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Research Article

ELECTRIC VEHICLE BLOCKCHAIN: PROBLEMS AND OPPORTUNITIES

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A R T I C L E I N F O

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ABSTRACT

These days, we are observing a very rapid spread of the electric vehicle industry. This means a significant increase in the data and energy exchanged between these vehicles. The existing centralized approach is less secure and more vulnerable to data destruction and manipulation by intruders. Therefore, it became necessary to search for an alternative that provides excellent protection for this massive amount of data and energy. Although blockchain technology and cryptocurrencies are closely associated, they also have many other potential applications in fields including energy and sustainability, the Internet of Things (IoT), smart cities, smart mobility, and more. In the Internet of Vehicles (IoV) idea, blockchain can provide security for electric vehicle (EV) transactions, enabling electricity trading to be carried out in a decentralized, transparent, and secure manner. . This paper will explain the use of blockchain in this field and how it can handle the trade of transmitted and received energy between electric vehicles. The advantages of using blockchain with electric cars and how it can secure the transactions of energy trading will be shown too. A group of researchers in this field and the challenges that face this technology in energy trading will be discussed too; the studies will be looked at, and recommendations for investments and security will be made. Additionally, the future implications of various blockchain technologies will be highlighted.

1. INTRODUCTION

can find a clean environment, less noise due to their silent engine, no crowded-on fuel station, lower costs, maintenance savings, and convenience. However, most information and communications technology systems are centralized [3], which means non-transparency, disintegration, insecurity, and less trust. Thus, this led to the search for other sources of available and appropriate solutions with blockchain technology. Blockchain is a decentralized technology [4]. It can solve the trading of energy between the electric vehicle parties and be summed up by the power grid stations, charging stations, and electric vehicles. And to directly perform business operations, this technology makes the owners of electric cars communicate due to its peer-to-peer network [5]. Another thing blockchain uses is immutable technology, which means the data and the transactions are stored on it in complex ways. So dishonest or cheating drivers in this system cannot change the records because the blockchain network data is visible to all with high clarity to the parties who trade energy on the network [6]. The ledger is open with the blockchain that stores electric vehicles' energy trading data in time order

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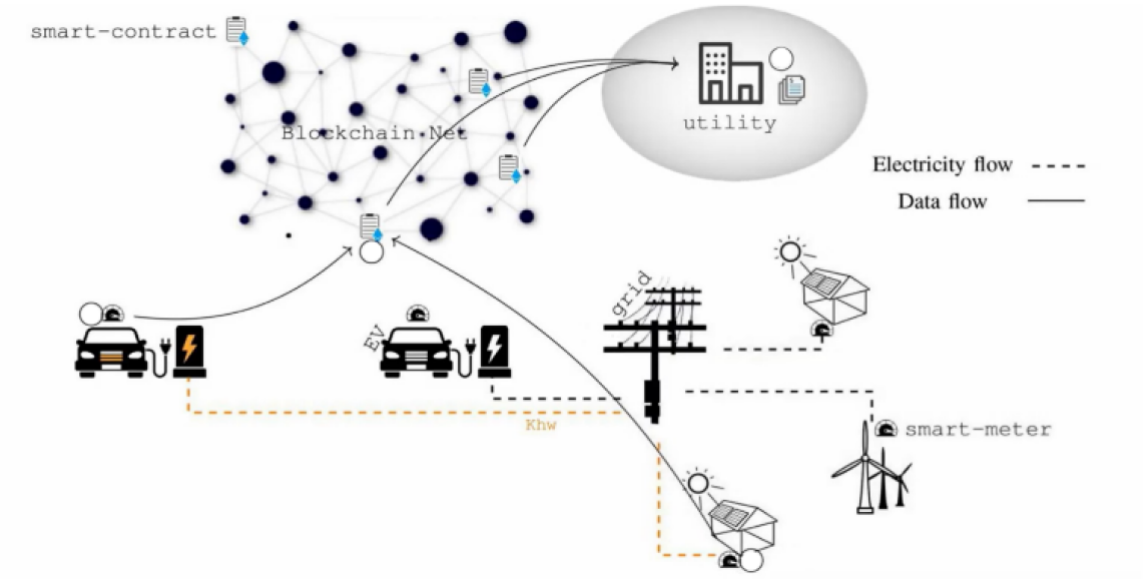

Fig. 1. General Picture for Blockchain and EVS[6]

[3]. Trading the energy between the participants in the electric vehicle system using blockchain makes this trading more traceable, transparent, and trusted [7]. The following will explain how the blockchain system generally works with electric vehicles. From Figure. 1, the three leading players are utility companies or power grids, electric vehicles, and charging stations. And there is data and electricity exchanged between those three elements. Blockchain will connect all these things. Initially, the utility or the grid will register every electric vehicle and charging station as a new user on the smart contract. It is also responsible for adding wallet balances. To take advantage of the battery swapping and charging services offered by the power grid stations to offer some benefits to electric vehicles, the drivers need to recognize the trusted and reliable power grid stations. So complete information about power grid stations should be publicly available to help them choose the good one from the existing charging and swapping stations [8], essentail things that can cover our daily needs in the system of the electric vehicle, and the blockchain can handle them, such as: calculating battery discharge rate [7, 13], identifying good reputable charging stations [9], what is the energy request at the peak off hours, and finding the closest route between the start point and the endpoint of charging station [10]. selling the excess energy to benefit from it or power grid stations (vehicle to grid and the grid to vehicle), and what is the energy need during the peak hours [11, 12].

2. BLOCKCHAIN CONDITIONS IN EVS

The centralized system for energy trading in electric vehicles does not have enough ability to deal with the development of many electric vehicles [13]. And the use of blockchain technology in this field will give this system excellent protection, data against external attacks, the possibility of tracking, and arguably more transparency [14]. The following points must be available in the blockchain system to be applied to electric vehicles:

2.1 Accuracy

At this point, the required applications for energy trading have to be correct, visible, and trusted. So blockchain can ensure the operations of individuals for the duration of electric vehicle electricity trading. An example of decreasing data accuracy is using inappropriate platforms to store and process data related to energy trading[14].

2.2 Fast processing

For fast transsection processing, electric-powered vehicles are growing each day. In the last two years, hundreds of electricity charging stations have spread worldwide to cover the electricity demand, so blockchain is needed to technique several thousand transactions per second. Also, the developers of smart contracts should have enough experience in writing smart contracts and not using bugs; the bugs inside the smart contracts can change the goal of intelligent contracts to a

damaging cause[15].

2.3 Privacy protection

As it is known that any breach of data privacy or identity theft will degrade the user's trust in the device and the reputation of the electricity companies, centralized data storage can enable machine individuals to get access to information about strength trading events [16]. So, the solution will be with the blockchain, as the records are forever to be had with no chance of hacking, changing, or security breaking. Moreover, blockchain is an immutable era secured by using cryptographically hashed values of facts 15, 16. Another essential thing is that blockchain uses cryptographic keys to recognize users; it also hides the recognition of the users[17].

2.4 Security

For security, the solution is the blockchain. You know the contributors to electric vehicle power trading require fully secure and reliable information for sharing and processing. Blockchain technology affords a public and allotted machine that could successfully shop, manipulate, proportion, and replace electricity buying and selling statistics at the ledger; the catalog is sent to some of the miners who go on with display and affirm the statistics up-dates to assure records integrity[18].

2.5 The legal issues

For legal issues, most of the blockchain systems do not offer a way to confirm the identification of the members. The conventional centralized systems can discover customers through third parties; in a blockchain-based answer, cryptocurrencies may be transferred online, which can help with money laundering or maybe finance terrorist tasks[19].

2.6 Communication between platforms

In platform use, the members of energy buying and selling systems for electric cars can use special blockchain systems. Blockchain platforms ought to have complete help to alternate correctly and manner information in an on-hand, efficient, and rapid manner amongst those unique platforms[47]. Blockchain generation is an excellent preference in this region as it has a united records code to observe[20].

2.7 Storage

The size of the data generated by electric motors will increase due to storage problems. And present electric-powered cars can create thousands of gigabytes of information each second; thus, the increased fee of the ledger may be affected without delay; ledger size grows depending on the type of the Blackchin and the used applications[21].

3. OPPORTUNITIES OF BLOCKCHAIN IN ENERGY TRADING

The opportunities in electric vehicles can be energy traceability, improving market efficiency, stakeholder' reputation, billing and payments, energy auctioning, and vehicle-to-grid energy trading. It will be explained one after the other; the following points show the opportunities of blockchain technology[22].

3.1 Traceability

Managing the assets: The blockchain's traceability feature allows for coping with the belongings records all through asset processing, and the blockchain's smart contracts can report the alternate transactions. At the same time, energy is transferred from the battery to another customer. The reputation of the plant supplying: through the use of blockchain, the electric automobile proprietors can also affirm the type and popularity of the plant supplying electricity to the grid stations. The actual time gets right of entry to the smart grid: this will keep away from the crowding resulting from electric automobiles at a smart grid, especially at some stage in the top hours, via information traceability and an immutable transaction file[23].

3.2 Market Efficiency

This can be done by lowering energy buying and selling prices, maximizing contributors' earnings, and satisfying community restrictions. Blockchain generation can play multiple roles in the energy trading market. The proprietors of electrical chargers can be provided a reward for carrying their chargers online for public use; this assists the operators of power

grid stations in higher management. More excellent energy chargers inside the community allow electric vehicle owners to buy energy from people who provide reasonably-priced services [24].

3.3 Stakeholders' reputation

It is the opportunity that electric vehicle drivers may offer at the wrong time to restrict statistics to the clever grid. And this will motivate unfair power allocation to electric-powered automobiles. A smart contract can put penalties on dishonest or selfish drivers [25].

3.4 Payments

Electric car owners prefer a quick, relied-on, and verifiable charge machine to decrease billing and price dishonesty. Many digital currencies consisting of Bitcoin are primarily based totally on a public decentralized blockchain ledger; Bitcoin and Ethereum platforms support micropayment transactions like Satoshi. Blockchain technology allows micro-payments with no need for a third party [26].

3.5 Car-to-grid energy trading

The existing car-to-grid power buying and selling platforms are intended to reduce the mismatch between demand and supply of electricity during peak hours. Purchasing power from electric automobiles can encourage automobile proprietors to participate in the automobile-to-grid electricity trading technique (32, 33). The blockchain era can assist in automating and securing car-to-grid power buying and selling. Through smart contracts with digital signatures and consensus algorithms, it can be emphasized that cryptocurrency rewards are transferred to the pockets of the electric automobile owner who sells strength to the smart grid. Blockchain creates healthy competition among smart grid owners to shop for electricity from electric-powered motors to meet man or woman's demands for the duration of peak hours [27].

4. RELATED COMPANIES

Vandebron & TenneT companies. Vandebron is located in Amsterdam, was founded in 2013, and supplies inexperienced electricity to communities [28]. However, this business enterprise no longer generates any electricity. TenneT is a power transmission operator in the Netherlands and Germany and provides power to more than 41 million users [29]. In both organizations, the energy trading transactions between the stakeholders have finished using a hyper-ledger blockchain platform that's advanced via IBM and hosted on a Linux basis [30]. The aim of this partnership between the two businesses is to stabilize the grid's demand for its transport through the assessment of statistics stored on the blockchain. MotionWerk is a German corporation startup that makes a specialist of personal and public strength charging stations accountable to exchange energy between electric automobiles. The implementation of the blockchain era right here is the use of percentage and charge [31]. Percentage & Charge is software that gives a P2P issuer that lets electric-powered vehicles and charging station proprietors change power in a relaxed and dependable manner without a third-party carrier [32]. Percentage and fee also propose a decentralized protocol for electrical motors' power charging statistics system. Power Ledger, this company has developed the usage in Australia and permits P2P solar power buying and selling between electric vehicles (V2G, G2V, POWR token, and ATM) [33]. Presents a platform that permits tracking, buying, and selling strength using blockchain generation. It also enables car-to-grid and grid-to-automobile electricity buying and selling. Moreover, it offers flexibility to the users to sell surplus energy by shifting the cryptocurrency as bills to the pockets of the power producers. The business enterprise also created a software token known as the Strength Ledger Coin (POWR) that allows participants to invest in the device. And in the latest years, they've turned out to be more interested in electric car electricity by turning electric automobiles into cellphone ATMs [34]. Lightens, based in 2018, affords software- and program-based answers to power businesses. Presents a decentralized power market to connect individuals, which include customers, grid operators, and prosumers [40]. Lightency lets customers become prosumers and will enable them to promote the surplus strength for coin benefits. The difference between a consumer and a prosumer A consumer is a person who buys a product and uses it; a prosumer is a person who buys a product, uses it, and spreads the word about it [41].

5. CHALLENGES

Scalability The blockchain may be tormented by the scalability of current blockchain systems [42]. The current state of blockchain technology can't host billions of electric vehicles with real-time information processing [43]. but personal structures are more scalable than public blockchain plat-paperwork; however, most no longer observe a decentralized shape for storing and processing facts and transactions. The most famous blockchain coins, Bitcoin and Ethereum, can

execute up to twenty transactions per second most effectively [44]. Researchers have proposed solutions, along with hashing, to address the scalability problems of current blockchain structures. Inevitably, in the blockchain, records are immutable, meaning that the facts saved in the ledger can't be modified, deleted, or hacked; therefore, irreversibility is a top-notch characteristic of the blockchain and guarantees information protection. For Privacy Public blockchain platforms consisting of Ethereum and Bitcoin provide immutable information and hide identification from the device. Then again, non-public blockchain platforms are extrmoreolved approximately gadget performance than hiding identity. Consistent with the (GDPR) which is fashionable data safety law in abbreviation any virtual entity inclusive of (encrypted or hashed digital identifiers or private records) ought to be inaccessible to unauthorized users 46. The researchers have applied unique techniques to ensure that facts saved on the Blockchain comply with GDPR standards[45].Last for security Attackers may utilize the weak spot of smart contracts to transfer cryptocurrency tokens from a consumer's wallet[46,47].

6. CONCLUSION

Fewer skills in blockchain theory can much affect the energy trading inside the EVS companies. One of the things that causes great concern when breaching information security is the frightening phase that occurs in quantum computer systems. The blockchain structures can affect transaction execution and velocity, as well as the strength of buying and selling operations. One of the demands for the winning public blockchain is the privacy of the facts because facts and transactions are open and easy to anyone.

Conflicts Of Interest

The authors declare no conflicts of interest.

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