AUTONOMOUS ASSITANCE FOR ALZHEIMER'S PATIENTS

A PROJECT REPORT

Submitted by

NITHIN KUMAR (0019132002)

Under the guidance of

Mr. Julian Menezes
Assistant Professor(S.G)

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BONAFIDE CERTIFICATE

Certified that the project report titled "**AUTONOMOUS ASSISTANCE FOR ALZHEIMER'S PATIENTS**" is the bonafide work of **NITHIN KUMAR (0019132002)** who carried out the project work under my supervision.

SIGNATURE

Dr. V.CERONMANI SHARMILA

PROFESSOR

HEAD OF THE DEPARTMENT

DEPARTMENT OF IT

SIGNATURE

MR. JULIAN MENEZES

ASSISTANT PROFESSOR

SUPERVISOR

DEPARTMENT OF IT

INTERNAL EXAMINER

Name: ________________________

Designation:___________________

EXTERNAL EXAMINER

Name: _____________________

Designation:_________________

Project Viva - Voce conducted on ___________

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ABSTRACT

Alzheimer's disease (Ad) is a disease that becomes more and more inhibiting of memory with a progressive course over time it also affects thinking and causes visual impairment. Visual impairment is a customary symptom of AD, and recent studies have shown that visual interventions may improve the functioning of AD patients. This paper aims to use image processing techniques to detect AD at an early stage using Magnetic Resonance Imaging (MRI) of the brain. The proposed technique also includes camera-based detection for visually impaired or AD individuals to recognize text, objects and known people in real-time using face recognition and sign language. Optical Character Recognition (OCR) method is used to transform pictures to text, and ML is used to detect known faces, objects and sign language. The output will be expressed in the form of an audio stream with the help of test to speech

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MRI	Magnetic Resonance Imaging
OCR	Optical Character Recognition
CNN	Convolutional Neural Network
SGD	Stochastic Gradient Descent
AD	Alzheimer’s Disease

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

The project is capable of providing the doctor partial insight on the progression of Alzheimer's via performing multiclass classification of MRI into said 4 classes which are Non Demented, Very Mild Demented, Mild Demented, Moderately Demented which can be off help to doctors who receive a severable number of MRI to manually process per day by providing a probable start point. The system can additionally help patients who suffer from visual impairment which is a common symptom of Alzheimer's continue doing their day to day activities by providing them an all in one assistive system containing Family Member recognition, Object detection, OCR . The system has Dual purpose Aids for doctors and patients

1.2 OVERVIEW OF PROJECT

Visually impaired individuals face many challenges in their daily lives, including difficulties in reading printed text, recognizing faces, and identifying objects. Assistive technology has the prospective ability to alleviate challenges and enhance the standard of living for individuals with visual impairments.

The number of people with near or distance vision impairments worldwide is estimated to be at least 2.2 billion. One billion - or almost half of these cases are yet to be treated for vision impairments. Recent advancements in OCR and face recognition technologies have made it possible to develop camera-based systems that can accurately recognize text, faces, and objects. However, these systems have not yet been fully explored for their potential to assist visually impaired individuals. There are several studies that have developed OCR and face recognition systems for the visually impaired, but these systems have limitations such as not being able to recognize text in real-time, not being able to recognize faces and objects. We additionally add sign to speech as an additive functionality in the integrated system that will help other people understand the sign language being expressed by the affected

Jennifer R. Evans et al. conducted a study in which 13900 individuals were studied to determine if depression and visual impairment were related. The study results showed that the presence of depression was rife within individuals who were visually impaired to those who are not visually impaired. This suggests that there may be a link between visual impairment and depression. In all likelihood it is possible that individuals with visual impairment are to a greater extent prone to experiencing difficulties in functioning their daily lives, such as difficulty with mobility, reading, and completing tasks that require visual acuity. These difficulties can have a negative impact on an individual's mental well-being, leading to depression. Additionally, visual impairment can also lead to social isolation, which is another risk factor for depression. In conclusion, this research highlights the importance of recognizing the potential impact of visual impairment on mental health, and the need for interventions that can help alleviate the burden of depression in this population.

The gap the proposed method is trying to fill is to make a real time working system without significant trade-offs as a balanced and robust system is vital and a necessity for assisting the visually impaired.

1.3 SCOPE OF THE PROJECT

- The dual aid system helps the doctors by providing an initial insight on the stage of dementia in MRI images which will help detect AD as it's the most common form of dementia
- The project can be deployed onto a local network via a server , so anybody with access to the local network can run the dementia classification without running the source code on their local device
- The dual Aid system can also help the patients by providing assistive modules which can improve the quality of life for those who are visually impaired by Alzheimer's by providing an efficient and reliable system that provides assistive technology for communication, reading and other basic functions that will help them participate in basic activities without seclusion from society

1.4 SUMMARY

The system has dual aid purpose where it'll help doctors gain a initial insight giving them a probable start point when analysing MRIs for dementia which will help doctors save time as they receive many MRI images. One of the common symptoms of AD is visual impairment which has found be taking an effective toll of the the visually impaired's inclusion in the society and mental health hence we propose a patient's aid system that will contain family member recognition , object detection , OCR and sign to speech detection to assist them with basic functionalities

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

Maisha Mashiata et al. conducted an all-inclusive sweeping review on the status quo and anticipated prospects of assistive technology catered to the visually impaired individuals. The review aimed to provide an overview of the various assistive devices that are currently available, as well as their features and limitations. Various types of assistive devices are being used for visually impaired individuals, including capturing devices , working hours, response times , coverage areas and feedback . The devices reviewed include those that use image processing, computer vision, and machine learning techniques to assist users with visual impairments. The review also discussed the features of the assistive devices, such as the type of sensors used, their working hours, response time, coverage area, and feedback mechanisms. The devices were also evaluated on their ability to provide assistance to users in different scenarios, such as indoor and outdoor environments. However, the review concluded that at the time of the review, there was no single device that met all the requirements for designing assistive technology for visually impaired individuals. While some devices offered excellent image processing capabilities, they were limited in their coverage area and working hours. Others had good coverage area and working hours but required frequent maintenance. In conclusion, the review highlights the need for continued research and development in assistive technology for visually impaired individuals to create devices that can meet the needs of all users. The review suggests that it is important to consider the trade-offs between different features when designing assistive technology for visually impaired individuals, in order to provide the best possible assistance to users in different scenarios. For this reason , we aim to provide a fully provisioned system for persons with visually impaired that will contain 5 modules which are MRI Alzheimer's detection , OCR , Sign to Speech , Object detection and face detection that will help the visually impaired to perform basic functions

2.2 INITIAL INVESTIGATION

In the field of assistive technology for the visually impaired, there have been several studies and projects related to camera-based text recognition and object identification that has ranged over a long period of time with significant developments.

Jiri Martinek et al. presented an OCR system that is able to perform two crucial tasks: analyzing the layout of a page, including identifying text blocks and lines, and recognizing text using OCR. The system utilizes fully convolutional networks for segmentation and recurrent neural networks for OCR. Additionally, the team created a new dataset specifically designed for real-time use, sourced from the Portafontium portal.

Jongkil Hyun et al. An architecture for face detection using a Haar classifier was proposed that aims to enhance the computational speed of the system. This is achieved by eliminating unnecessary iterations during the classification process. By removing these unneeded iterations, the proposed architecture was able to increase the processing speed by 4.46%. This means that the new architecture is able to complete the face detection task faster than previous methods, which can be beneficial for real-time applications such as security systems and video surveillance. Additionally, the use of Haar classifiers in this architecture is a conventional system for detecting faces in images, making it a reliable and robust solution

Chunming Wu et al. an experiment with a 99.85 accuracy rate was achieved by the improved facenet in the experiment which demonstrates the ability to effectively recognize faces in real-time. A face detection and recognition system that uses this technology can detect and ecognize faces with high accuracy

Sustainability is a key concern in face detection systems, as they often rely on small processing units. A common issue faced in these systems is the bottleneck problem. Rana Qarooni et al. notes that the location of the bottleneck can be unclear. However, using mixed displays that combine faces and non-faces can lead to the detection of additional faces without compromising on system efficiency.Natal et al. presented a methodology for detecting and tracking dynamic objects using four different architectures with the help of OpenCV and a Microsoft Kinect RGB Camera. The four architectures were FOF, BS, CamShift, and Haar Cascade. Of these, the Haar Cascade had the best accuracy of 95%, followed by CamShift, BS, and FOF. The team also recorded the effectiveness of the data and the speed of detection for the dynamic object in a spreadsheet

Anandh Nagarajan et al. addressed the challenge of object detection in indoor environments, which have relatively low light compared to outdoor environments. They proposed an hybrid algorithm which is the incorporation of the Honey Badger algorithm with african vultures optimization and Adam's optimizer called the Haavo (Honey Adam African Vultures Optimization) algorithm which provided a high level of accuracy for object detection Larbi Guezouli proposed a method to use Pseudo Zernike Moments and stroke features for text extraction and signboard detection which were captured from a video camera. The method consisted of text localization, signboard detection and filtering of non-textual regions. The method employed for text localization and extraction in this study was PZMs, and non-textual regions were eliminated using outline functions. The model was evaluated to be resilient to lighting changes , camera angle deviations and resolution variations.

Gabriel B Holanda Et al. proposed a reading system was proposed that utilizes a portable device and combines ML techiques , segmentation and feature extraction to achieve an accuracy of 99.86% and a specificity of 99.3%. The system integrates a central moments extractor with a multi layer perceptron.

Sheirg wang et al. 400 training images and 100 gaze attention maps were classified using a classification algorithm which has Resnet 50 as a backbone. The first initial epochs don’t show considerable improvement but after 10 epochs there was significant improvement Resnet 50 proved to be a conventional system to classify medical images.

2.3 FEASIBILITY STUDY

The conducted literature survey helped us understand that need for continued research and development in assistive technology for visually impaired individuals to create devices that can meet the needs of all users. The review suggests that it is important to consider the trade-offs between different features when designing assistive technology for visually impaired individuals, in order to provide the best possible assistance to users in different scenarios is required and a system with reliable functions need to be used to help the patients who suffer from Alzheimer’s to help them perform basic functionalities..

2.3.1 Techincal Feasibility

The conducted literature survey helped us understand that there are already various techniques present that are competent enough to help the Alzheimer's patient with their basic symptoms , but they need to be streamlined into a single system or combined to be off noticeable aid to them.

2.3.2 Economic Feasibility

The conducted literature survey helped us understand that the economic constraint has been extended too far or too short and a middle spot must be found in order to be accessible to all parts of the crowd and be useful to everyone .

2.3.3 Behavioural Feasibility

The conducted literature helped us understand that the common people and organizations should easily get accustomed to the technology as the complexity can be abstracted behind the deployment. There are certain features like working hours, response time, coverage area, and feedback mechanisms that will determine how people respond to the technology .

2.4 LITERATURE SURVEY

2.4.1 Survey on Pytesseract

A benchmarking experiment comparing the performance of various Optical Character recognition algorithms was conducted where tesseract , amazon textract and google document AI was compared where in Google

Document Ai had consistently lower error rates with Amazon Textract coming close second and tesseract last .

2.4.2 Review In Feasibility Of Assistive Devices For Visually Impaired Indiviudauls

An all-inclusive review of the current status and future prospects of assistive devices for the visually impaired was conducted where the evolution of assistive devices, taxonomy of assistive devices , features of assistive devices ,commonly employed algorithms was considered to find that in conclusion is that no device is regarded to be an optimal device. Therefore, there is a requirement for designing an intelligent system capable of covering essential characteristics for supporting visually impaired people. This review however doesn’t consider the accessibility of the devices to people from different countries as group was picked from a single country.The ideology behind our project is to develop a cost effective , reliable and robust system for the visually impaired . We integrate functionalities to help the affected

2.4.3 Survey On Resnet 50

A survey was conducted to compare three pretrained networks on the Cohn kanade Dataset to compare the accuracy alongside other performance matrices like precision and recall . The algorithms used where vgg16 , resnet50,Se-Resnet50.It was found that Resnet 50 achieved the best accuracy , precision and recall and takes much lesser epochs compared to SeResNet50 . Resnet has a notably good validation accuracy of 0.9954. There are methods to further reduce the epochs that has not been implemented . We also use Xception architecture with Resnet50 to further improve accuracy

An additional study was conducted where Resnet50 proved to be a conventional system to classify medical images .

2.4.4 Survey On Haarcascades And Lbph

A Study was conducted To solve the illumination problem of the conventional face recognition system using Haarcascade algorithm, LBPH is merged into the system with the HOG linear SVM object detector . It was found that an Efficient face recognition scheme is proposed and implemented By merging LBPH algorithm into conventional Haarcascade scheme, recognition performance to detect face region is improved for not only front-view facial images but also slanted ones

2.5 SUMMARY

The algorithms were selected on basis that there aren’t significant trade-offs and the system has a reliable and robust architecture. Three pretrained networks were shortlisted to detect Alzheimer’s in a MRI image VGG-16, Resnet50, SE Resnet50 of which Resnet seemed to be more accurate than the others.The Haar cascade classifier is used due to its quick result , low computational costs and reliability.The Haar cascade for face detection then use the LBPH (local binary pattern histogram) algorithm for face recognition due to its known performance and ability to recognize the face from the frontal , rear or side view .The sign to speech module will be carried out using a regular CNN with tuned pretrained models .An open source engine tesseract will be used to conduct OCR . Tesseract was selected over other tools though tesseract isn’t as good as the google docs ocr, Abby Fine Writer as tesseract is an offline tool and doesn’t need to handle with the variability of internet connection to operate . Object detection is carried out using the Caffe model . The output is in form of an audio stream which is converted with the help of GTTS (Google text to speech)

CHAPTER 3

PROJECT DESCRIPTION

3.1 INTRODUCTION

Our objective is to develop a Dual Aid system that comprises two main components: the Doctor's Aid and the Patient's Aid. The Doctor's Aid module is designed to offer doctors a preliminary understanding and a starting point for analyzing MRI scans of patients with Alzheimer's disease. This model can be deployed on a server to provide local access within the hospital's network. Considering that visual impairment is a common symptom in Alzheimer's disease, the Patient's Aid is divided into four sub-modules that can help patients with Alzheimer's perform basic activities. These sub-modules include face detection for identifying family members, object detection for recognizing common objects in the environment, OCR for reading large print signs, and sign-to-speech, which allows patients who communicate via sign language to converse directly with their doctors.

Doctors aid - We propose an ensemble method that concatenates Resnet 50 and Xception that will perform a multiclass classification of four categories of MRI images, namely Mild Demented, Moderate Demented, Very Mild Demented, and Non Demented.

Patients Aid - The primary module of the patients aid is the face detection module where the Haar cascade classifier is used due to its quick result , low computational costs and reliability .The Haar cascade for face detection then use the LBPH (local binary pattern histogram) algorithm for face recognition due to its known performance and ability to recognize the face from the frontal , rear or side view Optical character recognition also known as OCR will be carried out by pytesseract that will help the patients read big signs For object detection we are using the caffe model that can detect multiple objects in a screen Sign to speech will be carried out with a Pretrained CNN Sequential model. These algorithms have been selected upon extensive literature survey so that the selected algorithms work properly in all conditions where speed or accuracy is not compromised for reliance.

3.2 EXISTING SYSTEM

There are various existing systems for the visually impaired but there isn't no single device that met all the requirements for designing assistive technology for visually impaired individuals as per a literature review conducted in 2022 . The are existing system that provide singular functionalities that on their own are not of noticeable use to the visually impaired . One of the conventional systems for medical image classification is Resnet50 , we improve upon this algorithm by concatenating it with the xception algorithm to form an ensemble method . The reason to form this ensemble method was that xception can complement Resnet50's weaknesses

3.3 PROPOSED SYSTEM

3.3.1 Resnet50 and Xception

To process the four categories of MRI images, namely Mild Demented, Moderate Demented, Very Mild Demented, and Non Demented, we employed an ensemble approach that combined ResNet50 and Xception architectures. The reason for choosing this approach is that ResNet50 and Xception have complementary strengths - ResNet50 is proficient at capturing long-range dependencies, while Xception excels at capturing local features. Since the details in MRI images are often subtle, combining both these architectures allowed us to capture both local and global features accurately. We selected ResNet50 for its complexity, having 50 layers, which makes it more effective at capturing complex patterns present in MRI images, crucial for dementia classification. Furthermore, ResNet50 is a conventional backbone algorithm for classifying medical images, making it a preferred choice. We leveraged the pre-trained weights of ResNet50 from ImageNet dataset to bring prior knowledge to the task of dementia classification. Similarly, Xception, known to work well with ImageNet weights, was combined with ResNet50. The availability of a wide range of resources for both ResNet50 and Xception made it feasible to use them together to form an Ensemble method.Resnet 50 is a adaptation of the Resnet model having 50 layers which consists of 48 convolutional layer with 1 Average pool and 1 Max pool layer

layer name	output size	18-layer	34-layer	50-layer	101-layer	152-layer
conv1	112×112	7×7, 64, stride 2				
conv2_x	56×56	3×3 max pool, stride 2				
		$\begin{bmatrix} 3\times3, 64 \\ 3\times3, 64 \end{bmatrix}\times2$	$\begin{bmatrix} 3\times3, 64 \\ 3\times3, 64 \end{bmatrix}\times3$	$\begin{bmatrix} 1\times1, 64 \\ 3\times3, 64 \\ 1\times1, 256 \end{bmatrix}\times3$	$\begin{bmatrix} 1\times1, 64 \\ 3\times3, 64 \\ 1\times1, 256 \end{bmatrix}\times3$	$\begin{bmatrix} 1\times1, 64 \\ 3\times3, 64 \\ 1\times1, 256 \end{bmatrix}\times3$
conv3_x	28×28	$\begin{bmatrix} 3\times3, 128 \\ 3\times3, 128 \end{bmatrix}\times2$	$\begin{bmatrix} 3\times3, 128 \\ 3\times3, 128 \end{bmatrix}\times4$	$\begin{bmatrix} 1\times1, 128 \\ 3\times3, 128 \\ 1\times1, 512 \end{bmatrix}\times4$	$\begin{bmatrix} 1\times1, 128 \\ 3\times3, 128 \\ 1\times1, 512 \end{bmatrix}\times4$	$\begin{bmatrix} 1\times1, 128 \\ 3\times3, 128 \\ 1\times1, 512 \end{bmatrix}\times8$
conv4_x	14×14	$\begin{bmatrix} 3\times3, 256 \\ 3\times3, 256 \end{bmatrix}\times2$	$\begin{bmatrix} 3\times3, 256 \\ 3\times3, 256 \end{bmatrix}\times6$	$\begin{bmatrix} 1\times1, 256 \\ 3\times3, 256 \\ 1\times1, 1024 \end{bmatrix}\times6$	$\begin{bmatrix} 1\times1, 256 \\ 3\times3, 256 \\ 1\times1, 1024 \end{bmatrix}\times23$	$\begin{bmatrix} 1\times1, 256 \\ 3\times3, 256 \\ 1\times1, 1024 \end{bmatrix}\times36$
conv5_x	7×7	$\begin{bmatrix} 3\times3, 512 \\ 3\times3, 512 \end{bmatrix}\times2$	$\begin{bmatrix} 3\times3, 512 \\ 3\times3, 512 \end{bmatrix}\times3$	$\begin{bmatrix} 1\times1, 512 \\ 3\times3, 512 \\ 1\times1, 2048 \end{bmatrix}\times3$	$\begin{bmatrix} 1\times1, 512 \\ 3\times3, 512 \\ 1\times1, 2048 \end{bmatrix}\times3$	$\begin{bmatrix} 1\times1, 512 \\ 3\times3, 512 \\ 1\times1, 2048 \end{bmatrix}\times3$
	1×1	average pool, 1000-d fc, softmax				
FLOPs		1.8×10^9	3.6×10^9	3.8×10^9	7.6×10^9	11.3×10^9

Fig 3.1 Resnet architecture

As shown in Fig 1 Resnet 50 consists of a convolutional kernel of size 7*7 and 64 different kernels with a stride size 2 giving 1 layer the next convolution has 1*1 , 64 kernel following a 3*3, 64 kernel and a 1*1, 256 kernel which are repeated 3 times that gives another 9 layers. Next there is 1*1,128 then 3*3,128 then 1*1 ,512 kernels repeated 4 times giving us another 12 layers then after which there is 1*1, 256 then 3*3,256 then 1*1, 1024 kernels that are repeated 6 times giving another 18 layers , again followed by 1*1, 512 then 3*3 , 512 and 1*1,2048 repeated 3 times giving us another 9 layers , the final layer is the average pool layer with softmax function that gives us 1 more layers . Adding all this up we get 50 layers.

Xception is an altered variation of the Inception architecture that has demonstrated success in a variety of computer vision tasks. One of its defining characteristics is its use of depthwise separable convolutions, which enable it to achieve performance that is comparable to traditional convolutional networks while utilizing fewer computations and parameters. This is due to the fact that depthwise separable convolutions separate the process of spatial filtering and channel-wise filtering, reducing the number of computations required to extract features from the input data.

Furthermore, Xception uses skip connections to facilitate the flow of information from earlier layers to later layers, allowing the network to preserve significant information throughout the training process. This is accomplished by adding shortcut connections between the layers of the network, allowing for direct communication between them. This allows the network to take advantage of the knowledge it has learned in earlier layers when making predictions in later layers, improving the performance and accuracy of the network. Overall, the Xception architecture is a powerful and efficient tool for computer vision tasks, due to its unique combination of depthwise separable convolutions and skip connections

3.3.2 **Haar cascades and LBPH**

Haar Cascade classifiers are a banking technique for object detection that was introduced in a paper by Paul Viola and Micheal jones namely “Rapid Object Detection using a Boosted Cascade of Simple Features” by Paul Viola and Michael Jones. The Haar Cascade classifier is trained using a substantial amount of positive and negative images. Positive images contain the object of interest, while negative images do not. The training process involves building a large set of simple classifiers and combining them in a sequential manner to create a final, more complex classifier. The final classifier is then used to detect objects in new images. The Haar cascade classifier has proven to be an efficient and accurate object detection technique, making it a popular choice for various computer vision applications.

The Haar Cascade algorithm is a multi-stage process, consisting of the following four steps:

1. Calculating Haar features: This step involves analyzing the image and calculating the Haar features of the objects in the image. These features are used to describe the objects and distinguish them from their surroundings.
2. Creating Integral Images: In this step, the integral image is calculated. An integral image is a pre-processed version of the original image, which allows for efficient calculation of features.
3. Training with AdaBoost: In this step, the AdaBoost learning algorithm is applied to the set of negative and positive images to train the Haar Cascade classifier. The algorithm selects a confined set of features from the large set of Haar features calculated in the first step, and creates a set of simple classifiers based on these features.
4. Implementing the cascading classifiers: In the final step, the simple classifiers are combined in a cascading manner to create a more complex classifier, which is then used to detect objects in new images. The cascading approach allows the Haar Cascade algorithm to quickly reject regions of the image that do not contain the object of interest, and focus on the regions that are more likely to contain the object.

Haar Cascades are a computer vision algorithm used for object detection. They are based on Haar Wavelets, which are mathematical functions that have a square shape and are used to analyze pixels in an image. The Haar Wavelets form the basis for the analysis, which is achieved by dividing the image into squares and evaluating each square to determine if it contains an object of interest. The Haar Cascades use machine learning techniques to train the system with a large set of positive and negative images, allowing it to achieve a high degree of accuracy for the training data. The final result is a classifier that can accurately detect objects in new images based on the learned features from the training data.

The Haar Cascades object detection technique leverages the concept of an “integral image” to calculate the features being detected. It utilizes the “Adaboost” learning algorithm to identify a select few crucial Haar like features (as shown in Fig 3.2) from a large set, resulting in an efficient set of classifiers.

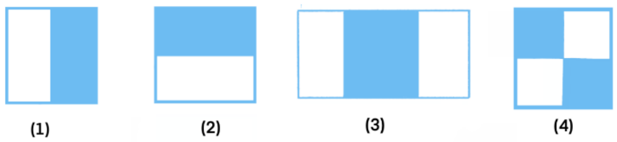


Fig 3.2 Haar like features as proposed by Viola and Jones

The Haar Cascade classifiers were improved with the introduction of dimensionality in the set of features by Liendhart and Maydt. This extension added three types of features to the Haar Cascade classifier: edge , line and center surround features (as shown in Fig 3) . These additional features allowed the classifier to detect objects with greater accuracy and improved its overall performance. The introduction of these features into the Haar Cascade classifier marked a significant improvement in object detection, and they continue to be widely used in computer vision applications today.

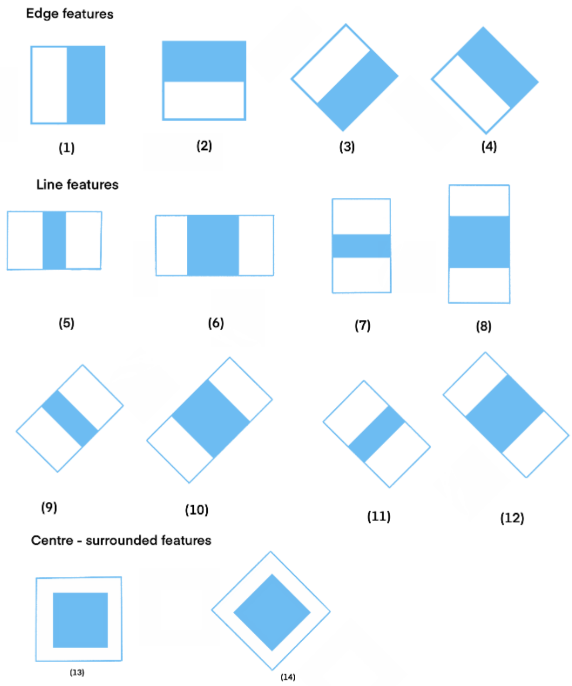


Fig 3.3 Extension proposed by Lienhart and Maydt

The Haar Cascade algorithm is a popular technique for detecting objects in images, including faces. The theoretical face model of the Haar Cascade algorithm(as shown in Fig 3.3) is based on the idea that a face can be represented by a set of simple geometric features, such as edges, lines, and center-surround regions.

The algorithm starts by dividing the face image into a set of smaller squares or rectangular regions, and evaluating each region to determine if it contains a face. This evaluation is done by calculating Haar features for each region, which are then used to train a set of simple classifiers using the AdaBoost learning algorithm.

The simple classifiers are combined in a cascading manner to create a more complex classifier, which is then used to detect faces in new images. The cascading approach allows the Haar Cascade algorithm to quickly reject regions of the image that do not contain a face, and focus on the regions that are more likely to contain the face.

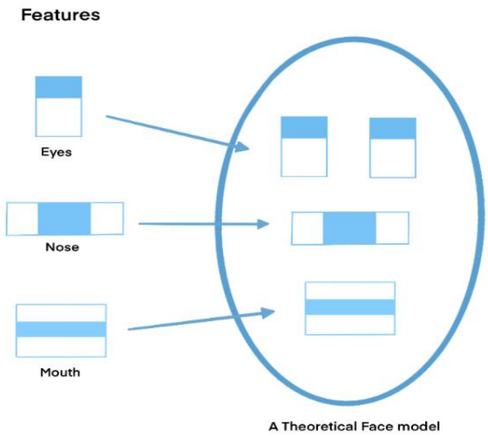


Fig 3.4 A Theoretical Face Model

Local Binary Patterns Histogram (LBPH)

The Local Binary Patterns Histogram (LBP) algorithm is built on the concept of local binary operations.Based on the concept of local binary operations the Local Binary Patterns (LBP) algorithm is built. LBP is an effective texture operator that assigns a binary label to each pixel in an image by evaluating the surrounding pixels and transforming the results into a binary number. The algorithm is popular for facial recognition because it is computationally simple

The steps involved to achieve this are:

- Acquiring the face
- Extraction of features
- Dataset Creation
- Classification

LBPH

1.Parameters

The LBPH algorithm uses four parameters in its implementation:

1. Radius – defines the circumferential region that surrounds the center pixel , which is usually set to 1
2. Neighbours – denoted the needed quantity of sample points needed to generate the circular local binary pattern with a higher number of sample points leading to increased computational complexity.The default value is normally 8.
3. Grid X –denotes the number of cells present in the horizontal direction, with a larger number of cells resulting in a finer grid and a higher dimensional feature vector. The default value is normally 8.
4. Grid Y – Represents the quantity of cells in the vertical direction, with a larger number of cells resulting in a finer grid and a higher dimensional feature vector. The default value is normally 8

2.Training the Algorithm:

The training process of the algorithm involves utilizing a dataset comprised of images of the individuals to be recognized. Each image must be assigned an identification label, which can be either a number or the name of the person. This information is then used by the algorithm to recognize an input image and provide an output. It is important to ensure that all images belonging to the same person have the same ID.

3. Applying the LBP operation:

The initial computation of the LBPH (Local Binary Patterns Histograms) involves creating an intermediate representation of the original image that better showcases its facial features. This is achieved by applying a sliding window technique, utilizing the radius and neighbors parameters.(as shown in fig 5).

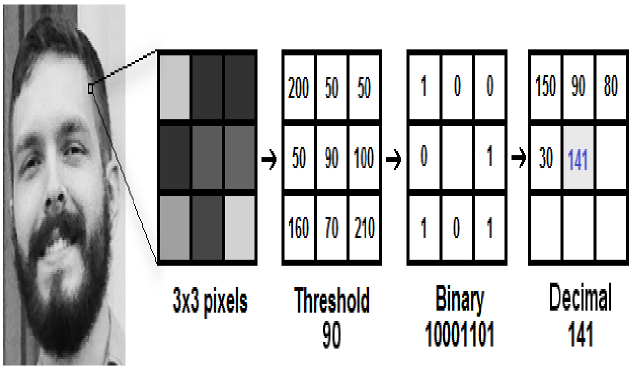


Fig 3.5 LBPH procedure

- The picture undergoes a transformation to grayscale.
- A 3x3 section of the image is selected as a window.
- This window is usually depicted as a 3x3 matrix of pixel intensities, which range from 0 to 255.
- The threshold is established as the median value of the matrix.
- The values from the eight surrounding cells are determined based on this threshold value.
- For each neighboring cell, if it is above the threshold, if the value is above, it is assigned a binary value of 1, and if it is below, it is assigned a binary value of 0.

- This results in a matrix that only contains binary values and the central threshold value. To obtain a new binary value, the binary values from each position in the matrix are concatenated line by line.
- The center value of the matric , which symbolizes a pixel in the original image , is then assigned to this binary value after being transformed to a decimal value
- After the Local Binary Pattern (LBP) procedure is completed, a new image that better captures the characteristics of the original image is obtained

4 . Extraction of the Histograms:

With the image produced in the previous step, the Grid X parameters and Grid Y parameters can be utilized to break the image down into multiple grids.

5 . Executing face recognition:

Histograms have already been generated to depict each image from the training dataset after the training of the algorithm has been completed. When creating a histogram for an input image, we iterate the procedure for each image to identify a match. In order to determine the image that is closest to the original, the resulting histograms are compared. Euclidean distance, Chi-square, or absolute value are some of the ways to compare the histograms. An algorithm's accuracy will be determined by a threshold and confidence level, with a lower confidence level indicating success.

3.4 SUMMARY

1. Improved independence**:** By being able to recognize the faces of friends, family, and colleagues, they would be able to more easily

navigate social situations and participate in everyday activities without relying on assistance from others.

2. Enhanced social interaction: Face recognition technology could also improve the social interactions of visually impaired individuals by allowing them to better recognize and engage with others. This could lead to increased socialization and a sense of belonging within their communities.
3. Increased employment opportunities**:** By being able to more easily identify and interact with coworkers and customers, visually impaired individuals may be more likely to be hired for jobs that require social interaction.
4. Decreased stigma: The use of face recognition technology could also help to decrease the stigma surrounding visual impairments. As the technology becomes more widespread and accepted, it may help to reduce the negative stereotypes and biases that some people hold about individuals with visual impairments.
5. The system uses algorithms in a manner that there are significant trade-offs so that the system doesn't fail at any point of time and is able to perform in diverse environments
6. Cost effective system
7. Minimal hardware inclusion which reduces possibility of failure
8. Apart from helping the patients with Alzheimer's who are visually impaired it can also help the general visually impaired

CHAPTER 4

PROJECT REQUIREMENT

4.1 INTRODUCTION

One of the main objectives of the project is not to have many requirements .However there are minimal requirements to this project . The project requires various python packages such as streamlit , keras , tensorflow , numpy , etc

4.2 SOFTWARE REQUIERMENTS

4.2.1 Windows – The project was run on windows with all the basic dependencies installed

4.2.2 Python – The program was fully run on a python on which the whole backend was run . Python helped us integrate many other dependencies to run the project

4.2.3 OpenCV – Is an image processing module that helped in use image processing modules like Haar Cascade , LBPH , etc

4.2.4 Tensorflow – famous framework for machine learning and deep learning . It helps us use existing algorithms for problem statement . This framework contains an important library called keras that helps us with deeplearning operations

4.3 TECHNOLOGY OVERVIEW

Image processing - Image processing is a technique of analyzing and manipulating digital images to improve their quality or extract useful information from them. It involves using mathematical algorithms to perform various operations on the images, such as filtering, enhancement, restoration, and segmentation. These operations are performed to improve the visual appearance of the image or to extract some useful information from it. We have use image processing throught our project to provide aid for the doctors and patients

4.3.1 Streamlit - Streamlit is an open-source Python framework used for building data-driven applications quickly and easily. It is designed to simplify the process of creating and sharing interactive web apps for data science and machine learning. Streamlit provides a simple and intuitive interface for creating web apps with Python scripts that can be easily shared and deployed.

4.3.2 Tkinter - Tkinter is a Python library that provides a graphical user interface (GUI) for desktop applications. It is built on top of the Tcl/Tk GUI toolkit and is included with most Python installations.Tkinter allows developers to create interactive graphical applications by providing widgets such as buttons, labels, text boxes, and canvas. It also supports various layout managers to help arrange these widgets on the screen.

CHAPTER 5

SYSTEM DESIGN

5.1 INTRODUCTION

The system has been divided into 2 subsystems namely Patient's Aid and Doctor's Aid. The Doctor's is deployed onto streamlit that will help abstract the complexity of accessing the system where an axial cut of the Mri image can be uploaded and the classification result will be displayed, as we have deployed it onto streamlit, anybody on the local network of the server can access the program without running the backend on their device. The Patients Aid has been integrated into a single user interface using Tkinter were we can access the face detection , ocr , object and sign to speech detection module.

5.2 SYSTEM ARCHITECTURE

5.2.1 Input Design

The Patient's aid can use a live camera feed to process the stream to perform face detection , ocr , object and sign to speech detection

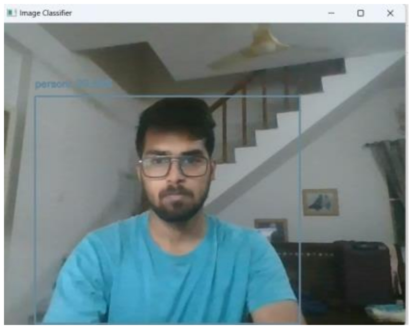


Fig 5.1 Object detection Sample

The Doctor's aid uses an axial cut of the MRI for classifying the level of dementia . It only reads JPG format images

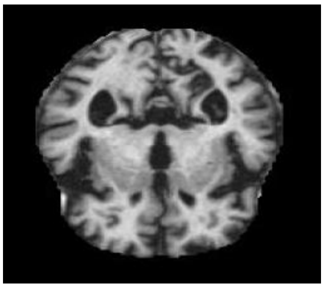


Fig 5.2 Sample MRI Axial Cut

5.2.2 User Interface Design

The patient's Aid User Interface lets us select any module we need in an integrated interface

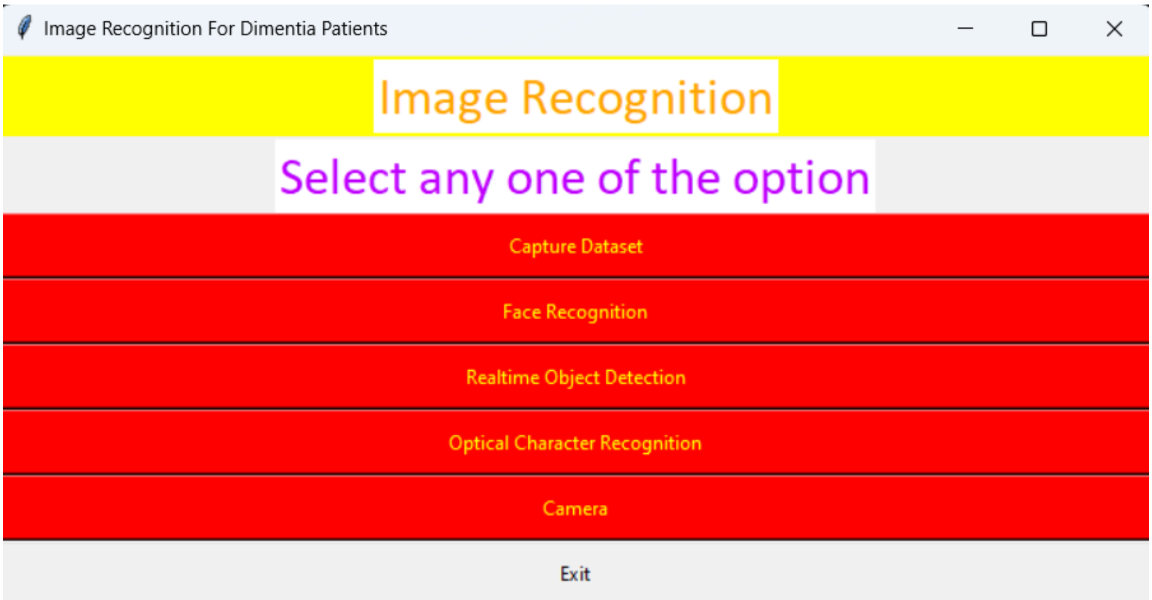


Fig 5.3 Patient's Aid UI

The Doctor’s Aid User Interface lets us upload MRI axial cut images to get it classified into 4 levels of dementia

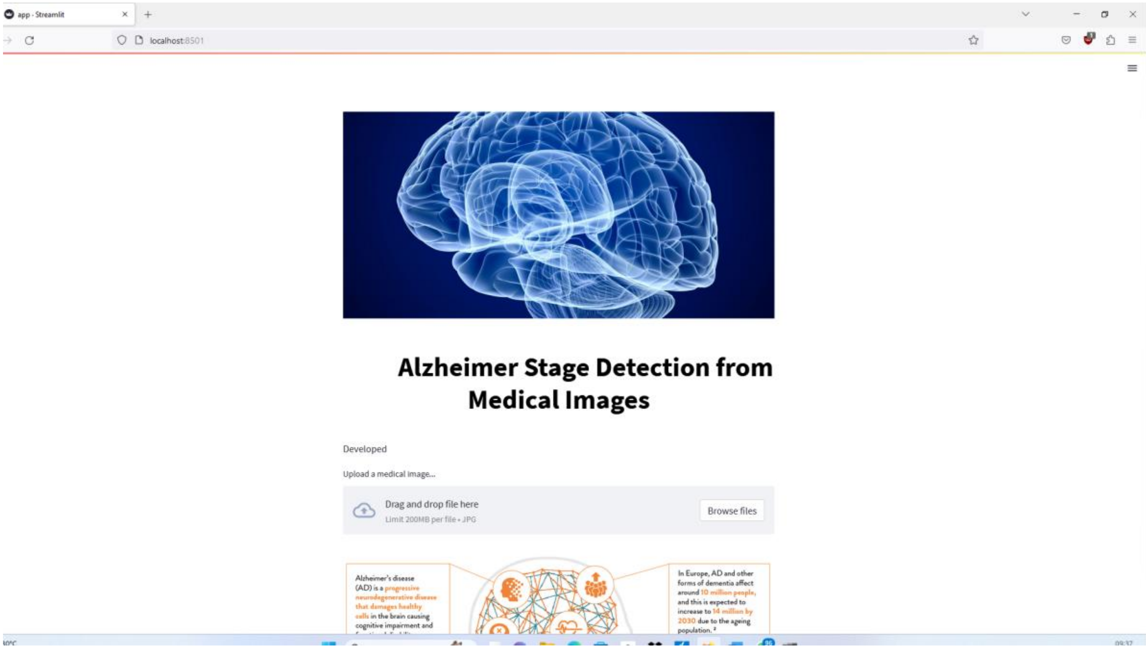


Fig 5.4 Doctor’s Aid UI

5.2.3 Output Design

In the Patient’s Aid the text is converted to speech using Google text to speech but can also be viewed as text

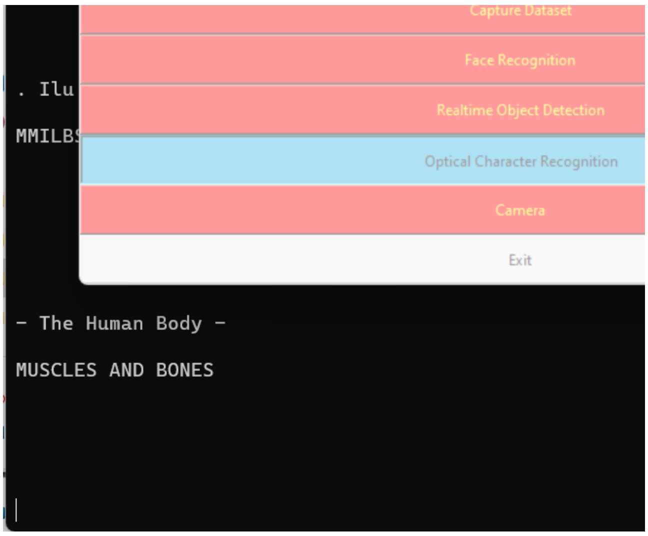


Fig 5.5 Patient's Aid sample Output

The doctor's Aid displays the classification result of the uploaded image

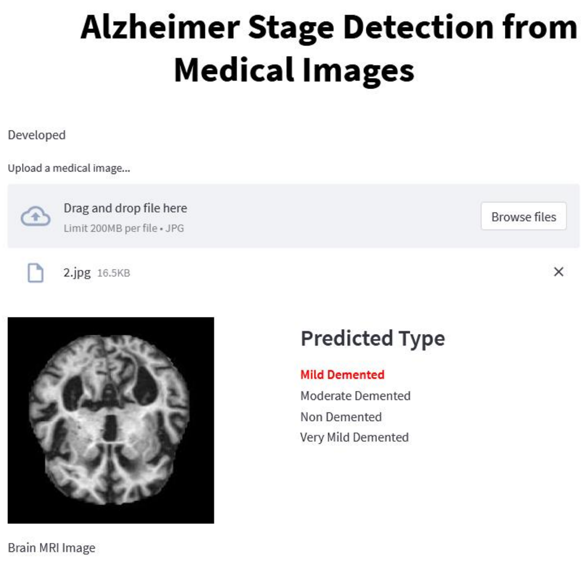


Fig 5.6 Doctor's Aid sample output

5.3 SUMMARY

The doctor's aid is deployed onto streamlit with the capability of anyone within the local network accessing the program without running the backend locally whereas that is not the case for the Patient's aid which runs locally. In total there are 2 systems one for the Doctor's insight on the level of Dementia and another for the patients who are visually impaired that will help them do basic functions

CHAPTER 6

MODULES

6.1 INTRODUCTION

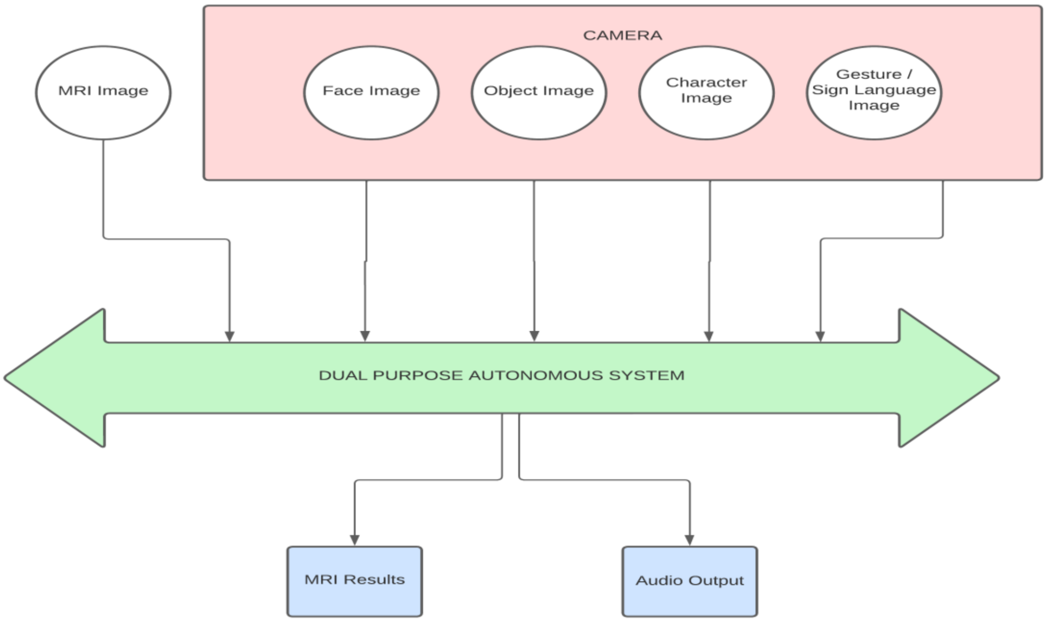


Fig 6.1 System Architecture

This is an image of the architecture of the system . The patient's will have a live video feed as an input whereas the MRI module will have an axial slice of the brain MRI as in input . The patient's aid will have an audio output whereas the MRI multiclass classification will have a text result as an output

6.2 MODULES

6.2.1 MRI Module

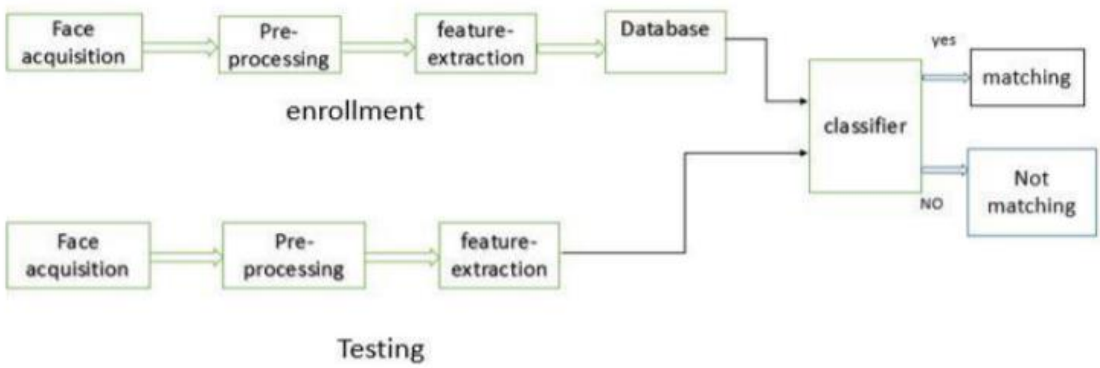
The steps involved in the MRI module are

- Data collection
- Data preprocessing
- Data training
- Data tesing and validation
- Visualizing the model
- Deploying onto streamlit

This module will perform a multiclass classification of MRI images of the axial slice of the brain and classify it into Non Demented , Very Mild Demented , Mild Demented , Moderately Demented.

This module is part of the doctor's aid and will be deployed onto streamlit.

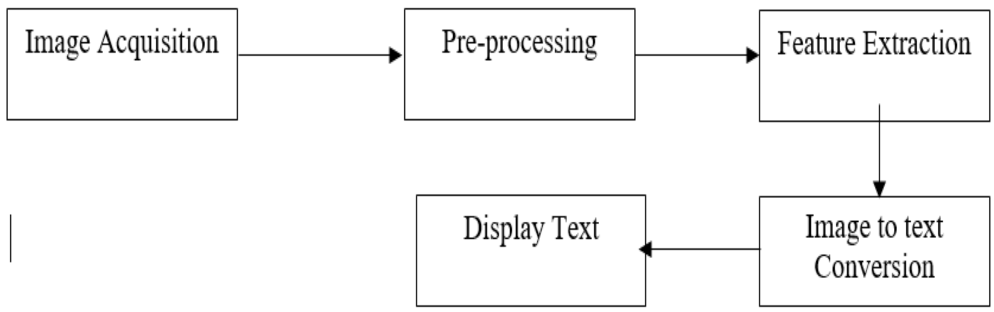
6.2.2 Family Member recognition



The family member recognition can help the visually impaired recognize family members. This module uses the Haar cascade for face detection and

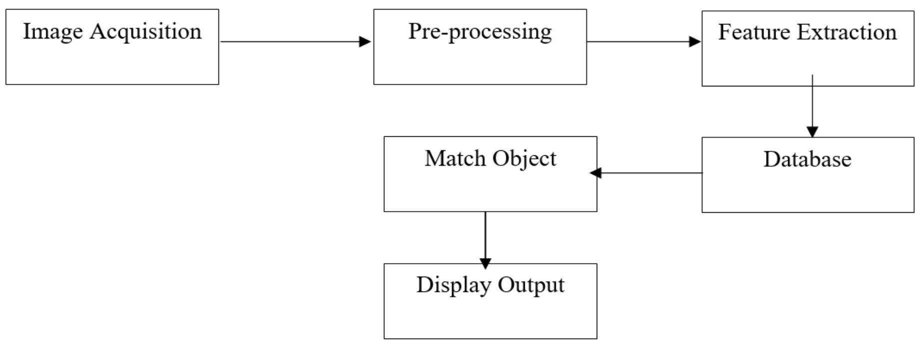
LBPH for face recognition. This module is part of the patient's aid and will integrated into Tkinter

6.2.3 OCR



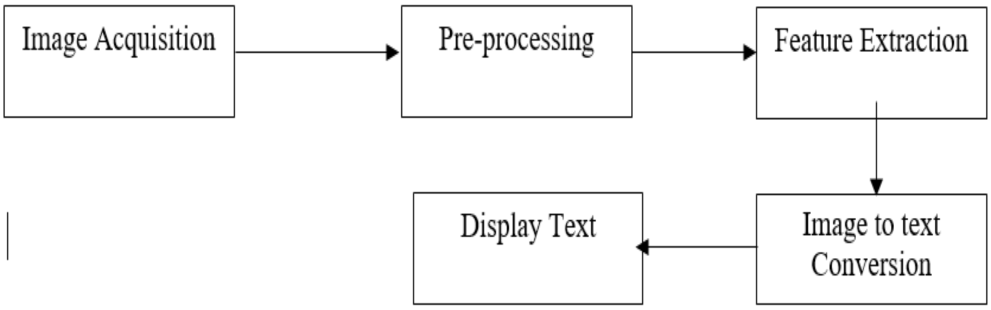
This module can help the visually impaired read big signs and big text . This module uses pytesseract a wrapper for python and tesseract to recognize text. This module is part of the patient's aid and will integrated into Tkinter

6.2.4 Object Detection



This Module will help the visually impaired recognize basic objects . This module uses a pretrained Mobilnet SSD to identify objects. This module is part of the patient's aid and will integrated into Tkinter

6.2.5 Sign to Speech



This module can help people understand sign language . This model uses a sequential CNN that uses the HSV color space to detect sign language. This module is part of the patient's aid and will integrated into Tkinter

6.2.6 Mlops/Deployement

All the machine learning processes were streamlined and deployed onto tkinter and streamlit.

6.3 TECHNICAL CONTRIBUTIONS OF THE INDUVIDUAL PROJECT

S.No.	Module Name	Contributor Name	Description

1.	MRI	Nithin Kumar (19132002)	• Dataset collection and concatenation from Kaggle • Dataset preprocessing and resizing • Ensemble Model fitting and training • Result evaluation, fine tuning • Result visualization
2.	Family Member Recognition	Nithin Kumar (19132002)	• Environment Setup • Haarcascade and LBPH integration • Dataset Capture • Result evaluation and fine tuning
3	MLOPS	Nithin Kumar (19132002)	• Integration of patient's aid modules into Tkinter • Integration of doctor's aid module into Streamlit • Testing and running
4	Sign to speech	Rishwanth Praveen (19113028)	• Sequential CNN integration • Loading pretrained model • Result evaluation and testing

5	Object Detection	Rishwanth Praveen (19113028)	• Mobilenet SSD integration • Loading pretrained model • Result evaluation and testing
6	OCR	Rishwanth Praveen (19113028)	• Pytessaract integration • Loading pretrained model • Result evaluation and testing

Table 6.1 Induvidual Contributions

6.4 SUMMARY

There are various modules integrated into 2 purposes. The output is in form of audio with the help of Google text to speech for the patient's aid ie face detection , sign to speech , object detection and OCR will have output in the form of Audio whereas for the Doctor's Aid the classified image will be displayed as text .There are a total of 5 modules , 4 of the being for the patient's aid that is deployed onto Tkinter and another module that is deployed onto streamlit. The MRI module is trained from scratch whereas the other modules are pretrained.

CHAPTER 7

IMPLEMENTATION

7.1 INTRODUCTION

The Doctor’s Aid was implemented on Jupyter Notebook environment. The results were calculated using parameters like model loss , model accuracy , precision , recall , Auc , validation loss , validation accuracy , validation precision , validation auc , validation recall and confusion matrix from which it all gave optimal results .The Patient’s Aid was implemented on Python IDLE and was tested in real time to check if its working .

7.2 DOCTOR’S AID

We performed simulations to investigate the behaviour of different algorithms with different optimizers. We experimented with several algorithms and optimizers, and after analysing the results, we shortlisted two algorithms: Xception and Resnet 50. Xception is a variant of the Inception network, while Resnet 50 is a variant of the Resnet network. Furthermore, we shortlisted three known optimizers for these algorithms: Stochastic Gradient Descent (SGD) optimizer, Adaptive Moment Estimation (Adam) optimizer, and Root Mean Square Propagation (Rmsprop) optimizer. These optimizers are widely used in deep learning for optimizing the parameters of neural networks. The shortlisting process was based on the performance of the algorithms with the different optimizers, computational efficiency, or other relevant factors. The shortlisted algorithms and optimizers was hence chosen to be further analysed and compared to determine the best combination for a specific task.

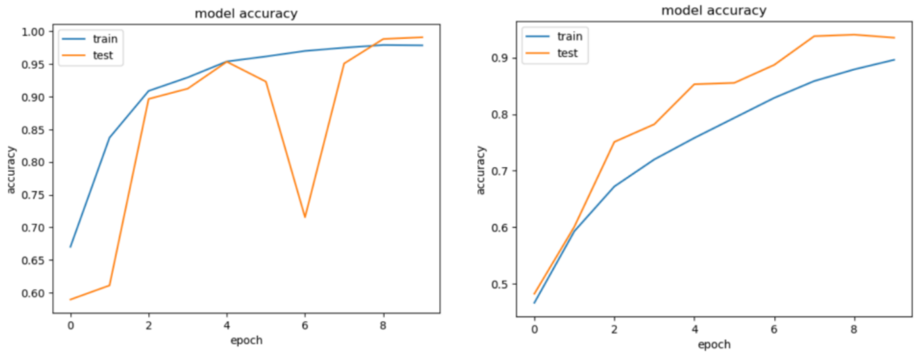


Figure 7.1. Resnet 50 with Adam and SGD optimizer respectively

We observed that for the given dataset Resnet 50 performed better with the Sgd optimizer giving us a more stable test accuracy and also higher highs and less lower lows as compared to Adam optimizer. Similar observations were observed for Xception paired with Sgd and Adams optimizers

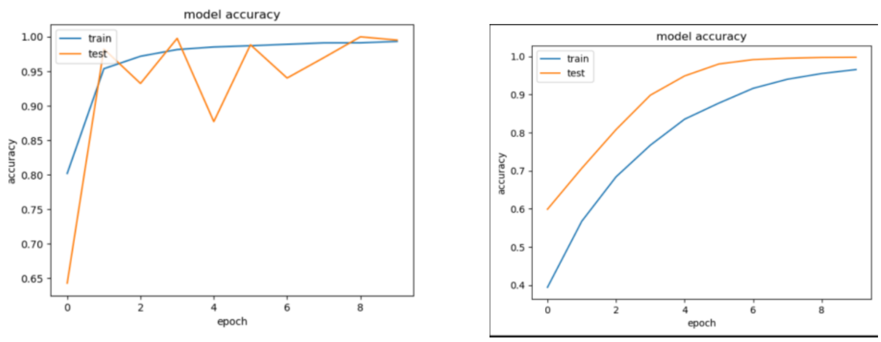


Figure 7.2 Xception with Adam and SGD optimizer respectively

It was additionally notices that xception wasn't able to get trained effectively during initial epochs and there was an accuracy drop of around 10-12 % in the testing accuracy.

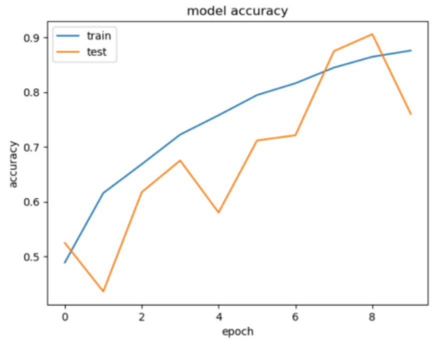


Figure 7.3 Resnet 50 and Xception concatenated with Rms prop optimizer

Rms prop (as shown in figure 7.3) doesn't seem to be a competent optimizer for this ensemble method as we can see there is a difference of about 15 % and fluctuation in the test accuracy.

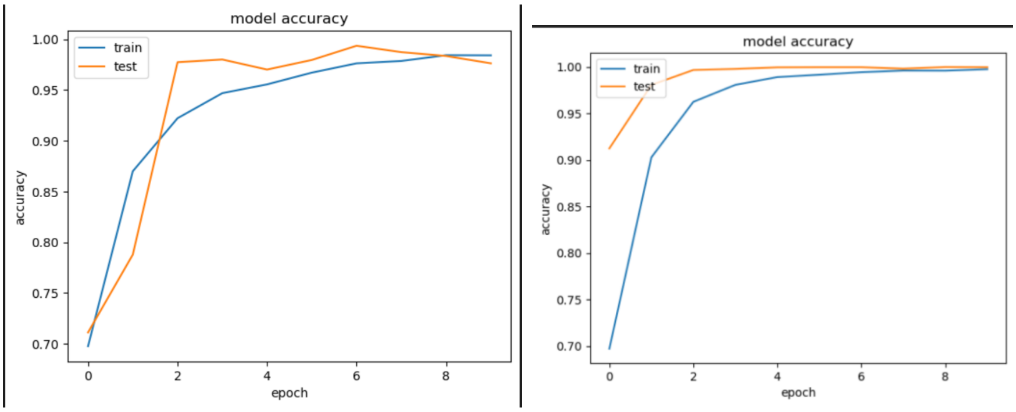


Figure 7.4 Resnet50 and Xcpetion concatenated with Adam optimizer and SGD optimizer respectively

From Fig 7.4 we can see that Resnet 50 and Xception concatenated with SGD optimizer performs with increased stability through the epochs. Extra Augmented data was added to the ensemble model.

All the simulations were carried out for 10 epochs with a learning rate of 0.001

7.3 PATIENTS AID

The patients Aid uses a camera feed that can help perform modules like face detection for family member detection, OCR for reading big signs, Object detection for interacting with the environment. All these modules have been implemented into a single user interface using Tkinter that has a button like user interface that can help choose the necessary function

7.4 SUMMARY

The Doctor's aid and the Patient's aid modules combine to provide assistance for Alzheimer's . Where the Patient's Aid uses a camera bases feed and the doctor's aid uses an MRI axial brain slice as an input .

CHAPTER 8

CONCLUSION AND FUTURE WORK

8.1 CONCLUSION

In conclusion, an effective framework has been built to for a multiclass classification where an ensemble method of concatenating the Xcpetion and Resnet 50 algorithm paired with the Sgd optimizer for classifying Mri axial cut images into for classes namely Mild demented , Very Mild Demented , Moderate Demented and Non demented provides benefits over the respective independent methods . The Patient's Aid proved to be usable in real time

8.2 FUTURE WORK

However, we need to extend the functionality of this framework to include the coronal and sagittal brain slices and add other data modalities such as, FDG-Positron Emission Tomography(PET), FDG-Positron Emission Tomography(PET), , Structural Magnetic resonance Imaging (SMRI), Computer Tomography(CT) and Functional Magnetic Resonance(Fmri).As only the Axial cut is not sufficient to provide the doctor noticable insight. The sign to speech and object detection modules need further work as they are not consistent and is built for a custom library that is restricted to a small group of objects and signs

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APPENDIX

A. SAMPLE CODE

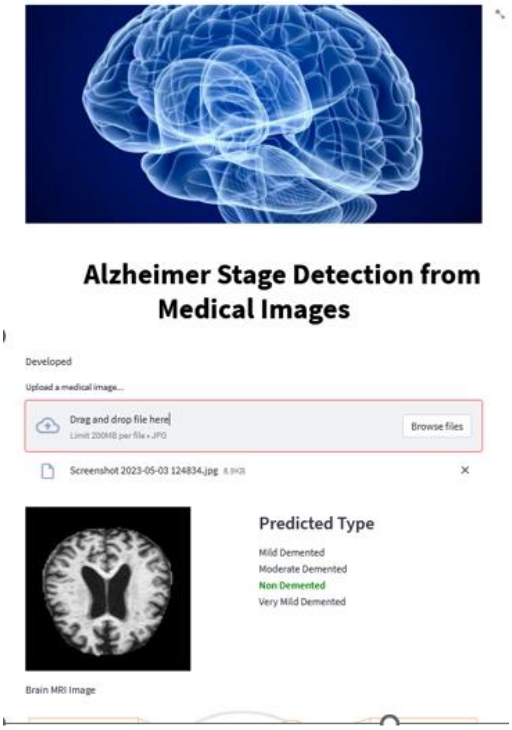
Doctor's Aid

```
#Model
input_shape = INPUT_SHAPE
inputs = Input(input_shape)
input_tensor = Input(shape= (128,128,3))

#xception and resnet
xception = Xception(include_top=False, input_shape = input_shape, weights = 'imagenet')(inputs)
res_net = ResNet50(input_tensor = input_tensor, include_top = False, weights = 'imagenet')(inputs)

#output
outputs = Concatenate(axis=-1)([GlobalAveragePooling2D()(xception), GlobalAveragePooling2D()(res_net)])

outputs = Dropout(0.25)(outputs)
outputs = Dense(len(classes), activation='softmax')(outputs)

# Optimizer
opt1 = Adam(learning_rate=TRAINING_RATE)
opt2 = SGD(learning_rate=TRAINING_RATE)
opt3 =RMSprop(learning_rate=TRAINING_RATE)

model = Model(inputs, outputs)
model.compile(optimizer=opt2,
              loss='categorical_crossentropy',
              metrics=['accuracy','Precision','Recall','AUC'])

model.summary()
```

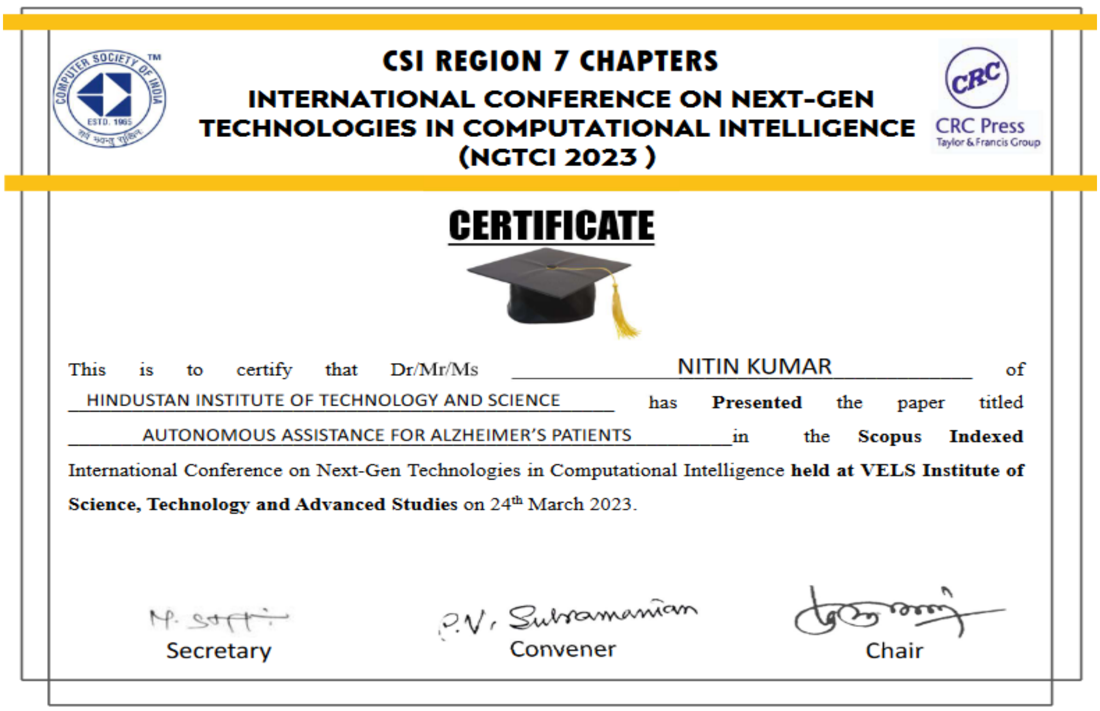
Patient's Aid

```
buttoncd = Button(root, text='Capture Dataset',command = captureDataset,bg="red",fg="yellow")
buttoncd.configure(width = 102,height=2, activebackground = "#33B5E5", relief = RAISED)
buttoncd.grid(column = 0 , row = 2)

buttonfr = Button(root, text='Face Recognition',command = faceRec,bg="red",fg="yellow")
buttonfr.configure(width = 102,height=2, activebackground = "#33B5E5", relief = RAISED)
buttonfr.grid(column = 0 , row = 3)

buttonr = Button(root, text='Realtime Object Detection',command = realtime,bg="red",fg="yellow")
buttonr.configure(width = 102,height=2, activebackground = "#33B5E5", relief = RAISED)
buttonr.grid(column = 0 , row = 4)

buttonsts = Button(root, text='Sign To Speech Recognition',command = STS,bg="red",fg="yellow")
buttonsts.configure(width = 102,height=2, activebackground = "#33B5E5", relief = RAISED)
buttonsts.grid(column = 0 , row = 5)

buttonocr = Button(root, text='Optical Character Recognition',command = OCR,bg="red",fg="yellow")
buttonocr.configure(width = 102,height=2, activebackground = "#33B5E5", relief = RAISED)
buttonocr.grid(column = 0 , row = 6)

buttonc = Button(root, text='Camera',command = cam,bg="red",fg="yellow")
buttonc.configure(width = 102,height=2, activebackground = "#33B5E5", relief = RAISED)
buttonc.grid(column = 0 , row = 7)

exit_button = Button(root, text="Exit", command=root.destroy)
exit_button.configure(width = 102,height=2, activebackground = "#33B5E5", relief = RAISED)
exit_button.grid(column = 0 , row = 8)
```

B SCREENSHOTS



C. PUBLICATION



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