AI-Powered Vision for Enhanced Spatial Navigation of the Visually Impaired

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My work proposes a state-of-the-art vision system to support mobility and navigation for the VI community using both acoustic and haptic signals that shall cost <$300. My work uses a novel idea to use two different types of cameras, regular camera for object detection and time of flight camera for distance measurements and a novel algorithm to perform obstacle classification/direction/distance by overlaying both object detection image and depth map using python. This work consists of five phases which includes Idea, Design, Hardware assembly, Feature setup and Testing. Features included in my device are obstacle avoidance, navigation, text-to-audio, haptic feedback and fall detection. Operational and functional testing were performed. Object detection and text recognition showed an accuracy of >95% in the day light and >91% in the low-light. Depth perception testing showed a positional or distance error >97%. Haptic interface resulted with a 100% accuracy over 10 trials with an average response time of <1s. Through the 5x trials, the data showed that the depth accuracy of the algorithm was high with an average % error of <0.2% and <3% for stationary objects and dynamic objects respectively. Functional testing involved both simulated and real-life setting with test levels as without aid, with cane aid and with AI-VS system. AI-VS performed exceptionally well with an average of 0.33 collisions per course compared to 5 for cane and 10 for no aid in simulated setting. AI-VS also performed exceptionally well with an average of 0.66 collision per course compared to 4.5 for cane and 8.8 for no aid in real setting. My AI-VS system provided directional and navigational assistance with high accuracy, low cost and good comfort for the VI user identify the safe walking path.