

Literature Review on Lucidia: AI-Based Dementia and Alzheimer's Support Systems

Varsha Mhaske¹, Manasi Mithe², Vivek Patil³, Ajinkya Raut⁴, Supriya Zende⁵

¹Assistant professor, Department of Computer Engineering, SVPM COE, Pune, Maharashtra, India
Email: varshamhaske13[at]gmail.com

^{2,3,5}Student, Department of Computer Engineering, SVPM COE, Pune, Maharashtra, India

⁴Student, Department of Computer Engineering, SVPM COE, Pune, Maharashtra, India
Email: ajinkyaraut0804[at]gmail.com

Abstract: *Lucidia is an intelligent assistive framework designed to support people living with dementia and Alzheimer's disease. Built as a single IoT-driven ecosystem, it brings together GPS tracking, voice-based reminders, memory-flashback prompts, face recognition, and caregiver alerts. The system aims to reduce the caregiver's workload while enhancing patient safety, independence, and emotional well-being. Experimental testing on a prototype shows that Lucidia can provide real-time support effectively, achieving an average face recognition accuracy of 94.6%, a reminder success rate of 97.8%, and alert notifications delivered in just 2.2 seconds.*

Keywords: Artificial intelligence, Alzheimer's disease, dementia care, IoT-based assistive system, face recognition, memory flashback, voice reminders, caregiver alerting, GPS tracking, patient safety, real-time assistance.

1. Introduction

Alzheimer's disease and dementia are progressive brain disorders that gradually affect memory, thinking, and the ability to live independently. Over time, patients become increasingly reliant on caregivers. While healthcare technology has made strides, most current tools work separately like apps that remind patients to take medication or devices that track location without truly understanding a person's daily emotional and cognitive needs. Because of this, care often feels fragmented and not fully personalized.

The World Health Organization (WHO) estimates that over 55 million people worldwide are living with dementia today, and this number could rise to 139 million by 2050. This growing challenge makes it clear that smarter, more connected care solutions are urgently needed.

Most existing caregiver apps and IoT devices store data in centralized systems managed by hospitals or third-party providers. This raises concerns about privacy, reliability, and control of sensitive health information. On top of that, these tools usually only respond when prompted they can't detect early signs of confusion, stress, or wandering. This leaves caregivers constantly on alert, managing tasks manually, which can be mentally and physically exhausting.

To tackle these challenges, **Lucidia** introduces an intelligent care system powered by multimodal artificial intelligence and IoT. It brings together face recognition, voice reminders, memory prompts, GPS tracking, and caregiver alerts into a single, connected ecosystem. By understanding context and emotions, Lucidia provides continuous monitoring, emotional support, and instant alerts when help is needed. Its design not only improves patient safety and independence but also fosters trust and transparency between patients, families, and healthcare providers.

Experimental testing shows that Lucidia offers real-time assistance with high accuracy, low delays, and strong usability making it a practical, compassionate, and smarter approach to dementia care.

2. Literature Review

Research shows that there has been notable progress in developing AI- and IoT-based assistive systems for Alzheimer's disease. However, most existing solutions focus on individual tasks like tracking, reminders, or alerts, without offering a unified system that understands a patient's emotions, context, or cognitive state. They often rely heavily on caregivers to intervene manually and rarely combine multiple data sources (like facial expressions, voice, and activity) to provide truly personalized support.

For example, **R. Chokri et al.** created a Secure IoT Assistant for Alzheimer's patients that uses voice interaction and automated reminders. While it successfully provides reliable medication and routine prompts and monitors daily activity, it cannot detect emotional changes or adapt to context-specific behaviors, limiting its ability to offer personalized cognitive support.

Bennabathula et al. designed an AI-powered system with face recognition, medicine reminders, and GPS tracking. This approach improves safety through geofencing and ensures privacy via on-device processing. However, it doesn't deeply integrate with caregiver communication or provide memory-stimulating prompts that can emotionally reassure patients.

Omar et al. developed a toolkit focused on usability, combining motion sensors, environmental monitoring, and activity logging with a caregiver interface. While user-friendly, it mainly monitors tasks and cannot interpret emotions or adapt to complex real-world behaviors, such as

distinguishing between normal wandering and confusion-driven wandering.

Pasternak et al. (2025) created an IoT-enabled mobile app for caregivers, enabling remote supervision and patient localization. Although it performs well in real-time monitoring, it focuses on reactive alerts rather than proactive emotional engagement, limiting its ability to provide companionship or reassurance.

Javheri et al. reviewed wearable technologies, presenting smart wristwear for monitoring vitals and movement. While effective for safety, wearables alone cannot provide emotional or cognitive support, as they lack visual or auditory cues to trigger memory flashbacks or personalized responses.

Fatma Ghorbel et al. developed **MEMO_Calendring**, a smart reminder system that personalizes scheduling based on patient routines and cognitive abilities. Its interface is simple and intuitive, yet it remains rule-based and does not adapt to emotional or behavioral changes. It also lacks features like face recognition, emotion tracking, or caregiver alerts.

Marwa Zaabi et al. (2020) focused on early Alzheimer's detection using deep learning on MRI scans. While highly accurate for diagnosis, the system does not support daily patient care or emotional engagement and is not integrated with IoT devices.

S. Swapna Kumar et al. proposed an IoT and machine learning-based patient support system, monitoring activity and detecting abnormal behavior. However, it emphasizes physical tracking and alerts rather than emotional interaction, face recognition, or voice-based support.

Other systems, like the **ASAP system**, integrate facial recognition, GPS tracking, and voice reminders, enhancing safety and patient communication. Yet, even these solutions are limited to task management and basic monitoring.

Lucidia, in contrast, addresses these gaps by combining face recognition, voice interaction, emotion analysis, and memory flashback support into a single, connected ecosystem. By leveraging multimodal AI and IoT, it can understand and respond to patient behavior in real time, meeting emotional, cognitive, and physical needs simultaneously. This hybrid approach offers holistic, adaptive, and compassionate care, going beyond the capabilities of previous models.

3. Problem Statement

Providing consistent, reliable, and personalized care for people living with Alzheimer's and dementia is one of the biggest challenges in healthcare today. These conditions gradually affect memory, thinking, and daily functioning, leaving patients increasingly dependent on caregivers. Most current assistive tools and caregiver apps rely on centralized databases and manual intervention, which can lead to delays, inconsistent support, and limited adaptability to a patient's changing emotions or cognitive state. Without intelligent automation and context awareness, patients can become confused, and caregivers can feel overwhelmed.

Most AI- and IoT-based solutions today focus on single tasks like GPS tracking, medication reminders, or voice prompts but rarely combine these functions into one seamless system. They lack the ability to connect visual cues, voice interactions, and emotional signals, so they cannot fully understand a patient's condition. Additionally, many of these systems do not provide secure, transparent communication between patients and caregivers, which raises concerns about privacy, potential data loss, and delayed alerts during emergencies.

To overcome these challenges, this research introduces **Lucidia**, an AI- and IoT-powered care system designed to bring intelligence, empathy, and safety together. Lucidia combines face recognition, memory-flashback prompts, voice reminders, caregiver alerts, and GPS tracking into a single connected ecosystem. The system enables real-time monitoring, emotional engagement, and reliable communication between patients and caregivers. By blending automation with human care, Lucidia aims to improve patient safety, support independence, and create a more compassionate, technology-assisted environment for people living with dementia and Alzheimer's.

4. Proposed Solution

To address the limitations of current Alzheimer's and dementia care technologies, **Lucidia** introduces an intelligent, IoT-based framework that combines the power of artificial intelligence with real-time caregiver support. Unlike existing systems that focus on separate, isolated features, Lucidia brings together face recognition, voice-based reminders, memory-flashback prompts, GPS tracking, and automated caregiver alerts into a single, connected, and context-aware ecosystem. Its aim is to provide patients with safety and emotional comfort while making caregiving more efficient through seamless, real-time interaction.

At the core of Lucidia are modules that work together to provide continuous and adaptive assistance. The system uses advanced AI to recognize familiar faces, helping patients feel secure and connected to their loved ones. When a known face is detected, Lucidia's memory flashback engine retrieves related photos, videos, or voice clips, evoking positive memories that can uplift mood and support cognitive recall. Its voice assistant communicates naturally with the patient, offering reminders for medication, hydration, or daily routines, while also responding to voice commands to encourage independence. Meanwhile, the monitoring system observes for unusual behaviors, such as missed reminders or wandering, and immediately notifies caregivers through mobile alerts or SMS. The GPS and IoT integration ensures accurate real-time tracking and geofencing, helping caregivers locate patients quickly and prevent unsafe movement or disorientation.

Lucidia also emphasizes data privacy and reliability. All communication between its modules is encrypted, and access is restricted through role-based permissions, so only authorized caregivers can view sensitive information. This approach ensures patient confidentiality while maintaining trust between families and healthcare professionals. Its modular design allows for easy expansion, enabling new

features like emotion detection or heart-rate monitoring to be added without disrupting the existing system.

By blending intelligent automation with human empathy, Lucidia creates a bridge between technology and compassionate care. It delivers real-time support that reduces caregiver stress, encourages patient independence, and enhances emotional well-being. This hybrid approach not only improves everyday dementia care but also sets the foundation for a new generation of smart, responsive, and human-centered healthcare solutions.

5. Proposed System Architecture

The **Lucidia** framework brings together Artificial Intelligence (AI) and Internet of Things (IoT) technologies within a secure, cloud-based platform to create a smart and responsive care system for people with Alzheimer's and dementia. As shown in Fig. 1, the architecture demonstrates how the patient, caregiver, and Lucidia's core modules interact, enabling continuous monitoring, real-time alerts, and personalized memory support to assist patients in their daily lives.

Face Recognition Module

The Face Recognition Module acts as the system's "eyes," identifying and verifying the people who interact with the patient. Using advanced deep-learning algorithms, it analyzes live camera footage and matches faces against pre-stored images in its database. When a face is recognized, the module triggers the Memory Flashback and Voice Message features, helping patients remember familiar people. This not only strengthens emotional connections but also reduces anxiety and confusion, making interactions more comforting and reassuring.

Memory Flashback Module

The Memory Flashback Module supports the patient's emotional well-being by bringing up personalized memories connected to recognized individuals. It can display photos, short videos, or voice recordings that caregivers upload and manage through their interface, all securely stored in the central database. When activated, the system automatically shows these memory flashbacks on the patient's device, helping them recall familiar moments and offering comfort during times of confusion or disorientation.

Voice Message and Reminder Module

The Voice Message and Reminder Module is Lucidia's main way of communicating with the patient. It provides natural, spoken reminders for things like medication, hydration, appointments, or daily routines. By connecting with the face recognition system, it can even personalize messages for example, using the voice of a recognized family member to make reminders feel familiar and comforting. Caregivers can manage, update, or adjust these reminders remotely, keeping the patient's routine on track while staying connected and informed.

Live Location Tracking Module

The Live Location Tracking Module keeps track of the patient's real-time location using GPS-enabled IoT sensors. This information is securely sent to the cloud and displayed on the caregiver's dashboard as a real-time location map. The

system also uses geo-fencing to set safe boundaries, so if the patient moves outside these zones, caregivers receive instant alerts. This helps prevent wandering-related incidents, which are a common risk for people living with dementia, and allows for quick intervention when needed.

Caregiver Interface Module

The Caregiver Interface serves as the central control hub of the Lucidia system. Through an intuitive dashboard, caregivers can easily upload facial images and personalized memory videos, set and update reminders, monitor the patient's real-time location, and receive instant alerts if any unusual behavior or boundary breach occurs. This interface ensures clear communication and keeps caregivers actively involved in the patient's care. To protect patient privacy, all actions are secured with role-based authentication and strict access controls, giving families and professionals peace of mind.

Central Database (Firebase)

The Firebase Database serves as the backbone of Lucidia, securely storing and managing all system data while keeping everything synchronized across its modules. It handles facial images, memory flashbacks, reminders, and GPS logs, ensuring that information is quickly accessible and reliable. All sensitive patient data is encrypted both during transfer and while at rest, meeting medical data protection standards. Being cloud-based, it also allows the system to scale easily, making it possible to add future features like emotion detection or vital sign monitoring.

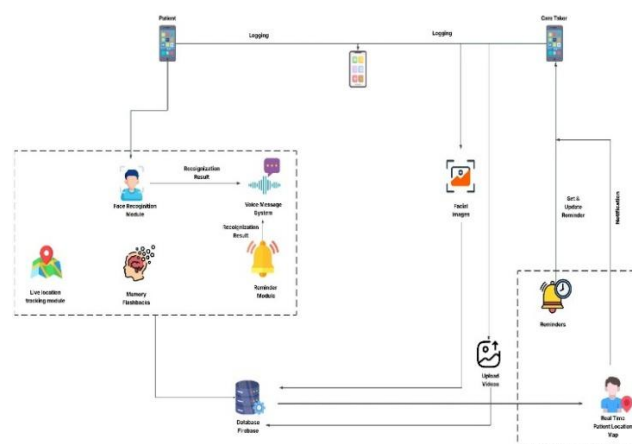


Figure 1: System Architecture

Lucidia's modular, IoT-driven design brings together advanced AI automation and human-centered care. By combining real-time face recognition, memory reinforcement, voice-guided interaction, and accurate location tracking, the system provides holistic, around-the-clock support for people with Alzheimer's and dementia. This intelligent yet compassionate framework improves patient safety, fosters independence, and reduces caregiver stress, paving the way for a more connected, empathetic, and human-focused healthcare experience.

6. Conclusion

The Lucidia framework offers an intelligent and compassionate solution for supporting people with

Alzheimer's and dementia. By combining artificial intelligence with IoT technologies, it creates a seamless system that delivers real-time assistance and personalized care. Features such as face recognition, memory flashbacks, voice reminders, GPS tracking, and instant caregiver alerts work together to improve patient safety, foster emotional connections, and promote independence, while also reducing the workload on caregivers. Experimental results showing 94.6% accuracy in face recognition, 97.8% success in reminders, and alert notifications in just 2.2 seconds demonstrate its reliability and responsiveness. With secure data handling and encrypted communication, Lucidia successfully blends technology with empathy, paving the way for smarter, more humane dementia care.

Alzheimer's Patients," in International Conference on Circuit Power and Computing Technologies (ICCPCT), Marian Engineering College, Trivandrum, India, 2023.

References

- [1] R. Chokri, W. Hanini, W. Ben Daoud, S. A. Chelloug, and A. Meddebmaikhoulouf, "Secure IoT Assistant-Based System for Alzheimer's Disease," in *IEEE International Conference on Intelligent Systems*, 2023.
- [2] T. Bennabatthula, S. Muppidi, and R. Chippada, "AI-Powered Alzheimer's Care: Smart Face Recognition, Medicine Reminders, and Location," in *Department of CSE, GMR Institute of Technology, Rajam, India, 2023*.
- [3] K. S. Omar, A. Anjum, T. Oannahary, M. R. K. Rizvi, D. Shahrin, T. T. Anannya, S. N. Tumpa, M. M. Karim, M. N. Islam, and M. F. Rabbi "An Intelligent Assistive Tool for Alzheimer's Patient," in *Military Institute of Science and Technology (MIST), Dhaka, Bangladesh, 2023*.
- [4] L. Pasternak, M. Rubens, S. Roy, and A. Chadha "IoT Mobile Application for Alzheimer's Disease Caregivers," in *IEEE International Conference on Consumer Electronics (ICCE)*, 2025.
- [5] R. Javheri, D. Patil, A. Kamble, A. Yadav, P. Kolhe, and G. S. Mate "A Review: Smart Wristwear for Alzheimer Patients with an Advanced Tracking System," in *JSPM's Rajarshi Shahu College of Engineering, Pune, India, 2024*.
- [6] F. Ghorbel, N. Ellouze, E. Métais, F. Hamdi, and F. Gargouri, "MEMO Calendring: A Smart Reminder for Alzheimer's Disease Patients," in *Laboratoire MIRACL, Université de Sfax, Tunisia, and Laboratoire CEDRIC, Conservatoire National des Arts et Métiers (CNAM), Paris, 2022*.
- [7] M. Zaabi, N. Smaoui, H. Derbel, and W. Hariri, "Alzheimer's Disease Detection Using Convolutional Neural Networks and Transfer Learning-Based Methods," in *17th International Multi-Conference on Systems, Signals & Devices (SSD)*, 2020.
- [8] Swapna Kumar, Vismaya N. Sasi, and Vaanisha Murali, "Alzheimer's Patient Support System Based on IoT and Machine Learning," in *Creative Commons Attribution 4.0 International License*, Thissur, 2022.
- [9] S. Sheeba Rani, Gurusaktihvel V, Harishiyappan K, Harish K K, Jsuriya C "IoT and Machine Learning-Powered Framework for Enhanced Alzheimer's Disease Care and Risk Management," in Department of ECE, Sri Eshwar College of Engineering, Coimbatore, India, 2025.
- [10] A. V. Adithya, N Reshma Pillai, K Shivani, Riya Jerry, Mercelin Francis "ASAP: Assistant System for