

Contact Tracing and Vaccination Certification with Blockchain and NFTs

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Abstract - COVID-19 has taken the world by storm. Contact tracing is a method employed to contain the spread of such communicable diseases. The infected persons' contacts are identified and notified to self-quarantine themselves to further prevent the spread of the disease. Current forms of contact tracing are fully centralized. Apps like ArogyaSetu have been criticized for infringement on privacy and lack of transparency. Using distributed, decentralized, and immutable databases such as blockchain addresses concerns of data privacy, quality, transparency, and compliance. Travel history and contact data can be securely stored on the blockchain ledger. As people get vaccinated and borders to other nations start opening up, countries will start asking for proof that the person trying to enter their country has been vaccinated. Vaccination certificates are sent digitally on apps such as Arogya Setu and Cowin. People who haven't been vaccinated can forge fake certificates to enter into countries. It is also very tough to prove ownership of such certificates. All this along with the drawbacks of storing data centrally brings us to the solution to this problem. We can issue vaccination certificates as NFTs (non-fungible tokens). An NFT is digital data stored on the blockchain. An NFT certifies a digital asset to be unique and not interchangeable. NFTs live on the blockchain, thus it is a kind of proof of ownership of that particular data.

Key Words: Blockchain, Travel, NFTs, Contact tracing, COVID-19

1. INTRODUCTION

Due to the limitations of existing measures for contact tracing during this COVID pandemic and the reasons for limitations in privacy and verifiability of vaccination certifications, we propose a blockchain-based model to do the same with the help of crypto tokenomics and NFTs.

The idea is to use a blockchain to store and maintain vaccination data and transportation data. This allows for a governing body to know the rough idea of the number of vaccinated persons in a geographic location. The vaccination data is collected in vaccination centers/camps while the transportation data is collected from public transport records.

The vaccination certificates are stored in the blockchain as NFTs. The vaccine and transit data are then retrieved via a node server and visualized in a frontend react application.

1.1 Vaccination Certification

NFTs (Non-fungible tokens) are unique and non-interchangeable units of data stored on a digital ledger (the blockchain). The NFTs are basically digital entities that live on the blockchain. For example, any two Rs. 100 notes are the same in value and also are interchangeable, this is not the case with NFTs. No two NFTs are the same. Since NFTs live on the blockchain they also inherit all their properties of immutability, trustlessness, security, decentralization and much more.

The problem with the current handling of vaccination certificates is that their authenticity and ownership cannot be easily determined. There is a lot of scope for fraud and duplicity. Our portal aims to solve this very problem by providing vaccination certificates in the form of unique NFTs. Each person who gets vaccinated will have to receive a unique 1 of 1 NFT, a unique hexadecimal address will be tied to each NFT to verify ownership. We'll be using the ERC-721 non-fungible token standard for this purpose. ERC-721 is a standard of representing ownership of an NFT. It is a smart contract paradigm that we can customize to fit our own needs. Smart contracts will be written in Solidity. We will be deploying NFTs on the public blockchain using a platform called OpenSea. This platform will host our unique NFT.

2. LITERATURE REVIEW

Through a survey to investigate all the current blockchain technologies for reducing the spread of Covid-19 infections, Laura Ricci et. al [1] describe solutions that use the latest technologies for immunisation certifications, ensures safe and secure authenticity of documents while also maintaining privacy. Blockchain Protocols like LCT, PCT and MOCT show disadvantages. The approach that this paper shows solves the issue.

In [2], the authors point out the applications of Blockchain in the travel industry - the use of cryptocurrency for easy payments in online travel bookings, Identity Management, Fraud Prevention, Overbooking, etc. Unfortunately this is too complex to understand for most developers. Another disadvantage is that it requires a large network of users. In [3], The Authors discuss the current landscape of contact tracing mobile applications, and the way blockchain could contribute positively to contact tracing applications. The paper also discusses the various disadvantages of using a contact tracing mobile application. Some of these include

blockchain's decentralization, consensus, provenance and finality causing issues, privacy issues, etc.

[4] In this paper, a system wherein a blockchain technology is used to guarantee the integrity of the data thereby avoiding identity thefts and impersonations. Smart contracts are characterized to screen and track the appropriate distribution conditions of vaccines against the safe handling rules characterized by the vaccine producers which enables the awareness of all network peers. As a result, this system assures transparency and correctness in the registration and management of the waiting list for immunization. In [5], The paper consists of high-level design of three blockchain-based systems to enable the governments and medical professionals to efficiently handle health emergencies caused by COVID-19. The three design principles are used for tracking and tracing Personal Protective Equipment (PPE), Logistics Monitoring of Vaccine and Incentive-Based Volunteer Participation in Clinical Trials. In [6], Authors showcase a blockchain-based approach to enable and ensure distribution and delivery of COVID-19 vaccines in a manner which is fully trackable and traceable, transparent, auditable, reliable, trustworthy, and secure. They propose to develop smart contracts to automate functionalities and generate events and notifications in case of violations to the smart vaccine container throughout the COVID-19 vaccines' delivery and distribution process. Ethereum blockchain is connected to off-chain storage to overcome the large-sized data storage limitations.

A generic solution is also proposed which can be customized as per the requirements of all types of vaccines in terms of their distribution and delivery. Security and cost analysis is conducted in order to evaluate the performance of the proposed blockchain-based solution in terms of affordability and checking robustness against possible security attacks and vulnerabilities.

In [7], the authors point out the lack of transparency and reliability in traditional databases in crucial pandemic data and therefore suggest the use of blockchain for the same. It is suggested that blockchain is the best means of storing historically crucial medical data. [8] Here, in a similar manner the author emphasizes the privacy protecting features in the blockchain architecture and the importance of a trustless network for medical records. In [9], Maha et al. showcase an IBM study that demonstrates blockchain's relevance in vaccination tracking and as a digital health passport platform. In [10], Zhang et al. suggest a technological framework for contract tracing with existing blockchain networks.

3. PROPOSED METHODOLOGY

We propose a solution that uses blockchain technology with travel to aid in efforts to minimize the spread of Covid-19. The overall idea is to create a web-based

frontend that could be used to contact trace people who travel around the country and use NFTs to create immutable and tamper-proof vaccination certificates.

We aim to create a dashboard that acts as a complete destination for tracking Covid cases, vaccinated, Partially vaccinated and non vaccinated travellers.

With the concept of NFTs, we will be able to provide live analytics on authentic data. The front end of this dashboard/application has been carried out using React and Node Modules. We have designed different components for this application which consists of Live charts, Transit records, and our very own currency (Bitcoin) Tracify.

Each Bitcoin is basically a computer file that is stored in a 'digital wallet' app on a smartphone or computer. People can send Bitcoins (or part of one) to your digital wallet, and you can send Bitcoins to other people. Every single transaction is recorded in a public list called the blockchain.

The live chart depicts a graph that has the count of people tested, confirmed and vaccinated for Covid19 on a particular day which gives a detailed study day wise. The Transit records give the details about passengers travelling from a place to their destination along with their unique Id for better tracking of their vaccination status.

Using blockchain, we can implement a system that collects location data from many interconnected systems and deliver exact location details to the customers. The application of this project can be extended to other areas like airlines to find lost baggage, for tracking rented cars etc.

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The vaccination certificates are stored in the blockchain as NFTs. The vaccine and transit data are then retrieved via a node server and visualised in a frontend react application.

4. NOVELTY/INNOVATION

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concerns of data privacy, quality, transparency, and compliance.

Travel history and contact data can be securely stored on the blockchain ledger. As people get vaccinated and borders to other nations start opening up, countries will start asking for proof that the person trying to enter their country has been vaccinated. Vaccination certificates are sent digitally on apps such as Arogya Setu and CoWin. People who haven't been vaccinated can forge fake certificates to enter into countries. It is also very tough to prove ownership of such certificates.

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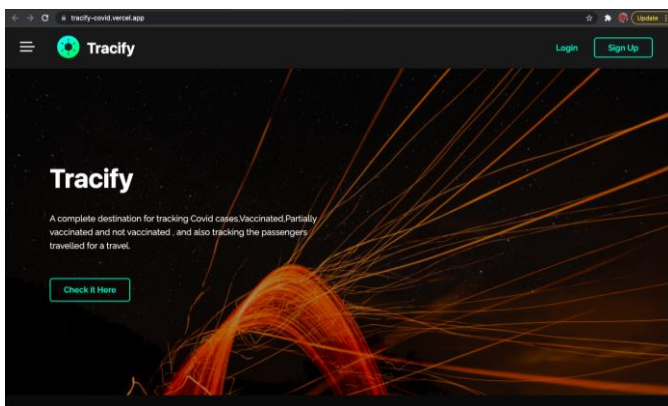


Fig -1: Tracify

5. RESULTS

The assembling of endless merchandise today involves an intricate interaction, with many parts needed to make a basic item. The multicomponent idea of the interaction and the successive part of assembling adjust well to the execution of blockchain innovation for information catch and recording along the assembling system.

Even though blockchain is a promising technology, there are still several difficulties that need to be addressed.

The most important is connected to blockchain platforms' throughput, which may be insufficient for particular applications and is determined by the number of nodes participating in the protocol and the amount of transactions generated by them. Transaction acceptance latency, which is determined by the time it takes to validate a block, is a closely related issue. New consensus algorithms have been created to address these issues, and they are actively being studied.

The effectiveness of immunity and vaccine certifications will be heavily reliant on public authority trust, which in many nations cannot be taken for granted. The adoption of blockchain technology, which by design delivers confidence in a trustless environment, may help to increase public acceptance of these certifications.

6. CONCLUSIONS

Today, NFTs are extremely simple to make for yourself. As the decentralized money circle grows its range to more clients, the quality and amount of NFTs will keep rising. To close, NFTs addresses a profoundly inventive use-instance of the amazing Blockchain innovation that is presently evacuating the universes of calculation and money.

There is no lack of NFT commercial centers where you can purchase, sell, and even make your own exceptional NFTs. To study how you can exchange NFTs, join with 1K Daily Profit and begin exchanging. Indeed, even subsequent to getting what a NFT is, it is normal to think about what the reason for this is. Today, NFTs address melodies, advanced craftsmanship, and games that can be sold on NFT commercial centers. Considering that the NFT game is still especially in its youth stages, many keep on finding more creative manners by which these advanced resources can be put to utilize. With a very good product with varied features can be a very good asset to today's scenario.

REFERENCES

- [1] L. Ricci, D. D. F. Maesa, A. Favenza and E. Ferro, "Blockchains for COVID-19 Contact Tracing and Vaccine Support: A Systematic Review," in IEEE Access, vol. 9, pp. 37936-37950, 2021, doi: 10.1109/ACCESS.2021.3063152.
- [2] S. V. and A. S. Prasad, "Application of Blockchain Technology in Travel Industry," 2018 International Conference on Circuits and Systems in Digital Enterprise Technology (ICCSDET), 2018, pp. 1-5, doi: 10.1109/ICCSDET.2018.8821095.
- [3] M. Kassab and G. Destefanis, "Blockchain and Contact Tracing Applications for COVID-19: The Opportunity and The Challenges," 2021 IEEE International Conference on Software Analysis, Evolution and

Reengineering (SANER), 2021, pp. 723-730, doi: 10.1109/SANER50967.2021.00092.

- [4] C. Antal, T. Cioara, M. Antal and I. Anghel, "Blockchain Platform For COVID-19 Vaccine Supply Management," in IEEE Open Journal of the Computer Society, vol. 2, pp. 164-178, 2021, doi: 10.1109/OJCS.2021.3067450.
- [5] Ahmad, R. W., Salah, K., Jayaraman, R., Yaqoob, I., Ellahham, S., & Omar, M. (2020). Blockchain and COVID-19 pandemic: Applications and challenges. IEEE TechRxiv.
- [6] A. Musamih, R. Jayaraman, K. Salah, H. R. Hasan, I. Yaqoob and Y. Al-Hammadi, "Blockchain-Based Solution for Distribution and Delivery of COVID-19 Vaccines," in IEEE Access, vol. 9, pp. 71372-71387, 2021, doi: 10.1109/ACCESS.2021.3079197.
- [7] Amirul Azim, Muhammad Nazrul Islam, Paul E. Spranger, "Blockchain and novel coronavirus: Towards preventing COVID-19 and future pandemics", Iberoamerican Journal of Medicine, vol.2, n3, p.215-218, 2020, 10.5281/zenodo.3779244
- [8] Khurshid A. Applying Blockchain Technology to Address the Crisis of Trust During the COVID-19 Pandemic. JMIR Med Inform. 2020;8(9):e20477. Published 2020 Sep 22. doi:10.2196/20477
- [9] Rotbi, M.F., Motahhir, S., & Ghzizal, A.E. (2021). Blockchain technology for a Safe and Transparent Covid-19 Vaccination. ArXiv, abs/2104.05428.
- [10] H. Xu, L. Zhang, O. Onireti, Y. Fang, W. J. Buchanan and M. A. Imran, "BeepTrace: Blockchain-Enabled Privacy-Preserving Contact Tracing for COVID-19 Pandemic and Beyond," in IEEE Internet of Things Journal, vol. 8, no. 5, pp. 3915-3929, 1 March, 2021, doi: 10.1109/IIOT.2020.3025953.