Modeling Virus Spreading in a Modern Environment
TJHSST Senior Research Project
Computer Systems Lab 2009-2010

Tyler Haines

Fall 2009 – Spring 2010

Abstract

This project explores the development and use of a real-time simulation to model the spread of a virus through the hallways and confined walking areas in a modern environment, such as schools and other public places. In addition, it explores the use and creation of various pathing algorithms used for real-time simulations.

Keywords: real-time simulation, virus spread, pathing algorithm

1 Introduction

In new and modern buildings built today, one will generally find the hallways to be quite large both in width and height. Comparing these buildings to older buildings, you will see the newer buildings are much wider and greater in height. One factor in the design decisions could be the spread rate of a virus from person to person as people walk through the building. The purpose of this project is to explore question of why the newer buildings have larger hallways through the development of a real-time situation to accurately model the spreading of a virus from person to person as they walk through a building.

2 Background

A virus let loose in a building can be a major problem today, especially in today's schools. In addition to the large amount of contact between children, most schools do not take into account the fact that building design can affect the spread of a disease or virus. The easiest factor to control in a design decision for a new school building is hall width. In theory, this factor can have an effect on the rate of a virus or disease spreading through a building from person to person. Making a building wider would decrease the population density per area, which one would assume to decrease the rate of the virus.

A subsection of this project is to explore pathing algorithms and AIs for real-time simulations. There are various pathing systems, each with its own advantages and disadvantages. The first system is a Potential Field AI.[1] Potential field AIs are developed for RTS games, or Real Time Strategy games, which as the name says, are real-time and need to be consistently very fast. However, they are most useful in large open areas and maps, where the terrain is generally static and non-changing. Another choice for a pathing system is to develop a system of avoidance by using "probe points" to scout ahead and beside a person.[2] A unit will also check in front of itself in a larger area for any units that may get in its way.

3 The Problem

The main language for this project will be Java. I have chosen Java over languages due to its simplicity of use and ability to easily create a graphical display for many different things. I developed a simple display showing the outline of the building, the people walking through the building, and I will have a display showing the concentration of infections.

3.1 Simulation

The main part of this project is to develop a real-time simulation where virtual people walk through the hallways of a given building layout. I have planned to create outlines of the TJ building in addition to other real buildings that I can find the floor plans of.

3.2 Pathing

After experimenting with various pathing systems for the people in the simulation, some systems have been deemed not applicable to this project and some seem possible. By itself, a potential field AI is not the best choice for a simulation of people in a building with tight areas. Potential field AIs work best in open spaces and not the tight hallways of a school or building. However, when used to get the general direction of movement and combined with another pathing system, it can be very useful. In this case of this project, I implemented the "probe point" system for pathing as the main pathing system, while the potential field will provide directional assistance.

3.3 Virus Spread

Currently, I have a very simple airborne virus with an infection chance from a person to another person dependent on the distance from the infected person to the non-infected person. I have tried to put in as many random aspects to the spread of the virus as possible, including changing the max infection distance slightly and giving a random chance to become infected.

4 Conclusion

The end result of this project will be a real-time simulation where people make human-like movements through a modern environment. As for simulation results, I expect to come up with results showing that there is a correlation between various aspects of a building and concentrations of virus infection events. I also hope that my research and creation of a simulation modeling the spread of a virus in a building could aid in the construction of new buildings to reduce the chances of getting a virus while walking through hallways. One application would be to aid in the design of the new TJ building, the hallways of which could be designed with my results in mind to help reduce the chances of getting a virus or disease during the school day.

References

[1] Johan Hagelbäck and Stefan J. Johansson. Using multi-agent potential fields in real-time strategy games. *Proc. of 7th Int. Conf. on Autonomous Agents and Multi-agent Systems*, page 12, 2008.

[2] C. W. Reynolds. Steering behaviors for autonomous characters. *Game Developers Conference 1999*, pages 763–782, 1999.