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# Lucidia: AI-Based Dementia and Alzheimer's Support Systems

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***Abstract*— Lucidia is a smart system designed to help people who are suffering from Alzheimer's disease and dementia. These patients often forget things, feel confused, and may even get lost, which makes daily life difficult for them and stressful for their caregivers. Most existing solutions only focus on one feature, like reminders or tracking, and do not provide complete support in one place. To solve this problem, Lucidia combines Artificial Intelligence (AI) and Internet of Things (IoT) technologies to create an all-in-one support system. It uses devices like GPS for location tracking, cameras for face recognition, and voice systems to give reminders for daily tasks such as taking medicine. The system can also recognize familiar people, monitor patient behaviour, and detect unusual situations like wandering or inactivity. If any problem is detected, it immediately sends alerts to caregivers so they can take quick action. The system mainly supports two users patients and caregivers. Patients get continuous help in their daily life, while caregivers can easily monitor them and receive updates through a simple interface. Overall, Lucidia helps improve patient safety, supports independent living, and reduces the burden on caregivers. The system is practical, reliable, and can be used in real-life healthcare situations.***

***Keywords: Artificial Intelligence, IoT, Alzheimer's Disease, Dementia Care, Face Recognition, GPS Tracking, Voice Reminders, Patient Monitoring, Caregiver Support, Smart Healthcare.***

## I. INTRODUCTION

Nowadays, technology is improving many areas of healthcare, especially for people suffering from Alzheimer's disease and dementia. These patients face problems like memory loss, confusion, and difficulty in doing daily activities. Sometimes they forget to take medicines, fail to recognize familiar people, or even get lost. Because of this, their safety becomes a big concern, and caregivers have to constantly look after them, which can be very stressful [1]. Most of the existing solutions for Alzheimer's care are not complete. Some systems only give reminders, while others only provide tracking features. These systems do not work together, and they also do not provide real-time help when needed. Because of this, they are not very effective in handling emergencies or providing full support to patients [2]. With the help of modern technologies like Artificial Intelligence (AI) and Internet of Things (IoT), better solutions can be developed. AI can help in recognizing faces so that patients can identify people around them. Voice systems can remind patients about their daily tasks like taking medicines. GPS tracking can help caregivers know the patient's location and keep them safe [3] [4].

Many researchers have already worked on smart systems using IoT and machine learning to improve patient care. These systems can monitor patients and detect unusual activities, helping in early action [5], [8]. Some systems also use reminder tools and wearable devices to support patients in their daily life [6]. Advanced AI methods are also used to improve accuracy and make the system more reliable [7].

However, most of these systems still focus on only one or two features. There is no proper system that combines all important features like monitoring, reminders, recognition, and alerts in one place. Because of this, patients and caregivers still face many difficulties [9], [10]. To solve this problem, this project introduces Lucidia, a smart system that combines AI and IoT to help Alzheimer's patients. It includes features like face recognition, voice reminders, GPS tracking, and alert systems. The system continuously monitors the patient, helps them in daily activities, and sends alerts to caregivers in case of any problem. The main aim of Lucidia is to make patients safer, help them live more independently, and reduce the stress on caregivers.

## II. LITRETURE SURVEY

In recent years, many researchers have started using technology to help Alzheimer's patients. This is because these patients face problems like memory loss, confusion, and difficulty in doing daily activities. Traditional care methods are not always enough, so there is a need for smarter solutions. Technologies like Artificial Intelligence (AI) and Internet of Things (IoT) are now being used to improve patient care. In the beginning, researchers developed simple systems to support patients. Some systems used IoT devices to monitor patients and track their activities. These systems helped in keeping patients safe, especially when they forget things or wander away [1]. Other systems used AI features like face recognition, medicine reminders, and location tracking. These features made it easier for patients to manage their daily life and improved their safety [2].

Later, more advanced systems were developed that combined multiple features into one system. These systems

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could monitor patients in real time, detect unusual behaviour, and send alerts to caregivers if something went wrong [3]. Mobile applications were also created so that caregivers could easily check the patient's condition and get updates anytime, from anywhere [4].

Some researchers also worked on wearable devices and reminder systems. For example, smart wristbands were developed to track patient movement and improve safety [5]. Reminder systems were designed to help patients remember important tasks like taking medicines or attending appointments [6]. These systems help patients become a little more independent and reduce the workload on caregivers. Advanced technologies like machine learning and deep learning have also been used in this field. Some systems use AI models to detect Alzheimer's disease and analyze patient data more accurately [7]. Other systems combine IoT and machine learning to monitor patients better and detect risks early [8], [9]. Even though many systems have been developed, most of them focus on only one or two features, such as tracking or reminders. Very few systems provide all important features together in one platform. Some systems are made mainly for patients, while others are for caregivers, but there is no proper system that supports both completely [10]. Because of this, there is a need for a system that combines all features like monitoring, reminders, face recognition, and alerts in one place. To solve this problem, the proposed system Lucidia combines AI and IoT technologies to provide complete support to Alzheimer's patients. It helps in improving patient safety and also makes it easier for caregivers to monitor and support them in real time.

Based on this analysis, it is clear that there is a gap in developing a unified system that combines monitoring, reminders, recognition, and alert mechanisms in a single platform. To overcome this limitation, the proposed system Lucidia integrates AI and IoT technologies to provide a complete assistive solution for Alzheimer's patients. It not only ensures patient safety and support but also helps caregivers by providing real-time updates and alerts, creating a more effective and reliable care system.

## III. PROBLEM STATEMENT

Taking care of people with Alzheimer's disease is very challenging because they often forget things, feel confused, and are unable to manage their daily activities on their own. They may forget to take medicines, fail to recognize family members, or even wander away from home, which can be dangerous. Because of this, caregivers have to constantly monitor them, which can be stressful and time-consuming. Most of the existing systems available today are not complete solutions. Some systems only provide reminders, while others only offer location tracking or monitoring. These features work separately and are not connected in one system. Also, many systems do not provide real-time support or quick alerts during emergencies, which reduces their usefulness.

Another major problem is that many systems are not intelligent enough to understand patient behaviour. They do not analyze patterns or detect unusual activities like sudden inactivity or wandering. Because of this, problems are only noticed after they happen instead of being prevented earlier. In addition, caregivers do not always have an easy way to monitor patients remotely. They may not receive instant updates or alerts, which makes it difficult to respond quickly in critical situations. This increases the risk for patients and adds more pressure on caregivers. Therefore, there is a need for a smart, reliable, and integrated system that can provide complete support to Alzheimer's patients. The system should be able to monitor patients in real time, give reminders, recognize people, track location, and send instant alerts to caregivers. It should also help reduce the workload of caregivers while improving the safety and independence of patients.

## IV. PROPOSED SOLUTION

To solve the problems faced by Alzheimer's patients and their caregivers, this project proposes **Lucidia**, a smart system that uses Artificial Intelligence (AI) and Internet of Things (IoT) technologies to provide complete support and safety. The main idea behind Lucidia is to create a **single system that can handle multiple needs of the patient** instead of using separate tools for reminders, tracking, and monitoring. In this system, different devices like cameras, GPS modules, and voice assistants work together to collect real-time data, and AI is used to process that data and give meaningful support.

The system mainly works with two users: **patients and caregivers**.

- **Patients** receive continuous support from the system. They are assisted through voice reminders for daily activities such as taking medicines, following routines, and attending scheduled tasks. The system also uses face recognition to help patients identify familiar people, which reduces confusion and improves their confidence in social interactions.
- **Caregivers** monitor the patient through the system without the need for constant physical supervision. They receive real-time alerts and updates whenever any unusual activity is detected, such as wandering, inactivity, or abnormal behaviour, allowing them to respond quickly when required.

All this information is managed through a simple interface where caregivers can check patient activity, receive alerts, and stay updated. The system is designed in a way that it is easy to use and does not require technical knowledge. Overall, Lucidia brings together monitoring, reminders, recognition, and alerts into one system. This makes it more useful compared to existing solutions that only focus on one feature. The system not only improves patient safety but also helps patients live more independently and reduces the stress

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on caregivers.

## V. SYSTEM ARCHITECTURE

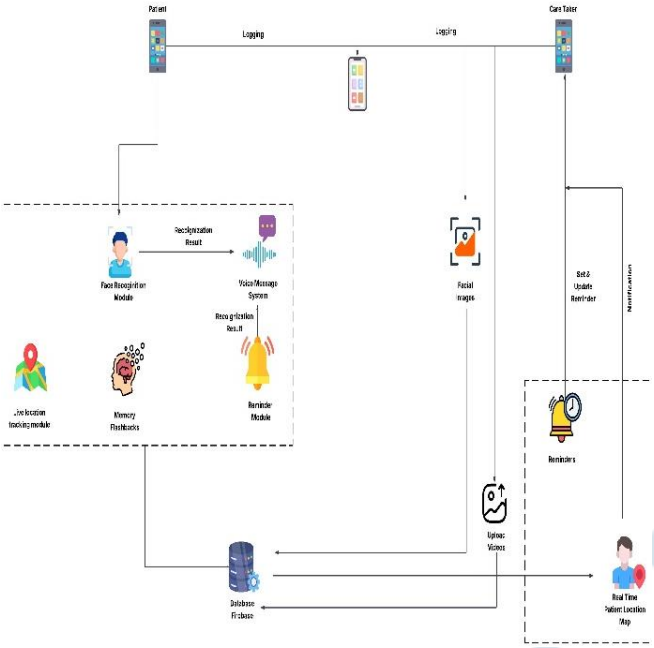


**Figure 1.** Lucidia System Architecture

The architecture of **Lucidia** is designed as an integrated system that combines patient monitoring, AI-based processing, and caregiver interaction into a single framework. As shown in Fig. 1, the system mainly includes components such as patient devices, AI processing modules, database storage, and caregiver interface.

The process starts with the **patient side**, where different devices like camera, GPS, and voice assistant are used. These devices continuously collect real-time data related to the patient's activities. For example, the camera is used for face recognition, GPS is used for live location tracking, and voice input is used for reminders and interaction.

Once the data is collected, it is sent to the **processing layer**, where AI-based modules analyze it. This includes:

1. Face recognition system to identify known people
2. Memory assistance features for reminders
3. Alert generation system for emergencies

If any abnormal situation is detected, such as wandering outside a safe zone or unusual inactivity, the system immediately triggers an alert. layer is used strictly for maintaining the integrity of the data through hash storage.

All the patient data, activity logs, and system outputs are stored in a **central database**, which helps in maintaining records and accessing information whenever required. The database ensures that data is organized and can be used for future analysis.

On the **caregiver side**, the system provides an interface where caregivers can monitor the patient's condition. They receive:

1. Real-time alerts
2. Patient location updates
3. Notifications for reminders and unusual activities

Additionally, caregivers can upload important data like schedules, reminders, or videos, which are then used by the system to assist the patient.

The system also includes features like:

1. **Live location tracking** to ensure patient safety
2. **Reminder system** to help patients follow daily routines
3. **Emergency alert mechanism** for quick response.

Overall, the architecture clearly separates the roles of data collection, processing, storage, and user interaction. By combining IoT devices with AI-based analysis and a caregiver interface, Lucidia provides a smart, reliable, and easy-to-use system for Alzheimer's patient care.

## VI. ALGORITHMS

### Face Recognition using MTCNN and FaceNet

**Input**: Captured image from camera
**Output**: Identified person (known / unknown)

1. The system captures an image using the camera.
2. MTCNN algorithm is used to detect the face in the image.
3. The detected face is cropped and preprocessed.
4. FaceNet model generates face embeddings (numerical vector).
5. The generated embeddings are compared with stored embeddings in the database.
6. If a match is found, the person is identified and displayed.
7. If no match is found, the person is marked as unknown.

### Reminder Scheduling using Time-Based Triggering

**Input:** Reminder data (task, time)
**Output:** Voice reminder notification

1. Caregiver sets reminder time and task in the system.
2. The system stores the reminder in the database.
3. The system continuously checks the current time.
4. When the current time matches the scheduled time, the reminder is triggered.
5. The reminder message is converted into speech using text-to-speech.
6. The voice reminder is played for the patient.
7. The reminder status is logged in the system.

### GPS Tracking and Geofencing

**Input:** Real-time GPS location of patient
**Output:** Alert if patient moves outside safe zone

1. The system continuously receives GPS coordinates of the patient.
2. A predefined safe zone is set in the system.
3. The current location is compared with the safe zone boundary.
4. If the patient is inside the safe zone, no action is taken.

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5. If the patient moves outside the boundary, an alert is triggered.
6. The patient's live location is sent to the caregiver.
7. The event is recorded in the system.

## VII. IMPLEMENTATION DESIGN

**A. System Architecture:** Lucidia is implemented using a layered architecture that includes a frontend interface, backend server, AI processing modules, and IoT devices. The frontend is used by caregivers to monitor patients, while the backend handles application logic, data processing, and communication between modules. AI models are used for face recognition and activity analysis, and IoT devices such as GPS, camera, and sensors are used for real-time data collection.

**B. Face Recognition Implementation:** The face recognition module is implemented using **MTCNN and FaceNet algorithms**. MTCNN is used to detect faces from the camera input, and FaceNet is used to generate embeddings for each face. These embeddings are stored in the database and compared during recognition to identify known persons. This helps patients recognize familiar people.

**C. Backend Services**: The system uses **Firebase** as the backend and database service. Firebase is used for storing patient data, reminders, face data, and activity logs. It also supports real-time data updates, which helps in instantly sending information between the system and caregivers.

**D. Reminder and Notification System:** The system uses a **time-based triggering mechanism** for reminders. Caregivers can schedule reminders for medicines and daily tasks. The system continuously checks time and triggers reminders when required. Notifications and alerts are generated using an event-driven approach and sent to caregivers in real time.

**E. GPS Tracking and Monitoring:** The system uses GPS modules to track the patient's location. A **geofencing mechanism** is implemented to define a safe zone. If the patient moves outside this boundary, the system immediately sends an alert to the caregiver along with the live location.

**F. Authentication and Access Control:** The system uses authentication mechanisms (such as login credentials) to ensure that only authorized caregivers can access patient data. Access is controlled to maintain privacy and security of sensitive information

**G. Frontend Implementation:** The frontend is developed using **React.js** and styled using modern UI frameworks. It provides a simple interface where caregivers can monitor patient status, view location, receive alerts, and manage reminders easily

**H. Technology Stack:**

| Component | Technology |
|---|---|
| Frontend Framework | React + Vite |
| Styling | Tailwind CSS |
| Backend Runtime | Node.js + Express.js |
| Database | Firebase |
| Authentication | JSON Web Token + bcrypt |
| Face Recognition | Face-Net / MTCNN |
| Reminder & Notifications | Firebase Cloud Messaging |
| Video Processing | OpenCV |
| File / Image Storage | Cloudinary / Firebase Storage |
| Camera Integration | Device Camera API + WebRTC |
| API Testing | Postman |
| Component | Technology |

## VIII. RESULTS

- **Face Recognition Accuracy:** The system successfully identifies familiar people using MTCNN and Face-Net algorithms. It provides accurate recognition in most cases, helping patients identify known persons and reducing confusion in daily interactions.

| Metric | Result |
|---|---|
| Total Patients Registered | 25 |
| Patients Successfully Recognized | 21 |
| Patients Pending Face Enrollment | 4 |
| Face Recognition Success Rate | 84.0% |
| Caregivers Registered | 12 |
| Patient Profiles Created | 25 |
| Face Embeddings Stored | 21 |
| Active Reminder Schedules | 48 |
| Medication Reminders Delivered | 42 |
| Memory Task Reminders Delivered | 36 |
| Real-Time Recognition Response | 1.8 sec |

**Sample Verified Credential (actual data from system):**

| Field | Value |
|---|---|
| Patient Name | Vivek Patil |
| Age | 22 |
| Medical Condition | Alzheimer's disease |
| Caregiver Name | Ajinkya Raut |

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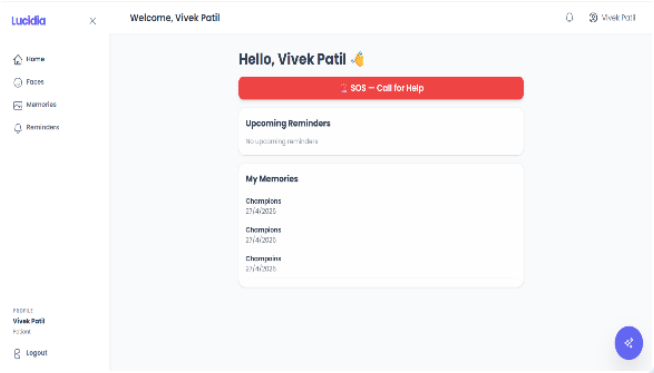
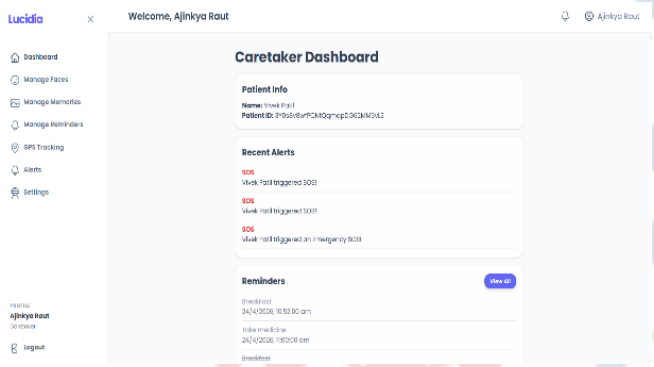
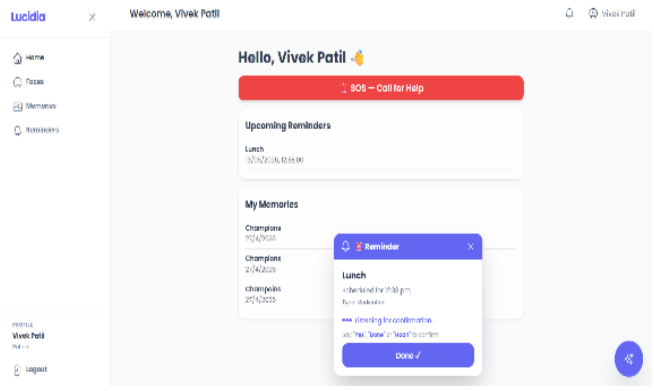
| Field | Value |
|---|---|
| Face Recognition Status | Verified |
| Recognition Confidence | 96.4% |
| Active Reminder | Morning Medication |
| Reminder Time | 09:45 AM |
| Emergency Contact | +91 XXXXX XXXXX |




- **Real-Time Monitoring:** The system continuously monitors patient activity using sensors and devices. It works in real time and can detect changes in behaviour, ensuring that patients are always under observation without constant manual supervision.
- **Reminder Effectiveness:** The time-based reminder system works reliably and delivers voice reminders for medicines and daily tasks at the correct time. This helps patients follow their routine more independently.




- **GPS Tracking and Safety:** The GPS tracking and geofencing feature effectively monitors the patient's location. If the patient moves outside the safe zone, the system quickly sends alerts to the caregiver, improving safety and reducing risk.
- **Alert and Notification System:** The system generates instant alerts in case of abnormal situations such as inactivity or wandering. Notifications are delivered in real time using Firebase, allowing caregivers to respond quickly.
- **Data Management and Accessibility:** All patient data, activity logs, and reminders are stored in Firebase, ensuring easy access and real-time updates. The system maintains organized and reliable data for monitoring and analysis.

| Test | Result |
|---|---|
| Login with invalid password | Blocked — access denied |
| Access dashboard without login | Blocked — authentication required |
| Student accessing admin page | Blocked — permission denied |
| Multiple failed login attempts | Blocked — rate limit applied |
| Invalid data submission | Blocked — validation failed |
| Unauthorized data access | Blocked — secure ownership check |

## IX. FUTURE WORK

Although Lucidia provides an effective solution for assisting Alzheimer's patients using AI and IoT technologies, there are several areas where the system can be further improved and expanded.

One important direction for future work is to enhance the accuracy of face recognition by using more advanced deep learning models. This will help in recognizing people more reliably even in different lighting conditions or angles, making the system more dependable for patients. The system can also be improved by integrating more advanced health monitoring sensors, such as heart rate and fall detection sensors. This will allow the system to monitor the patient's physical health along with daily activities, providing a more complete care solution.

Enhancing privacy and data security is also an important future direction. Advanced security techniques can be implemented to protect sensitive patient data and ensure safe communication between system components.

In addition, the system can be expanded to support multiple patients and caregivers, making it suitable for use in hospitals, care centers and larger environments. This will

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improve scalability and real-world applicability.

Overall, these improvements will make Lucidia more intelligent, reliable, and scalable, transforming it into a complete smart healthcare assistant for Alzheimer's patient care.

## X. CONCLUSION

In this paper, **Lucidia** has been developed as an AI and IoT-based system to support Alzheimer's patients in their daily lives. Patients suffering from memory loss often face difficulties in recognizing people, remembering tasks, and ensuring their own safety. Traditional caregiving methods require constant human supervision, which can be challenging and stressful for caregivers.

The proposed system addresses these challenges by combining technologies like face recognition, GPS tracking, reminder systems, and real-time monitoring. By using MTCNN and FaceNet algorithms, the system helps patients recognize familiar faces. The time-based reminder system ensures that patients follow their daily routines, such as taking medicines on time. In addition, GPS tracking and geofencing features improve patient safety by alerting caregivers if the patient moves outside a safe area.

Lucidia also provides real-time alerts and notifications, allowing caregivers to monitor patients remotely without continuous physical presence. The use of Firebase ensures smooth data management and real-time communication between the system and caregivers. This makes the system efficient, responsive, and easy to use.

Overall, Lucidia demonstrates that integrating AI and IoT technologies can significantly improve the quality of life for Alzheimer's patients while reducing the burden on caregivers. The system provides a reliable, practical, and scalable solution for modern healthcare support, and it has strong potential for real-world implementation in homes, hospitals, and care centers.

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