Blockchain-Based AI-Assisted Hospital Management System

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Abstract - *Healthcare has become one of the top priorities for most countries of the world. The development of healthcare institutions has prevailed and healthcare access has been increasing by an inspiring 2% per annum. Even major countries are too slow to prevent an outbreak because the necessary data is accessed only after the outbreak is noticeable. Vaccination and medicine development takes so many years to understand its effects. But this time duration can be reduced if data is not only continuously collected, but also constantly analysed using data of a huge region. Another major issue is that people's health data, in particular, is not trustable, not centralized, and not transparent causing questioning of the difference between visible health data and the actual stored health data. This shows that there is a major caveat in healthcare development in many regions. But they all share the same problem and we'd like to call it lack of Data Care and Refurbishment. Data in health care institutions must be as transparent as possible using decentralization. And the same data must also be used as the ready-to-use source of information for governments to take immediate action if there is a chance of an outbreak, lack of medication supply and equipment, vaccination and clinic drives and many other plausible problems faced by certain locality surrounding the health institutes. What was really missing was a sturdy median that connects the network of healthcare starting from the citizens, the median, and the nation. For this, we introduce this system.*

***Key Words*: Data Care and Refurbishment**

1. INTRODUCTION

The system is a fully functional hospital data management system that incorporates state-of-the-art technologies like Machine Learning and Blockchain. It is a platform where authorized hospital professionals can load the medical records of a patient and can be accessed by the patient anywhere anytime. In this way, a simplex communication is established between hospitals and patients. The data of all patients can be used for analytics purposes without compromising the personal information of a patient effectively by using this platform. In this way, government organizations can pinpoint the adverse effects of diseases, allocate funds efficiently to the need, find the origin of any outbreaks, predict any upcoming phenomena, properly plan and organize themselves and create awareness.

It comes with advanced features like Data Analytics for Data Care, Medicine purchasing redirection, Medical Reports

Analyser for individuals. Along with all these features what makes it stand out from conventional systems is that its backend architecture is completely built based on Blockchain technology. One of the main important factors which concern any person/organization is the privacy and security protocols incorporated in the application. With systems becoming more computationally powerful day by day, complex time-consuming programs are executed and cracked at a faster rate. The use of Blockchain especially in medical-related fields increases more security towards data tampering. As a result, the system provides an insight into an organization's health condition/situation along with advanced features and strong security protocols to benefit the patients and organizations.

1.1 Literature Review

Healthcare data is increasingly digitized and like in most other industries, in healthcare too, data is increasing in velocity, volume, and value. Proper data management techniques are required to extract sensible information, derive sensible insights to deliver better medical outcomes. According to a survey, most healthcare organizations collect **EMR** abstracts, claims data, and data about enrolment and medical programs. Only leading organizations additionally use electronic EMR feeds and disease management program data. Whatever might be the case, under no circumstance these management systems can be considered valuable outside the respective hospital management. The reason is, these management systems are designed to respond and store data of only their respective organization. It lacks the ability to serve the purpose of an institution-independent solution system that provides valuable medical information to any person or organization or the government - **one nation, one system.**

Very few cases of **PaaS** exist that have aimed at establishing a system that can be used by any group of people or organizations. IBM has developed an app, a **digital health pass**, to hold the medical information of its users. The app maintains information about each of its users chronologically. Digital Health Pass is designed to enable businesses to verify health credentials for employees, customers, fans, and travellers entering their site based on their own criteria. The foundation of this app is built on the concept of decentralization (to minimize the amount of personal data collected), blockchain (to secure data and store it efficiently), and cryptography (to secure data).

2. METHODOLOGY

2.1 User Profiles - Doctor and Patient

The system has two login profiles. Common users can sign up as 'Patients'. This profile consists of all the medical records of the particular user recorded date wise which makes it easier for them to retrieve any time. The doctor profile is specially built such that the authentication is based on a unique ID, which the platform provides only after he/she sends the data of his/her practicing license which is given by the concerned department of government. If the doctor works at a hospital, then they will have to register each doctor working in it. The doctor profile is a superset of the patient's profile. This means that the doctor also has the provision to act as a patient and will have their medical records stored under his/her profile. The system provides all the essential features of user-profiles such as profile settings, password resets, and also email verification.

The following content will be based on a scenario where a patient is visiting their family doctor, assuming that they have met more than once before. Once the doctor has understood the patient's health issue(s), he/she can check the patient's previous health record. This access is verified by the patient using **One Time Password (OTP) Authorization**. Patient records can be seen date wise and this gives more insightful information for the doctor from his past meetings with the patient. After gaining information from the patient, the doctor can move on to the prescription page.

The prescription page of the system is based on a formal **document-based layout** that shows the patient details along with a simple form. This form accepts a report of the patient's condition and the medicine required along their day and time duration. This prescription is then formatted into a formal document and it is **printable** into a pdf file and the soft copy is then appended into the patient's records. Once the visit is over, the patient can remove access to their records and it won't be visible to the doctor.

Fig -1: *Flowchart of the working platform for individuals from health institutes registered under the system.*

2.2 Keyword extraction API

The report that the doctor gives for each patient goes into the Natural Language Processing pipeline before getting stored at the backend. This model uses a trained model called **en_core_web_sm** from the Spacy Library. Using this, the report gets tokenized into singular tokens (simple words without any special characters and punctuation). Then the tokens are filtered again using parts of speech and the nouns are taken out separately. These tokens are then compared with common words of diseases and symptoms. The spacy provides functions that convert each token as a vector and apply cosine similarity among them. The similarity value ranges from 0 to 1, 1 being the most similar word (usually when two same vectors are compared, it results in 1). A *threshold similarity of 0.4* is kept to extract all the words which are similar to common words, diseases and symptoms. This program is then backed up with a separate server and is changed into a **REST API**.

2.3 Providing online purchase features of medicines using Google Search Engine API

The prescription layout of the medical records has interactive links across the medicine in each row. These links redirect to a purchase page option on the Pharmeasy website.

These links are provided using the Google search API which is a search engine that can be customized as per the developer's needs. The Search API in the system is customized such that the input search string (also called keyword) only produces results from the Pharmeasy website so that relevant links are produced. After the results are generated, the first hyperlink is taken as it is assumed to be the most relevant result to the input keyword. This API is requested every time the user redirects to the prescription layout page. The medicine name in each row becomes the input keyword for the API, and the links are retrieved from the API and automatically embedded into the prescription layout. This allows users to directly purchase medicines online, without the hassle of searching over the web.

2.4 Blockchain Implementation

The system uses blockchain to protect data of the patient from getting tampered with in the server. A separate blockchain is maintained which stores all the encrypted hashes of patients details and whenever patients details are getting updated, a new hash is built and then appended into the blockchain as a singular block. The encryption is in the form of sha 256 algorithm and a signature is also generated using a private key given to the doctors. Once encrypted with the doctor's private key, the whole report becomes a signature and this will be stored with the patient's record. Whenever the patient wants to verify that his or her records are not tempered, they can use the public key of the doctor to decrypt the signature and verify it against the blockchain records with an algorithm inbuilt into the system backend. With this process we can ensure that patients' data are not tampered illegally. Given below is the flowchart of the blockchain model embedded into the system.
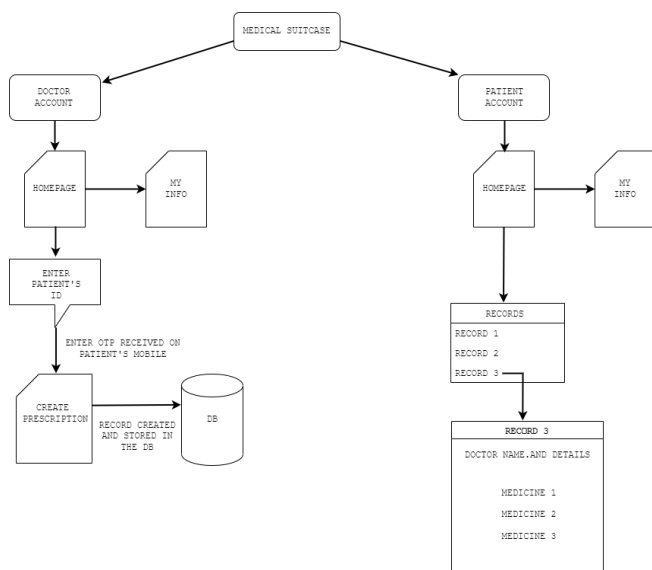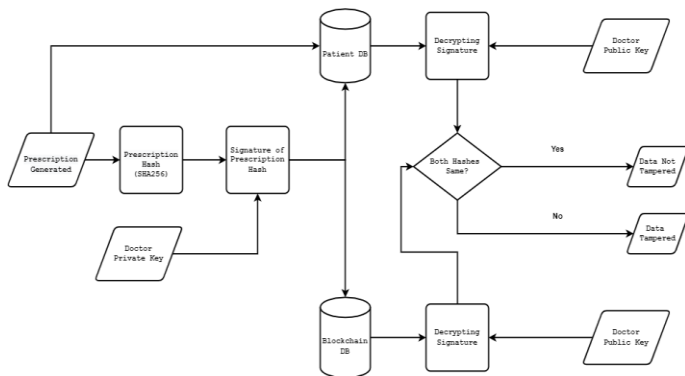
Fig -2: *Flowchart of backend Blockchain Architecture*

2.5 Data Analytics

The other phase of the system serves the nationwide organization with data analytics and machine learning. When the doctor submits a patient's prescription, the description of the patient's issues is processed using NLP, and major words are taken and stored in a separate global database. There is no involvement of the patient's direct data. For example, the number of cases having the same diseases and symptoms and their frequencies are recorded for a specific time duration. During storage, they are grouped and locations/regions, and then during visualization they are brought together in a singular form and are represented on the Data Analytics page. The Data Analytics page gets real-time updates every moment a patient's health record gets stored from any institute which is registered under the system.
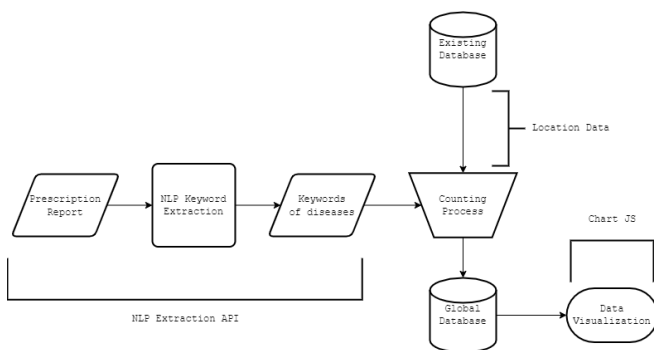

Fig -3: *Flowchart of the data analytics backend in the system*

3. RESULTS AND DISCUSSION

The main objective of the system is to provide transparent simplex communication between hospitals and patients and help the organizations like the government to utilize the medical data of patients without compromising privacy and security. This is very well achieved by the clever and efficient use of technologies like Blockchain along with a flexible data management system. Due to a very simplistic and robust UI/UX, people from all classes would be able to easily use and access the platform without any trouble. The use of Blockchain architecture in the backend improves the security by an extra layer.

Conventional data management systems used in hospitals usually have very few features and are confined to a specific location (usually hospital) and can't be accessed anywhere else. The system addresses these issues by having features that most hospital data management systems don't have. Also, the data in the system can be accessed anywhere at any time, which reduces the clutter of hard copies of medical records and helps to save huge amounts of time, and reduces the risk of losing important medical documents.

With features like Advanced Data Analytics, it is highly useful for organizational bodies to keep track of the health status across a region and helps them to accurately pinpoint any abnormalities in health domains. With Machine learning, suggestive models can be developed to spot the abnormalities and proper solutions can be suggested by the models. The hidden patterns which can't be seen by humans can be easily observed by the model as it gets trained with new data regularly.

The implementation of Natural Language Processing enables the doctor to see a patient's chronic diseases without referring to previous medical records of the patient.

In this current online mode world, everything is available within the fingers. The redirection to the medical store for buying medicines enables the patient a hassle-free ordering of any medicine.

Any product is not always perfect during its initial release due to some constraints like implementation barriers due to the early stage of technology, lack of developers, and many more. The system as a hospital data management platform has a lot of scopes to improve in the future with more additional features. These features depend on the demand of the future society and technology. New features should not compromise any performance of the existing system and must abide by all protocols followed by the existing model and must not deviate from the existing model's core ideology.
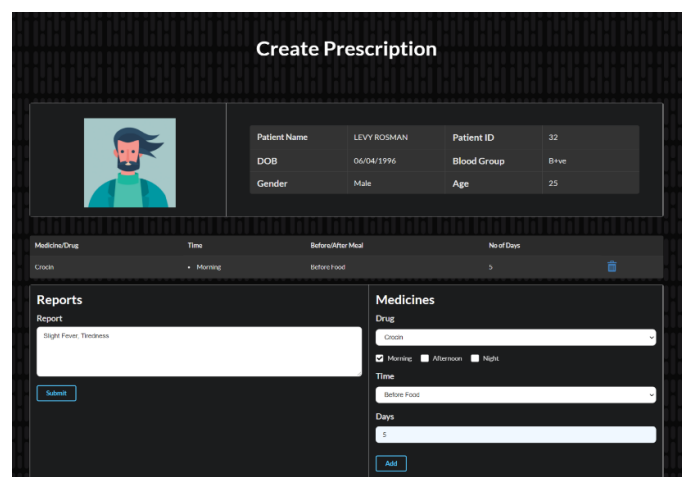

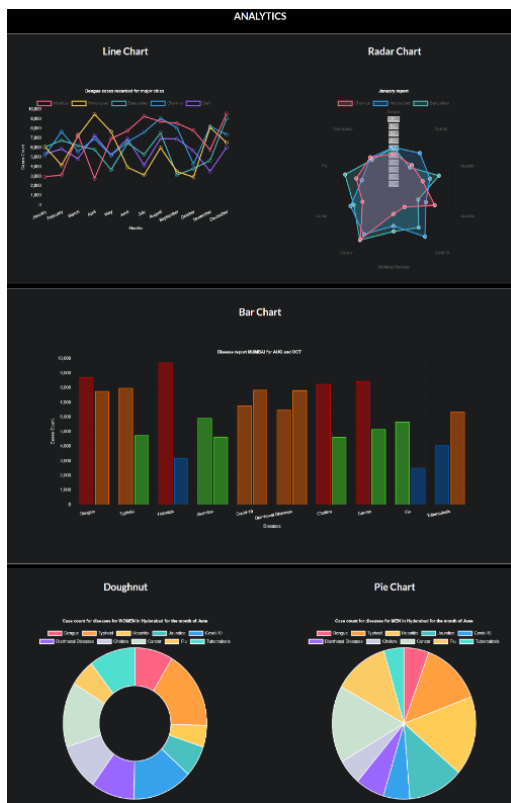**Fig -4**: *The 'Create Prescription' page of the system.*

Fig -5: *The Data Analytics feature of the system*

4. CONCLUSION

The pandemic has made all the countries focus more on their health sector. Technologies evolve to solve a particular problem and improve current situations. Pandemic made us realize that medical systems are highly useful to monitor each and every aspect of a health issue. The system brings a new dimension to the existing medical systems. Its highly efficient features like Data Analytics, NLP, and Prevention of Data Tampering enable it to be a complete all-rounder.

The use of the system gives the right to a patient to view his/her medical data which current systems prevent. The implementation of NLP enables doctors to easily know about a patient's chronic illness from the past without referring to his/her past medical records which could save a huge amount of time. Governments rely on data from hospitals all around the nation and are usually not fed with proper data due to miscommunication or lack of resources to contact every hospital all over the nation. The real-time data from hospitals is not available due to conventional medical systems implemented in hospitals. The system addresses all these problems and provides the government and people with real-time data. This is highly useful for monitoring any outbreaks like Covid by reducing the error of undercounting. The system also enables the government to allocate funds to the health sector in a very efficient way.

There is a huge future scope for this system. Many new features can be implemented to make it even more flexible and robust in its operation. Governments can issue identity cards for health just like Social Security numbers. This card can be used everywhere across a nation and any reimbursement through Insurance can also be easily done without any hectic paperwork. The application of this system is very huge and can be extended with features in the future.

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