Empowering Every Step: Towards Intelligent Wearable Assistants

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ABSTRACT

This summary outlines my research vision for developing intelligent wearable assistants that deliver personalized, context-aware computing support. My prior work explored information presentation using smart glasses, socially-aware interactions, and applications in learning, communication, and documentation. Current research focuses on developing tools for interaction research, including data collection methods, multimodal evaluation metrics, and a platform for building context-aware AI assistants. Future directions include expanding these assistants into new domains including physical spaces through telepresence, and investigating collaborative human-AI learning. Ultimately, this research aims to redefine how humans receive seamless support through proactive, intelligent wearable assistants that understand users and their environments, augmenting capabilities while minimizing manual effort.

CCS CONCEPTS

• **Human-centered computing** → **Ubiquitous and mobile computing systems and tools**; **Mobile devices**; **Mixed / augmented reality**; *Information visualization*; • **Computing methodologies** → **Artificial intelligence**.

KEYWORDS

context-aware system, wearable, AI assistance, notifications, interruptions, smart glasses, HMD, interactions, Augmented Reality, MR, XR

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1 INTRODUCTION

Imagine a future where every individual is equipped with a personalized, intelligent, wearable assistant that seamlessly understands both the user and their environment, adapting to specific activities. Such assistants would streamline a wide range of tasks, both routine and novel, by reducing cognitive load and errors, enhancing performance, and decreasing reliance on specialized manual labor, such as coaching.

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This vision, which aligns with the goal of making computing unobtrusive, has already begun to materialize [17]. It has shaped my research focus (Figure 1) on designing **intuitive and seamless interfaces for intelligent wearable assistants** within the broader field of human-computer interaction (HCI) targeting key stakeholders, including end users, researchers, and developers/designers. To realize this vision, I am committed to deeply understanding user behaviors and requirements through a combination of qualitative methods (e.g., observations) and quantitative methods (e.g., surveys). Building on this foundation, my approach involves designing, developing, and validating systems, interfaces, and interactions that effectively support users in real-world settings, incorporating both controlled experiments and field studies. By integrating user needs and preferences with an iterative design and evaluation process, my goal is to develop proactive, intelligent, context-aware, and personalized solutions that enhance users' productivity, efficiency, and overall satisfaction in daily life.

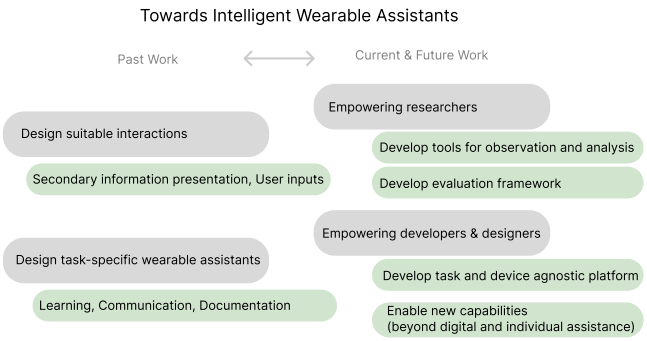

Figure 1: My research interests and goals.

Background and Previous Work

Designing wearable assistants presents several challenges, including interaction challenges (e.g., aligning system inputs and outputs with user capabilities), research challenges (e.g., effectively analyzing and modeling assistance), and development challenges (e.g., streamlining the creation of new assistants) [13]. One key consideration is selecting suitable device platforms. Current mobile devices often demand excessive attention [1], whereas heads-up computing paradigms, enabled via augmented reality (AR) smart glasses or optical see-through head-mounted displays (OST-HMDs, OHMDs), enhance multitasking and engagement with the physical world [19].

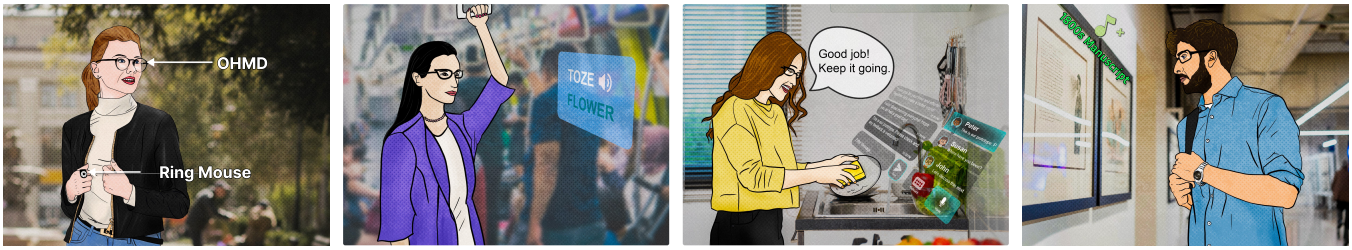

Figure 2: Assistance applications, (a) a common setup consisting of OHMD and subtle gesture (e.g., ring) interaction, (b) microlearning on the go, (c) messaging during daily activities, and (d) in-context experience documentation

Information Presentation and Interactions. Heads-up displays must balance delivering just-in-time information while minimizing distractions, particularly for secondary information [15]. My dissertation [5, 6] introduced strategies leveraging visual perception, including paracentral displays [10], graphical formats [14], and luminance adjustments [12]. These techniques, validated through user studies, reduce interference with primary tasks. Additionally, collaborative work extended these designs to support bi-directional interactions, such as *ParaGlassMenu* [4], which integrates AR smart glasses and subtle input devices to enable effective, socially aware interactions.

Assistance Applications. As shown in Figure 2, wearable assistants can address domain-specific needs such as learning, communication, and documentation. For example, microlearning with smart glasses facilitates bite-sized learning during commutes [11], while tools like *GlassMessaging* [9] improve messaging in multitasking scenarios. Solutions like *PANDALens* [2] leverage AI for in-context travel documentation, while *AiGet* [3] supports informal learning, enhancing personal productivity and user experience.

Current and Future Work

My goal is to redefine seamless computing assistance [7]. To achieve this, I focus on:

Developing Assistance for Diverse Scenarios. To demonstrate the utility of wearable assistants, their presence in daily activities must be increased by expanding application domains (e.g., sports training, generative AI-based personalized learning) and enhancing capabilities (e.g., collaborative multi-user assistance, extending digital functionalities to physical environments through human-robot interactions [18]).

To this end, we are enhancing *The Other Me (TOM)* platform [13], which enables the development of context-aware, personalized wearable assistants using off-the-shelf hardware. This effort aims to democratize access to intelligent assistance.

Evaluating Assistance across Diverse Scenarios. We are also developing tools such as *PilotAR* [8] to streamline data collection and analysis for wearable interactions. Enhanced frameworks will facilitate the evaluation of multimodal interactions (e.g., [16]), providing a holistic understanding of performance, effectiveness, and user experience across diverse scenarios.

Summary

In summary, my research envisions the design and development of intelligent wearable assistants that comprehend both the user and their context, delivering proactive support during daily activities with minimal intrusion. With advancements in hardware and software technologies, these assistants are poised to become seamless daily companions, offering personalized guidance while enhancing human capabilities and reducing reliance on costly manual labor.

Moreover, these assistants will empower users to fully leverage their bodily capabilities, removing constraints associated with limited interactions or task-specific tools. This will enable individuals to live, work, learn, and play in ways that align with their aspirations.

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