Design and Evaluation of Walk-Man: A Wearable Assistive Device for Enhanced Navigation in Individuals With Visual Impairment

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Conventional visual assistive devices primarily rely on canes, limiting independence and ease of use. The Walk-Man project aims to develop a wearable, non-obtrusive assistive device to enhance mobility for individuals with severe visual impairment. The development followed an iterative design process, advancing through three prototypes. Prototype 1 incorporated a basic microcontroller and ultrasonic sensors for obstacle detection. Prototype 2 improved sensor accuracy and feedback mechanisms. Prototype 3 integrated a compact microcontroller, an enhanced ultrasonic sensor, and GPS functionality. The device underwent rigorous testing for object detection, sensor accuracy, and GPS performance. A lightweight, 3D-printed casing was designed to ensure ergonomic usability. Walk-Man demonstrated increased obstacle detection efficiency, providing real-time auditory feedback. Objects within 3 meters were accurately detected, with detection reliability decreasing beyond 5 meters. Sensor performance was optimal for larger, regularly shaped objects. The ultrasonic sensor covered a 10-degree x-axis and a 5-degree y-axis arc. GPS readings were highly accurate, aligning with commercial-grade devices. The third prototype's 3D-printed casing proved to be lightweight, durable, and compact. The Walk-Man device successfully integrates obstacle detection and GPS guidance in a compact, wearable format. Prototype 3 met the initial design objectives, providing a cost-effective alternative to commercial mobility aids. Future refinements will focus on expanding sensor coverage and refining real-time user feedback. Walk-Man presents a viable assistive technology solution to enhance mobility and independence for individuals with visual impairment.

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