Clients Driving Innovation:
Moving Ideas into Practice
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Wayfinding swarm creatures exploring the 3D virtual world

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CRC Construction Innovation
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Outline

- Introduction
- Wayfinding in Virtual Environment
- Wayfinding aid with swarm intelligence
- 2D studies
- 3D In SecondLife
- Research ahead
- Conclusion

Introduction

- Virtual environment is
  - Interactive
  - Real-time 3D
  - Multi-user platform
- Allows
  - Interaction
  - Real-time viewing of spatial information

Introduction

- Uses include
  - Simulation of design
  - Co-ordination of detail design
  - Construction scheduling
  - Platform for seamless technology integration in the construction industry
- Problem
  - Not easy to use VE
  - But easy to be lost in VE

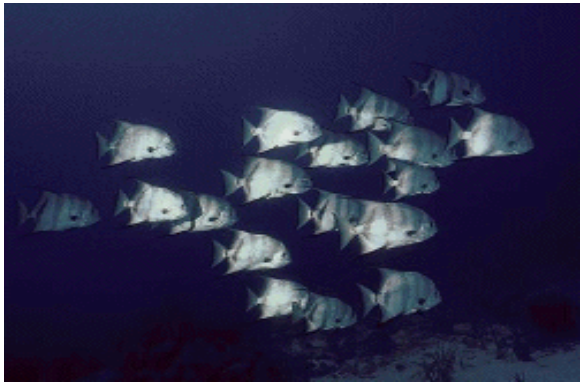
Wayfinding in Virtual Environment

- Wayfinding is
  - Often an unconscious activity
  - A cognitive process of
    - Defining a path through an environment
    - Using and acquiring spatial knowledge

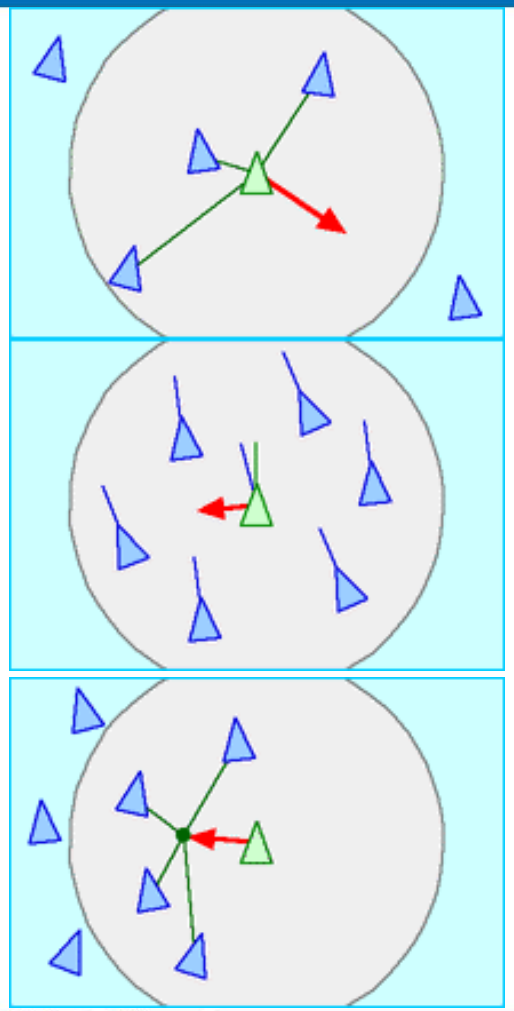
    using both natural and artificial cues
- Knowing where you are, where you want to go, and how to get there
- Challenge is to provide wayfinding aid in dynamic VE

Wayfinding aid with swarm intelligence

- Why swarm intelligence?
  - Distributed hence no central control or data source
  - No explicit model of the environment
  - Ability to change the environment

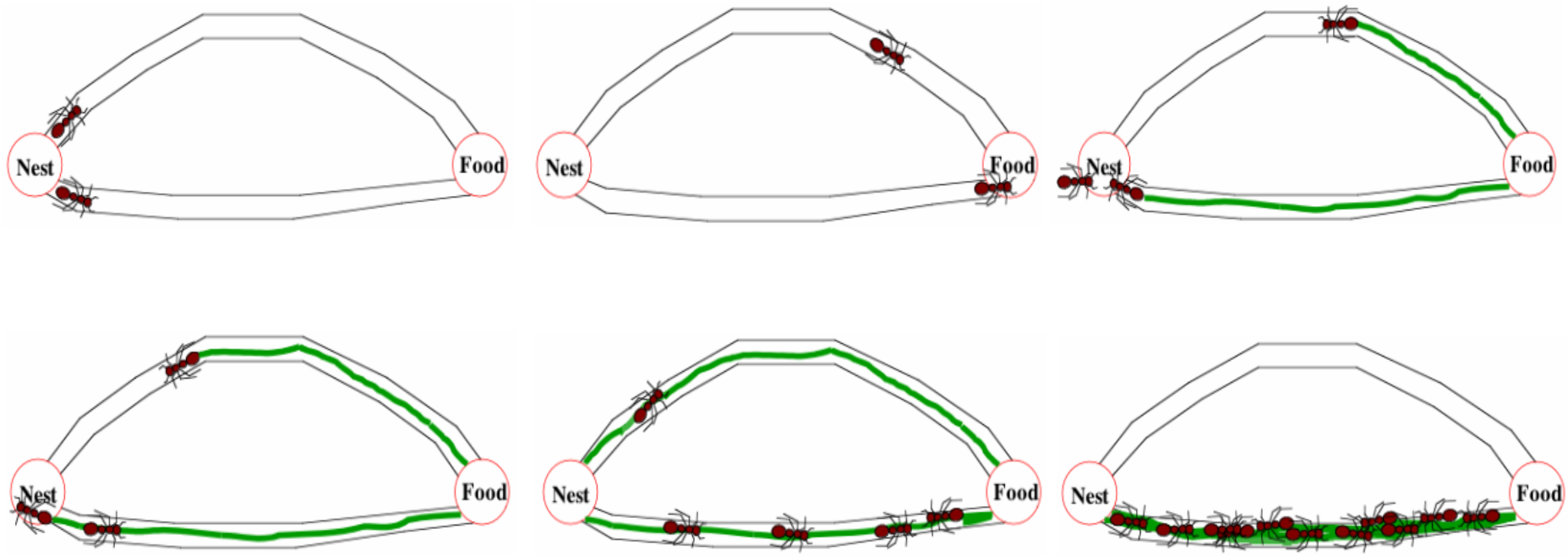


Flocking

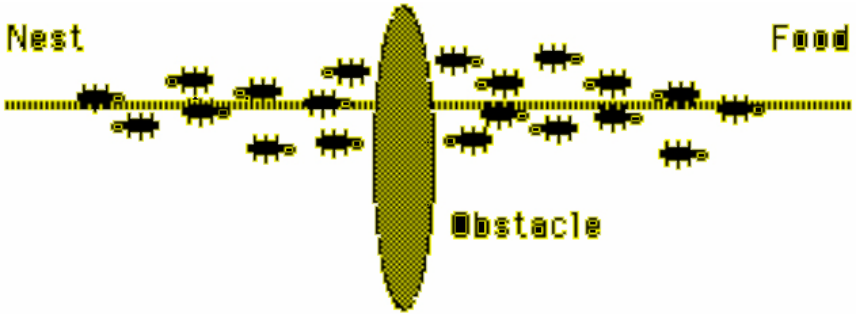


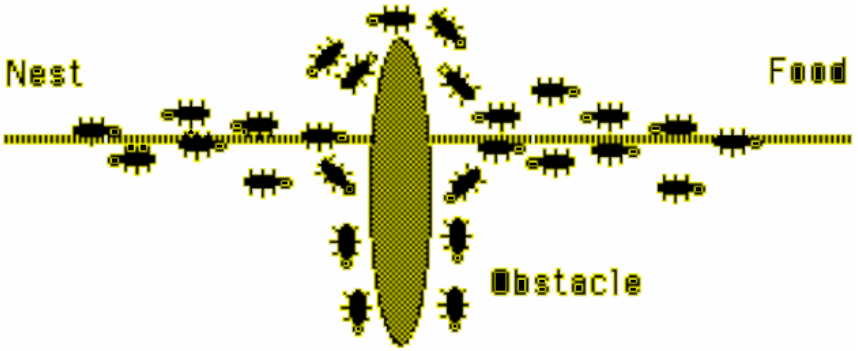
- 3 behaviours
- Separation
  - Avoid crowding local flockmates
- Alignment
  - Steer towards average direction of local flockmates
- Cohesion
  - Move towards average position of local flockmates

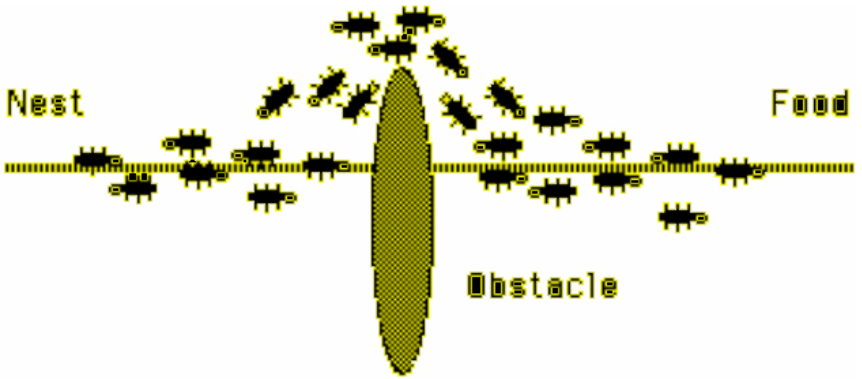
Foraging ant



Foraging ant







Foraging ant

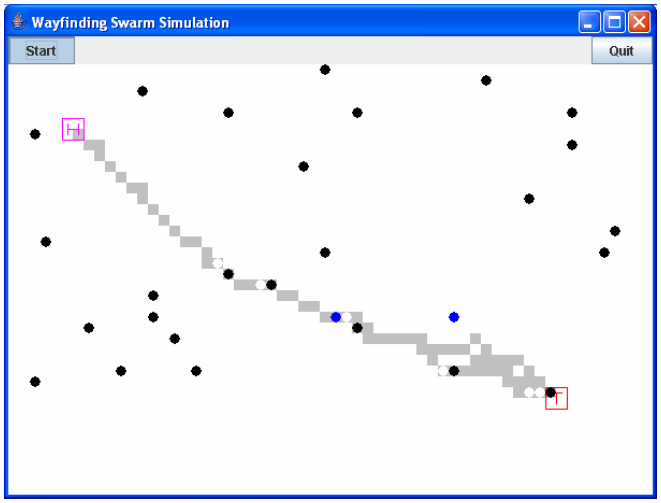
1. Looking for food
   * If pheromone trail is weak then wander
   * Else move towards increasing concentration
2. Acquiring food
   * If at food then
     a. Pick it up
     b. Turn around
     c. Start laying pheromone trail
3. Returning to nest
   * Deposit pheromone
   * Decrease amount of food available
4. Depositing food
   * If at nest then
     a. Deposit food
     b. Stop laying pheromone trail
     c. Turn around
5. Repeat forever

- Ability to coordinate trail making process without direct intervention
- Able to adapt to the changing environment without changing behaviour

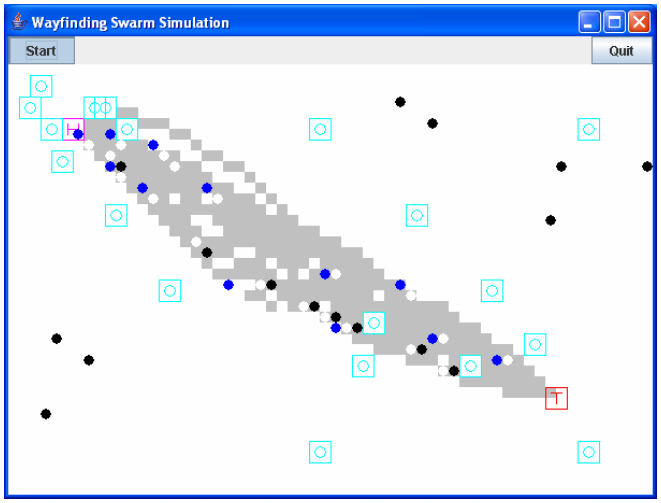
2D Simulations

- Purposes
  - Used as a case study
  - Develop sets of sensors and effectors needed
- Limitations
  - VE is 3D
  - Scaling up to 3D
  - Timing issues
  - Object creation

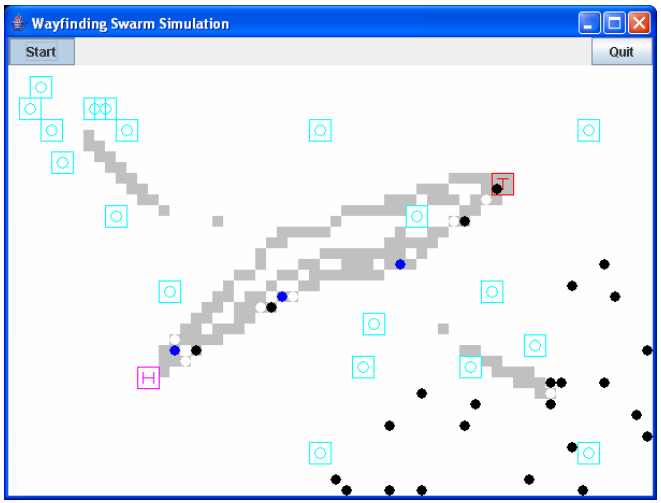
2D Simulations



- Setup 1 (left)
  - No obstacles
  - Predetermined target
  - 30+ creatures
  - Moving target and home



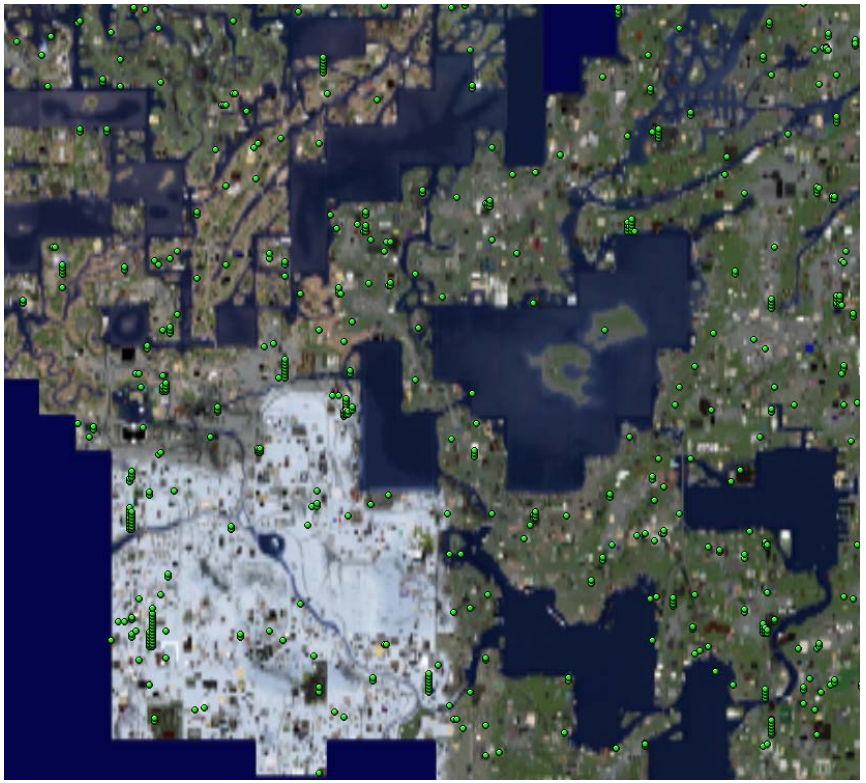
- Setup 2 (right)
  - Obstacles
  - Predetermined target
  - 30+ creatures
  - Moving target and home



3D In SecondLife

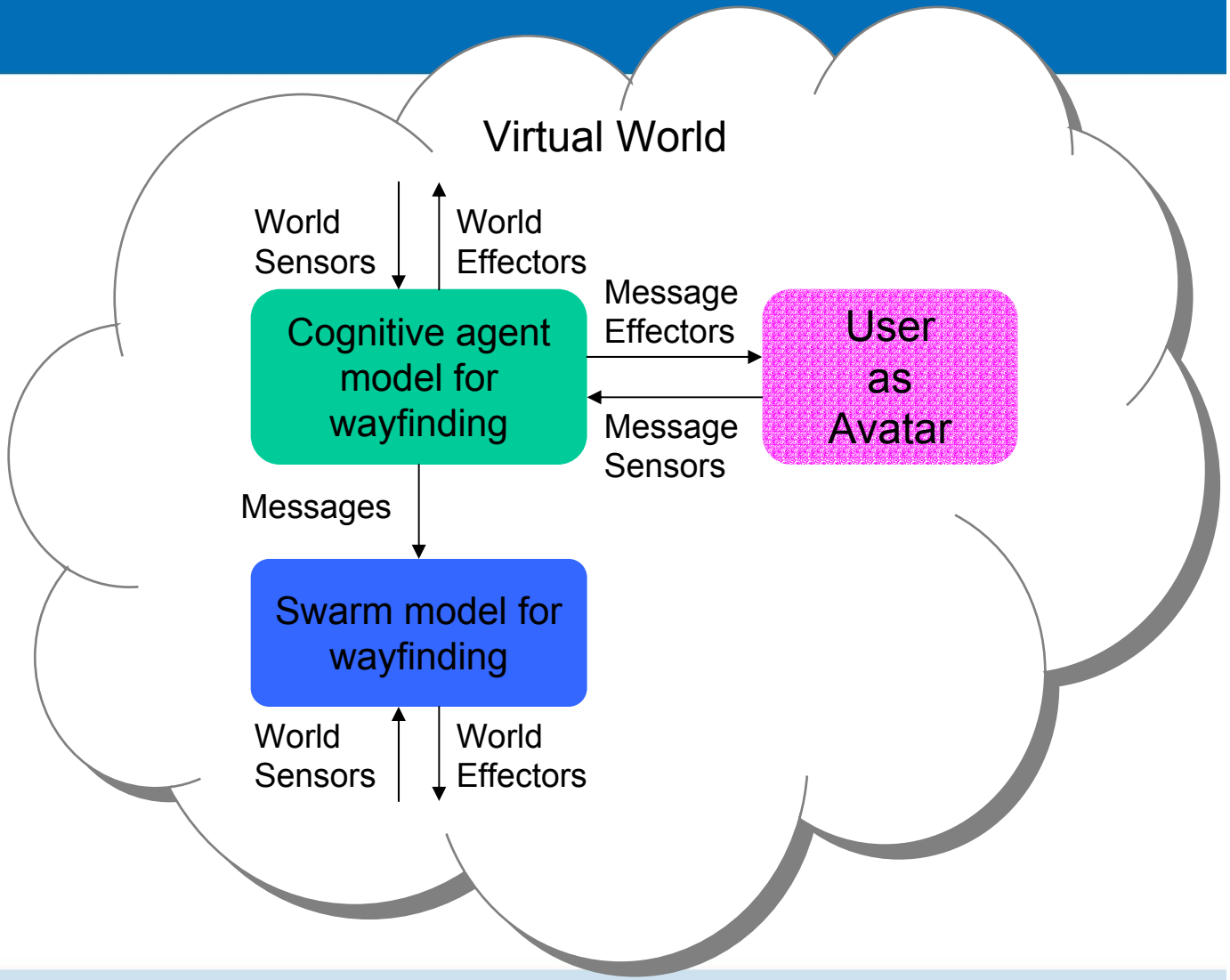
3D In SecondLife

- Issues
  - Number of creatures feasible
  - Timing
  - Limitations of sensors
  - Land rights
  - Object creation
  - Size



Research ahead

- Cognitive agent model design
- Investigate the role of pheromones for VE



Conclusion

- A wayfinding aid, based on swarm, designed to help users to wayfind in dynamic virtual worlds
  - By constructing paths
  - By constructing teleports
- Adaptable to dynamic environments
- Ease use of virtual environment related technology
- Hence facilitate adoption of VR technology to construction industry