

# Enhancing Alzheimer's Patient Care with an Automated Wearable Assistance Device based on AI and IoT

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## ABSTRACT

In recent years, the growing rate in dementia, a broad category of neuro-degenerative disorders with Alzheimer's Disease (AD) as the most common cause. The escalating prevalence of AD poses significant challenges for patients, caregivers, and healthcare systems. This research focuses on developing an Artificial Intelligence (AI) and Internet-of- Things (IoT) based healthcare assistive tool to address the multifaceted needs of AD patients and their caregivers. The proposed system aims to provide support through health monitoring, lost item detection, medication reminders, and location tracking. Evaluation results demonstrate the system's effectiveness and usability. This survey paper comprehensively explores the landscape of technological innovations in AD care, highlighting the potential of AI and IoT-based solutions. By identifying research gaps and recommending future directions, this study contributes to the ongoing development of advanced AD care strategies and efficient analysis of providing better services to the AD patients.

**KEYWORDS :** *AI & IoT, Wearable devices, Alzheimer's disease, Caregiving, Automated assistance.*

## INTRODUCTION

As a term, dementia refers to neuro-degenerative disease within the elderly people who are most susceptible to be affected with diseases. There are over 55 million people living with dementia worldwide. The majority of whom live in low and middle-income countries where rate of increase in neuro-degenerative diseases are highest. These are expected to be close to 10 million new cases every year according to a report published by the World Health Organization in 2023 [1].

Alzheimer's Disease is the most common form of dementia, accounting for 60 to 70 percent of the cases and globally ranks as the seventh leading cause of deaths. In 2019, dementia was the most expensive (\$1.3 trillion) disease on earth in terms of expenditure incurred on treatment and care giving. Astonishingly, it dis-proportionately impacts women as patients more than men in terms of impact (by a factor of two or more in developing countries), but also caregivers [5].

Alzheimer's disease progresses through several stages, starting with pre-clinical form of Alzheimer's where brain changes can be detected before symptoms appear in patients. As it advances to mild cognitive impairment, individuals may experience subtle memory issues. These issues may become more pronounced in mild dementia with noticeable memory loss and difficulties in daily life. In moderate to severe dementia, the decline becomes more severe, with increased confusion, significant memory loss, and a need for full assistance with personal care and sympathetically communicating with them [2].

An estimated 115.4 million people will be living with dementia worldwide by the year 2050 (Alzheimer's Disease International), and through all stages of this disease, family caregiving is essential. The majority of care is indeed unpaid, and provided by spouses or adult children but the number of hours we are going to need in twenty years hence will be several times what it now. Aging research in this area includes an examination of

the health effects on caregivers, such as burden and strain leading to poorer mental and physical health outcomes among care providers [8] along with differential service delivery for aging populations due to variation in the provision and utilization of services compared by caregiver type-barriers like stigma; language barriers that restrict access to appropriate caregiving [3].

Innovations in sensor technology and usage of wearables for monitoring health are thus being seen as viable alternatives to facilitate independent living, especially with the anticipated increase in dementia cases. Ensuring the compliance and participation of individuals with dementia to these new technology-supported goal-directed interventions is expected to prove more challenging but, ultimately, is needed for promoting meaningful recovery in existing health systems. By integrating sensors into wearable items we are better able to support both caregiving challenges as well as a much necessary real-time health management. User as a proactive Wellness & Disease Manager promotes user involvement in the monitoring and care towards their health, providing easy-to-understand feedback through technology (technology-based solution), whilst supported and advised by doctors who execute complex technical setups that may confuse less tech-savvy users [4].

Mobile apps help caregivers to find reminders, symptoms tracking and patient management tools which lighten up the caregiver stress. This paper presents work to develop and evaluate a wearable device that could help caregivers of AD patients by minimizing use for requiring professional care services in person [5].

Continuous monitoring using wearable assistive technology can improve the quality of life and ensure real-time data collection for individuals with disabilities as well as Alzheimer's disease. Traditional medical imaging can achieve early discovery, but is costly and invasive in general which reduce the possibility of regular monitoring; therefore healthcare-oriented IoT sensors and wearables appear to be an alluring solution providing vigilant-monitoring for chronic disease management [6].

This digital health ecosystem for managing patients with Alzheimer combines telemedicine, e-health services, smart home technologies and IoT to provide remote

monitoring of the patient care according to his/her level of dependence. Used in tandem with one another to facilitate care and promote patient independence, these systems rely on advancements like Ambient Assisted Living (AAL) as well as Personalized Assistance Systems (PAS) [7].

It makes it difficult to identify your relatives or acquaintances. For the improvement of Alzheimer patients, we provide a facial recognition and safety functions along with these concepts that no one can know what is in those messages via steganography. For examples it has functionalities to send notifications about the status of patient [7].

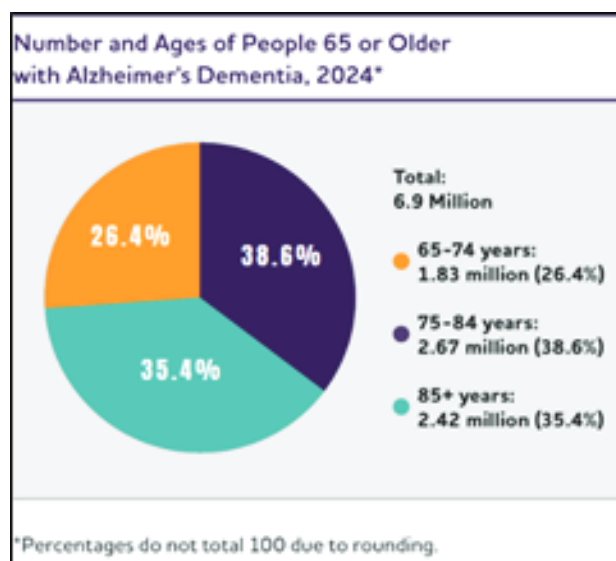


Fig. 1

(Recent statistical data published by Alzheimer Association [2024] <https://www.alz.org/media/Documents/alzheimers-facts-and-figures.pdf>)

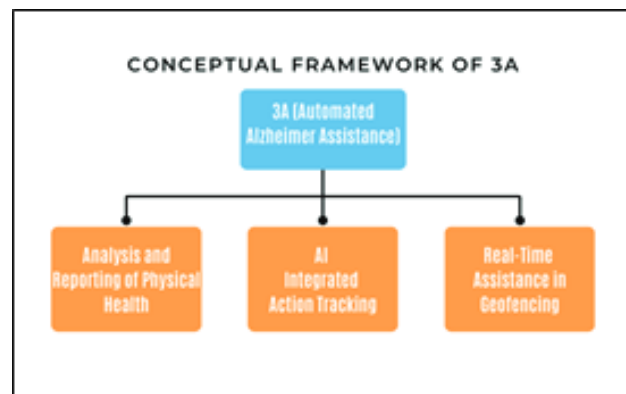
## LITERATURE REVIEW

Over the last few years, IoT-based healthcare solutions (particularly wearable devices), drew attention of many as a potential enabler for meeting the care needs related to Alzheimer. This section integrates existing research for the application of these technologies in supporting individuals with Alzheimer's disease and their caregivers. Some of the topics include how to handle symptoms, and help caregivers deal with their caregiver duties as well as this: what do IOT mean for healthcare anyway?

- A. IoT and wearable technology in Alzheimer's care: Application of Internet-of-Things (IoT) technology in wearable devices has provided new solutions for monitoring, and data collection at the time it occurs i.e., real-time to control Alzheimer Diseased (AD). Sensors in wearables can monitor basic signs, detect falls and observe patient's activities physical as well as mentally. This provides caregivers and doctors with real-time reports, faster. Chen et al. Wearable Sensors in AD Care (2018) For example, they reported that these devices were able to improve patient safety by monitoring their daily activity in real-time and reducing the risks of wandering and falling [8]. Wearable tech which also has been demonstrated that it catches disease progress by continuous monitoring, It is a non-invasive and much cheaper modality compared to routine medical imaging [9].
- B. Aiding in Patient-Caregiver Interaction: Smoking drones are capturing more and smarter IoT-based source data, which results in somewhat of a progression to the interaction between Alzheimer's patients and their caregivers. For example, some of the caregivers' work can be automated by using these technologies so they could focus on other tasks and receive real-time alert about patient conditions. Smith et al. A study conducted by (2019) concluded that mobile health applications connected to wearable devices deliver insights about the patient's well-being such as alteration in behavior and daily routine this would help caregivers take timely actions [10]. This is important as AD care takes a heavy emotional and physical toll, and reducing this burden would contribute to the health of both patient and caregiver.
- C. Personalization through Adaptive Technologies: Adaptive technologies are common for wearables, devices that can easily adapt to individual needs will be the future of Alzheimer's care. Said adaptive systems employ sensor data that inform them on the proper type and amount of assistance to adjust to current needs. For example, one developer built an adaptive reminder system that helps transmit messages about daily tasks from taking medicine to keeping appointments all: {health-related} based

on your needs. Memory loss and cognitive decline often make these tasks difficult for patients. Garcia et al. It was observed by (2020) that these systems enhance the standard of living in AD patients. This makes patients no longer dependent on caregivers [11].

- D. Challenges and Limitations: Despite showing great promise in Alzheimer's care, these IoT based wearable devices face many challenges. Of particular concern are privacy and data security, since these devices collect and transmit precious patient information. This information is the kind that contains some person [or patient] identification, so it must be stored and transmitted under encryption. Additionally, this tech is not an option for all patients in a country where the cost of wearables and their infrastructure are expensive. In addition, digital natives may accept these technologies sooner than older adults who are less accustomed to the use of digital devices setting back their escalation [12]. Additional long-term studies are required to assess the potential impact of wearable technologies on Alzheimer's disease management.



**Fig. 2**

(This diagram illustrates the core components of the proposed methodology, focusing on the analysis of physical health, AI-integrated activity tracking, and real-time geofencing assistance, all aimed at improving the daily life of Alzheimer's patients.)

- E. The Digital Health Ecosystem and the Care of Alzheimer Diseases: The broader digital health ecosystem, which includes telemedicine and e-health smart home tech as well as IoT, offers

more comprehensive Alzheimer's care. Wearable devices can be integrated into this ecosystem for a comprehensive care that responds quickly to the patients with AD. We can see how this integration occurs in systems like Ambient Assisted Living (AAL) and Personalized Assistance Systems (PAS), bringing continuous care for the patient, improving the independence of a patient. Patel et al. Systems such as Patient Pass, for example: can reduce the need of direct access to healthcare services and thus lower overall cost for faster and better patient outcomes [13].

## CONCEPTUAL FRAMEWORK OF THE PROPOSED METHODOLOGY

On the other hand, our method is composed of three main parts demonstrated in the conceptual diagram [Fig. 2] to Automated Alzheimer Caregiver system: 3A These three pillars are:

1. **Monitoring and Reporting Physical Health:** This focuses on the ongoing monitoring of quantifiable physical health changes in patients. The system will also work with many third-party health monitoring devices including heart rate monitors, sleep trackers and others to give a complete look at the patient's condition. This information will be stored securely and available to caregivers as well health professionals, providing more effective care in a timely manner.
2. **AI-driven Action Tracking:** At the heart of our proposed solution is an AI integrated with automated action tracking system. The wearable device, which is meant to be easy-to-use and offer comfortable all-day usage, will track how patients are moving in real time using internal sensors and camera. These data are then analysed by the AI system to identify trends, changes in behaviour and provide help when necessary. So, if the patient is disorganized, or walks in a different way that he/she normally does, will put into place an instruction from the system ... making their mind of personal develops to assist them what they need.
3. **Live Help in Geofencing:** With the elderly carrying Alzheimer's or who're pocketers might wander about and get missing, it is extremely important to

have them secure. The device comes with an in-built GPS tracker to ensure geofencing of the patients within safe zones. If the patient leaves these zones, an alert will sound and provide nursing support in leading the patient back to safety.

Our proposed methodology aims at designing an action tracking system which essentially changes the way day to day life of Alzheimer patients with respect to normal humans. The objective for continuous monitoring of their activities and health is to facilitate timelier support/intervention, positively impacting on the quality of life. Paired with a wearable device, it will be an indispensable tool for both the patients and their caregivers - helping keep these individuals safe while managing day-to-day activities and alleviating some of the stress that comes in trying to ensure loved ones are protected from potentially dangerous situations.

## PROPOSED METHODOLOGY

The wearability and ease of use will take priority in the design of such wearables. While wearing small, light and almost invisible goggles to look like regular eyeglasses patients can use throughout the day. Containing built-in camera and other tools, the device is in real-time monitoring of the living environment or activities of daily life. Most importantly, the camera will deliver a constant feed of visual information that is crucial for monitoring and interpreting what people are doing.

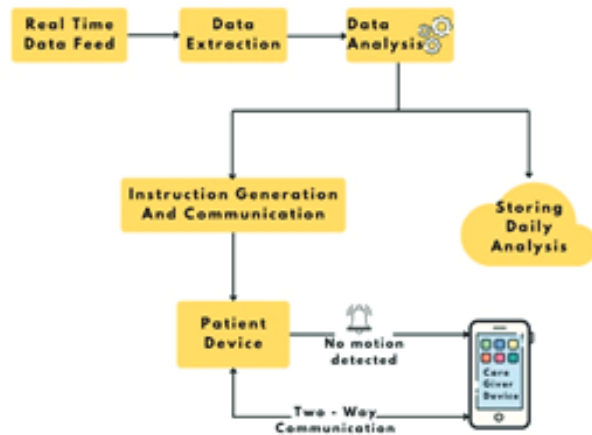
The methodology put forth aims to build a system of complete care for the person with Alzheimer's. In doing so through a marriage of comfort-oriented design and next-gen AI-driven analysis/remediation capabilities the methodology is intended to not only improve outcomes/enhance patient safety, but also nurse assistant quality-of-life by providing essential support personnel with much-needed deliverables as well.

## SYSTEM DESIGN AND DATA FLOW

A systematic workflow [Fig. 3] is presented around the proposed solution that supports competitive analysis and validates process design, for implementing real-time assistance to Alzheimer's patients using the function of data collection: analyse-communicate-response mechanisms. It starts at the Real-Time Data Feed, which is constantly fetching information from patient's



environment. And this data is sent to the Data Extraction phase where only useful data points are separated for handling it further Illegal Access Exception.



**Fig. 3 Workflow of proposed solution.**

(Workflow of the Proposed Solution for Real-Time Assistance to Alzheimer's Patients. This flowchart illustrates the process of data collection, analysis, communication, and emergency response integrated into the system.)

After extracting the Data, it proceeds to a second step that is known as Data Analysis stage. In this step, the incoming data is analysed against predefined patterns and anomalies in the patient behaviour like sudden drop of activity. These results are twofold, one side guiding the Instruction Generation for Communication system that interacts directly with the patient through a Patient Device. The system gives the patient cues and instructions they need to be more independent in everyday life. The other side, the data is in cloud to Storing Daily Analysis that helps caregiver review and analysis of daily patterns of patient over time.

Upon no movement detected by the Patient Device, it will send an alert to Caregiver Device. This enables Two Way Communication (rather than one way communication from the caregiver to the patient) enabling immediate intervention if needed. From there, should the issue escalate to a point where outside intervention is appropriate, this workflow also allows for Emergency Service calls. The whole system is designed to make sure the patient gets advocated for at the right time, while care providers get in-time update

of their conditions all most real time. This holistic approach available gives assurance for a complete environment that not only helps in managing everyday tasks but is also safe and secure to any patients with Alzheimer's disease.

## CONCLUSION & FUTURE SCOPE

This paper conveys a live personalized help system for Alzheimer's patients. It employs AI, ML and computer vision to improve patient independence, offering a higher quality of life. Therefore, it is proposed to relate the customizing technology advanced with our idea of creating a wearable device that we have named as "SmrutiPankh".

Considerations are taken into account for other technologies and devices to improve the quality and adaptability of the proposed product.

In future, the thought of planning to develop a customizable environment for the development of "SmrutiPankh" is also on the anvil. On the advanced scenario, differentiating a patient's health in stages of Alzheimer's would be taken up for research and accordingly the adaptive devices and a robust methodology would be developed.

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