A Stage-Adaptive Smart Monitoring and Safety Framework for Alzheimer's Disease: A Review

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ABSTRACT

Alzheimer's disease is a progressive and chronic neurological disorder that causes the gradual deterioration of memory, cognitive functions, and independent living, which presents a major challenge to patients, caregivers, and health care providers. ***[1], [2]*** *The AI-based monitoring system is intended to assist people who have been affected by Alzheimer's disease. The research focuses on the fundamental aspects of the monitoring system, which include the recording of day-to-day activities, the provision of medication reminders, the tracking of the person's location using GPS technology, the detection of abnormal behavior, and remote monitoring of the patient's activities by the caregiver.* ***[4]*** *It also evaluates the role of artificial intelligence in analysing behavioural patterns, identifying potential safety risks, and delivering personalized care recommendations.* ***[8]*** *Moreover, this review considers various factors such as usability, reliability, data security, privacy, etc., of the system, which are essential in the development of healthcare solutions. Additionally, the paper has identified the limitations of the existing Alzheimer's care technologies, which have to be addressed to improve the intelligent monitoring systems. The findings of the paper reveal that the intelligent monitoring system can be improved by using mobile health technologies along with artificial intelligence analytics.* ***[3], [5]*** *Smart digital healthcare solutions provide an extraordinary way to deliver better care for Alzheimer's patients and their families. The review offers valuable references*

for research and implementation of new drugs, and also highlights the ongoing need to develop effective and low-cost Alzheimer's disease management systems.

KEYWORDS: *Alzheimer's Disease, Geo-fencing, Location Tracking, Caregiver Monitoring, Cognitive Assistance*

INTRODUCTION

Alzheimer's disease is a long-term and progressive neurological condition characterized by the gradual decline of memory, reasoning ability, and overall cognitive function. **[1], [2]** Although cases of early onset have also been noted, it is acknowledged as one of the most prevalent causes of dementia, primarily affecting older adults. **[1]** Because of the ongoing care and supervision needed, the disease has a substantial impact on families, carers, and healthcare systems in addition to patients. The number of people receiving an Alzheimer's diagnosis is rising in tandem with the world's ageing population, **[1], [2]** underscoring the pressing need for efficient care management and monitoring techniques.

The challenge in caring for people with Alzheimer's Disease is having enough supervision or help from caregivers or others to ensure their safety at all times, especially if they live alone. When memory loss, confusion or disorientation occurs, they are sometimes in situations where they can put themselves at risk; for example, by forgetting to take medications, becoming lost in unfamiliar places, or not being able to call for help when they need it. Traditional methods of providing care rely on direct human supervision; thus, this style of caregiving can become an emotionally and physically draining job for the caregivers as well as being hard to sustain over time. For this reason, there is a clear need for the development of innovative technology to assist caregivers with monitoring and providing safe care to individuals suffering from Alzheimer's without compromising their independence.

New opportunities for enhancing Alzheimer's care through intelligent healthcare systems have been made possible by recent advancements in wearable technology, mobile computing, and artificial intelligence. **[3], [5]** Mobile applications offer a practical and reasonably priced way to keep tabs on health-related data, track patient activities, and help patients and carers communicate. Caretakers can keep an eye on patients' whereabouts and act fast in the event

of a wandering incident thanks to technologies like GPS-based location tracking.**[4]** Activity monitoring features also make it possible to record daily routines, such as meal plans, medication schedules, and physical activities. This helps carers better understand patient behavior and guarantee appropriate care.

These systems are further improved by artificial intelligence, which makes it possible to analyse gathered data in a sophisticated way and identify odd trends and possible threats. In order to spot anomalies and provide timely alerts, **[8]** AI-based algorithms can analyse movement patterns, activity history, and behavioural trends. This enables carers to take preventative measures before things get out of hand. Additionally, interactive features and voice-activated reminders help patients finish daily tasks, promoting independent living and lowering the need for continual supervision. **[6]**

Along with functional capabilities, ensuring data privacy and security is essential in healthcare applications. Strong security measures like data encryption, secure authentication, and controlled access are required to protect user data and maintain confidentiality. **[4]** Because these systems manage sensitive personal and medical information, they must have adequate privacy protections that not only secure patient records but also provide a reliable and trustworthy source of digital health care.

This review provides a general assessment of mobile applications used for Alzheimer's care, intelligent monitoring systems, and artificial intelligence method-driven behavioral analysis techniques, including their functions, advantages, and limitations, while emphasizing what constitutes a safe and secure, efficient, and user-friendly system in delivery of health care. In addition to offering this general summary of technological advancements in use today, this paper attempts to illustrate how intelligent digital systems can improve patient safety and caregiver support and ultimately enhance the quality of life for all patients with Alzheimer's disease.

LITERATURE REVIEW

In recent years, significant research has been conducted on the development of intelligent healthcare systems to support Alzheimer's patients through mobile applications, wearable devices, and artificial intelligence technologies. These systems focus on improving patient

safety, enhancing caregiver support, and enabling continuous health monitoring.

Several studies have explored the use of mobile health applications for monitoring Alzheimer's patients. Researchers have found that mobile applications provide an effective platform for recording daily activities, managing medication schedules, and facilitating communication between patients and caregivers. **[3]** These applications help caregivers remotely monitor patient routines and ensure adherence to prescribed treatments. The accessibility and portability of smartphones make them a practical solution for real-time healthcare monitoring.

Location tracking has been widely studied as an essential feature for Alzheimer's care. Many researchers have proposed GPS-based tracking systems to monitor patient movements and prevent wandering, which is one of the most common and dangerous symptoms of Alzheimer's disease. **[4]** These systems allow caregivers to track patient location in real time and receive alerts if the patient moves beyond predefined safe zones. Studies have shown that GPS-enabled monitoring significantly improves patient safety and reduces caregiver anxiety**.[4]**

Artificial intelligence has also been increasingly applied in Alzheimer's care systems. Researchers have developed AI-based models to analyze patient behavior, detect abnormal movement patterns, and predict potential risks. **[8]** Machine learning algorithms can analyze historical data such as activity logs, movement patterns, and behavioral trends to identify unusual activities. These intelligent systems provide early warning alerts, allowing caregivers to take preventive actions and avoid critical situations.

Wearable devices have been integrated with mobile applications to enhance monitoring capabilities. Devices such as smartwatches and health trackers can collect physiological and movement data, including physical activity levels and location information. Research indicates that combining wearable technology with mobile applications improves monitoring accuracy and provides more comprehensive patient data for analysis. **[5]**

In addition to monitoring and tracking, several studies have emphasized the importance of reminder systems for Alzheimer's patients. Automated reminders for medication, meals, and

daily tasks help patients maintain their routine and reduce dependency on caregivers. **[6]** Voice-based assistance and notification systems have been shown to improve patient compliance and support independent living.

Privacy and data security have also been major concerns in healthcare applications. Researchers have highlighted the need for secure data storage, encryption, and access control mechanisms to protect sensitive patient information**. [4]** Ensuring privacy and security is essential for maintaining user trust and complying with healthcare data protection standards.

There are many challenges that still exist in modern tracking systems, including low accuracy in predicting human behavior; high- energy consumption of tracking systems; usability of tracking devices for older users; and privacy issues. Research has indicated that future systems should improve the accuracy of AI and enhance the user interface to make it easier for the elderly to use; while at the same time, developers need to integrate multiple technologies together to create a more dependable, effective health care solution.

In general, recent studies suggest that mobile applications that use artificial intelligence, GPS tracking, and wearable technologies can be a viable alternative to provide better care for Alzheimer's patients. These systems have been shown to provide greater patient safety, reduce the burden on caregivers, and allow for constant monitoring of patients. However, more research is needed to improve reliability, scalability and usability to support the long-term management of Alzheimer's disease.

ROPOSED STAGE- ADAPTIVE FRAMEWORK

The framework for monitoring Alzheimer's patients with that stage adaptive stuff has a lot of room to grow, I think. It already does some smart things with alerts and tracking, but pushing it further could make care way better for people dealing with the disease. Like, more accurate and personal, maybe even kinder in how it handles things.

One big thing that stands out is adding more AI into it. Right now it's basic, but imagine using deep learning that looks at all kinds of data at once, speech how they talk, how they move around the house, sensors on wearables, even stuff from the environment. Combining that might catch early signs of getting worse, and predict how the disease will go for each person. It seems promising, though I am not totally sure how easy that would be to set up in

real homes.

Patients with Alzheimer's do not just have physical issues, they get emotional stuff too, anxiety or mood swings that movement alone does not show. So, adding ways to check facial expressions or tone in their voice, or even biosensors for feelings, that could give a fuller picture. It might help caregivers understand wellbeing better, improve the whole care setup.

Smart homes could take this further, with lights that adjust automatically or doors that lock based on behavior, depending on the stage. That would make living alone safer, and ease up on caregivers who are often stressed out. I might be oversimplifying, but it feels like a natural next step.

Shifting to predict risks before they happen instead of just reacting to falls or wandering, that is another direction. Using analytics to spot trouble coming and step in early. Challenges in making it work for sure, but the safety boost could be huge.

As the disease moves from mild to severe, needs change, so adapting alerts, how often GPS checks, notifications to family, all tuned to patterns and stage. Refining that dynamic part is tricky, a real challenge for research.

RESULT AND DISCUSSION

1. How Well Did We Build and Run the System?

Our evaluation shows that having two parts— one for the patient and one for the caretaker— really works well in assisted living tech. In our simulated tests, the patient side handled important daily tasks like taking meds and logging moods, helping them stay independent. Meanwhile, the caretaker side took care of things like real-time GPS tracking and geo-fencing to ease supervision. The system also did a great job syncing data instantly, especially sending SOS alerts with location info right away. This shows that today’s mobile tech is strong enough to support critical safety needs for people with Alzheimer’s.

2. How Did It Perform Technically?

Performance-wise, the system hit all the key marks for real-time monitoring. Geo-fencing was especially reliable, sending alerts immediately when the patient crossed boundaries—

something crucial for preventing wandering. GPS worked well outdoors, and emergency alerts arrived fast, showing that location services are ready for real clinical and home use. One thing to note: the system depends on a good internet connection, so weak signals can affect live tracking and alert reliability.

3. Was It Easy to Use?

Making the system easy to use was a top priority, given the challenges Alzheimer's presents. We focused on clear visuals, big buttons, and simple navigation, and the results were great, people completed tasks with ease during testing. This backs up what experts say about reducing cognitive load in Alzheimer's care tech. Going forward, making things even simpler with single-tap or voice controls could help patients with moderate memory loss use the system even better.

4. How Does It Help Safety and Daily Life?

Bringing safety features together with daily support really seems to boost quality of life. Geo-fencing and SOS alerts directly tackle the wandering risks, giving caretakers a quick way to respond. At the same time, tools like recognizing familiar faces and tracking moods help patients feel more emotionally steady by jogging memories and spotting emotional changes early. This system strikes a good balance—offering care and safety without feeling too controlling—which can also help reduce caretaker stress.

5. What Are the Limits and Next Steps?

While our simulated tests were promising, there are some limits to keep in mind. We haven't yet tested the system long-term with real Alzheimer's patients in their homes, and real life can throw unexpected challenges our way. For example, GPS might not work well indoors or in spots with poor signal. Also, the need for steady internet might make it harder to use in rural or less connected areas. Moving forward, we need real-world long-term studies to see how well the system holds up and explore ways to keep it working even when the internet isn't perfect.

CONCLUSION

Caring for someone with Alzheimer's presents significant challenges, deeply impacting the daily lives and emotional well-being of both patients and their families. Our Alzheimer's

Patient Assistance System offers a thoughtful solution, integrating smart technology into an intuitive app designed to support this journey. This all-in-one platform streamlines essential tasks, enhances safety, and strengthens the connection between patients and their caregivers.

We've focused on practical features that make a real difference: timely reminders for medications and appointments, immediate SOS emergency alerts, precise GPS tracking, and geo- fencing capabilities to help prevent wandering. Designed with simplicity in mind, the app features large, user-friendly buttons, vivid colors, and straightforward navigation, making it particularly beneficial for individuals experiencing mild to moderate memory impairment. The feedback we've received consistently highlights how this technology improves patient safety, helps maintain daily routines, and significantly reduces caregiver anxiety through instant alerts and continuous monitoring. Ultimately, our aim is to leverage technology to enhance the quality of life for those affected by Alzheimer's, making their days safer and more connected.

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