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ALZHEIMER'S ASSISTANT using AI

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Abstract

Alzheimer's is a memory degenerative disease which affects a person in a gradual increasing severity. It is a type of dementia that affects the brain and it's behaviour, thinking and memory. Alzheimer'sis one of the leading causes of deaths in the older population all over the world.
Alzheimer's patients, as we know, have short term memory problems which leads to them having problems executing a plethora of day to day activities. Some of the well known issues include inability to recognise their family members or known people, forgetting about food and risk of wandering off due to forgetting locations and routes. They may even forget their own house or the doctors treating them. Hence a caretaker is assigned to them, to assist resolving the above issues. So we would like to use today's modern technology to implement similar assistance in terms of recognising people, reminders for medicine or food and so on, to the people affected by this so far incurable disease.
In order to achieve our proposed goal because it is optimal as our data consists of images. The proposed system is an Android application with built-in capabilities for face recognition, location tracking and timely alert system. With our project, we have made an attempt to help the patients suffering from Alzheimer's Disease by assisting them in their day-to-day activities using concepts of modern Computer Science and Artificial Intelligence.

Keywords: *Alzheimer's, dementia, patient, Face Recognition, Location Tracking, caretaker,Android application,Computer Science, Artificial Intelligence.*

1. Introduction

Dementia is actually quite common with more than 4 million cases in India as reported in 2015. Statistics suggest that these numbers are expected to be twice as much by the year 2040. India has the second most number of cases in the world. In 2015, all over the world the total number of cases can be estimated over 40 million.
Alzheimer's disease is one of the most common reasons contributing to dementia cases with estimated numbers suggesting that 60-70% of dementia cases. It is a chronic neurodegenerative disease that shows mild symptoms at first but the condition keeps getting worse eventually. Some of the early symptoms indicate difficulty in remembering recently occured events or short term memory.With our project, we have made an attempt to help the patients suffering from Alzheimer's Disease by assisting them in their day-to-day activities using concepts of modern Computer Science and Machine Learning. The main users of the system are people suffering from Alzheimer's disease with varying degrees of severity. The purpose of this project is to assist the patients and relive some load from the kind caretakers using the latest advancements in science and computer technologies.

Alzheimer's disease (AD) is a chronic neurodegenerative disease which affects memory and the Central Nervous System (CNS).People suffering from Alzheimer's disease require constant assistance.No previous digital solution has been able to make an impact.Hints or clues help patients recall memories.So, a Face Recognition and Location Tracking model is a proposed solution.

From the knowledge as we know, Alzheimer's disease is not a disease like high blood pressure or diabetes that can be recovered or maintained by just taking medicine on time without specific help from

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others to take care or manage them. Alzheimer's disease causes the patient to forget what they had done even a minute ago. So they need some specific applications to take care and remind them of what they should do.

We aim to build such a system that can help Alzheimer's patients to recognize people.We are trying to build a system which will protect Alzheimer's patients from entering dangerous zones.

2. Literature Review

In **[10] C. Giraldo, S. Helal, and W. Mann** introduces mobile patient care-giving assistant.They use widespread computing technologies such as smartphones and multi modal sensors in smart homes which can assist patients with moderately affected Alzheimer's disease. It also implements integrated local positioning systems.

MiWI device[11] is introduced by "An efficient tracking device for Alzheimer patients using miwi" .This device is connected with the patients all the time. If the patient goes out of a certain range from the device, an alert is immediately sent to the caretaker's device along with the details such as latitude and longitude. People can also track and let know the caretaker if the patient is found.We learnt about the technology to track the patient from this paper.We decided to apply the same technology in our application.

Pei-Ju Cheng, Ming-Chyi Pai[2] Have used event related potentials (ERPs) to recognise known faces and location scenes to help patients with very mild Alzheimer disease (VMAD).
It was presented that two variants like familiar and novel were used for each type of stimuli, namely scenes and faces. Event related potentials were used to study the difference between the recognition of familiar faces and scenes in patients with very mild Alzheimer's disease (VMAD). It was discovered that different neural regions were used for early visual processing.

Smart location tracking system for dementia patients[1] was introduced by paper.This paper proposes a system by integrating GSM module and the GPS module along with a programmed microcontroller to enable real time tracking of dementia patients who could potentially get lost outside their homes. In this system their positioning coordinates were reported to the caretaker's android mobile device and the tracked latitudes and longitudes can easily be seen and routed on Google maps.

We learnt from the above technologies and tried to implement them in our project.

System Design

The system consists of various modules which work in unison to provide service to the patient and the caretaker.The camera module functions by providing an image using the device's external camera.The captured image is then given as an input to the CNN model which is a trained model on the images dataset.It classifies the image which helps the patient to recognize the captured image.The GPS feature is used for obtaining the current location of the patient.The system monitors the patient's location in real time using the GPS module.Further, the location information shall be uploaded to the firebase database system for the tracking and routing purposes and the real time face and scene recognition shall be provided to the patient

DATA FLOW DIAGRAM

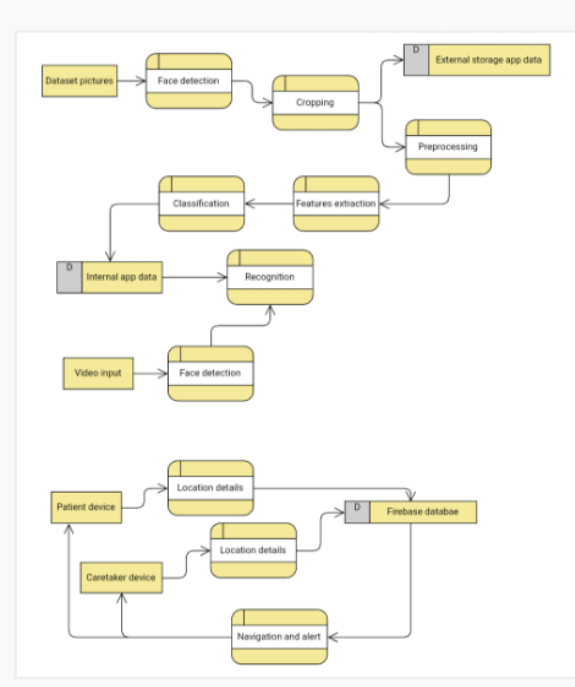


Fig.1: Data Flow diagram

The above diagram graphically represents the data flow in the system.The images and the algorithm(Viola Jones Algorithm) are given as an input for training the model.Images(Faces) are classified and distributed and segregated in sets according to the ordering, preference and role.The final steps are mapping the classified images after the user's input is undertaken.

MODULAR DIAGRAM

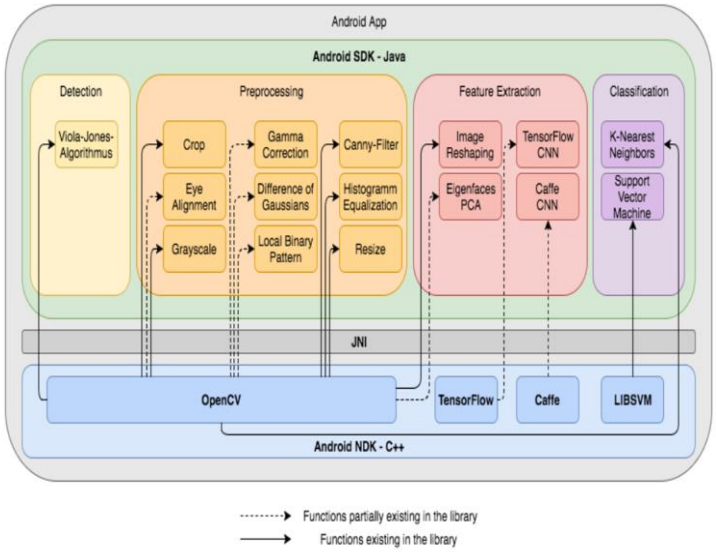


Fig.2: Modular diagram

The diagram to the left(Fig.2 Modular diagram) is the modular design of our system. Through this modular design we are trying to show the interaction between the different layers of our system, mainly the application and the underlying algorithms and libraries used. The first layer depicts the users, which is the external layer of our entire architecture.The users use the android application.Users can be the patient as well as the caretaker.The figure shows an interaction between the users and the Android application. All the requests of the users are taken by the Android application and processed using Convolutional Neural Networks that recognizes patterns through the use of neural networks and available dataset.The various modules present are - Detection, Preprocessing, Feature Extraction and Classification.The libraries used are - OpenCV, Tensorflow, Caffe, LIBSVM.

3. Implementation Details

5.1 Methodology Applied:

Patient Side

Face recognition training algorithm

- Firstly the detection of the face takes place through viola-jones algorithm.
- Now on the detected faces the preprocessing of data is carried out.
    1. Cropping
    2. Gray scaling
- These processed images are saved in phones memory.

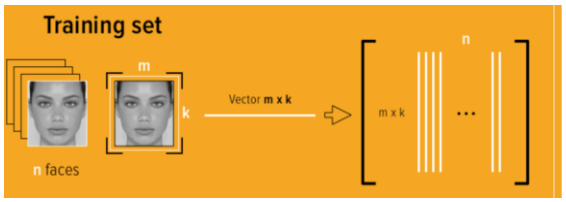


Image 1: Transformation of the training set of faces into a single matrix

- After that feature extraction will take place with help
    1. Eigenfaces
    2. Tensorflow CNN
    3. Caffe CNN

Image 2: An example of the eigenfaces obtained for a trained set of faces

- After that the classification of images will take place through algorithm
    1. K-Nearest Neighbors
    2. Support Vector Machine

Real time location tracking

- Connect to the firebase.
- Get the current location of the patient through GPS.
- The current coordinates are obtained in the firebase.

Caretaker Side

Get patient location

- Connect to the firebase.
- Run query to get the latest location.
- Display on default maps app.

5. Algorithms implemented:

Viola-Jones Algorithm:
Paul Viola and Michael Jones developed this object recognition framework algorithm in 2015 that allows detection of real-time image features detection.It has two 2 stages : Training and Detection.

Training: The machine is trained to identify these features. To train the machine and allow it to learn to predict, we feed it information. The algorithm helps us set a certain threshold which can allow the machine to classify something as a feature or not.

Detection: This algorithm was designed focusing on the frontal faces, hence it may not be as effective for faces looking down, up or sideways. The image data is converted into grayscale as it helps in better processing and it's easier to work with it. Grayscale also helps in reducing data bandwidth as there's less input data to process.

The Google FaceNet Algorithm:
This algorithm is widely used in modern applications implementing face recognition. Technique used by this algorithm is also called "one-shot learning". The network used by this algorithm has a batch input layer, a deep Convolutional Neural Network (CNN) and then using L2 normalisation.

The FaceNet Convolutional Neural Network doesn't extract features from an image, but rather uses the individual image pixels as the features. In short, it focuses on representing a face as a 128-bit embedding, while mapping features to vectors.

Vector distance can be used to calculate similarity between two vectors as these vector embedding are represented in shared vector space. This is used to determine the amount of similarity between two faces.

The minimization of the distance between anchor and a known positive (how much two faces are similar) along with simultaneous maximization of the distance between a known negative and anchor is taken care by "triplet loss" which is the last stage in the FaceNet architecture.

6. Comparison with Existing System

Sr No	Existing System	Proposed System
1	**Alzheimer's Daily Companion[13]** The Major Drawbacks of "Alzheimer"s daily companion" are as follows: 1)It does not provide GPS tracking or any other mechanism to solve the wandering problem of the patient. 2) It does provide Independence to the Patient and always requires a Caretaker to keep a Track thus useless It's not Patient Oriented application.	1)Our system provides GPS tracking system 2)Our system helps patient to identify people by face to patient
2	**Alzheimer Caregiver Buddy[14]**	

	The features of "Alzheimer caregiver buddy" are: 1) Get instant help and advice. 2) Provides the Caregiver an Idea about how to deal with wandering, bathing and meals i.e how to interact with patients. Drawbacks of this system are: It is again not Patient oriented. It doesn"t Provides Location information to the patient	1)Our app provides location information to caretaker 2) Our system show red alert when patient enters dangerous zone
3	**Tell My Geo[15]** Drawbacks of this system are as follows: 1)It Doesn"t provides Notification of to do list	1)We are adding notification feature in our app.Caretaker will be notified

Table 1: Comparison with Existing System

TESTING

Various test case scenarios considered:

- Using multiple Android versions for project demonstration
- Changing the quality of images used for model training
- Checking for system compatibility with multiple varied backgrounds.
- Checking for systems working in various scenarios with poor input conditions.

7. Inference drawn from the test:

The model was found to recognize the face in every image very accurately. The system was found to be compatible with various Android versions considered. It also displayed the exact same user interface as planned

Below table shows the result of above test cases**:**

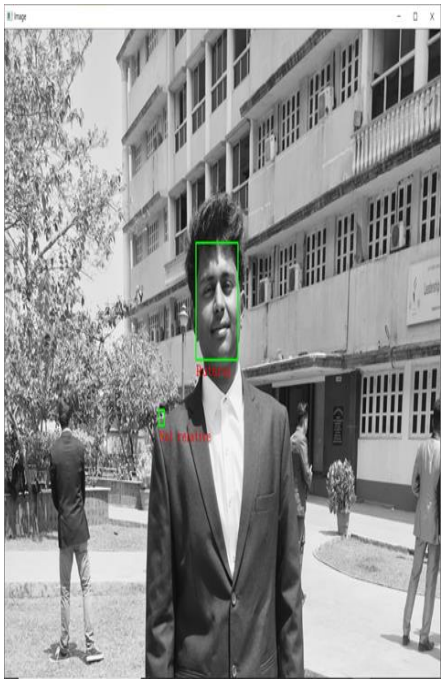
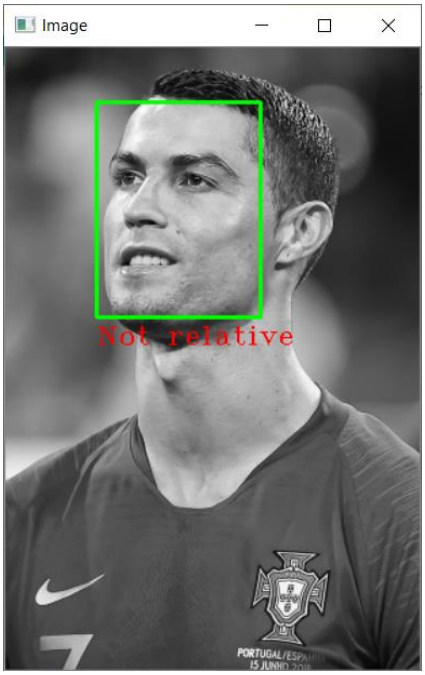
	Figure 1	**Figure 2**
		
Class probability	**0.69232827(High)**	**0.4099701(low)**
Result	**Relative**	**Non Relative**

Table 2: Test Results

8. Conclusion and Future Work

This paper puts forward an Android application for providing assistance to patients diagnosed with alzheimer's disease and their caretaker. It can be used with ease by the patients as well as the caretaker. It provides aid to patients in their daily tasks. The setup includes installation of the app and providing some additional input for the initial configuration, but once done the user shall be able to access all the features easily. When the modules require access to the internet, location services and camera, and would not work fully as intended if any permissions are denied. Interviews with Alzheimer's patients and their caretakers helped us determine their issues and how we could use technology to provide them assistance. These interactions also gave us information about what technologies they currently use and what technologies will help them further.

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