Covid-19 Vaccine Provenance Using Integrated Blockchain and IoT

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Abstract - *The Novel Coronavirus disease (COVID-19) has appeared to be the enormous challenge as a result of its continuous structural evolution. As we initiate to combact the global pandemic with the fast-track roll-out of the covid-19 vaccine vials, its invincible demand and the enforcement of the immunization campaign all over the world is pivotal, but its favourable results mainly depend on the accessibility of a sustainable and an optimized supply chain. This study focuses on contributing a solution which uses forefront technologies Blockchain and IoT enabled vaccine vials provenance .This review also proposes the use of RFID cards as verifiable vaccination certificates that privately and securely reports the status of immunization. Lastly, this paper aims to propose a contact tracing technique using geolocation of the mobile user to determine the probable Covid-19 infected citizens.*

***Key Words*: Covid-19, Vaccine, RFID cards, Blockchain, immutable, IoT, provenance, verifiable certificates, immunization.**

1. INTRODUCTION

Since World War II, the noval corona virus (COVID-19) is being regarded to be the most life-threatening event. As the transmission of the virus was abrupt and the spread rate could not be foreseen in advance, only a few countries have been fortunate to restrict this pandemic. The foremost reason for the success to control this global pandemic was the ability to trace the contacts of the infected citizens on time and quarantine them to cut-off the spread. Immunization and contact tracing have been proven to be the most beneficial way to delimitate the increase of this disease. To address the challenges in smart phone app-based contact tracing of COVID-19, we propose the idea of using mobile phone users' geo location data for contact tracing. The proposed solution, allocates a mechanism where with the use of IoT equipments such as temperature sensors and location sensors are used to monitor the vaccine vials supply chain. The information

recorded from these sensors are encrypted using blockchain algorithm such as SHA-1 algorithm (also called as the hashing algorithm). Use of RFID cards accelerates the process of vaccination as well as acts as an verifiable certificate. These certificates cannot be vandalized or varied. Along with the vials distribution the system also targets to deploy a contact tracing system that does not intrudes one's privacy. Coast-to-coast the framework is designed to upgrade the current privacy issues and finer allocation of the vials without being damaged and wasted.

2. LITERATURE REVIEW

The compelling demand of the Covid-19 vaccine without being tampered or wasted, acknowledge technologies such as Blockchain and IoT to provide economical and enhancing the quality of the vaccine provance .[1]This paper provides a solution in which the blockchain technology is implemented to gain immutability, eliminate travesty and identity theft and also assurance of data integrity. With the aid of Ethereum test network, Ropsten, the prototype was executed in consideration of all the current Covid-19 vaccine distribution tracking conditions. Numerous features such as traceability of the vaccine, transparent and tamper-proof side effect self reporting solution were achieved. The proposed blockchain system showed promising outcome in terms of the scalability and outturn. [2] This paper presents an integrated blockchain-IoT system which intended to help sustain the trust among the stakeholders. With the ratification of these leveraging technologies the direct involvement of workers will be lowered which reduces the possibility of infection. The system enhances the transparency, privacy and visibility medical fundamentals and details. [3] In this paper, a decentralized blockchain based solution was proposed to automatize the process of forward supply chain of Covid-19 medical equipments and facilitate information exchange involved in the waste management. Algorithms are designed to define interaction rules regarding waste handling of Covid-19 medical equipments. [4] This paper proposed a blockchain based solution for immunity

certificates and digital health passports. Self-sovereign identity, re-encryption proxies and association biometric information was incorporated. Four smart contracts was proposed that anticipate on leverage on-chain events and notifications and trivial on-chain storage. [5] This paper highlights the extensive challenges that have emerged during the this global pandemic. To assess the pertinence of blockchain technology, potential use cases have been established to encounter current requirements. Agriculture and food distribution, immigration and emigration procedures, contact tracing, supply chain management, patient information sharing etc are the various fields where blockchain technology can be adapted. [6] This paper proposed a solution contain the spread of the novel coronavirus disease by the method of contact tracing. The proposed method helps the authorities to spot the numerous probable affected people without using smart phone based mobile applications. In this solution a new method for Covid-19 contact tracing is established on mobile phone user's geolocation acquired directly from the mobile operators. This system demonstrates numerical instances which significantly outperform the smart phone mobile application based solution.
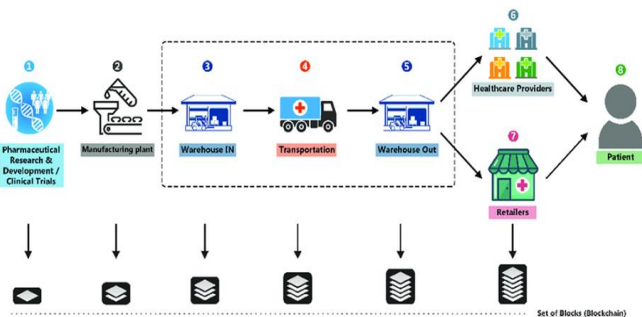
3. METHODOLOGY

Fig -1: System design of the Vaccine supply chain
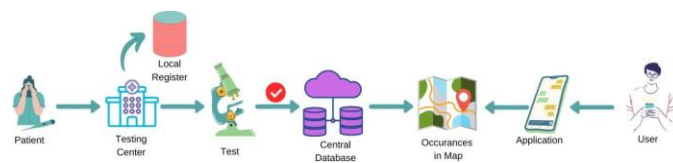

Fig -2: System design of the contact tracing

We structure the overall framework in five operational phases. Phases and their operations are listed below:

Phase 1 - Vaccine Distribution: In this phase, the manufacturer dispatches the vials to the distributors to

supply to the designated destination along with prerequisite data is updated.

Phase 2 – Vaccine Transportation: In this phase, the conveyances which transports the vaccine is equipped with IoT sensors (such as Temperature sensor and gps sensor). With the support of these sensors the prerequisites are monitored. This data is eminently crucial and sensitive. Increasing the urge of data security, this is achieved by implementing blockchain technology using SHA-1 algorithm.

Phase 3- Data Collection : In this phase, the primary data for the COVID-19 patients will be collected from the designated test centers. Then the infected areas will be shown using any map services (e.g. Google map).

Phase 4- Identifying Probable Occurrences using Haversine formula.

Phase 5- Vaccinate the Patients: In this phase, to track the vaccinated citizens, the citizens are provided with RFID card.

4. PROPOSED SYSTEM

In the proposed system, a decentralized and immutable blockchain and IoT based solution is provided in which employing blockchain technologies such as SHA-1 algorithm guarantees data security, here based on factors of data updation a hash value is generated and encrypted data is stored in the database. The utilization of IoT sensors such as temperature sensors, location sensors allows the stakeholders to supervise whether the vaccines are secured or being tampered. The use of RFID card is to keep track of the immunization campaign and also act as an verifiable certificates. This RFID card will possess a unique id of the citizen. When the citizen is getting immunized this RFID card is scanned and the unique identification number is procured and sent to the server. The server will provide all the vaccination related information of that citizen. Along with the Covid-19 vaccine distribution, we aim to cutoff the spread of this Novel Coronaviru disease by the process of contact tracing. In our system, there is no requirement of either Bluetooth or NFC or even wi-fi , we use Geolocation – based tracing approach to distinctly locate the citizens who can be infected . Implementing this method circumvents panic trepidation spread among people.

System Modules:

Manufacture model: Manufacture will be managing the vaccine, distributors, will dispatch the vaccines and track the vaccine vials.

Distributor Module: The distributor will hospitals, update location and temperature and delivers the vaccines.

Hospital Module: The hospital will be updating temperature and locations, send alerts to probable infected citizens, manage vaccinated patients.

Citizen Module: The citizens will update their geolocation, receive notifications and update side-effects.

5. CONCLUSIONS AND FUTURE SCOPES

The review paper equips an in-depth analysis of the approaches to efficacious provenance and contact tracing process. We proposed integrated solution, with the use of the leading edge technologies such as blockchain, IoT sensors and RFID card stipulates the logistics of the Covid-19 vaccine. Along with the tracking and supervising of vaccine dispersal, we proposed a contact tracing method in which we have addressed privacy issue by circumventing the use of Bluetooth/Wi-Fi/NFC, the proposed model uses mobile user's geolocation updated by the user to determine the predictable infectious citizens. Using this outlook the global contact tracing performance enhances significantly while safeguarding the user's privacy. This system can be used for logistics of the remdisivir and plasma of citizens who have recovered from the coronavirus disease which is the need of the hour to treat people from this vicious disease as the system provides all the necessary features be it being tamper-proof, scalable, and optimized.

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