# APPLY VEHICLE BATTERY USING BLOCKCHAIN TECHNOLOGY

**Miss. Harshali Pawar[1], Prof. Gunjan Behl[2]**

[1]*MCA Final Year Student, Bharati Vidyapeeth's Institute of Management & Information Technology Navi-Mumbai.*

[2] *Professor, Bharati Vidyapeeth's Institute of Management & Information Technology Navi-Mumbai.*

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**Abstract** - Battery Exchange is an electric vehicle (EV) battery refueling solution. For electric vehicle owners, the accuracy, openness, traceability and immutability of battery and transaction information are difficult to ensure in a traditional centralized systems.

The lack of trust between the owners of electric vehicles and the exchange station is caused and becomes a big challenge for the rapid development of electric vehicles.

An objective mechanism based on a decentralized blockchain system is proposed to manage the exchange of batteries and solve the problem of lack of trust. With this solution, battery life cycle information and all operating histories are permanently recorded in the blockchain network.

***Key Words***: *Battery exchange, electric vehicles , blockchain , blockchain network.*

## 1.INTRODUCTION

Battery swapping or battery-as-a-service allows electronic vehicle owners to replace the discharged batteries with charged ones at the swap stations. When the battery is discharged, the owners can change it with the fully charged one. This will address the problem of setting up charging stations and also reduce the range anxiety of drivers. Further, battery leasing can help EV owners save on the cost of purchasing a battery. The service is less time-consuming and takes only a few minutes compared to charging at a battery station which could take hours. It also requires minimum infrastructure.

Over the past decades, with the increasing development of battery technologies and environmental concerns, electric vehicle (EV) technologies have experienced rapid development. The large-scale use of electric vehicles not only significantly reduces greenhouse gas emissions, but also lowers the cost of fuel for electric vehicle drivers. It improves the security of the electricity system and stimulates the development of renewable energy technologies.

However, EV drivers face the problem of refueling the battery on a daily basis. Once the battery is discharged, drivers can recharge it in the charging station. And drivers are also allowed to replace a dead battery with a fully charged battery supplied by the charging station and eliminate much of the waiting time. How to ensure that electric vehicle drivers have full confidence in the network of stations and how to ensure the fairness and justice of the battery swap process are the two important questions. In this article, we have proposed a solution using blockchain, a distributed private and secure block ledger, to solve trust issues for electric vehicle battery swap application. For the battery refueling procedure, in particular the battery exchange between the electric vehicle and the station network, many factors affect the fairness of the refueling transactions.

For example, different brands of battery, different charging currents, battery wear, remaining capacity, etc. In the traditional centralized system, all farm and transaction information was stored unilaterally in central servers. These features make it difficult to ensure the fairness of the transaction, especially for owners of electric vehicles. Therefore, we need an objective mechanism to assess the quality of the battery to ensure fairness and justice. Considering the advertising and self government characteristics of smart contracts, this is the best option.

The blockchain was first introduced in Bitcoin, which is a distributed crypto currency system that allows users to exchange coins anonymously. The structure of the in. Each block contains a number of transactions and is chained using the hash value of the previous block. This type of structure makes transactions immutable. Blockchain is also a distributed and decentralized system.

## 2.OBJECTIVE / SCOPE :

The overall vision is to catalyze the large-scale adoption of EVs by improving efficient and effective use of scarce resources (viz. public funds, land, and raw materials for advanced cell batteries) for the delivery of customer centric services.

This Policy would support the vision by promoting the adoption of battery swapping technology implemented via BaaS business models which will ensure lower upfront costs, minimal downtime, and lower space requirements. The Policy addresses key technical, regulatory, institutional, and financing challenges that will help develop battery swapping ecosystems to unlock the large-scale adoption of 8 battery swapping in India.

The key objectives of this policy are to :

•Promote swapping of batteries with Advanced Chemistry Cell (ACC) batteries to decouple battery costs from the upfront costs of purchasing EVs, thereby driving EV adoption.

•Offer flexibility to EV users by promoting the development of battery swapping as an alter- native to charging facilities.

•Establish principles behind technical standards that would enable the interoperability of components within a battery swapping ecosystem, without hindering market-led innovation.

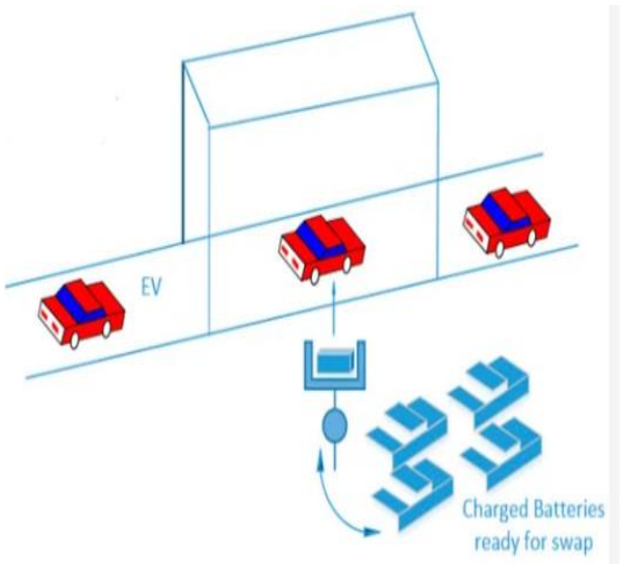


**Fig -1**: Figure

## 3.BACKGROUND

**Smart contracts**
**For our demonstration, we have set up 3 smart contracts.**

**3.1 Balance Process :** It is a contract to manage the electrical parts of different users. We have defined a token called E-coin as the currency of our system. When the user initiates a currency transfer transaction, such as purchasing a battery from the manufacturer, the smart contract calculates the price. Then it will automatically transfer the e-money margin to the target account.

**3.2 Battery interface :** This contract provides an API interface for terminal users. Currently, there are three different roles for terminal users: Station Operator, VE Owner, and Super Account.
Station operator means the employee of the battery station. They can manage the batteries that belong to the station. And they have to process the trade-in request that was sent by the electric vehicle owners.
The EV owner can manage their own battery. When it wants to perform a battery swap with a station, it can send a request and wait for confirmation.
The super account is configured to manage the GAS required by each account to invoke the smart contract. He is also considered the manufacturer of the battery. When the station operator and the owner of the EV purchase batteries, they must send a certain number of electronic parts to this account.

**3.3 Deployed environment :** A real and available blockchain environment is generated for our demonstration. is the main deployed environment of our system. We have reached six Ethereum nodes as a private blockchain network. In these six nodes, there are three miners and three RPC nodes. The mining node pulls blocks for the network, while the RPC nodes support the RPC service for the front-end user interface.

A real and available blockchain environment is generated for our demonstration. is the main deployed environment of our system. We have reached six Ethereum nodes as a private blockchain network. In these six nodes, there are three miners and three RPC nodes. The extraction node extracts the blocks for the network, while the RPC nodes support the RPC service for the front-end UI environment, we use Geth as the Ethereum client to generate all the nodes in the network.

**3.4 Battery detail page :** This page is used to verify detailed information about a specific server farm, including static and dynamic information, and the list of associated transactions. Station operators can also charge this battery or confirm a specific exchange process on this page.

## 4.ABOUT TRACEABILITY

We also present a module for tracing a specific farm or a specific account. At the bottom of each page, shown in Figures 9 through 12, is a Current Account or Battery Transaction List component. For the index page, it displays all transactions related to the account. And for the farm detail page, it shows all the transactions related to the farm.
Station operators and electric vehicle owners can verify the detailed information of each transaction.

Dynamic simulation. The accuracy and feasibility of smart contracts are most important in battery swap mode. In order to assess the accuracy and feasibility of our price and equilibrium module, we have designed a dynamic simulation of iterative operations. The simulation procedure follows the steps of the battery exchange scenario. To be precise, an iterative circle is:

(1) The EV owner invokes the discharge action to simulate power consumption.

(2) The EV owner selects a full energy battery from a station's battery list and submits a trade-in request. The station and battery are chosen at random.

(3) The station operator checks and confirms the exchange request.

(4) Smart contract automatically calculates the prices of two batteries. If there is a price difference, it will be charge parts on one side with a low cost battery and compensate on the other side.

Initially, we set up 2 stations and 7 electric vehicles, each with 10,000 electronic parts as the original scale. Each station has four batteries and each EV has only one battery. Based on these simulation steps, we use Python scripts to run the iterative circle hundreds of times. The program recorded both balance and price information in each circle.

Result of the balance after 500 times the iteration In Figure 13, the blue line is the total balance of 2
stations, while the orange line is the total balance of 7 VE. This balance result shows that our balance logic module makes enough sense to users.

The EV battery price curve is received after an exchange with the station. Blue dots are normal battery prices, while red dots are abnormal prices. The value of the abnormal price is very high, even above 1E + 74. After checking the source code of smart contracts and debugging, found that the reason is the unit overflow when the price is negative.

Since solidity doesn't support floating point or double point types, we need to multiply the numerators by 10,000 to keep the decimal part. We use the unit as the price type and the corresponding depreciation rate. For example, the original source code snippet:

amended. Therefore, we have no idea to ensure that the battery identified by RFID is consistent with that of virtual identification.

## 5.LITERATURE REVIEW :

(1) In December 2021 published an article said that; The popularity of electric vehicles has been limited by factors such as range, long charging times, and fast power failure in winter. In order to overcome these challenges, battery swapping stations (BSS) have been constructed & greatly promoted in recent years. In this paper, the related literature on electric vehicle service is reviewed and the co-occurrence of keywords is analyzed using CiteSpace. The literature is classified according to clustering results and recurring themes, such as the location of BSS, inventory decisions, charging strategies, and BSS assignments. In each topic, typical optimization models and algorithms proposed in previous studies are summarized. Then, this paper gives a case about the business model and revenue capacity calculation of BSS. Finally, it points out the future research directions of battery swapping stations more effectively for electric vehicles.

(2) In 2020 published an article saying that;- the Wiley online Library; the transportation industry contributes a significant amount of carbon emissions and pollutants to the environment globally. The adoption of electric vehicles has a significant potential to not only reduce carbon emissions but also to provide needed energy storage to contribute to the adoption of distributed renewable generations. This research paper focuses on the design model and methodology for increasing EV adoption through automated swapping of battery packs at battery sharing stations (BShS) as a part of a battery sharing network (BSN), which would become integral to the smart grids. Current battery swapping methodologies are reviewed as well a new practical approach is proposed considering both the technical and socio-economic impacts. The proposed BShS/BShN provides novel solutions to some of the most preeminent challenges that electronic vehicle adoption faces today such as range anxiety, grid reliability, and also cost is important factor.

## 6.RESEARCH QUESTIONS :

1] Is electric Vehicles (EVs) have generated a lot of interest in recent years, due to the advances in battery life and low pollution?

2] How does battery swap work for EVs and what happens when they retire?

3] What's Going To Happen To The Millions Of Electric Car Batteries After Their Lifespans End?

4]What is the lifespan of an electric car battery?

## 7.RESEARCH METHODOLOGY :

In this part, the research methodology is described, including the design science research strategy and how it is implemented in this study. A description of the study's methodology is provided, followed by an assessment of its strengths and weaknesses.

## 8.DESIGN SCIENCE RESEARCH :

An IT artefact that addresses critical organisational issues is the goal of design science research in information systems. In order for the implementer to utilise the artefact in the right domain, it must explain the implementation and the application. It has been reported that Hevner et al

In contrast to conventional design and development, design science study focuses on the unknown. Researchers might claim that they are really doing research rather than just designing and creating products like the rest of the business.

## 9.RESEARCH APPROACH :

Two distinct sorts of artifacts are being created as a result of this study. Instantiation is the initial sort of artifact.

Implementation of Ethereum-based cyber-physical battery refueling system Electric vehicle battery refueling.

Due to the development of battery technologies and environmental awareness, EV technologies have developed rapidly over the past decades. With the large-scale use of EV technologies, greenhouse gas emissions can be reduced and energy use can be more efficient. However, refueling the battery is still an issue that has not been addressed well. There are three main methods of refueling electric vehicle batteries: alternating current (AC) charging, direct current (DC) charging, and battery swapping. It's convenient but time-consuming. It will take more than eight hours to fully recharge a depleted EV battery by charging it with AC power. DC charging can be provided by a charging station. It will take you 1-2 hours to fully charge a depleted EV battery by charging DC power. However, DC charging may damage the EV battery due to the large power. Battery swapping is the least time-consuming of the three methods of refueling the EV battery. It will only cost you a few minutes to replace a dead battery with a fully charged battery by a battery swap station. Tesla Inc. and NIO Inc. introduced their EV battery swap technologies in 2013 and 2017 respectively, suggesting that battery swap may be a promising solution for EV battery refueling. In our previous work, a blockchain-based EV battery exchange system (in the form of a web application) was proposed to evaluate the batteries to be fairly traded by smart contracts and to manage the 8 pieces of information about the batteries such as their manufacturer, brand, power capacities, price and supply history. It is actually an IoT scenario to use our previous blockchain-based EV battery exchange system in real life, as battery exchange stations and EVs need to be connected to the internet, and cyber interaction -physical battery information must be involved. In this section, we check if our blockchain-based IoT solution can be used in the EV battery swap scenario.

IOTA entanglement

Ethereum's implementation uses the power as well as the flexibility of smart contracts to implement application logic on a blockchain, ensuring that all nodes run the same code & data is not mutable as per the concept. The first difference between IOTA and other blockchain platforms is the way the data is stored (directed acyclic graph vs chained linear blocks). This solves the scalability issue by linking a new transaction to two previous transactions by validating them, the IOTA network has no transaction fees, and the implementation can run on the public network. A significant downside is that IOTA does not (yet) support smart contracts, and therefore application logic has to be managed by a master node, resulting in a semi-decentralized system. In this case, the master node has to perform additional operations to extract and filter the data from the tangle, whereas in the Ethereum version these operations were handled directly by the smart contract functions. For example, the equivalent of the new User operation of the Ethereum implementation would have the structure described in. the application running on the public development network, any user can create a transaction with this tag. However, since all transactions are still handled by the master node as the sender, the application will only filter its own transactions from the tangle. Since the IOTA implementation uses the Dev net public tangle, these tags can be used to examine the transaction. where IOTA Address is the address of the master node and IOTA JSON Data is a JSON object containing the measurement information, with the same properties as the new Data function of the Ethereum implementation. The proposed Transaction object is a transaction that was created locally and has not yet been submitted to the network

The architecture of the battery exchange system. We implemented the battery swap system based on our proposed rich-thin client architecture. how the system is composed. We use Raspberry Pi (RPi) as the hardware of a thin client, each thin client represents one EV. In each EV, a “truffle” is used to invoke the blockchain's Remote Procedure Call (RPC) service, and a local “express” server is used to control the cyber-physical interconnections. We use USB disks that can be connected to the RPi to represent real batteries, the information of each battery is stored in a file on each corresponding USB disk. displays static information and dynamic information from a typical battery information file. (Static information and dynamic information are introduced later in “smart contracts” in 3.3.) A station consists of a battery exchange interface (an RPi works like an electric vehicle) and an Ethereum node full. We use "Geth"] as the command-line interface to run full Ethereum nodes and provide RPC service for summoners

Maintenance of the blockchain. There are 3 types of blockchain networks in Ethereum: private, consortium, and public. For the sake of simplicity, we have deployed and tested on the private blockchain. Drivers of electric vehicles and station doors have the right to be mining nodes. However, in practice, EV could not be an Ethereum cluster node due to limitations in network bandwidth and computing resources. Accordingly, we should think about an alternative authorization method. In fact, the consortium's blockchain network may also be applicable. If so, we should think about how to control peer nodes. Such as managing peer add and remove permissions, and maintaining the checkout power of each peer node.

## 10. SUMMARY AND DISCUSSION :

In 2011, MIT published an article saying that an EV battery could cost up to 25-50% of the total cost of a car [18]. Therefore, the EV owner will be very concerned about the quality of the battery received during the exchange with the station network.

Using blockchain technology, we have proposed an objective mechanism to automatically assess the quality of the battery. Battery related operations are implemented with a smart contract. On top of that, battery life cycle information is stored in the blockchain network, keeping the data immutable and traceable. This data is public to both electric vehicle owners and stations, to check the condition of the battery. As a result, it guarantees fair transactions between the trustless VE owner and the station operator.

However, there are some aspects that we did not take into account very well.

Battery identification. In the blockchain, each battery has a unique virtual identification. All battery information has been mapped to its virtual ID. Ideally, each battery can be connected with an RFID in the physical world. However, there is no guarantee that the RFID information from the battery cannot be. Electric vehicle technologies have developed rapidly in recent years. One of the biggest challenges in the large-scale use of electric vehicles is the question of trust between the counterparties when refueling the battery, especially for the battery change. The traditional centralized solution is not able to solve these kinds of problems.

This article proposed a decentralized blockchain-based solution for refueling batteries. All battery operations during its lifetime have been kept in the blockchain network. Based on this unchanging information of the battery, its quality can be assessed automatically by smart contract. Not only the degradation of the battery's performance over time, but also its depreciation during each recharge cycle have been taken into account. Therefore, our solution guarantees the fair transaction between the trustless driver of the EV driver and the station network.

However, while blockchain and smart contract are fascinating technologies, they are still at the proof of concept level. In order to apply our decentralized solution in the real world, continuous improvements are needed. Such as monitoring the physical RFID of the battery, and recording and synchronizing various discharge currents for different conductors.

Also, due to the high cost of the distributed network and the immutable smart contract, it would be better to do a simulation before deployment. Therefore, an important point of research is to find a solution to simulate the real environment.

So far, we have only considered this battery swap and refueling solution in terms of actual application. In the next step, we will try to build our theoretical foundation for this topic. In addition, we will also develop our own blockchain framework. the

The framework will focus on 1) a less expensive and more efficient network, for example, using a new consensus mechanism; 2) Simulate the real environment, collecting more real cases, as a viable battery identification solution.

## 11. LIMITATIONS :

Not carmakers for sure, since battery management systems are both software and battery technology remain one of the most closely guarded secrets for all electronic vehicle brands. Given how similar electronic vehicle performance is likely to feel in the future, it's the electronic vehicle's range and software capabilities that'll determine its success in the market.

Tesla, which continues to dominate the US electronic vehicle market, succeeded not only because of an early mover advantage but because it created an indispensable ecosystem consisting of a large supercharger network and software which boasted of semi-autonomous capabilities and superior in battery management. Tesla's build quality has frequently come under criticism, with panel gaps and overall finishing being touted as a weak point for the brand.

Despite this, its clear dominance in the electronic vehicle space has remained unchanged. Simply put, car companies do not and will not share batteries technology, and forcing them to adhere to some standardized form of battery tech will work to their detriment. Mostly those brands see India as a potential manufacturing destination.

The first in line to benefit from this scheme is the electric two and three-wheeler customers, who can lease or else subscribe to a battery swapping service much like one does for domestic LPG. Then there are battery manufacturers, which will now work under a specific framework to adhere to interoperability standards. Mohinder Gill, Director General, Society of Manufacturers of Electric Vehicles (SMEV) said the policy "will benefit the whole segment, i.e E2W, E3W, electronic vehicle, and buses".

## 12. CONCLUSIONS

Conclusion and future work:

The optimized code will check all depreciation rates to avoid underpayments. In addition, we will also deal with batteries that have a negative or zero damping rate.

Beyond these two equilibrium and price simulations that we have carried out, there are other logic modules to simulate or test.

Battery swapping or battery-as-a-service allows EV owners to replace the discharged batteries with charged ones at the swap stations in minimum time. When the battery is discharged, the owner can change it with a fully charged one. This will address the exact problem of setting up charging stations and also reduce range anxiety of drivers.

## 13.REFERENCES

[1] G. Wood, "Ethereum: A secure decentralised generalized transaction ledger", Ethereum Project Yellow Paper, 2014.

[2] S. Nakamoto, “Bitcoin: A peer-to-peer electronic cash system”, white paper, 2008.

[4] https://www.journals.elsevier.com/blockchain-research-and-applications

[5] https://ieeexplore.ieee.org/document/9129916

[6]https://www.researchgate.net/figure/The-blockchain-interface-for-the-proposed-battery-swapping-and-charging-system-POW_fig6_341375744

[7]https://www.frontiersin.org/articles/10.3389/fbloc.2019.00016/full

[8] https://blockchain.ubc.ca/research/research-papers

[9]https://www.niti.gov.in/sites/default/files/2022-04/20220420_Battery_Swapping_Policy_Draft.pdf

[10]https://www.cnbctv18.com/energy/how-does-battery-swap-work-for-evs-and-what-happens-when-they-retire-12393092.htm