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Implementation of Battery Replacement Technology for Electric Vehicle as Fast Charging Medium

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Abstract: ***The increasing level of global warming due to burning of fossil fuels and reducing amount of crude oil have caused a substantial shift from internal combustion engine vehicles towards EVs. This paper explores the idea of battery charging infrastructure by replacing battery unit from electric vehicle in power station or at home. This paper focuses on the fast and emergency charging option as an alternate source for plug in charging it deals with infrastructure of battery. Type of battery used in EV and the device which is used to charge the battery which is removed from the EV we have also worked on position of the battery, various tastes were done on sliding mechanism for holds the battery by which it can be easily removed.***

Keywords: Emergency charging, replacing battery, sliding mechanism

1. Introduction

The increasing level of pollution caused due to automobile and increasing prices of oil had led to shift for environmental friendly cars such as EVs and fuel cell EV. Due to less noise and low price for fuel it is has becoming attraction for environmental friendly peoples. Electric vehicles (EV) are powered by electric batteries, which need to be recharged with electricity from the grid. There are two types of battery charges first if off - board and second is on - board battery charger having uni - directional and bi - directional power flow as we know batteries are more often charged on utility grid. Which has uni - directional chargers. These chargers reduce the interconnection issues and battery degradation. The chargers used in workplace or household plug or shopping malls are called on - board charger, and chargers on gas station used for conventional vehicles and their purpose is to charge fast are called off - board charger. As off - board chargers have a fast charging but they are not convincible as they take long time for charging, so the people are thinking while buying EV car over gasoline car. This is the reason we have come with this idea of replacing (low) battery with fully recharged battery at the utility grid. We have divide battery into two parts with each part can be removed separately and can be replaced with new one by doing this we can reduce the charging time. This is applicable in any emergency situation also. With which owner of car can enjoy traveling for a long distance without wasting time for charging by only going to power station and replacing battery. Which can bring revolution in EVs car technology.

2. Methodology

The system consists of two separate battery units which are placed at the bottom portion of the car. Which can be removed separately and can be replaced by new one with fully charged. Battery circuit is connected with the microcontroller which displays both battery charged percentage and which battery should be replaced with newly charged battery from utility grid. The microcontroller also gives estimated distance and time that car can travel by calculating battery percentage. The position of the battery is mounted in vertical so it can be easy to remove. And the idea of building a device which can charge the removed battery's. As gasoline cars have switch that opens (valve) through which oil is filled in the car, the same system we are also going to apply here only difference is the switch will release the battery holding lock which will release the battery from the circuit for replacement.

Battery type:
The battery's used in the EVs are lithium ion (Li - ion) which have more energy capacity than other battery's as proven by researcher

Lithium ion battery:
A lithium - ion battery or Li - ion battery is a type of rechargeable battery. Lithium - ion batteries are commonly used for portable electronics and electric vehicles and are growing in popularity for military and aerospace applications. In the batteries, lithium ions move from the negative electrode through an electrolyte to the positive electrode during discharge, and back when charging. Li - ion batteries use an intercalated lithium compound as the material at the positive electrode and typically graphite at the negative electrode in part because of lithium's small size and light weight (third only to hydrogen and helium), Li - ion batteries are capable of having a very high voltage and charge storage per unit mass and unit volume. Li - ion batteries can use a number of different materials as electrodes. The most common combination is that of lithium cobalt oxide (cathode) and graphite (anode), which is most commonly found in portable electronic devices such as cellphones and laptops.

Figure 3.1

Needs of battery vehicle

Cheaper to run - Owners of an EV have the advantage of much lower running costs than combustion engine. The cost of one - unit electricity is 3.58 rupees and the cost of petrol is 108 rupees which makes EV cheaper. The electricity to charge an EV works out around a third as much per kilometer as buying petrol for the same vehicle.

Cheaper to maintain - A battery electric vehicle (BEV) has a lot less moving parts than a conventional petrol/diesel car. There is relatively little servicing and no expensive exhaust systems, starter motors, fuel injection systems, radiators and many other parts that aren't needed in an EV. With just one moving part – the rotor – BEVs are particularly simple and very strong. Just maintain the brakes, tires and suspension and that's about it. Batteries do wear out so replacement batteries will eventually be needed. Plugin Hybrid Electric Vehicles (PHEVs) have a petrol engine that needs regular servicing so more cost to maintain. However, because the electrical motor requires little maintenance due to far fewer moving parts, this leads to less wear and tear of the petrol engine components.

Device used for charging removed battery's

The main purpose of designing this device is to charge the battery's which are removed from the electrical vehicles this device takes input as AC power supply and converts into DC power supply which is stored in battery it has a LCD display which shows battery percentage when inserted and how much time will it take for charging battery. Alert system is also inserted to show when battery is fully charged it indicates by glowing light and after few minutes it automatically cut - offs electric supply going to battery through which electricity is also saved and damage occurring by overcharging to battery is also stopped So that battery is saved from damaging. The machine can charge many batteries at a time depending on size of grid and can fit in small size.

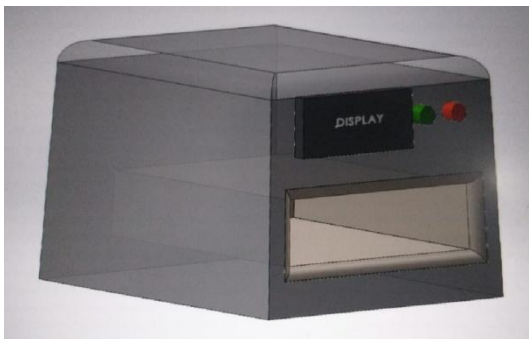


Figure 3.2

Charger type	phase	Supply	time	Charging %
Level 1	AC	120V	16 - 20hrs	100%
Level 2	AC	240V	> 6hrs <	100%
Level 3	DC	480V	> 1hrs	80%
Tesla supercharger	DC	480V	40min	80%
Replacing technology	DC	480V	10min	100%

Processor (ARDUINO UNO)

The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC - to - DC adapter or battery to get started. It is used as microcontroller in which data can be stored to show battery percentages, distance car will travel and which battery should be replaced.

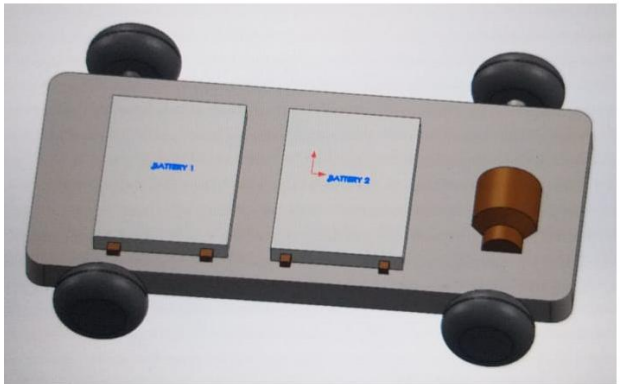
Figure 3.3

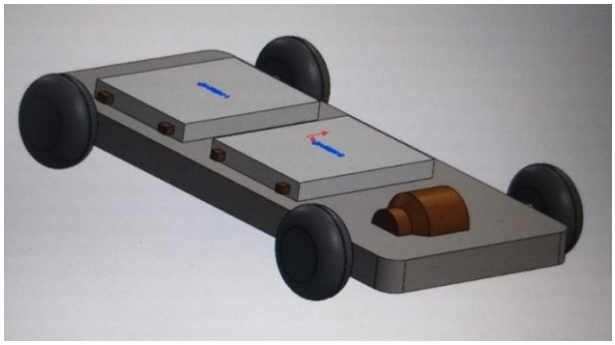
Drawbacks of plug - in - charging:

- Time required for charging is more
- More components are required
- Confusing options for chargers
- Less power stations are available
- It cannot be portable for charging

Advantages of battery replacing:

- Time required is less as compared to other methods
- Less components are required
- Doesn't need power station can be charged at home also
- It is easy to carry anywhere by taking extra pair of battery





3. Conclusion

In this report the innovative idea of implementing battery replacement system is discussed and there by analysed its various parameters for regular realistic application. Battery replacement is one of the smart options which can be implemented in various electrical vehicle's. previous research study clearly explains that battery in EV plays vital role in assembly. In the present work various experiments were conducted to check the effect of various parameters such as position of battery, easy access to remove battery. it is the fast charging method compared to type1 and type2 chargers so it is time saving method. We have studied previous research work on how researchers are working hard to developing fast charging method for EV so we have discovered this idea of battery replacement which is optional method for plug - in - charging. With the help of device that we have made for charging the removed battery will help to charge the battery in simple and easy manner. These technologies will not only disrupt the transportation industry but will affect the entire energy landscape with its potential to support the grid. The approaches and conclusion that we present are somewhat preliminary and are in need of further significant investigations.

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