Trust Reputation in Blockchain Environment: A Review

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Abstract Creating trust in online environments for users is the main goal of reputation systems. With the effort put into creating an efficient system there are some aspects that need to be further discussed. The aspects involved are the authenticity of the ratings, storage and the costly calculation methods. Blockchain offers potential in solving some of these issues and others due to its decentralized and immutable nature. The aim of this paper is to look into reputation systems and what benefits blockchain can offer and challenges that it could create.

Keywords Trust · Reputation · Blockchain

1 Introduction

The Internet has emerged into many aspects of modern life. It offers many services that cover different aspects such as e-commerce and social networking. And with all services provided on the internet comes uncertainty and risk of falling prey to hazards online such as viruses and trojan horse infected documents (Abdui-Rahman and Hailes 1998). One way to alleviate these risks is by developing strategies to establish trust and build systems to allow the users to provide the level of trust they should place on e-commerce transactions (Battah et al. 2021). Reputation systems is an example of a system that assists the users to form trust on the quality and

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reliability of the transaction based on the community's past experience (Xiong and Liu 2004). As most of the interactions done on the web are between peers who do not know each other in real life, therefore establishing a subjective trust is keen in order to perform any transaction. According to Jøsang et al. (2007) trust is defined as "subjective probability by which an individual A expects that another individual B performs a given action on which its welfare depends". With all the effort put into establishing reputation systems to solve the trust issues occurring online, there are still some difficulties that need to be addressed. Among these difficulties are behavioral evidence collection and storage (Battah et al. 2021). Blockchain technology is a promising field that could support solving these challenges due to its immutable and decentralized nature. In this paper we are going to discuss existing reputation systems and focus more on the blockchain based reputation system application and how it can solve the existing challenges faced by reputation systems.

2 Reputation Systems

Reputation systems are systems that aim to produce a reputation score for a provider peer by using methods that collect and aggregate user's feedback about an individual or an object (Abdel-Hafez 2016). These systems are used to aid users in the decision making process of choosing the best provider peer and protect the provider peers from malicious ratings. The methods used to compute the trust score of users varies depending on the factors chosen by the creators. Some reputation systems include the reliability of the feedback source in order to obtain the final reputation score. Reliability according to Abdel-Hafez (2016) is defined as how close the rating by the user to the average rating by all users is. RateWeb system by Malik and Bouguettaya (2008) is one example of a system that uses the reliability and takes into consideration the possibility that a rater may provide a rating that is far from the majority rating without malicious intention by modifying their method to include the consistency of the rater. The systems that use trust as a factor are called trust-based reputation systems. Trust-based reputation systems according to Jøsang (1997) "employ trust scores for individuals, to aggregate a global user trust score, which can be used as a weight in the ratings aggregation process". PeerTrust by Xiong and Liu (2004) is an example of trust-based reputation systems. PeerTrust's reputation score is calculated using five factors. The feedback a peer receives from other peers, the feedback scope, the credibility of the feedback source, transaction context and community context (Ronghua et al. 2018). The system uses these factors to create four different algorithms to compute the reputation score (Malik et al. 2019). TRUE-REPUTATION framework by Oh et al. (2015) evaluates the trustworthiness of the ratings (confidence) in $x + y = z$ order to compute the reputation of the provider peer. The confidence of the rating is based on three factors: activity, objectivity and consistency. The evaluation of confidence and the computation of reputation are done iteratively.

3 Blockchain Based Reputation System

3.1 Blockchain

Blockchain is a distributed system that deploys on the network for the public to see which provides integrity and transparency in data. Although blockchain has contributed to many industries due to its characteristic in being a reliable distributed system, it does not solve the trust problem associated with input data and human relations. It carries a distinctive value that helps build trust between user and the system for its forging mechanism of Proof-of-Work (PoW) that provides a finalized statement of a successful transaction which means that any interaction that has been agreed on between two entities has been concluded and written in the blockchain. From technical point of view, Blockchain is a distributed database that exists on a P2P network (Fig. 1) (Almasoud et al. 2020). This P2P network is a backbone of the system because every node in the network is on the same level as all the other nodes. Although nodes can come in many forms, there is no central node that is an authority. Every node stores a local copy of the Blockchain. If consensus of nodes agrees upon transaction's validity, then the transaction is considered valid (Almasoud et al. 2020).

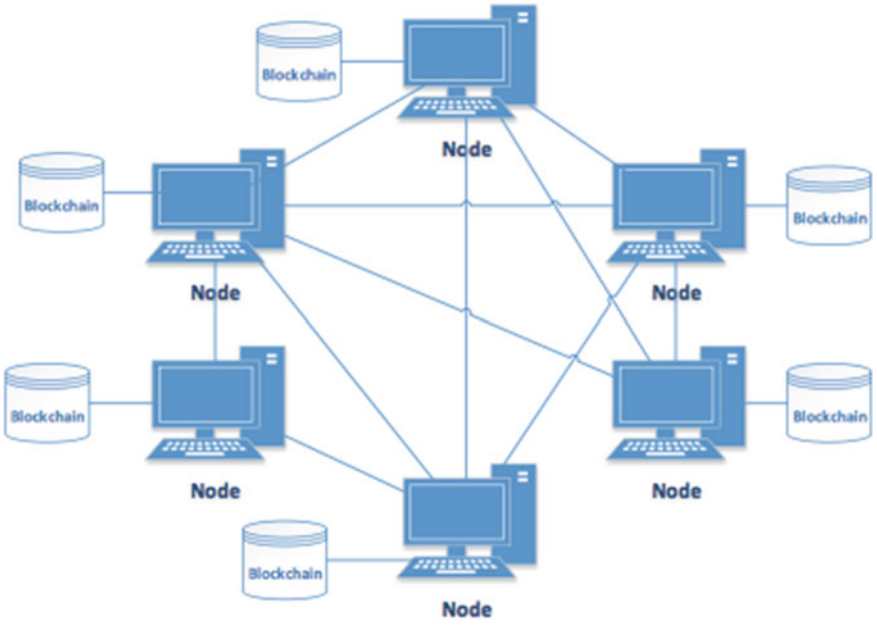

Fig. 1 P2P blockchain nodes (Almasoud et al. 2020)

3.2 Blockchain-Based Reputation System

The immutable and decentralized nature of blockchain makes it a suitable framework to apply the reputation systems and deal with the challenges presented in non-blockchain based reputation systems. FarMed is a smart contract based reputation system framework that is driven by service-oriented computing (Almasoud et al. 2020). FredMed is implemented using a two layers framework. The first layer contains the smart contracts that store all the reputation values of all users on the network. The second layer is the AI layer which calculates the analysis of the information presented on the smart contracts. The system aim is to meet five requirements which focus on the three time frame of applying the smart contract, before, during, and after executing the smart contract. 1) The ability to derive the reputation value for the provider peer from the values on the smart contract. 2) The ability to determine the trust value of a provider peer in a context. 3) The ability to treat the trust value as a digital asset that can be moved across different platforms. 4) The ability to detect malicious behavior. 5) The ability to include mathematical models and algorithms.

4 Application Scenarios and Research Challenges

The problem that has not been discussed is the authenticity of the data being exchanged and whether the immutability of data can incentivize future studies. The BLESS system, also known as Blockchain-Enabled Social Credit System, runs most of the calculations and transactions in the blockchain via a smart contract. The enabled credit rating for this system practices benefit those with a substantial amount of credit rating, which the certified credit rating entities will do. Like any other trust management system, they adopted the reward and punishment strategy for those who act accordingly in the evaluation. This will drive the system user to promote more honest feedback and give them the voice to speak out on injustice as one of the purposes of this strategy is to promote value and dignity in any jobs they can provide for the community. The paper, however, failed to mention how the credit rating system will be evaluated statistically (Ronghua et al. 2018). Adopting this strategy in the system is to say that the authorize role or the admin has been given the context of what is bad behaviour to categorize someone for credit reduction and what is a good behaviour that the system should reward. As there will be an investigation done on the claims of either behaviour, the guideline to act as an individual is based on a community perspective and in relation to the public affair (Malik et al. 2019).

4.1 Suggestion for Improvement for the Usage of Blockchain in the Reputation System

The main goal of applying blockchain in a system is to ensure that the data provided do not need any verification of its truthfulness. The challenge that will be faced is that: a) most services or products can be in bulk, so the receiving peer should be instructed to do an individual assessment of each item b) For a system to assess the login data before it is distributed in the blockchain to enhance the integrity of the information provided c) Increase accountability and responsibility of peer to ensure accurate data provided.

Trust as a form of statistics can be manipulated to improve the services and reputation of an individual. The problem is how can we use *trust* as a mechanism to verify a peer's integrity and reputation. With a strong foundation, *trust* can be formed explicitly between two entities if the underlying reason of the trust is understood in the context of a system or an environment. Overall, understanding the intention and purpose of an entity to trust can be unstable if the objective is to gain only individual benefit. That could impact the overall trust rating over time as trust is a human characteristic that changes. Therefore, we have to establish what is the principle of *trust* to apply for each distributed system because *trust* weighs heavily on the perception of that certain community.

For hundreds of years, humans tend to be unpredictable in their actions and thoughts as we change to adapt and survive. It will be hard to understand ourselves completely but with new rising technology, predicting human behaviour has been made much easier. The goal of creating a trust rating system is to honour nobility and honesty in feedback. But what happens if that is threatened with malicious intent? Offence is the new defense so our main goal should be to analyze what are the possible malicious threats a peer can do and imply that can jeopardize the other peer's reputation. By predicting, we set predetermined rules and validated methods in the smart contract that can detect hostile claims made from any peer before processing it to a reputation score (Almasoud et al. 2020). This is where machine language (ML) comes in handy in categorizing fraud behaviour via incomplete profile details of a peer, inaptitude to bootstrap newcomers or even the ability to factor a valid certificate which is proof that the peer is part of the network. To achieve non-compliant behaviour is to always update the and review the smart contract using plugins like Metamask.

In Trustchain, the focus is referring to the roles of the peer in an environment before evaluating trust value by observing their status, role and contribution in that environment to observe whether the data in different levels of authority is relevant to the trust value accumulated (Malik et al. 2019). The Trustchain is divided into three layers and each layer requires input from peer or system to further evaluate the reputation score which adapts hand-in-hand with the supply chain events given a certain weightage of recent and older events resulting in an overall reputation score to evolve in time. The general trust parameter is when the trader reaches below the minimum amount of trust score, as provided in the system, and gets eliminated

from the network. Though a trader's reputation can mature in a certain period, this approach can further make any peer in the network understand the trust between peers in the system and how they need each other to complement a successful event in trading.

After observing many reputation systems, we have come up with a few solutions to address the problem above. Considering how costly some calculations in a reputation system can be, it is essential to find a function suitable with the pre-defined conditions for the smart contract as there are limitations to implying smart contracts for different purposes. Another problem to consider is how smart contracts are expected to give deterministic results in calculating trust reputation. Therefore, the result representation should consider that smart contracts use the IEEE 754 standard, equating to inaccurate representation impact. For example, if 53×5 should result in 1.666; the result here is 5. The solution can be expensive and limited, but the founder of the Ethereum, Vitalik, provides Taylor Series to approximate a logarithmic function when dealing with smart contracts (Battah et al. 2021).

Time management in the context of smart contracts plays an important role in calculating the reputation system using a common method called decaying. A method to evaluate the trust value of a user by comparing the weight of recent feedback received with older feedback while still relying on the timestamp, an embedded property in a blockchain. Furthermore, the proposed method which uses publicly available dataset of Amazon product review, successfully maintains the original reputation value of a blockchain by using less than 50 feedbacks where the augmentation has a margin error that is lower than 1% of calculated feedback. This shows that the method works seamlessly with existing contracts and can be of interest to all contract-based blockchains (Battah et al. 2021).

A computation concern in applying blockchain in a reputation system is to accommodate the interactions from reputation system to the network. We suggest that designing the architecture should be optimized with the functionality of smart contracts in the system (Battah et al. 2021). It is detrimental for us to remember that the Peer-to-Peer (P2P) mechanism in a blockchain where each local node has to interact, gain consensus amongst each other and provide PoW will inquire more data and create the need for more space and real-time output. For efficiency, it is only logical that we separate where we store data whether it is on-chain or off-chain. Understanding how to apply smart contracts in the system and focusing on deterministic results as we acknowledge that trust data is the main form of data.

A smart contract is a type of digital contract that can store and display reputation status. This is done through the use of Oracles. Oracles are external services that provide the needed information to a smart contract. To implement oracles, we must authenticate data and the status from the point it is out of the blockchain to the moment it re-enters, maybe by stamping a signed message with the results for proof of integrity (Malik et al. 2019). The oracles can be managed by an independent smart contract whose job is to handle oracles. Besides, implying a decentralized storage system like Swarm or Inter-Planetary.

5 Conclusion

In this paper, we have introduced how blockchain can be implied in a reputation system and the different types of reputation systems that have been practiced for different purposes that range from a supply chain network to a mobile application. This systematic literature review provides the struggles of using blockchain in a reputation system and how we plan to solve the problem. The implementation of blockchain has yet to be realized as it was just discovered in 2008 and the potential it brings is part of the digital age evolution. The smart contract is a valuable asset for any system that needs to communicate with blockchain and can be structured and legalized to best suit any system. Reputation exists as a catalog to others who need the service they offer and we believe that protecting the integrity and craftsmanship with the service they offer should mobilize interactions between user and system besides understanding that there are still room to improve our advances in detecting malicious intent that could jeopardize the trust system.

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