DodgeUI: Leveraging Adaptive Window Movement as Implicit Environmental Cues in Mobile AR

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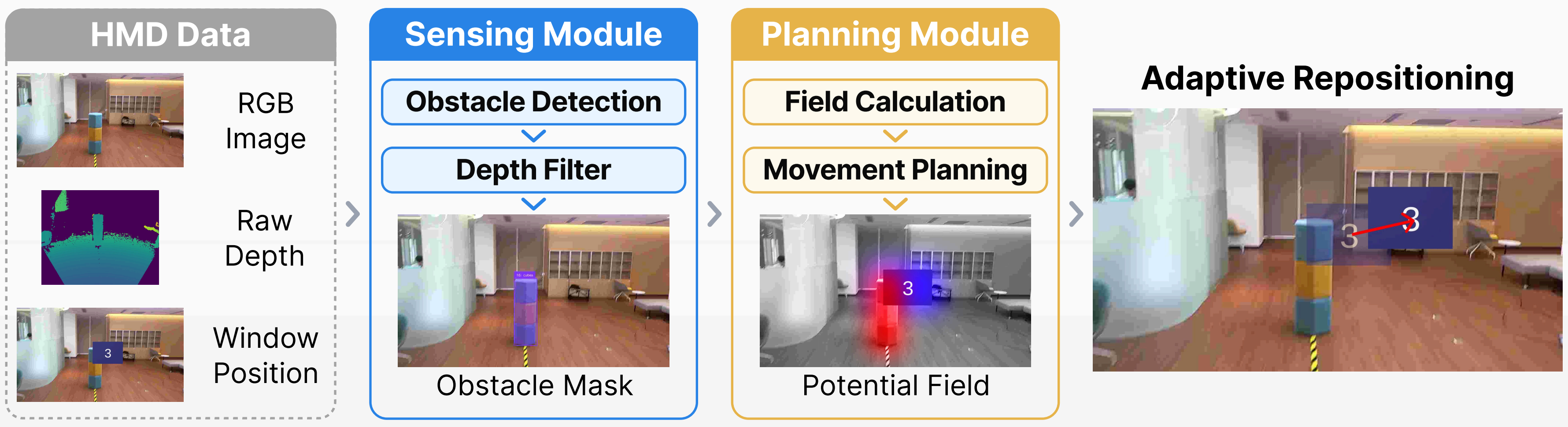
Motivation

- **Attentional Conflict:** Interacting with AR while walking creates a "dual-task" scenario, splitting limited attentional resources between digital content and physical safety [5, 6, 7].
- **Safety Risks:** Reduced situational awareness may lead to collisions with various obstacles.
- **Visual Clutter:** Existing methods using explicit visual signals like icons or flashes may interfere visual perception [1].

DodgeUI - an adaptive interface that dodges physical obstacle

- leverage *Artificial Potential Field (APF)* for dynamic and timely movement calculation and planning
- use window movement as **implicit environmental cues**

Technical Approach



Obtain data from Hololens 2

Offload computation on Server

Artificial Potential Field

Repulsive Force
Generate from obstacle

Attractive Force
Generate from anchored position

Adaptive Behaviors of Virtual Window

- **Remain unchanged** with no hazards
- **Slightly shift** with near obstacles
- **Pushed out of view** with close obstacles

Methodological Approach

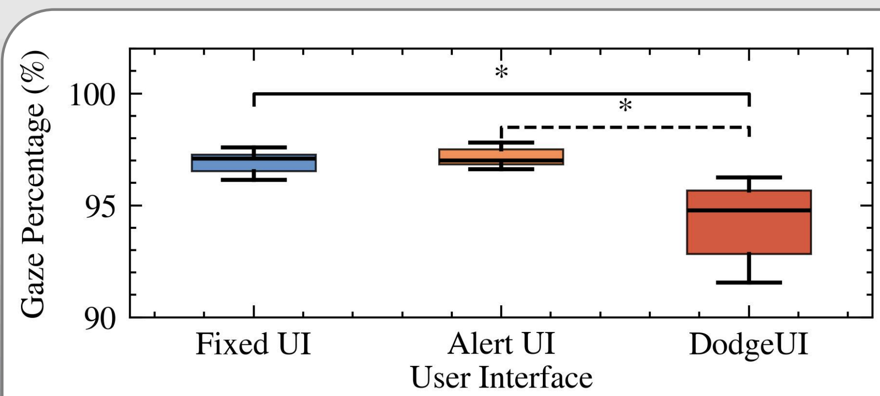
3×3×2 Within Subject Design

User Interface	Fixed	Alert	DodgeUI
Distance to Obstacle	Far 1.0m	Near 0.5m	Close 0.0m
Obstacle Type	Static Obstacle	Dynamic Pedestrian	

24 Participants
14 male, 10 female; age: 22.8±3.5 years

Continuous Performance Task
Respond to specific numbers on AR display
Click a physical button to respond

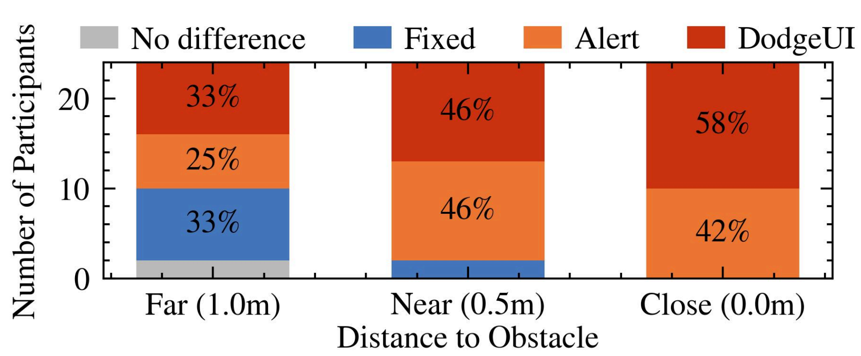
Results & Discussion



Eye Gaze fixation time on the virtual window

Significant reduction for DogdeUI compared to other methods.

Window's movement successfully **prompted a shift in visual focus** from the virtual content to the physical environment during potential hazard.



User Preference

Shifted to DogdeUI in high-risk scenarios.

Prioritize safety in complex environment and **perserve interaction** with virtual elements in mild conditions.

NASA TLX & SUS Scores
Remain consistent across conditions.

Window movement did not introduce additional task load and maintained ease of use.

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