COUNTERFEIT DRUG IDENTIFICATION AT SUPPLY CHAIN

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Abstract: Counterfeiting of drugs and medications have been enrooted into our community and the general public isn't aware of it. According to Outsourcing Pharma in 2012 [1], 75% of the world's counterfeit drugs had some origins from India. The volume is alarming and shows the inefficiency in the current system not capable of tracking the counterfeit drugs. To fix situation of such scale will be requiring a complete change in the system and can't be achieved without the help of general public. SmartChain is the software as service we are providing to manufacturers, pharmacists, and general public to make a system which will be able to make each drug identifiable and help pharmacists and users distinguish between counterfeit and authentic drugs. The main objective of SmartChain is to help users from distinguishing counterfeit and genuine drugs in doing so helping overcome other problems such as Ensuring brand safety, preventing hazards led by consuming, counterfeit drugs, creating awareness in general public, being a support system to authorities to track the origin of counterfeit drugs.

Indexed Terms - ReactJS, Blockchain, bigChainDB, QR code, Cloud Services, Hash.

I. INTRODUCTION

This paper covers the issues with the current supply management systems' measures taken to help distinguish between the genuine and counterfeit drugs. The paper also includes chapters which will be talking about the project work done on the same issue to build a system which works more efficient than existing ones and will have a positive impact on not just improving the numbers statistically but also creating awareness in society that not to take consumption of medicines for granted.

Blockchain has been our choice to develop the project, Blockchain holds blocks linked together. Each block contains a cryptographic hash of the previous block, a timestamp, and transaction data. By design, a blockchain is immutable, meaning the data can only be asserted to the chain and no existing data can be modified. The blockchain is also transparent, meaning any public address transactions and holding are open for viewing. The system is also decentralized; hence the servers won't be overloaded with requests. The system is hence resistant to tampering while being transparent to public.

II. RELATED WORK

The current supply chain management system works based the Drug companies. The drug companies handle the medicines being supplied at their will, based on the margins, return of investment, vulnerability of drug getting counterfeited, hence we can conclude there is no uniformity in how the drugs are supplied or managed. Some of the existing techniques [2] include improving packing of drugs where the packing is done in such a way that if there is any tampering of packages meaning the drug has been counterfeited, RFID where medicines are tagged and these tags are used as seals to identify the product as genuine, mass encryption technology, and use of holograms which is also used to tag products to help others identify it as authentic. These techniques have proven to be expensive as per either price or time consumed. The techniques used are an overhead to manufacturer to integrate such methods as margins are very low and won't be worth for manufacturer to deliver products who's packaging will cost more than actual medicine. These techniques have

neither caused awareness in public and the consumers end up buying counterfeit drugs. As per the statistical data [1], 75% of the world's counterfeit drugs had some origin from India, and the situation has not been improved. SmartChain tries to solve this problem along with the help of crowd, at the same time not being expensive to either consumer nor manufacturer.

III. DESIGN

The design aspect plays a big role in building any system. While building a supply chain application, the software had to be versatile, reusable, and not application specific. The application should be capable of easily getting configured to different environments as each manufacturer have specific set of inputs which has to be derived from a generic SmartChain application.

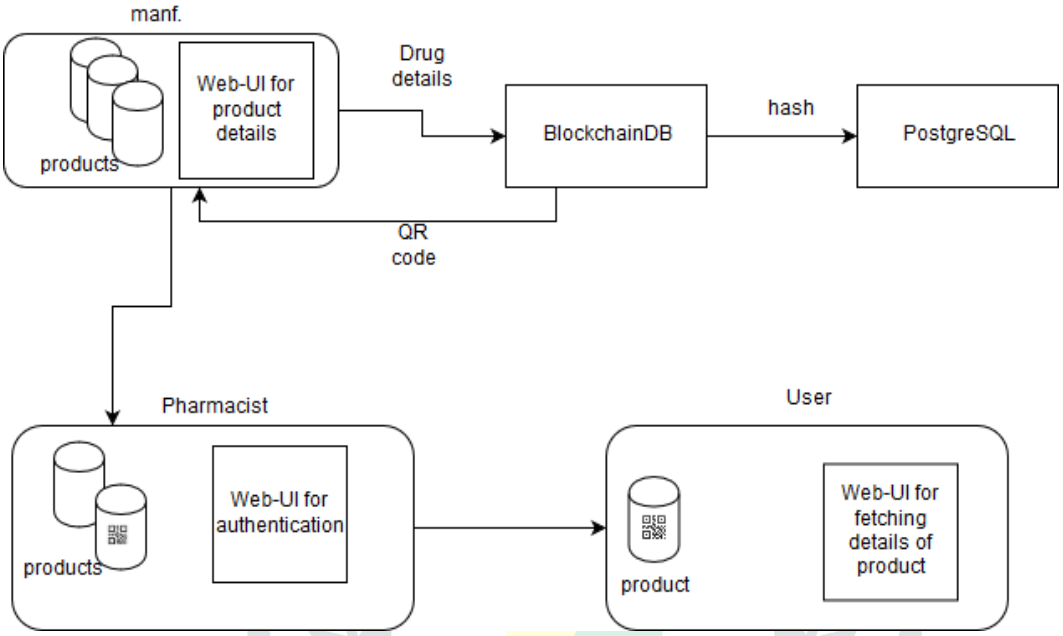

Fig 1. Architectural design of SmartChain.

The Fig 1. depicts the architectural design of SmartChain. To make the application more versatile the entire system is split into four modules. The manufacturer requires a module to interact with SmartChain, which will perform all operations such as post the details of the drug being manufactured to BigChainDB, create a unique ID for each drug which will be used to generate a QR code. A UI module has been built for the pharmacists to perform authentication of the drugs that were supplied. The drugs are validated based on unique ID that is embedded in the QR code. UI module has been created for users, the UI provides users to check the validity of the drug purchased and also will be able to provide details provided by manufacturer such as chemical composition, manufacturing date, expiry date and other details. Another module is built to handle all these requests and to perform transactions of moving data from database to modules and vice-versa.

The manufacturer while manufacturing a new drug will enter the details of the drug which will be posted to SmartChain server, the data gets stored in bigChainDB and each drug entry will have a unique hash which will be used as identifier. The hash entry will also be pushed to PostgreSQL which will be used for validity check. The unique hash created will be the response to the manufacturer's request which will embedded in the QR code. The pharmacist will scan the goods supplied from the manufacturer, once the QR code is scanned, the API references the PostgreSQL for the entry and flags the drug as validated. This can't be validated again thus it will be expensive to create fake drugs as it can be replicated only once. The API will alert local authorities if too many black flags are raised in the particular pharmacy which will help in tracking down the counterfeit establishments. The user's application will also have a QR code scanner which will be used to check the legitimacy of the drugs being purchased. It also provides interface to view the manufacturing details provided by the manufacturer.

IV. TECHNOLOGY STACK

ReactJS: Three interfaces have been built using ReactJS which are hosted on firebase. They include web-UI for manufacturer to provide inputs for generating a unique ID for each product. Pharmacist web-UI will be providing interface to perform validity. user's web-UI will help the users to check for validity and to fetch details provided for manufacturer.

BigChainDB: It is a database system with properties of blockchain such decentralization, immutability, assets and tokens, and query. This hybrid system helps us in storing data provided by manufacturer along with hash value used for identification. The properties help us to keep the data secure and won't let it to be manipulated by anyone, thus it's ideal choice for SmartChain. The BigChainDB is hosted on AWS EC2.

PostgreSQL: The database holds hash values which are present in BigChainDB, hence is used as lookup table when pharmacist queries to perform validation. The Database is hosted on Heroku.

Django Framework: Django is web framework for python. Using Django, we have created REST service for backend application. Django outsmarts other web frameworks by handling multiple concurrent requests.

V. RESULTS

SmartChain was successfully built and the entire product is running on cloud. The UI applications is running on firebase, BigChainDB on AWS EC2, and routing and request handlers are running on Heroku. The manufacturer's application is a form which will be posted and pushed to BigChainDB. Pharmacist application performs extraction of the hash value from the QR code it scans and validates fresh QR code, if not fresh it will be flagged and posted with geotag. User's application is used to validate the product is authentic or not, it also retrieves other information provided by manufacturer viz. chemical composition, manufacturing date, expiry date, batch number.

Impact

The SmartChain reduces the work of manufacturer, there is no need to print the details of the product behind the medicine, with the help of QR code all the details can be fetched thus helping manufacturer cut cost in packing their medicines.
Each scan of the products is posted along with geotag, the geotag will help authorities in tracking and tracing any illegitimate activities rooting to counterfeiting of drugs.
SmartChain works with the help of peers, it scales based along with the number of peers. With use of SmartChain, general public become more aware and purchase products cautiously, this will reduce population who are prone to purchase of fake drugs.
The application for users has a module which displays the number of illegitimate cases of medicines (fig2), the application graphically represents the cases in comparison to other locations, this will rise awareness in general public and will make more people to use the application thus helping fight drug counterfeiting.
A psychological study says humans tend to interact with enigmatic objects than the obvious ones, we can say the same goes with buying medicines. There is a high chance of people reading information of medicines off their phones after scanning the QR code than reading from printed label. This will make people more aware and educated of what they buy.

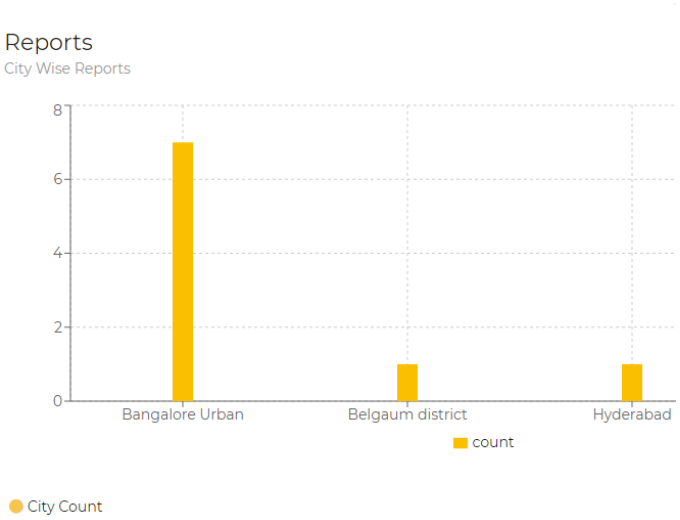

Fig 2 Graphical report of counterfeit drug cases

Future Development

The application can be developed in many dimensions which we have thought of enhancing, but due to the insufficient time allocated we are considering some of the features can be add-ons in the near-future. The application provided to users can be upgraded with a module which performs data mining from other webpages, retrieving useful information for the user before he consumes the product. Suppose if a person has bought a medicine to cure his headache, once the tablet is scanned the application will retrieve information such as directions to use, expert advice, and side-effects of the drug, all of these useful for the person. Making a reward system for users to scan the product, this will encourage the users to perform drug validation and also creates awareness in public to validate the products before purchase. The data provided by application stored in BigChainDB can be mined and valuable information can be extracted from them, information such as which products are sold at which locations can be used for restocking by the supply chain, information such as type of medicines being purchased at certain demographic can help in finding which disease is common at that region and also might help in predicting outbreaks. In this way data mining can be implemented to retrieve useful data to help improve any service in the healthcare industry.

VI. CONCLUSION

SmartChain is a simple concept that can be implemented to prevent counterfeiting of drugs, which in-turn will be ensuring brand safety and also helping in preventing consumption of fake drugs by general public. The system works with the help of peers, its efficiency improves as the number of peers using it increases, we can say peers are the pillars to this application. Raising awareness and educating people is also part of the application, making people aware of what they are buying, knowing information such as expiry date, type of drug will be helping the consumer, for instance sometimes pharmacist provides a substitute drug to the consumer, the consumer could just scan and get to know if it's a substitute by checking type of drug, say paracetamol, aspirin, etc.

Authorities also will find good use from the application, constantly tracking the location for every scan performed will help the authorities to find any ill activities that might be intruding the supply chain, also the pharmacies get flagged if there are cases of counterfeit drug scans, which will be notified to the authorities.

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