AMNECARE: An Application using Machine Learning and IoT for monitoring elders suffering from Amnestic Syndrome

[1]Prachi Navale, [2] Snehal Marne, [3]Ritika Gupta, [4] Neha Bhavsar, [5]Tejasvita Vaidya
[1-4]Student, Department of Computer Engineering, Sinhgad College of Engineering, Pune, Maharashtra, India
[5]Assistant Professor, Department of Computer Engineering, Sinhgad College of Engineering Pune, Maharashtra, India

ABSTRACT

Amnesia is a lethal disease that causes loss of memory, facts, experiences thus, affecting the lifestyle of millions of people causing a significant impact on their independence. However, current solutions are overpriced or fail to provide ways to customize actions and alerts which can help the patient and their families. This study proposes a healthcare application named Amnecare that monitors people suffering from Amnesia by sending pill alerts, daily schedule with reminders, and locating the patient via real-time GPS tracking thus ensuring its safety. This application aims to help the patient by providing artificial intelligence-based face and voice recognition to remain connected. Furthermore, Amnecare provides a unique cost-efficient feature for patient security using an ESP32-cam which provides visitor identification.

KEYWORDS

Amnesia disease, Face Recognition, Voice Recognition, Mobile Application.

I. INTRODUCTION

Tending to forget things is very common as a person starts aging, but, when forgetfulness begins to interfere with our daily activities, taking physician help becomes necessary. A person has Amnesia when they start to lose the ability to recollect information. Emotionally challenging symptoms like anxiety, depression, and stress are also seen to be accompanied.

Research shows that as age increases, the prevalence of dementia increases. As per the census taken in the year 2011, India is home to almost 65 million people of which 5.5% of the population includes people of the age 65 and above. The ubiquity of the disease dementia in India is reported to be almost 2.7% [1]. With the increase of the elderly population, dementia poses a great challenge. Gerontologists and psychologists often refer to the families of those with memory loss as the 'invisible second patients.' While dealing with routine day-to-day activities, caregivers or family members must provide round-the-clock support to their loved ones. Unfortunately, caregivers often tend to get physically and emotionally overburdened.

In most cases, amnesia resolves itself with time but sometimes treatment may be necessary. Treatments often involve techniques and strategies to help reimburse for the memory problem [2]. This may involve:

- Working with therapists to gain new information on how to replace lost memories.
- Strategies that help to organize information which makes it easier to store.

One of the possible solutions is to motivate the use of smartphones by the patient which helps the patient with their daily tasks and reminders [3]. Smartphones also play a crucial role for the family members since it helps to monitor patient's activities from time to time.

Using modern technology and its advancements, the proposed application Amnecare acts on various problems faced by amnesia patients in daily routine. People suffering from amnesia tend to forget their loved ones. This application serves as an assistant in such situations by providing face recognition techniques, which helps the patient to recognize the person and their relationship with them. Also, this problem can be solved through voice recognition in situations where face recognition is not working. Often patient comes across situations where they are unable to remember the way after leaving the house and unfortunately, they get lost. Thus, Amnecare has a feature that supports GPS tracking which provides the last known location of the patient which helps the caregivers to locate the patient. The application also helps in assisting the caregiver to take proper care of the patient even if not present physically at home, such as sending alerts to take medications from time to time and setting reminders for important.

When the patient is alone at home it is difficult to monitor them. Also, the hardware and sensors required for a smart home setup do not come cheap [4]. Thus, Amnecare provides a cost-efficient doorbell notification feature that uses ESP32-camera as a security camera and recognizes the person at door using AI-based technology. Keeping in mind the patient's security, the caregiver can then send an alert to the patient to deny or accept the visitor. The authors propose an application named AMNECARE that tends to be a one-stop solution for providing all these facilities to the patients and an application with interactive GUIs to enhance their cognitive abilities.

The remainder of this document is arranged as follows. Section **II** discusses existing applications for dementia patients and compares them to our proposed solution. Section **III** presents the proposed framework and its concepts. Finally, conclusions and prospects of this research are presented in Section **IV.**

II. RELATED WORK

A. *Existing Applications*

1) Timeless:

Timeless is a caregiver-assisted mobile application for people suffering from Dementia that helps them recognize their loved ones with the help of artificial intelligence technology and set reminders about daily tasks. Unfortunately, Timeless only works on Apple devices including iPhones and iPads [5].

Main Features:

- UPDATES**:** The photos of families and friends are tagged with names and relationships to the patient using AI-based facial recognition technology.
- TODAY: Provide reminders for daily activities.
- CONTACT: It is a picture phonebook.
- IDENTIFY: Identifies the person using facial recognition technique by using the phone's camera.

2) Remember Me-Caregiver:

Remember Me is a household manager that aims to share tasks and reduce the burden of caring for a person who depends on others for day-to-day activities [6].
Main Features:

- Interactive Calendar: Schedule events and notify family members of scheduled events.
- News Board: Stay updated about all events.
- Alerts: Alerts family members for a new event.

3) CareZone:

CareZone helps you organize the information you're challenged to manage in healthcare situations and coordinate with family and caregivers [7]. It is compatible with both IOS and Android devices.
Main Features:

- To-dos keeps a synchronized list that need to get done and assign tasks to get the help you need.
- Notes stores important information.
- The calendar keeps track of appointments.
- Helps you to keep up-to-date medications.

4) It's Done:

Unlike calendar and task apps that hector you to complete the work, It's Done simply just confirms whether routine tasks have been completed or not [8].
Main Features:

- Task set up to repeat daily or at a fixed time.
- Categorize and prioritize tasks.
- Sends text automatically or via email showing confirmation of task completion to caregivers.

5) SYMON-A (SYstem for MONitoring Alzheimer's patients):

The SYMON-A uses smartphones to act as intermediaries for sending and storing data from smart things in the cloud. By using this information from several sensors, a computational model that can monitor the patient's condition and taking preventive or corrective actions to avoid injuries and accidents is proposed [4].

Main Features:

- Uses various sensors for monitoring patient
- Sends alerts to the caretaker in case of emergency.
- The routines tab, set by the caretaker, provides access to the risk scenarios that are continuously monitored by the system.

B. *Our Proposed Solution*

In India, the elderly or people suffering from dementia are looked after by the families and caregivers. With the increase of the elderly population and a reduction in the number of the joint family system in our country, dementia poses a great challenge [1]. Therefore, this study proposes an application called Amnecare, which helps patients to live an independent life. The application also helps families or caretakers to monitor the routine of the patient by sending voice alerts for medications, daily routine, keeping track of visitors, emergency call feature and the last known location of the patient using GPS. The application also includes artificial intelligence-based face and voice recognition technology to be able to identify their loved ones.
Main Features:

- Calendar with daily routine tasks and pill reminders.
- Recognize people by clicking pictures or recording voice using AI-based face and voice recognition.
- Tracking of visitors using ESP32-Cam and sending notification with the name of the person at door.
- Two interfaces for the patient and caregiver
- SOS/Help me call to caretaker or family, in case of emergency.

C. *Comparative Analysis*

The authors carried out a comparative analysis among the existing applications for dementia patients and the proposed application solution as shown in Table 1 and Table 2. Patients tend to forget to check notifications regularly, thus as shown in Table 1 Amnecare incorporates pill voice alerts to ensure the patient is reminded to take medication even when forgot to check notifications and the application also supports face and voice recognition to ensure connectivity. As shown in Table 2, it also includes location tracking and a video monitor at door to ensure the safety of the patient.

Table 1. Comparative Analysis of features Face recognition, voice recognition, pill voice alerts, and daily task reminders.

Applications	Features			
	Face Recognition	Voice Recognition	Pill voice alerts	Daily task reminders
Timeless	✓			✓
Remember Me-Caregiver				✓
CareZone				✓
It's Done!				✓
SYMON-A				✓

AMNECARE	✓	✓	✓	✓

Table 2. Comparative Analysis of features GPS tracking, SOS, Visitor Identification, and multiple interfaces.

Applications	Features			
	GPS tracking	SOS/Help me	Visitor Identification	Multiple Interface
Timeless				✓
Remember Me-Caregiver				
CareZone	✓			
It's Done!				
SYMON-A		✓		
AMNECARE	✓	✓	✓	✓

III. PROPOSED SYSTEM

To handle this problem, the authors propose a modular framework to help live an independent life and monitor patients with Amnesia. The patient is the primary user of the application and the patient's caretaker or relative is the secondary user of various features of the proposed solution. This will be a mobile application built in Flutter so that it supports both Android and IOS platforms. The approach is reliable, flexible, and can be used even when the patient has not been diagnosed with Alzheimer's. The application is also helpful for patients suffering from memory loss due to aging, or any accident. Below explained are the modules/features of the proposed application.

1) Face Recognition Module

The main symptom of people suffering from amnesia is the tendency to forget people and their relationships. Thus, the main aim of this application was to help the patient to recognize their loved ones. The patient would pan the camera on the person, click a picture and the application will show up the picture with the person's name and relation. This face recognition module will use Firebase ML vision for face detection and CNN models like MobileFaceNets tailored for high accuracy real-time face verification on mobile and embedded devices.

2) Voice Recognition Module

This feature serves a similar purpose as the face recognition module. The goal is to help the patient recognize a person with sound and tone of voice. The patient would record audio and the application will scan for existing audios in the database to recognize the audio. After processing, the name of the person will be displayed on the screen. This voice recognition module will use a voice-recognition flutter plugin to detect recognize the voice.

3) Task manager and Pill schedular

Since one of the most common symptoms of amnesia is the ability to forget things or predict the future, it's important to have constant reminders that help remember tasks and most importantly, to take medications. For this, the application comprises a feature called Task Manager and Pill Schedule. With the help of this feature, the caregiver can send reminders to the patient in the form of voice alerts so that tasks can be completed, and pills can be taken at an appropriate time. Caregivers can also set reminders for daily tasks at a scheduled time. No firebase storage is taken under consideration as the tasks will not be the same daily thus saving memory. These tasks are automatically deleted after 12 hours from the notification time. In the case of Pill Scheduler, caregiver can set notification alerts for up to 8 weeks. This includes the name, quantity, type, and structure of the pill which makes it easier for the patient to recognize the tablet. These modules will use Flutter Plugins, flutter_svg, flutter_native_timezone, flutter_local_notifications.

4) Notes

Patients can create shopping lists, task lists, pictures, and events with a full live tile-like experience. The patient can quickly create, edit, and easily access all the notes. The patient can also add pictures along with any note. Notes module will use Flutter plugins flutter_local_notifications, flutter_native_timezone, firebase_storage, image_picker.

5) Emergency Call Button

This module can be used when the patient is in any sort of emergency and needs help from the caretaker. In this module, a button named SOS will be situated in the app which when pressed will send an alert notification to the caregiver saying that 'I'm in an emergency my location is long: lat:'. This will make it easier for the guardian to locate the patient without wasting time trying to find the current location.

6) GPS Tracking

Sometimes when the patient steps out of the house alone without informing, it is difficult for the family members to find them. This GPS tracking feature will help the caregiver to locate the patient. This will keep continuous track of the patient's location. The prerequisite is that the GPS location of the mobile phone should be turned on all the time. With a simple click, the caregiver can get to know the patient's location. This module will use google maps, geolocator-a cross-platform (iOS, Android) API for generic location functions, and a few flutter plugins to get the location in latitude and longitudinal readings.

7) Doorbell Alert System

To ensure the security and safety of the patient this module is introduced. Whenever the patient is alone at home and someone arrives at the door, it can be risky at times to allow anybody to enter. Hence, this module will notify the caretaker as well as the patient that a visitor has arrived at the door. Here, the application takes the help of an ESP32 camera and sensor. When a person rings the doorbell, the camera is turned on and an image is captured. This image is then verified with the database and if a match is found for the captured image a message is displayed with the person's name. If the verification fails, the captured image is sent to the caregiver to verify the image if the visitor is familiar or not and inform the patient whether to open the door or not.

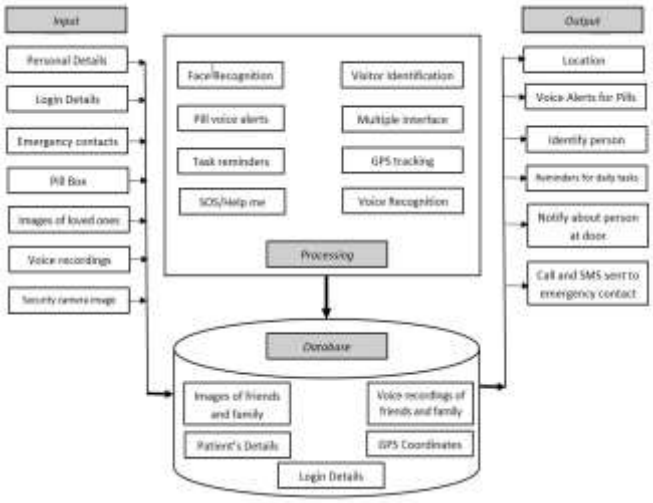

Figure 1. Architectural Diagram

IV. Conclusion

People suffering from amnesia often tend to forget their family and friends. By motivating the use of modern technologies, the patient can remain connected to their loved ones. The proposed application supports face and voice recognition to help patient identity people along with their relationships. Amnecare also incorporates location tracking, pill voice alerts to ensure the patient is reminded to take medication, and a video monitor at door for the security of the patient. The main goal is to make people with Amnesia more confident and help them live an independent life by motivating the use of a smartphone.

V. Future Scope

To make the application more reliable, the application can be integrated with any external devices such as smartwatches, smart bands, fit bit for better communication and tracking. This will help the caretaker monitor the health of the patient and this health-related information can be updated to the doctor for consultation. Integration with these devices will also track the location of the patient and hence avoids the compulsion of carrying the phone 24x7. As an advancement to the ESP-32 face recognition module at the door, threat detection through facial expressions can be performed to reduce manual interruption.

References

[1] National Health Portal. (Sep 16, 2015). *Dementia* https://www.nhp.gov.in/disease/neurological/dementia

[2] Yvette Brazier. (2017, December 13). *What is amnesia and how is it treated?* MedicalNewsToday.com. https://www.medicalnewstoday.com/articles/9673

[3] C. Yamagata, J. F. Coppola, M. Kowtko and S. Joyce, "Mobile app development and usability research to help dementia and Alzheimer patients," 2013 IEEE Long Island Systems, Applications and Technology Conference (LISAT), 2013, pp. 1-6, doi: 10.1109/LISAT.2013.6578252

[4] A. Araújo *et al.*, "A Framework for Monitoring Patients with Alzheimer's and Other Dementias," *2019 International Conference on Systems, Signals and Image Processing (IWSSIP)*, 2019, pp. 175-180, doi: 10.1109/IWSSIP.2019.8787250.

[5] *Timeless* (2019). https://www.timeless.care/

[6] *Remember Me – Caregiver* (2019). https://apps.apple.com/in/app/remember-me-caregiver/id1481000591

[7] *CareZone* (2020). https://carezone.com/

[8] *It's done* (2019). http://www.itsdoneapp.com/

[9] Guide to Assistive Technology, Aids & Apps for Persons with Dementia & Caregivers. (2020, June 29). Dementia Care Central. https://www.dementiacarecentral.com/caregiverinfo/technology/#safety