P3 Block: Privacy Preserved, Trusted Smart Parking Allotment for Future Vehicles of Tomorrow

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Abstract. As the urbanization is advancing day by day and demand of vehicles is being increased (or cheaper cost of vehicles), it made increased number of vehicles over the road, which faces several issues like traffic accidents, finding a parking spot, etc. Finding a car park slot has become one of the residents' key pain points. The key reason behind this is the restricted provision of parking lots and the struggle to spot vacant parking space during peak times. To overcome this restriction, one solution is to create smart allocation of free spaces that are easier to locate and use (i.e., trusted and privacy preserved for user or driver). In this work, we provide privacy preserved parking allotment (as a smart solution) to users (or vehicle users) who are willing to pay more charges when they require parking slot near to their destination (or urgent need). In this work (called as P3 Block: Privacy Preserving parking using Blockchain 2.0), one useful and different approach we used as "Incentive based smart parking". People will get cashback or reward for alerting or spreading genuine information among users. Also, miner will be rewarded for verifying users. Incentive feature will attract more users, also more trust and reputation of specific service provider matter a lot in providing efficient parking slot to vehicle user. Today world is moving towards automation, so automation will be available in all possible applications like manufacturing, finance, retail, food supply management, transportation, home appliances, etc.

Keywords: Automation industry · Privacy preserved paring · Smart parking · Vehicles of tomorrow

1 Introduction

Smart parking schemes in a smart city typically strive to make it easier for car users to reserve available private parking spaces (just like time-sharing). Current day techniques are capable of verifying and supervising the parking spaces and automobiles without satisfying the privacy issues of the customers. This paper puts forth the underlying basis for an efficient parking system using Blockchain which is created with the aim of securing the privacy of the users by emitting the intervention of a third-party agency. The system which has been elucidated (i.e., P3-Block) incorporates the concepts of Blockchain and smart contract methods share parking spaces amidst drivers.

Note that in majority of the existing works, in general, parking systems are not designed to keep security and privacy issues in the respective work [2–4], but any system failure can leak private (sensitive) information from drivers/users.There are many threats (external, insider) that can affect the Internet of Things (IoTs) such as Eavesdropping, Sybil, Denial of Service or Controlling [14]. For the very same reason, Internet of Things (IoTs) or Internet Connected Things (ICT) or Smart Devices need to be tested and cross verified way before they're combined with Blockchain. They also need to be identified with respect to their locations and condensed in the perfect place to prevent any sort of physical modifications along with the inclusion of system crash detection methods each time they occur.

An Improved Parking System
Parking in densely populated, wealthy urban areas is a constant challenge for residents and drivers. Traffic jams and chaotic conditions on the road are majorly caused by drivers who hunt for empty parking lots. This indirectly leads to excessive petrol consumption and emissions of pollutants [1]. Drivers looking for available parking spaces used an additional 47,000 gal of fuel and 95,000 h of driving in 2017 [2]. These massive amounts indicate the necessity for an efficient parking program. Usually, parking systems depend on centralised control to manage the parking spaces which also include the private ones which provide reservation services. It's mandatory for the owners and customers of these parking lots to validate themselves with the supervisor of the parking station. Majority of the providers are local due to the difficulties they face from the logical perspective which consist of maintaining these in different cities and areas. In spite of the fact the parking systems aren't built for security and privacy reasons, a minute device crash can lead to data breaches of the users.

We implement a parking system based on Blockchain that securely stores user information and manages parking services. We select Blockchain in our work because it is transparent, immutable, distributed (without the need to involve a trusted third party), auditable (accessible anytime anywhere eon a public network by joined peers). Some popular success of Blockchain in previous decade are BitCoin [1], and Ethereum [12]. Today, we can use Blockchain revolution, Blockchain 2.0 or Smart Contract, in many applications for a transparent transition. Mark that the smart contracting allows owner to set rules and access controls. The system we architected implements smart contracts to procure the helping modules for registrations and transaction purposes, i.e. drivers and parking supervisors. Moreover, smart contracts aid to permit drivers to account for empty parking spaces which cater to ones needs. To protect the privacy of

users, we selected a Blockchain consortium to verify that user information is readily available. In our work, the transactions are managed by privileged nodes which render information available or accessible only to union members in the chain. This program helps in overcoming the geographical limitations and permits the drivers to perform electronic transactions among each other. Eradicating the central control of the entire network can often result in reduces maintenance and overhead expenditure. Every individual node of the Blockchain contains system data for a system based on Blockchain which runs independent of a supervisor.

Hence, the organisation of this work is as follows: Sect. 2 discusses related work to our work. Section 3 discusses motivation behind our work, or our intention towards writing article on this critical problem of parking. Section 4 discusses our proposed work with discussing each and every module in detail. Further, system implementation is discussed in Sect. 5. And in the last section, this work is concluded with some remarks in brief.

2   Related Work

There are many attempts traced in previous years which provide efficient parking slot to drivers/users like ParkBid [9], ParkChain [11], etc. But, to best of our knowledge gained through our survey, till now no author has tried in preserving privacy of user's including building trust between service providers and drivers. In this section, we provide basic information about Blockchain, its types and its revolution in different applications [15].

State of the Art - Blockchain Basics
With the massive victory of Bitcoin, Blockchain has been implemented in it and in several other applications [4]. In simple words, Blockchain is a form of electronically dispatched ledger which is considered as a linear block series that can collect information like events and processes. Majority of the network nodes need to make use of consensus to validate the block (with its data). The details confined in the blocks are maintained in an orderly fashion while preserving their order. These blocks can join hands to form data chains, such that each block's head contains a hash from the previous block. When blocks are modified, every block succeeding it, shifts as well. In another sense, all validated alterations can be ignored. Blockchain can be classified as public, cooperative, or private. Every individual in a concerned network are treated equally in a public chain, such that they have equal access to the data in a Blockchain. However, this transparency and flexibility comes at an expense of the consumers' privacy. On the contrary, private chains are generally centralised form of Blockchain in which the creator alone has the rights to create information. Deployment architectures are in-built in this software. Though such a Blockchain proposes high level of privacy in comparison to public Blockchain methods, it's completely dependent on a reliable source for validating the information. The union, or gathering of super peers, choose the efficiency of the blocks and its' processes in a consortium chain. If a person prefers to join a chain, it has to be positively welcomed by most of the union committee members. The details in the chain can be either available (to the public) or accessible

only to trade union leaders. Such a Blockchain, while implementing partial decentralization, can thus provide privacy to an extent.

State of the Art – Blockchain Integration

The thing to include in this chapter is related to the interactions between the Internet of Things (IoTs), i.e., the connectivity between the underlying Internet of Things (IoTs) infrastructures. Once Blockchain is implemented, it must be determined where those interactions will take place: within the IoT, a hybrid system involving IoT and Blockchain, or through Blockchain. Note that IoT- Cloud Computing was not that much valuable (or popular), but IoT- Fog (Edge) Computing integration can change the computing world (in terms of accessing services efficiently). Hence, integration of IoT can be discussed as:

Internet of Things - Internet of Things: This seems to be the solution which is the quickest with respect to latency and health because they can function offline too. A variety of methods for exploration and routing are of prime importance for the IoT systems to communicate with each other. Only a small portion of IoT data in gathered and collected in Blockchain when IoT interactions take place without the interference of Blockchain. This method is highly fruitful in scenarios with steady IoT data where there is reduced potential for IoT interactions.

Internet of Things –Blockchain: This method involves each and every interaction to parse through the Blockchain leading to unaltered interaction records [13, 16]. This process assures a traceable platform for all chosen communications as their data can be questioned in the Blockchain which in turn helps in increasing the autonomy of the IoT devices. All IoT applications which prefer to sell or lease (for example Slock) can adopt this approach. Moreover, keeping track of the Blockchain interactions would indirectly lead to increased bandwidth and data – one of the commonly known issues of Blockchain. On the contrary, Blockchain needs to store all IoT data which is linked with the concerned processes.

Hybrid approach: In the long run, a mixed or hybrid framework which permits only selected communications and data transfer to take place within the Blockchain works better as the remaining ones are directly exchanges with the IoT devices. Selection of experiences which must parse through the Blockchain is indeed a task. A victorious arrangement of this method/technique is the ideal way to holistically combine all technologies as it controls the benefits of Blockchain along with those of IoT communications in real time. Fog computing and even cloud computing, steps ahead here as they're capable of surpassing the drawbacks of Blockchain and IoT. In fact, fog computing calls for reduced number of devices which are restricted computationally (like gateways) and it has latency for mining repositories similar to other projects which implement IoT devices.

A general IoT application would utilize limited -Resource gadgets as end nodes which are capable of communicating with a gateway which is engaged in transferring the data from sensory apparatus to the cloud or the server. If the end nodes require communicating with the Blockchain during the process of integration, cryptographic operations provide a helping hand to the IoT gadgets. This is of grave seriousness as it plays

a supreme role in identifying the IoT autonomy, which comes at the cost of highly sophisticated hardware and increased overhead expenditure (it is addressed in [14–16] an estimation of the cost of using Blockchain in IoT devices). It is also possible to incorporate gateways in these implementations, just as conventional applications do, though the advantages of using Blockchain in this way are less.

Today and Tomorrow Blockchain's Applications

Another popularly known application, apart from Bitcoin [4], based on Blockchain is Ethereum, which uniquely has its very own electro monetary system. However, peers in Ethereum can utilize smart contracts to produce anomalous dispersed implementations. Putting it in a nutshell, Bitcoin captures the financial processing while smart contracts provide more space for builders to venture into different applications, so as to exploit the use of Blockchain to its maximum. Smart contracts are basically chunks of code which can churn out random rules and norms. In other words, smart contracts are of the binary form and are situated in Blockchains as they can be executed by its virtual machine [6]. Similarly, in the parking-management system we have put forth calls for the capacity to create user validated smart contracts and parking lot sharing. Thus, we have decided to implement the usage of smart contracts to capture necessary and important details and data which can be made use of to control and supervise the system. Extensive explorations are being made in the field of Blockchain for numerous IoT related applications [7, 8]. Privacy preserving contracts have been elucidated in [5, 9] with the help of distributed Blockchain and zero-knowledge techniques. Chemical industries have implemented Blockchain to produce a Bitcoin-based electricity-sharing market [10], likewise Blockchain-based decentralized file-storage system and linkable ring signature have been used to implement privacy protection [11, 12]. Note that today Blockchain is used in many other applications like retail, finance, manufacturing, transportation, agriculture, supply chain management, logistics, etc. Hence, this section discusses related work regarding Blockchain, its types/variant, evolutions and used in many applications. Now, next section will discuss out motivation behind writing this article/doing this work.

3   Motivation

Due to the limited parking spaces available in the cities, parking has become one major problem for the people with the ongoing urbanization process. Parking is a constant struggle, especially in city areas, due to the acute space constraints. People have to travel long distances in a crowded locality searching for parking spaces. In our work, we provide a Blockchain based smart solution to all drivers to get a hassle free parking place. We use Blockchain in our work, because it is distributed ledger technology, immutable, transparent, auditable and does not require any intermediary (or central authority) for verifying the transactions. In this technology, trust among people is made through its consensus mechanism, i.e., proof of work and proof of stake. The parking system which we have put forth can be easily incorporated into the current day parking systems for granting parking pools to guarantee smart service to the clients along with which we can generate a transparent and flexible revenue model for their rental works.

By creating an unalterable audit trail in Blockchain, smart contracts would assure the acquiescence of logical terms such that the aspiring participants are secured from the legal complexities indulging in the process. In summary, our primary task in this proposed research is to provide revenue to parking service providers, and to protect privacy services to drivers/users in a minimum of time.

4   Our Proposed System Model – A Smart Parking Allotment System

The solution which we have thrown light on has an additional advantage of producing plush green surroundings and cities which have reduced pollutants, traffic blocks, decreased travel duration, healthy income production, better and fruitful lifestyle routines and healthy relations with landlords, authorities, tenants, etc. This paper puts forth a program with the help of non-fungible parking tokens to generate digital belongings which are compared to that of famished land to develop a smart parking pool. Blockchain techniques can provide trust, liability and ever-lasting traceability which are extremely important to rent out the unused parking lot. This work develops an audit-able system that uses smart contracts to ensure transparency in law and in financial matters. Now, every module of our proposed work is dealt with as:

Entities of the Proposed System
Majority of the modern and smart parking systems depend on a centrally controlled management to monitor the infrastructure and framework, clients, and information and this clearly doesn't provide any privacy to the users. We have put forward the technique of Blockchain which helps in uplifting the distance from the controlled version to a dispatched system by simultaneously assuring safety and security to users' (i.e. drivers and owners) data. Drivers can identify and lease out the vacant parking lots which meet their needs.

The owner of the parking lot has the rights to broadcast and modify the details related to their parking lots which include spot, timings, expenses, gate code, etc. It is to be noted that the users are free to retrieve and provide data to the network. In particular, users will need to provide the management layer with basic information to be authenticated. The Blockchain stores these kinds of private information and operations. Note that *Basic* Entities in Parking – Allotment (in our work) are: Service Provider (parking owner), vehicle users (who need free slot), and miners (who will verify transactions publicly).

The layer of management comprises trusted agencies including government departments and the certification authority. Such organizations are usually network issuers and authentication partners, and are represented as privileged members of a Blockchain consortium. The issuers own the smart contracts, and are solely responsible for the design, development, initialization and maintenance of the network. Issuers may also publish relevant details and allow customers asking to join the network. The authentication party mainly manages user authentication and ensures privacy for the users. In the case of a consumer conflict, the authentication party also serves as an arbitration body.

The Blockchain consortium acts as a distributed ledger within the storage layer. As the blocks are attached towards the end and linked to the preceding one with the help of hash, it grows and flourishes incessantly. Details pertaining to the users and their contract codes are collected and maintained in the chain which prevents any form of modification in the absence of detection. Transactions are implemented to handle data from the perspective of modifications, reviews, or work from the Blockchain server, and all the operations can be backtracked to assure transparency and flexibility through Blockchain.

Algorithm 1: Preserving Privacy in Smart Parking

Step 1: Service Provider will send Parking Slot to all users/drivers available in a public network
Step 2: Interested Driver/Vehicle User will approach to respective service provider for parking
Step 3: Among all existing users, one head will be elected
Step 4: Head will collect information from interested user and will provide to service provider for registration
Step 5: User's information is hidden from service provider, higher anonymity is maintained.

Algorithms 2: Building Trust during Allotment of Parking Slot

Step 1: Once Algorithm 1 process is completed
Step 2: Received Information is cross verified by peer users (or miners)
Step 3: Miners will validate authenticity of information
Step 4: Once Authenticity of information is done, information is stored in block and block become a part of Blockchain
Step 5: Once parking slot's use is over, payment will be done (automatically through smart contract, parking information will get updated) with a feedback mechanism (proceed by driver/user)

Hence in algorithm 2, higher trust is maintained through feedback and decentralized ledger technology.

Function Modules
The anticipated system has been created with Blockchain and smart contracts architecture (Fig. 1) and its functional module possesses registration, search and rent, waiving off expenses and rewarding modules.

In this work, Smart contracts handle the entire income cycle, as well as revenue sharing, and increase the ease with minimal differences of doing business. IoT related gadgets like On Board Unit (OBU) driven sensors and preceptors which are connected to the network monitor, track the parking frequency. The mobile application thus, proves to be the drivers' and parking owners' widgets.
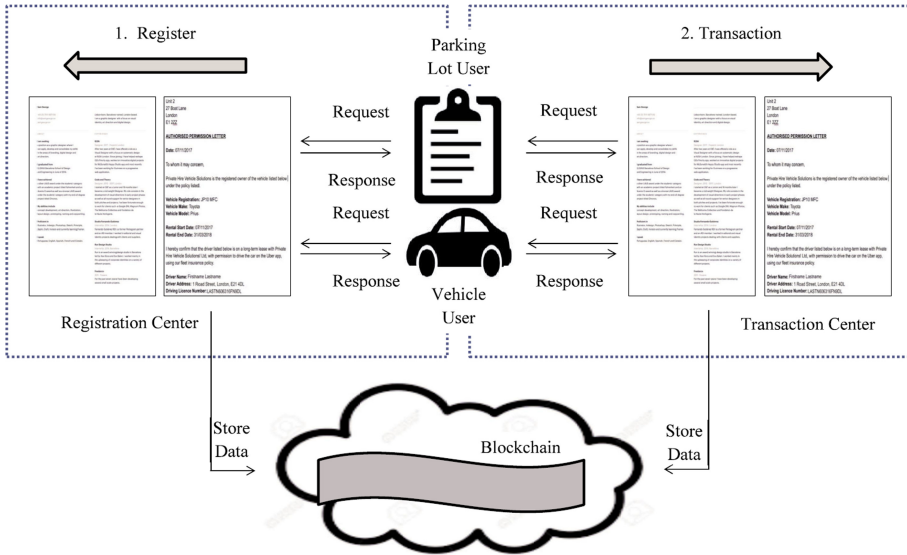
Fig. 1. Proposed model for privacy preserved, trusted smart parking

A. *Registration Module*

Each user is epitomised by a smart contract account which is based on Blockchain which is distinctly linked to different private keys. Users then provide their identities to the Blockchain consortium's privilege nodes at the time of registration so that each node can validate and authenticate the identities they are maintaining. For every novel transaction process, the user is likely to receive a different address which is to ensure that the fellow partners can't disclose the identity of the user by attempting to track their address. Once the user enters the network, they need to mandatorily submit the certification authority along with their basic details through smart contract; it's then stored in the Blockchain. Smart contracts are the basic underlying framework for controlling and managing the identities and records for the Blockchain. It can maintain the basic user records for sign up and then lock them into Blockchain. Vehicle users and parking lot owners have numerous types of data pertaining to the user along with a plethora of user inputs. These consist of the following fields: User ID, car ID, and user address. These further contain parking ID, location, and time of availability, price and owner's address for parking space owners. It's the users' responsibility to submit his/her user ID and parking ID at the time of sign up while the other fields are initialised to Null.

Along with that, smart contract provides a number of platforms which permit the user to scan, modify or extract details. The administrators can publish and alter their details with the help of smart contract after the successful registration. Consider this case as an example: Owners can alter the timings are cost of the parking lots. Each user's identity is secured under an array of address characters, such that, only the

privileged workers in the management can retrieve the personal details. Other IoT applications can be found in [14].

Note that in this work, Smart Contracts provide on the Blockchain a decentralized, cheaper, safe and verifiable system for parking vehicles using private land area. In next module, IoT devices sense actual location/distance of driver/vehicle for providing efficient parking/nearby parking, i.e., with a minimum walking distance.

B. *Searching and Renting Module*

This module facilitates drivers and vehicle users to explore for available parking spaces which fulfil their needs by forwarding them to smart contract transactions which contain details consisting of location and time. If the administrator authenticates and validates the user, the contract is then passed on to the list of parking lots which would in turn return a number of suitable parking IDs. Each time the driver decides to reserve an empty parking space, he/she has to deposit an amount to the account linked with the contract (e.g., virtual or physical cash, a currency used in Counties). This deposit is later credited back into ones account after the user pays and leaves the parking space. Further, the status of the parking space will be updated to be locked or inaccessible accordingly as this would not allow chaotic scenarios like double booking which is similar to the value of double Bitcoins. Smart contract dependent on Blockchain are classified into external and client accounts. External accounts can be compared to Bitcoin accounts, while the latter is implemented for maintaining smart contracts. It's to be noted that though the contract account possesses the external account features, the amount is stored in the contract account. This account can only be accessed with a private key which belongs to the administrators. Smart contracts which are based on Blockchain also features the one-time pad function which is executed with a smart contract to allow the clients to disclose their identity. It calls for new addresses to be created by the users each time they prefer to process transactions with a different user or a contract.

C. **Payment Module**

The payment will be handled and accounted accordingly to invoke the transfer function. The vehicle user is required to form a transaction with a number of inputs and outputs to transfer the amount. Every input contains a public key pk_s for the sender and a secret key sk_s along with a public key pk_r for the receiver which is then topped up with some amount of virtual money. Sk_s is used for signing the contract while pk_r is used for encoding the transaction. Hence, only people who possess the right sk_s linked with the pk_r value can claim their charge. This is quite similar to that of Bitcoin, where in every input contains a reference to the previous output of the transaction. The outputs are of three types: payment recipient, shift charge and transaction fee. Transaction fee is to be waived off by the miner who publishes the transaction to the Blockchain. Money transfer modules are made use for the efficient performance of the rental and payment processes. Once the driver leaves the parking space during the payment process, he/she must transfer the sufficient amount of money to the respective address of the owner by virtual money transfer arrangements so as to return their deposit. Transaction sending is the root cause for performing the three featured modules with the help of the users' private key. So, each operation will cost a small amount of Virtual/Physical cash, payable to the Blockchain

network miner. The process will be stored on the Blockchain to avoid fraud, forgery, or denial as each point in the chain network owns a copy of the full database.

D. *Incentive Module*

Numerous witnesses in this module authenticate and validate transaction signatures and time stamps by including them in blocks. Elections are performed with the help of opinion polls and are rewarded each time a witness creates a block successfully. This permits the delegates to set block dormancy within moments and validate transactions.

So, with the coming smart cities and the ever-increasing number of vehicles on the road, there will be demand for effective traffic management systems. For solving this critical problem of parking slots, this work provides a Blockchain based solution (or Blockchain based IoT powered transparent framework) Where parking pools can be built through the creation of a transparent network, where individuals can rent their unused land for a specified period. For the consistency of the entire system a non-fungible token system will be developed that reflects individual parking lots. Blockchain's public ledger process serves as the foundation of the framework for the management of unused land leasing. Note that if private owned unused land is available in each location, then some of these lands can be used to create smart parking slots, the vehicle congestion intensity on roads searching for a vacant lot can be mitigated or reduced. As a result, there may be fewer accidents over the road.

Hence, this section discusses our proposed work in detail with explaining each and every used module. Now, next section will provide details about our proposed system implementation.

5 System Implementation

We implement smart contracts based on Blockchain and this forms a chain that creates a number of peers of privilege (i.e., city and issuers). Smart contracts are standardised by solidarity. We also make use of Truffle [17] to compile and interpret binary codes for the smart contracts and post those contracts which are linked to Blockchain. In order to link it to the JSON-encoded remote call formality protocol for the implementation of Blockchain, we make use of JavaScript to develop an architecture which permits users to send and retrieve information in the smart contract which is based on Blockchain. The app enables users to sign up and modify the Blockchain records and also enables processes like scanning or reserving the available parking spaces which are compatible with the users' need. Further, the client also provides an interface for the easy transaction of money to the user. Until payment, some virtual/physical cash is prepaid by vehicle users as the deposit which is secured.

6   Blockchain Technology: A Way to Forward

As we know that merkle tree is the heart of Blockchain Technology, and mining is most important process/procedure for validating existing users in network (public or private). In near future, we see that Blockchain can be used for launching new cryptocurrencies by many nations that will be regulated or influenced by monetary policy. For example few nations like China, Russia, Venezuela, etc., have launched cryptocurrency for their nation. Few possibilities of Blockchain in near future are:

a. Decentralized Web
b. Decentralized Applications: for example, transportation – peer to driver to peer, in general, it needs to be peer to peer, provide by Blockchain Technology. It will remove fraud, bogus people in many applications with Saving time and money
c. Peer to Peer Economy
d. The Convergence of Blockchain, Machine Learning, Internet of Things and the Cloud
e. Retail/businesses: Find out sales per month for specific commodity
f. Smart Contact: Idea of smart contracts is its automatic execution when conditions are met. For instance, delivering goods after payment is received. However, other conditions of contracts should also be automatically regulated. Also, smart contract can be used to keep stakeholders documents, Distribution of funds, and KYC/AML utilities in a safe and secure way. In near future, we can use Smart contracts in Ethereum Blockchain. Also, we can solve the bug issue raised due to immutable systems. Bitcoin is a digital or cryptocurrency that verifies the number of digital currency a person has whereas, ethereum Blockchain mainly supports smart contracts. The programming language used in Ethereum Blockchain is complete during high level language called solidity. Ethereum Blockchain is not restricted only to currencies, ethereum protocol is not only visible to the parties involved in the smart contracts but also hundreds of people are witness and they validate the transactions. In near future, some possibilities of using smart contract in many applications are listed as:

- Internet of Things Networks: The smart contract can be used with some other technologies like the Internet of Things (IoT). Smart contracts and IoT can enable significant changes in industries, which help to develop new distributed applications.
- Agriculture: In agriculture, IoT sensors can be used which automatically initiate activities like irrigation or deployment of insecticide; this is being done with the help of programmed trigger values.
- Real estate: Internet enabled lock can be used for automatic locking of a house whenever the tenant is not paying the rent and then can unlock immediately after the completion of payment.
- Banking: Smart contract can be used significantly in banking sector which is an alternative to the traditional way of transactions. Smart contracts help to perform make payments, loans, and other transactions automatically.

- Supply Chain: In this area, smart contract can provide real-time visibility. Smart contracts guarantee inventory tracking which benefit supply chain financing and reduce the theft and fraud risks.
- Legal Issues: Smart contract can replace the traditional model of legal issues solving and document certification. If we use smart contracts, it removes the requirement of notarization, offering automated and cost-efficient solution. We can integrate Law into Smart Contracts for providing better services to users.
- Medical Records Management/e-healthcare: The medical reports associated to a person are one of the vital parameter of an individual's security, preserving this data is sole responsibility of the organization whosoever beholds it. While sharing the data among different platforms, the data may get leaked which may lead to some unavoidable circumstances. So in order to prevent this data to falling into dangerous hands, Blockchain Technology allows hospitals, other institutions/organizations and payers to split access to their networks without compromising or suspecting data security and integrity. Smart contract can be used to store sensitive personal health records, insurance related data. This also supports supervising drugs and other supplies, and also enables secure sharing of patient data for clinical trials and research
- Public Mobility: Due to increase in use of public transport of vehicles, it becomes difficult for government in cities to know the status of public transportation being used, so on implementing Blockchain Technology will help the cities to know and understand that how the public mobility is being used by their residents and how can they develop some different options for transportation.
- Charity: Using Blockchain Technology in charity institution or organization will help donators to track where their donations are going and who is going to use it. Blockchain will provide transparency and security to all the financial records and will give a greater visibility to the donors.

Hence, as mentioned above, there are many other similar industries that have great potential future with implementation of Blockchain in them like loyalty programs, natural resource management, education, advertisement, public assistance, publishing, gaming, travelling and even more. Moreover this, some other opportunities with Blockchain in near future are summarized here as:

- Improve social media functionalities
- Digital Ownership Revolution
- Keeping our ID (Identification) and Personal Information Secure
- Keep your identity safe and Location Privacy safe

Blockchain provides digital freedom by using smart contracts: It means that the system is not governed by any central authority so that any kind of manipulation cannot be done by them. Note that Blockchain is more popular in mortgage industry, i.e., with its transparent system, speed (when compared to the typical mortgage underwriting process), and immutability that will secure your home for as long as you own it. In near future, we can protect several important documents from several vulnerabilities by constructing smart contract for smart era's applications. Hence, this section discusses several possible applications of Blockchain (i.e., Blockchain 3.0) and for which smart

contracts can be created and also discusses several opportunities to protect smart contract for the same/similar applications. Now, next section will conclude this work in brief.

7   Conclusion

Our work discussed a smart parking allotment system based on Blockchain including privacy preservation. We highlight the distributed pattern of paid parking spaces amidst the parking lot owners and the drivers/users. This work removed the need for a trusted third-party entity or an intermediary using Blockchain solution. Also, this approach provides incentives to all drivers who verify other drivers and inform about free parking slot to other user who is searching for a vacant parking slot. Notice that our proposed system is built on the smart contracts platform based on Blockchain, and its functional module includes modules for registration, search and rent, payment and rewards. We can use physical or virtual currency for payment, that is, according to the convenience of the user. An additional benefit of producing income from their usually unused property is indeed a striking feature. Smart Blockchain contracts implement the contractual agreement between the participants which ensures financial transparency in the system proposed. Gunning towards future work, given Blockchain's growth, it would make no sense to use it in many applications where databases have ample functionality, as high performance is expected. In many other applications that require functionality, we work on Blockchain scalability, 51% attacks, storage and eclipse attacks for efficient solution for future work.

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