Interactive Simulation WS15/16
Project Proposal

EYES - Exchange Your Vision Simulator

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1. INTRODUCTION/MOTIVATION

- Give people the opportunity to experience other perception systems than the human eye ⇒ understanding why moths are caught by light, why flies fly in your eye while bicycling, why flies fly against glass...

2. CONCEPT

- At least 2 other visual systems to choose from
- One or more tasks to solve using those available systems.
  - Find a flower or some sweets (Bee/Wasp)
  - Find something and return to the colony as fast as possible (Ant)
  - Go as far as possible in the night without dying (moth)
  - Find an exit to the room/café/drinking glass (caught by some human)/...
  - Cross the highway
- Model the visual systems as realistically as possible.
- Use oculus rift / Google Cardboard to address each eye individually → different modes:
  - Both human eyes see the same images to have a flat, monitor like view
  - For binocular systems: One-to-one mapping of the eyes For multiocular systems: Map them somehow to the two human eyes

2.1 User Experience

3. PROJECT REQUIREMENTS

The pinhole camera model used in most computer graphics software to mimic the human visual perception is a rather crude approximation to the real world. We do not recognize this most of the time, because we are used to it. In other words, our brains do a lot of preprocessing. One example is the *blind spot* where the optic nerve exits the eye. In this area there are no photoreceptor cells and thus no visual information is available. Yet, we don't notice this in everyday life since the brain merges the information of the left and the right eye and compensates this lack of information. Other effects are optical distortion or color sensitivity which is not uniform over the retina. Nevertheless, using this pinhole model yields better, actually the expected results on computer screen or a virtual reality device. Displaying the image captured by the retina of a human eye would not yield satisfying results (describe them?). Yet, the only thing we can do about other animals visual systems is reconstruct this image as closely as possible and invent a mapping of those images to our eyes which we believe comes close to the actual perception. This is especially evident when looking at species with more than two eyes.

Figure 1: Qualitative retina image captured by an apposition eye.

(a) Rendering of an environment as seen by a bee.

(b) Panorama rendering of the scene.

Figure 2: Renderings generated by InsectVision [MSZ15].

The same goes for the perceived range of the visual spectrum. If the perceived range exceeds the spectrum visible to humans, a remapping is required.

Science - Optical apparatus and movement of different species, e.g. Flies, Spiders, Wasps, Bees, Bats (sonic perception?), fish (deep sea?), birds, simple cellular organisms - Mapping

of the perceived spectra of the different species to the human perceivable spectrum (papers on this topic) - How is polarized light perceived? - Mapping of the layout of one system to the human visual system See [MSZ15]

Different eye types

- Simple eyes
  - Pit
  - Spherical lensed
  - Multiple lenses
  - Refractive cornea
  - Reflector
- Compound eyes
  - Apposition
  - Superposition
  - Parabolic superposition

Gamification - Search targets with different eyes. Different species have different ẗandardäctivities. Implement one/two/... which can be solved with any vision system. I.e. All n vision systems can be chosen in all m species specific activities, or to put it differently: Equip character with another vision system. E.g. Ant foraging: search food and return to base as fast as possible. - Possibility to create your own vision system by configuring n eyes(cameras) and attach them to the model (ant, spider, whatever) and choose a layout for the 2D-screen / oculus. This lets the user test and develop better, task specific visual systems. Of course: save/load - Species-task specific companions/enemies which need to be simulated

Complexity - In combination with the oculus rift: visual complexity in processing/perceiving the environment. - learning about the visual systems of other species - Dunno about model complexity, yet.

Aesthetics

4. TIMELINE

References

[MSZ15] Elmar Mair, Wolfgang Stürzel, and Jochen Zeil. *InsectVision*. Deutsches Zentrum für Luft- und Raumfahrt e.V. 2015. URL: `http://www.insectvision.org/flying-insects/bee-model` (visited on 10/20/2015).