

Distributed Health Care Framework for Patient Health Record Management and Pharmaceutical Diagnosis

2022-110

Progress Presentation 2
(90% completion)





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- Professor of Forensic Medicine, University of Sri Jayewardenepura, Sri Lanka
- Consultant Judicial Medicine
- He has published more than 150 publications including international and local publications. Won several awards for research and publications including presidential awards in 2014

Team Members



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Introduction



The world is confronting various healthcare issues with the COVID-19 pandemic, and healthcare automation is more crucial than ever.

The pandemic has revealed the limitations of existing digital healthcare systems to handle public health emergencies while maintaining service continuity when people stay at home conducting social distancing.



Research

**Implementing a distributed Healthcare
Framework for Patient Health Record
Management through Electronic Health
Records (EHR) and Pharmaceutical
Diagnosis.**



Background Study



A research was conducted among Medical Practitioners on health care problems confronted by the medical practitioners during COVID-19

<https://forms.gle/xQ4or8naPXzj9Sw69>

"This concept must be there in our health systems. This is efficient, accurate, faster, money-saving and needs less Human Resources. Drawbacks- It can be erased and have problems regarding security. Complex process and need trained personnel. Less privacy."

- Dr. B W B Rathninda (Acting consultant, Radiology, Base hospital Mahiyanganaya) -

"Existing healthcare systems are limited to a few wards. An automated solution is a dire need!"

- Prof Muditha Vidanapathirana (Professor, Forensic Medicine, Teaching hospital, Colombo South) -

"In existing healthcare applications, details are not up to date. It would be good if a system creates to store details of the patients in an automated way, because as a practitioner then we can get patients' details up to date."

- Dr. Renuka Marapana (Registered medical officer, Maliban Rehabilitation Unit - Teaching hospital Karapitiya) -

"In existing healthcare applications, accessibility to the network is a bit difficult in rural settings and introducing an automated solution will be a very appropriate intervention."

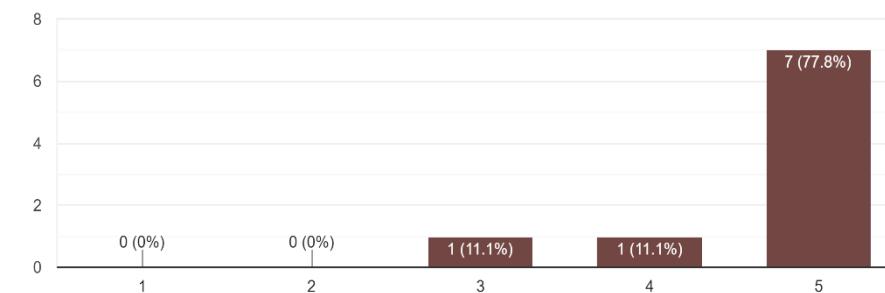
- Dr. Uthpala Muhandiram (Community Medicine, Ministry of Health)-

As healthcare practitioners do you face any healthcare issues during the COVID-19 pandemic?
9 responses



Do you agree that storing, accessing and sharing patient details in electronic format is critical in the occurrence of a pandemic?

9 responses



Research Problem



1

There is no registered population for many health care institution in Sri Lanka, as a result, there is a communication gap resulting in inadequate coordination of care.

2

Electronic Health Record systems are becoming more popular to share patient details between hospitals but accessing scattered data across several EHRs while safeguarding patient privacy remains a challenge.

3

Most of these medical records and documents are in printed format and manually entering those into EHR systems is time-consuming and error prone.

4

Pharmaceutical error is a critical healthcare problem, but it is even riskier to visit doctors for pharmaceutical diagnosis during a pandemic. Healthcare domain is in a need for a conversational agent to give reminders to take medication on time.



Research Gap

Product Name	Securely Store Patient's Data	Access Scattered Data across several EHRs	Scan printed Medical Documents	Drug Identification and give required details(Dosage, Side effects)	Virtual Conversational Medical Chatbot
eHealth 香港特別行政區政府 HKSAR GOVT	✓	✗	✗	✗	✗
EncryptScan	✗	✗	✓	✗	✗
Drugs.com	✗	✗	✗	✓	✗
OXYGEN	✓	✓	✓	✓	✓



Not Present



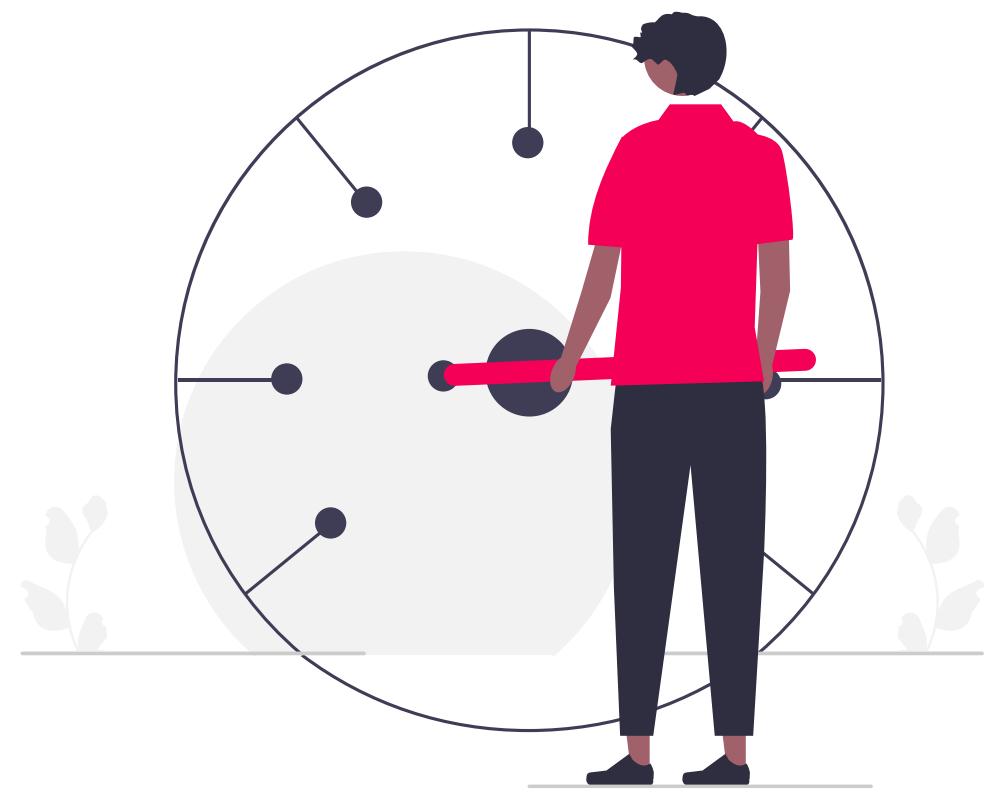
Partially Present



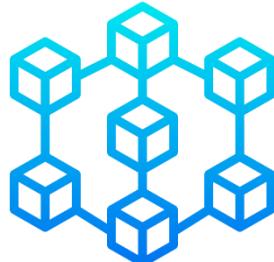
Present

Main Objective

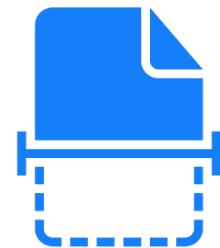
Solving healthcare issues during COVID-19 by providing a healthcare framework for automatically storing patients' records protecting users' privacy while providing healthcare services for people staying at home conducting social distancing.



Sub Objectives



To protect patients' data privacy while tracking/sharing healthcare records with healthcare professionals using Blockchain



To scan and extract relevant data from Patient Clinical Laboratory Reports using Optical Character Recognition and Natural Language Processing while preventing human errors that cause when manually entering data.



To identify Drugs using Image Processing and extracting pharmaceutical data such as its side effects, dosage, etc.



To assist patients with a smart chatbot based on Machine learning and Natural Language Processing for health care assistance

Solution

1

Blockchain component for securely storing and accessing patient data

2

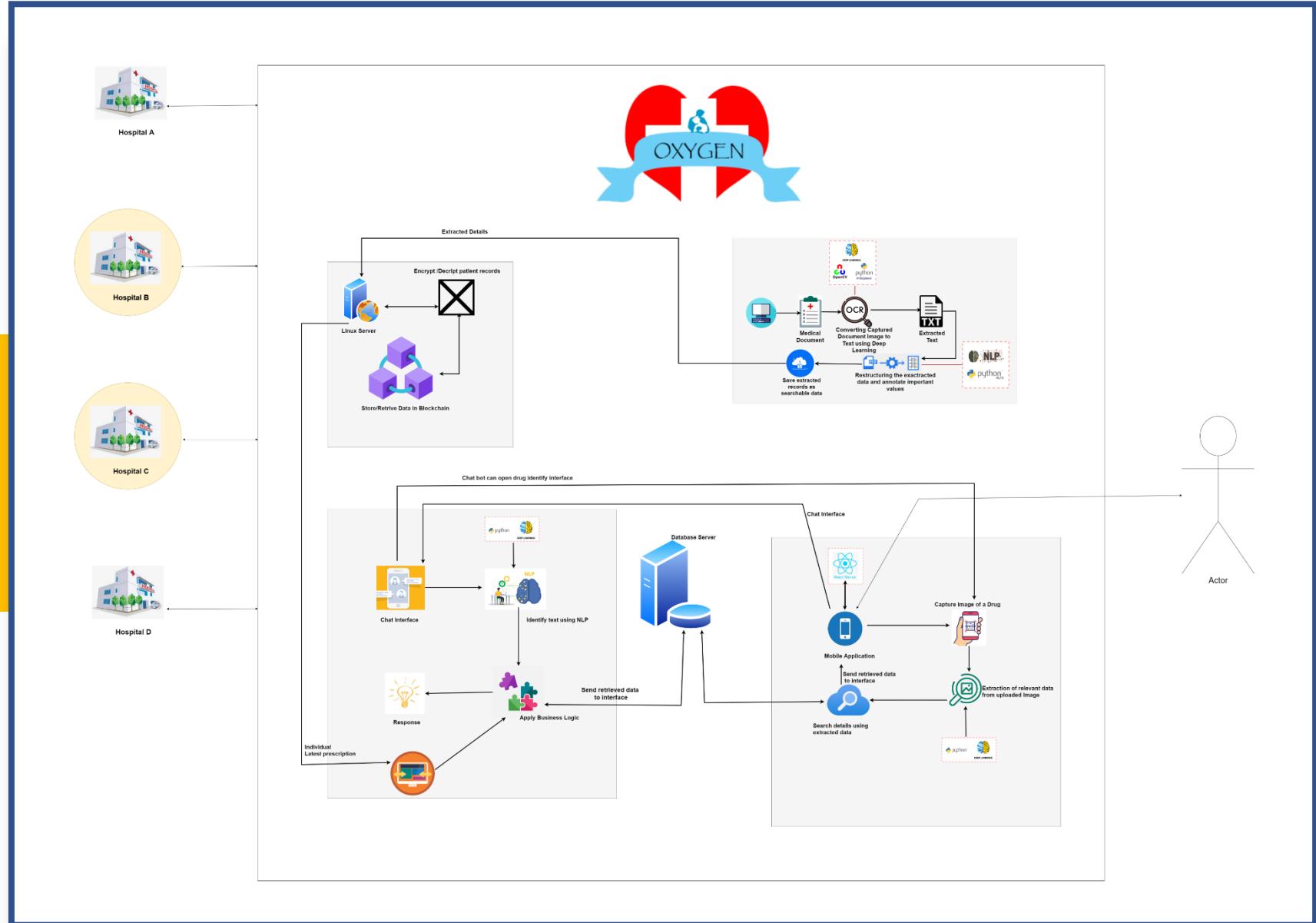
Medical Document Scanner to automatically extract text and important named entities from medical documents using Optical Character Recognition and Natural Language Processing

3

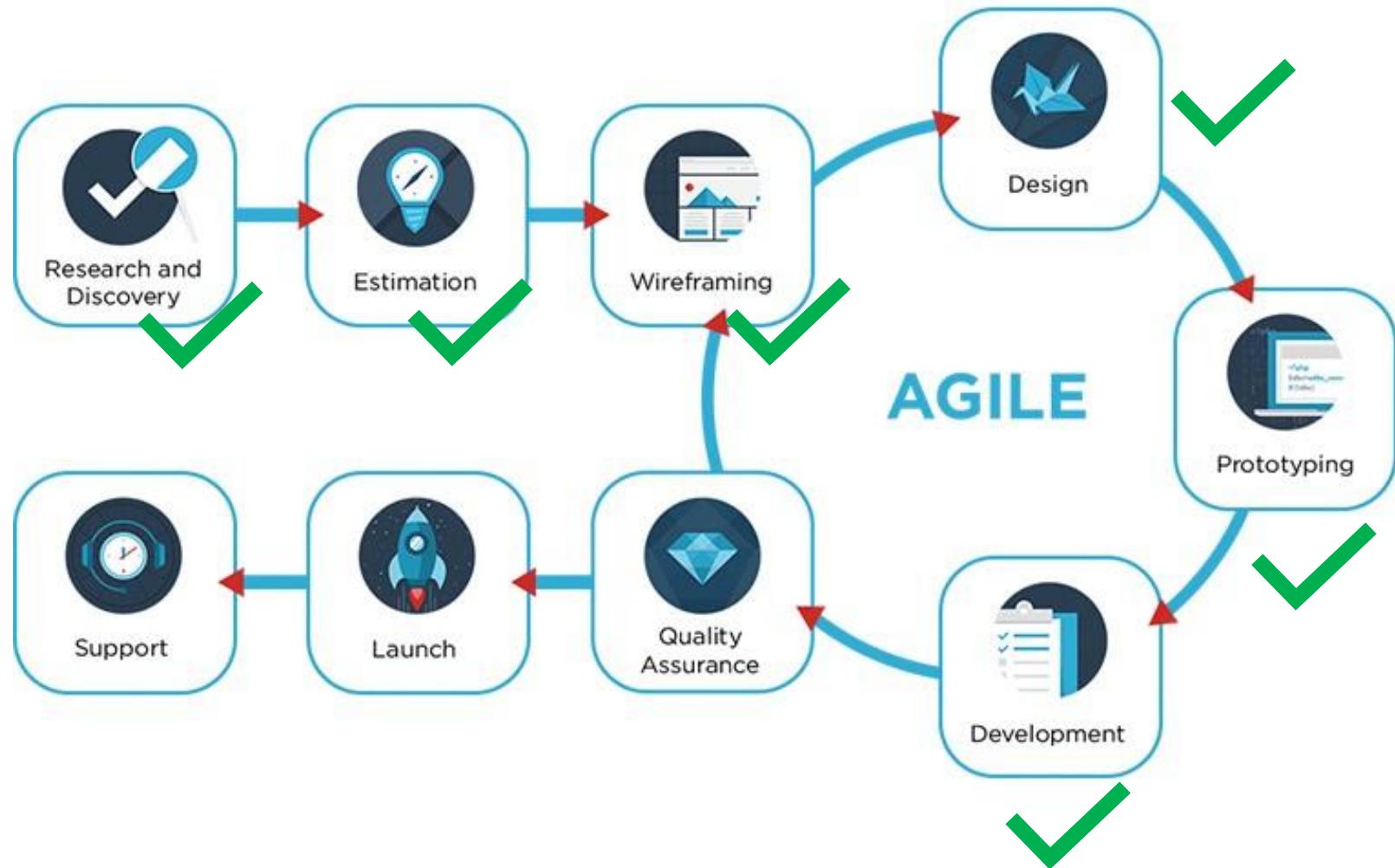
Drug Identifier for Drug Identification while extracting pharmaceutical data using Image Processing

4

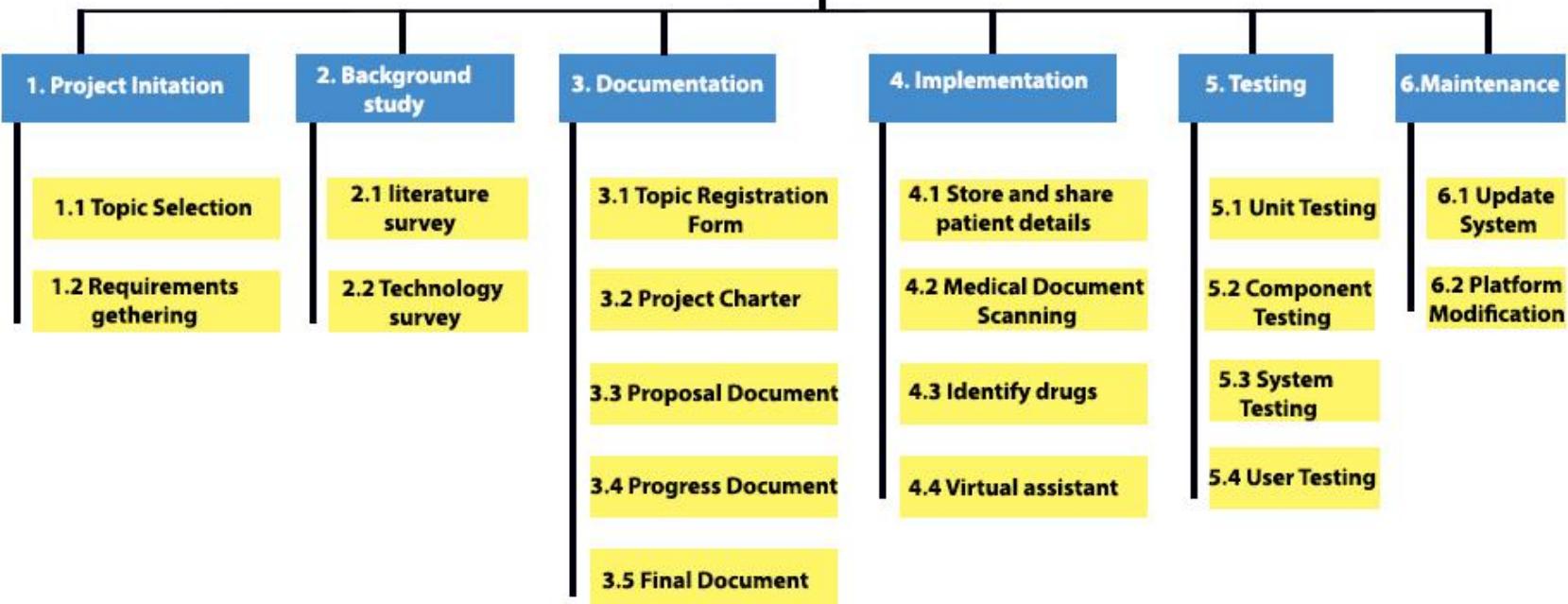
Medical Chatbot for healthcare assistance and for medication reminding using Natural Language Processing



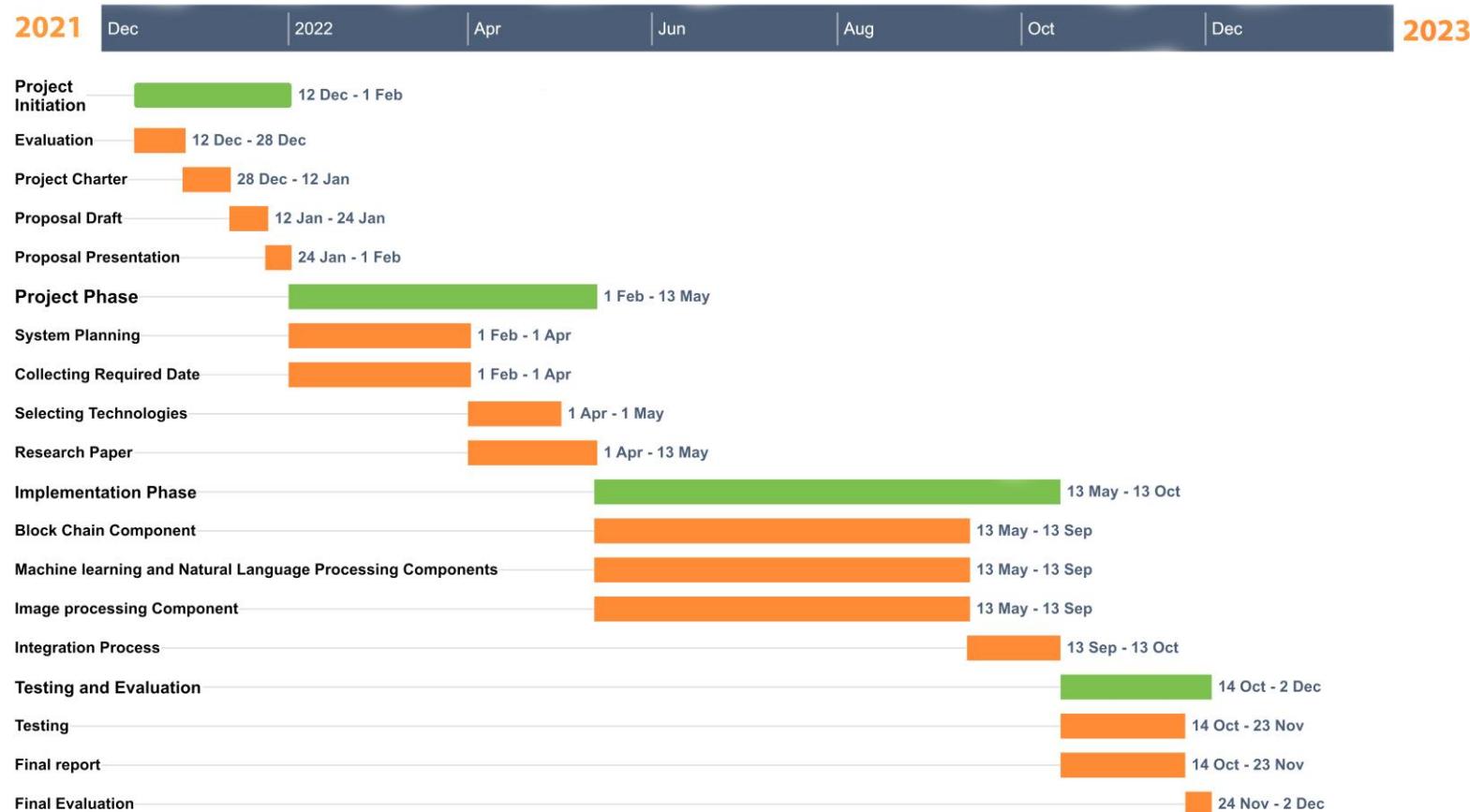
Overall System Diagram



DISTRIBUTED HEALTH CARE FRAMEWORK FOR PATIENT HEALTH RECORD MANAGEMENT AND PHARMACEUTICAL DIAGNOSIS



Work Breakdown Structure



Gantt Chart



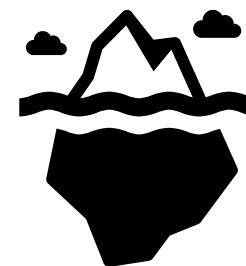
IT19004778 | Wickramarathna W.G.M.S

Bachelor of Science (Hons) in Information Technology Specializing in Software
Engineering



There is no automated method to track patients' medication history

Absence of a secure method to store patient details



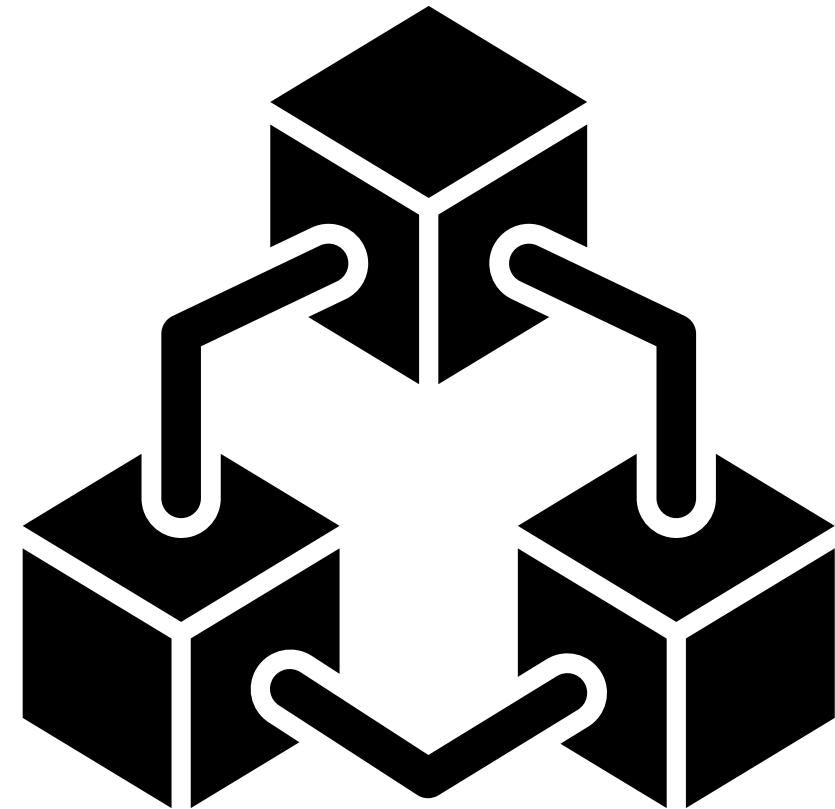
Research Problem

Sharing patient details with authorized people/organizations

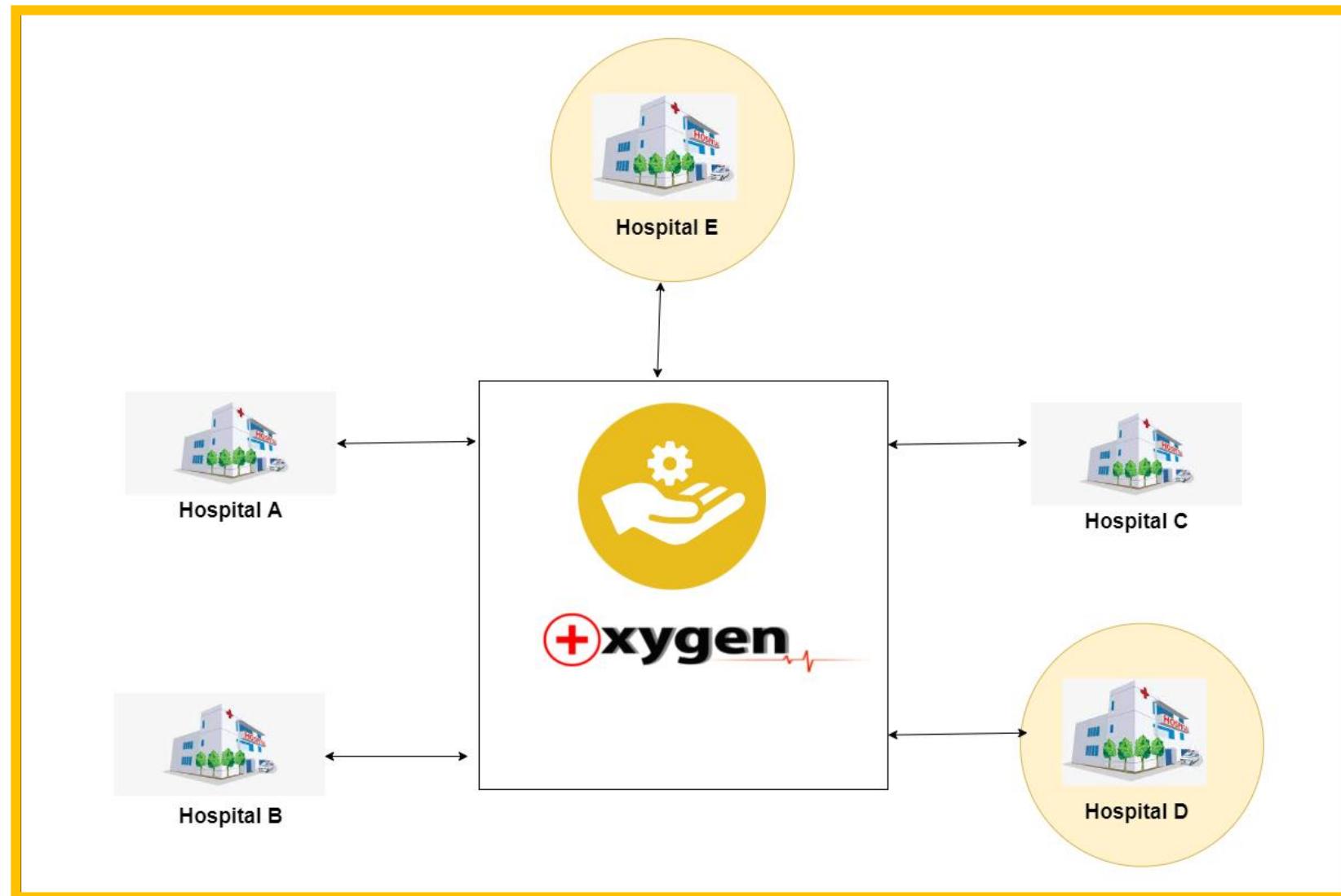
Research Gap



- There is no much health care product on Blockchain technology
- Most previous research work are for the generic usage, but our solution is designed specifically targeting the healthcare domain
- Use of smart contract technology in Blockchain for automating execution.



Research Gap Cont.



Objectives

Main Objective

- To protect patients' data privacy while tracking/sharing healthcare records with healthcare professionals.

Sub Objectives

- Prevent unauthorized access to the system data.
- Use smart contacts to automate the execution
- Prevent unauthorized apply changes to the system data
- Accessible from anywhere



Completion of Project

✓ Smart Contract Deployment

Server is up and running

MongoDB Connection success!

Attempting to deploy from account 0xE84D206CecD4Bd0B493a62BA1DfAb4A2643f9d2D

contract deployed to 0x78B45779734C4c8395d77433Cb904eC7E32cBF56

Address 0xE84D206CecD4Bd0B493a62BA1DfAb4A2643f9d2D

Overview	More Info	More
Balance: 0.144189034824043607 Ether	My Name Tag: Not Available	More

Transactions

Latest 25 from a total of 87 transactions

Txn Hash	Method ⓘ	Block	Age	From ↴	To ↴	Value	Txn Fee
0xc530d10cb9481df705...	0x60B06040	10618173	2 mins ago	0xe84d206cecd4bd0b49...	OUT Contract Creation	0 Ether	0.012302094798 ⚡



Completion of Project



Get Patient Details By NIC

http://localhost:8070/patient/getPatientDetails/025

Save

GET http://localhost:8070/patient/getPatientDetails/025

Send

Params Authorization Headers (6) Body Pre-request Script Tests Settings

Cookies

Body Cookies Headers (8) Test Results

Status: 200 OK Time: 810 ms Size: 1.57 KB Save Response

Pretty Raw Preview Visualize

```
{"basicInformation": {"genaralInformation": {"fName": "amal", "mName": "amal", "lName": "amal", "profilePic": "location", "dob": "2022-01-01", "gender": "male", "maritalStatus": "married"}, "contactDetails": {"mobileNumber": "0775099995", "email": "abc@gmail.com"}, "emergencyContact": {"mobileNumber": "0775099995", "homeNumber": "0775099995"}, "otherInformation": {"height": "123", "weight": "25", "bloodGroup": "b"}}, "prescriptions": [{"doctorName": "prescription 01", "date": "2022/01/01", "summary": "medication summary", "comment": ""}, {"doctorName": "prescription 02", "date": "2022/01/01", "summary": "medication summary", "comment": ""}], "vaccinationDetails": [{"vaccineName": "vaccine 01", "date": "2022/01/01", "placeOfVaccination": "Kandy", "batchNumber": "001", "dose": "1", "time": "9.20 am", "comment": "vaccine 01"}, {"vaccineName": "vaccine 01", "date": "2022/01/01", "placeOfVaccination": "Kandy", "batchNumber": "001", "dose": "1", "time": "9.20 am", "comment": "vaccine 01"}], "AllergiesDetails": [{"date": "2022/01/01", "comment": "Allergic data"}, {"date": "2022/01/01", "comment": "Allergic data"}], "detailsOfMedicalDocuments": [{"documentName": "name_date", "location": "./ac/"}], "chronicDeseasesDetails": [{"identifiedDate": "2022/01/01", "Disease": "Disease 01", "level": "level"}, {"identifiedDate": "2022/01/01", "Disease": "Disease 01", "level": "level"}]}
```



Completion of Project



Add New Patient Record

POST ▼ http://localhost:8070/patient/add Send ▼

Params Authorization Headers (8) **Body** ● Pre-request Script Tests Settings Cookies Beautify

none form-data x-www-form-urlencoded raw binary GraphQL JSON ▼

```
1 "nic": "026",
2 "data": {
3   "basicInformation": {
4     "genaralInformation": {
5       "fName": "amal",
6       "mName": "amal",
7       "lName": "amal",
8       "profilePic": "location",
9       "dob": "2022-01-01",
10      "gender": "male",
11      "maritalStatus": "married"
12    },
13    "contactDetails": {
14      "mobileNumber": "0775099995",
15      "email": "abc@gmail.com"
16    },
17    "emergencyContact": {
18      "mobileNumber": "0775099995",
19      "homeNumber": "0775099995"
20    }
}
```

Completion of Project



Transaction Status

Completion of Project



Status in ledger

Overview State

② Transaction Hash: 0x93d50f882d072132b6251221f2bff91ac66f19d16cfecb927d7bc11c74f6f2b1f ⓘ

② Status: Success

② Block: 10618209 5 Block Confirmations

② Timestamp: 1 min ago (May-04-2022 03:32:52 PM +UTC)

② From: 0xe84d206cecd4bd0b493a62ba1dfab4a2643f9d2d ⓘ

② To: Contract 0x1d8d0b2701235c30fbe875f01f7fce593112850 ⓘ

② Value: 0 Ether (\$0.00)

② Transaction Fee: 0.062123373496767744 Ether (\$0.00)

② Gas Price: 0.000000023813883636 Ether (23.813883636 Gwei)

② Gas Limit & Usage by Txn: 2,608,704 | 2,608,704 (100%)

② Gas Fees: Base: 21.313883636 Gwei | Max: 47.294833756 Gwei | Max Priority: 2.5 Gwei

② Burnt & Txn Savings Fees: ⚡ Burnt: 0.056601613496767744 Ether (\$0.00) 💸 Txn Savings: 0.06125484850184448 Ether (\$0.00)

② Others: Txn Type: 2 (EIP-1559) Nonce: 84 Position: 9

② Input Data:

```
0x511DAxIiwlZGF02S16TjIwMjIvMDE1LCJwbGfJZU9nVmFjY2luYXRpB24l01JLYW5keSISimJhdGNoTrVtYmVyIjo1MDAxIiwlZG9zS16TjE1LC38aW11Ijoi054yMCBhSISiNvbw11bnQ1o132YWNjaW51IDAxIn0seyj2YWNjaW51TmFtZS16InZhY2NpbmUgMDE1LC3kYXR1Ijo1MjAyMi8wMS8wMSIsInBsYwN1T2ZWYwNjw5hdG1vb1t6tktbmR51iwiYmF0v2hodw11ZXt1o1IwMDE1LC3kb3N1IjoiMStsInRpbwU1o1TS1jIwIGfTIiwiY29tbWVudCI6InZhY2NpbmUgMDE1fV0sIkFsbGVyZ21lc0RldGpbHM1o17ImRhGU1o1IyMDTyLzAxIiwiY29tbWVudCI6IkFsbGVyZ21jIGRhGEifSx7ImRhGU1o1IyMDTyLzAxIiwiY29tbWVudCI6IkFsbGVvZ211TGRhdGEifV0sImRldGfbHNP2k11ZG1tYwxEb2N1bWVudHM1o17ImRvY3VtZw50TmFtZS16In5hbWfZGF0ZStsImxvY2F0aW9uT1o1
```

View Input As ▾



Problems Encountered

↑ INFURA

Dear Infura User,

If you access the Optimism and Arbitrum networks on the Infura platform, please read this notice carefully.

Following the Ethereum Merge, all testnets except for Goerli and Sepolia will be deprecated. For more information on the Ethereum Foundation's planned testnets deprecation, visit [this link](#).

In line with the above changes, the Layer 2 network, Optimism, will be deprecating their Kovan testnet and Infura will deprecate the Optimism Kovan endpoints on October 5th 2022. Users should therefore migrate to the active Optimism Goerli testnet (<https://optimism-goerli.infura.io/v3/API-KEY>) as soon as possible, to avoid any disruption.

Also in response to the Merge activities above, the Layer 2 network, Arbitrum, will be deprecating their Rinkeby testnet. Infura will, in turn, deprecate the Arbitrum Rinkeby endpoints on October 5th 2022. Again, users should migrate to the active Arbitrum Goerli testnet (<https://arbitrum-goerli.infura.io/v3/API-KEY>) as soon as possible, to avoid any disruption.

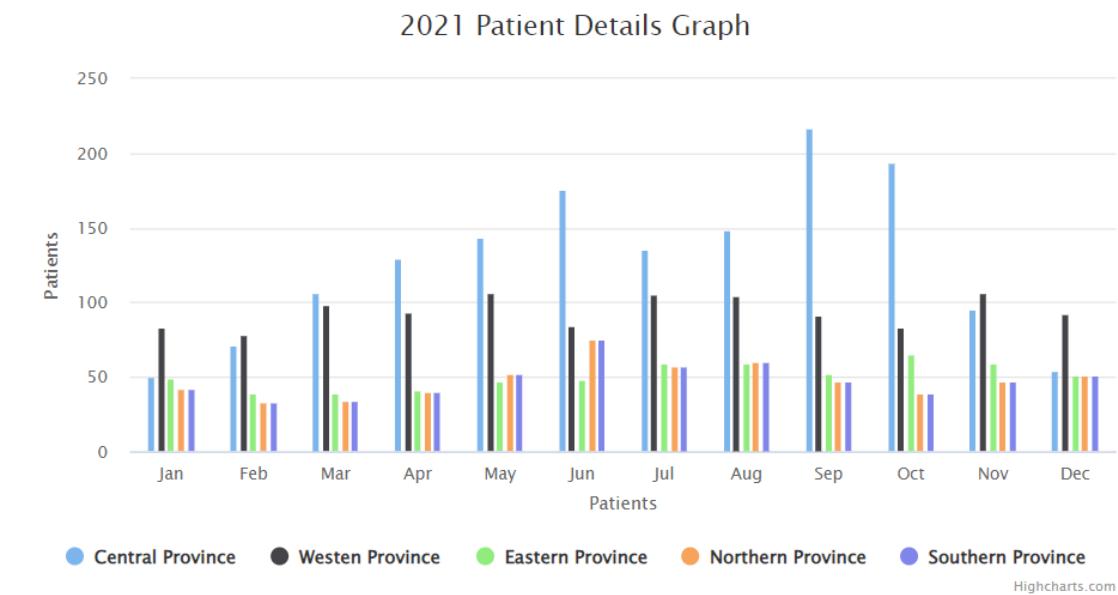
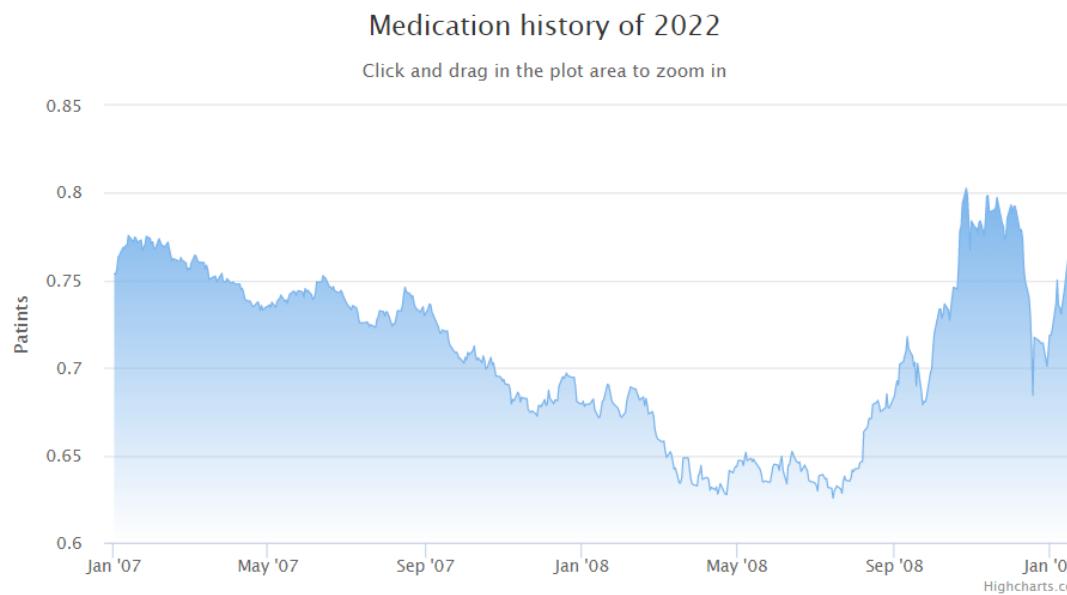
Thank you and please follow us on [Twitter](#) for further reminders or updates.



Developed Interfaces

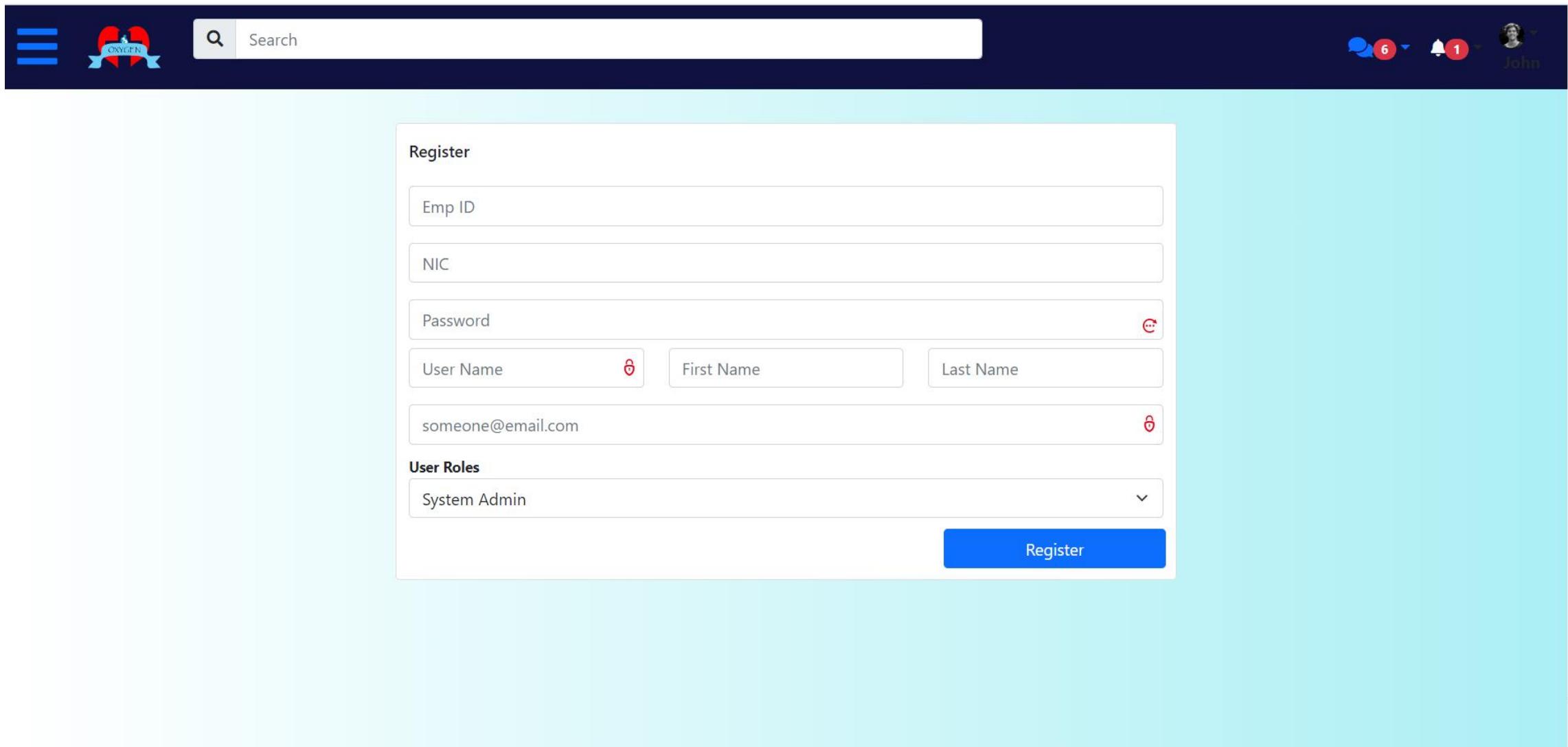


Dashboard





Developed Interfaces



Search

John

6

1

Emp ID

NIC

Password

User Name

First Name

Last Name

someone@email.com

User Roles

System Admin

Register



Developed Interfaces

The screenshot shows a web-based application interface for managing prescriptions. At the top, there is a dark header bar with a navigation menu (three horizontal bars), a search bar containing the placeholder "Search", and a user profile section showing a blue heart icon with "OXYGEN" text, a notification badge with the number "6", a bell icon with a "1", and a user profile picture labeled "John".

The main content area has a light blue background and features a white card titled "Add New Prescription". Inside this card, there is a form for entering prescription details. The form includes:

- A text input field for "Patient's NIC ex:962212441V".
- Three rows of input fields for "Medicine Name", "Note For Medicine", and "hours".
- A text input field for "Special Note" with a large text area below it.
- A row of five small circular icons, likely for navigating between pages or steps.
- A prominent blue "Upload" button at the bottom right.

Developed Interfaces

How Role Based Access
control works

Admin

-  Main dashboard
-  Add Users
-  View Patient Details
-  Document Scanner
-  Diabetic prediction
-  International
-  Partners
-  Calendar
-  Logout

Doctor

-  Main dashboard
-  Add Patient Details
-  Add Prescription
-  View Patient Details
-  Document Scanner
-  Diabetic prediction
-  International
-  Partners
-  Calendar
-  Logout

Lab Assistant

-  Main dashboard
-  View Patient Details
-  Document Scanner
-  Diabetic prediction
-  International
-  Partners
-  Calendar
-  Logout



Developed Interfaces

The screenshot shows a web-based application interface for managing prescriptions. At the top, there is a dark header bar with a navigation menu icon, a search bar containing the placeholder "Search", and a user profile icon for "John". To the right of the header, there are notification icons for messages (6) and notifications (1). The main content area has a light blue background and features a white card titled "Add New Prescription". Inside the card, there is a placeholder text "Patient's NIC ex:962212441V". Below this, there are three rows of input fields for medicine details. Each row contains a "Medicine Name" field, a "Note For Medicine" field, and a "hours" field. Below these rows is a "Special Note" section with a large text input field. At the bottom of the card, there is a blue "Upload" button followed by five small circular icons.

Developed Interfaces



Basic Information

First Name	Middle Name	Last Name
Alex	Alex	Smith
Date Of Birth	Gender	Marital Status
mm/dd/yyyy	Male	Single
NIC		
962212441V		
Address		
216/1 Kandy		
Blood Group	Emergency Contact Number	
AB+	0775099995	
Height	Weight	
185cm	75KG	

Vaccination Details

Allergies Details

Chronic Diseases Condition

Upload

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Developed Interfaces



Screenshot of a patient management application interface.

The main menu bar includes:

- Three horizontal bars icon
- Oxygen logo
- Search icon and "Search" input field
- Notifications: 6 messages and 1 notification
- User profile: John

The main content area shows sections for:

- Basic Information:** NIC: 973121510V, Name: Janith, Date Of Birth: 2022-10-04
- Last Medication Details:** Placeholder for adding new details.
- Vaccination Details:** Placeholder for adding new vaccine details.
- Allergies Details:** Placeholder for adding new allergies.
- Diseases Condition:** Placeholder for identifying diseases.

A modal window titled "Patient Information" is open, displaying the following details:

First Name: Janith	Middle Name: Chathuranga	Last Name:
Date Of Birth: 2022-10-04	Gender: Male	Merital Status: Single
NIC: 973121510V	Address:	
Emergency Number:	Blood Group: B+	
Height: 160	Weight: 88	

Patient Information

Janith

Chathuranga

Male

Single

973121510V

Address: [Empty]

Blood Group: B+

Height: 160

Weight: 88

Add New Vaccine Details

Add New Allergy

Add New Disease

Developed Interfaces

NEW!



Word suggestion Model:

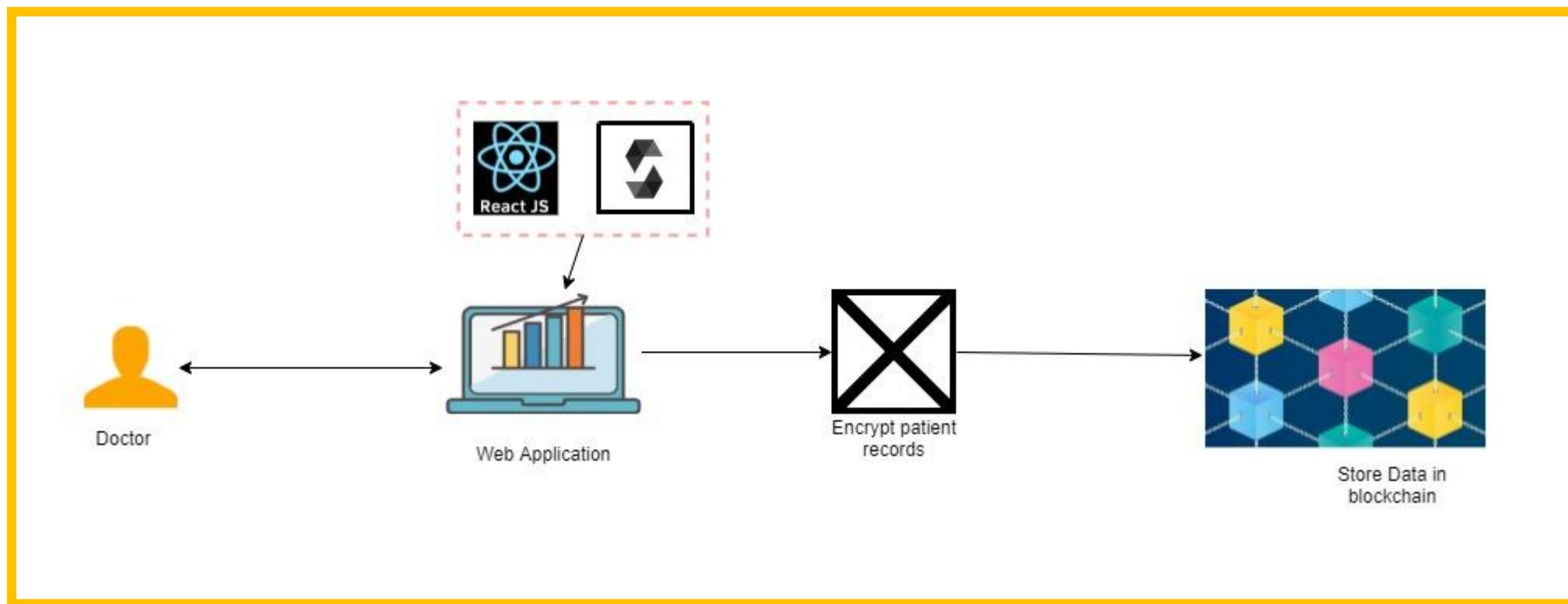
Developed as per the suggestions from the panel during the PP1

The screenshot shows a user interface for managing prescriptions. At the top, there's a dark header bar with a menu icon, a search bar containing "Search", and a user profile for "John". Below the header is a light blue main area. In the center, there's a form titled "Add New Prescription" with a patient ID "962212441v". The form contains three rows of prescription details:

Vitamin C	After eat	8
Vitamin D	After eat	8
Pendol	After eat	8

Below the rows, there's a note: "Should take the blood report". Underneath the note is a text input field with a blue border containing the placeholder text "The patient is identified a|". At the bottom of this field are five small circular buttons with the words "or", "with", "and", "against", and "mutations". At the very bottom right of the form is a blue "Upload" button.

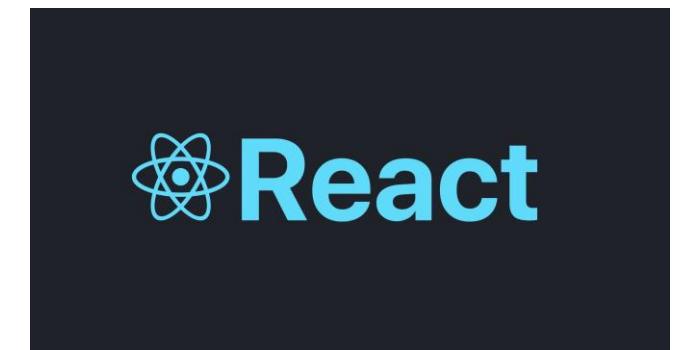
System Diagram



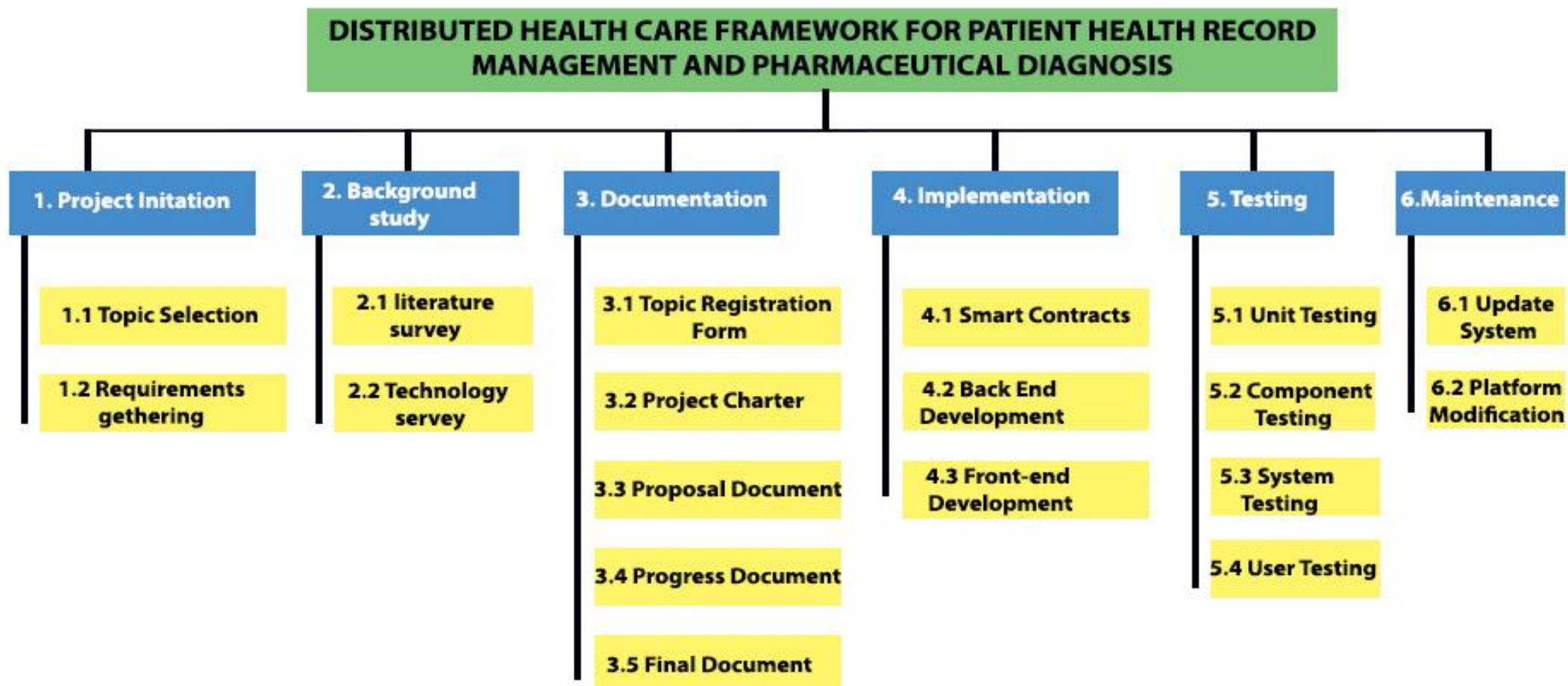
Tools and Technologies



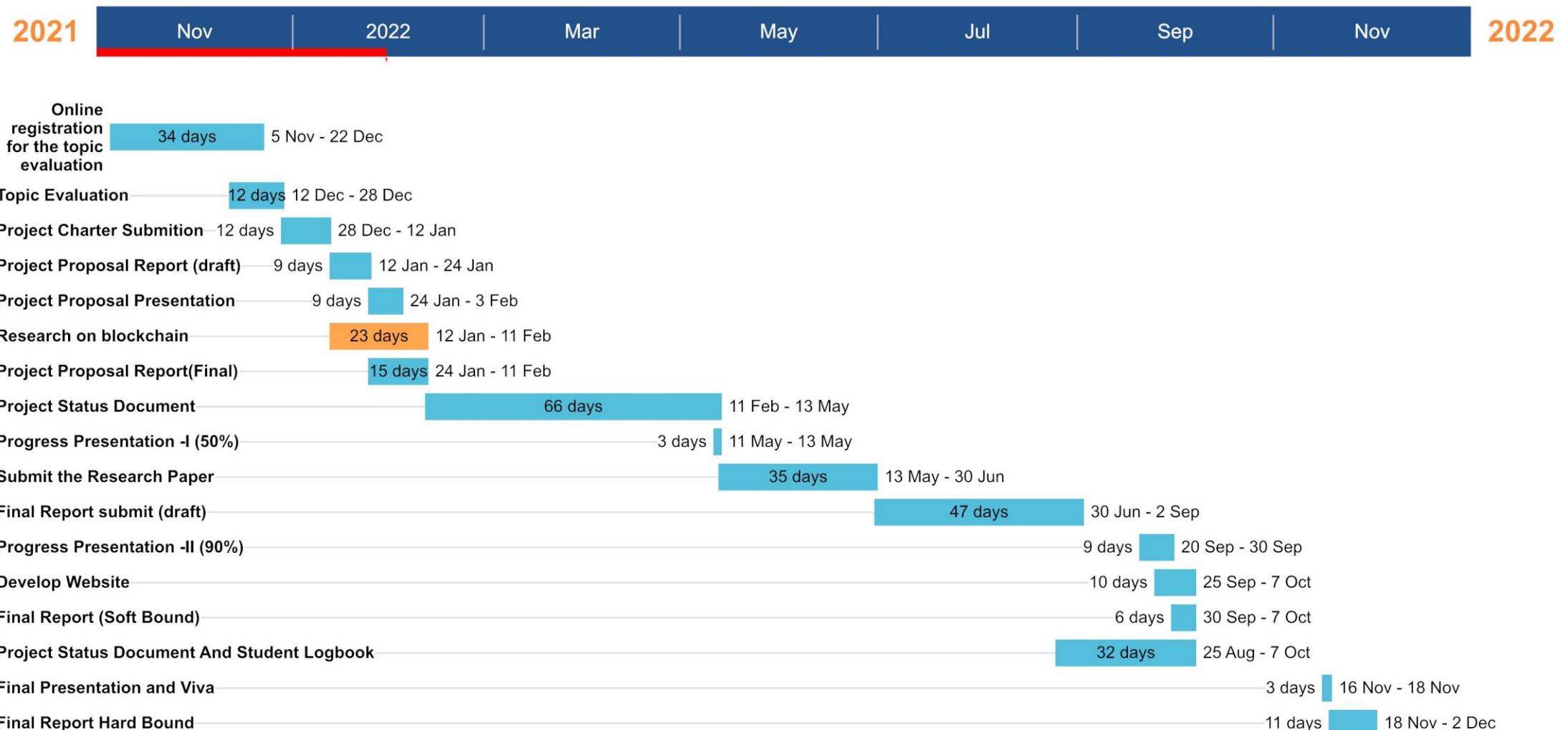
- Solidity
- Ethereum Network
- React JS
- Node.JS
- Web3JS
- INFURA.IO
- Python



Work Breakdown Structure



Gantt Chart



Project Requirements



Functional Requirements

-  Store / Access patient details
-  Share patient details among authorized people

Non-Functional Requirements

-  Accuracy
-  Speed
-  Reliability
-  Usability

Future Work



- Testing
- Increase the accuracy of the words suggestion model
- Do modifications to the front end to improve the user-friendliness



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Bachelor of Science (Hons) in Information Technology Specializing in Software Engineering





Introduction



Patient Medical Documents are an important source of information and healthcare professional use these documents to ensure continuity of care for the patient



Most of the medical documents such as clinical laboratory test reports, prescriptions from hospitals are in printed format



Converting these data into Electronic Health Records (EHR) and entering these details into blockchain often need to follow the manual data entering procedure



Research Problem



Most medical papers are in printed format and extracting information from them and transferring them to electronic health records takes a lot of time.



Manually entering these data into Blockchain is a risky task that frequently results in human errors.



As a result, an automated method for extracting textual data from printed medical records and converting them to editable and searchable formats should be introduced.

Research Gap

Reference ID	Modelled for Healthcare Domain-Specific words	Text Recognition	Important Entity Recognition	Extract Text from Low Quality Images
Research [1]	✓	✓	✗	✗
Research [2]	✗	✓	✗	✗
Research [3]	✗	✓	✗	✗
Research [5]	✓	✓	✗	✗
Our Solution	✓	✓	✓	✓

Name of the Application	Available Format / Platform	Limitations
Worldview Mobile Complete	Mobile Application designed for iPhones and iPads	Textual data will not be extracted Do not capture the important values or entities Data will be stored locally
EncryptScan by HIPAA 	Mobile Application designed for iOS & Android	Textual data will not be extracted Do not capture the important values or entities
Abby FineReader PDF 	Windows 10	Generic Document scanner Not specifically designed for healthcare-related documents
VueScan	Windows, macOS, and Linux	Generic Document scanner Not specifically designed for healthcare-related documents



Objectives



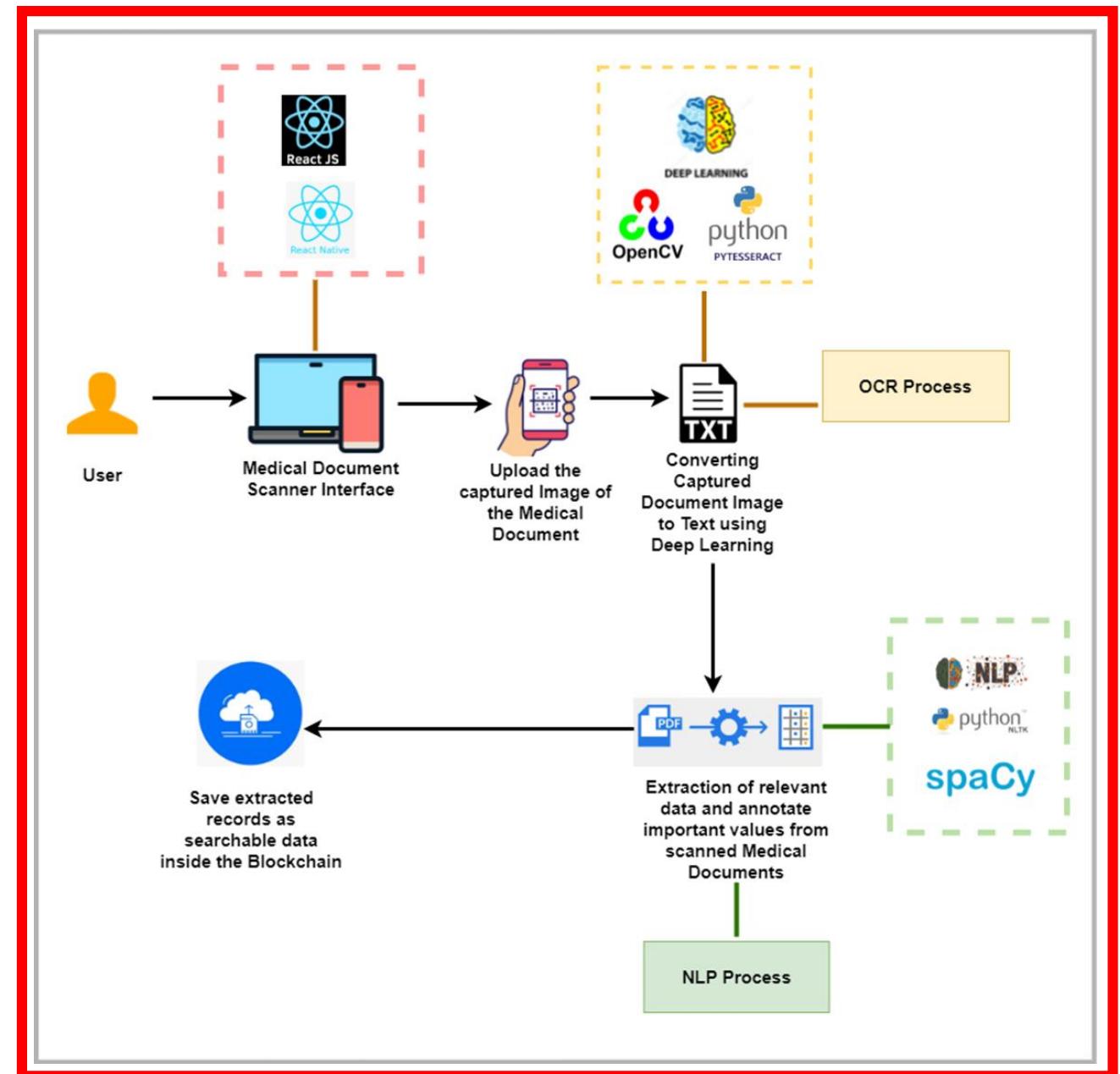
Main Objective

- To scan and extract text and important entities from Clinical Laboratory Test Reports using Optical Character Recognition and Named Entity Recognition while preventing human errors that cause when manually entering data.

Sub Objectives

- Prevent the errors that cause when manually entering data into Blockchain
- Automatically extract structured data from the captured images of the medical documents using Text Recognition
- Annotate and Recognize important entities from the recognized text

System Diagram



Methodology



First upload an Image of the Clinical Laboratory Test Reports through the Medical Document Scanner Interface



In *Computer Vision module*, we scan the document, identify the location of text and finally extract text in the captured image using techniques in Optical Character Recognition



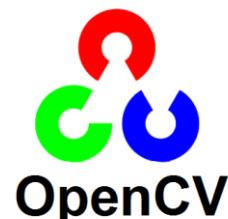
Then in *Natural language processing*, we will extract the entities from the text and do necessary text cleaning and parse the entities form the text.

Tools and Technologies



1. Text Recognition

- Optical Character Recognition using Deep Learning
 - ✓ OpenCV
 - ✓ Pytesseract
 - ✓ Numpy
 - ✓ pandas
 - ✓ matplotlib
 - ✓ pillow
 - ✓ Jupyter



OpenCV



NumPy



jupyter



Pandas

spaCy

2. Named Entity Recognition and extract important values

- Natural Language Processing
- Spacy Technology



Dataset to Train the Spacy Model

1. This Data set consist of images of Clinical Laboratory Test Reports issued by 24 laboratories in Egypt.

Link to download the Data set:

<https://data.mendeley.com/datasets/bygfmk4rx9/2>

2. A google form to collect Data from real users:

<https://forms.gle/YnwdShAsw1Mgqa6o7>

The screenshot shows a Google Form interface. At the top, there are tabs for 'Questions', 'Responses' (with a count of 0), and 'Settings'. The main content area is divided into two sections:

- Section 1 of 2:** A text area with a blue header containing the title. Below the title is a detailed description of the research project, asking respondents to share their clinical laboratory test reports for training machine learning models. It includes contact information for the researcher, Kithmini De Silva.
- Do you have any Clinical Laboratory Test Reports with you? ***: A question with two radio button options: 'Yes' and 'No'.
- Would you like to share those Lab Test Reports with us to develop a Healthcare application for the healthcare community in Sri Lanka? ***: Another question with 'Yes' and 'No' options.
- After section 1 Continue to next section**: A link at the bottom of the first section.
- Section 2 of 2:** A text area with a blue header asking respondents to take a photograph of their clinical laboratory test report. It includes a 'Description (optional)' field and a note about uploading the image.
- Please upload the Image of the Clinical Lab Test Report that you have. ***: A file upload field with a 'View folder' link.



Completion of Project

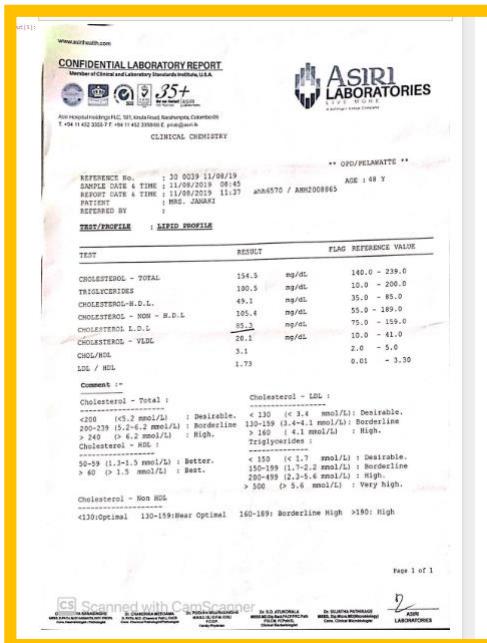


Software Installations

Tesseract-OCR, Pytesseract, Spacy Libraries, numpy, Pandas, matplotlib, OpenCV-python, Jupyter



Load Medical Document using OpenCV and extract Text from Image



Extract Text from Image

```
In [6]: text_cv = pytesseract.image_to_string(img_cv)
```

```
In [7]: print(text_cv)
```

TEST	RESULT	FLAG	REFERENCE	VALUE
CHOLESTEROL - TOTAL	154.5	mg/dL	160.0 - 239.0	
TRIGLYCERIDES	100.5	mg/dL	10.0 - 200.0	
CHOLESTEROL-H.D.L.	49.1	mg/dL	35.0 - 85.0	
CHOLESTEROL - NON - H.D.L	105.4	mg/dL	55.0 - 189.0	
CHOLESTEROL-L.D.L	85.3	mg/dL	75.0 - 159.0	
CHOLESTEROL - VLDL	20.1	mg/dL	10.0 - 41.0	
CHOL/HDL	3.1		2.0 - 5.0	
LDL / HDL	1.73		0.01 - 3.30	

CHOLESTEROL - TOTAL 154.5 mg/dL
TRIGLYCERIDES 100.5 mg/dL 10.0 - 200.0
CHOLESTEROL-H.D.L. 49.1 mg/dL 35.0 - 85.0
CHOLESTEROL - NON - H.D.L 105.4 mg/dL 55.0 - 189.0

CHOLESTEROL-L.D.L 85.3 mg/dL 75.0 - 159.0

CHOLESTEROL 1 35.3, 9.

CHOLESTEROL - VLDL 20.1 mg/dL 10.0 - 41.0

CHOL/HDL 3.1 2.0 - 5.0

LDL / HDL 1.73 0.01 - 3.30

Comment :~



Completion of Project



Convert Image to Text to Data frames



Draw Bounding Box around each word

Image to Data

```
In [10]: data = pytesseract.image_to_data(img_cv)

In [11]: # data.split('\n')
dataList = list(map(lambda x: x.split('\t'), data.split('\n')))
df = pd.DataFrame(dataList[1:], columns=dataList[0])
```

```
In [12]: df.head(10)
```

```
Out[12]:
   level page_num block_num par_num line_num word_num left top width height conf text
0      1       1         0       0       0       0    1082  1600    -1
1      2       1         1       0       0       0     45   40   139    17    -1
2      3       1         1       1       0       0     45   40   139    17    -1
3      4       1         1       1       1       0     45   40   139    17    -1
4      5       1         1       1       1       1     45   40   139    17    38  wwwasirinhealth.com
5      2       1         2       0       0     687  103    40    51    -1
6      3       1         2       1       0     687  103    40    51    -1
7      4       1         2       1       1     687  103    40    24    -1
8      5       1         2       1       1     687  103    40    24    95
9      4       1         2       1       2     697  127    16    27    -1
```

```
In [13]: print(data)
```

```
level page_num block_num par_num line_num word_num left top width height conf text
1      1       0         0       0       0       0    1082  1600    -1
2      1       1         0       0       0       0     45   40   139    17    -1
3      1       1         1       0       0       0     45   40   139    17    -1
4      1       1         1       1       0       0     45   40   139    17    -1
5      1       1         1       1       1       0     45   40   139    17    38  wwwasirinhealth.com
2      1       2         0       0       0     687  103    40    51    -1
3      1       2         1       0       0     687  103    40    51    -1
4      1       2         1       1       0     687  103    40    24    -1
5      1       2         1       1       1     687  103    40    24    95
4      1       2         1       2       0     697  127    16    27    -1
5      1       2         1       2       1     697  127    16    27    95
2      1       3         0       0       0     47   91   430    28    -1
3      1       3         1       0       0     47   91   430    28    -1
4      1       3         1       1       0     47   91   430    28    -1
5      1       3         1       1       1     47   91   176    27    96  CONFIDENTIAL
5      1       3         1       1       2     230   99   152   20    96  LABORATORY
5      1       3         1       1       3     387   99   90   20    93  REPORT
```





Completion of Project



Extract Text and Data from Medical Documents

- Save Data in CSV
- Labelling Data in CSV to train Spacy Model

B-DATE
O
B-AGE
I-AGE
O
B-PATIENTNAME
I-PATIENTNAME
O
B-TEST
I-TEST
O
B-RESULT
I-RESULT
O
B-COMMENTS
I-COMMENTS

	A	B	C	D	E	F
337	10.jpeg	:	O			
338	10.jpeg	MRS.	B-PATIENTNAME			
339	10.jpeg	JANAKIE	I-PATIENTNAME			
340	10.jpeg	GUNAWAFI	I-PATIENTNAME			
341	10.jpeg	REFERRED	O			
342	10.jpeg	:	O			
343	10.jpeg	AGE	O			
344	10.jpeg	:	O			
345	10.jpeg		50	B-AGE		
346	10.jpeg	Y		I-AGE		
347	10.jpeg		O			
348	10.jpeg		O			
349	10.jpeg		O			
350	10.jpeg		O			
351	10.jpeg		O			
352	10.jpeg		O			
353	10.jpeg		O			
354	10.jpeg	TEST	O			
355	10.jpeg	RESULT	O			
356	10.jpeg	FLAG	O			
357	10.jpeg	REFERENC	O			
358	10.jpeg	VALUE	O			
359	10.jpeg	SERUM	B-RESULT			
360	10.jpeg	ALT	I-RESULT			
361	10.jpeg	(S.G.P.T.)	I-RESULT			

BIO Tagging

B - Beginning

I - Inside

O - Out

Completion of Project



```
In [12]: allDocumentsData = []
for document in documents:
    documentData = []
    grouparray = group.get_group(document)[['text','tag']].values
    content = ''
    annotations = {'entities':[]}
    start = 0
    end = 0
    for text, label in grouparray:
        text = str(text)
        stringLength = len(text) + 1

        start = end
        end = start + stringLength

        if label != 'O':
            annot = (start,end-1,label)
            annotations['entities'].append(annot)

        content = content + text + ' '

    documentData = (content,annotations)
    allDocumentsData.append(documentData)
```

```
In [13]: allDocumentsData
[(520, 522, 'I-COMMENTS'),
 (523, 526, 'I-COMMENTS'),
 (527, 534, 'I-COMMENTS'))],
('laboratories 23082021 us fe pa 24082021 que 1 ay 7 al 27 y microbiology unit ref range stool examination physical examination colour brown consistency semiformed blood absent mucus absent worms absent microscopic examination pus cells 01 hpf 05 rbc 01 hpf 05 eggs oabsent giardia lamblia absent entamoeba histolytica absent undigested food muscle fibres fat others absent note aid pice cle 5 a yall 48 res pt branch line reviewed by page 1 of 1 printed by system pm printed on 22102021 ',
{'entities': [(31, 39, 'B-DATE'),
 (54, 56, 'B-AGE'),
 (57, 58, 'I-AGE'),
 (87, 92, 'B-TEST'),
 (93, 104, 'I-TEST'),
 (126, 132, 'B-RESULT'),
 (133, 138, 'I-RESULT'),
 (139, 150, 'B-RESULT'),
 (151, 161, 'I-RESULT'),
 (162, 167, 'B-RESULT'),
 (168, 174, 'I-RESULT'),
 (175, 180, 'B-RESULT'),
 (181, 187, 'I-RESULT')]
```

- ✓ Load and convert data into Spacy format
- Cleaning Text and convert Data into Spacy format



Completion of Project

Trained Spacy Pipeline

jupyter

[2022-05-04 00:09:18,122] [INFO] Initialized pipeline components: ['tok2vec', 'ner']
✓ Initialized pipeline

```
===== Training pipeline =====
i Pipeline: ['tok2vec', 'ner']
i Initial learn rate: 0.001
E # LOSS TOK2VEC LOSS NER ENTS_F ENTS_P ENTS_R SCORE
--- ---- ----- ----- ----- ----- ----- -----
0 0 0.00 50.30 0.00 0.00 0.00 0.00
0 200 202.68 7273.06 79.82 76.62 83.31 0.80
1 400 361.65 2899.33 87.54 86.88 88.21 0.88
3 600 373.46 1773.07 87.15 86.04 88.28 0.87
4 800 466.86 1756.66 88.77 88.27 89.28 0.89
6 1000 493.15 1371.85 88.45 87.78 89.13 0.88
8 1200 612.65 1433.24 87.98 86.64 89.36 0.88
11 1400 690.27 1391.24 89.02 88.08 89.97 0.89
15 1600 2878.89 1422.90 89.19 88.96 89.43 0.89
19 1800 911.98 1519.50 88.74 87.90 89.59 0.89
25 2000 926.61 1589.84 88.77 89.18 88.36 0.89
32 2200 934.71 1741.64 89.35 88.45 90.28 0.89
41 2400 997.61 1781.44 89.29 89.84 88.74 0.89
49 2600 990.80 1751.58 89.09 89.43 88.74 0.89
58 2800 996.74 1699.21 89.30 89.78 88.82 0.89
67 3000 992.15 1658.52 88.57 88.16 88.97 0.89
76 3200 992.59 1559.82 88.58 86.67 90.58 0.89
84 3400 921.29 1588.36 88.41 89.55 87.29 0.88
93 3600 791.82 1488.97 88.62 88.12 89.13 0.89
102 3800 924.88 1466.16 89.25 89.52 88.97 0.89
```

✓ Saved pipeline to output directory
output\model-last
PS D:\Y4S1\Medical Document Scanner\Notes\MedicalDocumentScanner>

ENTS_P - Named entities (precision)

=89.52

ENTS_R Named entities (recall)

=88.97

ENTS_F Named entities (F-score)

=89.25

Reference:

https://spacy.io/models/en#en_core_web_md-accuracy

Completion of Project



Final Prediction Pipeline

```

import Predictions as pred

In [15]: img = cv2.imread('./data/17.jpeg')

cv2.namedWindow('original',cv2.WINDOW_NORMAL)
cv2.imshow('original',img)
cv2.waitKey(0)
cv2.destroyAllWindows()

In [*]: img_results, entities = pred.getPredictions(img)

print(entities)
cv2.namedWindow('predictions',cv2.WINDOW_NORMAL)
cv2.imshow('predictions',img_results)
cv2.waitKey(0)
cv2.destroyAllWindows()

```

wawwasitthoalr com confidential laboratory report. eta asir fas se seas tw lab oratories live more 'asti hospital holdings plc 181 kirula road narahenpta colo mbo 05 t. 94 11 452 33557 f. 94 11 452 335866 e. prtabasiri tk automated count opdpelawatte 30 0037 110819 11082019 0841 age 21 y 11082019 1051 ahh7805 ahh200 6865 ms. kithmini reference no. sample date time report date time patient referred by testprofile complete blood count a test result flag reference value total white cell count 5.9 10⁹/l 4.0 11.0 differential count neutrophils 37.5 2.2 4 080 2.07.0 lymphocytes 50.0 3.0 2040 1.03.0 monocytes 5.9 0.4 02810 0.21.0 eosinophils 6.4 0.4 h 0106 0.020.5 basophils 0.2 0.0 0.18028 0.020.1 haemoglobin and rbc parameters haemoglobin 12.2 gdl 11.8 14.8 red blood cells 4.20 10¹²/l 3.8 4.8 mean cell volume 84.3 fl 76.0 96.0 haematocrit 35.4 118 l 36.0 44.0 mean cell haemoglobin 29.0 pg 27.0 33.0 m.c.h. concentration 34.5 gdl 32.0 36.0 red cells distribution width 13.3 12.0 15.0 platelet count 250 1091 150 400 page 1 of 1
{'AGE': ['21y'], 'DATE': ['11082019'], 'PATIENTNAME': ['Ms Kithmini'], 'TEST': ['Complete Blood Count'], 'RESULT': ['Total White Cell Count 5.9 10⁹/l', 'Neutrophils 37.5%', 'Lymphocytes 50.0 3.0', 'Monocytes 5.9%', 'Eosinophils 6.4 0.4%', 'Basophils 0.2 0.0', 'Parameters Haemoglobin 12.2 Gdl', 'Red Blood Cells', 'Mean Cell Volume 84.3 Fl', 'Haematocrit', 'Mean Cell Haemoglobin 29.0 Pg', 'Concentration 34.5 Gdl', 'Red Cells Distribution Width 13.3', 'Platelet Count 250'], 'COMMENTS': []}

TEST	RESULT	FLAG	REFERENCE VALUE
<u>TOTAL WHITE CELL COUNT</u>	5.9	10 ⁹ /L	4.0 - 11.0
<u>DIFFERENTIAL COUNT</u>			
NEUTROPHILS	37.5	% 2.2	L 40%-80% (2.0-7.0)
LYMPHOCYTES	50.0	% 3.0	H 20%-40% (1.0-3.0)
MONOCYTES	5.9	% 0.4	0.5%-10% (0.2-1.0)
EOSINOPHILS	6.4	% 0.4	H 0.5%-6% (0.02-0.5)
BASOPHILS	0.2	% 0.0	<0.1%-0.2% (0.02-0.1)
<u>HAEMOGLOBIN AND RBC PARAMETERS</u>			
HAEMOGLOBIN	12.2	g/dL	11.0 - 14.8
RED BLOOD CELLS	4.20	10 ¹² /L	3.8 - 4.8
MEAN CELL VOLUME	84.3	fL	76.0 - 96.0
MEAN CELL HAEMOGLOBIN	29.0	pg	27.0 - 33.0
M.C.H. CONCENTRATION	34.5	g/dL	32.0 - 36.0
RED CELLS DISTRIBUTION WIDTH	13.3	%	12.0 - 15.0
PLATELET COUNT	250	10 ⁹ /L	150 - 400

Page 1 of 1

Dr. Nalin Dahanayake MBBS, MRCP, MRCP(UK), MRCR, FRCR, FRCR Pathology Dr. Ranjitha Jayasinghe MBBS, MRCP, MRCP(UK), FRCR Family Physician Dr. Dilanthi Pathirana MBBS, MRCP, MRCP(UK), FRCR, FRCR Pathology Dr. Dinesha Pathirana MBBS, MRCP, MRCP(UK), FRCR, FRCR Clinical Endocrinologist Dr. Samantha Fernando MBBS, MRCP, MRCP(UK), FRCR, FRCR Pathology Dr. Asiri Laboratories

Completion of Project – 90%



Developed Document Scanner Web App

The screenshot shows a web browser window with a dark blue header. On the left of the header is the 'OXYGEN' logo. In the center is a search bar with the placeholder 'Search'. To the right of the search bar are three small circular icons with the numbers '6', '1', and '6' respectively, and a user profile icon labeled 'John'. Below the header, the main content area has a white background. The title 'Medical Document Scanner' is centered at the top in a large, bold, black font. Below the title is a dark blue horizontal bar containing the text 'Scan the Medical Documents' in white. Underneath this bar, a descriptive paragraph explains the service: 'Medical Document Scanner is a free online OCR(Optical Character Recognition) service and can analyze the text in the image you upload. The function of OCR is to help digitize documents in a timely manner and fashion. Instead of retyping files or manually typing out text within image files, you can use OCR to automatically scan and recognize text within your image or your scanned document.' Further down, another dark blue horizontal bar contains the text 'Upload the Medical Documents to Scan and Extract Text' in white. Below this bar is a file input field with the placeholder 'Choose File' and 'No file chosen'. To the right of the input field is a blue 'Upload Image' button.



Completion of Project – 90%

- **Image processing techniques were used to enhance the quality of the Image:**
 - Enhance
 - Grayscale
 - Blur
 - Edge Detection
 - Morphological transform
 - Contours
 - Find Four Points

Upload the Medical Documents to Scan and Extract Text

Choose File No file chosen

Upload Image

Wrap Document and Extract Text

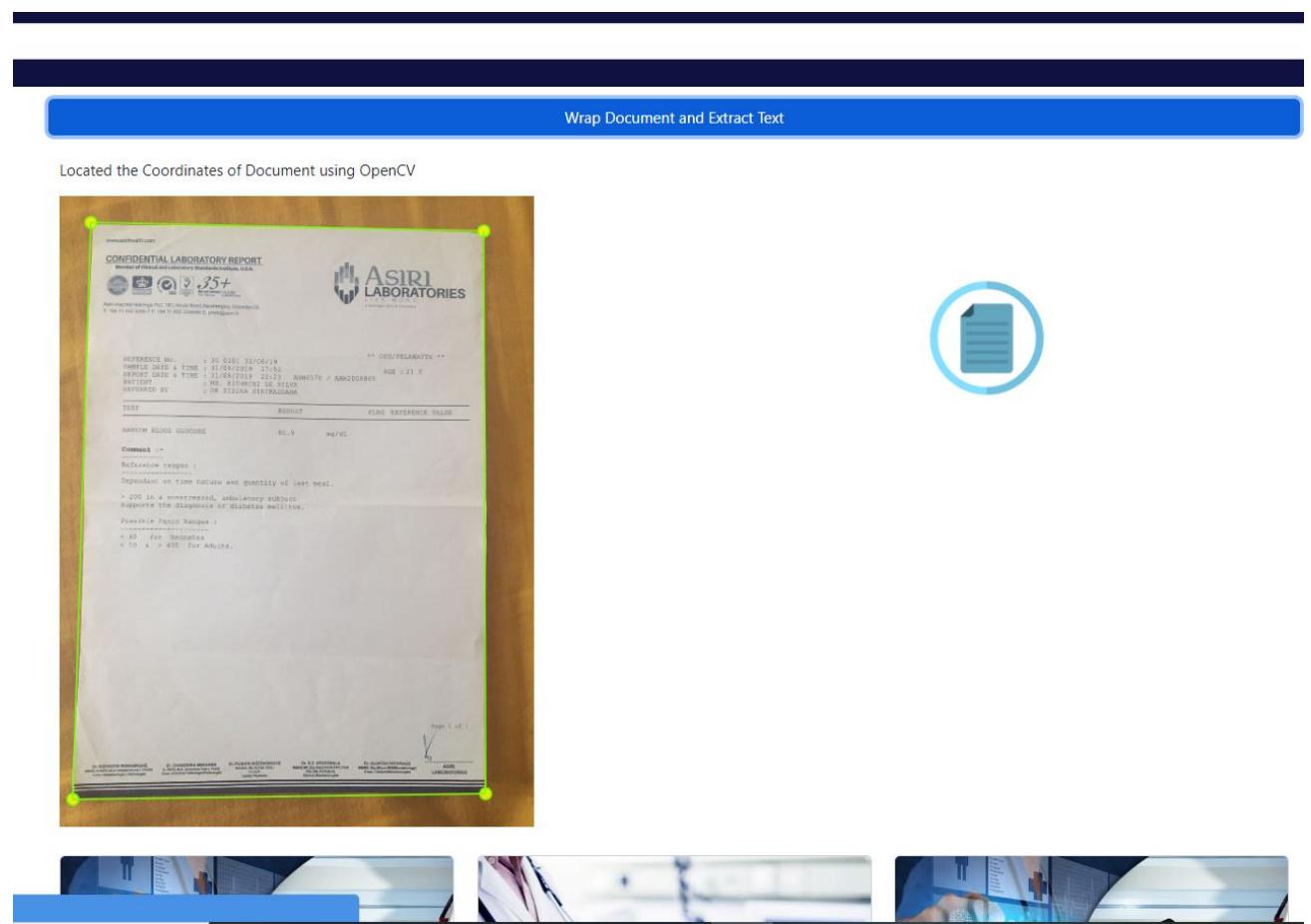
Located the Coordinates of Document using OpenCV

PATIENT NAME		Registered: 01-05-2020	Collected: 02-06-2020																																																																																																
Volt Number	Age: 28 Year	Authenticated: 02-05-2020	Printed: 03-06-2020																																																																																																
Referred By Prof. -		Client ID Prof. -																																																																																																	
Complete Blood Picture																																																																																																			
<table border="1"> <thead> <tr> <th>Test Name</th><th>Result</th><th>Unit</th><th>Reference Range</th></tr> </thead> <tbody> <tr> <td>Hæmoglobin</td><td>13.9</td><td>g/dL</td><td>12.5 - 17.5</td></tr> <tr> <td>Hæmatocrit (PCV)</td><td>41.4</td><td>%</td><td>41 - 52</td></tr> <tr> <td>RBCs Count</td><td>5.19</td><td>Millions / cmm</td><td>4.5 - 5.5</td></tr> <tr> <td>MCV</td><td>79.8</td><td>fL</td><td>88 - 100</td></tr> <tr> <td>MCH</td><td>29.8</td><td>pg</td><td>27 - 33</td></tr> <tr> <td>MCHC</td><td>33.5</td><td>g/dL</td><td>31 - 37</td></tr> <tr> <td>RDW-CV</td><td>11.8</td><td>%</td><td>11.5 - 15</td></tr> <tr> <td>Platelet Count (EDTA Blood)</td><td>248</td><td>Thousands / cmm</td><td>150 - 450</td></tr> <tr> <td>Total Leucocytic Count (EDTA Blood)</td><td>7.8</td><td>Thousands / cmm</td><td>4 - 11</td></tr> <tr> <td colspan="4" style="text-align: center;">Percent Values</td></tr> <tr> <td>Neutrophils</td><td>58.3</td><td>%</td><td>4.53 $\times 10^9/L$ 2 - 7</td></tr> <tr> <td>Lymphocytes</td><td>28.6</td><td>%</td><td>2.22 $\times 10^9/L$ 1 - 4.8</td></tr> <tr> <td>Monocytes</td><td>10.8</td><td>%</td><td>0.64 $\times 10^9/L$ 0.2 - 1</td></tr> <tr> <td>Eosinophils</td><td>1.0</td><td>%</td><td>0.18 $\times 10^9/L$ 0.1 - 0.45</td></tr> <tr> <td>Basophils</td><td>0.4</td><td>%</td><td>0.03 $\times 10^9/L$ 0 - 0.1</td></tr> <tr> <td colspan="4" style="text-align: center;">Absolute Values</td></tr> <tr> <td>Neutrophils</td><td>58.3</td><td>%</td><td>4.53 $\times 10^9/L$ 2 - 7</td></tr> <tr> <td>Lymphocytes</td><td>28.6</td><td>%</td><td>2.22 $\times 10^9/L$ 1 - 4.8</td></tr> <tr> <td>Monocytes</td><td>10.8</td><td>%</td><td>0.64 $\times 10^9/L$ 0.2 - 1</td></tr> <tr> <td>Eosinophils</td><td>1.0</td><td>%</td><td>0.18 $\times 10^9/L$ 0.1 - 0.45</td></tr> <tr> <td>Basophils</td><td>0.4</td><td>%</td><td>0.03 $\times 10^9/L$ 0 - 0.1</td></tr> <tr> <td colspan="4" style="text-align: center;">Other Cells</td></tr> <tr> <td colspan="4">Comment: Relative moncytosis. Follow up is recommended.</td></tr> </tbody> </table>				Test Name	Result	Unit	Reference Range	Hæmoglobin	13.9	g/dL	12.5 - 17.5	Hæmatocrit (PCV)	41.4	%	41 - 52	RBCs Count	5.19	Millions / cmm	4.5 - 5.5	MCV	79.8	fL	88 - 100	MCH	29.8	pg	27 - 33	MCHC	33.5	g/dL	31 - 37	RDW-CV	11.8	%	11.5 - 15	Platelet Count (EDTA Blood)	248	Thousands / cmm	150 - 450	Total Leucocytic Count (EDTA Blood)	7.8	Thousands / cmm	4 - 11	Percent Values				Neutrophils	58.3	%	4.53 $\times 10^9/L$ 2 - 7	Lymphocytes	28.6	%	2.22 $\times 10^9/L$ 1 - 4.8	Monocytes	10.8	%	0.64 $\times 10^9/L$ 0.2 - 1	Eosinophils	1.0	%	0.18 $\times 10^9/L$ 0.1 - 0.45	Basophils	0.4	%	0.03 $\times 10^9/L$ 0 - 0.1	Absolute Values				Neutrophils	58.3	%	4.53 $\times 10^9/L$ 2 - 7	Lymphocytes	28.6	%	2.22 $\times 10^9/L$ 1 - 4.8	Monocytes	10.8	%	0.64 $\times 10^9/L$ 0.2 - 1	Eosinophils	1.0	%	0.18 $\times 10^9/L$ 0.1 - 0.45	Basophils	0.4	%	0.03 $\times 10^9/L$ 0 - 0.1	Other Cells				Comment: Relative moncytosis. Follow up is recommended.			
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Completion of Project – 90%

- **findContours() method in OpenCV was used to find the four contours of the image to identify the location of the image.**
- **The four points is set to be adjusted using JavaScript**
- **Then wrapped and cropped the document and save the image**





Completion of Project – 90%

- Extracted Text and the Named Entities by calling the prediction model.
- Bounding Boxes are drawn with the suitable tag name.

Medical Document Scanner

Medical Document Scanner

alfa LABORATORIES

اسم المريض: المونسدة /
رقم المريض:
تاريخ الميلاد: 16/12/2020

جنس المريض: ذكر
العمر: 57

Hematology Unit

Complete Blood Picture (CBC)

Category	Result	Unit	Ref. Range
Haemoglobin	13.00	g/dL	11.5 - 16
Hematocrit	39.3	%	34 - 44
Red cell count	4.47	$\times 10^6/\mu\text{L}$	3.8 - 5.4
MCV	87.9	fL	78 - 96
MCH	29.2	pg	26 - 32
MCHC	33.2	g/dL	31 - 36
RDW	16.0	%	11.5 - 14.5
Platelet Count	319	$\times 10^9/\mu\text{L}$	150 - 450
T.L.C	10.3	$\times 10^3/\mu\text{L}$	4 - 11

Differential Count

Category	Percentage(%)	Result	Ref. Range	Absolute Count	Result	Ref. Range
Basophils	1	%	0 - 1	0.1	$\times 10^3/\mu\text{L}$	0 - 0.11
Eosinophils	2	%	0 - 6	0.2	$\times 10^3/\mu\text{L}$	0 - 0.6
Stab	0	%	0 - 7	0.0	$\times 10^3/\mu\text{L}$	
Segmented	35	%	40 - 75	3.6	$\times 10^3/\mu\text{L}$	2 - 7
Lymphocytes	52	%	20 - 45	5.4	$\times 10^3/\mu\text{L}$	1.5 - 4
Monocytes	10	%	1 - 10	1.0	$\times 10^3/\mu\text{L}$	0.2 - 1

Comments : Normal Hb. RBCs show mild anisocytosis.
Platelets are adequate.
Mild absolute lymphocytosis.
Follow up is recommended.

Reviewed By:

Branch: عامل الفا
Page 1 of 1 Printed by: PM Printed on: 16/12/2020
Call Center 16191 عامل الفا

Medical Document Scanner

alfa LABORATORIES

اسم المريض: المونسدة /
رقم المريض:
تاريخ الميلاد: 16/12/2020

جنس المريض: ذكر
العمر: 57

Hematology Unit

Complete Blood Picture (CBC)

Category	Result	Unit	Ref. Range
Haemoglobin	13.00	g/dL	11.5 - 16
Hematocrit	39.3	%	34 - 44
Red cell count	4.47	$\times 10^6/\mu\text{L}$	3.8 - 5.4
MCV	87.9	fL	78 - 96
MCH	29.2	pg	26 - 32
MCHC	33.2	g/dL	31 - 36
RDW	16.0	%	11.5 - 14.5
Platelet Count	319	$\times 10^9/\mu\text{L}$	150 - 450
T.L.C	10.3	$\times 10^3/\mu\text{L}$	4 - 11

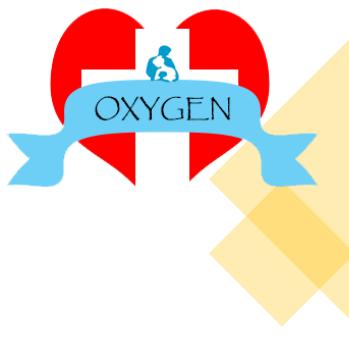
Differential Count

Category	Percentage(%)	Result	Ref. Range	Absolute Count	Result	Ref. Range
Basophils	1	%	0 - 1	0.1	$\times 10^3/\mu\text{L}$	0 - 0.11
Eosinophils	2	%	0 - 6	0.2	$\times 10^3/\mu\text{L}$	0 - 0.6
Stab	0	%	0 - 7	0.0	$\times 10^3/\mu\text{L}$	
Segmented	35	%	40 - 75	3.6	$\times 10^3/\mu\text{L}$	2 - 7
Lymphocytes	52	%	20 - 45	5.4	$\times 10^3/\mu\text{L}$	1.5 - 4
Monocytes	10	%	1 - 10	1.0	$\times 10^3/\mu\text{L}$	0.2 - 1

Comments : Normal Hb. RBCs show mild anisocytosis.
Platelets are adequate.
Mild absolute lymphocytosis.
Follow up is recommended.

Reviewed By:

Branch: عامل الفا
Page 1 of 1 Printed by: PM Printed on: 16/12/2020
Call Center 16191 عامل الفا



Completion of Project – 90%

Display the Entities and Extracted Text as the results on a table

Named Entities		
Entities	Extracted Text	
AGE	59 y	G
DATE	07/06/2021	G
PATIENTNAME	[]	
TEST	Chemistry Unit	G
RESULT	Fasting Plasma Glucose 111', 'Plasma Glucose 2Hrs Pp 103', 'Glycated Haemoglobin ', 'Serum Urea', '17', 'Serum Creatinine', 'Serum Uric Acid 7.0	G
COMMENTS	[]	

Completion of Project

Diabetes Prediction Using Logistic Regression

Search

John

Diabetes Prediction

Pregnancies: _____

Glucose: _____

Blood Pressure: _____

Skin Thickness: _____

Insulin: _____

BMI: _____

Age: _____

Submit

Result: ●

Card title

Some quick example text to build on the card title and make up the bulk of the card's content

Card title

Some quick example text to build on the card title and make up the bulk of the card's content

Card title

Some quick example text to build on the card title and make up the bulk of the card's content

NEW!



This dataset is originally from the National Institute of Diabetes and Digestive and Kidney Diseases. The objective is to predict based on diagnostic measurements whether a patient has diabetes. All patients here are females at least 21 years old of Pima Indian heritage.

- **Pregnancies:** Number of times pregnant
- **Glucose:** Plasma glucose concentration a 2 hours in an oral glucose tolerance test
- **Blood Pressure:** Diastolic blood pressure (mm Hg)
- **Skin Thickness:** Triceps skin fold thickness (mm)
- **Insulin:** 2-Hour serum insulin (mu U/ml)
- **BMI:** Body mass index (weight in kg/(height in m)²)
- **Diabetes Pedigree Function:** Diabetes pedigree function
- **Age:** Age (years)
- **Outcome:** Class variable (0 or 1)



Results and Discussion

Accuracy of the Spacy Pipeline

jupyter

[2022-05-04 00:09:18,122] [INFO] Initialized pipeline components: ['tok2vec', 'ner']
✓ Initialized pipeline

```
===== Training pipeline =====
i Pipeline: ['tok2vec', 'ner']
i Initial learn rate: 0.001
E # LOSS TOK2VEC LOSS NER ENTS_F ENTS_P ENTS_R SCORE
--- ---- ----- ----- ----- ----- ----- -----
0 0 0.00 50.30 0.00 0.00 0.00 0.00
0 200 202.68 7273.06 79.82 76.62 83.31 0.80
1 400 361.65 2899.33 87.54 86.88 88.21 0.88
3 600 373.46 1773.07 87.15 86.04 88.28 0.87
4 800 466.86 1756.66 88.77 88.27 89.28 0.89
6 1000 493.15 1371.85 88.45 87.78 89.13 0.88
8 1200 612.65 1433.24 87.98 86.64 89.36 0.88
11 1400 690.27 1391.24 89.02 88.08 89.97 0.89
15 1600 2878.89 1422.90 89.19 88.96 89.43 0.89
19 1800 911.98 1519.50 88.74 87.90 89.59 0.89
25 2000 926.61 1589.84 88.77 89.18 88.36 0.89
32 2200 934.71 1741.64 89.35 88.45 90.28 0.89
41 2400 997.61 1781.44 89.29 89.84 88.74 0.89
49 2600 990.80 1751.58 89.09 89.43 88.74 0.89
58 2800 996.74 1699.21 89.30 89.78 88.82 0.89
67 3000 992.15 1658.52 88.57 88.16 88.97 0.89
76 3200 992.59 1559.82 88.58 86.67 90.58 0.89
84 3400 921.29 1588.36 88.41 89.55 87.29 0.88
93 3600 791.82 1488.97 88.62 88.12 89.13 0.89
102 3800 924.88 1466.16 89.25 89.52 88.97 0.89
```

✓ Saved pipeline to output directory
output\model-last
PS D:\Y4S1\Medical Document Scanner\Notes\MedicalDocumentScanner>

ENTS_P - Named entities (precision)

=89.52

ENTS_R - Named entities (recall)

=88.97

ENTS_F - Named entities (F-score)

=89.25

Reference:

https://spacy.io/models/en#en_core_web_md-accuracy



Results and Discussion

Precision:

Measures how precise/accurate your model is. It is the ratio between the correctly identified positives (true positives) and all identified positives. The precision metric reveals how many of the predicted entities are correctly labeled.

$$\text{Precision} = \frac{\#True_Positive}{\#True_Positive + \#False_Positive}$$

Recall: Measures the model's ability to predict actual positive classes. It is the ratio between the predicted true positives and what was tagged. The recall metric reveals how many of the predicted entities are correct.

$$\text{Recall} = \frac{\#True_Positive}{\#True_Positive + \#False_Negatives}$$

F1 score:

The F1 score is a function of Precision and Recall. It's needed when you seek a balance between Precision and Recall.

$$\text{F1 Score} = \frac{2 * \text{Precision} * \text{Recall}}{\text{Precision} + \text{Recall}}$$

Reference: <https://learn.microsoft.com/en-us/legal/cognitive-services/language-service/cner-characteristics-and-limitations>

Results and Discussion



jupyter Diabates_prediction Last Checkpoint: 08/28/2022 (autosaved)

File Edit View Insert Cell Kernel Widgets Help



On GitHub, the HTML representation is unable to render, please try loading this page with nbviewer.org.

Making Predictions

```
In [8]: predictions = model.predict(x_test)
```

```
In [9]: print(predictions)
```

Evaluation

```
In [10]: accuracy = accuracy_score(predictions, Y_test)
```

```
In [11]: print(accuracy)
```

0.7337662337662337

Test Results



Search

Choose File No file chosen

Located the Coordinates of Document using OpenCV

Complete Blood Picture			
TEST NAME	RESULT	UNIT	REFERENCE RANGE
Haemoglobin (EDTA Blood)	11.5	g/dL	11.5 - 15.5
Haematocrit (PCV)	37.8	%	36 - 45
RBCs Count (EDTA Blood)	4.00	Millions / cmm	4 - 5.2
MCV	94.5	fL	80 - 100
MCH	28.8	pg	27 - 33
MCHC	30.4	g/dL	31 - 37
RDW-CV	14.5	%	11.5 - 15
Platelet Count (EDTA Blood)	257	Thousands / cmm	150 - 450
Total Leucocytic Count (EDTA Blood)	4.5	Thousands / cmm	4 - 11
Percent Values			
Neutrophils	33.9	%	1.52 x10 ⁹ /L 2 - 7
Lymphocytes	48.7	%	2.18 x10 ⁹ /L 1 - 4.6
Monocytes	13.6	%	0.61 x10 ⁹ /L 0.2 - 1
Eosinophils	3.1	%	0.14 x10 ⁹ /L 0.1 - 0.45
Basophils	0.7	%	0.03 x10 ⁹ /L 0 - 0.1
Absolute Values			
Other Cells			
Comment:			
Relative lymphocytosis. Relative monocytosis. Absolute neutropenia. Follow up is recommended.			

Page 1 of 1

19911

Named Entities	
Entities	Extracted Text
AGE	25 year
DATE	18-06-2021
PATIENTNAME	
TEST	Complete Blood Picture
RESULT	Haemoglobin ; 'Haematocrit' ; '36' ; 'Rbc Count Blood 4.00 Millions / Cmm' ; 'Mcv 94.5 Fl' ; 'Mch 28.8 Pg' ; 'Mchc L 30.4' ; 'Rdw' ; 'Platelet Count 257 Thousands / 150' ; 'Blood' ; 'Total Leucocytic Count 4.5 Thousands' ; 'Neutrophils 33.9' ; 'Lymphocytes 48.7' ; 'Monocytes 13.6' ; 'Eosinophils 3.1' ; '0.1' ; 'Basophils 0.7' ; '0' ; '1'
COMMENTS	Relative lymphocytosis. Relative monocytosis. Absolute neutropenia. Follow up is recommended .

Display the extracted Named Entities in a tabular format



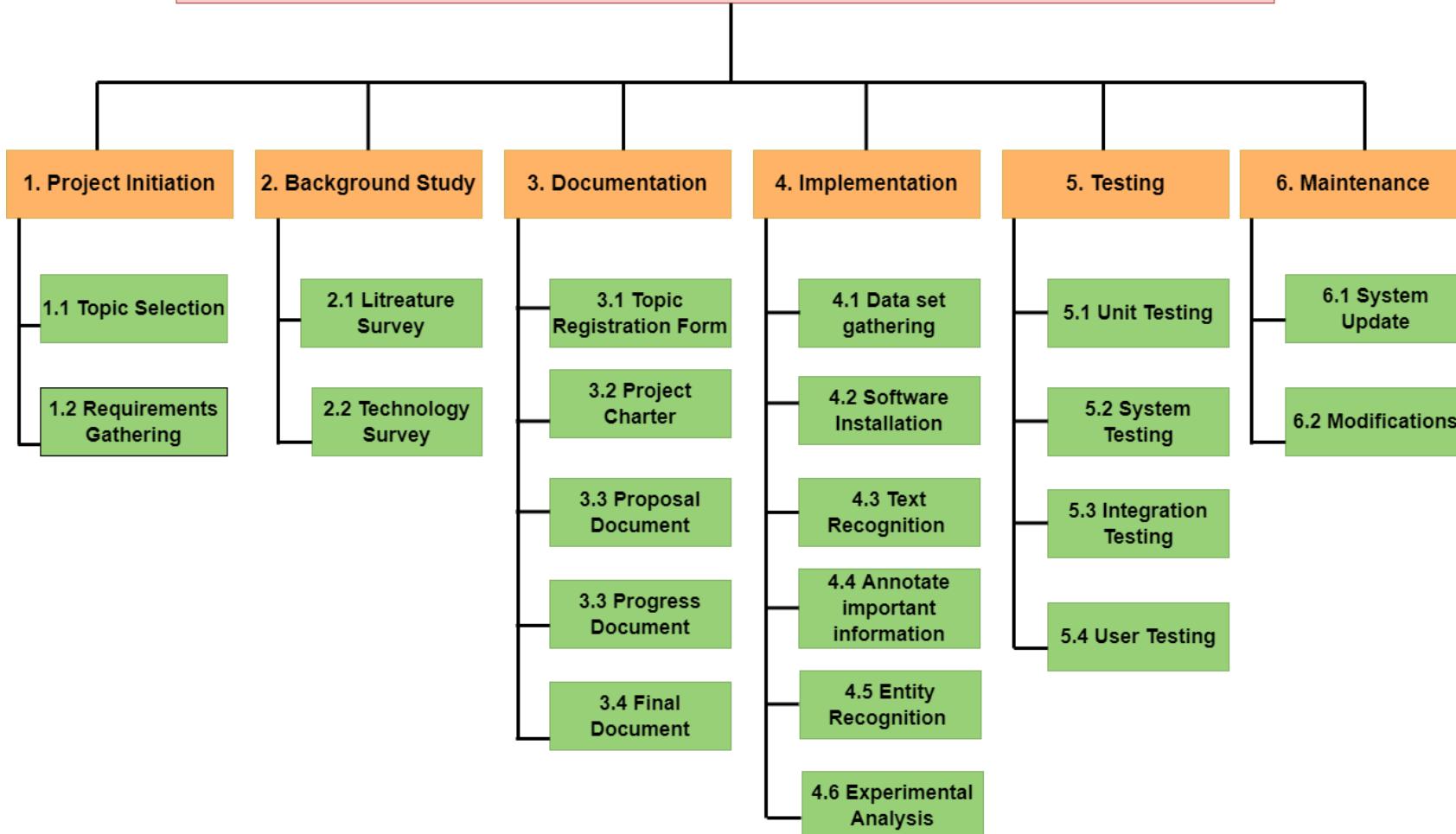
Automatically identify the four contours of the image and crop the background



Draw bounding boxes around the extracted Named Entities with the relevant tag

Work Breakdown Structure

DISTRIBUTED HEALTH CARE FRAMEWORK FOR PATIENT HEALTH RECORD
MANAGEMENT AND PHARMACEUTICAL DIAGNOSIS



Gantt Chart

Task Name	Project Timeline												
	Dec	Jan	Feb	March	April	May	June	July	August	Sep	Oct	Nov	Dec
Description													
Project Initiation													
Topic Registration (12th Dec 2021)													
Topic Evaluation (28th Dec 2021)													
Project Charter Submission (12th Jan 2022)													
Project Proposal Presentation (3rd Feb 2022)													
Project Phase													
System Planning													
Data Gathering													
Implementation Phase													
Software Installation													
Load document using OpenCV and PIL													
Pytesseract: Extract Text from Image													
Image to Text to Dataframe													
Draw Bounding Box around each word													
Extract Text and Data from Medical Documents													
Save data in CSV													
Labeling Data using manual BIO Tagging													
Spacy Training Data													
Cleaning Text, convert data into Spacy format													
Train Named Entity Recognition Model													
Predictions													
Develop Document Scanner Web App													
Host the Server													
Testing phase and Evaluation													
Project Status Document													
Final Presentation and Viva													
Final Report and Research Paper													
Final Evaluation													

Project Requirements



Functional Requirements

-  Extract Textual Data from Clinical Laboratory Reports
-  Annotate and Extract important values from Clinical Laboratory Reports

Non-Functional Requirements

-  Accuracy
-  Speed
-  Reliability
-  Usability

Future Work



- Testing
- Integrate the Diabetes Prediction model with Chatbot
- Do modifications to the frontend to improve the user friendliness

REFERENCES



- [1] Xue, W., Li, Q. and Xue, Q., 2019. Text detection and recognition for images of medical laboratory reports with a deep learning approach. *IEEE Access*, 8, pp.407-416.
- [2] Sahu, N. and Sonkusare, M., 2017. A study on optical character recognition techniques. *The International Journal of Computational Science, Information Technology and Control Engineering*, 4, pp.1-14.
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- [4] D'hondt, E., Grouin, C. and Grau, B., 2017, November. Generating a training corpus for OCR post-correction using encoder-decoder model. In *Proceedings of the Eighth International Joint Conference on Natural Language Processing (Volume 1: Long Papers)* (pp. 1006-1014).
- [5] Moon, S., Liu, S., Chen, D., Wang, Y., Wood, D.L., Chaudhry, R., Liu, H. and Kingsbury, P., 2019. Salience of medical concepts of inside clinical texts and outside medical records for referred cardiovascular patients. *Journal of Healthcare Informatics Research*, 3(2), pp.200-219.
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- [7] Widiastuti, N.I., 2019, November. Convolution neural network for text mining and natural language processing. In *IOP Conference Series: Materials Science and Engineering* (Vol. 662, No. 5, p. 052010). IOP Publishing.
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- [9] Mishra, A., Shekhar, S., Singh, A.K. and Chakraborty, A., 2019, September. Ocr-vqa: Visual question answering by reading text in images. In *2019 International Conference on Document Analysis and Recognition (ICDAR)* (pp. 947-952). IEEE.



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Introduction



Medication are one of the most useful medical services in the world because meds help to improve wellbeing for the ages



People use medication in their daily routine without knowing what are the reason to consume those and what are the side effect of them.



Sometimes those medication can make path to loss of a human life. Therefore, it is required way to overcome problems course by the medication



Research Problem



Currently there are no drug identification systems to identify drugs using just an image



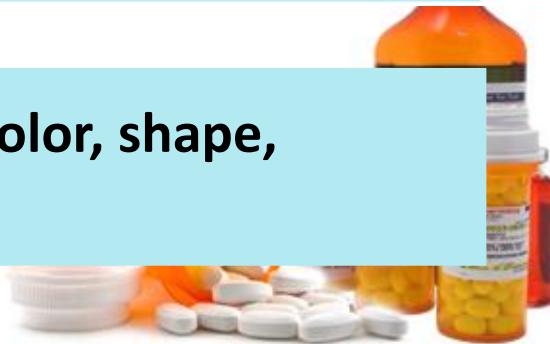
Drugs cannot be identified without the help of Doctors and Medical practitioners.



Most of the people aren't aware about the reasons to consume the prescribed medication and what are the side effects of them.



How to Identify and get to know about a drug using the Color, shape, and imprint



Research Gap

Product Name	Can Identify drug using image	Provide Details about drug	Provide Side Effects about drug
WebMD	✗	✓	✓
Drugs.com	✗	✓	✓
RxList	✗	✓	✗
Medscape	✗	✓	✗
Oxygen	✓	✓	✓



Objective

Main Objective

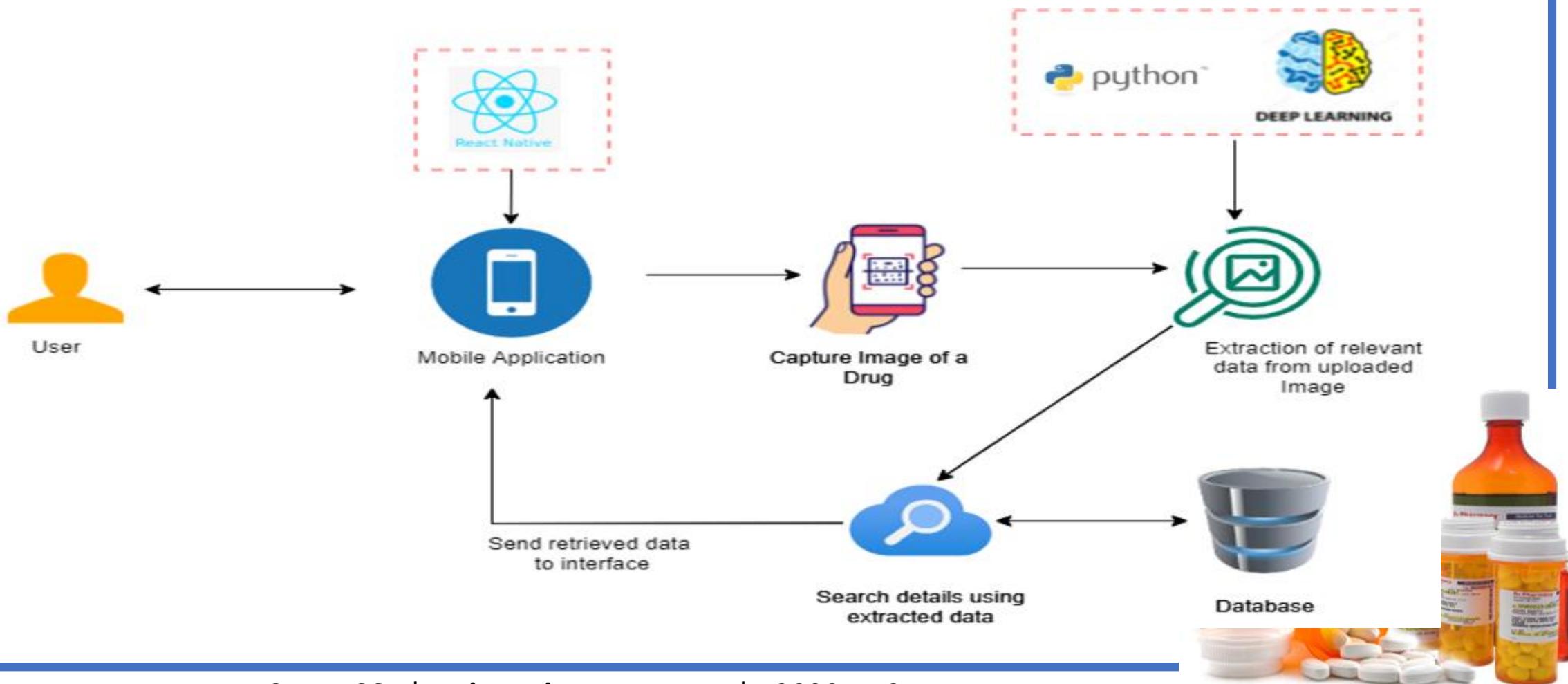
- Develop a system which can identify the medication and provide Detailed summary about the relevant drug.

Sub Objective

- Implement a dependable communication strategy between the application and cloud base server.
- Create A solid decision-making process in the cloud base server.
- Create an application to Carry out all the related functions.



System Diagram



Methodology

1. First upload drug's image to server using mobile application
 - In here we use React Native, NodeJS
2. Enhance the image quality and determined the color, shape and imprint of the pill
 - In here we use colorgram, contours and Amazon Rekognition
3. Find a most suitable result for retrieved data and make a summary and gave to the user.



Completion In PP1(50%)

Extract Data Using REST API

POST <http://localhost:8070/drug/identify>

Params Authorization Headers (8) **Body** Pre-request Script Tests Settings

none form-data x-www-form-urlencoded raw binary GraphQL

KEY	VALUE
<input checked="" type="checkbox"/> drug_image	acetaminophen.jpg 
Key	Value

Body Cookies Headers (8) Test Results

Pretty Raw Preview Visualize JSON 

```

1 "Imprint": "L403",
2 "color": "WHITE",
3 "shape": "CIRCLE"
4
5

```



POST <http://localhost:8070/drug/identify>

Params Authorization Headers (8) **Body** Pre-request Script Tests Settings

none form-data x-www-form-urlencoded raw binary GraphQL

KEY	VALUE
<input checked="" type="checkbox"/> drug_image	15.jpg 
Key	Value

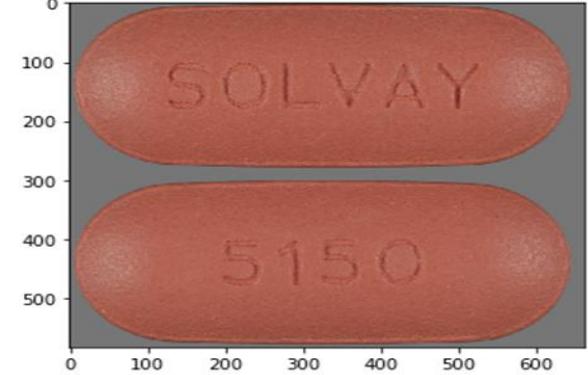
Body Cookies Headers (8) Test Results

Pretty Raw Preview Visualize JSON 

```

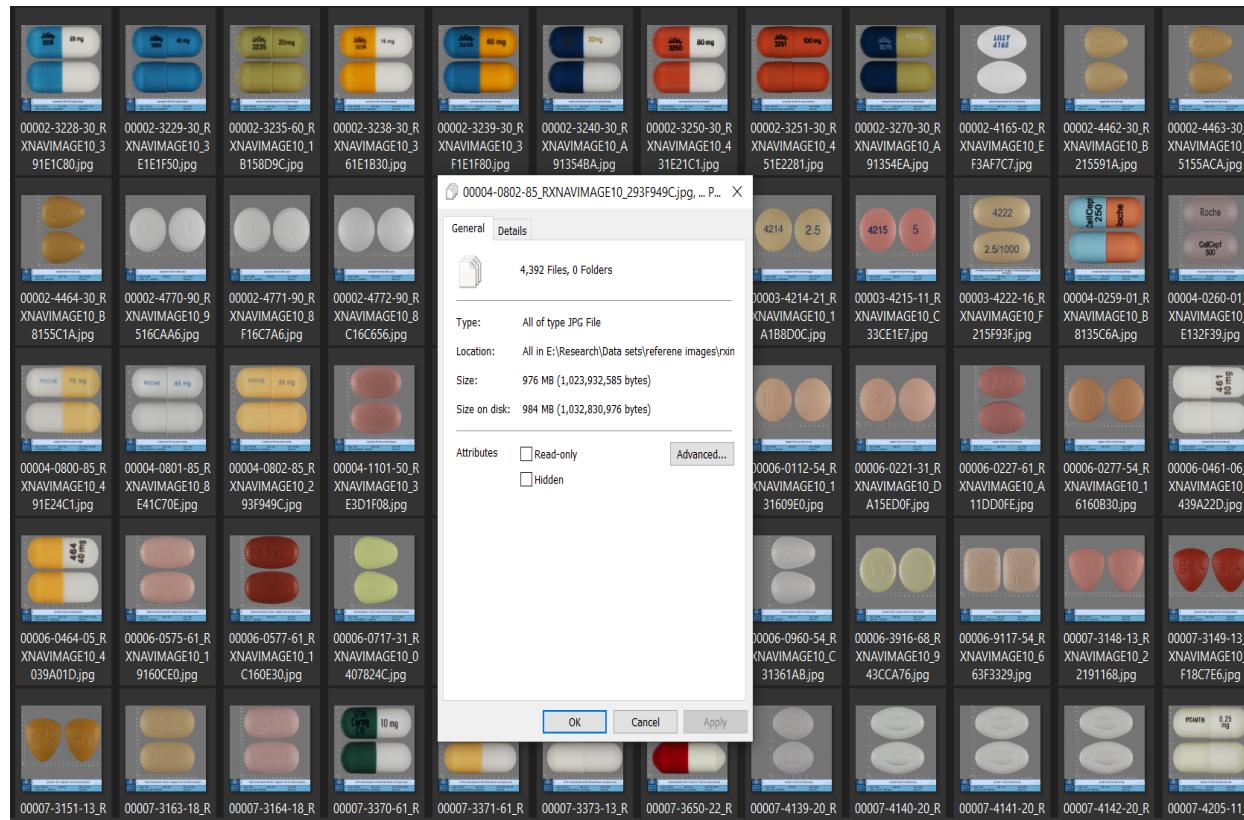
1 "Imprint": "SOLVAY5150",
2 "color": "RED",
3 "shape": "OVAL"
4
5

```




Completion In Project(90%)

Accuracy Calculation



$$\text{Accuracy} = \frac{TP + TN}{TP + FP + TN + FN}$$

= 354 / 517

= 0.68

Reference:

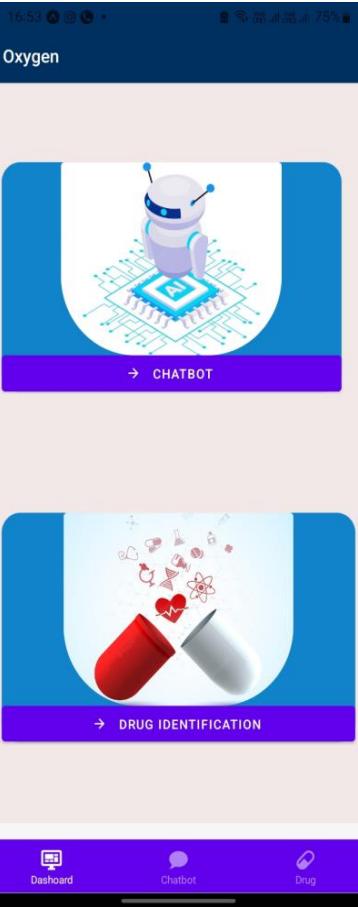
https://www.nlm.nih.gov/databases/download/pill_image.html





Completion In Project(90%)

1.



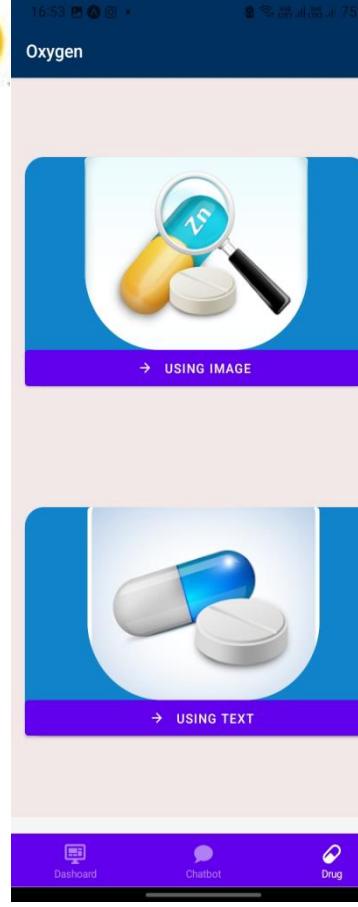
Oxygen

→ CHATBOT

→ DRUG IDENTIFICATION

Dashboard Chatbot Drug

2.



Oxygen

→ USING IMAGE

Dashboard Chatbot Drug

3.



← Oxygen

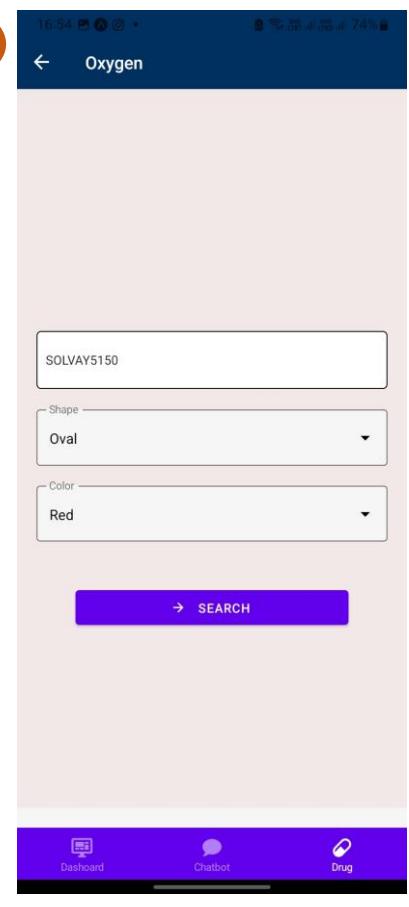
SOLVAY
5150

PLEASE SELECT DRUG IMAGE

UPLOAD

Dashboard Chatbot Drug

4.



← Oxygen

SOLVAY5150

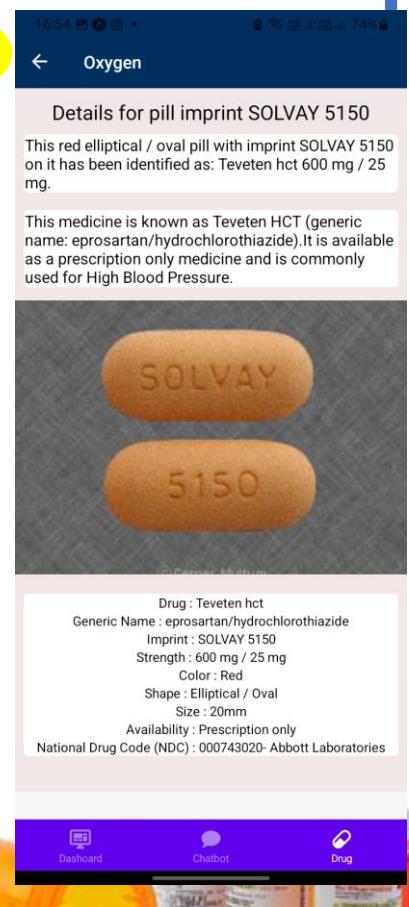
Shape – Oval

Color – Red

→ SEARCH

Dashboard Chatbot Drug

5.



← Oxygen

Details for pill imprint SOLVAY 5150

This red elliptical / oval pill with imprint SOLVAY 5150 on it has been identified as: Teveten hct 600 mg / 25 mg.

This medicine is known as Teveten HCT (generic name: eprosartan/hydrochlorothiazide).It is available as a prescription only medicine and is commonly used for High Blood Pressure.

SOLVAY
5150

Drug : Teveten hct
Generic Name : eprosartan/hydrochlorothiazide
Imprint : SOLVAY 5150
Strength : 600 mg / 25 mg
Color : Red
Shape : Elliptical / Oval
Size : 20mm
Availability : Prescription only
National Drug Code (NDC) : 000743020- Abbott Laboratories

Dashboard Chatbot Drug

Completion In Project(Extra)

NEW!



1. Oxygen app dashboard showing two options: "USING IMAGE" (with a magnifying glass over a pill) and "USING TEXT" (with a blue capsule).

2. Search screen with input fields for "Vitamin", "Shape", and "Color", and a "SEARCH" button.

3. Result screen for "Vitamin D2" with imprint "0140". It shows a large image of the pill, a "SEE MORE.." button, and another result for "Vitamin D" with imprint "PA140".

4. Detailed view of a green oval pill with imprint "0140", identified as Ergocalciferol 50,000 IU. It includes a large image of the pill, a summary table with drug details, and a photo of various prescription bottles at the bottom.

Technology & Tools

➤ Technologies

- Image Processing and machine learning

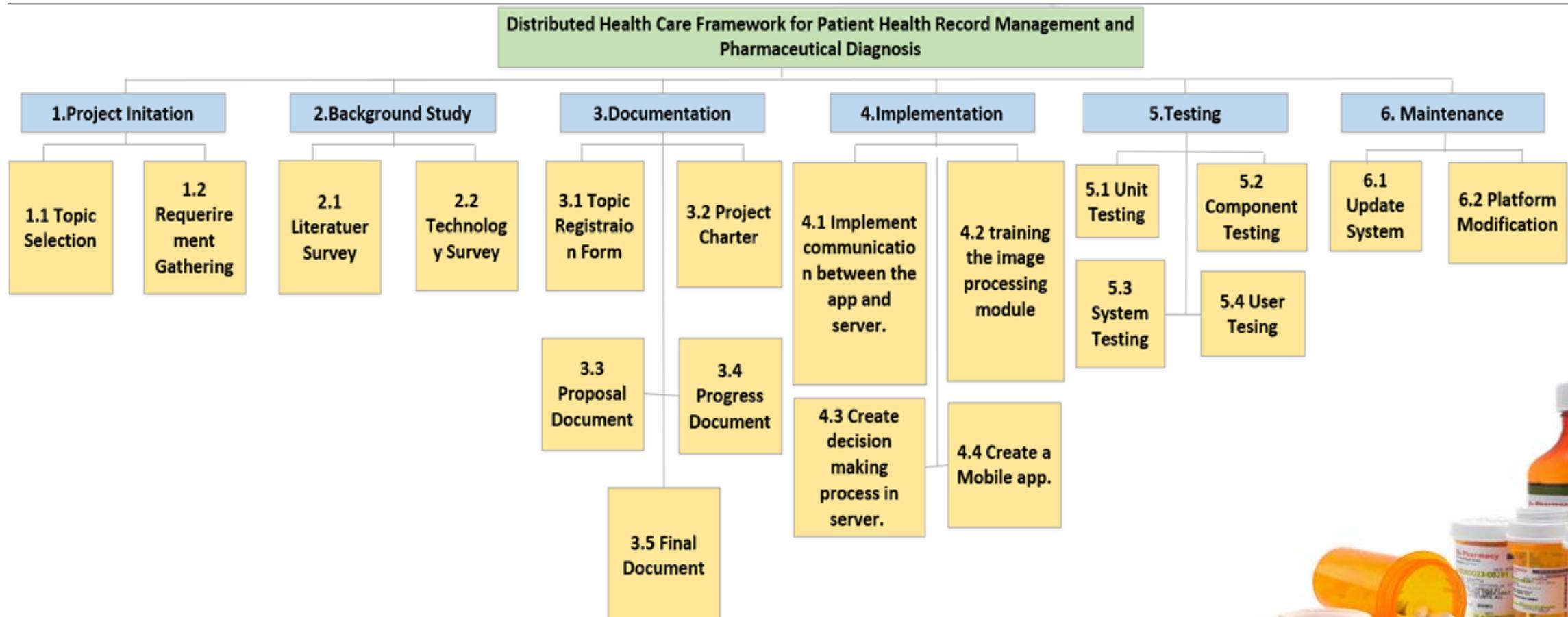


➤ Tools

- For image Processing- OpenCV
- For imprint Recondition - Amazon Rekognition
- For mobile application- React Native and Node JS
- For version controlling- GitLab
- Project Management



Work Breakdown Structure



Gantt Chart

Description	December	January	February	March	April	May	June	July	August	September	October	November	December
Project Initiation													
Evaluation													
Project Charter													
Proposal Draft													
Proposal Presentation													
Project Phase													
Collecting Required Data													
System Planning													
Selecting Technologies													
Research Paper													
Implementation Phase													
Implement communication between the app and server.													
training the image processing module													
Create an application to Carry out all the related functions.													
Create decision making process in server.													
Testing Phase and Evaluation													
Testing													
Final Report and Research paper													
Final Evaluation													



Project Requirements

➤ Functional requirements

- Extract data from uploaded drug's image and identify the drug and provide a summary about drug

➤ Non-Functional requirements

- Less manual work to use the overall system
- Take less time to extract data from drug's image.
- Accurate recognition.

➤ User Requirements

- Cell phone which has camera
- Internet Connection





Future Work

- Testing
- Do modifications to the frontend
- Further train the module for improve the accuracy

REFERENCES



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- [2] Bhatia, A., 2016. Enhanced Center of Mass Technique for Detection of Missing & Broken Pharmaceutical Drugs. *IJIRST-International Journal for Innovative Research in Science & Technology*, 3(01).
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Introduction



The importance of taking medication on time.



Fulfill All medication needs with the help of a single application.



Therefore, a way is needed to avoid that problem using single chat-bot

Research Problem



People are uniquely engaged in their current daily routine.



They tend to focus more on their work rather than their personal lives.



As a result, they often forget to get their medication on time and patient's prescription might go misplaced.



Research Gap

- Many healthcare virtual assistants use channeling to make necessary appointments to patients' relevant physicians and to diagnose their ailments diseases.

- Use to Smart Virtual Assistant for giving the medication time and give responses according to the prescription

Objectives



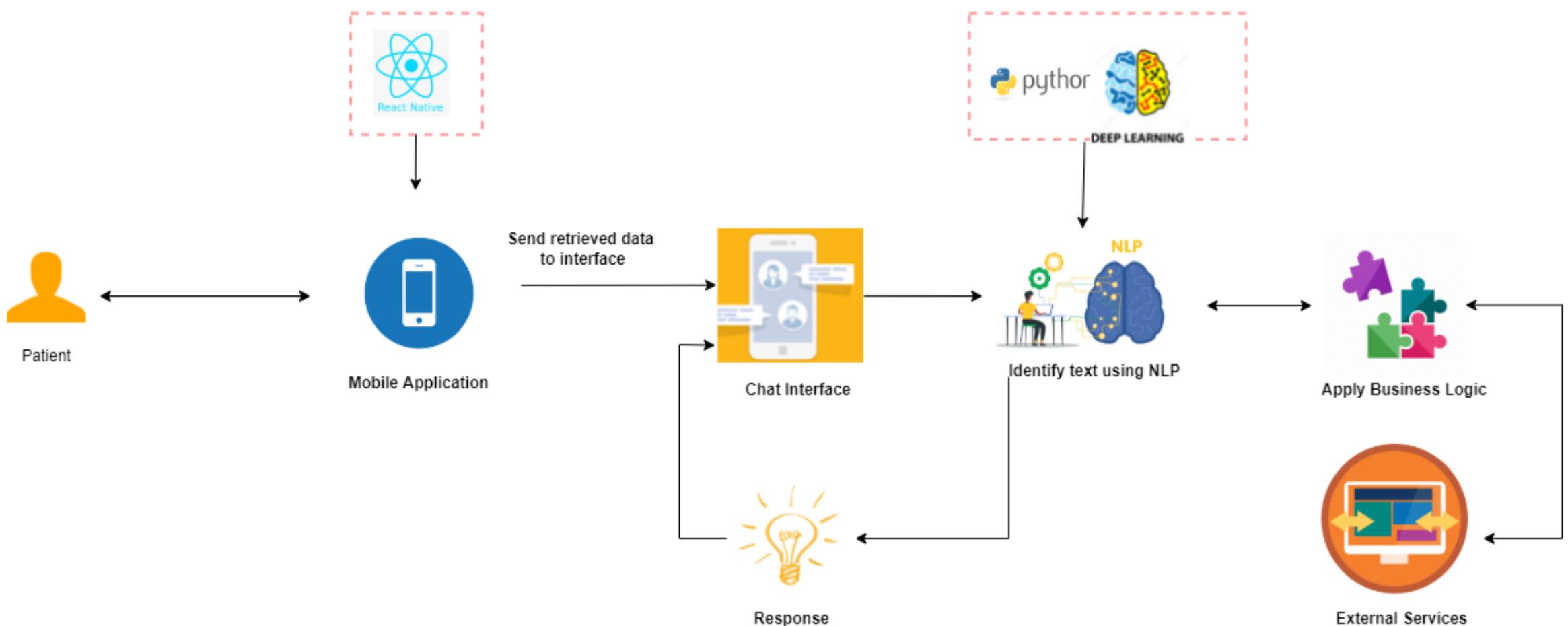
Main Objective

- To assist patients with a smart chatbot based on Machine learning and Natural Language Processing for health care assistance.

Sub Objectives

- Schedule Medication time.
- Give prescription details.
- User friendly interface.

System Diagram



Methodology



Get input from the patient.



Identify input using natural language processing and machine learning



Give an appropriate response to the relevant input

Tools and Technologies

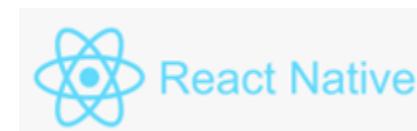
Technologies

- Natural Language and machine learning



Tools

- Chatbot Development (Rasa-SDK)
- For mobile application- React Native & Node Js
- Backend Service - Java
- For version controlling- GIT



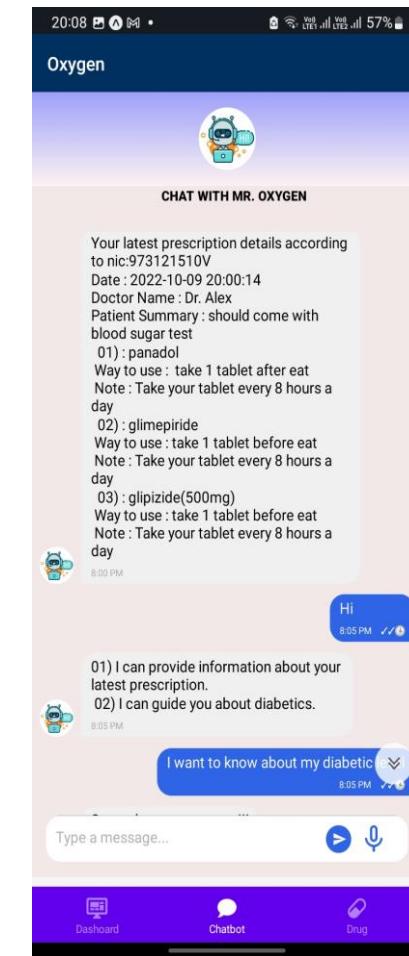
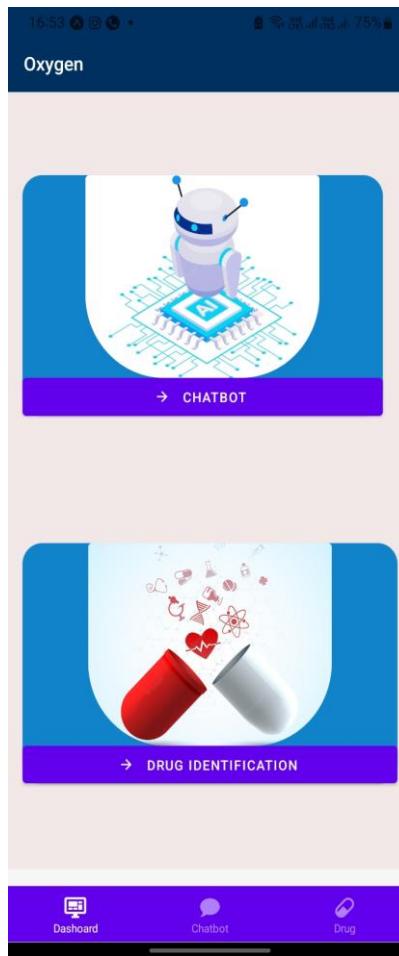


Completion of Project 50%

Sample chat output

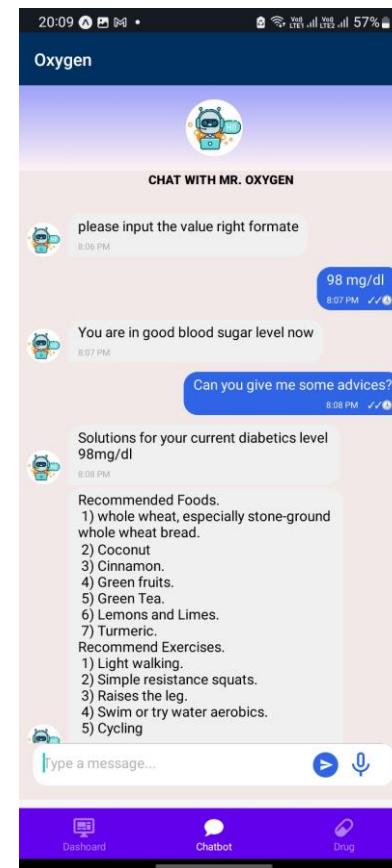
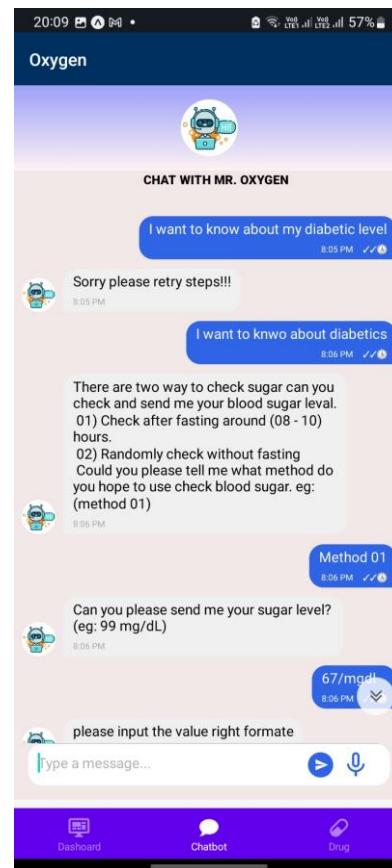
```
Your input -> hi
Hey! How are you?
Your input -> im good
Great, carry on!
Your input -> can you help me?
yes tell me i can help you.
Your input -> can you help me to find my prescription details?
Please Wait Im find your history.....
Your input -> 
```

Completion of Project 90%





Completion of Project 90%

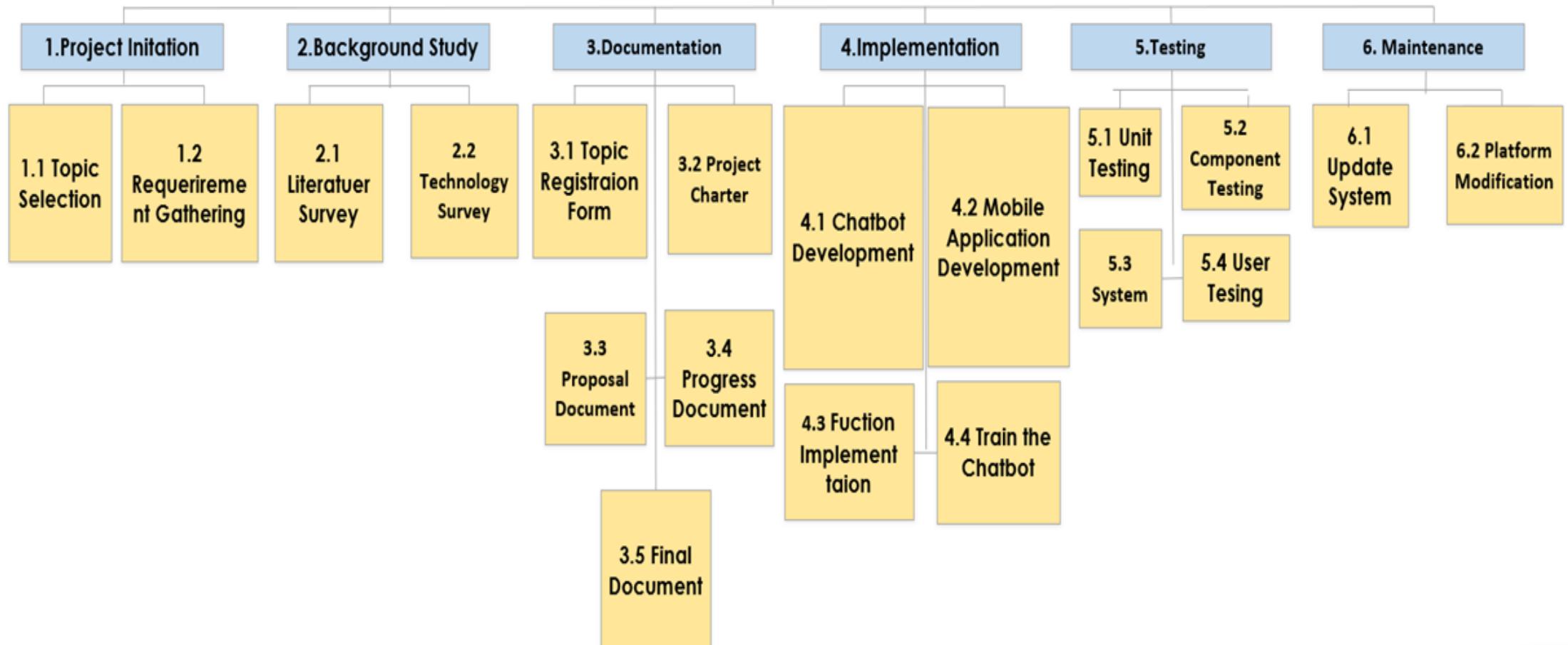


Completion of Project

Chat history with details

Chat History		
#	Bot	You
1	action_listen	
2		hi intent: greet 1.00
3	utter_greet 1.00 Hey! How are you? action_listen 1.00	
4		im good intent: mood_great 0.97
5	utter_happy 1.00 Great, carry on! action_listen 1.00	
6		can you help me? intent: help 1.00
7	utter_help 0.99 yes tell me i can help you. action_listen 1.00	
8		can you help me to find my prescription details? intent: prescription 1.00

Work Breakdown Structure



Gantt Chart

Task Name	Timeline												
	November	December	January	February	March	April	May	June	July	August	September	Octomber	November
Project Initiation													
Evalation													
Topic Assessment form													
Charter													
Proposal Draft													
Proposal Presentation													
Project Phase													
System Planning													
Collecting Required Data													
Selecting Algoritham tecnologies													
Implementation Phase													
Implement mobile application													
chatbot implementation													
Function Implementation													
Train the chatbot													
Testing Phase and Evaluation													
Testing													
Final Report and Research paper													
Final Evaluation													

Project Requirements

➤ Functional Requirements

- Identify the message and respond appropriately to the patient, identify the patient's prescription.

➤ Non-Functional requirements

- Accuracy
- Speed.
- Reliability.

➤ User Requirements

- Smart Mobile Phone
- Internet Connection

Future Work



- **Implement the notification part in the front end**
- **Application User Interface Improvement**
- **Host the server**
- **Train the model and Testing Application**

Business Potential



Supports any Hospital Chain across the world



24/7 support with no downtime



Free Drug Identification

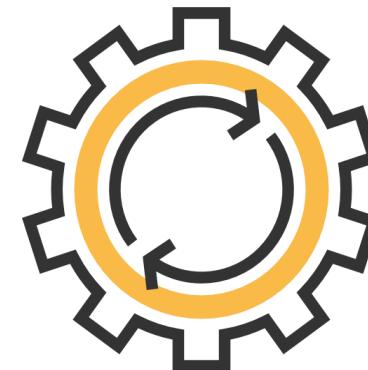


DATA PROTECTION

High Data Security



Medical Document Scanning from anywhere



100% Automatic Solution



24/7 Virtual Assistant

Business Model Canvas



Development and Hosting Cost

Marketing Cost

Oxygen



REVENUE SOURCES

Custom package plan

Subscription plan

Business Plan



Standard

What you'll Get

-  **24/7 support with no downtime**
-  **Free Virtual Assistance**
-  **Unlimited Users (10 Users only)**
-  **30GB Storage**

[Choose](#)

Premium

What you'll Get

-  **24/7 support with no downtime**
-  **Free Virtual Assistance**
-  **Unlimited Users**
-  **Unlimited Storage**

[Choose](#)



The flyer features a blue background with a red heart icon at the top left containing a small figure. A banner across the heart says "OXYGEN". The main title "CARE YOUR HEALTH" is in large white letters. Below it is a circular photo of a doctor in scrubs interacting with a patient in a hospital bed. To the left of the doctor is a detailed text block about the framework's purpose and objectives. On the right side, there are four circular icons with text: "100% PATIENT DATA SECURITY" (doctor icon), "FREE DRUG IDENTIFICATION" (pill icon), "FREE MEDICAL DOCUMENT SCANNING" (document icon), and "24/7 VIRTUAL ASSISTANT" (chat bubble icon). A stylized red hand holding a red drop is positioned on the left side of the text columns. At the bottom, the text "Sri Lanka Institute of Information Technology, New Kandy Rd, Malabe 0117 544 801" is displayed.

Oxygen is a healthcare framework to address the healthcare difficulties that may occur due the COVID-19 pandemic. The pandemic exposed healthcare's shortcomings, and this framework will automate the existing healthcare services. Key objective of this product is to securely store patients' healthcare information while protecting users' privacy and to provide healthcare services for Medical Documents Scanning, Conversational Chatbot for Virtual Assisting and remote pharmaceutical diagnosis.

**CARE YOUR
HEALTH**

100% PATIENT DATA SECURITY

FREE DRUG IDENTIFICATION

FREE MEDICAL DOCUMENT SCANNING

24/7 VIRTUAL ASSISTANT

Sri Lanka Institute of Information Technology,
New Kandy Rd, Malabe
0117 544 801



Business Potential

Healthcare Flyer



A group of diverse people, including men and women of various ethnicities, are gathered in a modern office or study area. They are smiling and appear to be engaged in a friendly interaction. In the foreground, a man with curly hair and glasses is looking towards the camera. Behind him, a woman with long dark hair is also smiling. To the right, a man wearing round glasses and a green sweater is laughing heartily. The background shows other people partially visible, suggesting a busy and positive environment.

THANK YOU

