

Using Trails To Aid Virtual Agent Navigation

1: The Problem

Holly is a virtual, intelligent, mobile agent. Her job is to explore and generate maps of previously unknown environments, identify key places within these and be able to use this information to plan routes. One option for achieving this is to watch how other users move in the environment. The movements can then be translated into the trails, and merged to give a full roadmap of the world. Trails have previously been used to help humans navigate virtual worlds and have the potential to help agents do the same.



2: Gathering Information

The virtual world we elected to use is Second Life. The servers provide several different sets of information. The world is represented as sets of geometric primitives and arranged in 255m³ cubes called regions. The location of all users in a region is freely available and updated constantly. By recording this information and interpreting it Holly can generate a list of trails created in the environment and determine how popular they are.

3: Processing

In an initial study user movement was recorded over four hours in a single region. This gave over 31,000 points where 313 avatars had been recorded. In Second Life there are three modes of transport available: walking, flying or teleporting from one point to another. At this stage we have assumed all movement is from people walking at ground level. Trails are generated by linking the points where an avatar is observed. A complication in this process is when avatars disconnect and then reappear in a different place later in the day. Using the time differences between points trails made at different times become apparent. A set of cluster points and a network of trails have both been generated from the initial information.



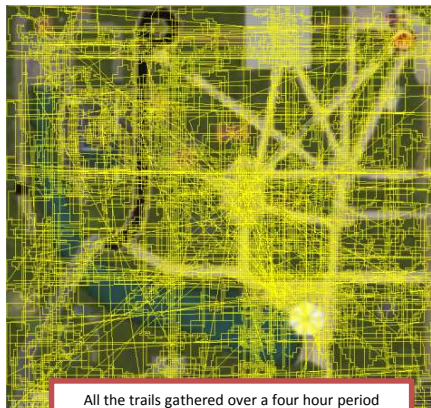
A single trail

4: Cluster Points

Cluster points are defined as a point on the map where multiple users have been recorded. The image to the left shows all the points in the environment where five or more have been. Note the emergence of two communal points and a popular trail between them. This leads from the starting point in the region to the virtual pub, where most users spend their time.



Cluster points shown where ≥5 avatars recorded



All the trails gathered over a four hour period

5: Trail Merging

Merging similar trails together to show popular routes can give a more useful and compact representation of the space. The merged trails can then be used in a similar way to roadmaps, giving the agent options for navigating from one point to another. As the cluster points are refined then these can be used to help merge the trails into single paths between two key places.

6: Further Work

Trails appear to be useful for understanding potential routes through an environment but many issues remain.

We do not currently take into account that the trails are actually being formed in three dimensions, as well as avatars being capable of teleporting from one location to another. There are also open research questions relating to the representation of information, navigation and exploration in the environment.