Generative AI-Aided Navigation for the Visually Impaired and Blind

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Introduction

Motivation: Reduce one of the most significant barriers to freedom for the visually impaired and blind [1] who account for around 2.2 billion people worldwide [2]

Current solutions are **insufficient**:

Limited information below the knee, up to only a few feet radius around the user [3]

Navigation apps cannot capture a real-time, dynamic environment

Research Goal: Improve safety, independence, and confidence through a reliable personal navigation assistant that will answer queries at any moment

Proposed Solution

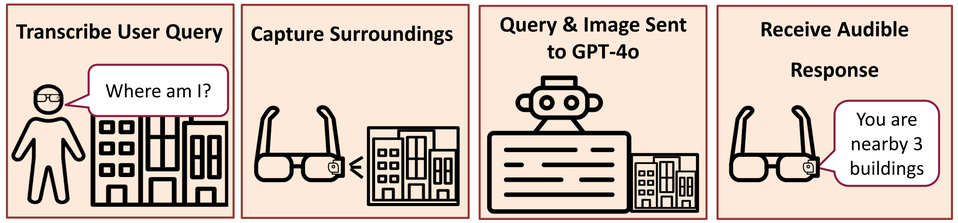


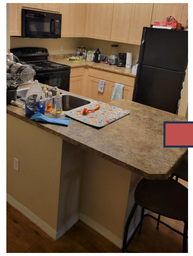
Figure 1: User Flow of Navigation Assistant

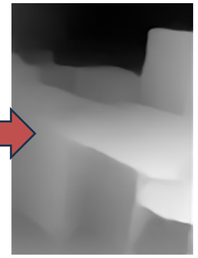
Criteria	Weight	VLM Scores: 1 (worst) - 5 (best)		
		VQA/ViLT	Moondream	GPT-4o
Spatial Reasoning	3	2	4	3
Detail Accuracy	3	1	2	5
Control	2	1	1	4
Speed	2	5	3	4
Cost	1	5	5	3
TOTAL SCORE	-	26	31	43

Figure 2: Decision Matrix Determines Best VLM

Hardware: Ray-Ban Meta Smart Glasses

Software: GPT-4o, YOLO, MiDaS





Results

GPT-4o

Spatial Reasoning Categories	Baseline GPT-4o	GPT-4o with Context
Right	11/20	13/20
Left	6/15	11/15
Above	5/9	6/9
Below	20/27	17/27
In Front	12/14	12/14
Behind	3/8	6/8

Logic Reasoning:

EX: Crossing Road

8/8 Tests Passed ✓

Error Handling:

EX: Obscured Object, Misheard Query, etc.

15/25 points achieved

YOLO

Known Object Accuracy: 73.33%

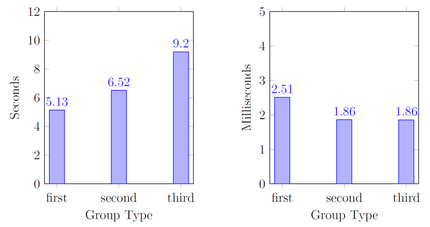
Unknown Object Accuracy: 80.77%

MiDaS

	Human	MiDaS
Indoor Error	2.31 ft	1.86 ft
Outdoor Error	13.84 ft	7.04 ft
Total Error	9.64 ft	5.15 ft

Human Range & Standard Deviation: 24.15 ft & +/-22.27 ft

Latency



GPT: 6.114 seconds

YOLO: 2.046 seconds

MiDaS: 3.527 seconds

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References

[1] Messaoudi, M. D., Menelas, B. J., & Mcheick, H. (2022). Review of Navigation Assistive Tools and Technologies for the Visually Impaired. Sensors (Basel, Switzerland), 22(20), 7888. https://doi.org/10.3390/s22207888.

[2] Liste, S. (2023). Vision Impairment and blindness. World Health Organization. https://www.who.int/news-room/fact-sheets/detail/blindness-and-visual-impairment.

[3] Isazade V. (2023). Advancement in navigation technologies and their potential for the visually impaired: a comprehensive review. Spatial Information Research, 1–12. Advance online publication. https://doi.org/10.1007/s41324-023-00522-4.

FURI

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