Visualising Building Evacuation Traces with EvacTrac

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ABSTRACT

In a given scenario, such as when a bomb goes off in a building, officials need to quickly extract important information from raw data. Raw recorded data on its own is not quickly comprehendible by humans. We have created an interactive 3D visualisation tool. This enables people to quickly answer important questions about the evacuation of a building.

1 INTRODUCTION

The project was undertaken in response to one of the 2008 VAST mini-challenges. That mini-challenge was to visualise fake data from a scenario in which a bomb goes off and the occupants evacuate the building. Occupants' movements have been recorded by tracking them with the RFID badges they wore.

Information visualisation is a method of presenting data or information in non-traditional, interactive graphical forms. VAST is the IEEE Symposium on Visual Analytics Science and Technology (IEEE VAST).

We have created a visualisation tool which enables us to answer the VAST challenge questions. Section 2 explains the implementation details of the tool. Section 3 reveals the results we got from the visualisation. We present our conclusions in section 4.

2 EVACTRAC

EvacTrac produces an animated visualisation of a given scenario. The implementation consists of a data mapper, written in Java and an X3D visualisation, as seen in Figure 1.

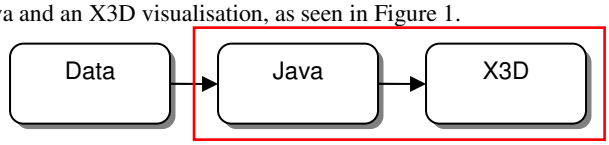

Figure 1. EvacTrac is a Java converter and X3D visualization.

The data mapper consists of two programs. One is for generating the building layout, and the other is for the animated people. These are run as console applications.

The building converter reads boolean values from a file into an array. Each '1' value corresponds to a wall piece in the X3D format. Walkable areas, represented by '0', are ignored. The people converter reads in the person information and creates objects which contain their names and associated IDs. It then reads in the path data for each person and stores it in the appropriate person objects.

The two building and people X3D output files are combined in with a third X3D file. This helped to keep the people and building parts of the visualisation separate.

The X3D files are as follows:

- evacuation.x3d
- buildingwalls.x3d
- people.x3d

The reason we chose to do the visualisation with a 3D technology, as opposed to 2D, is that the visualisation is easily scalable to include multi-story buildings. This would not be so clear to display in a 2D format. Also X3D viewers come with much built in functionality, such as navigation, that we did not have to create ourselves. For our work we have used the BS Contact VRML/X3D viewer on a computer with Windows XP.

In such a scenario as the one given, the visualisation of the scenario would be required shortly after it occurred. Potentially recorded data could be fed into the mapper, which has been configured for the building being monitored, producing a visualisation which will give immediate, comprehensible feedback to the viewer.

As seen in Figure 2, the building layout is made up of blue walls(1). We have included coordinates(2) on the floor so that specific locations can be made known. People(3) are represented as green cylinders, with their name and ID number above them.

The TimeClock animation controls(4) (Belloc, O., Cabral, M. and Suffo, M., 2007) have been included in the lower left of the screen. These controls allow the user to play, pause, rewind, and fast forward the animated scene. There is also a slider control below for sliding to any point of the animation.

When the user clicks on a person, they are highlighted with a red upside-down cone(5) above them, and their path they follow throughout the animation is also shown as a red line(6). These features help users to track individuals as desired.

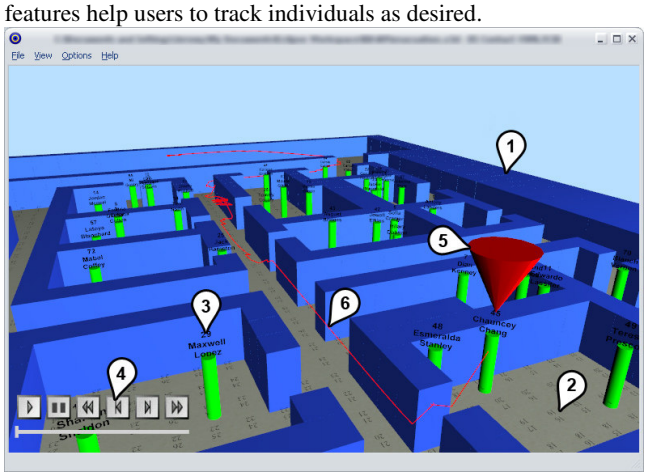

Figure 2. The EvacTrac visualization.

3 RESULTS

We now answer the questions from the Evacuation Traces mini challenge of the VAST Challenge 2008.

Where was the device set off?

To find the location the device was set of we first scrolled to the end of the animation using the slider on the animation controls. We then looked for people who had not evacuated, and weren't moving. We could tell they weren't moving by replaying the last part of the animation. We assumed that these people are casualties as a result of the device going off. This determined the general area the device was set off in.

We then scrolled back through animation to find the exact point the device went of, which was indicated by people in the entire building suddenly moving to evacuate the building. We clicked on each person who was in the 'general area' the device was set off at the start of the animation to highlight them and show their path lines. We saw that the path lines appear to move out from some origin, as if to be moved outward from a bomb blast, which we have assumed is the location the device was set off.

Playing the part of the animation where the device is set off also helps determine its location because the people closest to the device do not all move at the same time, therefore we concluded that the device was closer to the person who was moved first.

The fact there was a wall in the area also helped our decision making. The two people on one side of the wall managed to evacuate successfully, but the people in the room on the other side became casualties. We therefore concluded that the device was set off in the room with the casualties.

The identification of potential suspects or witnesses to the event.

We again used the highlighting, path lines and animation to see how each person in the group of rooms surrounding the location the device was set off has moved around. The people the area may be within hearing distance of any sounds or conversation related to the device, or may be the culprit(s) themselves.

We found that person 21 (Ramon Katalanow) exhibits particularly unusual behaviour, as his path lines are much straighter than the other paths. This person also comes close to the location the device was set off, and leaves the room again before it goes off.

The identification of any suspects or witnesses who may have escaped.

Witnesses and/or suspects who managed to escape the building were identified by reducing the set of people who were suspects and/or witnesses to those who were out of the building at the end of the animation.

Describe the evacuation and identify any casualties.

The evacuation scenario occurs in the single-story Department of Health Building, Miami, Florida. It consists of 81 people and their movements over a series of 837 steps of animation. Their movements have been recorded by a RFID tracking system, with each person wearing a RFID badge.

At the start of the animation we see that most people are showing little movement, likely seated in their offices. In the middle of the animation, everyone suddenly starts moving. At the end of the animation, everyone has evacuated down the hallways towards the nearest exits. This excludes a group of people on the east side of the building who appear to be casualties.

Possible casualties can be identified by people who are not moving for long durations of a scenario, particularly during and after the evacuation.

4 CONCLUSION

We have built the EvacTrac tool to visualize the evacuation scenario, and we were successfully able to answer the VAST Challenge 2008 questions using it. We intend on further developing the tool and doing user testing to see how usable the tool really is.

REFERENCES

[1] Belloc, O., Cabral, M., and Zuffo, M. 2007. TimeClock: flexible animation control in X3D. In Proceedings of the 3D Web Technology. Web3D '07. 105-108.

[2] Burtzman, D., Daly, L. 2007. X3D: Extensible 3D Graphics for Web Authors.