Evaluating Dynamic Surface Compensation for Robots with Projected AR



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Motivation

- Robots need to communicate spatial information to humans in the physical world.
- Traditional modalities such as gestures, gaze, sound lack precision and displays are illegible afar when referring to objects or locations in cluttered space.
- **Projected augmented reality (AR)** allows robots to visualize information directly on the environment, making it visible to multiple observers without requiring head-mounted displays.
- However, real-world environments often contain textured and non-planar surfaces, which distort projected images and require projection compensation.

RQ: Can existing projection compensation methods support mobile robots projecting AR while moving in complex environments?

Method & Search-and-Rescue Scene

- We evaluated the state-of-the-art projector compensation method, CompenHR, on a Go2 projecting AR in a search-and-rescue environment.
- We recreated a debris environment using concrete blocks, tiles, wooden boards, and asphalt shingles.
- These materials introduce irregular geometry and strong textures, making projection compensation difficult.
- We evaluated projections from three robot viewpoints.

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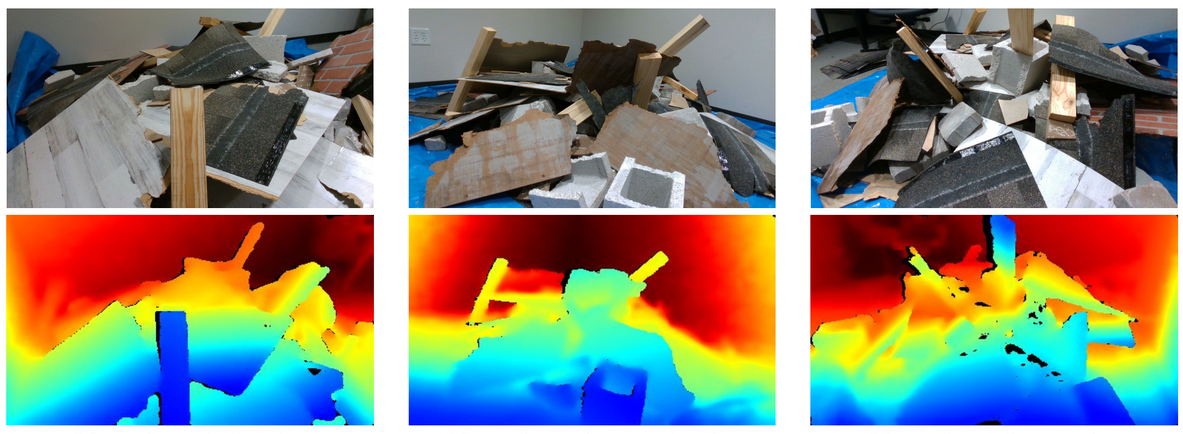
Environment Setup

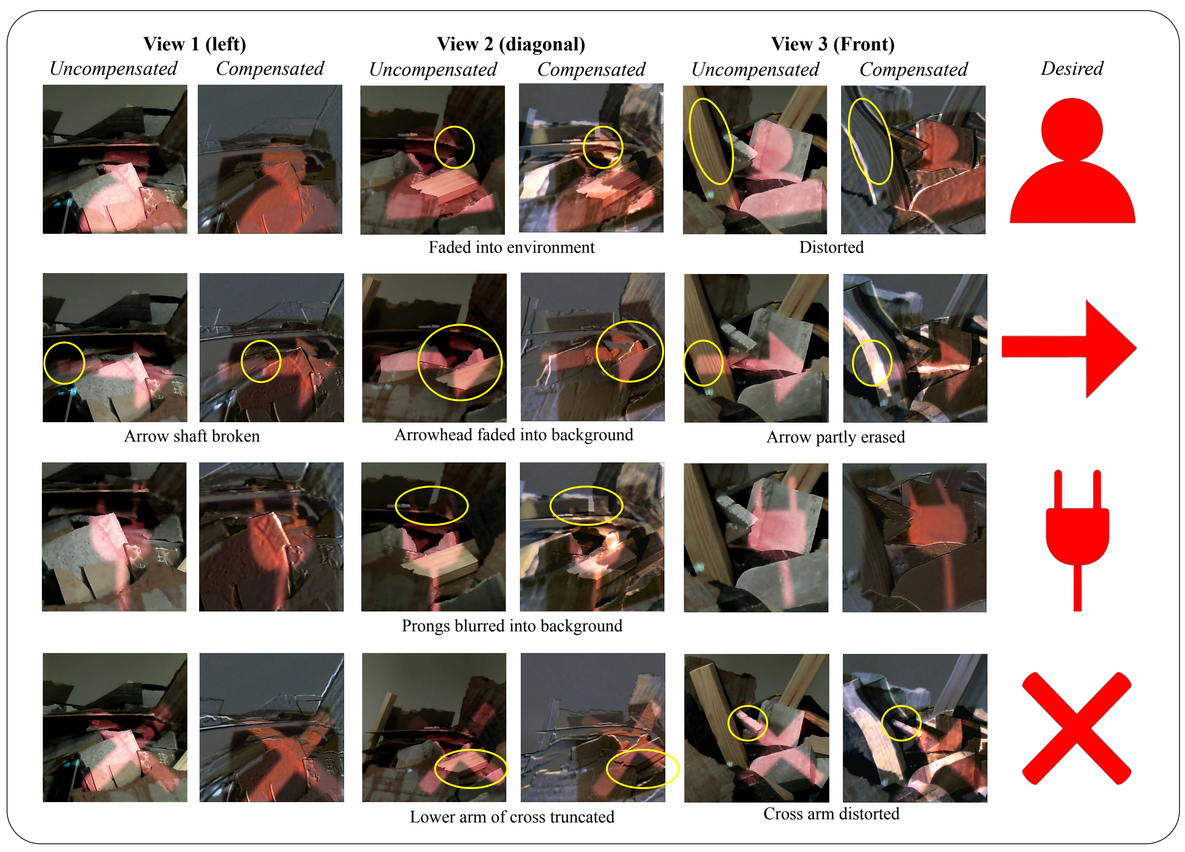
Debris surface with strong textures and irregular geometry



View from left side. View from diagonal side. View from front side.

Key Results

- Results show that compensation can improve symbol visibility at a calibrated viewpoint, but performance degrades when the robot moves to new viewpoints.
- Key limitation: Current compensation methods assume a fixed projector–camera–surface setup, which fails to generalize when the robot moves.



Takeaways & Next Steps

- Current methods degrade when the robot moves because they assume a fixed viewpoint.
- Next: Develop motion-adaptive projection compensation for mobile robots.

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Read the paper: