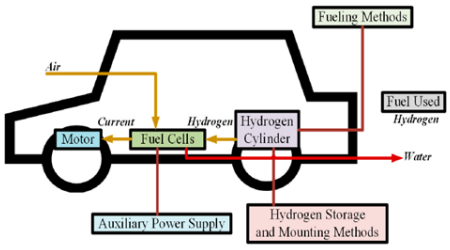
uses electric propulsion as the main driving force, so these vehicles require a bigger battery capacity than HEVs. PHEVs start in 'all electric' mode, runs on electricity and when the batteries are low in charge, it calls on the ICE to provide a boost or to charge up the battery pack. The ICE is used here to extend the range. PHEVs can charge their batteries directly from the grid (which HEVs cannot); they also have the facility to utilize regenerative braking. PHEVs' ability to run solely on electricity for most of the time makes its carbon footprint smaller than the HEVs. They consume less fuel as well and thus reduce the associated cost. The vehicle market is now quite populated with these, Chevrolet Volt and Toyota Prius sales show their popularity as well.



Plug in hybrid vehicle

4) Fuel Cell Electric Vehicle (FCEV)

FCEVs also go by the name Fuel Cell Vehicle (FCV). They got the name because the heart of such vehicles is fuel cells that use chemical reactions to produce electricity [15]. Hydrogen is the fuel of choice for FCVs to carry out this reaction, so they are often called 'hydrogen fuel cell vehicles'. FCVs carry the hydrogen in special high pressure tanks, another ingredient for the power generating process is oxygen, which it acquires from the air sucked in from the environment. Electricity generated from the fuel cells goes to an electric motor which drives the wheels. Excess energy is stored in storage systems like batteries or super capacitors. Commercially available FCVs like the Toyota Mirai or Honda Clarity use batteries for this purpose. FCVs only produce water as a byproduct of its power generating process which is ejected out of the car through the tailpipes. The configuration of an FCV is shown in Figure.



Fuel cell electric vehicle

5) Advantages

1. Reduced fuel consumption and emissions; Possibility tore cover energy from regenerative braking
2. Important grid connection potential; Reduced fuel consumption and emissions; Optimized performance; Possibility to recover energy from regenerative braking; 100% zero-emission capability.
3. Use of cleaner electric energy; Zero emissions Vehicle; battery recharging (Overnight or equipped Parking); Possibility to recover energy from regenerative braking; Lower operational costs; Quiet operation.
4. The vehicle response to steering input becomes quicker and more precise throughout the vehicle enter speed range.

6) Disadvantages

1. Higher initial cost; Component availability; Build complexity involving two power trains (Transmission Energy loss).
2. The system includes as many components (especially electronically) there is always a change to get any of the part inactive, thus the system become inoperative.
3. Wear and tear of wheel occurs in short period of time.
4. This system makes the vehicle more complicated.
5. Handling and a tendency to roll over when cornering or when traversing the side of steep hill. And you need to lift very young or very old people into it.

7) Applications

1. In industries for automation of raw material like automated guided vehicle (AGV).
2. In automobile sector there are so many type of vehicles are using to carrying goods from one position to another position, there is space problem in the industry so this vehicle is used in automobile applications because these vehicles consumes very less space as compared to other type of vehicle.
3. This vehicle is used in small industries for transportation of raw material from one position to another.
4. Modern development and economical progression of Indian society resulted in increase of vehicle in park, so there are also problem, in park other vehicle taking more space to move from one direction to another so that this vehicle used for overcome to parking problem.

4. Conclusion

In the near future, combining diverse energy sources and power trains in optimal way, as well as performing an accurate and robust power management control algorithm, will be essential to build a reliable and affordable EV while preserving our environment and intelligently using our limited resources. Many different approaches have been proposed to enhance our understanding of the fundamental vehicle system performance challenges. But among all the control methods, each control technique has its advantages and disadvantages. A vehicle also featuring low cost and user friendly steering mechanism has been introduced. A prototype for the proposed approach was

developed by introducing separate mechanism for normal steering purpose and 3600 steering purpose.

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