Modeling The Spread of a Virus in a Modern Building Environment

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Abstract

This project explores the development and use of a real-time simulation to simulate the spread of a virus through the hallways and confined walking areas in a modern building environment, such as schools and other enclosed public places. Various factors can effect the spread of a virus, such as hallway size and obstructions. In addition, the project explores the use and creation of various pathing algorithms used in real-time simulations.

Background and Introduction

Programming Language
This project is written Java in along with Java2D for the simulation display and control. There is also support for AIs and pathing algorithms written in Python by using Jython.

Human Pathing
Some systems have been deemed not applicable to this project and some seem possible. The possibilities for a pathing AI include:
- *Potential field*: using a “potential field” to guide a unit through the building.
- *Probe-point*: Using “probe points” to check for walls and other people ahead and to the side of the current person.
- *Physical collision*: Check for physical collisions with walls and other people.

The virus
The virus type used in this simulation is a basic 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. There is, however, a randomness to the infection of another person. Many aspects of the virus spread are controllable by the user of the simulation software, including variables such as maximum distance for infection, infection rate, and others.

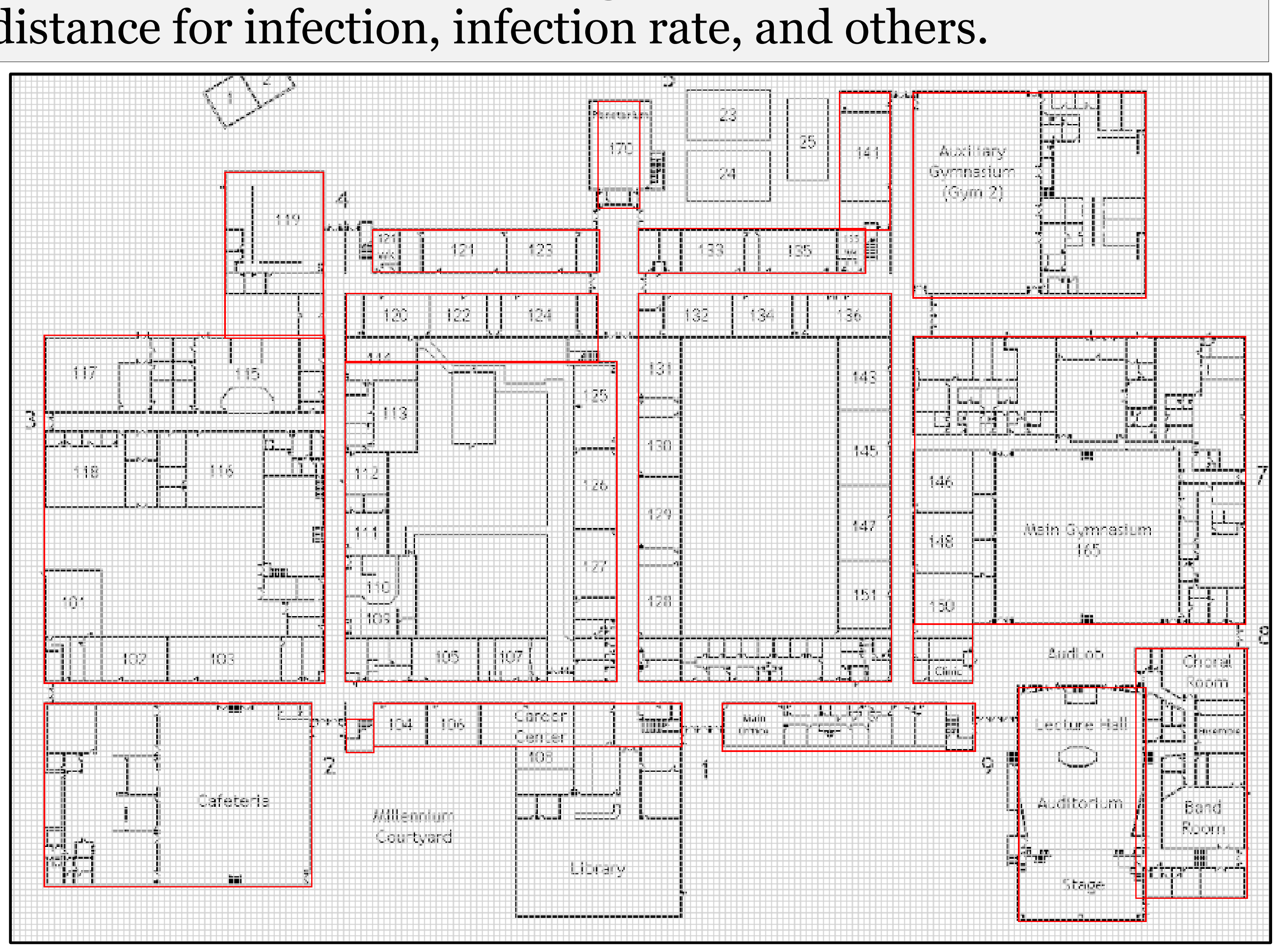

Fig. 2: A map of TJ used in testing the simulation

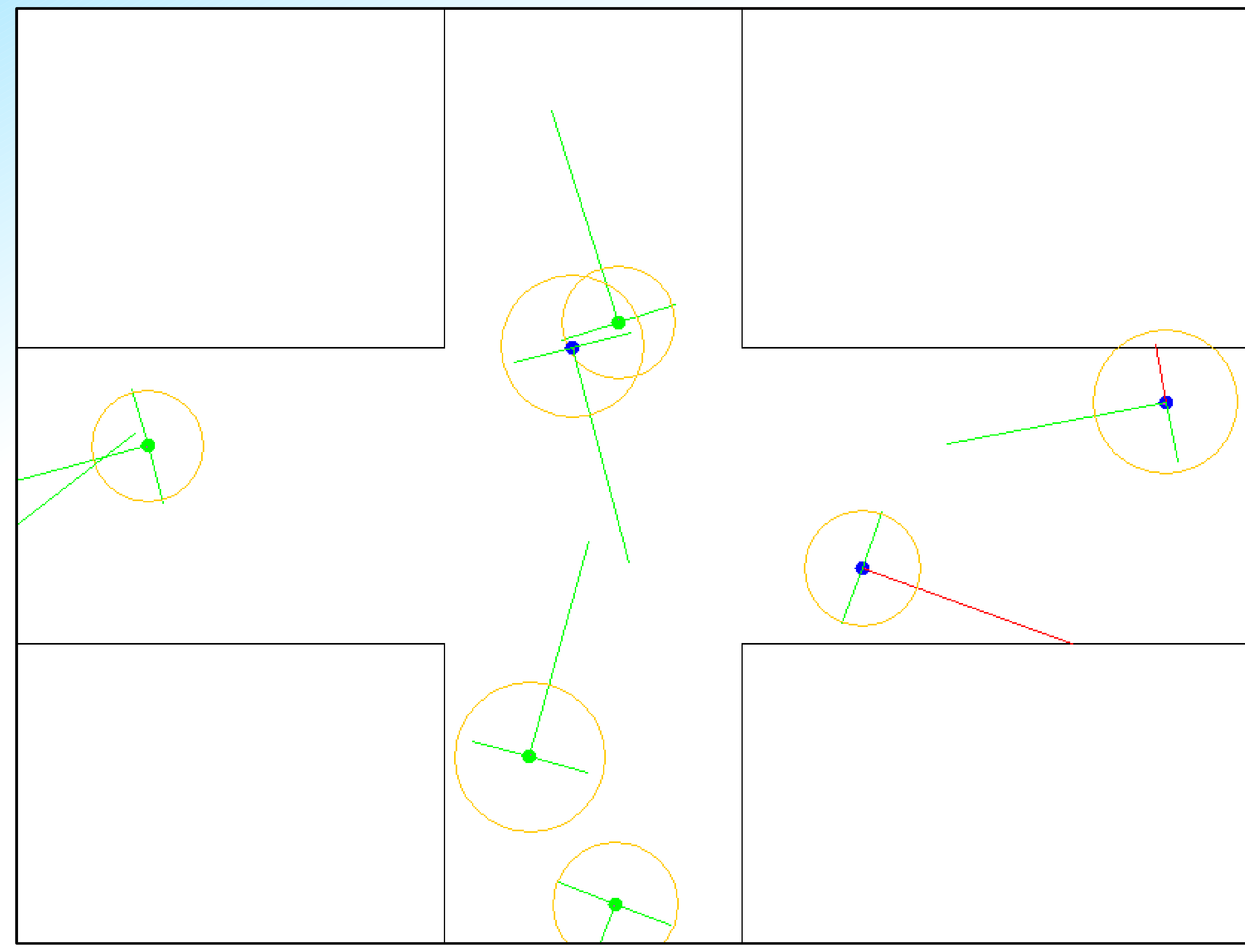

Fig. 1: The main simulation screen

Discussion

The project is a real-time simulation, where virtual people walk through the hallways in a building outline. The buildings are modeled after actual buildings such as the TJ building. As the people walk through the building, new people are randomly assigned a virus. This virus has the ability to spread to the other people in the building. The closer an uninfected person is to an infected person, the higher chance the uninfected person has of being infected by the virus. The simulation takes note of these infections and displays the concentration of infections along the hallways of the building. Some areas of the halls will have a higher concentration of infections than others.

Results and Conclusions

The results from this project show that there is indeed a correlation between various building and hallway features. Decreasing the size of a hallway will increase and adding sharp turns increase the infection rate of a virus in those areas. Adding obstructions also increase the infection rate, while creating large open areas decreases the infection rate.

For an application such as a this project, the pathing systems do not work well alone. Combinations of the systems, such as using the probe-point system for avoidance and the potential field system for direction, create an almost perfect pathing system for this type of project.