Minder: a mobile application using Machine Learning

Sameh Mahmoud Mahmoud, Youmna Magdy Mohamed, Maram Jamal Al-Farmawy, Hend Ali Abdel-Razek Kandil, Ahmed El-Sayed Mahmoud

sameeh1810@gmail.com, Yomnamagdy321@gmil.com, marramjamal@gmail.com, Hindkand2000@gmail.com, ahmedhaikel4@gmail.com

Misr University for Science and Technology college of Computers and Artificial Intelligence Department of Computer Science

Abstract: Alzheimer's disease is a progressive neurologic disorder that causes the brain to shrink and brain cells to die. Alzheimer's disease is the most common cause of dementia — a continuous decline in thinking, behavioral and social skills that affects a person's ability to function independently. Alzheimer's disease causes memory loss and affects daily task performance. Memory loss leads to challenges including remembering people's names, faces, places, or other information. As a result, the goal of this research is to help Alzheimer's patients in mild (early-stage) and moderate (middle-stage) stages stay active in society and live independently. We present a smartphone application that uses facial recognition technology to detect individuals faces. By incorporating a notification feature, the application intends to increase everyday communication while also boosting their capacity to do daily chores. The application has assisted persons with Alzheimer's symptoms and considerably aided their daily lives, according to the findings. As a result, this study emphasizes the relevance of using AI-based features, such as face recognition, in this context. To conclude, Alzheimer Assistant application expands on the current array of software tools that help people with Alzheimer's disease continue to engage in social activities with their family and friends. As a result, the essential knowledge, skill levels, and enthusiasm have been relentlessly employed in the design of this application in order to handle the issues associated with this current societal state. Furthermore, this application emphasizes the advantages of using advanced technologies, most notably facial recognition, to achieve this goal, given that there has been rising evidence in recent years that such systems can be employed in a variety of scenarios.

Keywords: Machine Learning, Mobile Application, Alzheimer's disease, face recognition.

1. Introduction

In 1906, German physician Dr. Alois Alzheimer first described "a peculiar disease" — one of profound memory loss and microscopic brain changes — a disease we now know as Alzheimer's. Just like the rest of our bodies, our brains change as we age. Most of us eventually notice some slowed thinking and occasional problems with remembering certain things. However, serious memory loss, confusion, and other major changes in the way our minds work may be because Alzheimer disease. Alzheimer's disease and related dementias (AD/RD) are progressive neurocognitive disorders that currently affect approximately 50 million people worldwide This number is estimated to increase to 131.5 million by 2050. Mobile phone apps have been well-integrated into daily lives and can be used to deliver and promote health care. There is an increase in the use of technology to provide care and support to AD/RD patients and their families. Artificial Intelligence (AI) and machine learning (ML) have transformed the mobile app development landscape.

The mobile app developer relies on cognitive technology like ML to write powerful algorithms to create intelligent apps that can understand human behavior, assist users, and entertain them. The machine learning technique of pattern recognition is a dynamic learning experience. On the other side, predictive analytics is applicable to financial, marketing, and banking data, face detection, image, and object recognition methods are essential for reliable security. The percentage of mobile app developers relying on ML techniques at various mobile app development stages is increasing.

Alzheimer's not only stealing people's memories but also their ability to recognize faces, which widens the gulf between people with this disease and their loved ones. beyond causing memory problems, Alzheimer's disease also impairs visual face perception. So, our main objective is to enhance the facial recognition capabilities of Alzheimer's patients, which will make them feel independent and safe. So, a key foundation of Our app is to help patients remember people and recall faces. One aspect of this functionality is an image gallery, which can have images of the patient family faces or of memorable events such as family birthdays, complete with a description of who is in the photo, details of the occasion, and when and where it was.

2. Literature review

Face Recognition:

The detection phase of facial recognition starts with an algorithm that learns what a face is. Usually, the creator of the algorithm does this by "training" it with photos of faces. If you cram in enough pictures to train the algorithm, over time it learns the difference between, say, a wall outlet and a face. Add another algorithm for analysis, and yet another for recognition, and you've got a recognition system.

Machine learning:

ML helps reduce the gap between understanding user behavior and utilizing it to create a customized solution. App developers embed ML into mobile applications to create customized applications for each individual. ML depends on continuous learning. Based on the user's everyday activity, the ML program learns and re-learns to create a customized solution. This advancement helps to create an adaptive app that can help to achieve an ideal omnichannel experience.

Smartphone Applications

In this section, we have identified several applications that have been developed to assist Alzheimer's patients and we undertook a comparative analysis between these applications and ours. We have concluded that our application differs from these, in that it provides specific features to assist Alzheimer's patients.

Alzheimer's disease pocket card: Manage Alzheimer's disease with confidence. The Alzheimer's Disease Pocket card app helps physicians and other health care professionals care for patients with Alzheimer's disease (AD) at the point of care. The App features clinically relevant information on AD and interactive tools to help clinicians efficiently assess patients and interview their caregivers.

The main features in Alzheimer's Disease Pocketcard:

Interactive tools to assess cognition and function, Clock Drawing Test, Saint Louis University Mental Status Exam, Functional Activities Questionnaire, and more. An Annual Wellness Visit algorithm developed by national experts to help clinicians assess cognition more efficiently. Current diagnostic criteria, the updated diagnostic criteria, and guidelines for Alzheimer's disease from the National Institute on Aging and the Alzheimer's Association. Education/support packets (PDF brochures) from the Alzheimer's Association that can be e-mailed directly to patients and caregivers. Bookmarking and notes capability.

It's Done: A.J. Lester & Associates, Inc. has developed It's Done! (2019) which is an Alzheimer's app for iPhone that is tailored to help patients remember tasks more easily.

It's Done! (iOS): this reminder app helps confirm if you have completed tasks throughout the day. You tick 'Done' for each of your routine tasks, like locking the door, then later if you cannot remember if you locked the door, the It's Done! the app confirms that the task has been completed. The app can also send a text message or email to others when a task is done, so family or carers can be at ease that the oven has been turned off, etc.

The main features in It's Done:

Ability to categorize tasks based on time and importance. Reminder alarm for time-sensitive tasks. Attachable notes for additional task information.

MindMate: Founded by three former caregivers (MindMate, 2019), MindMate is one of the leading apps for healthy aging. Its multi-faceted app allows caregivers and their loved ones to participate in a variety of activities together. For patients with dementia, it features mental and physical workouts, such as puzzles and simple stretches, as well as nutritional tips inspired by the MIND Diet.
MindMate also features tools to help caregivers interact with their loved ones; Its entertainment section features classic hits from different eras to help stir emotional responses. There is also a diary section for caregivers to help record their loved one's memories to share with family and friends.

The main features of MindMate:

Games and other mentally invigorating tasks. Workout with a free personal trainer for each patient via the Internet. Facility to add daily tasks, notes, and even a 'to-do list. Facility to add pictures. Facility to add patient information.

Remember Me: Remember me (Remember me, 2019) is an interactive mobile application aimed at Alzheimer's family members. It is a household manager which aims to share tasks and remove the burden of caring for a dependent person alone.
The main features in Remember Me:

Scheduling events or activities. Being updated in relation to all events that are occurring. Alerting everyone in the family when a new event is created in patient memories. Inserting and updating the patient data.

Alzheimer's Helper: Alzheimer's Helper (2019) is a mobile application that offers an alternative to more traditional paper-based systems, by assisting in the recording and storage of personal information on family
and friends, for example, their contact details.

The main features of Alzheimer's Helper:

Facility to add a picture. Facility to add patient information.

Alzheimer's Manager: Getting the Full Picture of Alzheimer's Disease Through This App. When you are living with Alzheimer's Disease, the Alzheimer's Manager can help you or your caregiver manage the symptoms that affect you every day. For many, the best part of using Alzheimer's Manager is seeing moods, pain, and medications When your health journey is presented this way, it is easier to spot trends, notice strengths, and identify areas of concern.
When You Download Alzheimer's Manager and Register, You Can:

Track your progress and symptoms• Manage your medications and treatments, including reminders. Use the photo upload feature to share visible symptoms with care providers. Connect to care providers so they can monitor your progress between visits and better understand how your condition is affecting you. Stay up to date with the latest information on Alzheimer's.

Luminosity: Luminosity's "Brain Training" app has been so popular that it has been used in cognitive functioning studies. Its research-based activities are specifically designed to challenge cognitive capabilities. The app has seven different types of activities to choose, each targeting a different ability. For example, users can test their memory, logical reasoning, speed, and other functions through specially tailored games. The free version allows users to play three games a day, which supplies them with plenty of material to try out the app.
By harnessing the power of technology, apps can help a person connect with old memories and even make new ones.

Comparison Regarding Market Stats

A Comparison between the smartphone apps based on the app markets.

	Alzheimer's disease pocketcard	*It's Done!*	*MindMate*	*Remember Me*	*Alzheimer's Helper*	*Alzheimer's Manager*	*Luminosity*
Platforms	**IOS**	**IOS / Android**	**IOS**	**IOS / Android**	**Android**	**IOS / Android**	**IOS / Android**
Pricing	**Free**	**Cost: $2.99**	**Free**	**Cost: $2.74**	**Free**	**Free**	**Free**
Avg. Store Rating	**3.1/5.0**	**3.7/5.0**	**4.8/5.0**	**4.5/5.0**	**4.6/5.0**	**3.7/5.0**	**4.4/5.0**
Installs	**300+**	**100+**	**3.3K+**	**453+**	**4.2K+**	**100+**	**2K**
Release Date	**April 8, 2014**	**2019**	**2019**	**2019**	**2019**	**2017**	**2020**

Table 1. A Comparison between the smartphone apps based on the app markets

Applications services Comparison.

	Face Recognition	*Task Reminder*	*Medication Timings*	*Adding People*
Alzheimer's disease pocketcard				
It's Done!		✓		
MindMate		✓		✓
Remember Me		✓		
Alzheimer's Helper				
Alzheimer's Manager		✓	✓	
Luminosity		✓		
Minder	✓	✓	✓	✓

Table 2. Applications services Comparison

Our application is an interactive memory care assistant for engaging seniors, especially those living with early-stage Alzheimer's. The app contains two core parts: A camera (for recognizing faces) and a Reminder section. It also helps users with memory loss, we provide our users a reminder section where either the patient or his assistant can add reminder notes and a to-do list to help the patient with doing the daily routine tasks and check it when the task is done. Then the camera section is responsible for recognizing people's faces. The mobile camera can detect faces using certain algorithms and recognize them using the user's saved database on our application, which tells the user the name of this detected face.

3. Implementation

The Alzheimer Assistant application builds on the existing suite of software solutions currently available to support those with Alzheimer's to continue to participate in social activities with their family and friends. Accordingly, the necessary knowledge, skill levels and enthusiasm have been resolutely applied in the design of this application, to address the challenges associated with this condition in society today. In addition, this application highlights the benefits in adopting advanced technologies, most notably, face recognition to achieve this goal, given that, over the last number of years, there is growing evidence to suggest that such systems can be used in multiple settings.

The Face SDK is a library for iOS and Android platforms that provides a solution for biometric verification by leveraging the power of Regula Face SDK Web Service.

Features included:

Face Matching: Check the likelihood that two faces belong to the same person.

Face Recognition: Automatically capture a photo with a person's face on it.

The algorithm used in this API is OpenCV.

The camera identifies faces using Face SDK algorithm which works as a loop of array that detects faces using bitmaps, then it recognizes the person if its already stored in the database, if the application couldn't detect the face this means that its new person and then the user can use Add Person function to add them.

4. Testing

The purpose of testing the proposed application is to verify if the application is functioning correctly and that it is returning the expected results. In this chapter, we will perform unit testing, integration testing, compatibility testing, and system testing. Unit testing checks the validity of each function individually, while integration testing is testing multiple components to see how they interact together when carrying out a function. Compatibility testing is applied to ensure that the application operates correctly on the devices, and, finally, system testing tests how the entire system is functioning. We conducted some tests that have completed the implementation of the application, while others were undertaken during implementation. We used Android phones to test the application, as well as the simulations available on the Android Studio. Additionally, we tested the accuracy of the face recognition method. We tested this feature by detecting the faces of five people, The system identified all of them.

5. Conclusion and future work

Alzheimer Assistant is a mobile application which its main aim to assist Alzheimer's patients to recognize and identify people faces using mobile camera. We have designed Face Recognition section using machine learning and AI to help in converting an image to a useful data which can match people's faces and identify them. We have given a thorough review of machine learning methods for intelligent data analysis and applications in this work. We've briefly reviewed how several sorts of machine learning algorithms can be used to solve various real-world problems, as per our goal. A successful machine learning model is dependent on both the data and the learning algorithms' performance. Before the system can aid with intelligent decision-making, the sophisticated learning algorithms must be taught using the collected real-world data and knowledge connected to the target application. We

also addressed many common machine learning application areas to show its relevance in a variety of real-world problems.

This application is specifically developed using machine and deep learning to help in identifying faces. After the comprehensive investigation and review the advantages and disadvantages of various algorithms libraries, we decided the best choice and most suitable for our application is Face SDK; an API algorithm that implements the most advanced techniques in the field of artificial neural networks and machine learning. It provides uncompromised performances to identify and recognize individuals. It is a library for iOS and Android platforms that provides a solution for biometric verification by leveraging the power of Regula Face SDK Web Service. It has several sections to enhance patient's mind and develop their memory such as: Reminder Section, Medication Section. This helps an individual to increase the intellectual level of them by doing such daily activities like this to enhance their memory in remembering their daily routines. People relatives are stored in database in mobile gallery and the patient can import saved image from their phone or opens the camera for photo shooting individual faces. The camera then identifies faces using Face SDK algorithm which works as an array of the face using bitmaps, then it recognizes the person if its already stored in the database, if the application couldn't detect the face this means that its new person and then the user can use Add Person function to add them.

The Application sends updated notification of patient's medical condition to remind patients of what they must do on any given day. Hence, this application motivates Alzheimer's patients to be more confident when participating in everyday activities, thus improving their ability to engage in social events daily. This application has clearly demonstrated its capacity to aid the patient's assistant and families of Alzheimer's patients.

To conclude, Alzheimer Assistant application expands on the current array of software tools that help people with Alzheimer's disease continue to engage in social activities with their family and friends. As a result, the essential knowledge, skill levels, and enthusiasm have been relentlessly employed in the design of this application in order to handle the issues associated with this current societal state. Furthermore, this application emphasizes the advantages of using advanced technologies, most notably facial recognition, to achieve this goal, given that there has been rising evidence in recent years that such systems can be employed in a variety of scenarios.

R E F E R E N C E S

[1] N. Lahoti, “Machine learning in mobile applications: The next wave of enterprise mobility,” *Mobisoft Infotech*, 14-Jul-2020. [Online]. Available: https://mobisoftinfotech.com/resources/blog/machine-learning-in-mobile-applications/. [Accessed: 20-Dec-2021].

[2] A. Shukla, S. Yadav, and V. Ku, “Voice recognition techniques: A review paper,” Irjet.net. [Online]. Available: https://www.irjet.net/archives/V7/i6/IRJET-V7I6965.pdf. [Accessed: 20-Dec-2021].

[3] Y. Guo, F. Yang, F. Hu, W. Li, N. Ruggiano, and H. Y. Lee, “Existing mobile phone apps for self-care management of people with Alzheimer disease and related dementias: Systematic analysis,” JMIR aging, vol. 3, no. 1, p. e15290, 2020.

[4] L. Li, X. Mu, S. Li, and H. Peng, “A review of face recognition technology,” IEEE Access, vol. 8, pp. 139110–139120, 2020.

[5] Y. Guo, F. Yang, F. Hu, W. Li, N. Ruggiano, and H. Y. Lee, “Existing mobile phone apps for self-care management of people with Alzheimer disease and related dementias: Systematic analysis,” JMIR aging, vol. 3, no. 1, p. e15290, 2020.

[6] N. Gillani and T. Arslan, “Intelligent sensing technologies for the diagnosis, monitoring and therapy of Alzheimer’s disease: A systematic review,” Sensors (Basel), vol. 21, no. 12, p. 4249, 2021.

[7] “2021 Alzheimer’s disease facts and figures,” Alzheimers. Dement., vol. 17, no. 3, pp. 327–406, 2021.

[8] C. Mazzi, G. Massironi, J. Sanchez-Lopez, L. De Togni, and S. Savazzi, “Face recognition deficits in a patient with Alzheimer’s disease: Amnesia or Agnosia? The importance of electrophysiological markers for differential diagnosis,” Front. Aging Neurosci., vol. 12, p. 580609, 2020.

[9] A. O. Elfaki and M. Alotaibi, “The role of M-health applications in the fight against Alzheimer’s: current and future directions,” MHealth, vol. 4, p. 32, 2018.

[10] T. Klosowski, “Facial recognition is everywhere. Here’s what we can do about it,” The New York times, The New York Times.

[11] Y. Bakhshi, S. Kaur, and P. Verma, “A study based on various face recognition algorithms,” Int. J. Comput. Appl., vol. 129, no. 13, pp. 16–20, 2015.

[12] S. S I, “Face and Speech Recognition Fusion in Personal Identification T,” A International Journal of Computer Applications, no. 2.

[13] D. Lu and L. Yan, “Face detection and recognition algorithm in digital image based on computer vision sensor,” J. Sens., vol. 2021, pp. 1–16, 2021.

[14] Dirin, A., Delbiaggio, N. and Kauttonen, J. (2020) “Comparisons of facial recognition algorithms through a case study application,” International Journal of Interactive Mobile Technologies (iJIM), 14(14), p. 121. doi: 10.3991/ijim.v14i14.14997.

[15] Dennis, A., Wixom, B. H. and Tegarden, D. P. (2004) Systems analysis and design with UML version 2.0: An object-oriented approach. 2nd ed. Nashville, TN: John Wiley & Sons.