# MEDiBase

*Internet and Web Systems (CSD 402)*

**Hari Sai Raghuram V**

1610110145

**Akhilesh Pothuri**

1610110049

**Rithvik Sallaram**

1610110285

Under the valuable guidance of

## Dr. Dolly Sharma

Asst Professor, Computer Science Dept

# DECLARATION

We hereby declare that the project work titled "MEDiBase" submitted as the coursework for Internet and Web Systems (CSD 402) project work, is a record of original work done by us under the guidance of Dr. Dolly Sharma, Assistant Professor Dept of Computer Science, Shiv Nadar University. We assert the statements made and conclusions drawn are an outcome of our research work. We further certify that

I.   The work contained in the report is original and has been done by us.
II.  The work has not been submitted to any other Institution for any other degree/diploma/certificate in this university or any other University of India or abroad.
III.   We have followed the guidelines provided in writing the report.
IV. Whenever we have used references from other sources, we have given due credit to them in the text of the report and giving their details in the references.

Hari Sai Raghuram V          Akhilesh Pothuri          Rithvik Sallaram

1610110145                    1610110049                 1610110285

# ABSTRACT

Medical Records and Patient History plays an important role in the accurate diagnosis and treatment of a disease. But, maintaining Medical Records is a very difficult and tedious task. Not only patients, but doctors also need to keep track of patient diseases to treat next patients effectively and take preventive measures as required. So, maintaining records is the most crucial part of medical diagnosis, albeit is very difficult to do so.

In the 20th century there has been a significant increase in the number of diseases and the extent to which they become deadly. Due to this fact people are striving to keep their health in check by taking regular health checkups. But this has arisen a serious issue in many countries. People in many developing countries are still illiterate and do not know the significance of keeping medical reports safe. They might forget to store them or lose them in course of time. This is not only the case of illiterate people but also the case of smart and educated people. As human lifespan is very large, maintaining records from the beginning is very hard or close to impossible.

Additionally, people in rural areas are not well versed with maintaining and understanding their medical records. Also, maintaining medical records, history, appointment details and prescriptions is becoming difficult for people with growing responsibilities. So we need a one stop solution to address these problems.

# TABLE OF CONTENTS

# LIST OF FIGURES

# LIST OF SYMBOLS AND ABBREVIATIONS

| EMR | Electronic Medical Records |
| EHR | Electronic Health Records |
| PHR | Personal Health Records |
| SMS | Short Message Service |
| PDF | Portable Document Format |

## INTRODUCTION

With the growing population and increase in demand for medical services, maintaining medical records has become a tedious process. Additionally, people in rural areas are not well versed with maintaining and understanding their medical records. Also, maintaining medical records, history, appointment details and prescriptions is becoming hard for people with growing responsibilities. So we need a one stop solution for this issue.

Although there are some applications which record disease history and some take medical data from the patient himself, none of the application actually record accurate medical records specific to each patient. For this purpose, we propose to build an application which stores all medical records in a cloud database and retrieve them securely when required.

## DEMOGRAPHIC STUDY

We conducted some studies about the medical pattern of patients around the world. We have identified that around 45% of the world population are living in rural areas where the technology has been a step behind. And out of these around 16-17% of the world population are still illiterate. Although 16% may sound like a small number, it accounts to 1.2 Billion people which is a huge number. According to a study, 70% of the population do not maintain all their medical records. Also developing countries in Asia and Africa have the highest percent of people living in rural areas.

According to studies we have found out that 80% of the people around the world use Android Mobile device. As android application would suit most of the users around the world and is easily accessible to people, it would be a good choice of mobile application platform. As 97% of the medical institutions have computers which can handle webpages, a web based application would be a good fit for our use.
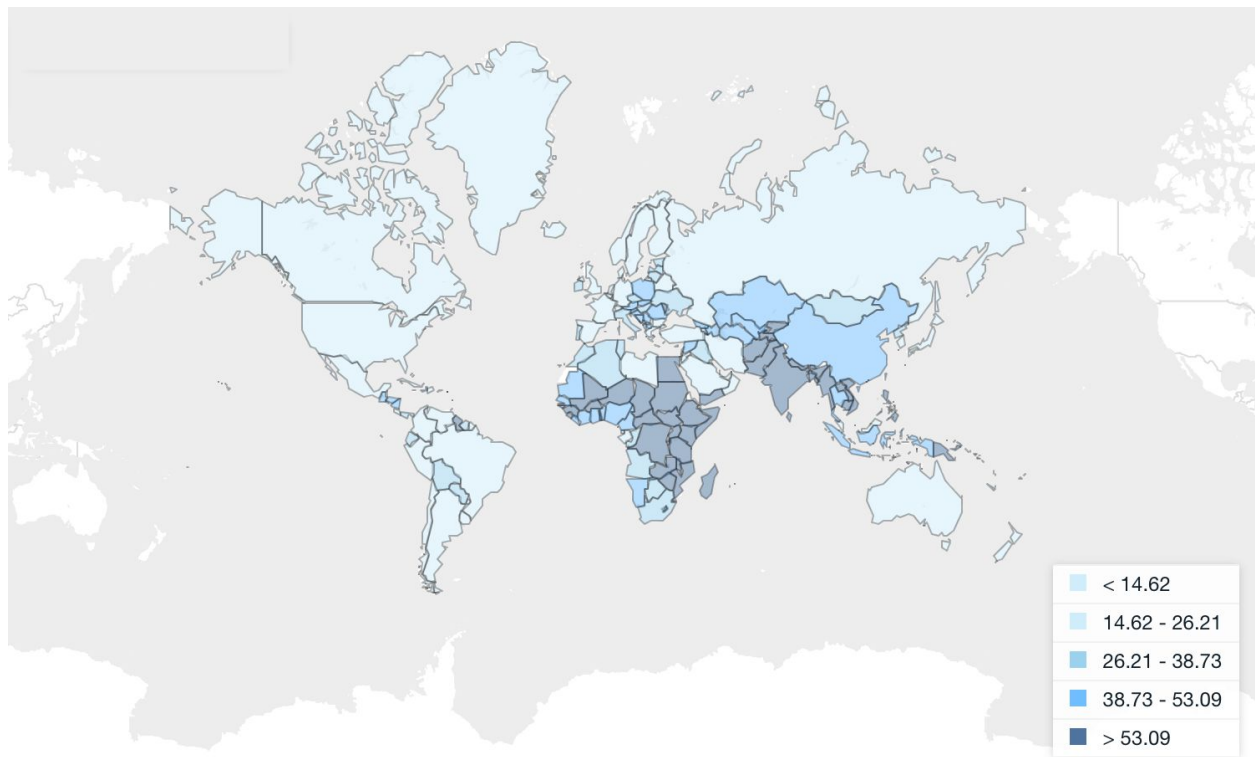
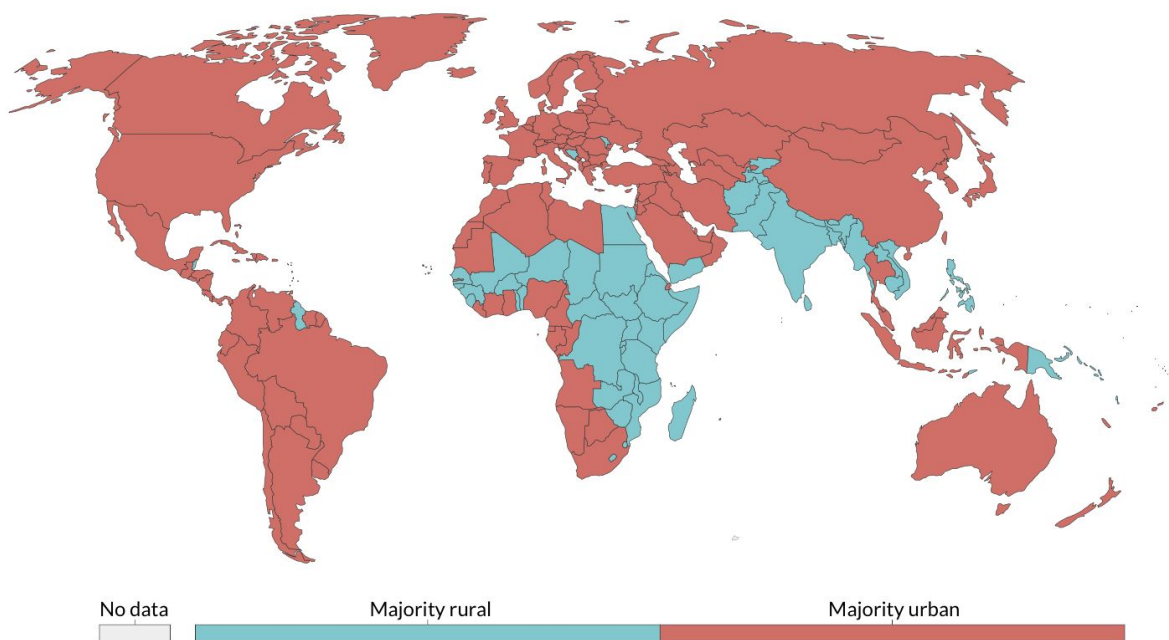Fig 1. Percentage of World Population living in Rural Areas according to world census 2018



Fig 2. Countries having the highest Rural Population around the world

Some EHR/EMR systems were introduced as early as 2000's. There has been a tremendous response from the public regarding these systems. We can see from Fig 3 that the percentage of physicians using these systems have risen from 18% to around 72% in 2012. Also considering the demand for the development of PHR around the world, we can estimate that MEDiBase will attract a large number of people.
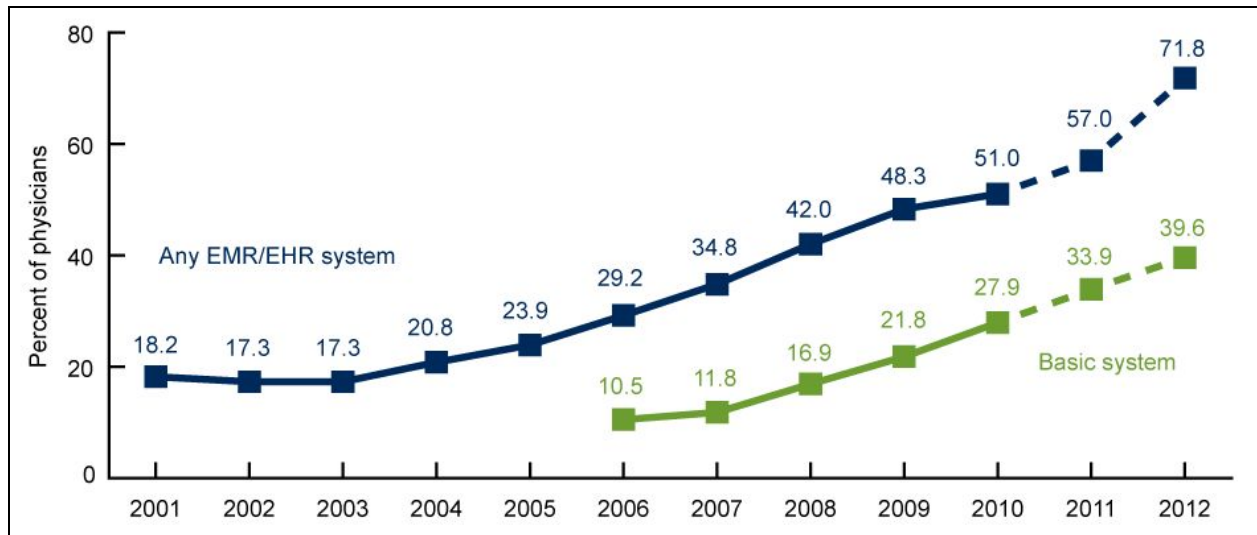


Fig 3. Percent of Physicians using any EMR/EHR systems in USA

## OBJECTIVE

Our main objective is to provide population around the world with a common platform to store all the medical records which can be accessed from anywhere. Another important thing that we need to consider is the security and integrity of the records. As these records consists of sensitive information of the patients, we want to keep these records safe and not fall in the wrong hands. Also the data must be correct and up to date. For this purpose we plan to keep the privileges of editing these records only to recognised and certified doctors and medical institutions. Although our focus is on rural population, we also need to track the needs of other people. For this purpose we plan to provide a mobile application for patients to check their records from time to time.

## MEDiBase - A Deep Insight

As a need to store records accurately and safely, we have introduced MEDiBase, a one stop solution to address all these problems. We have used biometric verification for ease of access for the patients. The biometric used are the facial scans of the patients. We have provided a means to display all records to the doctor on demand. To ensure the security and integrity of records, we have only provided the access to the doctors to add and modify the data. Also to remove unwanted access, we have made sure that doctor's can only access the patient's records in the presence of the patients.

We have also provided a feature which will generate a PDF document of the patient's medical record which provides the doctor with a clear retrospection of the patient's medical history and records. We even have a mobile application for patients with smart phones to lookup their medical records. To enable accessibility to all spectrum of patients, we have enabled SMS alerts for patients.

This application will enable patients to maintain accurate medical data securely. They need not maintain their medical records or remember their medical history. One more advantage of this application is that the patients need not carry their records everywhere and need not worry about them when travelling to a new place. Also, during disasters the patients can be identified easily using their biometrics instead of figuring out their medical history from the beginning. Thus, benefitting the medical practitioners to provide a more accurate diagnosis and treatment to the patients.
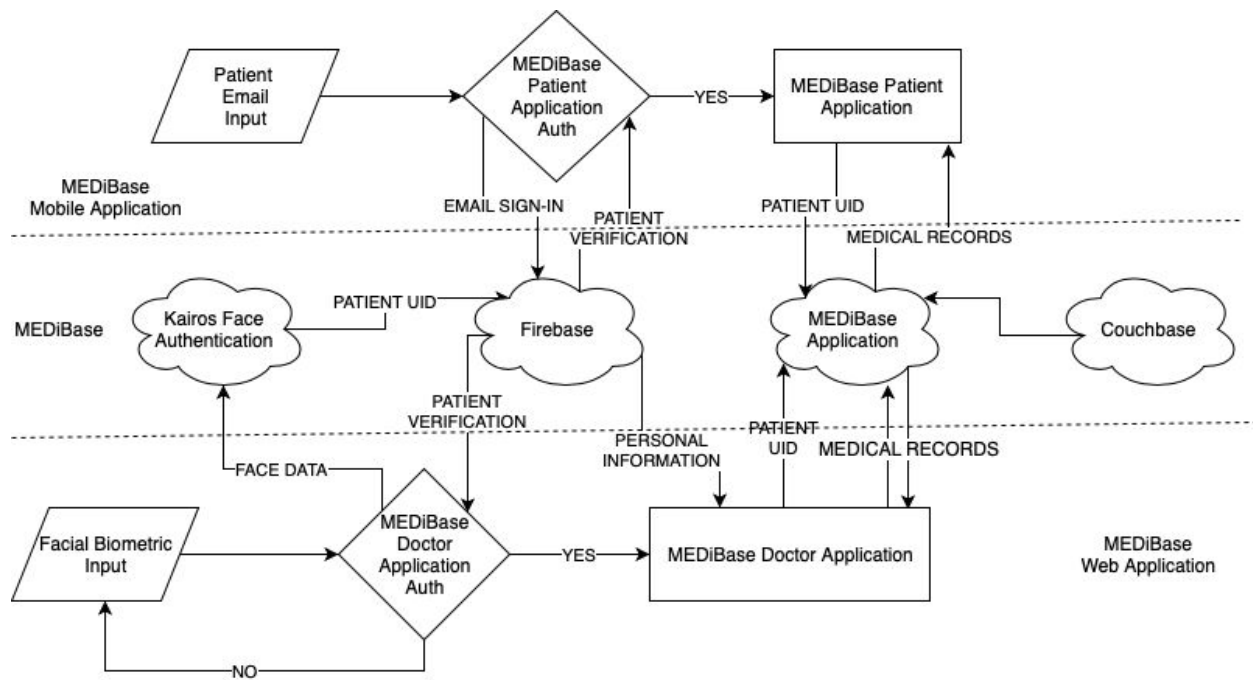
## ARCHITECTURE



Fig 4. Detailed flow of the application

Figure 3 describes the flow of the MEDiBase application. Each Part of the MEDiBase application is described clearly with the boundaries. The Web Application which is used by the medical institutions provide the facial biometric of patients as the input for the Application authenticator which then contacts the Kairos Face Cloud for verification. If the face is verified by Kairos and it returns a Unique Identifier (UID), then the patient records are retrieved from the databases. The UID is used to retrieve the patient personal details from Firebase and medical records from the Couchbase through a backend server.

A similar flow is followed in the mobile application. The only difference is that patients can login using their Google email id provided at the time of registration. And then the same process is used to retrieve medical records and personal information of the patient. Although patients can view their medical records, they cannot make any changes or add new data.

## LOGIN AND AUTHENTICATION TECHNIQUES

### WEBSITE

For the web application authentication we have provided a two-factor login authentication. The first being a valid and recognised medical institution. The second being the particular patient. This technique addresses the disadvantages by using any one of these alone.

The login privileges for the web application are only provided to certified medical institutes and doctors. The doctor can access the website through the credentials provided by their institute. Now the patient needs to provide his biometric details to fetch and provide the doctors with their records. This ensures a safe and secure way to login and avoid medical records being misused.

### FLUTTER

The mobile application is mainly developed for the patients with smartphones to enable them to check their records without visiting the medical institutions. This application only shows the medical records to the patients and does not allow them to make any changes to the records. For this purpose, we have kept the login simple. We have used google sign in for a quick login. If the user is not registered, the mobile app will prompt a null screen and request the user to register through the institute for integrity in the details section.

## DATA STORAGE TECHNIQUES

The data storage is an important part of our application. We have to rely on a fail-safe and secure storage system with high availability. As Centralised and Decentralised databases have their own disadvantages, we have used a hybrid data storage technique that stores important data in distributed database and other high access data in centralised database.

### CENTRALISED STORAGE SYSTEM - FIREBASE

Firebase is a well known cloud based NoSQL database provided by Google. Although this might be a reliable database service with high availability, we cannot store all medical data at a single place as it leads to bottleneck issues and issues related to the security of the data. So we have chosen Firebase to store personal information and low sensitive data on Firebase. This enables us to retrieve the UID of the patient at all times.

### DISTRIBUTED STORAGE SYSTEM - COUCHBASE

Couchbase is a distributed document based NoSQL database. The data stored on this database are stored at that particular nodes and are shared with other nodes when they are available. Although this might seem a problem in the beginning but with time and nodes the data becomes replicated n times with more availability and low latency. This also ensures the security of data.

The records and other medical details of the patients are stored in couchbase. We have separated the personal information, and the medical data in two different databases so as to ensure data security. At times when there is a leak in one of the databases, it won't be possible to access the other database. Both databases can be merged using an encrypted UID, which makes it difficult for anyone to map both the database contents without the encryption key.

## AUTOMATIC REPORT GENERATOR SYSTEM (ARGS)

Doctors sometimes need the detailed summary of patient for later reference. As we cannot allow a doctor to access the patient records without the patient actually being present, we came up with an Automatic Report Generator Systems, abbreviated as ARGS.

All the medical records and history of the patient can be printed in PDF by the doctor for a better understanding of the patient's medical conditions. The PDF will be downloaded in the doctor's system. This would lessen the burden of the patient of carrying all his historical records in hand.

## SMS ALERTS SYSTEM

We as humans, forget many things in this busy world , most of them being our medication schedule and prescription. To address this issue, we have developed an SMS alert system which sends out a reminder message to the patient prior to the medication time or at the beginning of the day. This system is a great advantage for working professionals who are wound in their work and forget about their medication
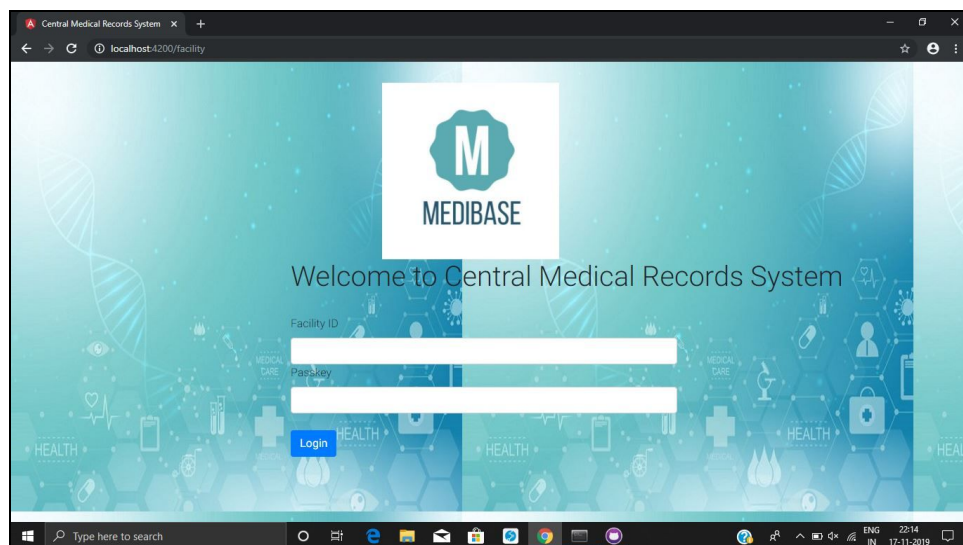
## APPLICATION INSIGHTS AND WORKING SCREENS

### WEB APPLICATION



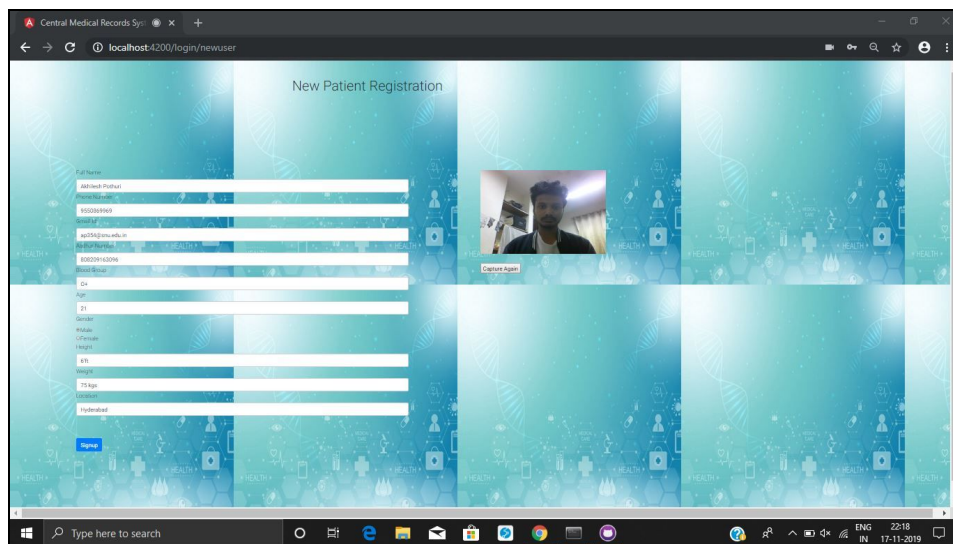Fig 5. Institute Login Page
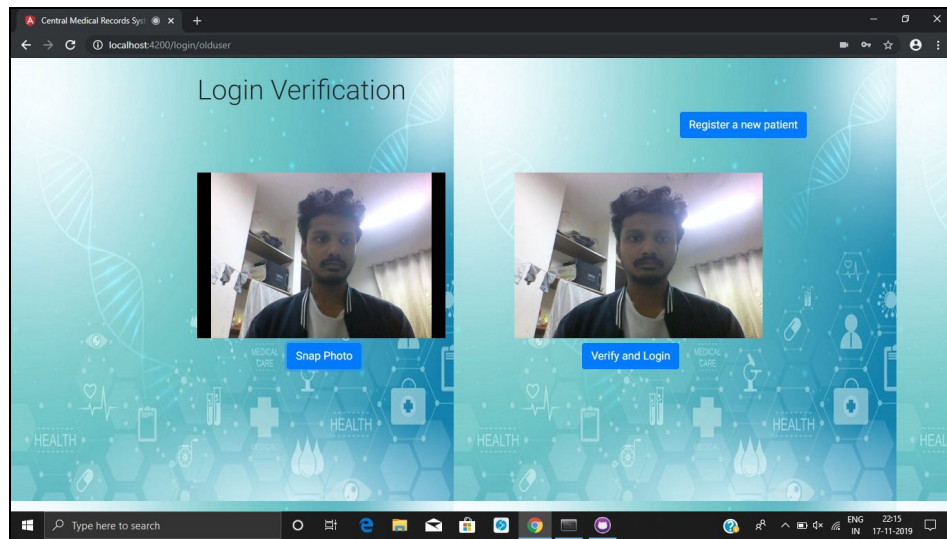
Fig 6. Patient Verification



Fig 7. Register New Patient
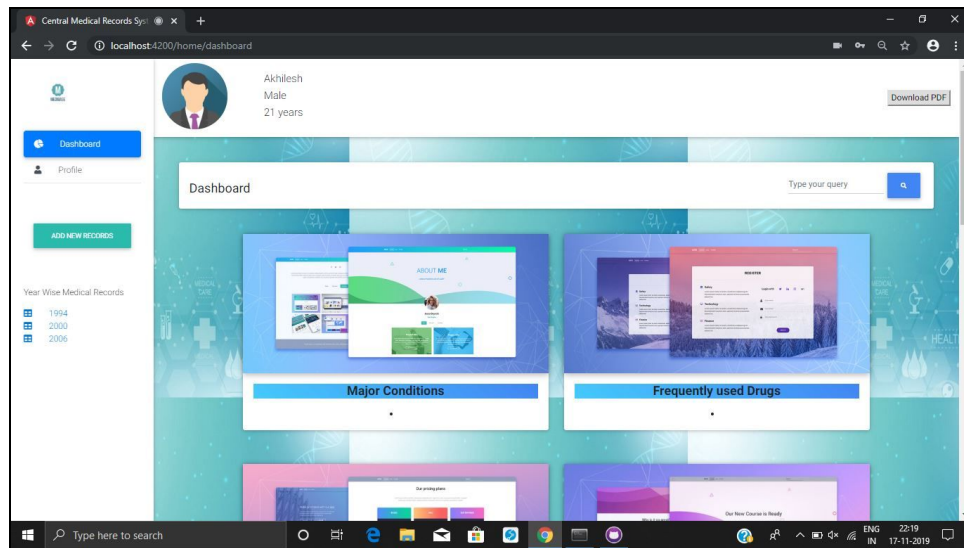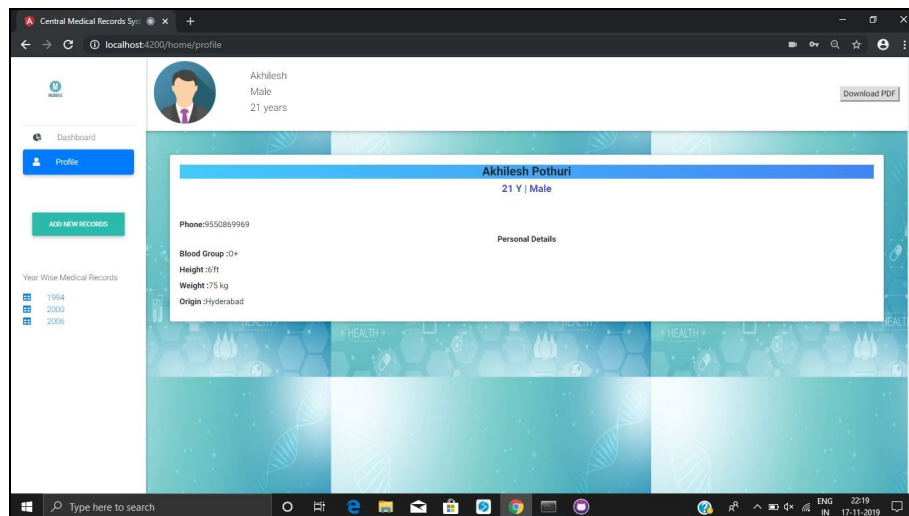
Fig 8. Dashboard



Fig 9. User Profile

Fig 10. Addition of new Medical Records
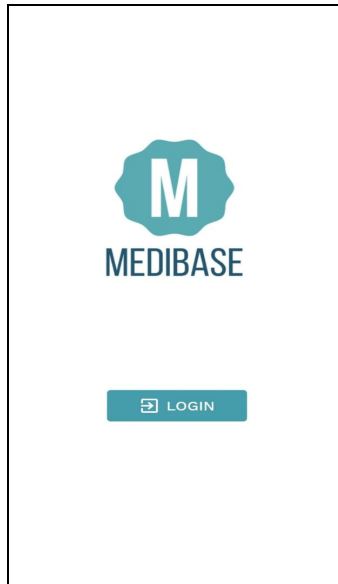


Fig 11. Year Wise Records
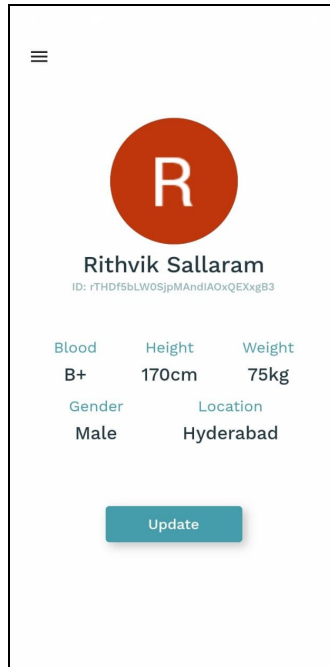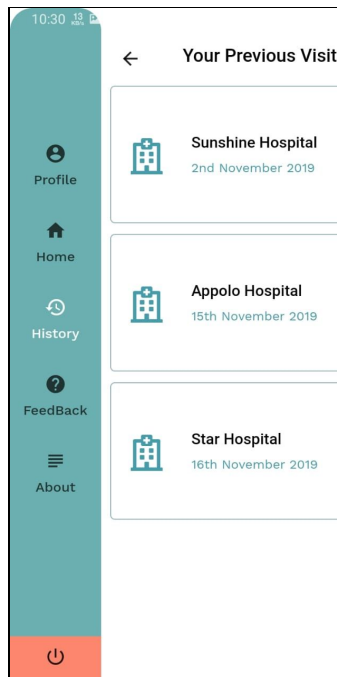
Fig 12. Login Page
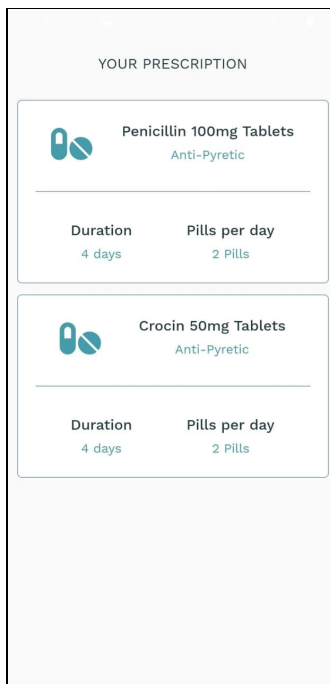


Fig 13. Home Page

Fig 14. Previous Visits



Fig 15. Prescriptions List

## WEBSITE VERSUS MOBILE APPLICATION

The website application is built for the doctors to access patient's medical records when required, with the consent of the patient. Verification of both the doctor and the patient will be required to access the medical records. Doctors will be able to print the patient's medical history for a better understanding of the patient's condition and new medical records, prescriptions for the patient. New Patient registration can only be done in the website application.

The android application is specifically designed for the patient usage. This may only cater the needs of the population who are educated and have a smartphone, but is very useful for patients who do have this facility. Patients can login using their email id mentioned during registration.

## CONCLUSION

Although the project's purpose is to unify various hospitals to follow a system, it can be difficult to convince these huge organizations to hop into a system. On a long term basis the project can be of great benefit to patients switching from one hospital to another as doctors can now have access to the medical history of their new patient within minutes of the patient entering the hospital. To make this possible,  an incentive has to be designed for hospitals to use Medibase. The incentive although cannot be measured quantitatively will grow exponentially as more and more institutes will join in, expanding the database in the system. However the initial period of take off will not be an easy task to achieve.

## NOVELTY

MEDiBase is the first of a kind application focused for all categories and kinds of people in the world. This application is mainly focused for people who are living outside the cities where the technological knowledge among people is mediocre or even less. This application even stands out among its competitors based on the fact that it uses both centralised and decentralised database for storage of the data, thus taking advantage of both kinds of storage.

Although there might be some Medical Records application available in the

market, these applications make use of medical data provided by the patient, which may not be accurate. Some applications record accurate data but are not patient specific. MEDiBase is built on the disadvantages of these applications and is the first of its kind to the best of our knowledge. This application even ensures the uniqueness of data by employing biometrics which is unique for each patient.

## FUTURE SCOPE

Although this application is unique among other medical record applications, this application can be further developed into an even better and optimistic application. Some of the future development features that can be implemented are:

1. **Use Two-phase biometric authentication:** Face authentication can be fooled many times as it only verifies facial features which may be fooled easily. To avoid this we can implement a thumb based authentication also in addition to face data. Both these techniques complement each other can cannot be fooled.
2. **Appointments and Reminders:** We can even implement some additional feature of storing doctor appointments. Lots of people tend to forget their doctor appointment, so we can even send reminders about appointments. This feature can be included in the android application.
3. **Website application for patients:** Right now, patients can only view their records using an android application. For patients who do not have access to an android smartphone need a way to access their records. A Website can be developed for patients to address this issue
4. **Blockchain Technology for Safe Transactions:** Blockchain technology can be implemented to preserve the integrity and provide added security to medical records as the transactions made to the medical data needs to be verified by ledgers. Also Blockchains prevent unwanted access to records

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## APPENDIX

**EMR: Electronic Medical Records**

An Electronic Medical Record is a digitised version of medical records. The EMR represents a medical record within a single medical facility.

**EHR: Electronic Health Records**

Electronic Health Record is an official health record for an individual that is shared among multiple medical facilities. Some countries have started taking incentives to standardise EHR. Examples of the developing EHR systems are Angel Systems and AmkaiSolutions. Although EHR maintain medical records, they

**PHR: Personal Health Records**

Personal Health Records is maintained by the individual to whom this record belongs. Some of the famous PHR systems include Apple Health, Google Health, Microsoft HealthVault and so on.