JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

BATTERY SWAPPING TECHNOLOGIES FOR ELECTRIC VEHICLES

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Abstract: The transportation business contributes a ton of carbon releases and toxic climate around the world. Electric vehicle (EV) adoption has a significant potential to reduce carbon outflows. A Battery Swapping Station (BSS) is an effective way to charge electric vehicles while decreasing the wait times at battery charging stations (BCS). For completing a lengthy interstate excursion, Swapping Technology offers the perfect option. This paper explores the advantages of building the BSS according to various perspectives and as needs be a strategy has been proposed to trade out batteries in relatively less time believing the area of the battery to be fixed. To tackle the charging issues in electric vehicles, battery swapping could be a suitable option.

Index Terms-*Electric vehicles,Battery swapping stations,batteries,*

1.INTRODUCTION

Now a day's demand for vehicles is increasing drastically and changing our lifestyle rapidly, but as the number of vehicles has expanded, severe problems with the environment and vehicle management have emerged. Furthermore, as they are powered by non-renewable resources, it is necessary to provide better alternatives for future public transportation with an effective vehicle management section. Electric vehicles (EVs) seem to be a decent choice for a greener tomorrow yet methods of battery use still need to be figured out [13]. Claiming an EV is laden with difficulties, for example, functional reach, battery substitution cost, long charging season of batteries and the significant expense of the vehicle. Battery switching is one such solution that offers fleet operators all these advantages.

2.BATTERY REPLACEMENT FOR ELECTRIC CHARGING

Battery swapping or battery-as-a-administration permits EV proprietors to replace the drained batteries with newly charged ones at the trade station. Among other EV categories, the technology is being developed for use in e-2wheelers, e-3 wheelers, e-cars, and even e-buses. The procedure is comparable to how customers utilize LPG cylinders [4]. Battery-as-a-Service (BaaS) Batteries must be viewed as a service sector, similar to that of liquefied petroleum gas or other usable batteries [8]

Fig1: batteries at the Gogoro swapping station [10]

3.EV BATTERY CHARGING STATIONS

There are two forms of EV battery swapping technologies: manual and autonomous, according to the EV charging infrastructure said by the NITI Aayog, Indian government [1].

3.1MANUAL TYPE BATTERIES

The manual battery-swapping technology is where the batteries are typically manually inserted into and from the various slots by hands. The owner can replace the discharged battery with a fully charged one. A trading station that is being introduced at a specific area contains different batteries getting charged continuously [1]

An EV client can find a trading station, supplant the draining battery with a charged one, put the unfilled battery on charge and can go to work. Due to battery swapping technology, fleet owners that want to keep their vehicles running without worrying about charging schedules now have a number of alternatives. The energy provider puts up charging stations and buys batteries in bulk to replenish depleted ones. It takes about the same amount of time to change a battery as it does to refuel an ICE car. However, (ICE)internal combustion engine vehicles may be refueled at any gas station, whereas an owner of an EV must sign a contract with a particular energy provider to swap batteries and visit their outlets on a regular basis. For electric vehicles, more specifically electric 2 and 3 wheelers, it is being done. These are utilized in applications requiring 2W and 3W batteries since they have smaller battery packs and can be lifted by one or two people. According to the Nitti Aayog's Draft Battery Swapping Policy, batteries with a larger range, at around 80– 100 kilometers each swap, should be promoted to accommodate demand for longer trips "without having to take diversions to find a battery swap dock

3.1.1. AUTONOMOUS

The mechanical arm is used in Independent, with the battery swapping process being semi/completely mechanized [3]. Because 4W and e-transport battery packs are larger and heavier, they require mechanical assistance. This type of trading station requires more room and will be more expensive than manual ones. According to the location of the vehicle's battery and the robotic arm's point of application, several switching strategies are distinguished and are listed.

3.1.2. SIDE SWAPPING

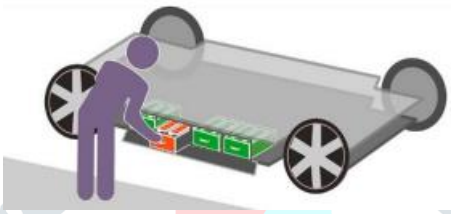

Fig2: side swapping [14].

This is typically used with vans and other vehicles because it is more practical to move them sideways.

3.1.3 REAR SWAPPING

For automobiles where the battery is installed from the backwards, rear switching is used. Typically, in the case of vehicles with huge trunks.

3.1.4. BOTTOM SWAPPING

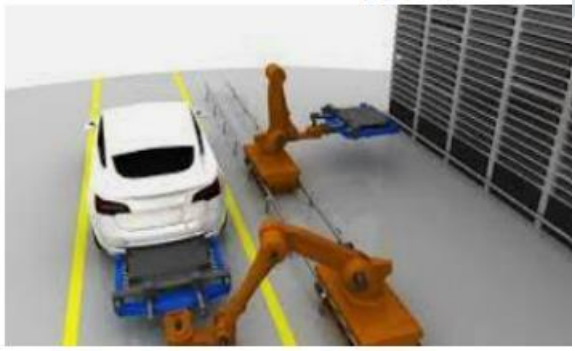

fig3: Bottom swapping of battery [15]

This technique is utilized for automobiles with bottom-mounted batteries. The swapping station is designed such that the vehicle is put on an elevated platform and the batteries are switched using a robotic arm and other equipment that are typically located below the ground [13].

3.1.4. TOP SWAPPING

This is most commonly seen in electric buses. When the vehicle arrives, the rooftop opens, allowing the robotic arm to perform the necessary changes [2]

4. THE EXCHANGE STATION'S OPERATION

Extensive planning is necessary to create and properly implement the swapping technique for buses, vans, and other vehicles, including the availability of batteries and chargers, data storage and administration through the cloud, and communication between components to ensure compatibility.

The smart car, swapping station, and information system are all in constant connection with one another, the BSS for the vehicles will function smoothly. Both the car and the station will be able to interact with each other through the information system. The BSS for the automobiles will run well if the smart car, swapping station, and information system are all connected to one another constantly.

The station and the car will be able to communicate with one another via the information system. In order to prepare the batteries by the time the vehicle arrives at the station, the information system will advise the station of the car's location, expected arrival time, and identifications. When the car arrives at the station, the driver swipes his membership card, prompting the computer system to locate all relevant information on it. The car, battery, previous swaps, transactions performed, and other relevant details are all included in this data. Operating staff will 4 confirm this information and point the customer in the direction of the swapping area, where a robotic arm will be used to switch the necessary batteries. To maintain total transparency throughout the processes, all the data is being backed up on cloud storage, where it will be accessible to both the authorities and the consumers.

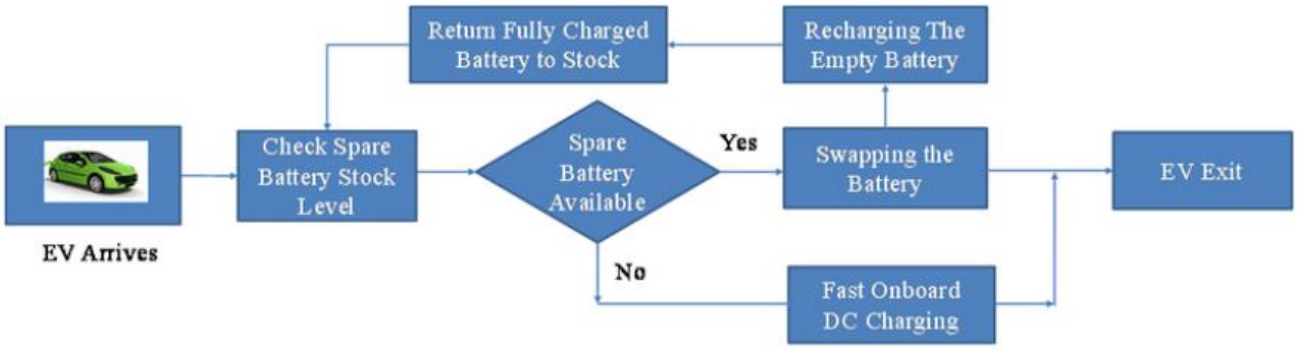

Fig3: operation of battery swapping [11]

Once the swapping is finished, the vehicle's battery will be checked quickly for its condition of charge, condition of wellbeing (SOH), remaining charge, battery age, battery duration, number of charging and releasing cycles gone through and as needs be the proprietor will be educated about the charges caused and the assessed time by which he can accept his completely energized battery.

The battery will be consecutively inserted into the charging racks, each of which includes a slot for charging the battery. The battery pack for the electric bus contains a battery management system that keeps an eye on the temperature, voltage, and safety of the individual cells to ensure that the charge is balanced and safe. The high voltage battery connector will need to be manually connected, and charging won't start until the connector and the inlet should have been sealed. A latch that will let the current flow after the contact is complete will protect the closed contact between the connector and the intake. Additionally, the switching station may execute a two-way power flow with the grid.

5. ADVANTAGES

- Decreased acquisition costs.
- Reducing the duration of charging.
- Equivalent infrastructure.
- Long battery life.
- Battery recyclable and disposable. [12]

6. MARKET SCOPE

According to a joint analysis by TÜV SÜD and Siemens, the demand for batteries is predicted to increase by 25% a year, reaching 2,600 GWh in 2030. The electrification of transportation and the use of batteries for energy storage are anticipated to be the key demand drivers. According to Way Gate Technology, a Baker Hughes Company, the commercial vehicle segment will account for 23% of the worldwide battery demand, while passenger vehicles will account for 60% of it. As regulatory emission limits become more stringent, China will continue to dominate the global battery industry.

7. FUTURE SCOPE

The market leader for battery changing stations is Gogoro from Taiwan. Gogoro has more than 2000 Go Stations and has provided more than 375,000 users with over 180 million battery replacements. In order to create the next generation of smart automobiles using Gogoro switching technology, Gogoro most recently teamed with Hero MotoCorp [9].

The establishment of lithium-ion battery swapping stations in Delhi NCR has been announced by the Tata Power Delhi Distribution (DDL), a joint venture between Tata Power and the Delhi government, and Sun Mobility, a provider of charging infrastructure for electric vehicles. EVI Technologies, an electric vehicle (EV) infrastructure startup based in New Delhi, announced that it has signed a ten-year Memorandum of Understanding (MoU) with telecom provider Bharat Sanchar Nigam Limited (BSNL) to install battery swapping and EV charging stations in 5,000 BSNL locations that will cover the country's major cities, state highways, and national highways. At each location, the collaboration will set up more than 100 public chargers and battery switch stations. In Maharashtra and Haryana, the first charging station launch is scheduled for February 2020.

8. GOVERNMENT POLICY

By finalizing the incentives under the battery swapping programme, our government is likewise making an effort to address this problem. The policy focuses primarily on battery exchange services for two- and three wheeled electric bikes and scooters [3]. Consumers of EVs will benefit from incentives of up to 20% on the battery's subscription or lease cost under the proposal. In India, charging is favored over the battery switching technologies that are currently in use. In the post-transition period, changing batteries is a very good substitute for refueling cars. [3]

9. CONCLUSION

Battery swapping will undoubtedly be the form factor to beat in the future for India's quickly expanding micro-mobility EV industry in terms of ease, affordability, and scalability.

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