Fire Rescue

New Mexico

Supercomputing Challenge

Final Report

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Melrose High School

Team #59

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Executive Summary:

In a short over-all description, our project is a study about and a representation of fire safety and rescue as it might impact a school situation. By this we mean a situation where there are a large number of students to be rescued, and a relatively small number of rescuers from a local fire department to act as rescuers.

We recreated this type of scenario using our own local school as a model for the floor plan, and within it we have the following actions taking place:

1) Students are distributed within the rooms as they might be during a routine day at school;
2) A fire is started in a random location in one of the rooms, and begins to produce smoke;
3) The children react to the fire and avoid it, but the smoke disorients them and they panic;
4) The fire spreads based upon a flammability level associated with each patch;
5) A rescuer is provided who can enter smoke filled rooms to guide kids to safety;
   (This rescuer is equipped with thermal imaging goggles and a respirator.)
6) If any person comes into contact with the fire, they die;
7) Smoke inhalation is kept track of, and only a certain amount can be survived;
8) The simulation monitors all the data: '# students', ' # remaining', 'deaths', and 'time'.

All of these actions and algorithms are developed using NetLogo, and has resulted in a basic model of this type of situation.

The project, that our team has coded, acts as a game where the player plays as a firefighter that must save the children from the burning school. The player will start in front of a building that has a fire that will slowly spread and move around throughout the school. The player will have to decide how to move the firefighter through the school and save the children from the fire that can cause the children and your firefighter damage and death.

Research by our team found that there are VERY few school fires that cause death to students, but we decided to continue with this situation as it allowed for a larger amount of 'game play' to allow rescuers practice in determining their plans for how to deal with these kinds of life threatening situation.

We feel our project has two main things to offer: 1) A practice situation for rescuer training. This can allow them the chance to have to think through complex rescue operations; and 2) This type of model gave our team a chance to work on a situation that was easily modelled but which gave enough differing actions and events for us to learn and improve upon our computer coding skills.

Problem Statement:

Our Project is a game where you, the player, get to become a firefighter and save children from a burning school. While going through the school, the player will have to avoid the fire and rescue the children from different rooms. Be careful, if the firefighter runs into the fire to many times the game will be over, and you will have to restart. If the player succeeds with rescuing all the children from the fire the player wins the game. Aspects of the situation that the player will have to deal with and keep in mind as he or she works through the situation are:

Building floor plans with limited access points;

Various random fire locations, often simultaneously;

Smoke distribution affecting visibility and health;

Students with unpredictable behaviors and movements; and

The passing of time, which increases the chances of injury and fire spread.

The player, or computer simulation operator, will control the actions of the rescuer using keyboard commands that allow him to move in various directions. As he finds the children, he will lead them through the room, and to safety. All the while, the player's actions will be influenced by the data

being monitored by the computer as to the number of students remaining to be saved, what other rooms are on fire with endangered students, and how much time has passed.

Method Description:

We used NetLogo to create our program. This program lets us use agents to create a map of our school's elementary school building to setup the simulation. The world does not 'wrap around' the map so that the fire does not jump from one side of the screen to another. We have also given the children and the firefighter custom looks and movements. We have designed the firefighters to look like they have yellow and red firefighter suits on, while the children have blue jeans and a red shirts and books in their hands.

The movements of the students are made to follow a certain set of algorithms to make them act in the following ways: The children will be moving randomly in a room unless there is a fire. At this point they will try to avoid it. If they come into contact with smoke, they will resort to random motion with randomly generated distances moved to model their unpredictable behavior in this situation. Our research told us that some kids will want to run, while others tend to freeze in place or hide. If a student contacts a rescuer, he will hang on to him to be led to safety.

The program is coded so that the player, AKA the firefighter, starts outside of the school building and the children are in different places throughout the school constantly moving. Movement of the rescuer is controlled by keyboard commands. The only way that the firefighter and children can move from room to room is by going through a different color part of the wall which represents a door.

We coded it so that the firefighter and the children cannot run through walls, but the fire CAN and will continue to grow. This growth is affected by a given 'flammability level' which was randomly

assigned to all patches of the map. This represents buildings have some materials that allow fire to spread more quickly in certain locations.

We have also added buttons to start the game, generate the background, and to restart the game. Throughout the code, we included comments to help explain what each section does, and to help us and others in using the program more efficiently. Especially if future changes are made in it.

Validation:

We did an experiment to show the necessity for firefighters to have thermal imaging goggles to help in fire rescues. These goggles allow them to see people through smoke filled rooms. In our experiment, we had to find an object, such as a water cooler, in a room without being able to see and then in another situation where you could see. We did this experiment to help demonstrate how firefighters need equipment in a room full of smoke so they can have a clear sight of what is happening in the area around them. When acting upon this experiment it showed that it takes a significantly longer time to find an object when you can't use your sight then when you can. It also provided us with information that the longer a firefighter has to look the more time there is for the fire to spread.

Products:

While coding we used 'monitors' that showed the number of student in the building, the number of students saved, the number of student remaining, the number of fires, and the number of fatalities. We have also added a timer to keep track of the how long it takes for the player to finish and a slider to adjust how many fires you want to start out with, which changes the difficultly of the situation.

Results:

We believe that the model we did in our project is functional, and can be helpful in teaching decision making processes. It can help simulate situations that the firefighters many face when on the job. This program can also help train firefighters to make a quick decision on what way they should clear a building and to help the children stuck within the fire. It may not have all the extra details added into the program, but we believe that we have gotten it to work in the way it was supposed to be made for.

The most significant achievement and hardest programming challenge with the project was having the fire move and spread in a realistic manor and for it to create smoke. This was extremely hard to code but with a lot of time and effort we were able to have it work in a very realistic way.

Conclusion:

Overall, the program helps simulate situations that firefighters may face when going into a burning building. This program can help teach firefighter many different ways to help a person who may be inside as well as teach them how they have to make quick decisions when they are faced with a life or death situation.

Also, this was a very good type of project for us to learn computer coding and agent based modelling on. Two of our team have been first year coders and participants in this event, and having a simple and easily explainable simulation to work on helped to make it more manageable. Also, there were enough complex issues to keep it a challenge for our more experienced team member. So all in all, it worked out well for us all!

Citations:

We have gotten most of our information from the Net or with interviews from locals.

Logo dictionary, https://ccl.northwestern.edu/netlogo/docs/dictionary.html , We also used examples from the NetLogo Models Library to get more information on codes we were uncertain about,

http://modelingcommons.org/account/login , We used the example videos our teacher Mr. D put up on his Wisdom online teaching platform page during the time we weren't allowed at school due to COVID,

We also got helpful information and critiques from the judges of the February Evaluation which we were able to use to add to our program's realism and complexity.

Lastly, we asked Mr. Daugherty to help with our program when we got stuck on finding the right codes and information needed.