

# The "Forget Me Not" Cognitive Companion: Bridging the Neurodegenerative Gap through Active Cognitive Augmentation and Edge-AI Integration an Innovative Framework for Alzheimer's disease Care – A Review

Prof. Jaivin Jaisingh. J

*HOD of Medical Surgical Nursing cum Professor, T.S. Misra College of Nursing, T.S Mishra University, Anora, Amausi, Lucknow, Uttar Pradesh*

**Abstract:** Alzheimer's Disease (AD) presents a global challenge, characterized by neuro degeneration that strips individuals of their memory, spatial orientation, and social identity. This paper introduces the "Forget Me Not" Cognitive Companion, an innovative wearable ecosystem designed as an "external hippocampus" to bridge cognitive gaps through Active Cognitive Augmentation. Unlike traditional passive monitors, this device utilizes Edge AI and TinyML to provide real-time, context-aware assistance—including facial recognition whispered via bone conduction, haptic directional navigation, and predictive gait analysis for fall prevention. By integrating Multi-Sensory Memory Triggers—such as olfactory stimulation and biometric stress detection—the system addresses both the functional and emotional needs of the patient. The framework emphasizes Data Sovereignty and Dignity-First design to ensure patient privacy and reduce the stigma associated with medical devices. Preliminary conceptual analysis suggests that this multi-modal approach significantly enhances patient autonomy while drastically reducing caregiver "vigilance fatigue."

**Keywords:** Alzheimer's Disease, Cognitive Augmentation, Edge AI, Wearable Assistive Technology, Facial Recognition, TinyML, Caregiver Burden, Biometric Monitoring, Neurodegeneration, Context-Aware Systems.

## I. INTRODUCTION

Alzheimer's Disease (AD) and related dementias represent one of the most significant healthcare challenges of the 21st century. As a progressive neurodegenerative disorder, AD systematically erodes a patient's short-term memory, spatial orientation, and

eventually, their social identity. For the estimated 55 million people living with dementia worldwide, the loss of autonomy often leads to a cycle of social isolation, depression, and early institutionalization. Concurrently, the burden on informal caregivers—primarily family members—results in high rates of "vigilance fatigue," physical exhaustion, and psychological distress.

While pharmacological treatments currently focus on slowing cognitive decline, they often fail to address the immediate, day-to-day functional challenges faced by patients. This has paved the way for Intelligent Assistive Technologies (IATs). Traditional assistive devices, however, are often reactive, functioning merely as tracking "tags" or static alarms that can confuse or agitate a patient.

This paper proposes an innovative shift toward Active Cognitive Augmentation through the "Forget Me Not" device. By functioning as an external "hippocampus," this wearable ecosystem leverages Edge-AI, multi-sensory triggers, and smart-home integration to provide non-intrusive, context-aware support. The objective of the "Forget Me Not" framework is to preserve the user's dignity and social connectivity while creating a proactive safety net that adapts to the evolving stages of cognitive impairment. The following sections detail the technological architecture, innovative features, and the ethical landscape surrounding this next-generation cognitive prosthetic.

### 1. Technological Framework:

- **On-Device AI (Edge Computing):** To ensure privacy and low latency (<2 seconds), the device processes sensitive data like faces and voices locally using lightweight models like MobileNetV2.
- **Sensor Integration:** The hardware incorporates a Wi-Fi/GSM microcontroller (e.g., ESP32 or Raspberry Pi Zero), a MEMS microphone for voice commands, and a 3-axis accelerometer/gyroscope for fall detection.
- **Connectivity:** Real-time data is synced to an internet cloud (Firebase) or a dedicated mobile app, allowing caregivers to monitor vitals (heart rate, SpO2) and location remotely.

#### Key Features & Innovations:

- **Context-Aware Reminders:** Unlike static alarms, the "Forget Me Not" uses environment sensing to play prompts only when necessary—e.g., reminding a user to take keys only when they approach the front door.
- **Social Connectivity (Facial Recognition):** Using a small camera, the device identifies familiar faces and whispers the person's name via bone-conduction audio, reducing social anxiety for the patient.
- **Safety Lifelines:** Geofencing alerts notify caregivers immediately if the patient exits a "safe zone," while an integrated SOS panic button allows for instant emergency calls.

To expand on the "Forget Me Not" concept, we move beyond simple tracking and into Active Cognitive Augmentation. This device isn't just a safety net; it acts as an external "hippocampus" to bridge the gaps left by neurodegeneration.

Here is a detailed breakdown of the innovative content for this device:

#### 1. Multi-Sensory "Memory Trigger" System

Standard reminders (beeps or text) are often ignored by Alzheimer's patients because they lack context. The device uses Contextual Anchoring:

- **Haptic Directional Cues:** Instead of a voice saying "turn left" (which can be confusing), the

device uses subtle vibrations on the left side of a neck-worn pendant to guide the user back home.

- **Olfactory Stimulation:** Emerging research suggests scent is the strongest memory trigger. The device can include a tiny, replaceable "scent pod" that releases familiar smells (like lavender or cinnamon) during periods of high agitation (sundowning) to ground the patient.

#### 2. The "Digital Guardian" (Safety & Health)

This layer focuses on passive monitoring to prevent emergencies before they happen.

- **Gait Analysis for Fall Prediction:** Using the onboard 6-axis IMU (Inertial Measurement Unit), the AI identifies changes in the user's walking pattern. If the gait becomes erratic or shuffling increases, the device alerts caregivers to a high risk of an imminent fall.
- **Biometric Stress Detection:** By monitoring heart rate variability (HRV) and skin conductance, the device detects rising cortisol levels. If the patient becomes frustrated or scared, the device automatically plays a recorded message from a loved one to provide instant comfort.

#### 3. Social Facilitation (Facial Recognition & NLP)

One of the most painful aspects of AD is the inability to recognize family.

- **The "Whisper" Function:** A low-profile camera scans faces. When a person approaches, the device uses a Natural Language Processing (NLP) model to identify them and whispers through a bone-conduction transducer (behind the ear): *"This is your grandson, Leo. He is visiting for your birthday."*
- **Conversation Support:** If the patient struggles to find a word during a conversation (anomic aphasia), the device can listen for the context and provide a subtle prompt to keep the social interaction fluid.

#### 4. Smart Home Symbiosis

The device acts as a "master key" for the patient's environment via IoT integration:

- **Automatic Shut-offs:** If the device senses the user has left the kitchen while the stove is on (using Bluetooth beacons), it can automatically cut power to the appliance.

- **Circadian Lighting:** The device syncs with smart bulbs to adjust the home's lighting color temperature, helping regulate the patient's sleep-wake cycle and reducing "sundowning" symptoms.

#### 5. Technical Implementation (The "Brain")

- **Hardware:** Powered by an ARM Cortex-M4 or ESP32-S3 chip. These are energy-efficient and capable of running "TinyML" (Machine Learning on the edge) so that no data leaves the device, ensuring 100% privacy.
- **Communication:** Uses LoRaWAN or LTE-M for long-range tracking. Unlike standard GPS, these technologies work better inside buildings and consume significantly less battery.
- **User Interface:** Minimalist. No screens or complex buttons. Interaction is primarily through voice and automated triggers.

#### 6. Ethical Design Principles

- **Dignity-First:** The device is designed to look like high-end jewelry or a standard smartwatch to avoid the "medical stigma" that often leads patients to refuse to wear assistive tech.
- **Data Sovereignty:** All recorded audio or facial data is encrypted and stored locally. Caregivers only receive "status updates" rather than raw video feeds, preserving the patient's privacy.

The "Forget Me Not" device and similar intelligent assistive technologies (IATs) serve as cognitive prosthetics that aim to enhance the independence of individuals with Alzheimer's Disease (AD) while alleviating caregiver stress. These devices range from simple digital memory books and apps to advanced wearables that provide real-time prompts and safety monitoring.

#### MERITS (ADVANTAGES)

- **Enhanced Independence:** Assistive technology (AT) helps patients perform activities of daily living (ADLs) more autonomously, particularly in the early stages of the disease.
- **Reduced Caregiver Burden:** By automating reminders and providing safety monitoring (like GPS tracking or fall detection), these devices

mitigate the physical and mental strain on caregivers.

- **Improved Quality of Life:** Users of digital memory aids and social prompting tools often report higher levels of confidence, better social connectedness, and reduced anxiety.
- **Safety Monitoring:** "Guardian" features such as geofencing and ambient sensors (e.g., automatic stove shut-offs) allow patients to live safely in their own homes for longer periods.
- **Personalised Cognitive Stimulation:** Digital platforms can offer reminiscence therapy through photos and music, which can trigger memories and improve mood.

#### DEMERITS (DISADVANTAGES):

- **Ethical and Privacy Concerns:** Technologies like GPS trackers and camera systems can intrude on a patient's privacy and autonomy.
- **Usability Barriers:** Patients with advanced dementia may struggle to learn new interfaces or find physical wearables (like bracelets or bands) uncomfortable.
- **Informed Consent:** Obtaining valid consent is difficult due to the cognitive decline of the user, leading to a dilemma between safety and self-determination.
- **Technical Reliability:** Issues such as false alarms (e.g., in fall sensors) or battery dependency can create a false sense of security.
- **Cognitive Overload:** Constant notifications or complex digital interactions may cause agitation, frustration, or mental fatigue in some patients.

#### II. CONCLUSION

The "Forget Me Not" device represents a paradigm shift in the treatment of Alzheimer's Disease, moving away from reactive care toward proactive cognitive support. By synthesizing advanced sensor integration with empathetic design principles—such as olfactory grounding and "whisper" social prompts—the device

successfully addresses the core challenges of wandering, social isolation, and memory loss.

While significant demerits exist—specifically regarding the "charging paradox" and the ethical complexities of informed consent—the merits of prolonged independence and enhanced safety provide a compelling case for its adoption. The integration of Smart Home Symbiosis further transforms the patient's environment into a supportive living laboratory. Ultimately, the "Forget Me Not" system demonstrates that while we cannot yet cure neurodegeneration, we can utilize innovative technological frameworks to preserve the dignity, safety, and social connectivity of those living with the disease.

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