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"PATIENT RECORD MAINTENANCE SYSTEM USING MACHINE LEARNING AND BLOCKCHAIN"

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Certified that the project work entitled "**PATIENT RECORD MAINTENANCE SYSTEM USING MACHINE LEARNING AND BLOCKCHAIN**" carried out by **Mr. Sandeep N S**, **Ms. Srivalli S B, Mr. Suprad S Parashar** bearing USN **1JB17IS079**, **1JB17IS091**, **1JB17IS096** are bonafide students of **SJB Institute of Technology** in partial fulfilment for the award of **BACHELOR OF ENGINEERING** in **INFORMATION SCIENCE AND ENGINEERING** of the **Visvesvaraya Technological University**, **Belagavi** during the academic year **2020-21.** It is certified that all corrections/suggestions indicated for Internal Assessment have been incorporated in the Report deposited in the Departmental library. The project report has been approved as it satisfies the academic requirements prescribed for the said Degree.

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ABSTRACT

We find that doctors face problems while diagnosing a patient due to a lack of proper medical record keeping. All medical records might not be available as some could have been destroyed, or even been misplaced by the patient. In such circumstances, doctors might find it challenging to diagnose the patient due to a lack of information. The purpose of this project is to provide patients with a platform to store their medical records without hassle such that they are easily indexable and searchable. The patient can simply take a picture of their medical report to generate a copy of the same which is searchable. The medical records can then be stored on a blockchain to ensure security and make it tamper-proof. The platform would also provide additional features such as reminders, appointments, sharing, etc to facilitate the Patient-Doctor Relationship.

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Chapter 1

INTRODUCTION

In the world of healthcare today, two major problems must be addressed: data security and proper management of medical records. Both these issues also lead to significant moral repercussions that must be resolved. Maintaining the reports and prescriptions clean and handy is of vital importance for any patient who goes for regular medical tests or otherwise. Keeping a good track of your health and reports is crucial for better identification of illness and faster diagnosis.

Patient records are given as a hard copy, printed on paper which is prone to destruction. Hence, a better alternative would be to keep it in an electronic format, which is easily accessible and searchable. But, storing the image of the report would not be of much help as the text within the image cannot be searched for. Hence, we aim to use Machine Learning and Optical Character Recognition to read the characters in the image and generate a virtual report which could be easily searchable.

The next major problem that we face is Data Security. Miscreants might try to fake medical records and edit doctor's notes to gain an advantage. Hence, a need to store records in a secure manner arises. To solve this, we are using Blockchain to store data that is secure, tamper-proof and permanent. Blockchain is permanent because once a block is added to the chain, anyone who wishes to alter it would need to recompute the altered block and all subsequent blocks, which requires an infeasible amount of computation power. Furthermore, blockchain is secure because there is no centralized structure for a malicious user to target, as the data is stored in numerous copies on different nodes. These properties render blockchain ideal in healthcare data management.

1.1 Objectives

1. To maintain all the previous medical records online, which facilitates easy access of the same.
2. To solve the problem of patients losing the reports or doctor's prescriptions.
3. To provide the patient with a better understanding of the reports, which in turn provides a good user experience.

4. To remind patients about the medicines that the doctor has prescribed.
5. To provide a highly secured, immutable, tamper-proof, reliable and trustworthy application for patients.

1.2 Existing System

There are a few apps and websites which provide a basic platform for patients. Listed below are a few of the existing systems.

1. **MedicalChain** - Medicalchain uses blockchain technology to securely manage health records for a collaborative, smart approach to healthcare. MedicalChain stores the images of the reports in a blockchain to make it secure, but it does not address the problem of searching within a file. It also does not provide any prescription analysis for reminders.
2. **Patient Medical Records & Appointments for Doctors** - Using this app, patients can manage all their medical records such as personal information, medication, visit history, clinical notes, patient history, and other notes. The app uses a database to store images which again does not address the problem of searching within a file. Although it provides a reminder feature, it has to be set automatically by the user. The files are stored on a cloud server, which is secure, but not tamper-proof.
3. **Medical Records** - Patients can use this Android Medical Records App to easily save anamnesis, patient records, patient history, and health information. This app is similar to the app above. The app uses a database to store images which again does not address the problem of searching within a file. Although it provides a reminder feature, it has to be set automatically by the user. The files are stored on a cloud server, which is secure, but not tamper-proof.

1.3 Proposed System

Using Blockchain and Machine Learning, we provide a patient record management application to store and track the medical tests that the user has undergone.

1.4 Technologies Used

1.4.1 Machine learning

Machine learning (**ML**) is the scientific study of algorithms and statistical models that computer systems use to perform a specific task without using explicit instructions, relying on patterns and inference instead. It is seen as a subset of artificial intelligence. Machine learning algorithms build a mathematical model based on sample data, known as "training data", to make predictions or decisions without being explicitly programmed to perform the task. Machine learning algorithms are used in a wide variety of applications, such as email filtering and computer vision, where it is difficult or infeasible to develop a conventional algorithm for effectively performing the task. Machine learning is closely related to computational statistics, which focuses on making predictions using computers. The study of mathematical optimization delivers methods, theory and application domains to the field of machine learning.

Being a field of science, machine learning deals with how machines learn using their experience. With the advent of new techniques and approaches to Machine Learning, we currently possess the ability to find a solution to health-related issues such as heart arrhythmia. A system using Machine learning techniques that can identify whether the patient has arrhythmia or not can be developed. Furthermore, detecting the arrhythmia in an early stage leads to treating the patients before it becomes critical.

1.4.2 Native Android Development

Android software development is the process by which applications are created for devices running the Android operating system. Google states that "Android apps can be written using Kotlin, Java, and C++ languages" using the Android software development kit (SDK), while using other languages is also possible. All non-JVM languages, such as Go, JavaScript, C, C++ or assembly, need the help of JVM language code, that may be supplied by tools, likely with restricted API support. Some programming languages and tools allow cross-platform app support (i.e. for both Android and iOS). Third-party tools, development environments, and language support have also continued to evolve and expand since the initial SDK was released in 2008. The official Android app distribution mechanism to end-users is Google Play; it also allows staged gradual app release, as well as distribution of pre-release app versions to testers. The Android software development kit (SDK) includes a

comprehensive set of development tools. These include a debugger, libraries, a handset emulator based on QEMU, documentation, sample code, and tutorials. Currently supported development platforms include computers running Linux (any modern desktop Linux distribution), Mac OS X 10.5.8 or later, and Windows 7 or later. As of March 2015, the SDK is not available on Android itself, but software development is possible by using specialized Android applications.

Until around the end of 2014, the officially-supported integrated development environment (IDE) was Eclipse using the Android Development Tools (ADT) Plugin. As of 2015, Android Studio is the official IDE; however, developers are free to use others, but Google made it clear that ADT was officially deprecated since the end of 2015 to focus on Android Studio as the official Android IDE. Additionally, developers may use any text editor to edit Java and XML files, then use command-line tools (Java Development Kit and Apache Ant are required) to create, build and debug Android applications as well as control attached Android devices (e.g., triggering a reboot, installing software package(s) remotely).

Enhancements to Android's SDK go hand-in-hand with the overall Android platform development. The SDK also supports older versions of the Android platform in case developers wish to target their applications on older devices. Development tools are downloadable components, so after one has downloaded the latest version and platform, older platforms and tools can also be downloaded for compatibility testing.

Android applications are packaged in .apk format and stored under the /data/app folder on the Android OS (the folder is accessible only to the root user for security reasons). APK package contains .dex files (compiled byte code files called Dalvik executables), resource files, etc.

1.4.3 Blockchain

Blockchain technology is a structure that stores transactional records, also known as the block, of the public in several databases, known as the “chain,” in a network connected through peer-to-peer nodes. Typically, this storage is referred to as a ‘digital ledger. Every transaction in this ledger is authorized by the digital signature of the owner, which authenticates the transaction and safeguards it from tampering. Hence, the information the digital ledger contains is highly secure.

It is highly secure. It uses a digital signature feature to conduct fraud-free transactions making it impossible to corrupt or change the data of an individual by the other users without a specific digital signature. It has a decentralized system. Conventionally, you need the approval of regulatory authorities like a government or bank for transactions; however, with Blockchain, transactions are done with the mutual consensus of users resulting in smoother, safer, and faster transactions. Blockchain technology uses hash encryption to secure the data, relying mainly on the SHA256 algorithm to secure the information. The address of the sender (public key), the receiver's address, the transaction, and his/her private key details are transmitted via the SHA256 algorithm. The encrypted information, called hash encryption, is transmitted across the world and added to the Blockchain after verification. The SHA256 algorithm makes it almost impossible to hack the hash encryption, which in turn simplifies the sender and receiver's authentication.

1.4.4 Firebase

Firebase is a platform developed by Google for creating mobile and web applications. It was originally an independent company founded in 2011. In 2014, Google acquired the platform and it is now their flagship offering for app development. Firebase evolved from Envolve, a prior startup founded by James Tamplin and Andrew Lee in 2011. Envolve provided developers with an API that enables the integration of online chat functionality into their websites. After releasing the chat service, Tamplin and Lee found that it was being used to pass application data that were not chat messages. Developers were using Envolve to sync application data such as the game state in real-time across their users. Tamplin and Lee decided to separate the chat system and the real-time architecture that powered it. They founded Firebase as a separate company in September 2011 and it launched to the public in April 2012.

Firebase's first product was the Firebase Realtime Database, an API that synchronizes application data across iOS, Android, and Web devices, and stores it on Firebase's cloud. The product assists software developers in building real-time, collaborative applications.

In 2014, Firebase launched two products. Firebase Hosting and Firebase Authentication. This positioned the company as a mobile backend as a service.

In May 2016, at Google I/O, the company's annual developer conference, Firebase introduced Firebase Analytics and announced that it was expanding its services to become a unified

backend-as-a-service (BaaS) platform for mobile developers. Firebase now integrates with various other Google services, including Google Cloud Platform, AdMob, and Google Ads to offer broader products and scale for developers.[12] Google Cloud Messaging, the Google service to send push notifications to Android devices, was superseded by a Firebase product, Firebase Cloud Messaging, which added the functionality to deliver push notifications to both iOS and web devices. In January 2017, Google acquired Fabric and Crashlytics from Twitter to add those services to Firebase.

In October 2017, Firebase has launched Cloud Firestore, a real-time document database as the successor product to the original Firebase Realtime Database.

1.4.5 ML Kit

ML Kit brings Google’s machine learning expertise to mobile developers in a powerful and easy-to-use package. Make your iOS and Android apps more engaging, personalized, and helpful with solutions that are optimized to run on the device. ML Kit’s processing happens on-device. This makes it fast and unlocks real-time use cases like the processing of camera input. It also works while offline and can be used for processing images and text that need to remain on the device. Take advantage of the machine learning technologies that power Google's own experiences on mobile. We combine best-in-class machine learning models with advanced processing pipelines and offer these through easy-to-use APIs to enable powerful use cases in your apps.

Chapter 2

LITERATURE SURVEY

[1] Hannah S Chen, Juliet T Jarrell, Kristy A Carpenter, David S Cohen, Xudong Huang. 2019. Blockchain in Healthcare: A Patient-Centered Model. National Institute of Health. [Base Paper]

The paper talks about a medical data management system using blockchain technology that is secure and allows patients to retain ownership over their records while allowing hospitals to have easy access.

A blockchain is a system for storing and sharing information that is secure because of its transparency. Each block in the chain is both its independent unit containing its information, and a dependent link in the collective chain, and this duality creates a network regulated by participants who store and share the information, rather than a third party. Blockchain has many applications in healthcare and can improve mobile health applications, monitoring devices, sharing and storing of electronic medical records, clinical trial data, and insurance information storage. Research about blockchain and healthcare is currently limited, but the blockchain is on the brink of transforming the healthcare system; through its decentralized principles, blockchain can improve accessibility and security of patient information, and can therefore overturn the healthcare hierarchy and build a new system in which patients manage their care.

Limitations - The paper gives a general idea of how blockchain can be used in healthcare but does not provide methods or means to include Blockchain in the system.

[2] Laure A. Linn and Martha B. Koo. 2016. Blockchain For Health Data and Its Potential Use in Health IT and Health Care Related Research.

Blockchain technology has the potential to address the interoperability challenges currently present in health IT systems and to be the technical standard that enables individuals, health care providers, health care entities and medical researchers to securely share electronic health data.

The authors throw light on how a blockchain-based access-control manager to health records would advance the industry interoperability challenges expressed in the Office of the National Coordinator for Health Information Technology's (ONC) Shared Nationwide Interoperability Roadmap.

Limitations - This paper does not discuss cost-effective methods of implementing blockchain.

[3] Karez Abdulwahhab Hamad, Mehmet Kaya. 2016. A Detailed Analysis of Optical Character Recognition Technology. International Journal of Applied Mathematics, Electronics and Computers.

A simple way to store information to a computer system from these printed documents could be first to scan the documents and then store them as image files. But to re-utilize this information, it would very difficult to read or query text or other information from these image files. Therefore a technique to automatically retrieve and store information, in particular text, from image files is needed. Optical character recognition is an active research area that attempts to develop a computer system with the ability to extract and process text from images automatically. The objective of OCR is to achieve modification or conversion of any form of text or text-containing documents such as handwritten text, printed or scanned text images, into an editable digital format for deeper and further processing. Therefore, OCR enables a machine to automatically recognize text in such documents. Some major challenges need to be recognized and handled to achieve successful automation. The font characteristics of the characters in paper documents and the quality of images are only some of the recent challenges. Due to these challenges, characters sometimes may not be recognized correctly by a computer system. In this paper we investigate OCR in four different ways. First we give a detailed overview of the challenges that might emerge in OCR stages. Second, we review the general phases of an OCR system such as pre-processing, segmentation, normalization, feature extraction, classification and post-processing. Then, we highlight developments and main applications and uses of OCR and finally, a brief OCR history are discussed. Therefore, this discussion provides a very comprehensive review of the state-of-the-art of the field.

Limitations - Images produced by cameras usually are not as good of an input as scanned images to be used for OCR due to the environmental or camera related factors.

[4] Rejean Plamondon and Sargur N Srihari. 2000. Online and Offline Handwriting Recognition: A comprehensive Survey. IEEE Transactions on Pattern Analysis and Machine Intelligence. Vol. 22. No.1 January 2000

The IEEE Paper provides insight on how Handwriting Recognition has practical applications and how they are useful across various domains.

Limitations - This paper is good for understanding just the basic concepts of the language recognition algorithms. Edge cases are not considered properly.

[5] Satoshi Nakamoto. 2008. Bitcoin: A Peer-to-Peer Electronic Cash System.

A purely peer-to-peer version of electronic cash would allow online payments to be sent directly from one party to another without going through a financial institution. Digital signatures provide part of the solution, but the main benefits are lost if a trusted third party is still required to prevent double-spending. We propose a solution to the double-spending problem using a peer-to-peer network. The network timestamps transactions by hashing them into an ongoing chain of hash-based proof-of-work, forming a record that cannot be changed without redoing the proof-of-work. The longest chain not only serves as proof of the sequence of events witnessed, but proof that it came from the largest pool of CPU power. As long as a majority of CPU power is controlled by nodes that are not cooperating to attack the network, they'll generate the longest chain and outpace attackers. The network itself requires minimal structure. Messages are broadcast on a best effort basis, and nodes can leave and rejoin the network at will, accepting the longest proof-of-work chain as proof of what happened while they were gone.

Limitations - The BlockChain technology relies on Decentralisation. High computational power is required to mine a block. Prone to 51% attack.

[6] Arik Poznanski and Lior Wolf. 2016. CNN N-Gram for Handwriting Word Recognition. Computer Vision Foundation.

Given an image of a handwritten word, a CNN is employed to estimate its n-gram frequency profile, which is the set of n-grams contained in the word. Frequencies for unigrams, bigrams and trigrams are estimated for the entire word and for parts of it. Canonical Correlation Analysis is then used to match the estimated profile to the true profiles of all words in a large dictionary. The CNN that is used employs several novelties such as the use of multiple fully connected branches. Applied to all commonly used handwriting recognition benchmarks, our method outperforms, by a very large margin, all existing methods.

Limitations - The model experiments with a Convolutional Neural Network to recognise characters which is newer than previously established RNNs.

Chapter 3

SYSTEM REQUIREMENTS SPECIFICATION

A software requirements specification is a detailed description of a software system to be developed with its functional and non-functional requirements, as well as hardware and software requirements. The SRS is developed based on the agreement between customers and contractors. It may include the use cases of how the user is going to interact with the software system. The software requirement specification document consists of all requirements required for project development. To develop the software system, we should have a clear understanding of the Software system.

Software requirements specification establishes the basis for an agreement between customers and contractors or suppliers on how the software product should function. SRS is a rigorous assessment of requirements before the more specific system design stages, and its goal is to reduce later redesign. It should also provide a realistic basis for estimating product costs, risks, and schedules. Used appropriately, software requirements specifications can help prevent software project failure.

Software Requirements:

- Operating System –
    - Android: Android 7(Nougat) or Higher.
- A stable internet connection

Hardware Requirements:

- RAM – 2GB and Above
- Camera - 8 megapixels or Higher

Chapter 4

SYSTEM DESIGN

4.1 Flow Diagram

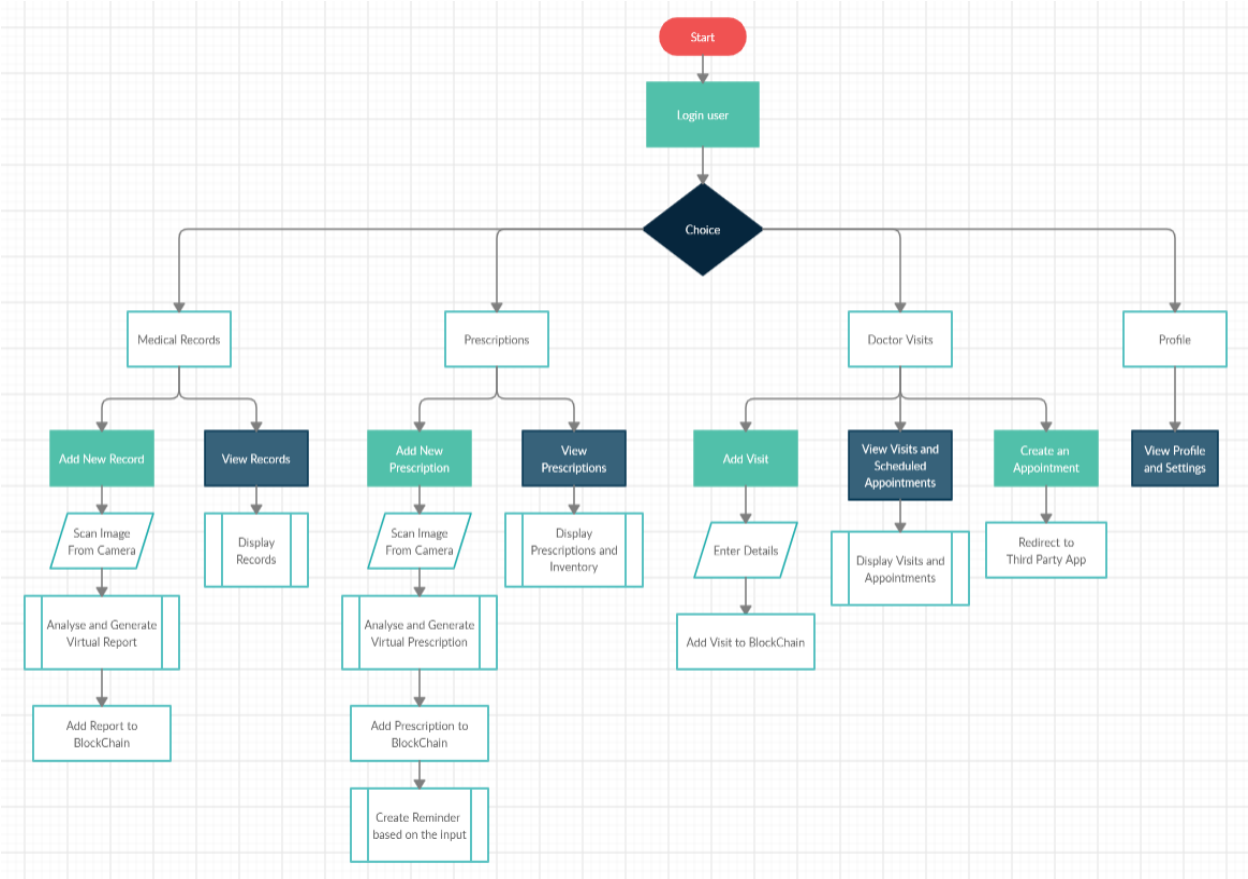

Figure: 4.1 System Design

4.2 Modules

The user would be presented with Four to five tabs namely -

1. Home
2. Hospitals
3. Upload
4. Reports and Prescriptions
5. Profile

4.3 Design Modules

For the purposes of building the project, the entire project will be divided into the following modules -

1. **Authentication** - This module is responsible for logging in and registration of users. This module will be implemented using Firebase Auth.
2. **Scanning** - This module handles the scanning of physical reports and prescriptions and converting them into typed reports which are searchable.
3. **Storage -** This module will add the generated reports into the block chain.
4. **Notifications** - This module is responsible to generate notifications and provide reminders to patients.

4.4 System Architecture

4.4.1 Authentication

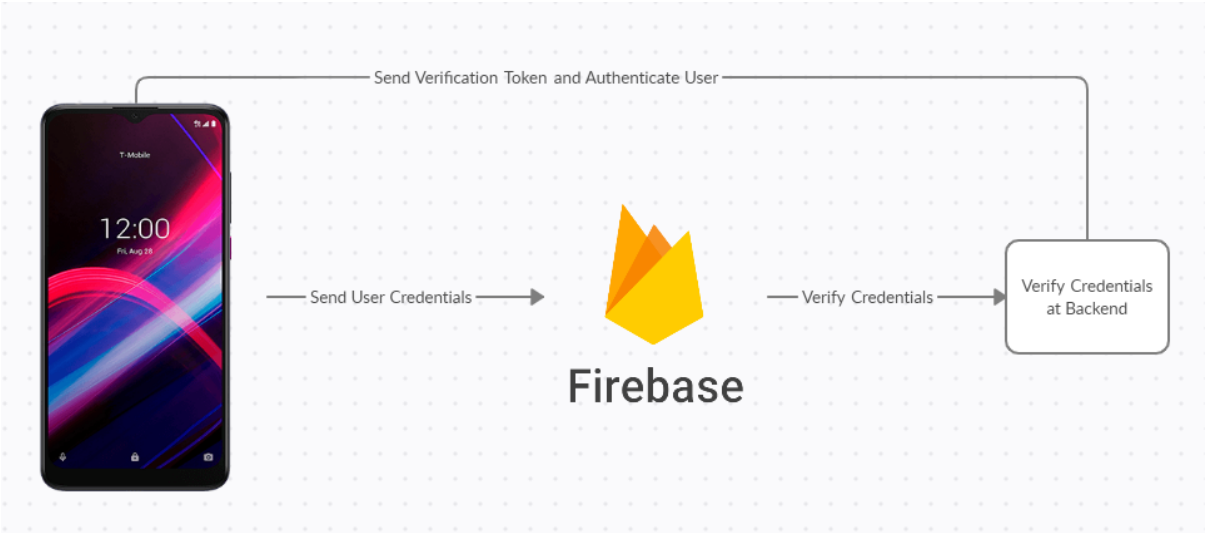

Fig – 4.2 Authentication System Architecture

Authentication Module is built using the Firebase Auth Feature which provide API to manage users. The application sends request to Firebase to Authenticate user credentials, the API verifies the user credentials and responds accordingly.

4.4.2 Scanning

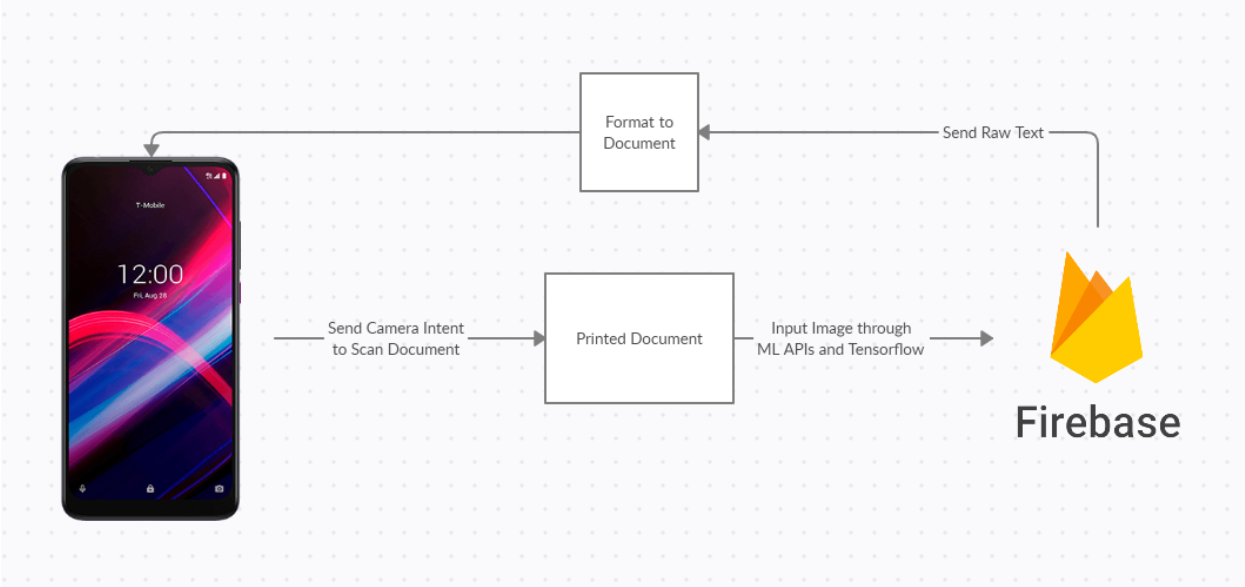

Fig 4.3 – Scanning Functionality Working

Scanning Module is built to handle the capture and analysis of the captured image. When the user prompts the application to capture an image, the scanning module captures the image and analysis the image using Machine Learning APIs and Tensor flow and uploads the analysis to Block chain and returns raw text.

4.4.3 Storage

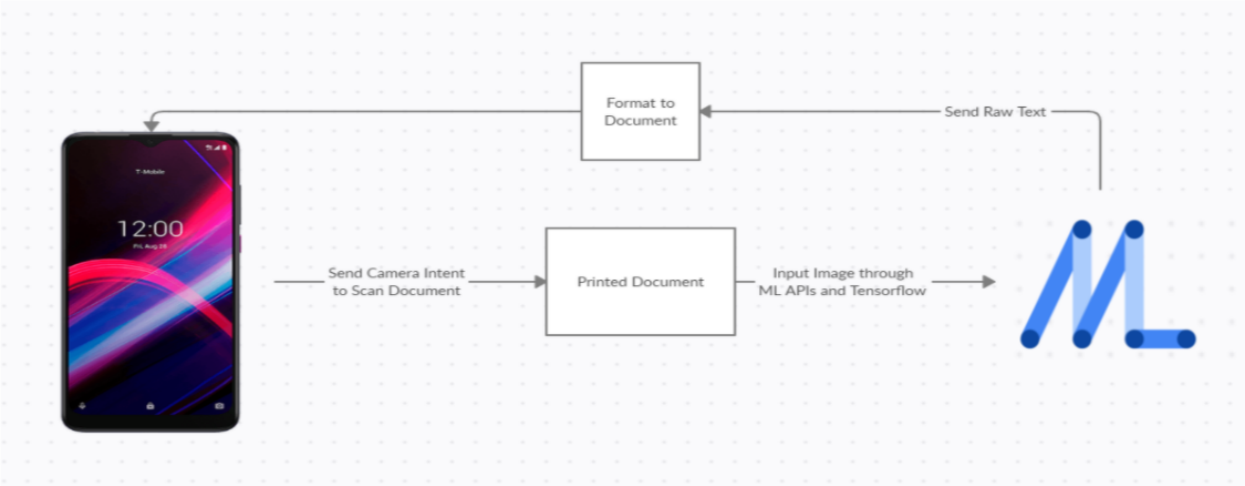

Fig 4.4 – Storage System Architecture

4.5 Technologies

Due to the various modules and the complexity of the application, we have decided to use the following technologies and frameworks to help us create the app.

1. **ML Kit** - Machine learning will be used to detect the characters in the medical reports and for Handwriting Analysis of prescriptions. This will be achieved by a combination of ML APIs from ML Kit.
2. **Android SDK** – Android SDK will be used to develop the App as it is a native framework designed for Android Application Development and will help us build apps for Android easily.
3. **Block chain** - Concepts of Block chain will be implemented to securely store the patient data.

Chapter 5

IMPLEMENTATION

Implementation is the process of defining how the system should be built, ensuring that it is operational and meets quality standards. It is a systematic and structured approach for effectively integrating a software-based service or component into the requirements of end users.

System Implementation is the process of ensuring that the information system is operational and used, ensuring that it meets the quality standards. It uses the structure created during architectural design and the result of system analysis to construct system elements that meets the stakeholder requirements and system requirements developed in the early life cycle phases.

5.1 Authentication

The authentication module enables users to log into the application using a registered email ID and a password. The authentication module used Firebase Authentication to interact between users and the server. The authentication module can be divided mainly into two parts, namely – Login and Registration.

Once the user is logged in, he/she will be logged in until the user manually logs out. To achieve this, we have used Persistant Authentication.

5.1.1 Login

1. The login module is the start screen of the application where the registered users can log into the application by entering their Email ID and password.
2. The application securely verifies the credentials using the APIs from Firebase Authentication and authenticates the user.
3. If the credentials are valid, the user is redirected to the Home Page of the application, otherwise, an appropriate error message is shown.
4. In case the user is not registered, a button redirects the user to the Registration page, where the user can register with the application.

5.1.2 Registration

1. The registration module enables users to create an account in the application by providing their Name, Email ID and password.
2. The Password is validated for security.
3. The application securely verifies the credentials using the APIs from Firebase Authentication and creates an account for the user with a unique user ID.
4. Once the account is created, the user is automatically logged in.
5. In case the user is already registered, an appropriate error message is shown.
6. The user can go back to the login page in case he is already registered.

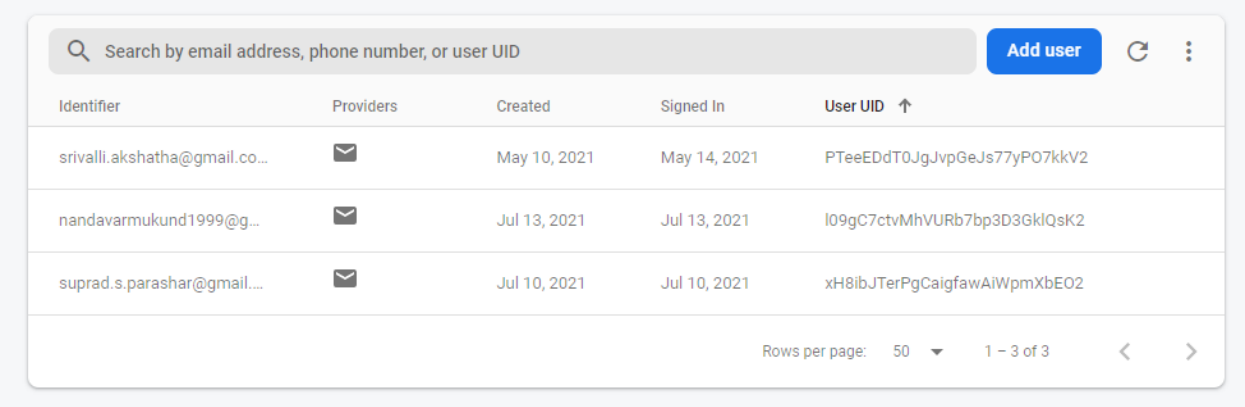

Fig. 5.1 Users

5.2 Scanning

The scanning module deals with scanning reports and prescriptions from an image and converting it into text format.

The scanning module is divided into two major parts –

1. Uploading an image from the gallery
2. Passing the image into the ML Model

5.2.1 Uploading Image

1. The upload button redirects the user to the gallery app using an ACTION_IMAGE Intent.
2. The image selected is selected and redirected to the onActivityComplete method of the Java File.
3. The Blob is then converted into Bytes and the image is retrieved.

5.2.2 Parsing the Image

1. The retrieved image is then passed to an MLKit object.
2. The ML Kit object uses OCR to read the contents of the image.
3. The Object categorises the letters into Blocks, then lines, then words and then finally into letters.
4. The blocks are then arranged to form meaningful data and passed back into the calling Activity.

5.3 Upload

The upload module takes in the document to be uploaded and adds it to the Blockchain. The upload module is mainly divided into 2 parts.

5.3.1 Creating Block

1. The document object passed to the uploader is used to create a Block Object.
2. The block object created is hashed and a Hash for the block is generated.
3. The nonce for each block is calculated such that the hash of the block starts with “abcd”.
4. The hash along with the previous block hash is validated and the Block is passed to the Uploader.

5.3.2 Uploading Image

1. The uploader calls the DatabaseReference object to the path of the users directory in Firebase Database.
2. The blocks are retrieved from the user's blockchain and the block is appended to the existing blockchain.
3. The user is redirected back to the Home Page.

Fig. 5.2 Blockchain

Chapter 6

SYSTEM TESTING

The aim of the system testing process was to determine all defects in our project. The program was subjected to a set of test inputs and various observations were made and based on these observations it will be decided whether the program behaves as expected or not. This Project went through two levels of testing –

1. **Unit Testing** - Unit testing is a level of software testing where individual units/ components of a software are tested. The purpose is to validate that each unit of the software performs as designed. A unit is the smallest testable part of any software. It usually has one or a few inputs and usually a single output. In procedural programming, a unit may be an individual program, function, procedure, etc. In object-oriented programming, the smallest unit is a method, which may belong to a base/ super class, abstract class or derived/ child class. (Some treat a module of an application as a unit. This is to be discouraged as there will probably be many individual units within that module.) Unit testing frameworks, drivers, stubs, and mock/ fake objects are used to assist in unit testing.
2. **Integration Testing** - Integration testing is a level of software testing where individual units are combined and tested as a group. The purpose of this level of testing is to expose faults in the interaction between integrated units. Test drivers and test stubs are used to assist in Integration Testing.
3. **System Testing** - System testing is a level of software testing where a complete and integrated software is tested. The purpose of this test is to evaluate the system's compliance with the specified requirements. System testing is the process of testing an integrated system to verify that it meets specified requirements.

Table 6.1 – System Testing

Functionality	Action	Expected Result	Actual Result	Test Result
Login to the application in the login Screen.	The required details are entered and the login button is clicked.	Redirect the user to the dashboard section	Redirected the user to the dashboard section	PASS
Accept user input to go to the registration page.	The Click to register button is clicked.	The user is redirected to the registration page.	The user is redirected to the registration page.	PASS
Accept User input to create a new User.	The required details are entered and the register button is clicked.	A new user is created and the user is redirected to the login page.	A new user is created and the user is redirected to the login page.	PASS
Display of Latest Activities	No Action Required	The last three activities of the user is shown.	The last three activities of the user is shown.	PASS
Open Different Tabs	Click on different Bottom Navigation bar tabs.	The respective fragments are opened	The respective fragments are opened.	PASS
Display the hospitals in the hospitals tab.	No Action required.	The hospitals are fetched and displayed.	The hospitals are fetched and displayed.	PASS
Open the gallery to choose Picture	Click on upload and any of the upload report or prescription and finally click on open gallery.	The gallery app is opened and an image can be chosen.	The gallery app is opened and an image can be chosen.	PASS
Upload Report/Prescription	Add data manually or upload image from the gallery and click save.	The data is added to the blockchain	The data is added to the blockchain.	PASS

View Reports/Prescriptions	The documents tab is clicked and the Report/Prescription tag is selected and the report/prescription is selected.	The report/prescription is shown in the digital format.	The report/prescription is shown in the digital format.	PASS
Profile Data is displayed	No action Required	The User's Display name and email is shown	The User's Display name and email is shown	PASS
Notifications are shown	A prescription is uploaded.	The user is notified with a push notification reminding the user to take the corresponding medications.	The user is notified with a push notification reminding the user to take the corresponding medications.	PASS
Logout	The logout button is clicked in the profile tab.	The user is logged out and is redirected to the login page.	The user is logged out and is redirected to the login page.	PASS

Chapter 7

SNAPSHOTS

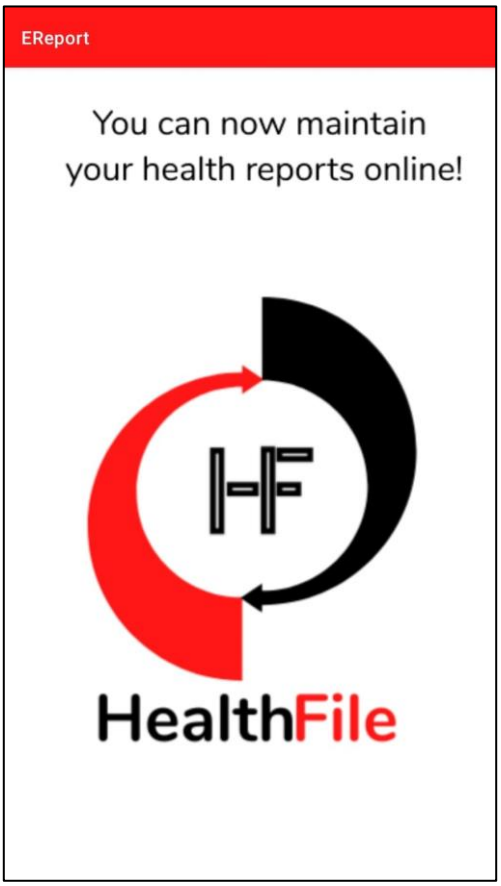

Fig. 7.1 Splash Screen

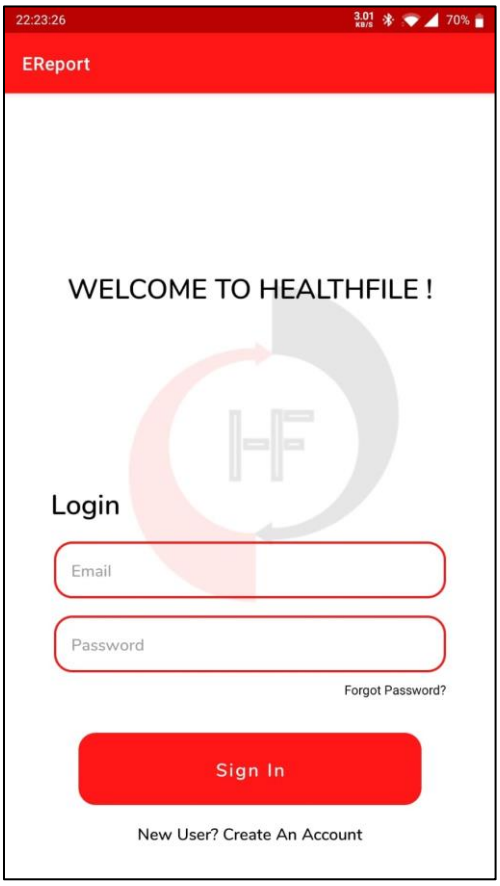

Fig. 7.2 Login Screen

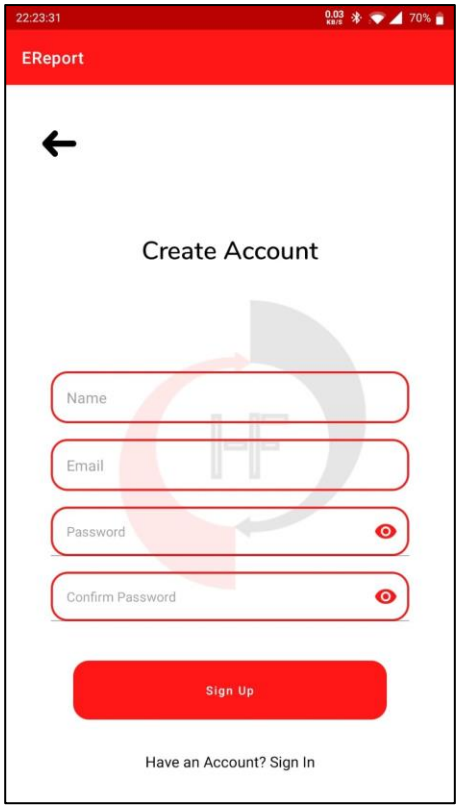

Fig. 7.3 Registration Screen

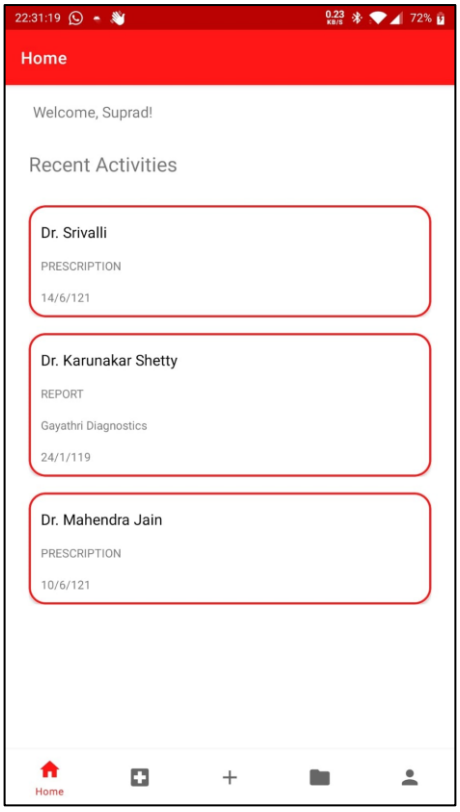

Fig. 7.4 Home Screeen

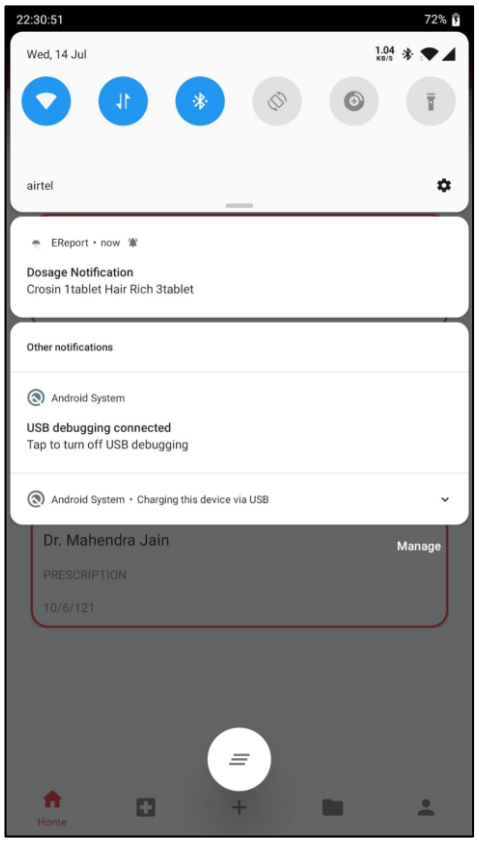

Fig. 7.5 Notification

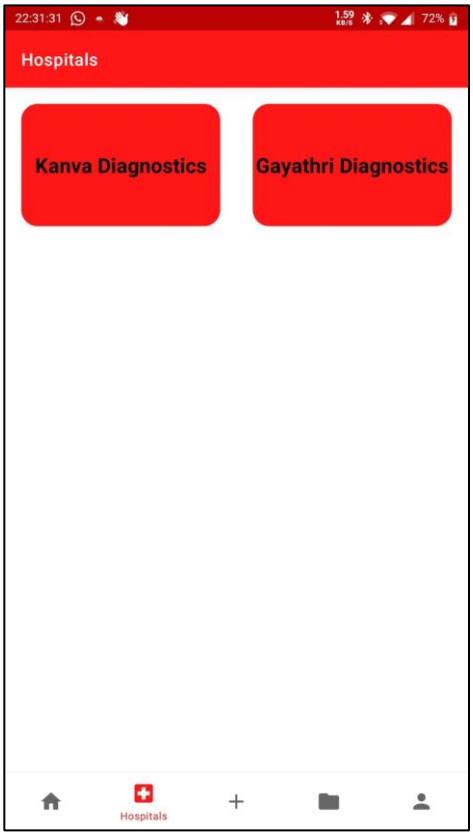

Fig. 7.6 Hospitals Screeen

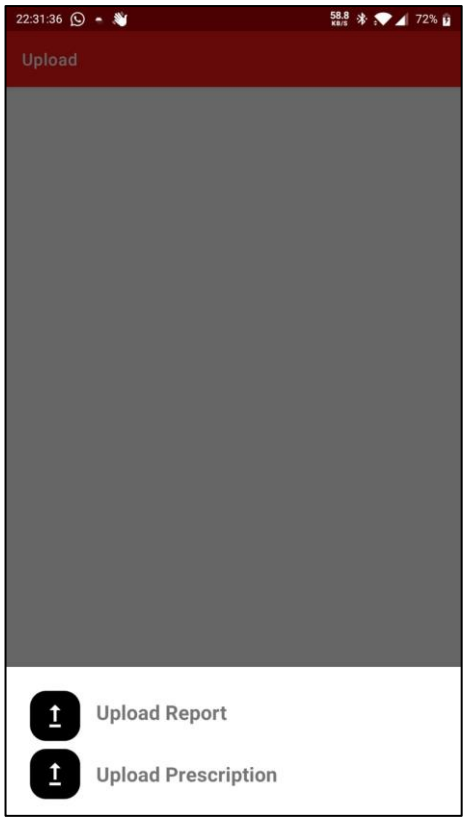

Fig. 7.7 Upload Bottom Sheet View

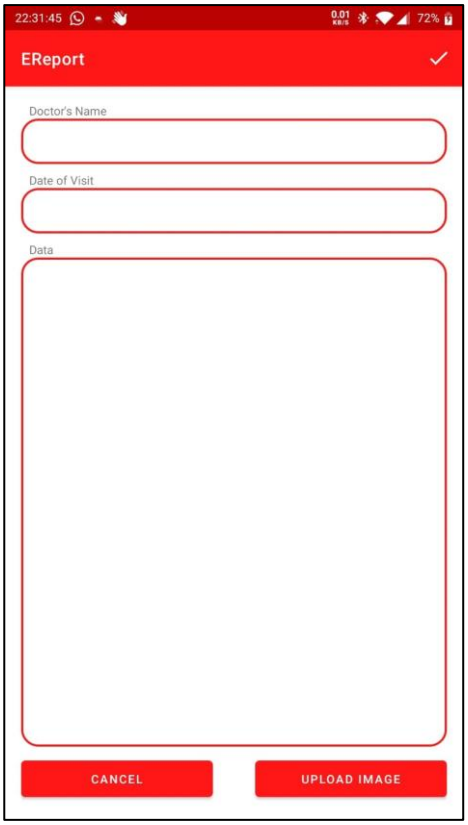

Fig. 7.8 Prescription Upload Screen

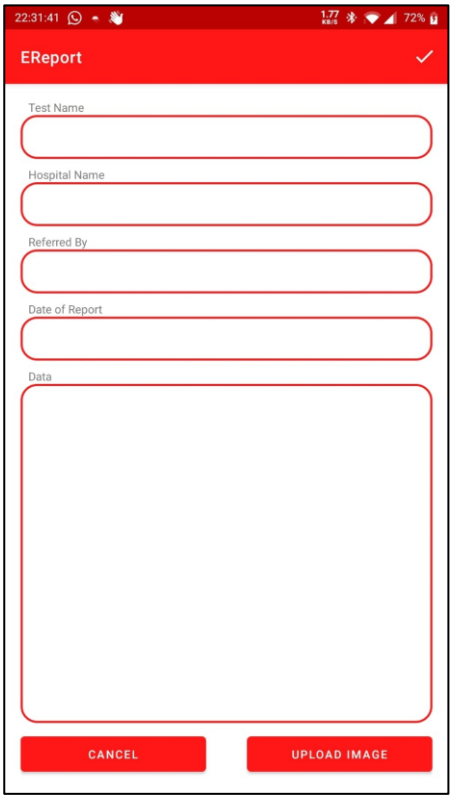

Fig. 7.9 Report Upload Screen

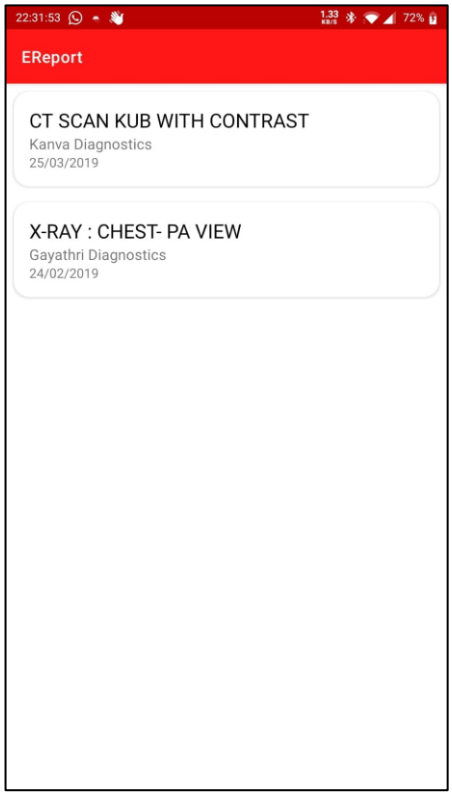

Fig. 7.10 Reports Listview

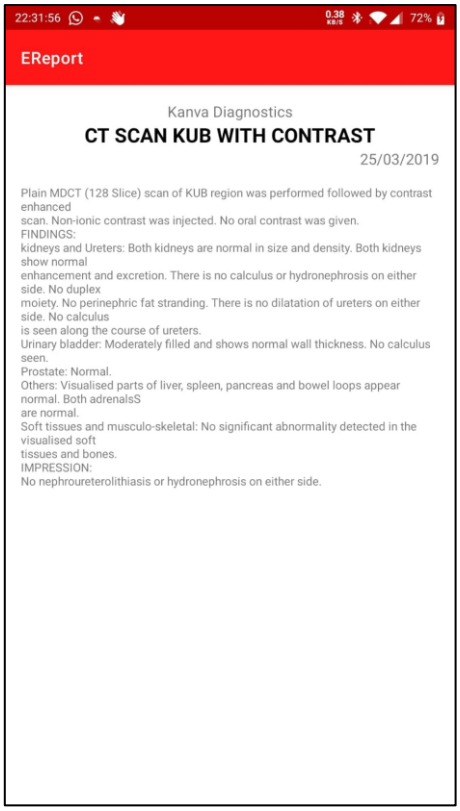

Fig. 7.11 Digital Report

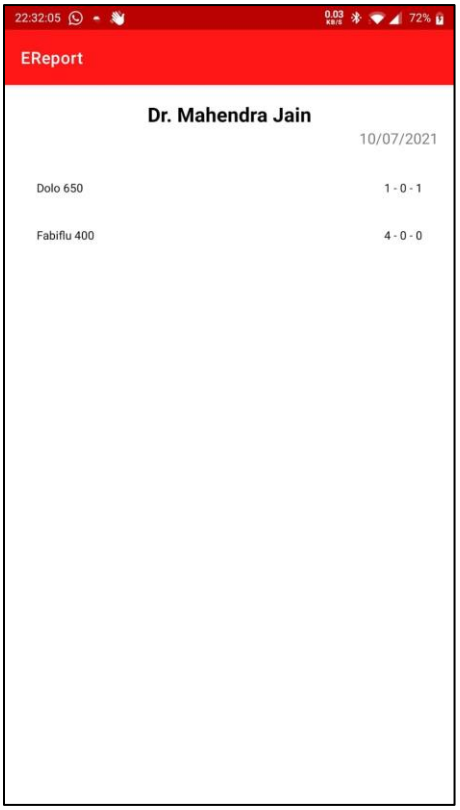

Fig. 7.12 Digital Prescription

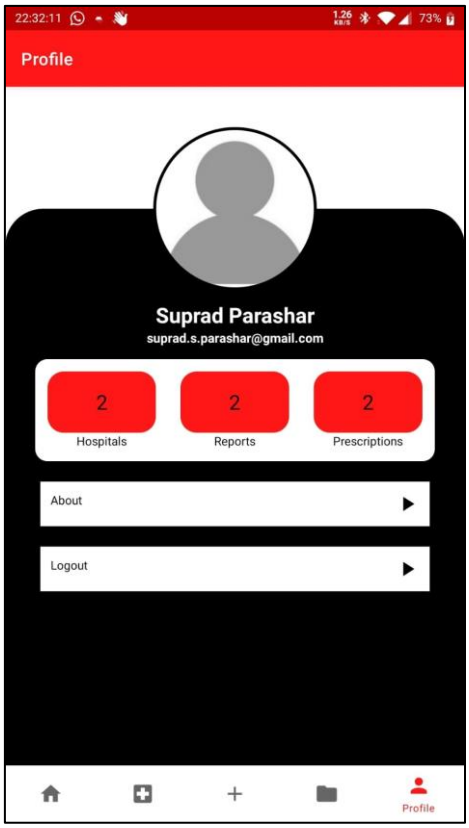

Fig. 7.13 Profile Screen

Chapter 8

CONCLUSION

We propose a health report management system and solve a major problem of the patients who might find it hard to remember and maintain all the reports of the medical tests and the prescriptions. Our application will help both patients and doctors to track and diagnose respectively. Having Electronic Health Records is better in this modern world, as everything seems to be digitized one way or the other.

Advantages/Applications

1. All the previous medical records are maintained online, which facilitates its access for the patients.
2. Once the reports are uploaded manually(pictures), the patients need not store them safely or keep a hard copy; rather the application saves the documents forever in their account.
3. Medical reports and prescriptions are scanned. Important conclusions are extracted and displayed to the user for better understanding and experience.
4. Information is highly secured, immutable and stored on the Blockchain, which makes the application tamper-proof, reliable and trustworthy.
5. Patients are reminded about the medicines that the doctor has prescribed (Prescription analysis).
6. Doctors can view the patients' previous medical history, which makes diagnosis easy. By knowing the previous medical tests, conclusions and doctor's notes, the medication could be given more effectively.

Chapter 9

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