Information Security Management - CSE3502 - EPJ Document

Slot: F2

Review 3 Document:

Submitted by:

Sarthak Goel (18BIT0098)

Adarsh Jha (18BIT217)

Yash Khandelwal(18BIT0024)

Topic: Implementing Blockchain Technology for efficient COVID Vaccination Drive

Google drive link for Review 1:

https://drive.google.com/file/d/1tius3RYRFDkF45kjvcoKCpMZ-T7jN-TO/view?usp=sharing

Google drive link for Review 2:

https://drive.google.com/file/d/1de6hPsD0BBB9GEDLr2qt0dxM2SbNM7eL/view?usp=sharing

Google drive link for Review 3:

https://drive.google.com/file/d/1QaV3USgYw-H6iKV7BUxiu3HRejAeGZXv/view?usp=sharing

Abstract

"Vaccinating the masses is the only choice to prevent mass spread of COVID in India". Said by a US Health expert, vaccination is probably the only way, to make India and the whole world, COVID free. Even though there are more than 5 approved vaccines in the world, less than 1% of Indians have been vaccinated till now. Though the Pharmaceutical industries of India are producing enough vaccines, they do not seem to suffice the demand. According to NEWS reporters, most of the hospitals don't have Vaccines, and the shortage is not expected to fulfill any soon. So why is this crisis for vaccine, even though, the industries are producing more than 14 Crore vaccines are being produced each month. The reason appears to be black marketing and supply of fake injections in the market, All this is causing distrust among citizens and loss of millions to the government and the country. So to counter this, we propose a technical solution, that uses Blockchain technology to track the status of each and every vaccine that is produced. Right from the industry to the consumer, anywhere, anytime, the status of the vaccine can be checked and its authenticity can be proved.

Introduction:

Since there are vaccination drives occurring throughout the country, and even the private hospitals have started vaccinating, an upcoming problem is the supply and consumption of duplicate/illegal vaccine shots. These duplicate vaccines, claimed as genuine are injected in patients. It has been reported that several private hospitals have started buying these duplicate vaccines from black markets, in order to maximize their profits. Duplicate Vaccines often cause side effects in the patient's body, as well as lead to generation of allergic reactions. In severe cases, fake vaccine shots could even prove to be fatal.

Idea:

Using Blockchain for COVID vaccine supply management: Using Blockchain, the government can easily manage this issue, by implementing the dose's batch code and a Lot Numbers on the blockchain as a smart contract on an Ethereum blockchain. When a patient is vaccinated, his information along with the vaccine shot detail can be stored in the blockchain. This would help in tracking the status of the patient as well as the consumption of the vaccines.

Blockchain can increase the efficiency and transparency of COVID-19 vaccine distribution assuring the traceability and the rigorous audit of the storage and delivery conditions. In our opinion, blockchain-based solutions may provide a fully automated implementation of data accountability and provenance tracking in vaccine distribution, which will enable the integration of different information silos as well owned and managed by different types of stakeholders on the entire distribution chain. Self-enforcing smart contracts may assure the traceability of the COVID-19 vaccine supply chain especially the cold part of the chain in which the vaccine needs to be kept at extremely low temperatures to remain viable. Moreover, a breach in assuring the delivery conditions will be registered on the chain in a tamper-proof manner and all the peers of the network will be made aware due to the distributed ledger block distribution and replication features. Furthermore, the blockchain can act as proof of the delivery chain, making it impossible to counterfeit the vaccine, since at any point the medical units and the vaccine beneficiaries would be able to trace it back up to the companies that have registered the vaccine lots in circulation.

Thus, developing a blockchain-based tracking system is important to ensure that the information received by the public and government agencies is reliable and trustworthy. In this paper, we review various blockchain applications and opportunities in combating the COVID-19 pandemic and develop a tracking system for the COVID-19 data collected from various external sources. We propose, implement, and evaluate a blockchain-based system using Ethereum smart contracts and oracles to track reported data related to the number of new cases, deaths, and recovered cases obtained from trusted sources. We present detailed algorithms that capture the interactions between stakeholders in the network. We present security analysis and the cost incurred by the stakeholders, and we highlight the challenges and future directions of our work. Our work demonstrates that the proposed solution is economically feasible and ensures data integrity, security, transparency, data traceability among stakeholders.

Literature Survey:

Submitted by Yash

1. Blockchain platform for COVID-19 vaccine supply management.

In the context of COVID-19 pandemic, the speedy roll-out of a immunizing agent and therefore the implementation of a worldwide immunization campaign is important, however its success can depend upon the supply of associate degree operational and clear distribution chain which will be audited by all relevant stakeholders. during this paper, we tend to discuss however blockchain technology will facilitate in many aspects of COVID-19 vaccination theme. we tend to gift a system within which blockchain technology is employed to warranty knowledge integrity and immutableness of beneficiary registration for vaccination, avoiding identity thefts and impersonations. good contracts square measure outlined to watch and track the right immunizing agent distribution conditions against the safe handling rules outlined by immunizing agent producers sanctionative the attention of all network peers. For immunizing agent

administration, a clear and tamper-proof resolution for aspect effects self-reporting is provided considering beneficiary and administrated immunizing agent association

2. Automating Procurement Contracts in the Healthcare Supply Chain Using Blockchain Smart Contracts.

Effectively managing the tending provide chain (HCSC) method is crucial for tending suppliers not solely throughout pandemics like COVID-19 however additionally in their traditional operations. Despite important advances in new technologies and treatment choices suppliers still suffer from poor procural, ordering, prognostication, and distribution practices. cluster buying Organizations (GPOs) square measure a vital neutral in HCSC and profit suppliers with price savings, volume discounts, and trafficker choice. However, this US Government Printing Office contract method is long and lacks potency. Hence, our projected resolution integrates blockchain technology and suburbanised storage to push transparency, streamlines communication with stakeholders, and minimize the procural timeline whereas avoiding rating discrepancies and inaccuracies. Our resolution connects all the stakeholders like manufacturer, GPO, distributor, and supplier exploitation Ethereum network. during this paper, we tend to propose a blockchain resolution exploitation good contracts to alter the US Government Printing Office contract method. we tend to propose a generic framework for acquiring method within the HCSC with elaborate algorithms depiction numerous interactions among HCSC stakeholders

3. Barriers to blockchain adoption in health-care industry: an Indian perspective.

Purpose This paper aims to spot barriers toward the adoption of blockchain (BC) technology in Indian health- care trade and additionally examines the many problems with B.C. applications in health-care trade.

Design/methodology/approach. The barriers of the study square measure known by 2 phases as well as the review of literature and semi structured interviews with hospital employees and administration operative in Asian country. The specialists (N = 15) square measure being taken from commanding management, IT specialists and patients from the hospitals. The study enforced integrated total instructive structural modeling-FUZZY-Cross-impact matrix operation applied to classification (TISM-FUZZY-MICMAC) ways for characteristic the interrelatedness among the barriers. Findings a complete of fifteen barriers are determined within the Indian health-care trade through discussion with the chosen specialists. TISM is applied to develop structure structure for B.C. barriers. Further, FUZZY-MICMAC has been accustomed work out driving and dependent barriers

Submitted by Sarthak(18BIT0098)

4. An Incentive Based Approach for COVID-19 using Blockchain Technology

The current state of affairs of COVID-19 demands novel solutions to spice up care services and economic process. A full-fledged resolution that may facilitate the govt. and other people retain their traditional style and improve the economy is crucial. By conveyance into the image a singular incentive-based approach, the strain of presidency and also the folks are often greatly reduced. By providing incentives for actions like voluntary testing, isolation, etc., the govt. will higher arrange ways for fighting the case whereas folks in want will take pleasure in the motivation offered. this concept of mixing strength to battle against the virus will bring out newer prospects that may offer AN favourable position during this war. because the unpredictable future develops, sharing and maintaining COVID connected information of each user may well be the required trigger to starter the economy and blockchain paves the means for this resolution with decentralization and unchangeability of information.

5. An IoT based Real-time Data-centric Monitoring System for Vaccine Cold Chain

In the context of COVID-19 pandemic, the fast roll-out of a immunizing agent and also the implementation of a worldwide immunisation campaign is vital, however its success can depend upon the supply of AN operational and clear distribution chain that may be audited by all relevant stakeholders. during this paper, we have a tendency to discuss however blockchain technology will facilitate in many aspects of COVID-19 vaccination theme. we have a tendency to gift a system within which blockchain technology is employed to warranty information integrity and unchangeability of beneficiary registration for vaccination, avoiding identity thefts and impersonations. good contracts area unit outlined to watch and track the correct immunizing agent distribution conditions against the safe handling rules outlined by immunizing agent producers enabling the attention of all network peers. For immunizing agent administration, a clear and tamper-proof resolution for aspect effects self-reporting is provided considering beneficiary and administrated immunizing agent association. A paradigm was enforced exploitation the Ethereum take a look at network, Ropsten, considering the COVID-19 immunizing agent distribution conditions.

6. A Review on Blockchain Technology and Blockchain Projects Fostering Open Science

Many sectors, like finance, medicine, manufacturing, and education, use blockchain applications to profit from the unique bundle of characteristics of this technology. Blockchain technology (BT) promises benefits in trustability, collaboration, organization, identification, credibility, and transparency. In this paper, we conduct an analysis in which we show how open science can benefit from this technology and its properties. For this, we determined the requirements of an open science ecosystem and compared them with the characteristics of BT to prove that the technology suits as an infrastructure. We also review literature and promising blockchain-based projects for open science to describe the current research situation. To this end, we examine the projects in particular for their relevance and contribution to open science and categorize them

Submitted by Adarsh

7. Blockchain in healthcare: A systematic literature review, synthesizing framework and future research

This study presents a systematic literature review (SLR) of research on blockchain applications in the healthcare domain. The review incorporated 42 articles presenting state-of-the-art knowledge on current implications and gaps pertaining to the use of blockchain technology for improving healthcare processes. The SLR findings indicate that blockchain is being used to develop novel and advanced interventions to improve the prevalent standards of handling, sharing, and processing of medical data and personal health records. The application of blockchain technology is undergoing a conceptual evolution in the healthcare industry where it has added significant value through improved efficiency, access control, technological advancement, privacy protection, and security of data management processes. The findings also suggest that the extant limitations primarily pertain to model performance, as well as the constraints and costs associated with implementation.

8. Blockchain in Health Care: Hope or Hype?

There has been an increasing interest in blockchain technology from the health care sector in the last couple of years. The value proposition for using blockchain technology in the health care sector is to share sensitive patient data among health care entities securely and to empower patients. Blockchain technology allows patients to have an active role in developing and updating their own patient data. However, is blockchain technology really the silver bullet it seems to be? With this paper, we aim to understand the benefits and challenges of blockchain technology in the health care sector. We discuss innovation and security implications concerning blockchain technology in health care. Furthermore, we show that there is a need for more use cases to ensure the secure sharing of data within the health care sector. In our opinion,

blockchain technology will not solve the issues encountered by the health care sector; in fact, it may raise more issues than it will solve.

9. Blockchain Technology in Healthcare: A Comprehensive Review and Directions for Future Research.

One of the foremost vital discoveries and artistic developments that's taking part in a significant role within the skilled world these days is blockchain technology. Blockchain technology moves within the direction of persistent revolution and alter. it's a series of blocks that covers data and maintains trust between people notwithstanding however so much they're. within the last few years, the upsurge in blockchain technology has duty-bound students and specialists to scrutinize new ways that to use blockchain technology with a good vary of domains. The dramatic increase in blockchain technology has provided several new application opportunities, as well as care applications

Review 2:

Proposed Model

How?

We plan to use Ethereum blockchain to deploy smart contracts that would help track the status of vaccines produced.

Every vaccine produced, will have a label that contains an encrypted QR code. A QR code scanner would show all the details about the vaccine, such as Date and place of manufacturing, cost, expiry, supplied to, and a hallmark for authenticity.

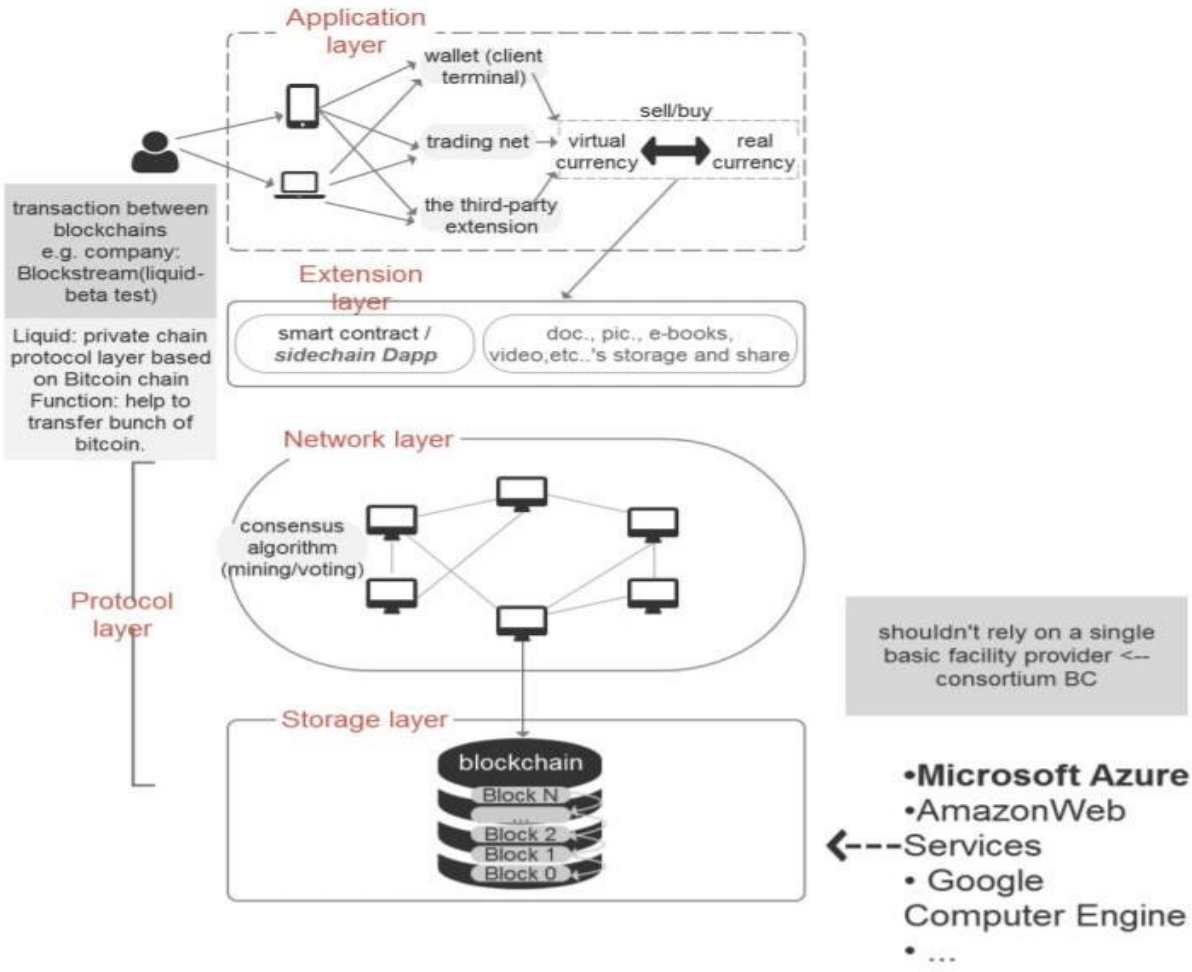
For every Distributor who sells the vaccine or the hospitals who inject vaccine, will have to update the status after completing vaccination, along with patient's information and the dose that he received. This will be helpful in preventing duplicate doses.

Technology Stack

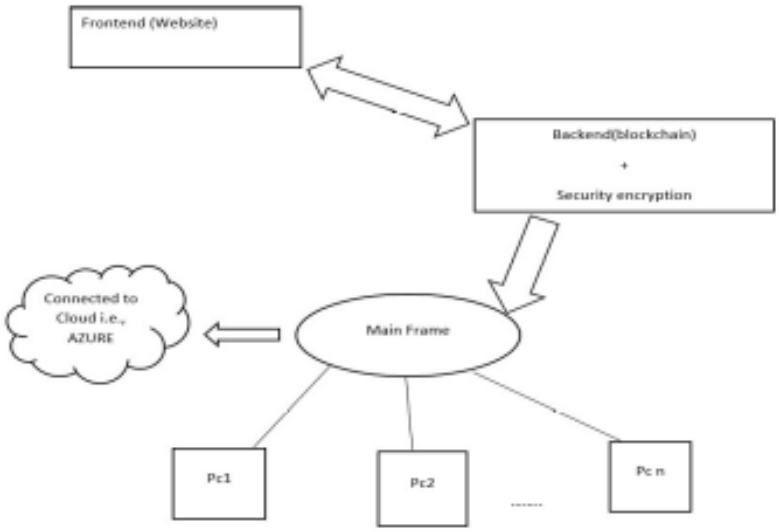
- Ethereum Blockchain - Main network blockchain for implementing the project
- Ganache - Private Blockchain
- Truffle Framework - dependencies for blockchain
- Node JS - forJavaScript dependencies
- Solidity - to code smart contracts
- Web3JS - to provide a web UI/ Client side script
- Ropsten Network - Test network to provide test Ethers and interact with Ganache Blockchain
- Remix.ethereum test bed - Test bed to compile and deploy Smart contracts
- Metamask - Cryptocurrency wallet
- XAMPP : LocalHost to run the Web3JS client side web application
- ZINT -QRCodegenerator:Togenerate anencrypted QRcode containing information about the vaccine, that will be printed on the label.
- QRScanner - AQRscannerthat would be usedto scan the QRcode printedon the label of the Vaccine Dose

Architecture Diagram:

Basic framework of Arch:-



Architecture acc to our project: -



Module Description with Snapshots:

We are creating an end-to-end Vaccine status application that stores the whereabouts of Vaccines at every stage on blockchain.

We have designed our vaccine management platform for two types of users effectively

1. As a hospital: Purchases the vaccines for the patients/consumers
2. As a Manufacturer: Produces the vaccines

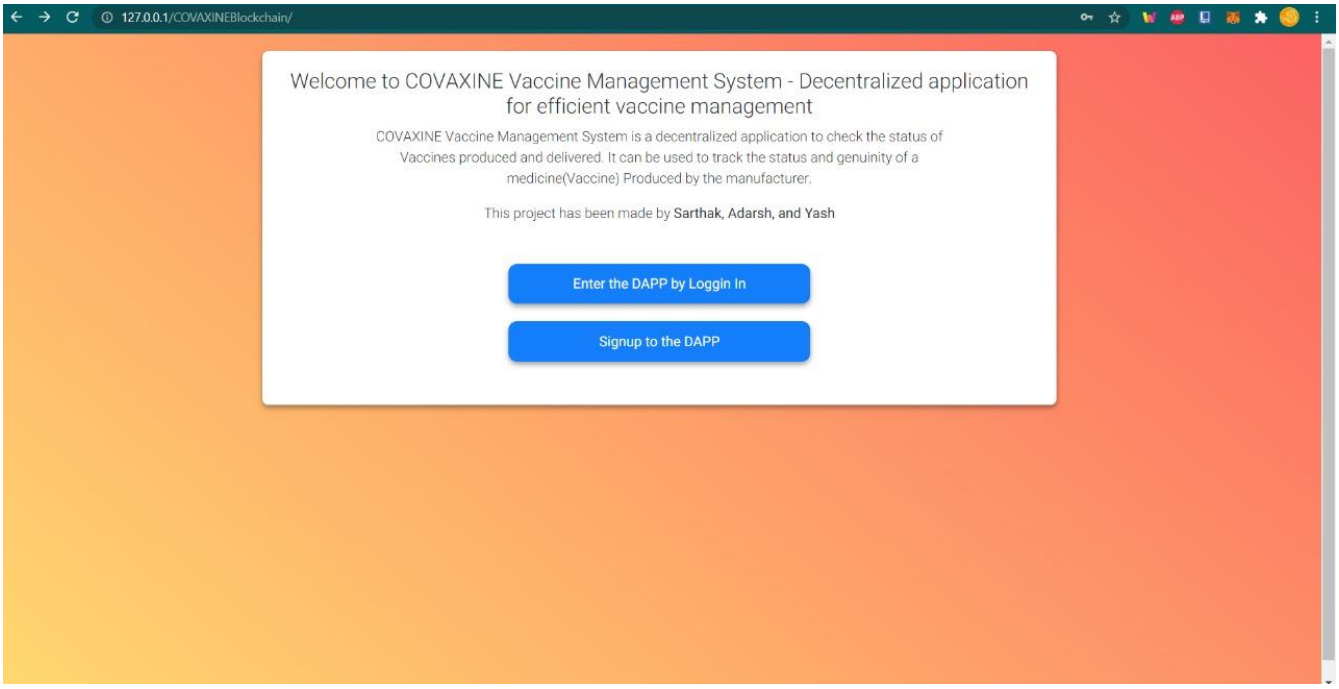
The user at the consumer end can simply scan the QR CODE of products and get complete information about the provenance of the product hence empowering consumers to only purchase and use authentic products.

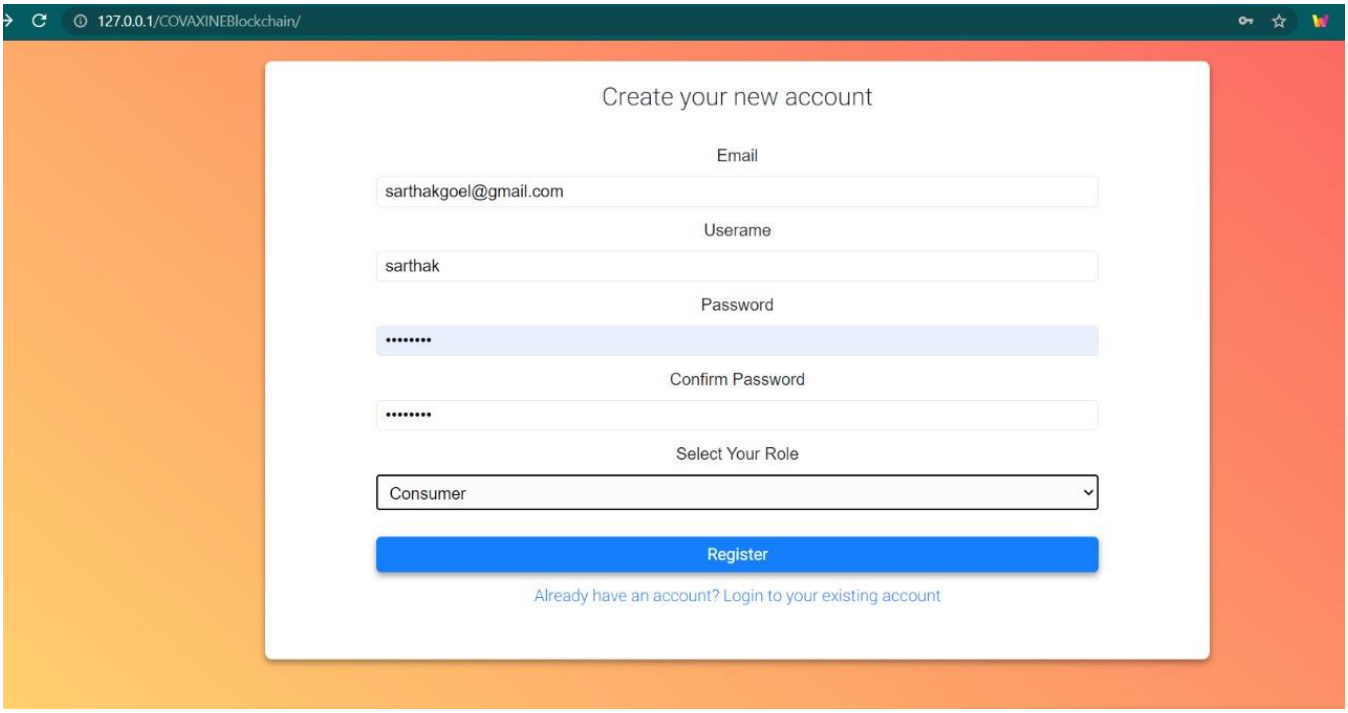
Logging in/Signing up

We can sign up as a customer, a Distributor (State Government) a Retailer (hospital), or a Manufacturer (Bharat Biotech, Serum Institute).

Or we can simply log in with an existing email and password

All the user info is stored in MYSQL database and all product related info is stored in blockchain





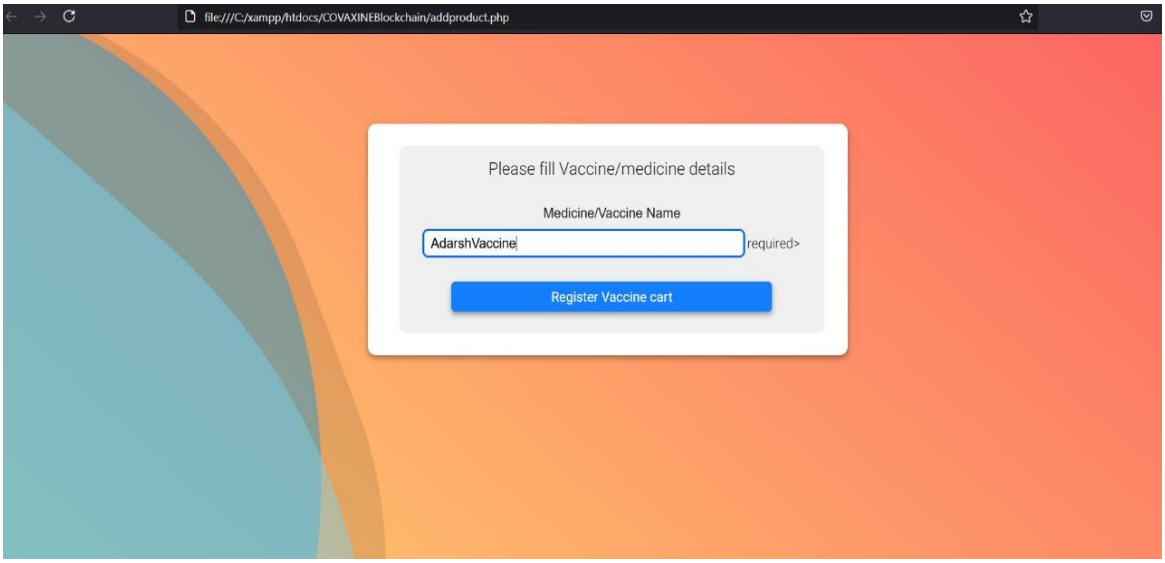
Vaccine addition by the Pharmaceutical Company:

The vaccine manufacturer can easily add new Vaccines.

We need to add product details and click on register item.

We'll be redirected to a QR code which will be generated for that particular added item along the product id number.

The manufacturer is supposed to print this QR code and target to the product. The product will be successfully added.

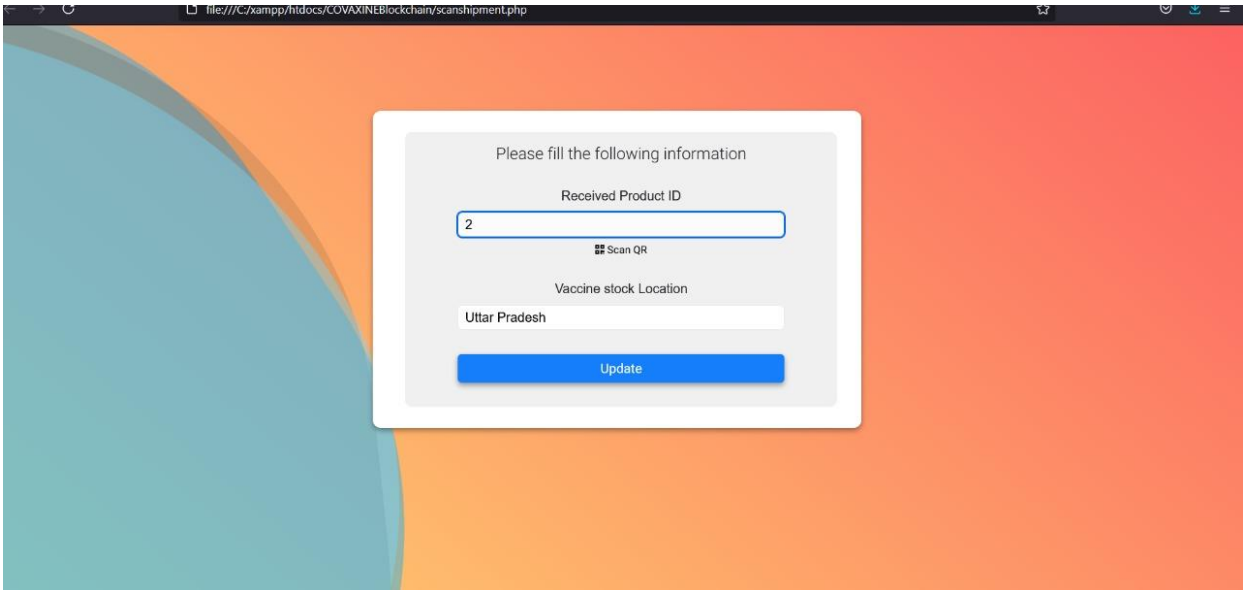


Scanning Shipment

This feature helps the pharmaceutical company to keep an eye on the vaccines lot and ship them to respective hospitals and state stock centers.

With the help of QR code generated and Product Id number we can scan and ship the products (vaccines in this case).

Location coordinates support will also be given, to get the exact location of the lot.

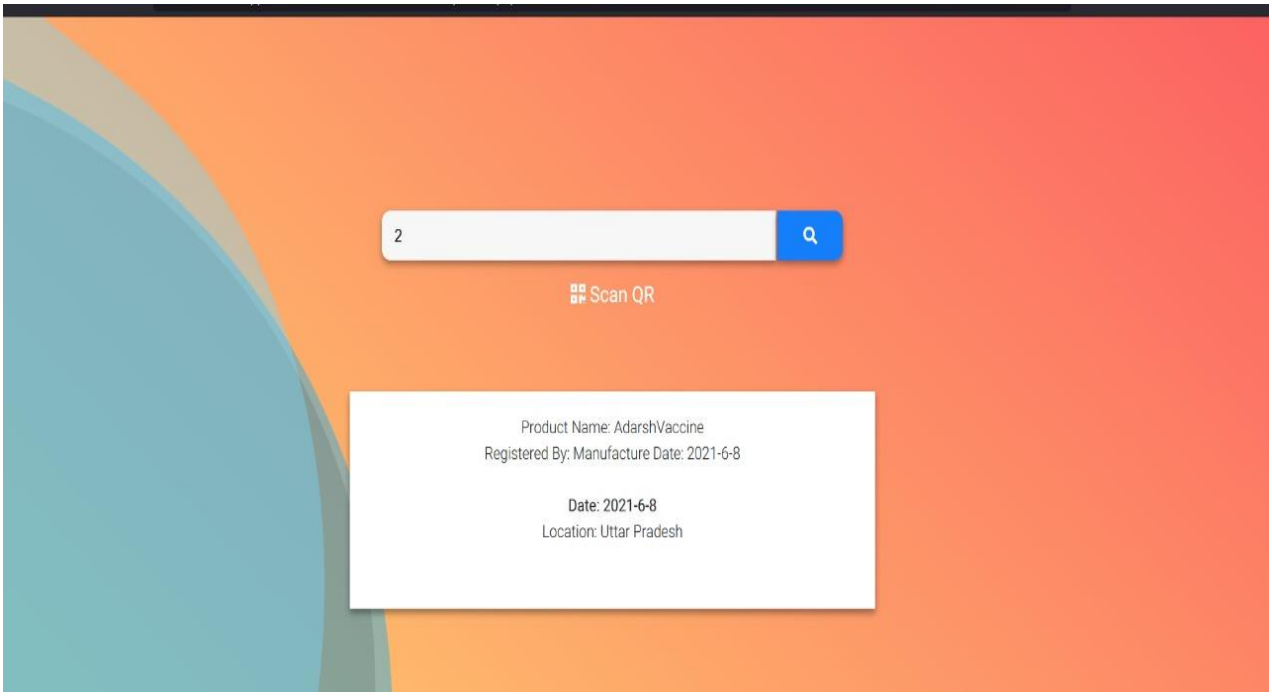


Checking Items as a Customer - QR Code module

With the help of QR CODE and Product Id number hospitals or patient can scan vaccine, to verify the authenticity of it.

The location last updated by the system is available to us.

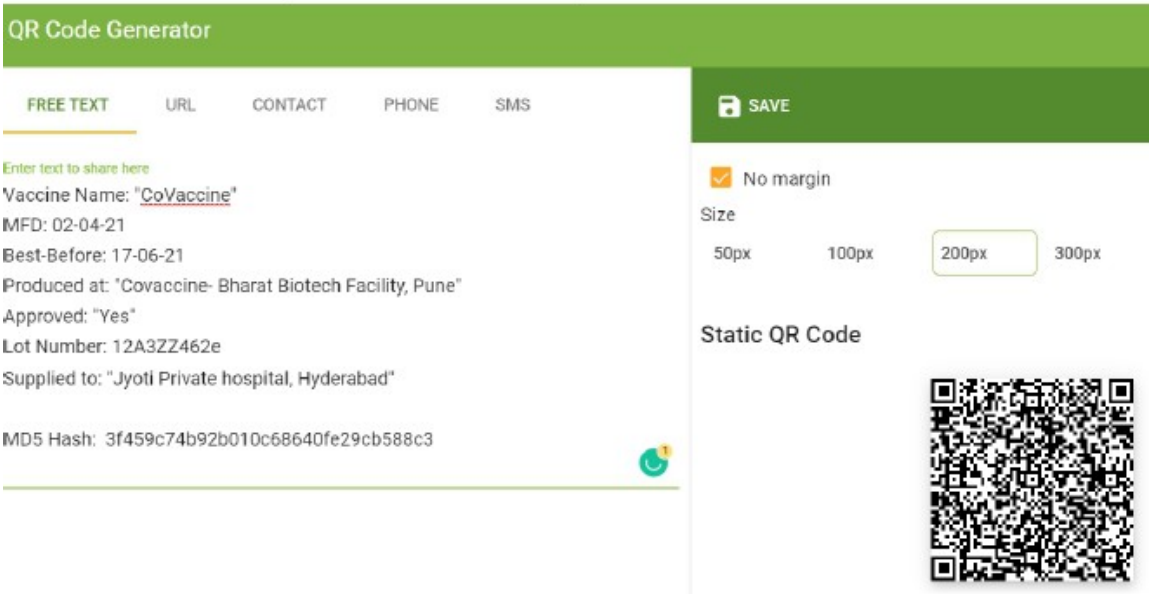
Along with this the Patient can also verify other details such as the Vaccine name, Manufacturing date and Pharmaceutical Manufacturer information who has actually manufactured the vaccine.



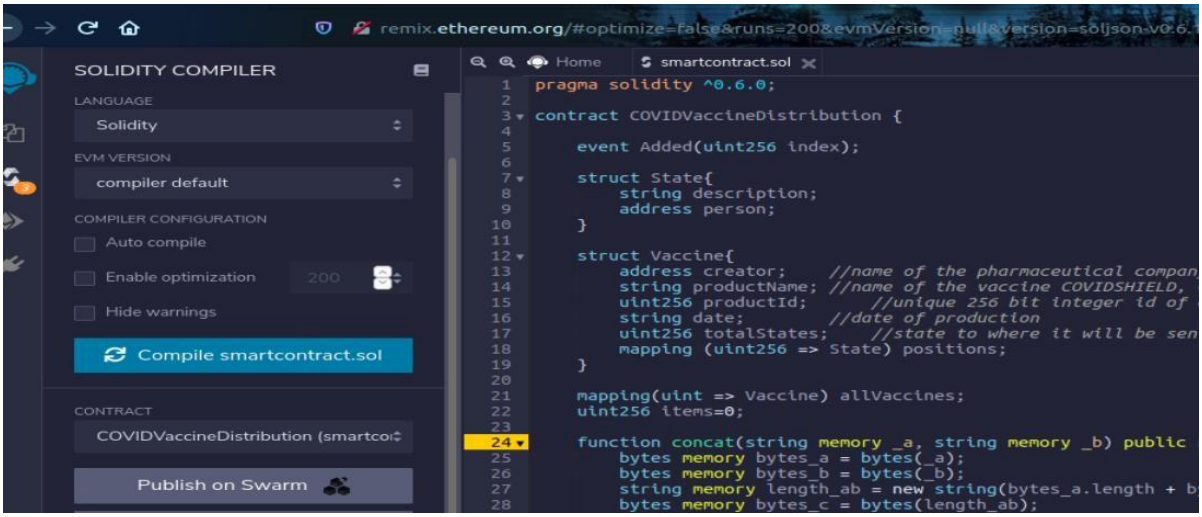
Static QR Code

QR Code Module:

SMART Contract QR code that will be put on a Vaccine label:



Solidity Code:



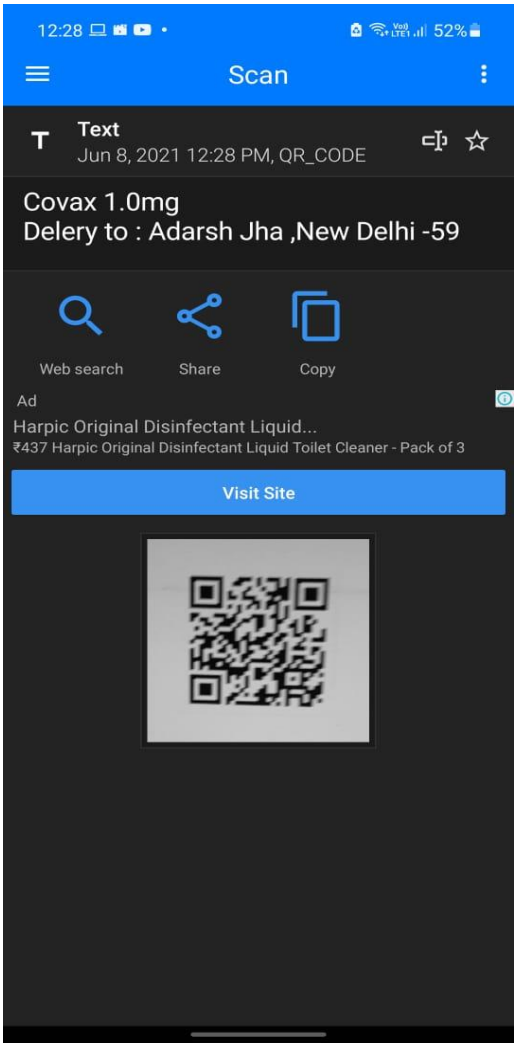
Review 3:

Plan for Review 3:

Thus far, we've created a blockchain web network for the adding, tracking and shipment of vaccines. This web network is usually controlled by officials.

Hence now we aim to complete the rest of implementation at backend and add more modules to our network and make it more efficient. We intended to build an interface for the user-end so that the user can track the whereabouts of the vaccine.

To achieve this and complete our model of blockchain tracking of corona vaccines we built an app. With the help of QR code that was generated, we at the user end can easily track the whereabouts of the shipped product I.e. vaccines in our model.



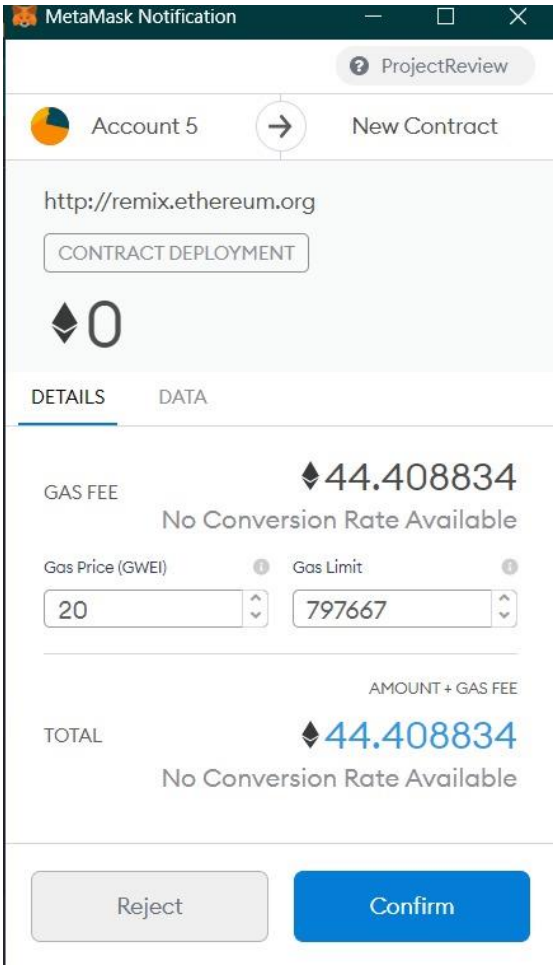
Performance Analysis/Discussion of the Results:

Our proposed blockchain-based solution for tracking the COVID-19 pandemic captures the main operations required for dynamically tracking the transmission and the current number of infected, recovered, and deaths.

To evaluate our blockchain based system we considered a setup for the COVID-19 vaccine using the rules for safe the transportation and storage. We have considered that the distribution company delivers the vaccine lots to the interested medical care unit,

COVID-19 vaccine distribution tracking:

A prototype has been tested on a public Ethereum test network, Ropsten . The results obtained for each on chain operation can be validated. he associated blockchain transactions receipt is presented, highlighting the user signing the transaction, the executed call and the transaction costs in gas.



At any point after the deployment of the smart contract, any beneficiary can subscribe on the waiting list for the vaccine. This is possible by issuing and signing a transaction on chain. The address of the signing beneficiary (msg.sender) will be stored in the waiting list on chain. Upon subscription the vaccine beneficiary must also provide a hash of his/her personal information

After reaching the medical care center, the beneficiaries will be scheduled for having the vaccine administered. Any vaccine beneficiary once reaching the doctor's office will have to provide the personal identification information QR code. The doctor will scan the QR code which will offer information about the beneficiary and the transaction hash proving that the subscribing vaccination list transaction has been mined

Security Analysis

Here, we discuss the security properties of the proposed blockchain COVID-19 data tracking solution in addressing core security concerns related to integrity, accountability, authorization, non-repudiation, and resistance to cyberattacks such as distributed denial-of-service (DDoS) attack.

Integrity

It is important to guarantee integrity and maintain data consistency when obtaining information from oracles related to COVID-19 statistics. Our solution ensures that the information added to the new block is collected from the right group oracles by making sure that miners verify these transactions to assure the truthfulness and validity of data. Moreover, once information is added to the blockchain network, then it becomes very difficult to tamper with it due to its decentralized structure and combination of cryptography and sequential hashing, unlike a traditional standard database.

Accountability

Every user or stakeholder is held responsible for their actions on the ledger. This is because whenever a user executes a function in the smart contract, then this action call is traced back to the Ethereum caller's address.

Authorization

Securing data access in blockchain networks is essential for ensuring that only users with authorized access can participate and add appropriate data accordingly. Our proposed solution makes sure that all oracles are first registered using the registration smart contract and then only they are allowed to interact with the aggregator smart contract. This shows that the presented approach satisfies the authorization and authentication controls needed for a reliable tracking system. Moreover, the blockchain infrastructure ensures that each data block is fully encrypted before it gets added to the chain of existing blocks. Thus, if an attacker were to gain access to the blockchain data and network, then this does not certainly mean that the attacker would be able to retrieve and read the information due to the use of end-to-end encryption methods. Only authorized users can decrypt and see this information through the use of their private keys. This would encourage many countries to use such a system as it promotes data access control and data confidentiality by using the latest cryptographic algorithms to generate public/private key combinations that rely on solving integer factorization problems that are almost impossible to crack using current computing power.

Non-repudiation

All transactions are digitally signed and timestamped when added to the blockchain. This indicates that users or organizations can trace back a particular transaction at a specific time and accordingly identify the user behind that transaction using their public address. This security property reassures users since no one can duplicate their signature on a transaction that has not been created by them. This enhances the system reliability as it becomes easier to detect fraudulent transactions because every transaction stored in the ledger is

cryptographically connected to its user. This auditing capability provides authenticity, transparency, and security over every transaction.

Resistance to Cyberattacks

Cyberattacks have become progressively more complex due to the increasing use of sophisticated malware and threat from professional cyberorganizations. Users or organizations with malicious intent attempt to steal valuable data such as financial data, personal identifiable information, intellectual property, and health records. Several strategies, such as monetizing data access through the use of advanced ransomware techniques or disrupting business operations through DDoS attacks, have been attempted. DDoS attacks, in particular, result in service disruption of websites and mobile apps, causing an increase in losses to businesses. However, such attacks are costly and difficult to execute in blockchain platforms as they would need to transact large volumes of small transactions to dominate the network.

Conclusion:

The difficulty does not lie in the technology, but rather in building and enlisting all of the multiple players to take part in the solution. It is in essence more of a political hurdle than a technological one.

While it is still unclear how long it will take until the vaccines are available for every last one of us, it is most certain that their supply chain must be closely monitored. Particularly for the COVID-19 vaccine which the entire world needs desperately, proof of proper storage recorded on the blockchain is indeed priceless.

Many supplies chain and provenance solutions are driven by commercial or cost saving incentives.

The results provided for an Ethereum based implementation show the feasibility of our proposed solution in terms of immutable actors and rules registration, decentralized vaccine distribution monitoring and finally administration and potential side effects self-reporting. The proposed system manages to successfully address all relevant aspects we had identified for the success of a monitoring campaign: (i) increase the efficiency and transparency of COVID-19 vaccine distribution assuring the traceability and the rigorous audit of the storage and delivery conditions (ii) assure the transparency and correctness in the registration and management of

the waiting list for immunization and (iii) provide a transparent and public reporting system of potential side effects.

References:

1. Rauf, A.; Abu-Izneid, T.; Olatunde, A.; Ahmed Khalil, A.; Alhumaydhi, F.A.; Tufail, T.; Shariati, M.A.; Rebezov, M.; Almarhoon, Z.M.; Mabkhot, Y.N.; Alsayari, A.; Rengasamy, K.R.R. COVID-19 Pandemic: Epidemiology, Etiology, Conventional and Non-Conventional Therapies. Int. J. Environ. Res. Public Health 2020, 17, 8155.
2. Andersen, K.G., Rambaut, A., Lipkin, W.I. et al. The proximal origin of SARS-CoV-2. Nat Med 26, 450–452 (2020). 3. WHO Coronavirus Disease (COVID-19) Dashboard, https://covid19.who.int/ (Accessed 5 December 2020
3. Kartoglu UH, Moore KL, Lloyd JS. Logistical challenges for potential SARS-CoV-2 vaccine and a call to research institutions, developers and manufacturers. Vaccine. 2020;38(34):5393-5395.
4. Manju Rahia, Amit Sharma, Mass vaccination against COVID-19 may require replays of the polio vaccination drives, EClinicalMedicine, The Lancet, Volume 25, 100501, August 01, 2020
5. Kaur SP, Gupta V. COVID-19 Vaccine: A comprehensive status report. Virus Res. 2020;288:198114.