AIDOC – *Pioneer in Mobile Healthcare*

A PROJECT REPORT

Submitted by

Daksh Patel	**171310132025**
Jainam Patel	**171310132029**
Meet Patel	**171310132034**
Tirth Patel	**171310132040**

In fulfilment for the award of the degree

of

BACHELOR OF ENGINEERING

in

Information and Communication Technology

Adani Institute of Infrastructure Engineering, Ahmedabad

Gujarat Technological University, Ahmedabad

Academic Year (2020-21)

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Name of Guide : Dr. VIJETA O KHARE

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Patent Search and Analysis Report (PSAR)	**Completed**
Final Plagiarism Report	**Completed**
Final Project Report	**Completed**

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Patent Search and Analysis Report (PSAR)	**Completed**
Final Plagiarism Report	**Completed**
Final Project Report	**Completed**

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Name of Guide : Dr. VIJETA O KHARE

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Dr. Vijeta Khare
(Internal Guide)
AIIE

Dr. Hitesh Chhikaniwala
Head of Department, ICT
AIIE

CERTIFICATE

Date:

This is to certify that the Project Work entitled "**AIDOC**" has been carried out by **JAINAM NARENDRAKUMAR PATEL (171310132029)** under my guidance in partial fulfilment of the degree of Bachelor of Engineering in **INFORMATION AND COMMUNICATION TECHNOLOGY(ICT) (7th Semester)** of Gujarat Technological University, Ahmedabad during the academic year 2020-21.

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(Internal Guide)
AIIE

Dr. Hitesh Chhikaniwala
Head of Department, ICT
AIIE

CERTIFICATE

Date:

This is to certify that the Project Work entitled "**AIDOC**" has been carried out by **MEET MANUBHAI PATEL (171310132034)** under my guidance in partial fulfilment of the degree of Bachelor of Engineering in **INFORMATION AND COMMUNICATION TECHNOLOGY(ICT) (7th Semester)** of Gujarat Technological University, Ahmedabad during the academic year 2020-21.

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(Internal Guide)
AIIE

Dr. Hitesh Chhikaniwala
Head of Department, ICT
AIIE

CERTIFICATE

Date:

This is to certify that the Project Work entitled "**AIDOC**" has been carried out by **TIRTH NILESHBHAI PATEL (171310132040)** under my guidance in partial fulfilment of the degree of Bachelor of Engineering in **INFORMATION AND COMMUNICATION TECHNOLOGY(ICT) (7th Semester)** of Gujarat Technological University, Ahmedabad during the academic year 2020-21.

Dr. Vijeta Khare
(Internal Guide)
AIIE

Dr. Hitesh Chhikaniwala
Head of Department, ICT
AIIE

DECLARATION OF ORIGINALITY

We hereby certify that we are the sole author of this report and that neither any part of this work nor the whole of the work has been submitted for a degree to any other University or Institution.

We certify that, to the best of our knowledge, our work does not infringe upon anyone's copyright nor violate any proprietary rights and that any ideas, techniques, quotations, or any other material from the work of other people included in our report, published or otherwise, are fully acknowledged in accordance with the standard referencing practices. Furthermore, to the extent that we have included copyrighted material that surpasses the bounds of fair dealing within the meaning of the Indian Copyright Act, we certify that we have obtained a written permission from the copyright owner(s) to include such material(s) in our work and have included copies of such copyright clearances to our appendix.

We declare that this is a true copy of our report, including any final revisions, as approved by our supervisor.

Date:

Place: Ahmedabad, Gujarat

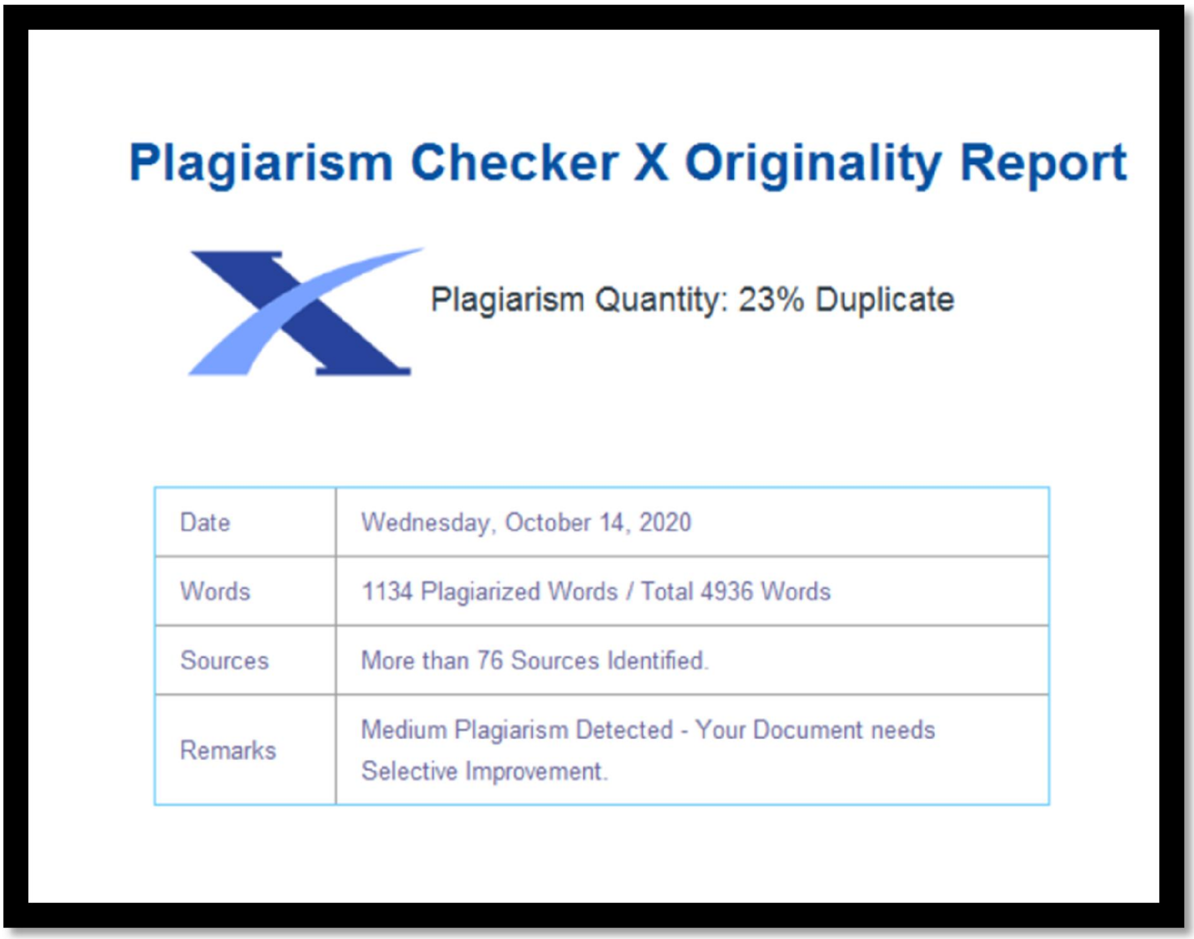
Signature of Student

DAKSH PATEL	**171310132025**
JAINAM PATEL	**171310132029**
MEET PATEL	**171310132034**
TIRTH PATEL	**171310132040**

Signature of Guide

Dr. Vijeta Khare

PLAGIARISM SEARCH REPORT/CERTIFICATE



Plagiarism Checker X Originality Report

Plagiarism Quantity: 23% Duplicate

Date	Wednesday, October 14, 2020
Words	1134 Plagiarized Words / Total 4936 Words
Sources	More than 76 Sources Identified.
Remarks	Medium Plagiarism Detected - Your Document needs Selective Improvement.

ACKNOWLEDGEMENT

We consider it privilege to be associated with Adani Institute of Infrastructure Engineering, Ahmedabad in this academic endeavour. We are heartily thankful to all professors and all staff members of our college for the co-operation and keep interests extended by them throughout our BE course. It is the base that they have built, which sustains such good job.

Presently, we would like to acknowledge and thanks to our guid Dr. Vijeta Khare, ICT department, AIIE who guided us throughout our project and helped us to create our project, her ideas and help proved to be extremely valuable during the creation of our project. We are extremely highly indebted to our Department Head Dr. Hitesh Chhikaniwala HOD of ICT department, AIIE for providing us this opportunity to prepare our project and give us stage to develop our mind.

We would also thankful to all staff members of ICT department for their kind support at various stages of the work. It is beyond the reach of our languages to express our sincere gratitude to our parents for their infinite inspiration and sacrifices for the benefit of our academic career.

DAKSH PATEL	**171310132025**
JAINAM PATEL	**171310132029**
MEET PATEL	**171310132034**
TIRTH PATEL	**171310132040**

INDEX

CH - 1 : Introduction

1.1 Problem Summary:-

In this project, we are going to develop cross platform mobile application to detect diseases related to images such as Pneumonia can be detected from chest X-ray images, Fracture can be detected from Bone X-ray, Diabetic retinopathy can be detected from eye images, COVID-19 can be detected from chest X-ray.

Our Project mainly outlines three Modules; Administrator, Doctor, Stakeholder.

App Highlights following activities in broader way:-

i) Registration (Sign Up) of User

ii) User Sign In

iii) Displaying Medical Articles

iv) Prediction of desired disease

v) Generation of report

vi) Chat-bot

vii) Recommending List of Doctors in given Proximity

1.2 Aim of Project:-

Creating a tool which help individuals to prognose diseases proactively with minimal clicks. Suggesting set of world class doctors and medical facilities which could help them if severity of discrepancy rises.

1.3 Objectives of Project:-

Developing a Cross platform application which would leverage the AI and revolutionize the way in which medical industry are operating today.

1.4 Prior Art Search:-

1) An Efficient Deep Learning Approach to Pneumonia Classification in Healthcare

Published Year: March 2019

Authors: Okeke Stephen, Mangal Sain, Uchenna Joseph Maduh, Doun Jeong

Abstract:

This study proposes a convolutional neural network model trained from scratch to classify and detect the presence of pneumonia from a collection of chest X-ray image samples. Unlike other methods that rely solely on transfer learning approaches or traditional handcrafted techniques to achieve a remarkable classification performance, we constructed a convolutional neural network model from scratch to extract features from a given chest X-ray image and classify it to determine if a person is infected with pneumonia. This model could help mitigate the reliability and interpretability challenges often faced when dealing with medical imagery. Unlike other deep learning classification tasks with sufficient image repository, it is difficult to obtain a large amount of pneumonia dataset for this classification task; therefore, we deployed several data augmentation algorithms to improve the validation and classification accuracy of the CNN model and achieved remarkable validation accuracy.

2) Efficient Pneumonia Detection in Chest Xray Images Using Deep Transfer Learning

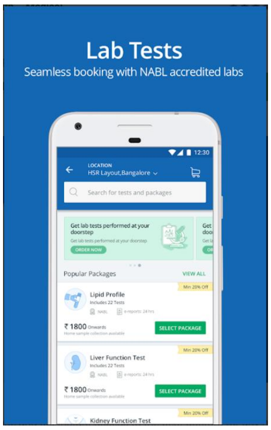
Published Year: June 2020

Authors: Mohammad Farukh Hashmi, Satyarth Katiyar, Avinash G Keskar, Neeraj Dhanraj Bokde, Zong Woo Geem5

Abstract:

Pneumonia causes the death of around 700,000 children every year and affects 7% of the global population. Chest X-rays are primarily used for the diagnosis of this disease. However, even for a trained radiologist, it is a challenging task to examine chest X-rays. There is a need to improve the diagnosis accuracy. In this work, an efficient model for the detection of pneumonia trained on digital chest X-ray images is proposed, which could aid the radiologists in their decision-making process. A novel approach based on a weighted classifier is introduced, which combines the weighted predictions from the state-of-the-art deep learning models such as ResNet18, Xception, InceptionV3, DenseNet121, and MobileNetV3 in an optimal way. This approach is a supervised learning approach in which the network predicts the result based on the quality of the dataset used. Transfer learning is used to fine-tune the deep learning models to obtain higher training and validation accuracy. Partial data augmentation techniques are employed to increase the training dataset in a balanced way. The proposed weighted classifier is able to outperform all the individual models. Finally, the model is evaluated, not only in terms of test accuracy, but also in the AUC score. The final proposed weighted classifier model is able to achieve a test accuracy of 98.43% and an AUC score of 99.76 on the unseen data from the Guangzhou Women and Children's Medical Centre pneumonia dataset. Hence, the proposed model can be used for a quick diagnosis of pneumonia and can aid the radiologists in the diagnosis process.

3) Tata Health App: -



Lab Tests

Seamless booking with NABL accredited labs

Get lab tests performed at your doorstep

Get lab tests performed at your doorstep

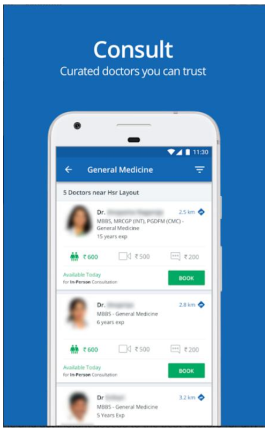
Popular Packages

Lipid Profile
Includes 22 Tests
NABL e-reports: 24 hrs
₹ 1800 Onwards
Home sample collection available

Liver Function Test
Includes 22 Tests
NABL e-reports: 24 hrs
₹ 1800 Onwards
Home sample collection available

Kidney Function Test

Tata Health app allows instant access to the best doctors for any health issues, online lab test booking, doctor appointment booking, specialty consultation for dermatological issues, paediatrician advice, gynaecology, and much more



Consult

Curated doctors you can trust

5 Doctors near Hsr Layout

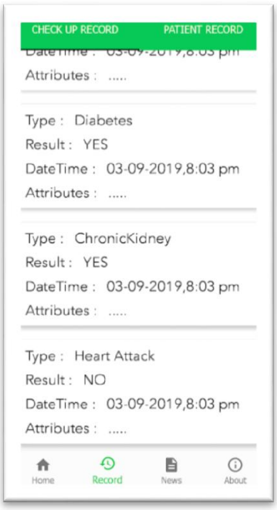
Dr. [redacted] 2.5 km
MBBS, MRCGP (INT), PGDFM (CMC) - General Medicine
15 years exp
₹ 600 ₹ 500 ₹ 200
Available Today
for In-Person Consultation

Dr. [redacted] 2.8 km
MBBS - General Medicine
6 years exp
₹ 600 ₹ 500 ₹ 200
Available Today
for In-Person Consultation

Dr [redacted] 3.2 km
MBBS - General Medicine
5 Years Exp

What we are recreating is an application which will utilize the consultancy functionality with AI Base Diagnosis of various diseases.

4) Disease Detector App:



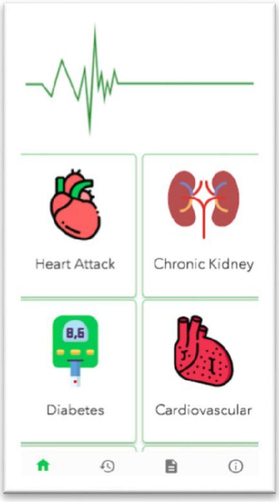
DateTime : 03-09-2019,8:03 pm
Attributes : .....

Type : Diabetes
Result : YES
DateTime : 03-09-2019,8:03 pm
Attributes : .....

Type : ChronicKidney
Result : YES
DateTime : 03-09-2019,8:03 pm
Attributes : .....

Type : Heart Attack
Result : NO
DateTime : 03-09-2019,8:03 pm
Attributes : .....

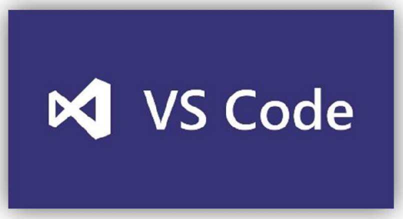
Disease Detector is especially intended to improve healthcare system for hospitals and medical examination by using AI technology.



Above Application Detects the disease based on Q/A and dosen't detect diseases related to Images which our application can perform with ease.

1.5 Materials/Tools Used:-

Tools used by our Developer Team is as follow:-



CH - 2 : Design: Analysis, Design Methodology and Implementation Strategy.

2.1 AEIOU Canvas:-

AEIOU stands for 5 elements: Activity, Environment, Interaction, Object, and User.

• Activities are goal-directed sets of actions—paths towards things people want to accomplish. What are the modes people work in, and the specific activities and processes they go through?

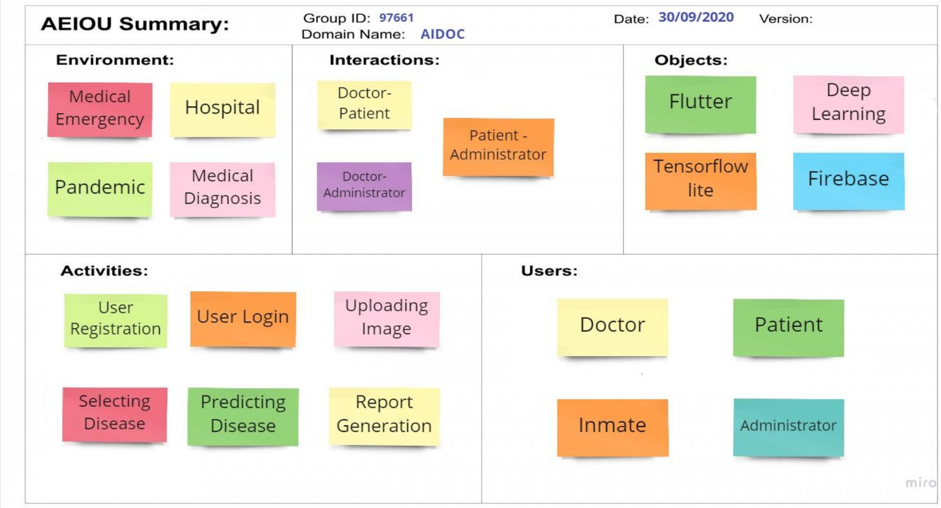
• Environments include the entire arena where activities take place. What is the character and function of the space overall, of each individual's spaces, and of shared spaces?

• Interactions are between a person and someone or something else; they are the building blocks of activities. What is the nature of routine and special interactions between people, between people and objects in their environment, and across distances?

• Objects are building blocks of the environment, key elements sometimes put to complex or unintended uses (thus changing their function, meaning and context). What are the objects and devices people have in their environments and how do they relate to their activities?

• Users are the people whose behaviours, preferences, and needs are being observed. Who is there? What are their roles and relationships? What are their values and prejudices?

In AEIOU canvas, our activities include Registration Activity of User, Login Activity of user, after login of user: Uploading image from gallery which is to be prognosed. Once the Image is selected, App predicts the confidence of desired disease. After prediction, User can write the file into external storage of smartphone. The Environment part of canvas includes Medical Emergency, Medical Diagnosis, etc. The objects used in our project are Flutter, Deep Learning, TensorFlow lite, Firebase. Users directly or indirectly related to our project are Doctors, Patient, Inmate, App Administrator



AEIOU Summary:

Group ID: 97661
Domain Name: AIDOC

Date: 30/09/2020
Version:

Environment:
Medical Emergency
Hospital
Pandemic
Medical Diagnosis

Interactions:
Doctor-Patient
Patient - Administrator
Doctor-Administrator

Objects:
Flutter
Deep Learning
Tensorflow lite
Firebase

Activities:
User Registration
User Login
Uploading Image
Selecting Disease
Predicting Disease
Report Generation

Users:
Doctor
Patient
Inmate
Administrator

2.2 Empathy Mapping Canvas

An Empathy map is a research tool which allows you to really get inside the head of your customer. It is mapped out with the customer's thoughts and feelings, their primary senses of seeing and hearing as well as their pains and gains. It can be used to research your users or different segments of your customer base.

Details of our Empathy Mapping Canvas:

User: Doctor, Inmate, App administrator, Patient

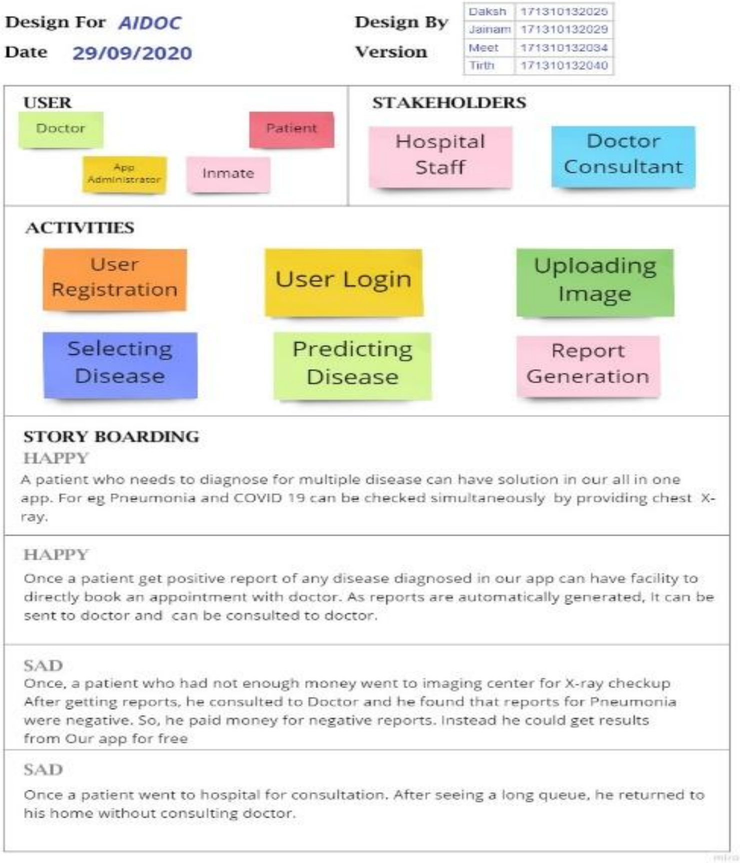
Stakeholders: Hospital Staff, Doctor Consultant

Activities: User registration, User login, Uploading image, Selection of Disease, Prediction of Disease, Report Generation

Story Boarding:

Happy: A patient who needs to diagnose for multiple disease can have solution in our all in one app. For eg Pneumonia and COVID 19 can be checked simultaneously by providing chest X-ray.

Sad: Once, a patient who had not enough money went to imaging center for X-ray checkupAfter getting reports, he consulted to Doctor and he found that reports for Pneumonia were negative. So, he paid money for negative reports. Instead he could get results from Our app for free



Design For *AIDOC*

Date 29/09/2020

Design By

Version

Daksh	171310132025
Jainam	171310132029
Meet	171310132034
Tirth	171310132040

USER

Doctor

Patient

App Administrator

Inmate

STAKEHOLDERS

Hospital Staff

Doctor Consultant

ACTIVITIES

User Registration

User Login

Uploading Image

Selecting Disease

Predicting Disease

Report Generation

STORY BOARDING

HAPPY

A patient who needs to diagnose for multiple disease can have solution in our all in one app. For eg Pneumonia and COVID 19 can be checked simultaneously by providing chest X-ray.

HAPPY

Once a patient get positive report of any disease diagnosed in our app can have facility to directly book an appointment with doctor. As reports are automatically generated, It can be sent to doctor and can be consulted to doctor.

SAD

Once, a patient who had not enough money went to imaging center for X-ray checkup After getting reports, he consulted to Doctor and he found that reports for Pneumonia were negative. So, he paid money for negative reports. Instead he could get results from Our app for free

SAD

Once a patient went to hospital for consultation. After seeing a long queue, he returned to his home without consulting doctor.

2.3 Ideation Canvas

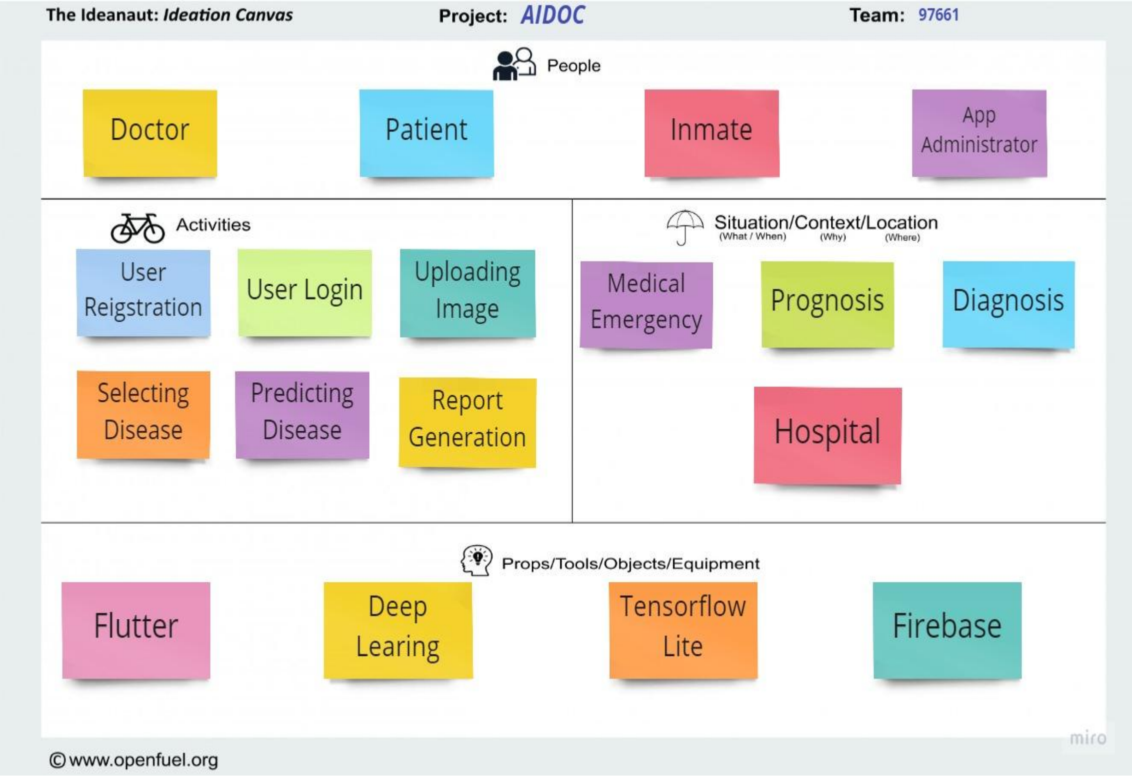
This was the second step of our project. From this canvas, we got the idea that who are the people involved. We have inspected which type of activities are related to our project? What are the suitable locations for our activities? At last we found the possible solutions for concerned problems.

Details of Our Ideation Canvas

People: Doctor, Patient, Inmate, App administrator

Situation /Context/Location: Medical Emergency, Prognosis, Diagnosis,Hospital

Props/Tools/Obejcts/Equipment: Flutter, Deep Learning, Tensorflow Lite, Firebase



The Ideanaut: *Ideation Canvas* Project: AIDOC Team: 97661

People

Doctor

Patient

Inmate

App Administrator

Activities

User Reigstration

User Login

Uploading Image

Selecting Disease

Predicting Disease

Report Generation

Situation/Context/Location (What / When) (Why) (Where)

Medical Emergency

Prognosis

Diagnosis

Hospital

Props/Tools/Objects/Equipment

Flutter

Deep Learing

Tensorflow Lite

Firebase

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miro

2.4 Product Development Canvas

Product Canvas will require us to start building a structutre of our product around the emotional need of the user. Building solution around the emotive needs of user is central to design thinking.

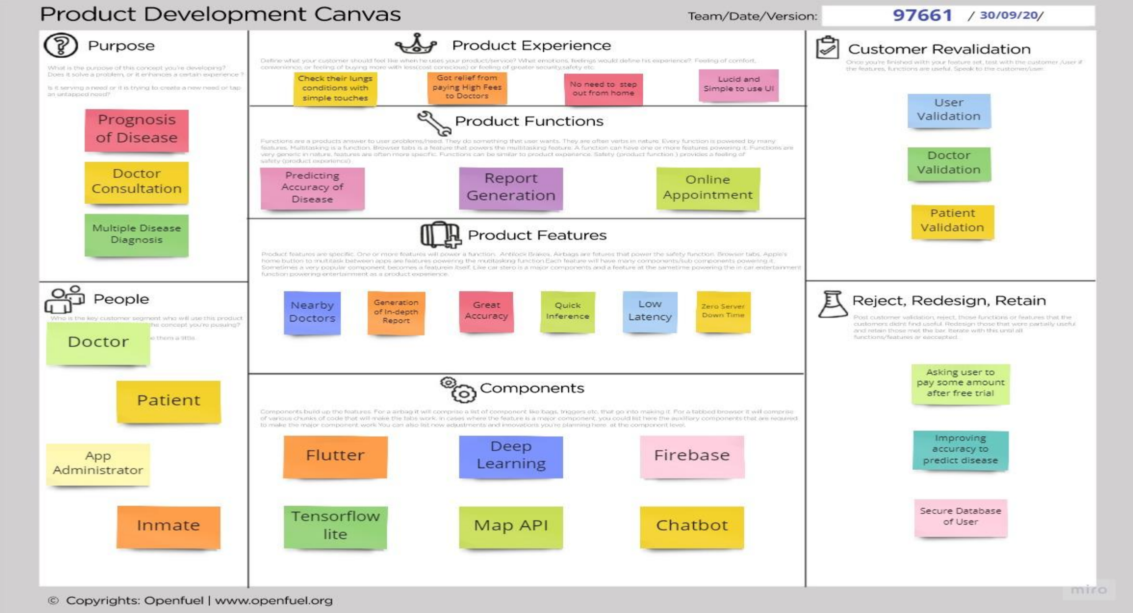
Designing Product Strategy had taught us a powerful and practical technique used by thousands of product people to design and execute a new product idea or even analyze and rejuvenate an existing one. From possible solutions we got the idea about the product which should be developed in order to solve the problems.

Details of Product Development Canvas:

Product Experience: Check user lungs condititon with minimal clicks, Got relief from paying High fees to Doctor,No need to step out from home, Lucid and Simple to use UI

Product Functions: Predicting accuracy of disease, Report Generation, Online Appointment,

Product Features; Nearby doctors, Great Accuracy, Quick Interface, Low Latency, Zero Server Down time



Product Development Canvas

Team/Date/Version: 97661 / 30/09/20/

Purpose

What is the purpose of this concept you're developing? Does it solve a problem, or it enhances a certain experience ?

Is it serving a need or it is trying to create a new need or tap an untapped need?

Prognosis of Disease

Doctor Consultation

Multiple Disease Diagnosis

People

Who is the key customer segment who will use this product ... the concept you're pusuing? ... e them a little.

Doctor

Patient

App Administrator

Inmate

Product Experience

Define what your customer should feel like when he uses your product/service? What emotions, feelings would define his experience? Feeling of comfort, convenience, or feeling of buying more with less(cost conscious) or feeling of greater security,safety etc.

Check their lungs conditions with simple touches

Got relief from paying High Fees to Doctors

No need to step out from home

Lucid and Simple to use UI

Product Functions

Functions are a products answer to user problems/need. They do something that user wants. They are often verbs in nature. Every function is powered by many features. Multitasking is a function. Browser tabs is a feature that powers the multitasking feature. A function can have one or more features powering it. Functions are very generic in nature, features are often more specific. Functions can be similar to product experiance. Safety (product function) provides a feeling of safety (product experience).

Predicting Accuracy of Disease

Report Generation

Online Appointment

Product Features

Product features are specific. One or more features will power a function. Antilock Brakes, Airbags are fetures that power the safety function. Browser tabs, Apple's home button to multitask between apps are features powering the multitasking function Each feature will have many components/sub components powering it. Sometimes a very popular component becomes a featurein itself. Like car stero is a major components and a feature at the sametime powering the in car entertainment function powering entertainment as a product experience.

Nearby Doctors

Generation of In-depth Report

Great Accuracy

Quick Inference

Low Latency

Zero Server Down Time

Components

Components build up the features. For a airbag it will comprise a list of component like bags, triggers etc. that go into making it. For a tabbed browser it will comprise of various chunks of code that will make the tabs work. in cases where the feature is a major component, you could list here the auxiliary components that are required to make the major component work You can also list new adjustments and innovations you're planning here. at the component level.

Flutter

Deep Learning

Firebase

Tensorflow lite

Map API

Chatbot

Customer Revalidation

Once you're finished with your feature set, test with the customer /user if the features, functions are useful. Speak to the customer/user.

User Validation

Doctor Validation

Patient Validation

Reject, Redesign, Retain

Post customer validation, reject, those functions or features that the customers didnt find useful. Redesign those that were partially useful and retain those met the bar. Iterate with this until all functions/features ar eaccepted.

Asking user to pay some amount after free trial

Improving accuracy to predict disease

Secure Database of User

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CH - 3 : Implementation

3.1 Implementation

1) Integrating CNN model to our App using Machine Teachable by Google

Teachable Machine is a web-based tool that makes creating machine learning models fast, easy, and accessible to everyone.

Working of Machine Teachable:

I. Gather

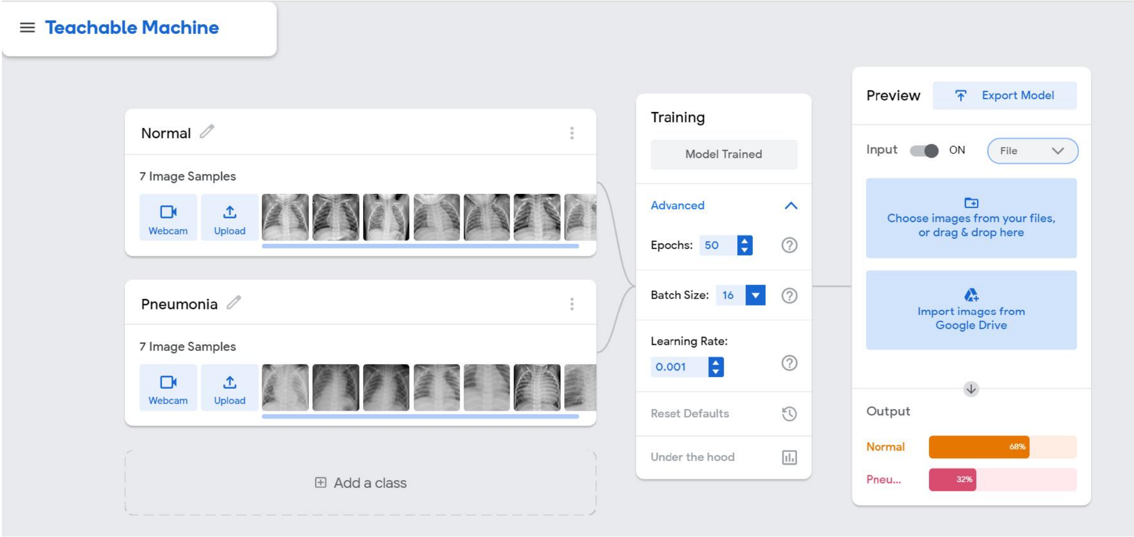
Gather and group your examples into classes, or categories, that you want the computer to learn.

II. Train

Train your model, then instantly test it out to see whether it can correctly classify new examples.

III. Export

Export your model for your projects: sites, apps, and more. You can download your model or host it online for free.



Teachable Machine

Normal
7 Image Samples

Pneumonia
7 Image Samples

Training
Model Trained
Advanced
Epochs: 50
Batch Size: 16
Learning Rate: 0.001

Preview
Input ON File

Output
Normal 68%
Pneu... 32%

Webcam
Upload
Webcam
Upload
Add a class
Reset Defaults
Under the hood
Export Model
Choose images from your files, or drag & drop here
Import images from Google Drive

We have used the dataset from Kaggle which contains 5863 image of chest x-ray of two categories i.e. Pneumonia and Normal.

Link for dataset: https://www.kaggle.com/paultimothymooney/chest-xray-pneumonia

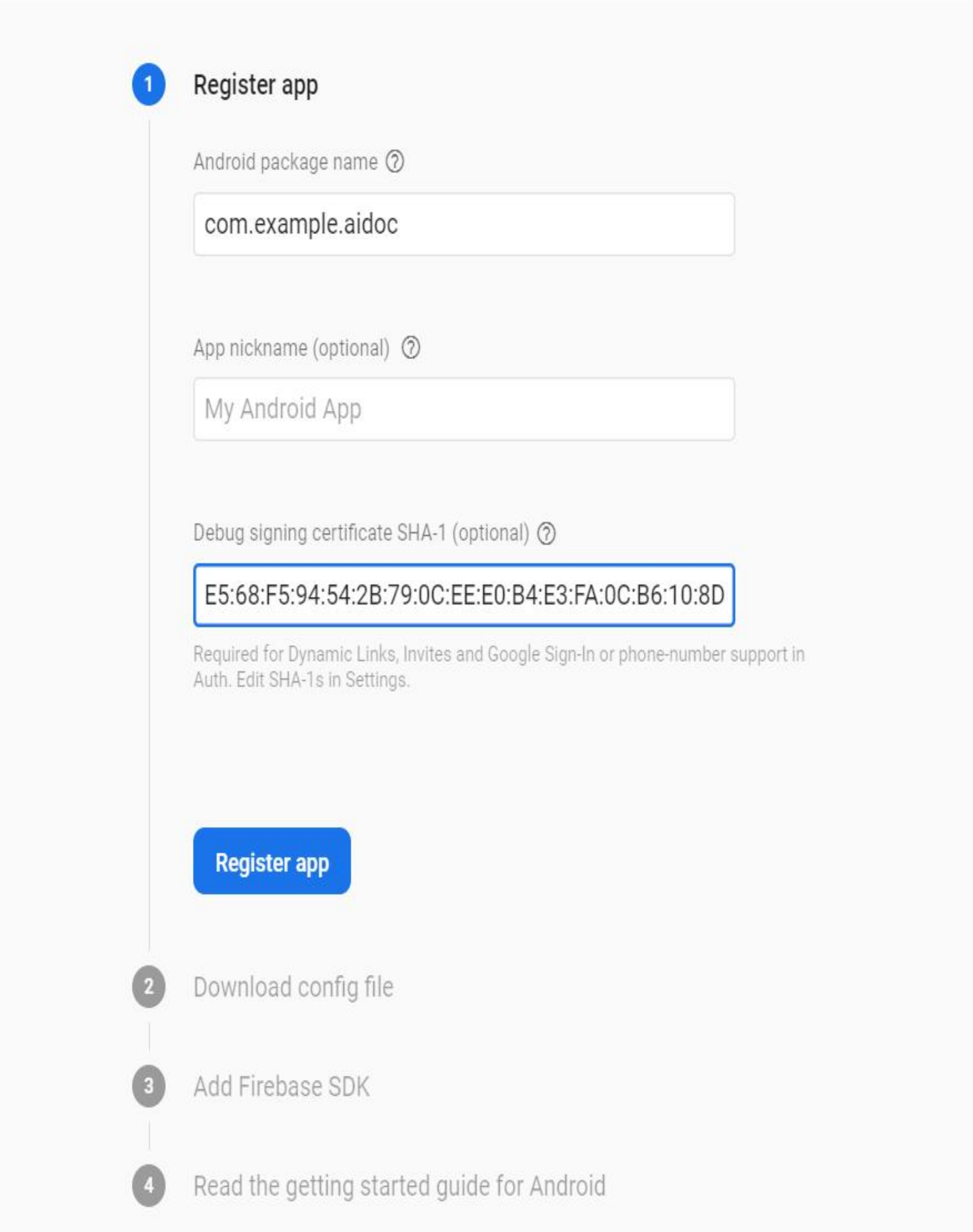
We have exported tflite file which is required for integration of deep learning model with smartphone. TensorFlow Lite is an open source deep learning framework for on-device inference.

2) Registration and Login of User using Firebase Console

Setup of Firebase:

I. App registration on Firebase Console
Android Package name: package name can be obtained from project directory in app\build.gradle

II. Debug signing certificate SHA -1
It can be obtained by code in terminal written below:
C:\Users\meet0\.android\debug.keystore" -alias androiddebugkey -storepass android -keypass android



1 Register app

Android package name: com.example.aidoc

App nickname (optional): My Android App

Debug signing certificate SHA-1 (optional): E5:68:F5:94:54:2B:79:0C:EE:E0:B4:E3:FA:0C:B6:10:8D

Required for Dynamic Links, Invites and Google Sign-In or phone-number support in Auth. Edit SHA-1s in Settings.

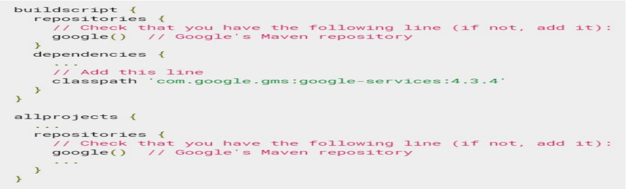
2 Download config file

3 Add Firebase SDK

4 Read the getting started guide for Android

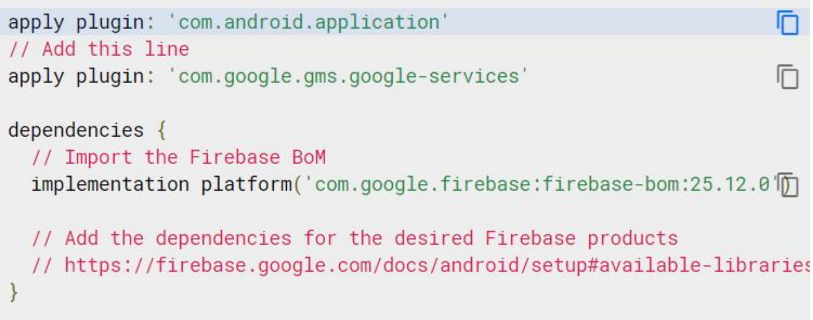
III. After registration of app, it allow us to download config file named "google-services.json".

IV. Modify your project level build gradle



```
buildscript {
  repositories {
    // Check that you have the following line (if not, add it):
    google()  // Google's Maven repository
  }
  dependencies {
    ...
    // Add this line
    classpath 'com.google.gms:google-services:4.3.4'
  }
}

allprojects {
  ...
  repositories {
    // Check that you have the following line (if not, add it):
    google()  // Google's Maven repository
    ...
  }
}
```

V. Modify app level build gradle



```
apply plugin: 'com.android.application'
// Add this line
apply plugin: 'com.google.gms.google-services'

dependencies {
  // Import the Firebase BoM
  implementation platform('com.google.firebase:firebase-bom:25.12.0'

  // Add the dependencies for the desired Firebase products
  // https://firebase.google.com/docs/android/setup#available-librarie
}
```

Registration of User:

User Registers himself by providing necessary details, which are highly secured. The fields which are mandatory to provide in order to get il with our service is as follow:-

a). User Name
b). E-mail
c). Age
d). Password

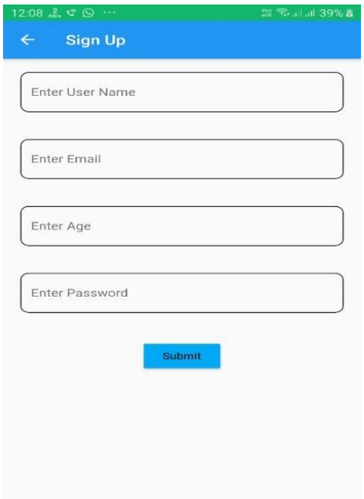
User registration code:

```
import 'package:firebase_auth/firebase_auth.dart';
import 'package:firebase_database/firebase_database.dart';
import 'package:flutter/material.dart';

import 'home.dart';

class EmailSignUp extends StatefulWidget {
  @override
  _EmailSignUpState createState() => _EmailSignUpState();
}

class _EmailSignUpState extends State<EmailSignUp> {
```

```
bool isLoading = false;
final _formKey = GlobalKey<FormState>();
FirebaseAuth firebaseAuth = FirebaseAuth.instance;
DatabaseReference dbRef =
    FirebaseDatabase.instance.reference().child("Users");
TextEditingController emailController = TextEditingController();
TextEditingController nameController = TextEditingController();
TextEditingController passwordController = TextEditingController();
TextEditingController ageController = TextEditingController();

@override
Widget build(BuildContext context) {
  return Scaffold(
      appBar: AppBar(title: Text("Sign Up")),
      body: Form(
          key: _formKey,
          child: SingleChildScrollView(
              child: Column(children: <Widget>[
            Padding(
              padding: EdgeInsets.all(20.0),
              child: TextFormField(
                controller: nameController,
                decoration: InputDecoration(
                  labelText: "Enter User Name",
                  enabledBorder: OutlineInputBorder(
                    borderRadius: BorderRadius.circular(10.0),
                  ),
                ),
                // The validator receives the text that the user has entered.
                validator: (value) {
                  if (value.isEmpty) {
                    return 'Enter User Name';
                  }
                  return null;
                },
              ),
            ),
            Padding(
              padding: EdgeInsets.all(20.0),
              child: TextFormField(
                controller: emailController,
                decoration: InputDecoration(
                  labelText: "Enter Email",
                  enabledBorder: OutlineInputBorder(
                    borderRadius: BorderRadius.circular(10.0),
                  ),
                ),
                // The validator receives the text that the user has entered.
                validator: (value) {
                  if (value.isEmpty) {
                    return 'Enter an Email Address';
                  } else if (!value.contains('@')) {
                    return 'Please enter a valid email address';
                  }
                  return null;
                },
              ),
            ),
            Padding(
              padding: EdgeInsets.all(20.0),
              child: TextFormField(
                controller: ageController,
                decoration: InputDecoration(
                  labelText: "Enter Age",
                  enabledBorder: OutlineInputBorder(
                    borderRadius: BorderRadius.circular(10.0),
                  ),
                ),
                // The validator receives the text that the user has entered.
                validator: (value) {
                  if (value.isEmpty) {
                    return 'Enter Age';
                  }
                  return null;
                },
              ),
            ),
            Padding(
              padding: EdgeInsets.all(20.0),
              child: TextFormField(
                obscureText: true,
                controller: passwordController,
                decoration: InputDecoration(
                  labelText: "Enter Password",
                  enabledBorder: OutlineInputBorder(
                    borderRadius: BorderRadius.circular(10.0),
                  ),
                ),
                // The validator receives the text that the user has entered.
                validator: (value) {
                  if (value.isEmpty) {
                    return 'Enter Password';
                  } else if (value.length < 6) {
                    return 'Password must be atleast 6 characters!';
                  }
                  return null;
                },
              ),
            ),
            Padding(
              padding: EdgeInsets.all(20.0),
              child: isLoading
                  ? CircularProgressIndicator()
                  : RaisedButton(
                      color: Colors.lightBlue,
                      onPressed: () {
                        if (_formKey.currentState.validate()) {
                          setState(() {
                            isLoading = true;
                          });
                          registerToFb();
                        }
                      },
                      child: Text('Submit'),
                    ),
            )
```

```
          ]))));
}

void registerToFb() {
  firebaseAuth
      .createUserWithEmailAndPassword(
          email: emailController.text, password: passwordController.text)
      .then((result) {
    dbRef.child(result.user.uid).set({
      "email": emailController.text,
      "age": ageController.text,
      "name": nameController.text
    }).then((res) {
      isLoading = false;
      /*Navigator.pushReplacement(
        context,
        MaterialPageRoute(builder: (context) => Home(uid: result.user.uid)),
      );*/
    });
  }).catchError((err) {
    showDialog(
        context: context,
        builder: (BuildContext context) {
          return AlertDialog(
            title: Text("Error"),
            content: Text(err.message),
            actions: [
              FlatButton(
                child: Text("Ok"),
                onPressed: () {
                  Navigator.of(context).pop();
                },
              )
            ],
          );
        });
  });
}

@override
void dispose() {
  super.dispose();
  nameController.dispose();
  emailController.dispose();
  passwordController.dispose();
  ageController.dispose();
}
                                                 }
```

Output:-



User Login :

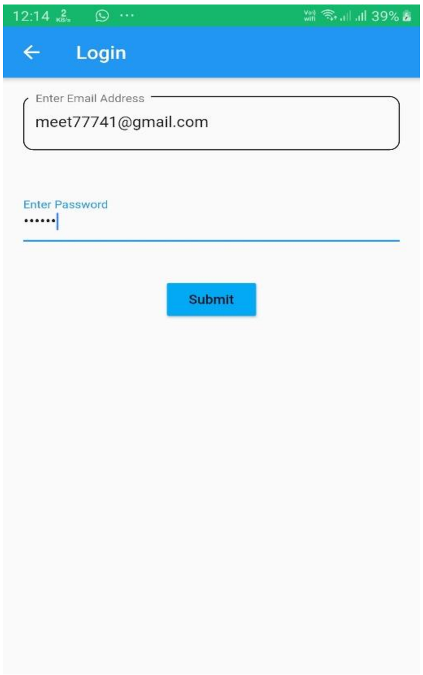
User credentials are verified with firebase when user enters the details for login. If the credentials are matched, then User can login and page will be redirected to Home screen of app or else an exception will be thrown.

User login code:

```
import 'package:firebase_auth/firebase_auth.dart';
import 'package:flutter/material.dart';

import 'home.dart';

class EmailLogIn extends StatefulWidget {
  @override
  _EmailLogInState createState() => _EmailLogInState();
}

class _EmailLogInState extends State<EmailLogIn> {
  final _formKey = GlobalKey<FormState>();
  TextEditingController emailController = TextEditingController();
  TextEditingController passwordController = TextEditingController();

  bool isLoading = false;

  @override
  Widget build(BuildContext context) {
    return Scaffold(
        appBar: AppBar(title: Text("Login")),
        body: Form(
            key: _formKey,
            child: SingleChildScrollView(
                child: Column(children: <Widget>[
              Padding(
                padding: EdgeInsets.all(20.0),
                child: TextFormField(
                  controller: emailController,
                  decoration: InputDecoration(
                    labelText: "Enter Email Address",
                    enabledBorder: OutlineInputBorder(
                      borderRadius: BorderRadius.circular(10.0),
                    ),
                  ),
                  // The validator receives the text that the user has entered.
                  validator: (value) {
                    if (value.isEmpty) {
                      return 'Enter Email Address';
                    }
                    else if(!value.contains('@')){
                      return 'Please enter a valid email address!';
                    }
                    return null;
                  },
                ),
              ),
              Padding(
                padding: EdgeInsets.all(20.0),
                child: TextFormField(
                  obscureText: true,
                  controller: passwordController,
                  decoration: InputDecoration(
                    labelText: "Enter Password",
                    enabledBorder: OutlineInputBorder(
                      borderRadius: BorderRadius.circular(10.0),
                    ),
                  ),
                  // The validator receives the text that the user has entered.
                  validator: (value) {
                    if (value.isEmpty) {
                      return 'Enter Password';
                    } else if (value.length < 6) {
                      return 'Password must be atleast 6 characters!';
                    }
                    return null;
                  },
                ),
              ),
              Padding(
                padding: EdgeInsets.all(20.0),
                child: isLoading
                    ? CircularProgressIndicator()
                    : RaisedButton(
                        color: Colors.lightBlue,
                        onPressed: () {
                          if (_formKey.currentState.validate()) {
                            setState(() {
                              isLoading = true;
                            });
                            logInToFb();
                          }
                        },
                        child: Text('Submit'),
                      ),
              )
            ]))));
  }

  void logInToFb() {
    FirebaseAuth.instance
        .signInWithEmailAndPassword(
            email: emailController.text, password: passwordController.text)
        .then((result) {
      isLoading = false;
      Navigator.pushReplacement(
        context,
        MaterialPageRoute(builder: (context) => Home(uid: result.user.uid)),
      );
    }).catchError((err) {
      print(err.message);
      showDialog(
          context: context,
          builder: (BuildContext context) {
```

```
      return AlertDialog(
        title: Text("Error"),
        content: Text(err.message),
        actions: [
          FlatButton(
            child: Text("Ok"),
            onPressed: () {
              Navigator.of(context).pop();
            },
          )
        ],
      );
     });
  });
 }
}
```

Output:-



Enter Email Address
meet77741@gmail.com

Enter Password
••••••

3) Preparing our own Custom deep learning model and converting it to tflite

For trial purpose, we had used machine teachable to train our model. But in this step, we have created our own custom deep learning model using transfer learning. We have used inception v3 model. After training, model is saved as .h5 file in which weights and bias are stored. But due to combability issue, It directly cannot be integrated with app. So, we need to convert our .h5 model to .tflite file which is compatible with our smartphones.

We have used the dataset from Kaggle which contains 5863 image of chest x-ray of two categories i.e. Pneumonia and Normal.

Link for dataset: https://www.kaggle.com/paultimothymooney/chest-xray-pneumonia

I. CNN model:

```
import os
os.environ['KAGGLE_USERNAME'] = 'meetpatel07'
os.environ['KAGGLE_KEY'] = '9a6c73b1674993e844a85662b4eb2471'

!kaggle datasets download -d paultimothymooney/chest-xray-pneumonia

!unzip chest-xray-pneumonia.zip
!unzip chest_xray.zip

"""## Checking out the data/images"""

import matplotlib.pyplot as plt
import matplotlib.image as mpimg

training_dir = './chest_xray/train'
validation_dir = './chest_xray/test'
test_dir = './chest_xray/val'

img = mpimg.imread(training_dir + '/NORMAL/IM-0115-0001.jpeg')
imgplot = plt.imshow(img)
plt.show()

def plot_images(path, labeled=False, max_images=6):
  amount = 0
  fig = plt.figure(figsize=(12, 6))

  for file in os.listdir(path):
    if file.endswith('.jpeg'):
      if amount == max_images:
        break

      img = mpimg.imread(os.path.join(path, file))
```

```
        plt.subplot(231+amount)
        if labeled:
          plt.title(file.split('_')[1])
        imgplot = plt.imshow(img)

        amount += 1

plot_images(training_dir + '/NORMAL')

plot_images(training_dir + '/PNEUMONIA', labeled=True)

"""## Train the model"""

import keras
from keras.applications.inception_v3 import InceptionV3
from keras.preprocessing.image import ImageDataGenerator

rescale = 1./255.0
target_size = (150, 150)
batch_size = 32
class_mode = 'categorical'

train_datagen = ImageDataGenerator(
    width_shift_range=0.1,
    height_shift_range=0.1,
    shear_range=0.2,
    zoom_range=0.2,
    horizontal_flip=True,
    rescale=rescale
)
train_generator = train_datagen.flow_from_directory(
    training_dir,
    target_size=target_size,
    class_mode=class_mode,
    batch_size=batch_size
)

validation_datagen = ImageDataGenerator(rescale=rescale)
validation_generator = validation_datagen.flow_from_directory(
    validation_dir,
    target_size=target_size,
    class_mode=class_mode,
    batch_size=batch_size
)

test_datagen = ImageDataGenerator(rescale=rescale)
test_generator = test_datagen.flow_from_directory(
    test_dir,
    target_size=target_size,
    class_mode=class_mode,
    batch_size=1
)

def get_model():
  base_model = InceptionV3(weights='imagenet', include_top=False)
  x = base_model.output
  x = keras.layers.GlobalAveragePooling2D()(x)
  x = keras.layers.Dense(1024, activation='relu')(x)
  x = keras.layers.BatchNormalization()(x)
  predictions = keras.layers.Dense(2, activation='softmax')(x)
  model = keras.models.Model(inputs=base_model.inputs, outputs=predictions)

  for layer in base_model.layers:
    layer.trainable = False

  model.summary()
  return model

model = get_model()

model.compile(keras.optimizers.Adam(0.001), loss='categorical_crossentropy',
metrics=['accuracy'])
history = model.fit_generator(
    train_generator,
    steps_per_epoch=len(train_generator),
    epochs=5,
    verbose=1,
    validation_data=validation_generator,
    validation_steps=len(validation_generator)
)

"""## Evaluate the model"""

result  = model.evaluate_generator(test_generator, steps=len(test_generator), verbose=1)
print('Loss:', result[0])
print('Accuracy:', result[1])

y_pred_batches = []
y_true_batches = []
y_img_batches = []

for i in range(0, len(test_generator)):
  y_img_batch, y_true_batch = test_generator[i]
  y_true_batch = y_true_batch.argmax(axis=-1)
  y_img_batches.append(y_img_batch)
  y_true_batches.append(y_true_batch)

  y_pred_batch = model.predict(y_img_batch)
  y_pred_batch = y_pred_batch.argmax(axis=-1)
  y_pred_batches.append(y_pred_batch)

y_pred_batches

def predict_images(images_path, label):
  amount = 0
  fig = plt.figure(figsize=(18, 8))

  for file in os.listdir(images_path):
    if file.endswith('.jpeg'):
      if amount == 8:
        break

      img = mpimg.imread(os.path.join(images_path, file))
      plt.subplot(241+amount)
      plt.title('{} ---- {}'.format(label, 'NORMAL' if y_pred_batches[amount] == 0 else
'PNEUMONIA'))
      imgplot = plt.imshow(img)

      amount += 1

predict_images('./chest_xray/val/NORMAL', 'NORMAL')
predict_images('./chest_xray/val/PNEUMONIA', 'PNEUMONIA')

"""## Model saving and loading"""
model.save('awesome_model.h5')
new_model = keras.models.load_model('awesome_model.h5')
```

II. Conversion of .h5 to tflite file

```
import tensorflow as tf

model = tf.keras.models.load_model('E:\Dataset\awesome_model.h5')
converter = tf.lite.TFLiteConverter.from_keras_model(model)
tflite_model = converter.convert()
open("model_unquant.tflite", "wb").write(tflite_model)
```

4) Creating UI for dashboard

Our dashboard contains an image, navigation bar, Carousel slide show with some images, and grid view for selection of disease. For instance, we have created Carousel slideshow with images but in future it will be replaced by articles related to health.

Code for Dashboard:

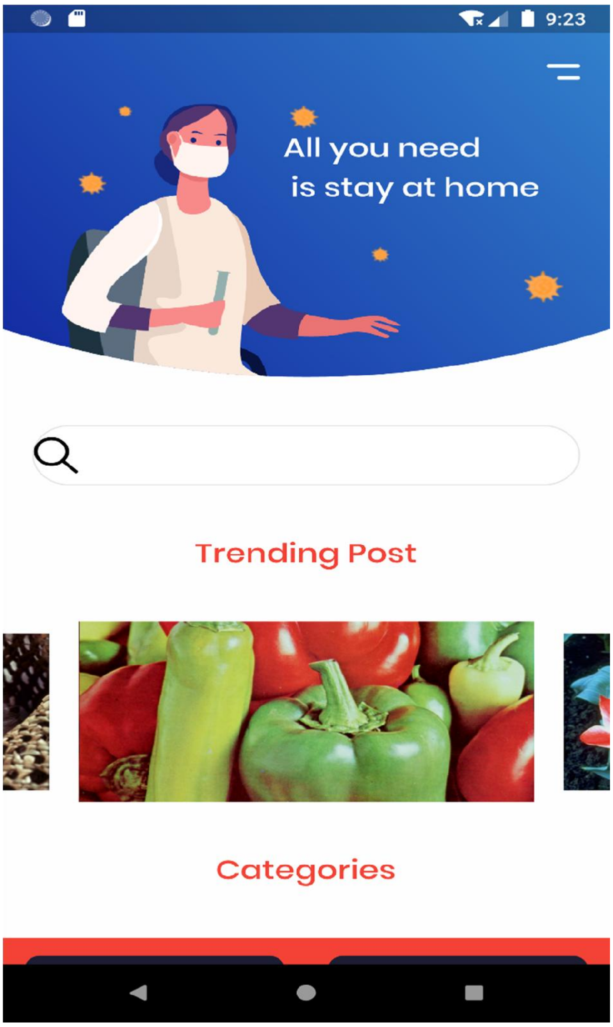
```
import 'package:firebase_auth/firebase_auth.dart';
import 'package:firebase_database/firebase_database.dart';
import 'package:flutter/material.dart';
import 'package:cloud_firestore/cloud_firestore.dart';
import 'main.dart';
import 'constant.dart';
import 'package:carousel_slider/carousel_slider.dart';
import 'package:flutter_svg/flutter_svg.dart';
import 'Pneumonia.dart';
class Home extends StatelessWidget {
  Home({this.uid});
  final String uid;
  final String title = "Home";

  List<String> imageLinks = [
    'https://homepages.cae.wisc.edu/~ece533/images/fruits.png',
    'https://homepages.cae.wisc.edu/~ece533/images/cat.png',
    'https://homepages.cae.wisc.edu/~ece533/images/peppers.png',
    'https://homepages.cae.wisc.edu/~ece533/images/tulips.png'
  ];

  void _navigateToNextScreen(BuildContext context) {
    Navigator.of(context).push(MaterialPageRoute(builder: (context) =>
NewScreen()));
  }



  @override
  Widget build(BuildContext context) {
    return Scaffold(
        appBar: AppBar(
          title: Text(title),
          actions: <Widget>[
            IconButton(
              icon: Icon(
                Icons.exit_to_app,
                color: Colors.white,
              ),
              onPressed: () {
                FirebaseAuth auth = FirebaseAuth.instance;
                auth.signOut().then((res) {
                  Navigator.pushReplacement(
                    context,
                    MaterialPageRoute(builder: (context) => MyApp()),
                  );
                });
              },
    )
  ],
),
body: SingleChildScrollView(
  child: Column(
    children: <Widget>[
      ClipPath(
        clipper: MyClipper(),
        child: Container(
          padding: EdgeInsets.only(left: 40, top: 50, right: 20),
          height: 350,
          width: double.infinity,
          decoration: BoxDecoration(
            gradient: LinearGradient(
                begin: Alignment.topRight,
                end: Alignment.bottomLeft,
                colors: [
                  Color(0xFF3383CD),
                  Color(0xFF11249F)
                ]
            ),
            image: DecorationImage(
              image: AssetImage("assets/images/virus.png"),
            ),
          ),
          child: Column(
            crossAxisAlignment: CrossAxisAlignment.start,
            children: <Widget>[

              Align(
                  alignment: Alignment.topRight,
                  child: SvgPicture.asset("assets/icons/menu.svg")
              ),
              SizedBox(height: 20),
              Expanded(
                child: Stack(
                  children: <Widget>[
                    SvgPicture.asset("assets/icons/Drcorona.svg",
                      width: 230,
                      fit: BoxFit.fitWidth,
                      alignment: Alignment.topCenter,
                    ),
                    Positioned(
                      top: 20,
                      left: 150,
                      child: Text(
                        "All you need \n is stay at home",
                        style: kHeadingTextStyle.copyWith(
                          color: Colors.white,
                        ),
                      ),
                    ),
                    Container(),
                  ],
                ),
              )
            ],
          ),
                  ),
                ),
                Container(
                    margin: EdgeInsets.symmetric(horizontal:20),
                    height: 50,
                    width: double.infinity,
                    decoration: BoxDecoration(
                      color: Colors.white,
                      borderRadius: BorderRadius.circular(25),
                      border: Border.all(
                          color: Color(0xFFE5E5E5)
                      ),
                    ),
                    child: Row(
                      children: <Widget>[

                        SvgPicture.asset("assets/icons/search.svg",width:50,height:
30,)
                      ],
                    )
                ),
                SizedBox(height: 40),
                Container(
                  child: Text("Trending Post", style:
kHeadingTextStyle.copyWith(color: Colors.red,),),
                ),
                SizedBox(height:40),
                Container(
                  child: Column(
                    children: <Widget>[
                      CarouselSlider(
                        height: 150.0,
                        items: imageLinks.map((imageLink) {
                          return Builder(
                            builder: (BuildContext context) {
                              return Container(
                                  width: MediaQuery.of(context).size.width,
                                  margin: EdgeInsets.symmetric(horizontal: 10.0),
                                  child: Image.network(
                                    imageLink,
                                    fit: BoxFit.cover,
                                  ));
                            },
                          );
                        }).toList(),

                        reverse:
                        false, //is false by default (reverses the order of items)
                        enableInfiniteScroll:
                        true, //is true by default (it scrolls back to item 1 after
the last item)
                        autoPlay: true, //is false by default
                        initialPage:
                        0, //allows you to set the first item to be displayed
                        scrollDirection: Axis.horizontal, //can be set to
Axis.vertical
                        pauseAutoPlayOnTouch: Duration(
                            seconds: 5), //it pauses the sliding if carousel is
```

```
touched,
                      onPageChanged: (int pageNumber) {
                        //this triggers everytime a slide changes
                      },
                      viewportFraction: 0.8,
                      enlargeCenterPage: true, //is false by default
                      aspectRatio:
                      16 / 9, //if height is not specified, then this value is
used
                    )
                  ],
                ),
              ),
              SizedBox(height: 40,),
              Container(
                  child: Text("Categories",style:
kHeadingTextStyle.copyWith(color: Colors.red,),)
              ),
              SizedBox(height: 40),
              Container(
                height:650,
                color: Colors.red,
                child: Column(
                  children: <Widget>[
                    Expanded(child:Row(
                      children: <Widget>[
                        Expanded(child:new GestureDetector(
                          onTap: (){_navigateToNextScreen(context);},
                          child: Container(
                              margin: EdgeInsets.all(15.0),
                              decoration: BoxDecoration(
                                color:Color(0xFF1D1E33),
                                borderRadius: BorderRadius.circular(10.0),
                              ),
                              child:Column(
                                mainAxisAlignment: MainAxisAlignment.center,
                                children: <Widget>[
                                  Text('Pneumonia', style:
kHeadingTextStyle.copyWith(color: Colors.white, fontSize: 25),),
                                ],
                              )
                          ),
                        ),
                        ),
                        Expanded(child:new GestureDetector(
                          child: Container(
                              margin: EdgeInsets.all(15.0),
                              decoration: BoxDecoration(
                                color:Color(0xFF1D1E33),
                                borderRadius: BorderRadius.circular(10.0),
                              ),
                              child:Column(
                                mainAxisAlignment: MainAxisAlignment.center,
                                children: <Widget>[
                                  Text('Fracture', style:
kHeadingTextStyle.copyWith(color: Colors.white, fontSize: 25),),
                                ],
                              )
```

```
             ),
            ),
            ),
           ],
          ),
          ),
          Expanded(child:Row(
           children: <Widget>[
            Expanded(child:new GestureDetector(
             child: Container(
               margin: EdgeInsets.all(15.0),
               decoration: BoxDecoration(
                color:Color(0xFF1D1E33),
                borderRadius: BorderRadius.circular(10.0),
               ),
               child:Column(
                mainAxisAlignment: MainAxisAlignment.center,
                children: <Widget>[
                 Text('COVID 19', style:
kHeadingTextStyle.copyWith(color: Colors.white, fontSize: 25),),
                ],
               )
             ),
            ),
            ),
            Expanded(child:new GestureDetector(child:Container(
              margin: EdgeInsets.all(15.0),
              decoration: BoxDecoration(
               color:Color(0xFF1D1E33),
               borderRadius: BorderRadius.circular(10.0),
              ),
              child:Column(
               mainAxisAlignment: MainAxisAlignment.center,
               children: <Widget>[
                Text('Pneumonia', style:
kHeadingTextStyle.copyWith(color: Colors.white, fontSize: 25),),
               ],
              )
            ),
            ),
            ),
           ],
          ),
          ),
          Expanded(child:Row(
           children: <Widget>[
            Expanded(child:new GestureDetector(
             child: Container(
              margin: EdgeInsets.all(15.0),
              decoration: BoxDecoration(
               color:Color(0xFF1D1E33),
               borderRadius: BorderRadius.circular(10.0),
              ),

             ),
            ),
            ),
            Expanded(child:Container(
                          margin: EdgeInsets.all(15.0),
                          decoration: BoxDecoration(
                            color:Color(0xFF1D1E33),
                            borderRadius: BorderRadius.circular(10.0),
                          ),

                        ),
                        ),
                      ],
                    ),
                    ),
                  ],
                ),
              ),
            ],
          ),
        ),
        drawer: NavigateDrawer(uid: this.uid));
  }
}

class MyClipper extends CustomClipper<Path>{
  @override
  Path getClip(Size size){
    var path = Path();
    path.lineTo(0, size.height - 80);
    path.quadraticBezierTo(size.width/2, size.height, size.width, size.height -
80);
    path.lineTo(size.width, 0);
    path.close();
    return path;
  }
  @override
  bool shouldReclip(CustomClipper<Path> oldClipper){
    return false;
  }
}

class NavigateDrawer extends StatefulWidget {
  final String uid;
  NavigateDrawer({Key key, this.uid}) : super(key: key);
  @override
  _NavigateDrawerState createState() => _NavigateDrawerState();
}

class _NavigateDrawerState extends State<NavigateDrawer> {

  void initState() {
    super.initState();
    getEmail();
  }

  Future<void> getEmail() async {
    var result = (await
FirebaseDatabase.instance.reference().child("Users").child(widget.uid).once()).val
ue;
    //print(result['email']
    print(result);
```

```
}


@override
Widget build(BuildContext context) {
  return Drawer(
    child: ListView(
      padding: EdgeInsets.zero,
      children: <Widget>[
        UserAccountsDrawerHeader(
          accountEmail: FutureBuilder(
              future: FirebaseDatabase.instance
                  .reference()
                  .child("Users")
                  .child(widget.uid)
                  .once(),
              builder: (context, AsyncSnapshot<DataSnapshot> snapshot) {
                if (snapshot.hasData) {
                  return Text(snapshot.data.value['email']);
                } else {
                  return CircularProgressIndicator();
                }
              }),
          accountName: FutureBuilder(
              future: FirebaseDatabase.instance
                  .reference()
                  .child("Users")
                  .child(widget.uid)
                  .once(),
              builder: (context, AsyncSnapshot<DataSnapshot> snapshot) {
                if (snapshot.hasData) {
                  return Text(snapshot.data.value['name']);
                } else {
                  return CircularProgressIndicator();
                }
              }),

          decoration: BoxDecoration(
            color: Colors.blue,
          ),
        ),
        ListTile(
          leading: new IconButton(
            icon: new Icon(Icons.home, color: Colors.black),
            onPressed: () => null,
          ),
          title: Text('Home'),
          onTap: () {

            print(widget.uid);
            Navigator.push(
              context,
              MaterialPageRoute(builder: (context) => Home(uid: widget.uid)),
            );
          },
        ),
        ListTile(
            leading: new IconButton(
              icon: new Icon(Icons.settings, color: Colors.black),
              onPressed: () => null,
            ),
            title: Text('Settings'),
            onTap: () {
              getEmail();
              print(widget.uid);
            },
          ),
        ],
      ),
    );
  }
}
```

Output:



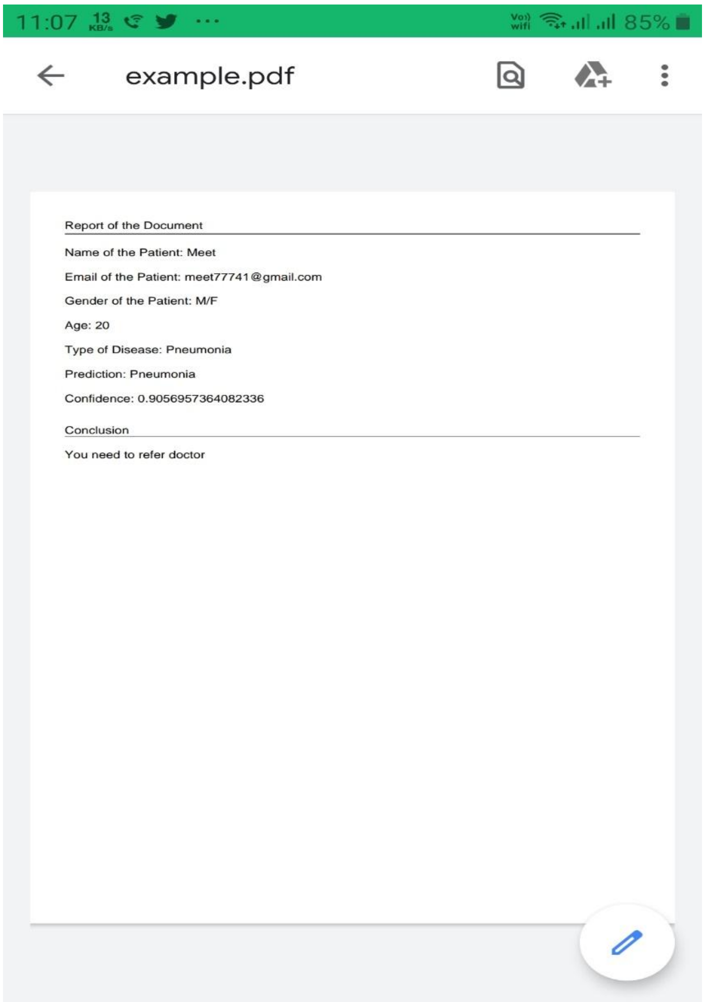
5) Report Generation

Once the disease is predicted, the results will be shown to user. A user has also facility to save report to External storage of smartphone. User only needs to click a button which saves report in pdf format. Report contains details like name of user, email, age, prediction of disease i.e. class, confidence.

Code for saving pdf:

```
final pdf = pw.Document();

writeOnPdf(){
  pdf.addPage(
    pw.MultiPage(
      pageFormat: PdfPageFormat.a4,
      margin: pw.EdgeInsets.all(32),

      build: (pw.Context context){
        return <pw.Widget>[
          pw.Header(
            level: 0,
            child: pw.Text("Report of the Document")
          ),

          pw.Paragraph(
            text: "Name of the Patient: XYZ"
          ),
          pw.Paragraph(
              text: "Gender of the Patient: M/F"
          ),

          pw.Paragraph(
            text:"Type of Disease: Pneumonia"
          ),

          pw.Paragraph(
            text:"Prediction: ${_recognition[0]["label"]}"
          ),
          pw.Paragraph(
            text:"Confidence: ${_recognition[0]["confidence"]}"
          ),



          pw.Header(
            level: 1,
            child: pw.Text("Conclusion")
          ),

          pw.Paragraph(
            text: "You need to refer doctor"
          )
        ];

      }
    )
  );
}

Future savePdf() async{
  Directory documentDirectory =await getExternalStorageDirectory();

  String documentPath = documentDirectory.path;

  File file = File("$documentPath/example.pdf");

  file.writeAsBytesSync(pdf.save());
  print('Documentpath : $documentPath');
}
```

Output:



Report of the Document

Name of the Patient: Meet

Email of the Patient: meet77741@gmail.com

Gender of the Patient: M/F

Age: 20

Type of Disease: Pneumonia

Prediction: Pneumonia

Confidence: 0.9056957364082336

Conclusion

You need to refer doctor

Ch - 4 : Summary and Future Work

4.1 Summary:

In a Nutshell, we have designed and developed mobile application which has a capability of forecasting the wide range of disease from user given input, which is supposed to be in form of image. To get started user needs to follow through registration process which requires some basic users' profile that may help in future. Our Application manifests available diseases which can be accurately and easily forecasted with zero or minimum user intervention. For an Instance, user has an image of Chest X-ray and wishes to check whether he/she is affected by pneumonia in such case our app comes handy. By following the steps guided through our tutor user can get his/her full fledge in depth report and analysis of disease. Along with this, if the severity of disease is above the par then our application also displays the nearby doctor in specific specialization with location on google map.

4.2 Future Work:

- News Article Integration
- Pointing Nearby Doctors' location on google map
- Deploying our app on AWS Server
- AI chatbot
- Online Doctor Consultation
- Enhancing UI

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