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Whom Do You Follow?
Pedestrian Flows Constraining the User's Navigation During Scene Exploration

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Introduction

Background
- Scene exploration in large-scale immersive virtual environments (IVEs) is non-trivial and needs to be supported
- Support options
  → *River* analogy as constrained navigation [Galyean1995]
  → Users following virtual pedestrian *flows* [Bönsch2021]
- Idea: Use *flows* as *rivers* by allowing users to leash themselves to a pedestrian and being dragged along

Research Objective
- Are constrained pedestrian flows effective for guiding users to areas of interest (AOIs)?
- How to visualize leashing to a virtual pedestrian?

Requirements
- Pedestrian flows connecting AOIs with varying walking speeds of virtual pedestrians

Leashing Cues

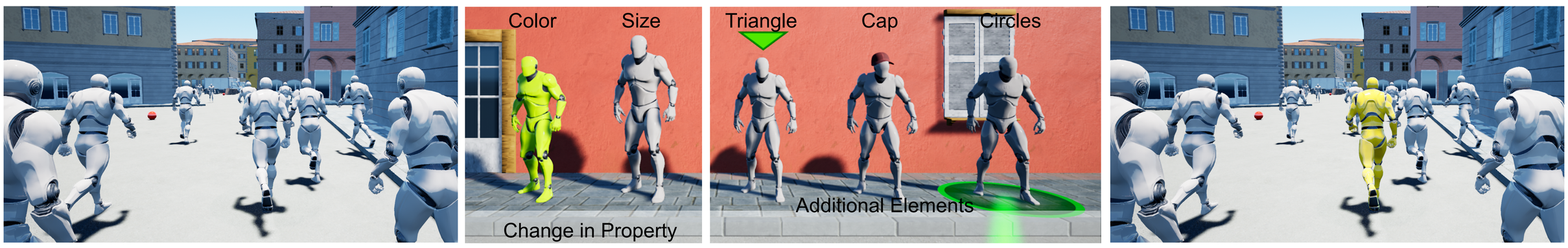


Fig. 1: Being dragged by a virtual pedestrian requires a leashing visualization highlighting this pedestrian to predict future motions.

VR-based User Study

18 Participants
- 12 males, 5 females, 1 undisclosed
- Age: M = 26.28, SD = 3.56

Part I: Evaluating Leashing Visualization
- Navigating in a flow and selecting different pedestrians of choice (POCs) via raycasting while testing all 5 leashing visualizations in a randomized order (1 min / cue)

Results Part I
- Preference ratings
  → *Color* was most, *Size* was least preferred cue
  → No clear preference for either element-cue
- Perceived identifiability
  → *Color* and *Circles* were preferred
  → *Size:* Insufficient while further enlargement may be too occluding or intimidating
  → *Triangle:* Assignment to pedestrian was ambiguous
  → *Cap*: Too hard to spot
- Impact on presence:
  → *Cap* and *Size* were rated best
  → *Circle* was rated worst

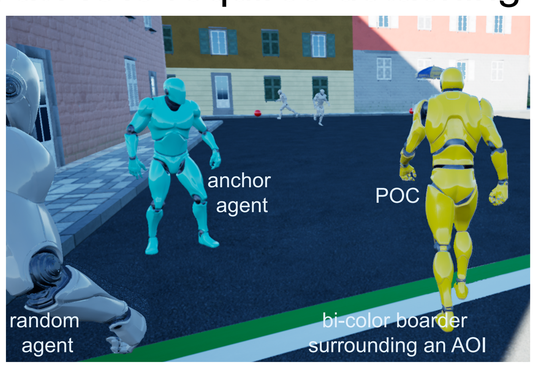
Lessons Learned Part I
- *Color* promising cue
- *Circle* and *Cap* need revision and improvement

Part II: Scene Exploration
- Exploring unknown IVE for 7 min to find all AOIs
  → with most liked element-cue
  → without constrained navigation
- Free roaming at AOIs requires detaching and re-leashing

randomized order

Extended Content

active option
- detachment via anchor agent
- re-leashing via active leashing to a POC



passive option
- detachment on being dragged over green line
- re-leashing to closest pedestrian when crossing white line

Results Part II
- Constrained navigation resulted in
  → Higher discomfort and cognitive load due to POC often being hidden within pedestrian flow
  → Lower task performance due to slower dragging speed
- Automatic detaching preferred for entering AOIs
- Manual re-leashing preferred for leaving AOIs

Lessons Learned Part II
- "*I could just rely on the pedestrians carrying me there.*"
  → Pedestrian flows were liked
  → Constrained navigation in pedestrian flows requires overcoming shortcomings of current version such as speed and occlusion issues

Literature

Galyean et al., 1995
Guided Navigation of Virtual Environments. Symp. on Interactive 3D Environments, https://doi.org/10.1145/199404.199421

Bönsch et al., 2021
Indirect User Guidance by Pedestrians in Virtual Environments. ICAT-EGVE, https://doi.org/10.2312/egve.20211336

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