COGNITIVE CARE : EARLY INTERVENTION OF ALZHEIMER'S DISEASE

PROJECT REPORT

Submitted by

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1. INTRODUCTION

1.1 Project Overview

Alzheimer's disease (AD) is a progressive and irreversible neurological disorder that affects the brain, leading to memory loss, cognitive impairment, and changes in behavior and personality. As the disease progresses, these symptoms become more severe, with individuals experiencing significant memory loss, difficulty communicating, and a loss of the ability to perform daily activities. By using deep learning models to analyze medical imaging data, it may be able to identify early signs of Alzheimer's disease before symptoms become severe. This can help healthcare providers to provide early treatment and support for patients and their families, ultimately leading to better outcomes for all involved.

1.2 Purpose

The application aims to support healthcare providers in making informed decisions regarding patient care and management. By providing timely and accurate predictions, healthcare providers can have a valuable tool at their disposal for planning appropriate interventions, developing personalized treatment plans, and providing necessary support for patients and their families. The system serves as a helpful tool that enhances the knowledge of healthcare professionals, empowering them to make decisions based on the best available evidence and raise the standard of care for those who have Alzheimer's disease or are at risk for it.

In the patient and caretaker's perspective it can be helpful to make the concerned party aware of the disease,the stage and provide moral support.

2. **IDEATION & PROPOSED SOLUTION**

2.1 Problem Statement Definition :

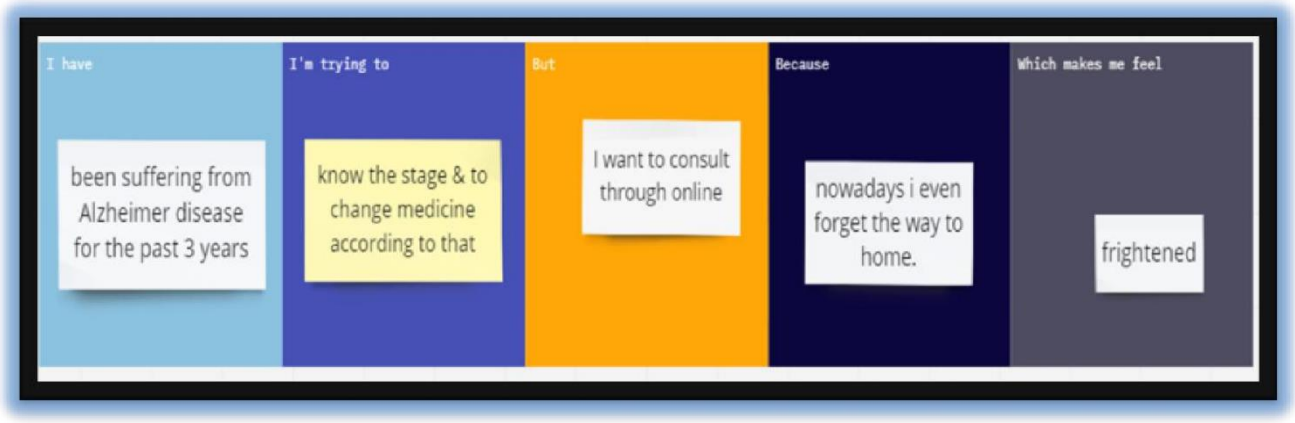
Problem Statement:

Alzheimer's disease is a progressive and irreversible neurological disorder that affects a growing number of older adults worldwide, leading to significant personal and societal burden. Early detection of the disease is critical for providing timely treatment and support for patients and their families. While medical imaging techniques such as MRI can provide valuable information about brain structure, accurately detecting early signs of Alzheimer's disease from these images is a challenging task. Therefore, there is a need for advanced deep learning models like Xception to analyze medical imaging data and improve the accuracy of early detection and diagnosis of Alzheimer's disease

Problem Statement For Early Intervention For Alzheimer's Disease

Problem Statement	I am	I'm trying to	But	Because	Which makes me feel
PS-1	Alzheimer disease patient	Know the stage of my disease	Available methods for predicting Alzheimer disease is not efficient	The website is not responsive and doesn't have a mobile version	Annoyed

PS-2	Primary care physician	Identify patients who may be at risk of developing Alzheimer's disease	I'm not sure about how much accurate they are	I have to provide appropriate medicines according to their stage	Doubtful in providing medicines
PS-3	A care taker for a Alzheimer disease patient	Better understand the progression of the disease and provide more targetted and effective care	It takes too long to respond	I have to provide a effective care	Helpless at times
PS-4	A member of patient advocacy group	Raise awareness about Alzheimer's disease risk factors	I'm unsure about the resources and strategies to use	I want to provide awareness in rural areas	Helpless and depressed
PS-5	Member of health care providers	Develop personalized treatment plans for individuals at risk of developing Alzheimer's disease	Current methods for predicting Alzheimer' s disease is limited	I have to inform patients with correct decisions about health	limited in providing optimal care

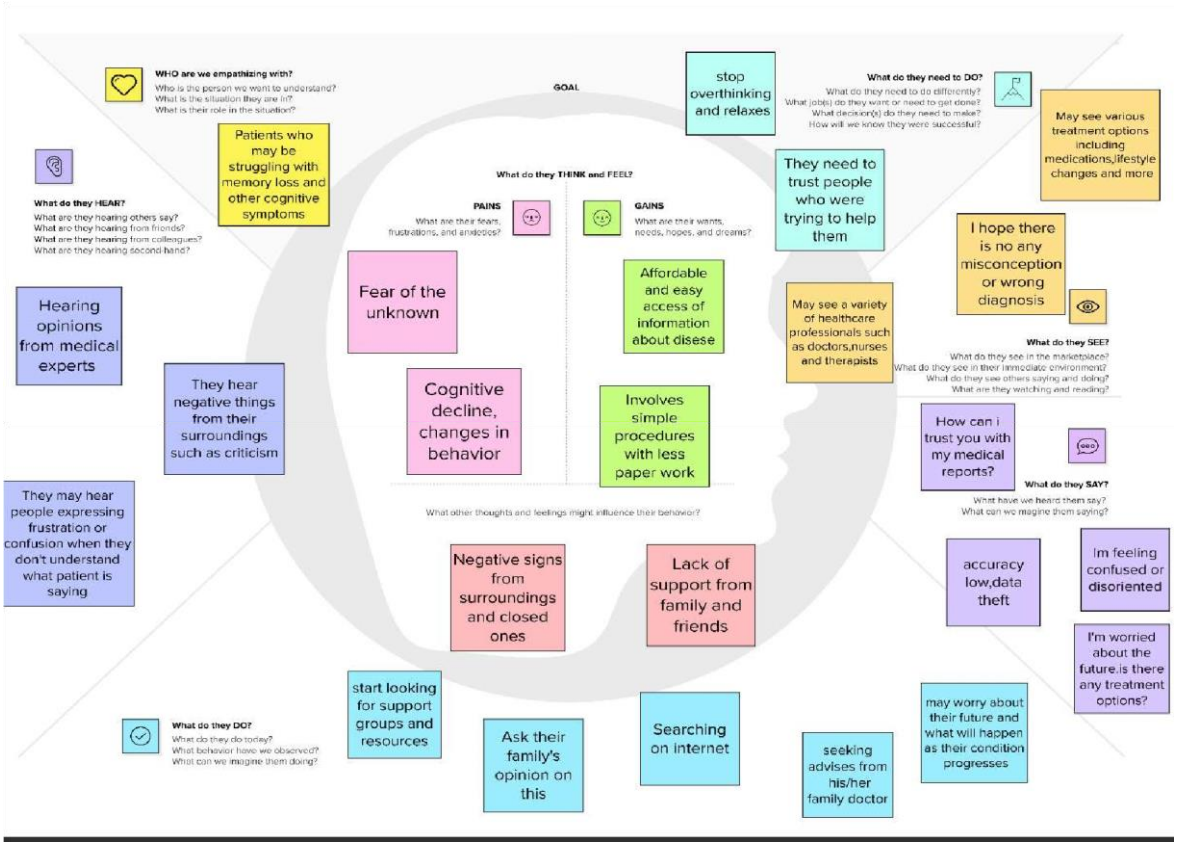


2.2 Empathy Map Canvas:

Empathy Map For Early Intervention For Alzheimer’s Disease:

Empathy Map Canvas is a tool used to better understand the needs, behaviors, and emotions of a particular target group. In the context of Alzheimer's disease, an Empathy Map Canvas can be a valuable tool to gain insights into the experience of individuals living with this condition. This tool allows caregivers and healthcare professionals to create a comprehensive picture of the patient's daily routine, including their emotions, thoughts, and feelings. By using an Empathy Map Canvas, caregivers and healthcare professionals can improve their ability to provide empathetic care that enhances the quality of life for individuals living with Alzheimer's disease.

Empathy Map For Early Intervention For Alzheimer's Disease



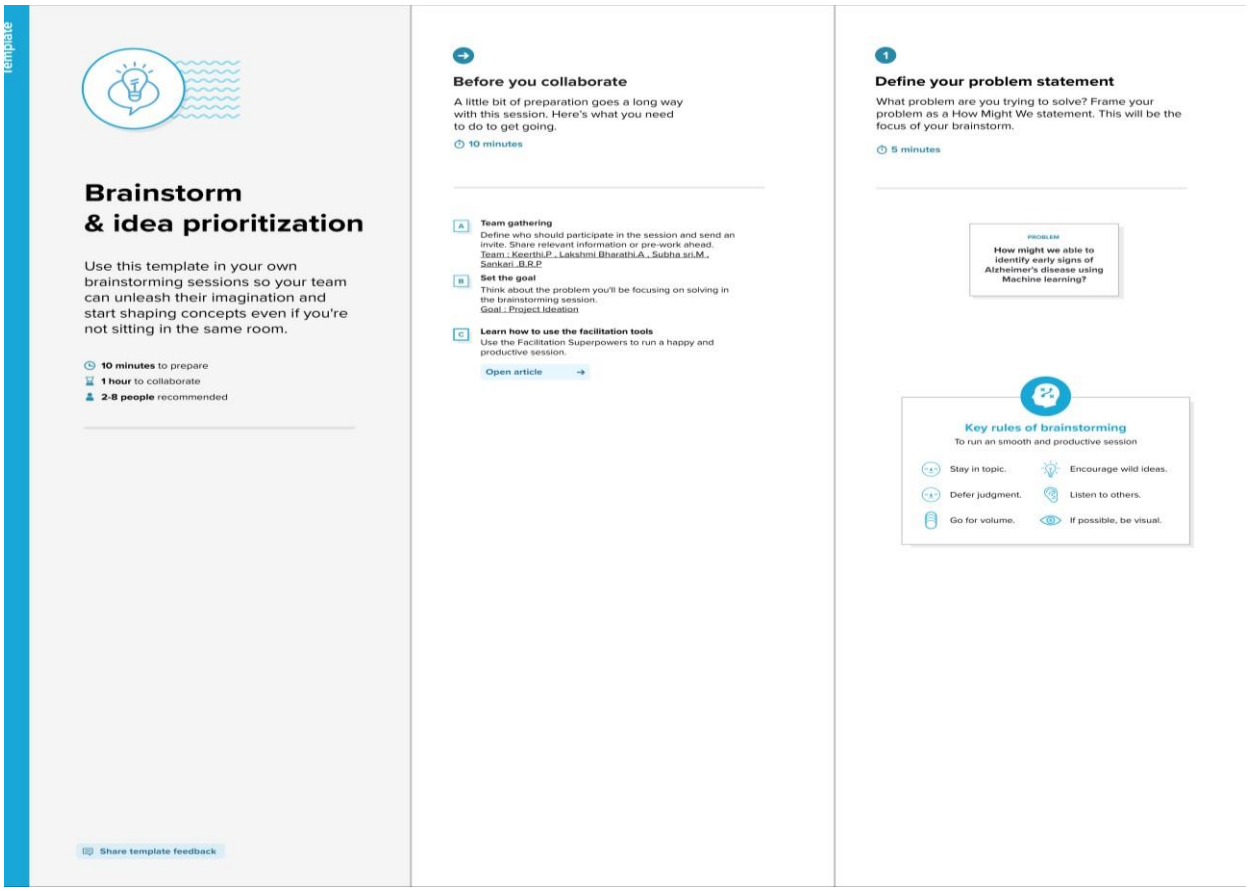
2.3.Ideation & Brainstorming :

Brainstorm & Idea Prioritization Template:

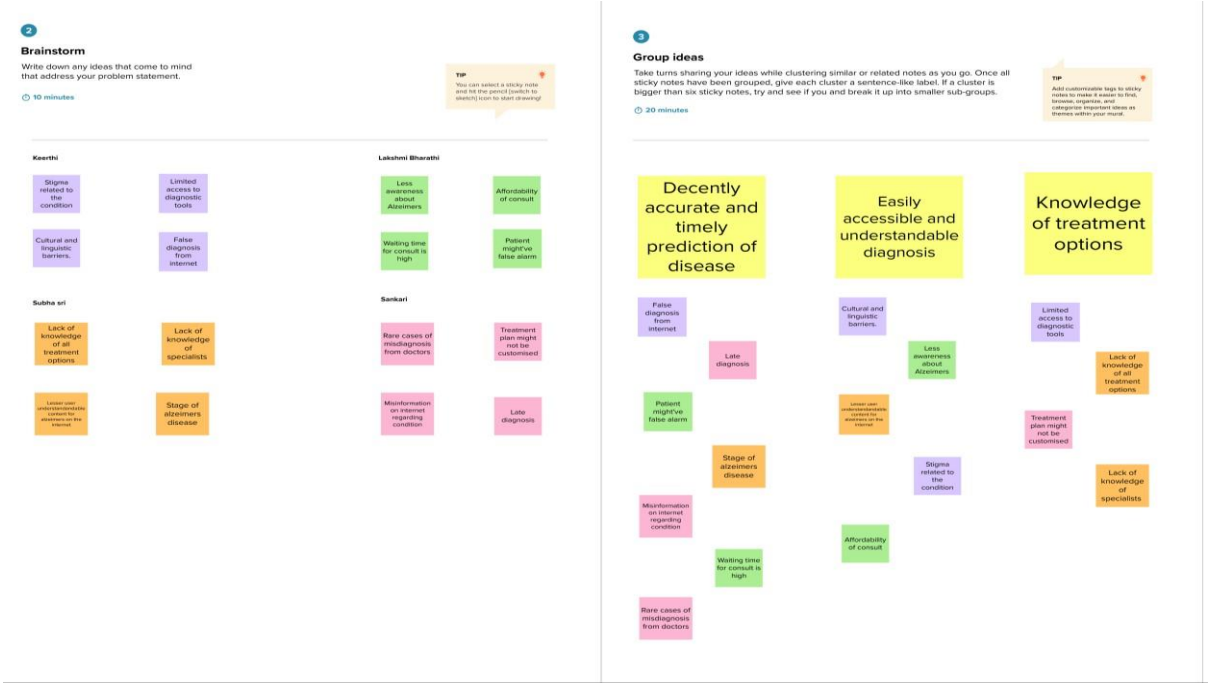
Through brainstorming sessions, various potential solutions were explored to address the challenges posed by Alzheimer's disease. By leveraging these ideas, it may be possible to detect early signs of Alzheimer's before symptoms become severe while simultaneously ensuring the system to be capable of performing well in the market.

Ideas were prioritised after analysing usecases from a customer perspective.

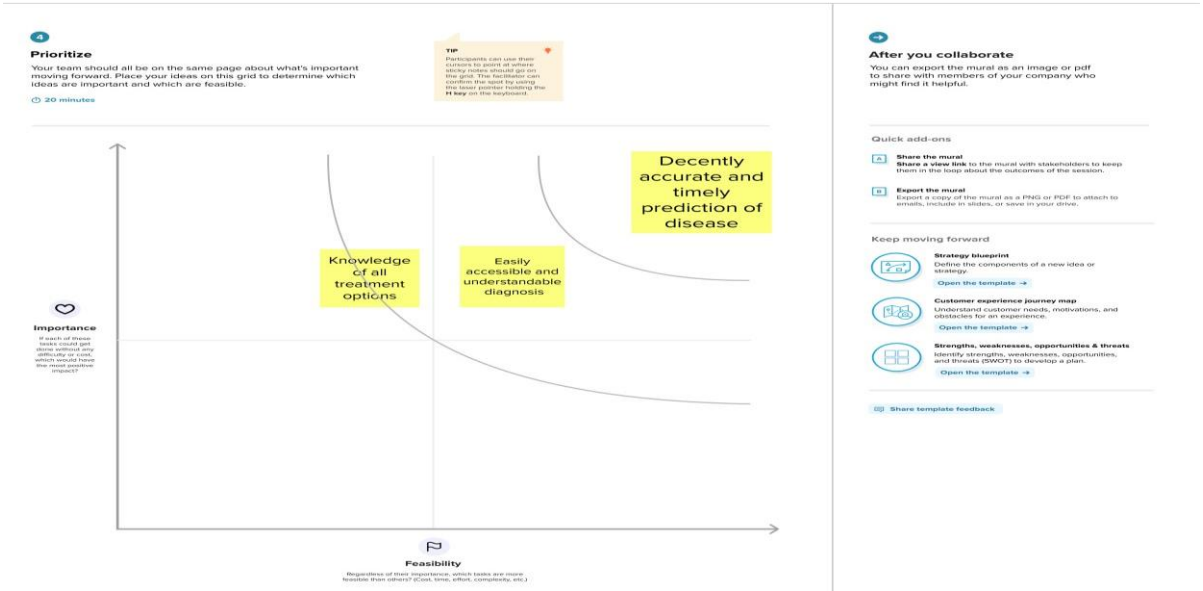
Step-1: Team Gathering, Collaboration and Select the Problem Statement



2: Brainstorm, Idea Listing and Grouping



Step-3: Idea Prioritization



2.4.Proposed Solution :

After brainstorming,a solution is proposed and it is illustrated below in the form of a proposed solution template.

Proposed Solution Template:

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	Alzheimer's disease is a severe neurological ailment that affects millions of individuals throughout the world and causes memory loss and cognitive deterioration. Current Alzheimer's disease diagnostic procedures are time-consuming and costly, resulting in delayed diagnosis and inferior results. Our preferred approach is to create a web application that uses a deep learning model to analyse brain scan images and properly predict the likely development of Alzheimer's disease. The availability of high-quality brain scan data, the accuracy of the deep learning model, and the necessity for more research to prove the efficiency of the web-based application are all constraints of our solution.
2.	Idea / Solution description	The solution we propose is to create a web application that analyses brain scan images and predicts the likelihood of Alzheimer's disease using a deep learning model.The application will have a user-friendly interface with three options: general information about Alzheimer's disease, prediction, and diagnosis based information. When a user selects the prediction option and uploads an image, the Xception deep learning model, integrated with a Flask application, will analyze the image and generate predictions. The predictions will be displayed on the Flask UI for the user to see. Additionally, if the predictions indicate the positive likelihood of Alzheimer's disease, the application will provide information about it.

3.	Novelty / Uniqueness	Our solution provides a more accessible and affordable approach to Alzheimer's disease diagnosis. By using a deep learning model to analyse brain scan images, the application provides fairly accurate predictions quickly. In addition to it, the integration of additional information provides users with a more comprehensive understanding of their diagnosis.
4.	Social Impact / Customer Satisfaction	Millions of individuals throughout the world who are afflicted by Alzheimer's disease might benefit from our approach. Patients can obtain earlier diagnoses, more efficient symptom treatment, and improved quality of life by offering a more accessible and affordable diagnostic strategy. Additionally, it might offer patients more tools for managing their illness.
5.	Business Model (Revenue Model)	This business model is to generate revenue through advertisements and SEO (Search Engine Optimization) strategies. As our web application gains more traffic and users, we can monetize the platform by displaying targeted ads that are relevant to our users. This approach will allow us to offer the web application for free to users while still generating revenue.
6.	Scalability of the Solution	Given that the application can be accessible from any location with an internet connection,the solution has the potential to grow internationally.The system may be expanded to meet the demand as there is a growth in the need for more accessible and affordable diagnostic methods and large amount of users may be accommodated

3.REQUIREMENT ANALYSIS

3.1.Functional Requirements:

Following are the functional requirements of the proposed solution.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	Brain Scan Image Input and Analysis	• User input image upload • Image Preprocessing
FR-2	Disease Diagnosis	• Analysis of image against Xception model • Generation of Prediction by model • Model prediction display in UI
FR-3	User Interface	• General Information about Alzheimer's Page • Diagnosis Prediction (from images uploaded) Page • Diagnosis Information Page

3.2.Non-functional Requirements:

Following are the non-functional requirements of the proposed solution.

FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	The application should be user-friendly and instructions are to be illustrated to ensure language barrier isn't a constraint.
NFR-2	**Security**	Application deployment must be in a secure platform since it hosts sensitive data and to ensure data privacy of user.
NFR-3	**Reliability**	Sudden increase in traffic must be handled without worrying about application crashing or experiencing

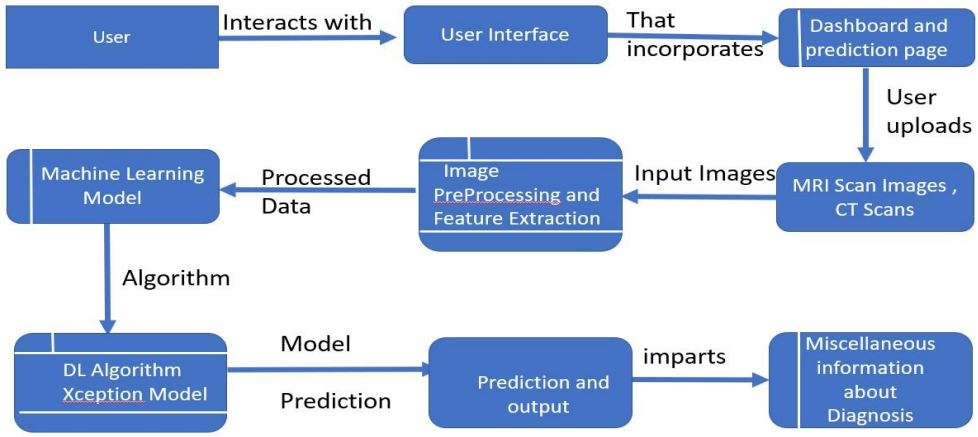
		downtime and if it does, backup and recovery options should be available.
NFR-4	**Performance**	The application should be fast and responsive and the model should take less time to generate result.
NFR-5	**Availability**	Addition of new pages or features and tuning of model should be possible.
NFR-6	**Scalability**	As a rough estimate, the system should be able to handle at least several thousands users per day.

4.PROJECT DESIGN

4.1.Data Flow Diagrams:

A Data Flow Diagram (DFD) is a traditional visual representation of the information flows within a system. A neat and clear DFD can depict the right amount of the system requirement graphically. It shows how data enters and leaves the system, what changes the information, and where data is stored.

DFD Level 0 (Industry Standard) for the proposed solution :



4.2 Solution & Technical Architecture :

Technical Architecture :

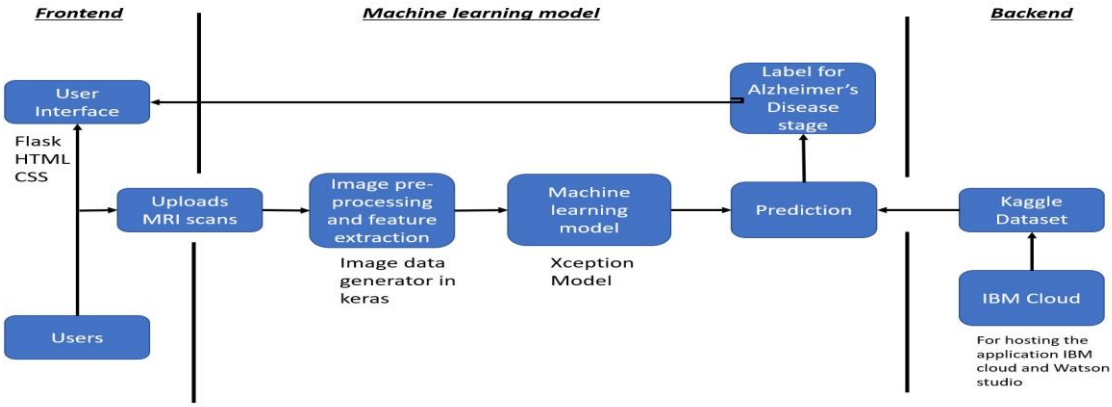


Table-1 : Components & Technologies:

S.No	Component	Description	Technology
1.	User Interface	How user interacts with application through a Web UI which has detailed information about the alzheimer's disease. And the final output is also delivered in the same page after prediction.	Flask, HTML, CSS.
2.	Application Logic-1	The user has a option to upload his/her scan images.	Flask, HTML, CSS.
3.	Application Logic-2	The uploaded image is pre-processed and feature extraction is done and the processed data is sent to the machine learning model.	Image data generator in keras.
4.	Machine Learning Model	The machine learning model uses certain algorithm for prediction.	Xception Model.
5.	External API-1	For dataset and training the model.	Kaggle.
6.	Infrastructure (Server / Cloud)	Application Deployment on Cloud.	Watson Studio, IBM cloud.

Table-2: Application Characteristics:

S.No	Characteristics	Description	Technology	
1.	Open-Source Frameworks	For the development and deployment of application	Watson studio, IBM cloud	
2.	Scalable Architecture	Further, Suggestion regarding nearby hospitals for treatment can be listed in the page.	APIs	
3.	Availability	The application is available all the time.	IBM cloud	
4.	Performance	The application will perform fast and can handle multiple users without crashing and can recover easily	IBM cloud	

4.3.User Stories :

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Team Member
Customer	Dashboard	USN-1	As a user, I gained more information about the disease.	I can access my dashboard	Medium	Subhasri.M, Sankari.BRP
		USN-2	As a user, I came to know about nearby hospitals with Alzheimer treatment options.	I can view my nearby hospitals.	High	Lakshmi Bharathi.A, Keerthi.P
		USN-3	As a user, I can upload my scan images for prediction.	I can upload image.	High	Lakshmi Bharathi.A
		USN-4	As a user, I can receive my diagnosis results.	I can get my results.	High	Keerthi.P
		USN-5	As a user, I can view miscellaneous information about my diagnosis.	I can learn about my disease condition.	Medium	Sankari.BRP
Customer care Executive	Contact	USN-1	As a customer care executive,I can view customer's queries and can provide necessaries about this.	I can clarify their queries.	Low	Subhasri.M

5.Coding and Solutioning

5.1 Feature 1

Feature1.1

In our project, we incorporate an essential element known as an API key. This unique identifier serves as a crucial security mechanism and grants access to the application programming interface (API) of our system. By generating and managing API keys, we can regulate and monitor the usage of our services, ensuring that only authorized users and applications can interact with our project.

```
<!-- ======= Nearby hospitals Section ======= -->
<section id="hospital" class="hospital">
 <div class="container">
  <!DOCTYPE html>
  <html>
   <body>
    <p>Click the button to get your coordinates.</p>

    <button onclick="getLocation()">Try It</button>

    <p id="demo"></p>

    <script>
     var x = document.getElementById("demo");

     function getLocation() {
      if (navigator.geolocation) {
       navigator.geolocation.getCurrentPosition(
        function (position) {
         var latitude = position.coords.latitude;
```

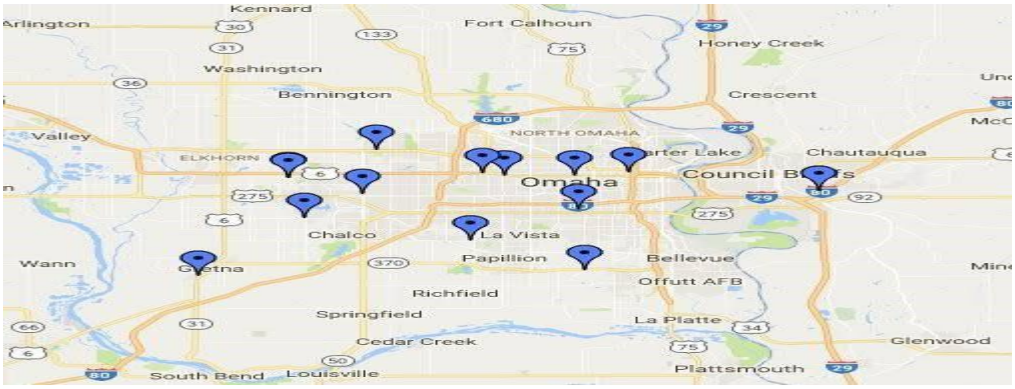
```
        var longitude = position.coords.longitude;

        x.innerHTML =
          "Latitude: " +
          latitude +
          "<br>Longitude: " +
          longitude +
          "<br>Fetching nearby hospitals...";

        var geocodingUrl =
          "https://maps.googleapis.com/maps/api/geocode/json?latlng=" +
          latitude +
          "," +
          longitude +
          "&key=YOUR_API_KEY";

        fetch(geocodingUrl)
          .then((response) => response.json())
          .then((geocodingData) => {
            if (geocodingData.status === "OK") {
              var address = geocodingData.results[0].formatted_address;

              var placesUrl =
                "https://maps.googleapis.com/maps/api/place/nearbysearch/json
?location=" +
                latitude +
                "," +
                longitude +
```

```
  "&radius=5000&type=hospital&key=YOUR_API_KEY";

fetch(placesUrl)
  .then((response) => response.json())
  .then((placesData) => {
    if (placesData.status === "OK") {
      var hospitals = placesData.results;
      var hospitalsList = "";

      for (var i = 0; i < hospitals.length; i++) {
        hospitalsList +=
          "<li>" + hospitals[i].name + "</li>";
      }

      if (hospitalsList !== "") {
        x.innerHTML =
          "Latitude: " +
          latitude +
          "<br>Longitude: " +
          longitude +
          "<br>Address: " +
          address +
          "<br>Nearby Hospitals:<ul>" +
          hospitalsList +
          "</ul>";
      } else {
        x.innerHTML =
```

```
            "Latitude: " +
            latitude +
            "<br>Longitude: " +
            longitude +
            "<br>Address: " +
            address +
            "<br>No nearby hospitals found.";
          }
        } else {
          x.innerHTML =
            "Error fetching nearby hospitals: " +
            placesData.status;
        }
      })
      .catch((error) => {
        x.innerHTML =
          "Error fetching nearby hospitals: " +
          error.message;
        console.log(error);
      });
  } else {
    x.innerHTML =
      "Error fetching address: " + geocodingData.status;
  }
})
.catch((error) => {
  x.innerHTML =
```

```
                    "Error fetching address: " + error.message;
                  console.log(error);
                });
            },
            function (error) {
              x.innerHTML = "Error getting geolocation: " + error.message;
              console.log(error);
            }
          );
        } else {
          x.innerHTML = "Geolocation is not supported by this browser.";
        }
      }
    </script>
    <script
src="https://maps.googleapis.com/maps/api/js?key=YOUR_API_KEY&libraries=
places"></script>
  </body>
</html>
</div>
</section>
```

Sample output



Feature 1.2

Our project is dedicated to providing comprehensive information about Alzheimer's disease and its various types. Alzheimer's disease is a neurodegenerative disorder that affects memory, cognition, and behavior. Understanding this condition is crucial for individuals, caregivers, and healthcare professionals alike. In our project, we have compiled a wealth of knowledge on Alzheimer's disease, including its causes, symptoms, progression, and available treatment options. Additionally, we delve into the different types of Alzheimer's shedding light on the unique characteristics and implications of each subtype. By offering this valuable resource, we aim to increase awareness, promote early detection, and support individuals and families affected by Alzheimer's disease in making informed decisions about their health and well-being.

```
<section id="about" class="about">
    <div class="container-fluid">

     <div class="row">
     <div>
       <div class="underalz">
         <div class="imagee">
           <img src="about.jpg" alt="Doctors image" width="500" height="400">
         </div>
         <h3>Understanding Alzheimer's disease </h3>
         <p>Alzheimer's disease is a progressive brain disorder that affects memory, thinking, and behavior. It is the most common cause of dementia, accounting for 60-80% of all cases. Alzheimer's disease is named after Dr. Alois Alzheimer, who first described the condition in 1906.</p>
         <p>The cause of Alzheimer's disease is not fully understood, but it is thought to be caused by a combination of genetic, environmental, and lifestyle factors. The disease is characterized by the accumulation of abnormal proteins in the brain, which leads to the death of brain cells and the breakdown of neural connections.</p>
```

Diagnosing Alzheimer's disease involves a comprehensive evaluation of a person's medical history, cognitive function, and physical and neurological examinations. There is currently no cure for Alzheimer's disease, but there are medications and therapies that can help manage the symptoms and improve quality of life for people with the condition.

As the population ages, the prevalence of Alzheimer's disease is expected to increase, making it a significant public health concern. It is important to seek medical attention if you or someone you know is experiencing symptoms of Alzheimer's disease, as early diagnosis and treatment can improve quality of life and slow the progression of the disease.

<h4 class="title">The early symptoms of Alzheimer's disease may be mild and include:</h4>

<pre class="description">

1. Memory loss that disrupts daily life, such as forgetting important dates, names, and events

2.Difficulty performing familiar tasks, such as cooking a meal or getting dressed

3.Problems with language, such as forgetting simple words or having difficulty following a

4.conversation

5.Disorientation, such as getting lost in familiar places

6.Misplacing items and being unable to retrace steps to find them</pre>

<h4 class="title">As Alzheimer's disease progresses, symptoms may include:</h4>

<pre class="description">

1.Increased memory loss and confusion

2.Difficulty recognizing friends and family members

3.Difficulty with spatial relationships, such as getting lost while driving or walking

4.Inability to perform simple tasks, such as buttoning a shirt or using a phone

5.Changes in mood and behavior, such as increased agitation or aggression

6.Difficulty with language, such as a tendency to repeat the same phrase or word

7.Inability to recognize common objects or faces.</pre>

<h4 class="title">Effective ways to live with alzheimer</h4>

<pre class="description">

1.Stay physically and mentally active.

2.Simplify tasks and routines.

3.Use memory aids.

4.Eat a healthy diet.

5.Get enough sleep.

```
                6.Take safety precautions
              </pre>
            </div>

          </div>
        </div>
    ">

          </pre>
        </div>
      </div>
    </div>

  </div>
</section><!-- End About Section -->



<!-- ======= Prediction Section ======= -->

</section>
<section id="pred" class="pred">
  <div class="container1" style="background-image:url('D:\IBM frontend\Medilab\assets\img\brainbg.jpg')">

    <div class="section-title">
      <h2>Prediction</h2>
```

```
<p></div>
  <div class="icon-box">

    <h4 class="title"></a>Dementia is a broad term that encompasses a range of neurodegenerative conditions characterized by progressive cognitive decline. Here are the most common types of dementia</h3>
    </h4>
    <div class="buttonn">
      <a href="alzpre.html">
       <button>want to predict</button>

        </a>
      </div>
    </pre>
  </div>
 <h4 class="title" style="font-size: 25px;color:black">Very Mild Demented</h4>
    <p class="description"  style="font-size: 25px;">
      Early detection and intervention are crucial during this stage to ensure appropriate support, including lifestyle modifications, memory aids, and regular cognitive stimulation, which can help slow down the progression of symptoms and promote overall well-being.</p>
  </div>

   <div class="icon-box">
    <div class="icon"><i class="bx bx-brain"></i></div>
    <h4 class="title" style="font-size: 25px;color:black";>Mild Demented</h4>
    <p class="description"  style="font-size: 25px;">
```

Mild dementia refers to a stage of cognitive decline where individuals experience noticeable but relatively modest changes in their thinking abilities and memory. People in this stage may have difficulty remembering recent events or appointments, finding the right words during conversations, or organizing and planning tasks.Early diagnosis and appropriate management strategies, such as medication, cognitive exercises, and a supportive environment, can help individuals with mild dementia maintain their quality of life and delay the progression of symptoms.

<h4 class="title" style="font-size: 25px;color:black";>Moderate Dimented</h4>

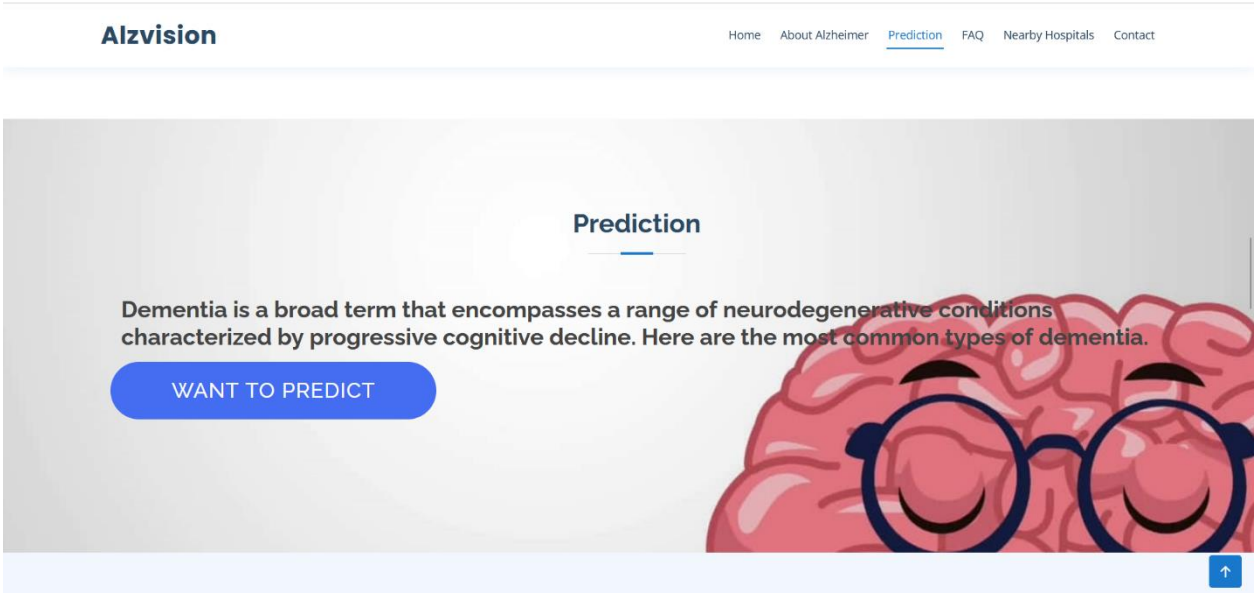
Moderate dementia represents a significant progression in cognitive decline, where individuals experience more pronounced impairments in memory, thinking, and daily functioning. At this stage, individuals typically require more assistance and supervision to ensure their safety and well-being.

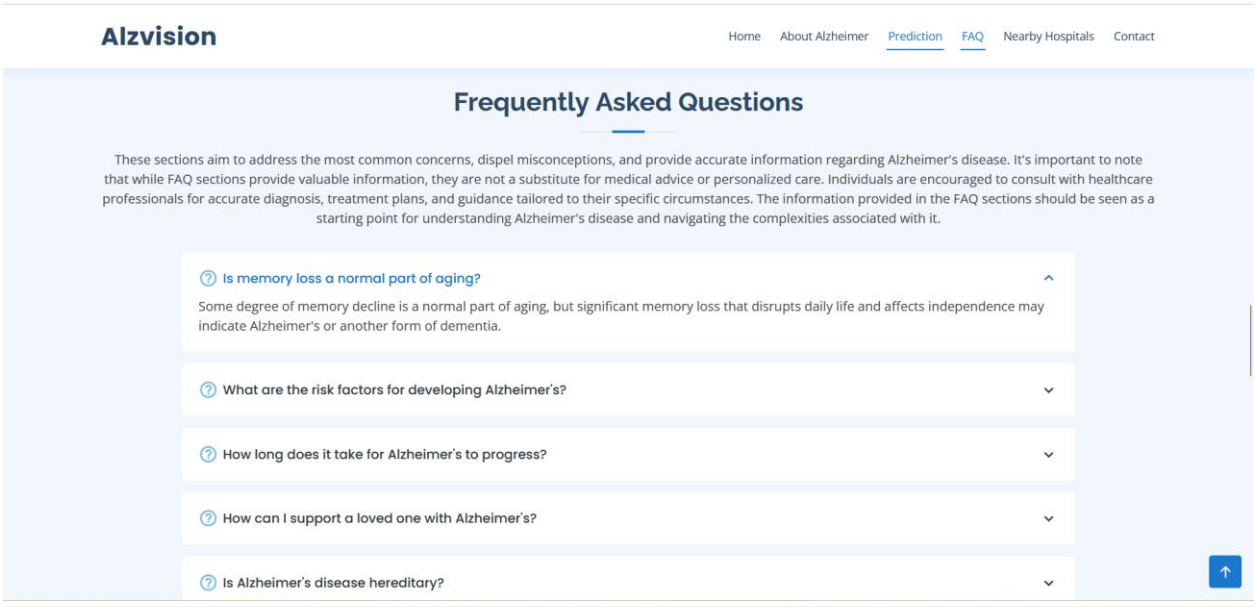
<h4 class="title" style="font-size: 25px;color:black";>Not Demented</h4>

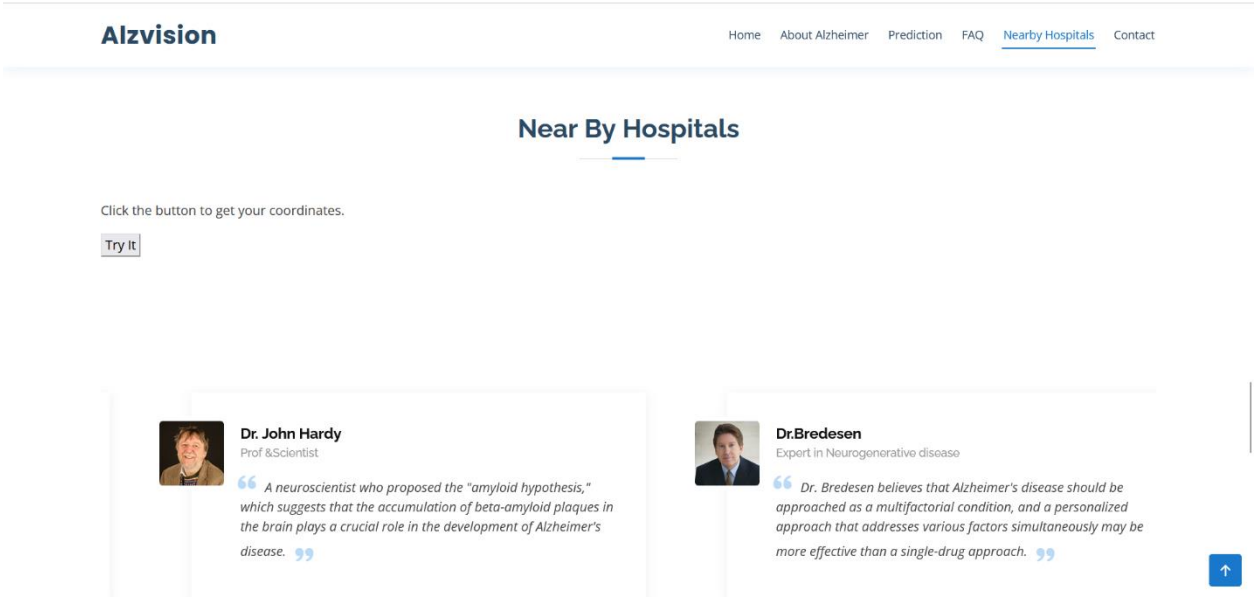
Non-demented individuals refer to those who do not exhibit any signs or symptoms of dementia or cognitive impairment.However Regular check-ups and adopting healthy habits are beneficial for overall brain health and well-being.

OUTPUTS :

index.html :


Alzvision
Home
About Alzheimer
Prediction
FAQ
Nearby Hospitals
Contact
Prediction
Dementia is a broad term that encompasses a range of neurodegenerative conditions characterized by progressive cognitive decline. Here are the most common types of dementia.
WANT TO PREDICT


Alzvision
Home
About Alzheimer
Prediction
FAQ
Nearby Hospitals
Contact
Frequently Asked Questions
These sections aim to address the most common concerns, dispel misconceptions, and provide accurate information regarding Alzheimer's disease. It's important to note that while FAQ sections provide valuable information, they are not a substitute for medical advice or personalized care. Individuals are encouraged to consult with healthcare professionals for accurate diagnosis, treatment plans, and guidance tailored to their specific circumstances. The information provided in the FAQ sections should be seen as a starting point for understanding Alzheimer's disease and navigating the complexities associated with it.
Is memory loss a normal part of aging?
Some degree of memory decline is a normal part of aging, but significant memory loss that disrupts daily life and affects independence may indicate Alzheimer's or another form of dementia.
What are the risk factors for developing Alzheimer's?
How long does it take for Alzheimer's to progress?
How can I support a loved one with Alzheimer's?
Is Alzheimer's disease hereditary?


Alzvision
Home
About Alzheimer
Prediction
FAQ
Nearby Hospitals
Contact
Near By Hospitals
Click the button to get your coordinates.
Try It
Dr. John Hardy
Prof &Scientist
A neuroscientist who proposed the "amyloid hypothesis," which suggests that the accumulation of beta-amyloid plaques in the brain plays a crucial role in the development of Alzheimer's disease.
Dr.Bredesen
Expert in Neurogenerative disease
Dr. Bredesen believes that Alzheimer's disease should be approached as a multifactorial condition, and a personalized approach that addresses various factors simultaneously may be more effective than a single-drug approach.

alzpre.html :

ALZHEIMER'S DISEASE

Very Mild Demented

Early detection and intervention are crucial during this stage to ensure appropriate support, including lifestyle modifications, memory aids, and regular cognitive stimulation, which can help slow down the progression of symptoms and promote overall well-being.

Mild Demented

Mild dementia refers to a stage of cognitive decline where individuals experience noticeable but relatively modest changes in their thinking abilities and memory. People in this stage may have difficulty remembering recent events or appointments, finding the right words during conversations, or organizing and planning tasks.Early diagnosis and appropriate management strategies, such as medication, cognitive exercises, and a supportive environment, can help individuals with mild dementia maintain their quality of life and delay the progression of symptoms.

Moderate Demented

Moderate dementia represents a significant progression in cognitive decline, where individuals experience more pronounced impairments in memory, thinking, and daily functioning. At this stage, individuals typically require more assistance and supervision to ensure their safety and well-being.

Not Demented

Non-demented individuals refer to those who do not exhibit any signs or symptoms of dementia or cognitive impairment.However, it is important to note that aging can still bring about minor cognitive changes, which are considered normal and do not interfere significantly with daily functioning. Regular check-ups and adopting healthy habits are beneficial for overall brain health and well-being.

5.2. Feature 2

Import dataset directly or gather it via Kaggle API

```
! pip install -q kaggle

! mkdir ~/.kaggle

! cp kaggle.json ~/.kaggle/

! chmod 600 ~/.kaggle/kaggle.json

!kaggle datasets download -d tourist55/alzheimers-dataset-4-class-of-images


!unzip /content/alzheimers-dataset-4-class-of-images.zip

# Import libraries

import os  # For interacting with the file system

import shutil  # For managing files and directories in a cross-platform manner

import keras  # For building deep learning models

import tensorflow

import numpy as np  # For numerical operations on arrays

from glob import glob  # For finding file paths

# Data visualization

import matplotlib.pyplot as plt  # For creating static plots

# Model architecture

from keras import Sequential  # For building sequential models

from keras.models import load_model  # For loading pre-trained models

from tensorflow.keras.layers import Dense,Droput, Flatten, Input # For defining

model layers
```

from tensorflow.keras.models import Model

Pre-trained models

from tensorflow.keras.applications import Xception # For using pre-trained model

EXPLORATORY DATA ANALYSIS

Set the paths to the dataset

data_path = '/content/Alzheimer_s Dataset'

data_pathtest='/content/Alzheimer_s Dataset/test'

data_pathtrain='/content/Alzheimer_s Dataset/test'

Get a list of class names from the data path

class_names = sorted(os.listdir(data_path))

class_namestest = sorted(os.listdir(data_pathtest))

class_namestrain = sorted(os.listdir(data_pathtrain))

Count the number of classes

num_classes = len(class_names)

num_classestest = len(class_namestest)

num_classestrain = len(class_namestrain)

Print the class names and the total number of classes

print("Class Names: \n", class_names)

print("Number of Classes:", num_classes)

print("Train lass Names: \n", class_namestrain)

print("Number of Classes:", num_classestrain)

print("Test Class Names: \n", class_namestest)

print("Number of Classes:", num_classestest)

Class Names:

['test', 'train']

Number of Classes: 2

Train lass Names:

['MildDemented', 'ModerateDemented', 'NonDemented', 'VeryMildDemented']

Number of Classes: 4

Test Class Names:

['MildDemented', 'ModerateDemented', 'NonDemented', 'VeryMildDemented']

Number of Classes: 4

class_sizes = []

for name in class_namestrain:

    class_size = len(os.listdir(data_pathtrain+ "/" + name))

    class_sizes.append(class_size)

print("Class Distribution:\n", class_sizes)

Plot a bar chart using the class names as the x-axis and class sizes as the y-

axis

sns.barplot(x=class_namestrain, y=class_sizes)

plt.title('Class distribution for train data')

Add a grid to the plot

plt.grid()

Add a legend to the plot

```
plt.legend()
# Show the plot
plt.show()

class_sizes = []
for name in class_namestest:
    class_size = len(os.listdir(data_pathtest+ &quot;/&quot; + name))
    class_sizes.append(class_size)
print(&quot;Class Distribution:\n&quot;, class_sizes)
# Plot a bar chart using the class names as the x-axis and class sizes as the y-
axis
sns.barplot(x=class_namestest, y=class_sizes)
plt.title(&#39;Class distribution for test data&#39;)
# Add a grid to the plot
plt.grid()
# Add a legend to the plot
plt.legend()
# Show the plot
plt.show()

CREATING *TESTING AND TRAINING DATASET*
trainPath=r&quot;/content/Alzheimer s Dataset/train&quot;
testPath= r&quot;/content/Alzheimer s Dataset/test&quot;
```

CONFIGURE IMAGEDATAGENERATOR CLASS

```
from tensorflow.keras.layers import Dense, Flatten, Input

from tensorflow.keras.models import Model

from tensorflow.keras.preprocessing import image

from tensorflow.keras.preprocessing.image import ImageDataGenerator, load_img

from tensorflow.keras.applications.xception import Xception, preprocess_input


from tensorflow.keras.preprocessing.image import ImageDataGenerator as IDG

IMG_SIZE =180

IMAGE_SIZE= [180, 180]

DIM=(IMG_SIZE, IMG_SIZE)

ZOOM= [.99, 1.01]

BRIGHT_RANGE=[0.8, 1.2]

HORZ_FLIP = True

FILL_MODE = &amp;quot;constant&amp;quot;

DATA_FORMAT = &amp;quot;channels_last&amp;quot;

WORK_DIR=&amp;quot;/content/Alzheimer_s Dataset/train&amp;quot;

work_dr = IDG(rescale =1./255, brightness_range=BRIGHT_RANGE,

        zoom_range=ZOOM, data_format=DATA_FORMAT,

        fill_mode=FILL_MODE, horizontal_flip=HORZ_FLIP)

train_data_gen=work_dr.flow_from_directory(directory=WORK_DIR, target_size=DIM,

batch_size=6500,
```

shuffle=False)

Found 5121 images belonging to 4 classes.

PERFORMING OVERSAMPLING TO HANDLE IMBALANCED DATA

```
#before handling imbalanced data
train_data,train_labels = train_data_gen.next()
print(train_data.shape,train_labels.shape)
```

(5121, 180, 180, 3) (5121, 4)

```
from imblearn.over_sampling import SMOTE
sm=SMOTE(random_state=42)
train_data,train_labels=sm.fit_resample(train_data.reshape(-
1,IMG_SIZE*IMG_SIZE*3),train_labels)
train_data=train_data.reshape(-1,IMG_SIZE,IMG_SIZE,3)
print(train_data.shape,train_labels.shape)
```

(10240, 180, 180, 3) (10240, 4)

SPLIT DATA

```
from sklearn.model_selection import train_test_split
train_data,test_data,train_labels,test_labels=train_test_split(train_data,tr
ain_l
abels,test_size=0.2,random_state=42)
train_data,val_data,train_labels,val_labels=train_test_split(train_data,trai
n_lab
els,test_size=0.2,random_state=42)
```

xm=Xception(input_shape=IMAGE_SIZE+[3],weights='imagenet',include_top=False)

for layer in xm.layers:

  layer.trainable=False

from keras.layers.pooling.global_average_pooling2d import GlobalAveragePooling2D

from tensorflow.keras.models import Sequential

from tensorflow.keras.layers import SeparableConv2D,

BatchNormalization,GlobalAveragePooling2D

custom_inception_model =

Sequential([xm,Dropout(0.5),GlobalAveragePooling2D(),Flatten(),BatchNormalizatioN

(),

 Dense(512,activation='relu'),BatchNormalization(),

Dropout(0.5),Dense(256,

activation='relu'),BatchNormalization(),Dropout (0.5),Dense(128,

activation="relu"),

BatchNormalization(),Dropout(0.5),Dense(64,

activation='relu'),Dropout (0.5),BatchNormalization(),

Dense(4, activation='softmax')

], name="inception_cnn_model")

METRICS=

[tensorflow.keras.metrics.CategoricalAccuracy(name='acc'),tensorflow.keras.metric

s.AUC(name='auc')]

custom_inception_model.compile(optimizer="rmsprop",loss=tensorflow.losses.Categor

icalCrossentropy(), metrics=METRICS)

history=custom_inception_model.fit(train_data,train_labels,

validation_data=(val_data,

val_labels),epochs=30)

Epoch 1/30

205/205 [==============================] - 44s 142ms/step - loss: 1.3443 - acc:

0.4396 - auc: 0.7083 - val_loss: 0.8814 - val_acc: 0.6083 - val_auc: 0.8674

Epoch 2/30

205/205 [==============================] - 21s 102ms/step - loss: 0.9225 - acc:

0.5781 - auc: 0.8447 - val_loss: 0.7093 - val_acc: 0.6785 - val_auc: 0.9067

Epoch 3/30

205/205 [==============================] - 21s 101ms/step - loss: 0.8005 - acc:

0.6318 - auc: 0.8828 - val_loss: 0.6611 - val_acc: 0.6998 - val_auc: 0.9197

Epoch 4/30

205/205 [==============================] - 21s 103ms/step - loss: 0.7295 - acc:

0.6696 - auc: 0.9026 - val_loss: 0.6210 - val_acc: 0.7059 - val_auc: 0.9264

Epoch 5/30

205/205 [==============================] - 22s 109ms/step - loss: 0.6767 - acc:

0.6914 - auc: 0.9160 - val_loss: 0.5856 - val_acc: 0.7352 - val_auc: 0.9360

Epoch 6/30

205/205 [==============================] - 22s 109ms/step - loss: 0.6603 - acc:

0.7061 - auc: 0.9211 - val_loss: 0.5592 - val_acc: 0.7486 - val_auc: 0.9426

Epoch 7/30

205/205 [==============================] - 23s 110ms/step - loss: 0.6243 - acc:

0.7244 - auc: 0.9295 - val_loss: 0.5482 - val_acc: 0.7596 - val_auc: 0.9447

Epoch 8/30

205/205 [==============================] - 22s 105ms/step - loss: 0.5959 - acc:

0.7442 - auc: 0.9366 - val_loss: 0.5171 - val_acc: 0.7621 - val_auc: 0.9502

Epoch 9/30

205/205 [==============================] - 23s 110ms/step - loss: 0.5681 - acc:

0.7639 - auc: 0.9427 - val_loss: 0.5199 - val_acc: 0.7718 - val_auc: 0.9497

Epoch 10/30

205/205 [==============================] - 23s 111ms/step - loss: 0.5463 - acc:

0.7711 - auc: 0.9472 - val_loss: 0.5199 - val_acc: 0.7804 - val_auc: 0.9510

...

Epoch 29/30

205/205 [==============================] - 21s 104ms/step - loss: 0.3055 - acc:

0.8961 - auc: 0.9817 - val_loss: 0.3409 - val_acc: 0.8688 - val_auc: 0.9793

Epoch 30/30

205/205 [==============================] - 22s 109ms/step - loss: 0.2862 - acc:

0.9037 - auc: 0.9841 - val_loss: 0.3666 - val_acc: 0.8523 - val_auc: 0.9782

custom_inception_model.save('adp.h5')

#Testing the model

from tensorflow.keras.models import load_model

model1 = load_model(r'C:\Users\keert\OneDrive\Desktop\alz\Training\adp.h5')

Preprocess the image

from tensorflow.keras.preprocessing import image

from tensorflow.keras.applications.xception import preprocess_input

```
img_path =
r&#39;C:\Users\keert\OneDrive\Desktop\alz\Dataset\test\VeryMildDem
ented\32
(69).jpg&#39;
img = image.load_img(img_path, target_size=(180,180))
x = image.img_to_array(img)
x = x / 255.0  # Normalize the image
# Make predictions
output = model1.predict(np.expand_dims(x, axis=0))
predicted_class = np.argmax(output, axis=1)
print(&quot;Predicted class:&quot;, predicted_class)
1/1 [==============================] - 6s 6s/step
Predicted class: [3]
```

CLOUD DEPLOYMENT :

```
from ibm_watson_machine_learning import APIClient
wml_credentials={
&quot;url&quot;:&quot;https://us-south.ml.cloud.ibm.com&quot;,
&quot;apikey&quot;:&quot;yYHU9PImJF2UehCoclxTyLyabP1MLxsZ
gXygHoJ9gDom&quot;}
client = APIClient(wml_credentials)
client
client.spaces.list()

space_uid = &quot;5e095459-6476-42d2-be25-868b6dd36afc&quot;
space_uid
```

```
client.set.default_space(space_uid)

client.software_specifications.list()

!tar -zcvf ibm_alzheimers.tgz adp.h5

mp=r&quot;C:\Users\keert\OneDrive\Desktop\alz\Training\adp.h5&quot;

model_details = client.repository.store_model(model=mp, meta_props={

   client.repository.ModelMetaNames.NAME:&quot;adp&quot;,

   client.repository.ModelMetaNames.TYPE:&quot;tensorflow_2.7&quot;,

   client.repository.ModelMetaNames.SOFTWARE_SPEC_UID:software_space_uid

})

model_details

client.set.default_space(space_uid)


software_space_uid = client.software_specifications.get_uid_by_name(&quot;runtime-

22.1-py3.9&quot;)

software_space_uid

model_details = client.repository.store_model(model=&quot;alz.tgz&quot;, meta_props={

client.repository.ModelMetaNames.NAME:&quot;alzpre&quot;,

client.repository.ModelMetaNames.TYPE:&quot;tensorflow_2.7&quot;,

client.repository.ModelMetaNames.SOFTWARE_SPEC_UID:software_space_uid

})
```

model_id = client.repository.get_model_id(model_details)

model_id

client.repository.download(model_id,'alz.tgz')

Flask

In our project we have used python flask for connencting the frontend with the trained model. Flask is written in Python, which makes it a natural choice for integrating machine learning models developed in Python. It can easily interact with popular machine learning libraries such as scikit-learn, TensorFlow, PyTorch, or Keras, allowing you to use these libraries alongside Flask to create and serve predictions.

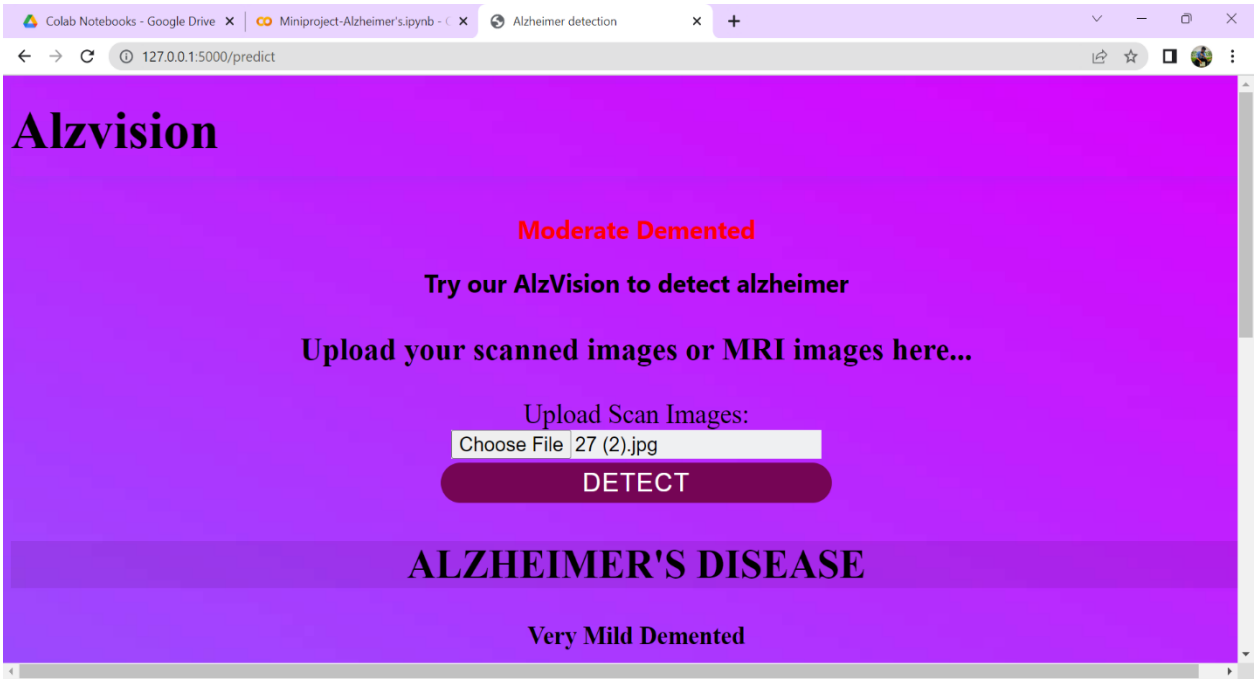
App.py

```
import numpy as np
import os
from keras.preprocessing import image
from PIL import Image
import pandas as pd
import cv2
import tensorflow.compat.v1 as tf
from flask import Flask, request, render_template
from werkzeug.utils import secure_filename
from tensorflow.python.keras.models import load_model
from keras.layers import BatchNormalization
from keras.preprocessing import image as tf_image

custom_objects = {'BatchNormalization': BatchNormalization}

app = Flask(__name__, static_url_path='/static')
print("TF", tf.__version__)
sess = tf.compat.v1.Session()
tf.compat.v1.keras.backend.set_session(sess)
```

```
model=tf.keras.models.load_model(r"C:\Users\mywal\OneDrive\Desktop\Cognitive Care-Early detection of alzheimers\Training\adp.h5", custom_objects=custom_objects, compile=False)

@app.route('/', methods=['GET'])
def index():
    return render_template('index.html')

@app.route('/alzpre', methods=['GET'])
def predict1():
    return render_template('alzpre.html')

@app.route('/predict', methods=['POST'])
def upload():
    if request.method == 'POST':
        f = request.files['image']
        basepath = os.path.dirname(__file__)
        file_path = os.path.join(basepath, 'uploads', secure_filename(f.filename))
        f.save(file_path)
        img = cv2.imread(file_path)
        img = cv2.cvtColor(img, cv2.COLOR_BGR2RGB)
        img = cv2.resize(img, (180, 180))
        x = np.array(img)
        x = np.expand_dims(x, axis=0)

        prediction = model.predict(x)
        if prediction[0].any() == 0:
            text = "Mild Demented"
        elif prediction[0].any() == 1:
            text = "Moderate Demented"
        elif prediction[0].any() == 2:
            text = "Non Demented"
        else:
            text = "Very Mild Demented"
```

```
        return render_template('alzpre.html',output=text)

if __name__ == "__main__":
    app.run(debug=True)
```

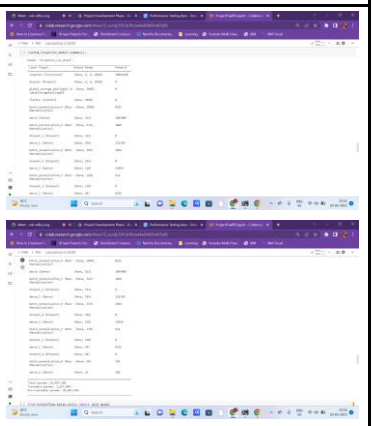
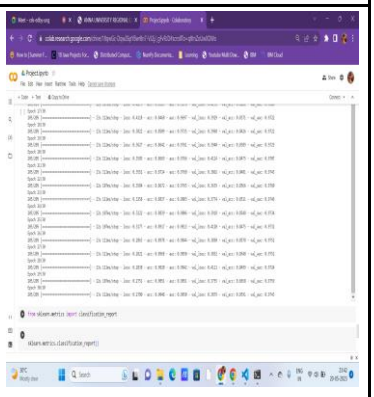
SAMPLE OUTPUT



6. RESULTS

6.1 Performance Metrics :

The performance metrics of the system is given below

S.No.	Parameter	Values	Screenshot
1.	Model Summary	Total Parameters : 20,095,340 Trainable Parameters : 1,227,844 Non – Trainable parameters : 20,867,496	
2.	Accuracy	Training Accuracy -90.48% Validation Accuracy -97.43%	

7.ADVANTAGES AND DISADVANTAGES

7.1.Advantages:

By simply visiting our website, users will gain a wealth of knowledge about Alzheimer's disease.We have crafted our platform to be a comprehensive and informative resource, presenting a wide range of information about this complex condition.

From the moment users land on our site, they will encounter an intuitive interface that guides them through various sections, providing an in-depth understanding of Alzheimer's disease.

Our content covers the symptoms, stages, and available treatment options, empowering visitors with valuable insights into the disease.

Furthermore, we offer personal stories, research updates, and practical tips for caregivers, fostering a holistic approach to support those affected by Alzheimer's.

With our website, users can easily navigate through the intricacies of Alzheimer's disease, equipping themselves with knowledge that can positively impact their lives and the lives of their loved ones.

7.2.Disadvantages:

In some cases, the cost of undergoing an MRI scan to predict Alzheimer's disease can be substantial. MRI scans are valuable diagnostic tools that can provide detailed images of the brain, helping healthcare professionals identify structural changes associated with Alzheimer's.

However, the expenses associated with MRI scans, including the equipment, personnel, and interpretation of results, can be significant. This cost factor can pose a financial burden on individuals, particularly those without adequate insurance coverage.

It's essential to consider the potential financial implications when deciding to pursue an MRI scan for Alzheimer's prediction. Healthcare providers and organizations are continuously working towards improving accessibility and affordability of diagnostic procedures, aiming to ensure that individuals receive necessary evaluations without enduring excessive financial strain.

8.CONCLUSION:

In conclusion, our project on the detection of Alzheimer's disease plays a vital role in raising awareness, providing comprehensive information, and promoting early detection of this debilitating condition. By leveraging innovative technologies, we aim to empower individuals, caregivers, and healthcare professionals with the knowledge and tools necessary for early intervention and improved patient outcomes. Through our user-friendly platform, visitors can access a wealth of information about Alzheimer's disease, its types, and the available diagnostic options. While the cost of certain diagnostic procedures may present challenges, we recognize the importance of making these evaluations accessible and affordable to all. By continuing to advocate for improved accessibility and by staying at the forefront of research and technology, we strive to contribute to the early detection and effective management of Alzheimer's disease, ultimately enhancing the quality of life for those affected by this condition.

9.FUTURE SCOPE

The future scope of early detection of Alzheimer's disease using exceptional models and MRI scans holds immense promise. As technology continues to advance, machine learning and artificial intelligence algorithms can be leveraged to analyze MRI scans with exceptional precision and accuracy. By training these models on large datasets of MRI images, we can develop powerful tools that aid in the early detection of Alzheimer's disease. These models can identify subtle patterns and biomarkers in brain images that may indicate the presence of the disease long before noticeable symptoms emerge. Early detection is crucial for timely interventions, personalized treatment plans, and improved patient outcomes. Furthermore, the development of such models can potentially reduce the cost and time associated with diagnostic procedures, making them more accessible to a wider population. With ongoing research and advancements in AI and medical imaging, the future holds great potential for utilizing exceptional models in

conjunction with MRI scans to revolutionize early detection and intervention for Alzheimer's disease.

10.APPENDIX

Source Code :

Github:

https://github.com/naanmudhalvan-SI/IBM--15599-1682498198

Demolink:

https://drive.google.com/drive/folders/1XTEI13mpQHsJi8JY2MuBAAkBgtkIkpos?usp=share_link