Blockchain Based Water Management System

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Abstract - *Water scarcity is one of the biggest problems throughout the centuries. The rise in adoption of IOT technologies and devices has reached out to the water supply chains too. The innovative research has resulted to development of a reliable, auditable and transparent traceable system like Blockchain. Blockchain , the distributed ledger technology brings out a new innovative approach for the realization of decentralized trust less systems. Implementation of Blockchain technology eliminates corruption due to its ability of maintaining records of every transaction. Blockchain provides inherent properties of fault tolerance, immutability, transparency, and full traceability of the stored transaction of the records as well as digital representation of the assets and transaction executions. This paper represents Blockchain based water management system a fully decentralized, blockchain based solution for water supply management where IoT devices collect the data along the setup and add it to the Blockchain. In our Blockchain based water management system we represent a supplier to consumer use case using Ethereum blockchain. We also discuss about the roles of the participants in the network in the water management system. Finally we evaluated and displayed how blockchain based water management is advantageous over current systems and would be a boon to the modern society.*

Key Words: **Blockchain, decentralization,IoT devices**

1. INTRODUCTION

The water management systems that are currently under existence merely track and store the orders and deliveries properly. They do not provide proper features of auditability , transparency and traceability. But by implementing blockchain technology into the water supply systems, we ensure improved safety in water management systems. Several research and development authorities are focusing on use of IoT devices with cheaper connected devices into water management system with fine granularity. But majority solutions work on a centralized cloud infrastructure where there is lack of transparency, auditability and confidentiality. In a certain water management systems it is important to maintain trust and reliability among the whole system participants. Hence a tamper-proof distributed ledger system

is an excellent solution because it does not rely on any centralized third party. The distributed ledger technology does not rely on centralized servers. All the records in the distributed ledger are based on reaching of consensus at least by majority of the peers of the network. In the view of IoT implementation , as other systems require connectivity to the central cloud , the blockchain based solution would only require stable connection to nearest located peer. Hence blockchain exposes traceability in multiple views and domains.

In this paper we present a blockchain based Water management system , a fully decentralized traceable system for the water supply chains management. We use a ethereum distributed ledger implementation for blockchain based water management systems. As the information of the IoT devices is directly stored into the blockchain , the system guarantees transparency between the participants. We assign roles to various network participants from resource to consumer. The requirements and need for distributed ledger implementations in water management system are also displayed. Also we focus on roles and processes of respective participants in the network. the paper evaluates how Blockchain based water management systems can be advantageous over traditional system.

2. NEED OF BLOCKCHAIN IN WATER MANAGEMENT

A water management system should ensure certain requirements

- Water conservation is the primary aim of any water management system. Hence proper tracing of water supply must be maintained.
- The data added into the records by the IoT devices and other participants should be tamper proof.
- The system should not be handled by any single entity or a central authority.
- The system should provide limited access to the participants depending on their roles.
- From producer to consumer any participant in the system should not be able to perform malpractices into the network.
- The records of water quality and water safety must be secure and non alterable.
- Customer should get transparent report as per his usage.

3. METHODOLOGY

Due to increase in scarcity of water a proper water management system has become very important. Last few years an explosive research has been done into blockchain technology and there by its applications. Due to different challenges like heterogeneity of the actors, confidentiality

between the participants and other such facts there has been a lack of a transparent water management system. In our Blockchain based water management system we use a resource to consumer based approach. We use ethereum blockchain framework due to is single production working ability. As Ethereum uses Proof of work consensus algorithm the network nodes can act only when consensus is reached. We use a REST API which brings abstraction and a good system integration facility. We use distributed ledger technology that provides all the advantages of the blockchain technology.

3.1 Assigning Roles

Every participant has be assigned a certain role. Multiple roles can be assigned to a single user. We have defined roles to the participants as per their tasks.
In our system we consider roles as

1) Resource manager
2) Processing Unit
3) Distribution Unit
4) Consumers

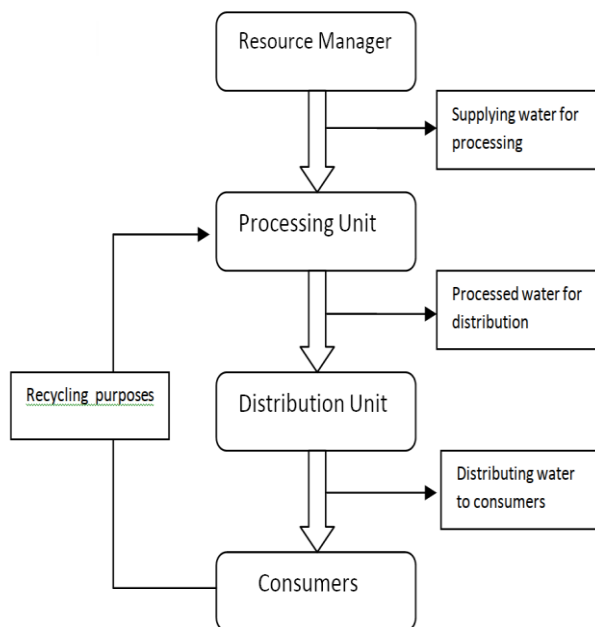The fig below displays the participants and their roles as part of water supply management.

Fig.1 Participants and Roles

3.2 Performing tasks

As we have summarized roles of the participants in Blockchain Based water management system ,now we display respective tasks that the participants would comply.

1) Resource managers

The resource managers is the primary stage of the water management system. They act as a interface between natural resource and the processing unit. The supply of water from resource such as rivers , dams, lakes , reservoirs etc to the processor is carried out by the resource unit. The resource unit manages the data management like amount of water present in water resource or water leveling sensing activities and analyzing working of IoT devices and smart contracts. Management of water supply to respective processors is carried out by the resource managers.

2) Processing Unit

The processing unit is the second stage of the water management system. The processing unit deals with processing of water before distribution. The purification of water and making it usable for the customers is carried out by thew processors. For water quality and quantity detection we can use devices like pH meters or flow sensors to analyze the parameters. They also perform processing activities over waste water given by consumers. The IoT devices ensure the security regarding the amount of ingredients that were added to the water for purification purpose. Hence a proper record of every activity of processing unit is maintained due to use of Blockchain. This ensures transparency and safety for customers in every water processing activities performed by the processing unit.

3) Distributor Unit

The distributor unit is the interface between the processing unit and the customers. As the processing unit supplies water to the distributor unit and the distributor unit thereby supplies water to the customer as per requirement. The consumers can be large scale or small scale industries, agricultural sectors, commercial sectors or household purposes. Distributor unit manages the distribution of water and thereby check the retail environment. They analyze whether the IoT devices charge the customers correctly as per their use. The IoT sensors play vital role during distribution phase. The output of the sensors can also make realize about amount of water wasted in processing to distribution phase. While distribution of water the GPS sensors on water container trucks, flow sensors and pH meters across pipelines and other such IoT devices ensure the safety during the water distribution. If anomalies are occurred during the distribution the smart contracts and the IoT devices act accordingly and display the errors.

4) Consumers

The consumers is the last phase of the water management system. The consumers are the most beneficiaries in the Blockchain based water management system. As no data can be altered or deleted hence every user will get a transparent

report regarding their own water usage . The water safety parameters are also ensured by the system as IoT devices and smart contracts display a clear report regarding safety parameters of water quality and water quantity. The customer satisfaction is totally maintained in the water management system.

4. SECURITY ISSUES

In any system security is the basic requirement which is to be ensured. Blockchain based water management system ensure maximum security in water supply system.
Some of the security issues can be listed as
• The regular checking of the IoT devices and their outputs must be carried out.
• The data added into the blockchain by IoT devices should be correct.
• Public/ private key pairing must be proper in the blockchain.
• System must ensure the digital signature security.
• Consumer feedback has to be regularly inspected.

5. ADVANTAGES

This decentralized water management system provides many advantages over the traditional centralized system.

• Every consumer gets a transparent report about their usages and charges as per usage.
• Malpractices cannot be performed as every single action is been recorded into the blockchain.
• The traditional water management system was based on centralized servers while Blockchain based system introduce a fully decentralized environment.
• Use of Blockchain provides transparency in the system where record of every transaction is maintained
• Blockchain provides auditability, traceability and immutability into the system.
• Due to increased capabilities of the modern edge devices use of robust devices can ensure maximum security.
• Ethereum provides availability ,reliability and availability for high level participation.

6. CONCLUSION

Water is the main resource for the living things on the earth. In this environment of such a huge water scarcity a good water management system has become a intense need . Blockchain based water management system is an attempt to initialize transparent and tamper proof system. Every system must ensure customer satisfaction whereas blockchain based water management system acts a perfect setup in a trust-less environment. Hence by defining the roles ,the load on any single authority is reduced. Introduction of distributed ledger technology and IoT devices makes the water management system more smarter and advantageous than the traditional system. By

considering economic perspective the cost of using ethereum can be prevented by using a private blockchain network. Moreover a certain limitation is occurred for writing smart contracts that is they are to be written in same language throughout the system. But the ethereum implementation provides CPU intensive environment which is very important in any perspective. Hence a blockchain based water management system will be a boon to the modern society.

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