Epidemic Alert System

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ABSTRACT

Infectious diseases are leading cause of mortality and morbidity in all countries. In developing countries, the concern is detecting infectious disease outbreaks early and stopping their mortality, spread and potential impact on society. Although there are some systems working toward early detection and prevention of disease outbreak but it involves m Epidemics alert system will act as mediator between public and health organizations. This alert system will create a network between public, organizations such as local government, health care centers and research institutes. Based on symptoms and location in record of disease template of the blockchain, possibility of an epidemic can be identified and subsequent alerts can be issued via an email or a text to the citizens over a particular geographic area. This alert will comprise of assistance information needed to control the spread of disease. Our system will also notify pharmacies about the infectious disease and will notify local government so that they will take preventive measures in order to stop spread of disease. Moreover, it can facilitate researchers in developing the vaccines and preventive medicines by leveraging the information about origin and spread of disease and symptoms. Additionally, blockchain if made available to the existing alert systems, can assist in authenticating of disease details for them. Blockchain will be used to securely maintain all the records and maintain flow of data between all the entities.

Keywords– Blockchain Technology, Healthcare, Epidemic Control and Prevention, Alert System

I. INTRODUCTION

1.1 What is Blockchain and how it works?

Blockchain technology is an open and distributed ledger which can record and maintain transactions among multiple parties efficiently in a permanent and verifiable way. Transactions can be controlled automatically by programming the ledger.

The advent of blockchain is attributed to a pseudonymous unidentified group called as Satoshi Nakamoto. Blockchain, a chain of trust, supports a new generation of streamlined business processes and transactional applications by establishing accountability, trust and transparency which is critical to the modern transactions. It is a distributed database consisting of records known as blocks, continuously growing as a part of chain, is secured from revision and tampering. Each block has a timestamp and is linked to the previous block so as to from the chain. Blockchain is a very secure by design and is a distributed system with a high fault tolerance which makes it suitable for maintaining medical records and other record management systems in transaction processing especially when the transactions need to be shared with multiple parties.

Blockchain databases are managed autonomously by using peer-to-peer network along with a distributed timestamping server.

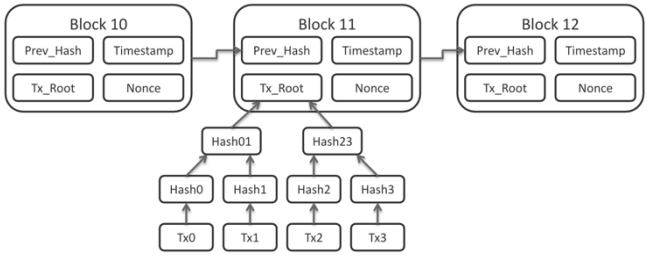


Fig 1.1: Blockchain Flow

As shown in the fig 1.1, it is data structure that is replicated and shared among the networks comprising of the blockchain.

Multiple nodes make up the blockchain which are representing the transactional changes.

Barring the first block, every other block will have transaction details and a hash to the previous block, which enables it to form a chain.

Each block is applied with a timestamp and once changes are committed, they are immutable. This is exactly why involving entities and the parties in the network can rely on the fact that these changes can not be altered. Any party that has an access to this blocks(cryptographic hash) can assess the information contained in it.

1.2 Why blockchain for our application?

Owing to the integrity and security blockchain imparts, mainstream applications of blockchain are found in the digital currency where concept of bitcoin is implemented using this technology. But such is the ability of blockchain and its potential has been realized which doesn't limit its use to only digital currency and business transactions.

As far as healthcare industry and epidemic alert is concerned, the internet has revolutionized many aspects of it, yet basic operations in which people and organizations have to depend upon unconsolidated data distributed over geographic region.

Detecting the origin of epidemic: After researching how WHO and other organizations work in tracing back the origin and spread of disease, it is evident that much of ground work is required where each locality should be physically visited and investigation should be carried out accordingly. There is a scope to avoid this if blockchain is used. If record of every patient who visits the hospital is stored with his pin code and symptoms, a pattern can be detected for a particular locality.

If the rate of people showing up with certain symptoms is abnormally high, then subsequent alerts can be issued to the citizens through text and email. While doing this, local governing bodies and research institutes can be kept in loop.

Assistance to researchers: Many a times researchers while developing preventive vaccines have to depend on the data which is

not available in a single and concurrent repository. If the patient profile can be shown using blockchain, all the required data for the researchers can be found at a one stop shop.

Data validation for existing systems: Existing systems are supposed to validate the data they are receiving for epidemic outbreak detection from local governing bodies. The blockchain will allow them to trace back the details by following information represented by blocks. Moreover, the blocks are timestamped, so the can be arranged in a chronological order which assists in tracking process.

II. Applications of Epidemic Alert System

Following are the nodes in the blockchain for epidemic alert system. Each node will receive patient's profile either to create, update or transfer it to the next node.

Regulator: Representative at hospital will create the patient profile. This is where first block of chain will be created.

Doctor: Doctor will update the patient profile after examination. The patient profile template will be filled properly.

Lab: At lab, the lab representative will conduct tests and transfer the patient profile if the disease is confirmed.

Hospital: Hospital will transfer the patient profile to the local governing body.

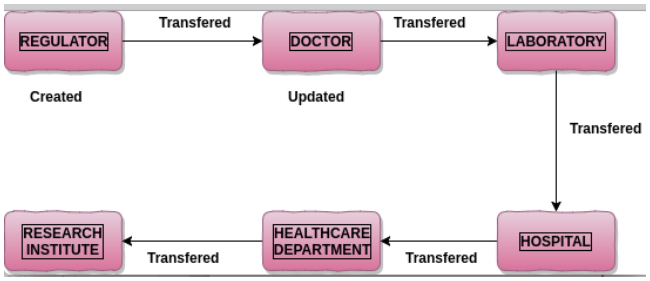
Department of Healthcare: They are kept in loop to assure the authenticity of the data. They will use this to alert the respective organizations and forward it to the research institute.

Researchers: They will use the patient template to get the necessary information for their research.

Fig 2.1 Parties in the System

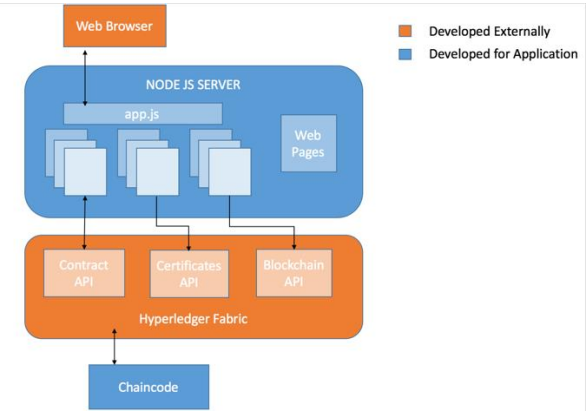
III. Application Scenario

1. Patient record is created as a template by the regulator.
2. Patient template is transferred to the doctor.
3. Doctor updates the patient template to define it as a patient profile giving it a zip code, disease name, medicines, symptoms etc.
4. Doctor transfers the patient profile to laboratory to be tested.
5. Laboratory transfers the patient profile to hospital.
6. Hospital transfers the patient profile to the respective HealthCare Department in that area. The HealthCare Department can use this data to analyze the health-trends to early detect the disease outbreak.
7. The HealthCare Department transfers the patient profile to the Research Institute.
8. Research institute will use this data for their research.



3.1 Blockchain Flow

IV. Architecture



4.1 Blockchain Architecture

V. IBM Blockchain in Epidemic Alert System

Smart Contracts and Chaincode: Blockchain technology is used to leverage the open blocks. Traditional smart contracts are the self executing agreements are extended in chaincode. These are included in the code that can be interacted with and trigger any other available smart-contracts. The Chain-code is written in golang and is executed in Docker.

Hyperledger Fabric: Hyper-ledger fabric is leveraged in the blockchain. Using the fabric smart contracts are created. It has container technology that generates the smart contracts dynamically.

VI. Functionalities

6.1 Home Screen

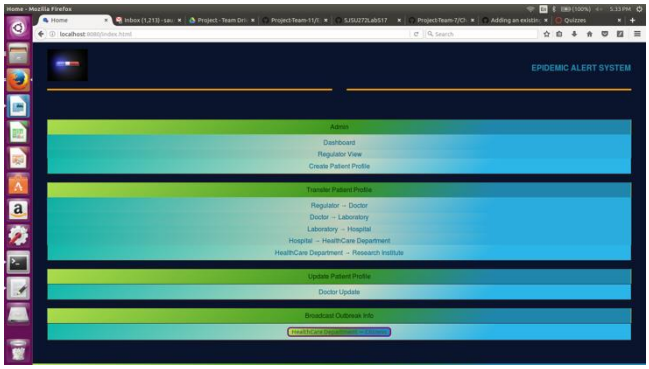


Fig 6.1 Home Screen

The Home Screen is divided as follows:

- Admin
  - Dashboard
  - Regulator's View
  - Create Patient Profile
- Transfer Patient Profile
  - Regulator => Doctor
  - Doctor => Laboratory
  - Laboratory => Hospital
  - Hospital => Healthcare Department
  - Healthcare Department =>Research Institute
- Update Patient Profile
  - Doctor Update
- Broadcast Update Info
  - Healthcare Department => Citizens

6.2 Live Stats

Real-time block information of patients can be seen on this page. Here, all the blocks represent each transaction. The patients profile can be tracked right from his examination till his profile being transferred to the researchers. Each block has hash of the previous block and in this way they are connected.

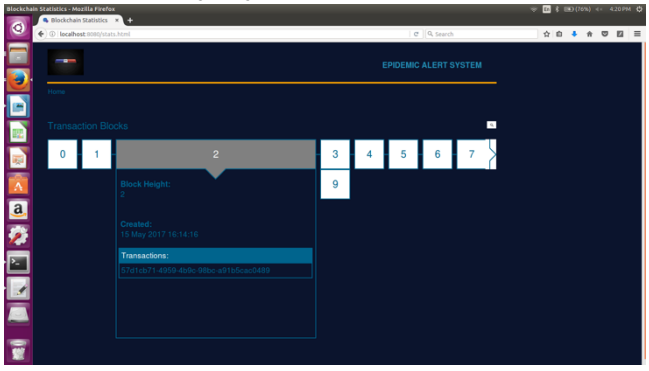


Fig 6.2 Stats Page

6.3 Creating Patient Profile

Patient's profile is created using the create profile button. Zip code, Symptoms, Medicines and possible name of disease are the fields. The Zip code can be utilized to identify the geographic location of patient which will help in determining the origin of outbreak

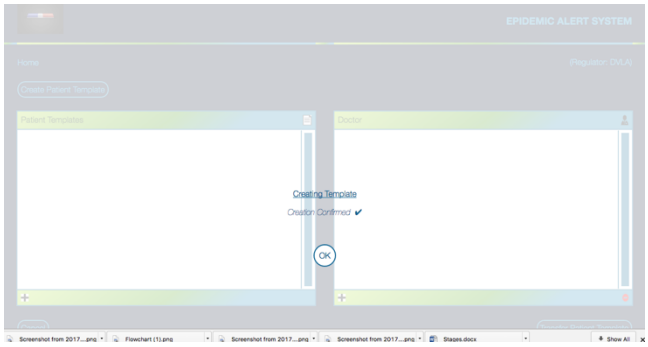


Fig 6.3 Create Patient Profile

6.4 Regulator's View

Regulator can view all the transactions in the form of blocks and how the profile is changed as it propagates through the chain.

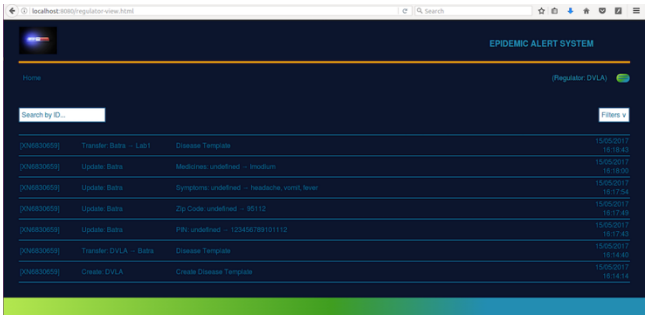


Fig 6.4 Regulator's View

6.5 Updating Patient Profile

Doctor is authorized to update the patient profile based on his/her examination.

Fig 6.5 Update Patient Profile

V5C	
V5C	BF5176436
PIN	0
Zip Code	undefined
Symptoms	undefined
Medicines	undefined
Disease Name	UNDEFINED

Fig 6.6 Update Patient Template

6.6 Transferring Patient Profile

For the purpose of transferring the profile, transfer function is used.

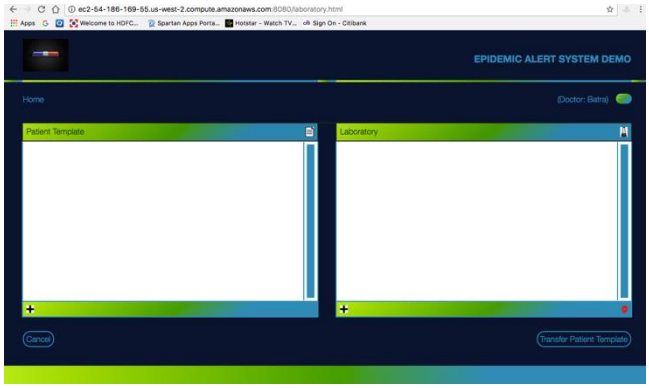


Fig 6.7 Transfer profile

6.7 Alerting the Citizens

A text alert can be sent to users if there is a caution of possible disease outbreak

Fig 6.8 Alert Text to Citizen

VII. REFERENCES

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