MEDICAL ENTITY TRACKING USING BLOCKCHAIN TECHNOLOGY

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Abstract: Healthcare is a data impulsive domain, where huge data is created, must be utilized efficiently with its concern to security, integrity, maintenance, tracing and many such important parameters which helps building smooth systems to rely and work with. Blockchain, the emerging technology which has been solving such important issues related to data is now worth in almost every domain to elaborate new and innovative solutions other than the financial sector. Healthcare sector is concerned about the documents of patients; more specifically its integrity, sharing and maintenance. Blockchain in health sector is one such domain where the forgery in any aspect is almost impossible. The literature survey gives the necessary path to improve security and runtime tracking techniques for smooth operation of system. Main focus is on the tracing of medicinal commodities which can be counterfeited in between the supply from manufacturer until it reaches the patient. Hyperledger is used as the advanced blockchain technology along with some other components contributing to avoid counterfeiting drug to attain an anti counterfeit supply of medicines thus avoid buggering with the health of patients.
Keywords: Blockchain, Hyperledger, forgery.

I. INTRODUCTION

Blockchain as a technology is emerging spontaneously in different sectors due to its outstanding features. No sector today has been without introducing the blockchain technology for using its benefits for the purpose of improvisation in their respective fields of interest. Researchers all over the world, have taken blockchain technology seriously for solving critical problems rather by using the old traditional methods. Evolution of the blockchian technology in various aspects, technically along with it's fascinating features and non-technically due to its convincing power for a solution both together makes it trustful for the new users to rely onto. All the credit goes to Satoshi Nakamoto for introducing a decentralized network which is now at the mark and still much advancement are yet to be introduced in the near future. The topmost current use of blockchain is with the electronic currency, Bitcoin, whose blockchain transactions involve moving specific amounts of Bitcoin currency from one account to the another. Anyone can verify a particular Bitcoin account by using appropriate software tools to examine the transactions on the public blockchain network. The term "blockchain" comes from the distributed database that blockchain uses. It creates a chain of transaction blocks or a "block chain" to store information. The blockchain, more specifically "chain" is an electronic,

shared, secured distributed ledger with a specialized purpose. For Bitcoin, this translates to a ledger that manages the ownership and exchange of the Bitcoin currency among the participants.

The financial sector has already found out new ways for using blockchain technology and still exploring new methods for making this sector grow. Other than financial sector, the other sectors are also exploring tremendous possibilities using blockchain such as healthcare sector, transport sectors, agricultural sector and many more are taking advantage from this trustworthy new technology. The trust is build on this technology from people lies in its features providing security, integrity, privacy, immutability and transparency.

Before taking a look at the technical part of the blockchain concept, some key points need to be understood related to blockchain. These concepts are the building blocks of this technology which are still under research domain to improvise its productivity by the research teams all over the world.

II. LITERATURE SURVEY

A. Decentralized Network

Decentralized networks are known for its two special features- immutability and non-reputability. Decentralized networks are meant to be more stable avoiding the risk of complete system failure as seen in a centralized one due to single point of failure in the network. This advantage of using a decentralized system of not affecting the entire system even if node failure occurs, makes it useful and more reliable for data handling purpose. A decentralized network is durable to withstand any circumstances overcoming the shortcomings of the traditional centralized networks.

That's the reason, blockchain being so popular for various applications to be built upon. Blockchain technology uses a distributed ledger system which is shared over the network to all the participants in the network, giving complete details of the transactions which are carried out providing transparency as a great feature which adds on to trust the technology.

B. Hyperledger

Hyperledger can be counted as the advancement in blockchain technology. It is an open source platform for carrying out any transaction only between the meant to be active participants for a particular transaction over a dedicated channel in the whole hyperledger network excluding the rest participants in the network. It means, that the transaction for any application will be visible only to those people who are actually participating in that transaction. This makes it even more secure and the ledger of

the transaction is shared over the network. Hyperledger has many types like Hyperledger Fabric, Composer, Sawtooth, Iroha, Burrow and Indy out of which Hyperledger Fabric is basically meant for beginners.

C. Healthcare Sector
In this section, we need to understand the need and importance regarding use of blockchain technology in healthcare sector. Healthcare sector has challenges regarding to Patient's data handling, focused individual health checkup by doctors, maintaining the patient's record with due privacy, and many more. Not only the healthcare comes in regard to doctor and patient alone, a patient's health can be in the hands of himself and also be in the hands of people who are involved in healthcare, for eg., the manufacturer of medicines till the patient himself if follows a proper and correct path may prove altogether as a beneficial step for a good healthy society. It means, avoiding counterfeit and forgery in any case may prove beneficial to attain a healthy society. As mentioned previously, each and every person directly or indirectly contributes to the better health environment. Counterfeit and forgery of drugs while transportation is a serious problem faced in healthcare sector. At the transportation time, the mediators or referred to as the participants during the complete supply chain management system are in direct contact with the goods transporting right from the pharmaceutical companies till the chemists. Each participant in this supply management is under the surveillance as these participants individually are responsible authorities at each stage to complete the supply management process successfully. If anyone among these participants become "Chiefly British" then it affects the overall system badly, disturbing the well functioned existing health situation in society.
Due to counterfeiting of drug, people's health gets affected largely as common people trust the pharmaceutical companies. Here the trust factor comes to a risk and thus the overall system fails to maintain healthy environment to the society. Along with this, economical instability adds on to this worst situation. Hence to avoid such situation, a proper tracking system must be implemented so that forgery can be limited. Researchers are finding out ways for solving this problem.

III. RELATED WORK
In order to avoid the counterfeiting of drugs while transportation, gives a solution of tracing the goods starting from its departure from the manufacturer till it reaches its destination. Tracing of goods using traditional methods such as most commonly telephoning and the barcode checking only is not a reliable choice to go with. As for the solution to the same problem, blockchain technology is introduced for tracing the location of goods. This is achieved by using a hyperledger network where the participants related to the particular supply system are only aware of the complete process of supply of medicines and the other participants in the network other than the actual participants of the supply management will be at rest. This is the feature in hyperledger which provides the users a dedicated channel for carrying out

business transactions with complete security and privacy. Consider an example of a supply of medical entities for clear understanding of the system. For this supply of medicines as a transaction to be successful, the participants should be known. Here, the participants are the manufacturer, wholesaler, distributor, chemists and patients are involved. Every participant is bounded by a common smart contract. The medical stock when departed from the manufacturer, the manufacturer as a first participant in the network, will do registration via a mobile application which helps update a ledger in the hyperledger blockchain with the information that the stock has been departed towards the next participant physically. Now this update to the ledger is visible to all the participants connected for that particular transaction. When the stock is received physically by the wholesaler who is the second participant in the network, will do the registration again via the same mobile application installed in his portable device too. This will make a new record to the same ledger as an update. From this the other participants come to know that the stock is now reached and is safe with the wholesaler. Same process is continued until it reaches the last participant. After the last participant in the network does the registration, the ledger will become immutable and no more updates will be added. Thus, we achieve tracking of goods at each stage of supply management process. This system is lacking at the registration part which each participant has to make. The problem statement arises here is that, if a participant even after receiving the goods physically forgets to update the ledger, the complete idea of using such an outstanding technology fails. Again it goes back to the traditional method. The main purpose to use hyperledger is to attain the following benefits-confidentiality, avoiding counterfeit of drug delivery, maintaining a permanent immutable record, tracking the complete process. The proposed work mentioned below will hopefully resolve this gap.

IV. PROPOSED WORK
The above related work does not provide a real time tracking system. Thus, still forgery can be done on practical basis as the authority is completely in the hands of the participants in the network for timely registration. This is achieved by adding of the members into the network in run time when the transaction bill is generated. To have a detailed understanding, let us consider an example. Initially, there are two fixed Members in the hyperledger network- Manufacturer and the second wholesaler. Smart contract will be designed in such a way that, it will have certain terms and conditions that will bind all the participants in the network. In the supply management system, multiple distributors approaches to the wholesaler to buy the medicine stock. Now, when the distributor purchases a part of overall stock, the bill generated signifies the completion of a transaction. Now this bill generated will be updated as a ledger entry into the network, giving information that a particular distributor has purchased this much amount of stock from the wholesaler at what time, at which place, on what date, at what price and personal details about the distributor for having his identity.

When these distributors sells out this stock of medicines which they bought from wholesaler previously, they will further sell some part of it to multiple retailers. Again bills will be generated for each transaction between the distributor and the retailers individually and these unique transactions will be updated over the ledger. Further again retailers or chemists in this case, will sell the medicines to the patients and final transaction level here ends for multiple patients purchasing medicines individually. All these ledger updates will calculate the total sell of the medicines from the point of wholesaler to multiple distributors and further. This calculation will give us a perfect value which will be compared with the very first transaction (between the manufacturer and the wholesaler) to check whether the complete stock has been utilized or not. If the value doesn't match, it is the indication that there exists still some stock which is either in process of sell or there is some problem.
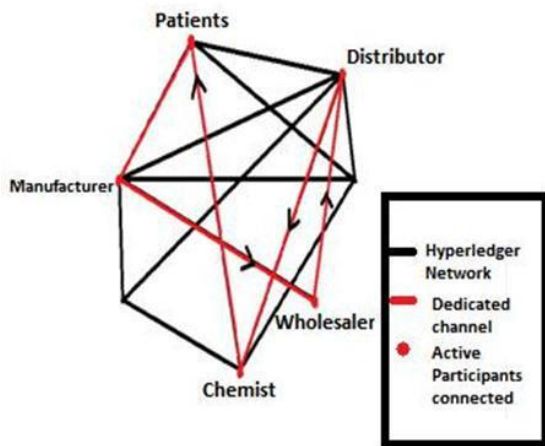

Figure 1: Hyperledger network for supply of medical entity

This will give live tracking, transparency, immutability, security, privacy, resulting in smooth functioning of the supply management system. Here, this is shown in figure 1 and figure 2. Figure 1 describes the hyperledger network and figure 2 shows the operation flow of proposed work.
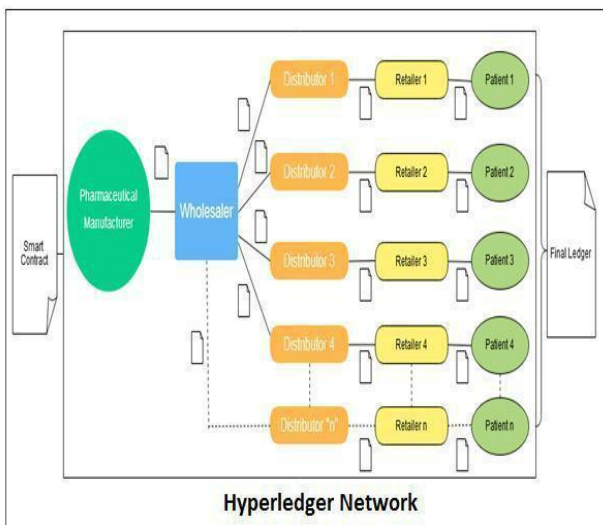

Figure 2: Proposed system block diagram

V. WORK DONE

In order to achieve successful implementation of this proposed system, I installed Hyperledger composer on the linux 16.04 system []. The purpose of choosing Hyperledger composer was to ensure a basic and easy understanding of blockchain network which also provides add-ons such as open-source, easy installation, security, reliability, user friendly. After the installation of Hyperledger composer, I created participants of the network; as a sample experiment for this project I created four participants in the network viz., manufacturer, distributor, retailer and customer. Two assets were created for searching of particular medicine. The first asset was named as 'medicine' and the second as 'medmedicine'. The first asset 'medicine' included details for the available medicines in the database. Adding of medicines details into the database was included via this asset, whereas the second asset created was for medicine search in the database. When queried, it would respond back with correct medicine details using unique medicine id. To achieve this, I developed a chaincode and model file which included the structure for this proposed system efficiently. Access control was open for all the participants in the network. This was achieved writing a separate code in the access control (.acl) file. The query file was written for querying for a particular medicine only. All these four files generated '.bna' file which was loaded to carry out transaction. This led to start a new business. Any transaction made among the participants, clearly reflected on the ledger. The ledger showed the details of participants; at what time, place and date they were on the network, details when the transaction took place among the participants included the time, date, location, which medicine is being transported, by what quantity, etc.

VI. FUTURE SCOPE

This project was implemented on a small scale considering for a single organization. But in reality, the business is carried out on a large scale with multiple organizations working for a single cause. The future scope here includes the working of multiple organizations on the same network. It means coding and querying for multiple participants or the product should be as simple as information provided by a single smallest network. Yet to be seen as a difficult task in current situation, but if implemented for large scale business, would definitely help gaining transparency, avoidance in forgery, increased capital security, better and stable relations and higher productivity. Another idea to improvise this system would include spotting of goods via GPS tracking devices. This would help achieve again live tracking of goods for more better performance, ultimately save delays in transporting of goods, availability of those goods in market, human errors etc.

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REFERENCES

[1] Mettler, Matthias. "Blockchain technology in healthcare: The revolution starts here." In e-Health Networking, Applications and Services (Healthcom), 2016 IEEE 18th International Conference on, pp. 1-3. IEEE, 2016.

[2] Esposito, Christian, Alfredo De Santis, GennyTortora, Henry Chang, and Kim-Kwang Raymond Choo. "Blockchain: A Panacea for Healthcare Cloud-Based Data Security and Privacy?." IEEE Cloud Computing 5, no. 1 (2018): 31-37.

[3] "Blockchain Technology in Pharmaceutical Industry to Prevent Counterfeit Drugs" Article in International Journal-of-Computer Applications. March2018DOI:10.5120/ijca20189165 79

[4] Alhadhrami, Zainab, Salma Alghfeli, Mariam Alghfeli, Juhar Ahmed Abedlla, and KhaledShuaib. "Introducing blockchains for healthcare." In Electrical and Computing Technologies and Applications (ICECTA), 2017 International Conference on, pp. 1-4. IEEE, 2017.

[5] Jiang, Shan, Jiannong Cao, Hanqing Wu, Yanni Yang, Mingyu Ma, and Jianfei He. "Blochie: a blockchain-based platform for healthcare information exchange." In 2018 IEEE International Conference on Smart Computing (SMARTCOMP), pp. 49-56. IEEE, 2018.

[6] Benhamouda,Fabrice,ShaiHalevi,andTziporaHalevi. "Supporting private data on Hyperledger Fabric with secure multiparty computation." In Cloud Engineering (IC2E), 2018 IEEE International Conference on, pp. 357-363. IEEE, 2018.

[7] Zhang, Peng, Michael A. Walker, Jules White, Douglas C. Schmidt, and Gunther Lenz. "Metrics for assessing blockchain-based healthcare decentralized apps." In e-Health Networking, Applications and Services (Healthcom), 2017 IEEE 19th International Conference on, pp. 1-4. IEEE, 2017.

[8] Stagnaro, Chet. "White paper: Innovative blockchain uses in health care." Freed Associates (2017).

[9] https://hyperledgerfabric.readthedocs.io/en/latest/whatis.html#permissionedvspermissionless-blockchains

[10] https://hackernoon.com/blockchain healthcare-opportunities-challenges-and-applications-d6b286da6e1f

[11] https://www.ibm.com/blogs/blockchain/category/blockchain-in-healthcare/

[12] https://medium.com/@sukantkhurana/solution-to-counterfeit-drugs-blockchain-af10544909e6

[13] https://www.nasdaq.com/article/blockchain-technology-can-help-reduce-flow-of counterfeit-drugs-cm721230

[14] https://www.forbes.com/sites/bernardmarr/2018/03/23/how-blockchain-will-transform-the-supply-chain-and-logistics industry/#235488905fec

[15] https://pharmaphorum.com/views-and-analysis/can-blockchain-solve-pharmas-counterfeit-drug-problem/

[16] http://theinstitute.ieee.org/resources/standards/how-blockchain-technology-could-combat-the-global-counterfeit-drug-market

[17] https://www.nasdaq.com/article/blockchain-technology-can-help-reduce-flow-of-counterfeit-drugs-cm721230

[18] https://www.gartner.com/en/information-technology/insights/blockchain?utm_source=cpc&utm_medium=google&utm_campaign

[19] https://rctom.hbs.org/submission/can-blockchain-help-solve-the-problem-of-counterfeit-drugs/

[20] https://www.tcs.com/blogs/drug-counterfeiting-blockchain-to-the-rescue