ALFIL: A Crowd Simulation Serious Game for Massive Evacuation Training and Awareness

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ABSTRACT
This article presents the current development of a serious game for the simulation of massive evacuations. The purpose of this project is to promote self-protection through awareness of the procedures and different possible scenarios during the evacuation of a massive event. Sophisticated behaviors require massive computational power and it has been necessary to implement several distributed programming techniques to simulate crowds of thousands of people. Even with the current state of computer hardware, the costs of building and operating this hardware is still prohibitive; so, it’s preferred to apply distributed programming techniques running on specialized parallel computing hardware.

Keywords: Behavior Modeling, Crowd Simulation, Distributed Systems, Emergency Response, Serious Games

INTRODUCTION
Serious games are played with a computer using specific rules and with a purpose beyond that of entertainment as its main function, but that uses entertainment as a means to advance domain-specific objectives, be it education, awareness, training, marketing, etc. in what Zyda (2005) called collateral learning. The dynamic environment of games provides an engaging and motivating experience that invites the user to learn and train on their own.

Much has been achieved in crowd simulation since the seminal works of Reynolds (1987), where artificial birds -or boids- demonstrated the concept of complex flocking behaviours by aggregation of individual perceptions and actions and we are using this well known-technique to provide realism for the serious game.

The importance of emotions for agent believability and realism has been long recognized. Bates (1994) proposed emotion in agents as a
way of showing intentionality, perception of their environment and interactivity.

We present the development of a serious game for simulating massive evacuations, with the purpose of promoting awareness and serving as training tool for first responders.

The problem description section presents the need and justification for this research.

The approach section describes the artificial brain developed for the crowd simulation software, along with the personality factors applied to enhance realism and the distributed system architecture that incorporates high-performance computing.

The instructional design section describes the application of pedagogic techniques for the development and evaluation of the serious game’s instructional content.

The contribution section states the desired impact of the project, mainly in the form of promoting self-protection awareness in the general population.

The conclusion and future work section presents our closing thoughts for this phase of the project and our expectations for the future of the system, planned to start live test on late 2012.

Finally, we recognize the participation of several public and private entities that have contributed to this project with their knowledge, technology or financial support.

PROBLEM DESCRIPTION

In the last decade, social-organizational phenomena such as human stampedes, panic attacks and, in general, lack of self-protection awareness have greatly become a threat in Mexico as shown in various news sources such as BBC News (“Deadly stampede at Mexico disco,” 2008; “Mexico football match abandoned,” 2011), Caballeri (2011), El Informador (“Pánico en el Corona,” 2011), etc.

We understand this as a threat given that in some situations the general population has failed to apply adequate self-protection measures, especially during evacuations. Even if Mexican law (2006) contemplates self-protection awareness and training for the general population, no effort is wasted in promoting awareness, specifically for massive events where thousands of people congregate in the same venue.

We have decided to create a serious game where such events can be realistically simulated and studied, with the main purpose of promoting self-protection awareness in the general population, and a secondary purpose of serving as a planning and training tool for first responders and massive event organizers.

We have divided this problem into several smaller parts, namely:

- Creation of an artificial brain to represent each person in the event.
- Modeling of individual behaviours, including specific personality factors for each actor.
- Replication of individuals into crowds, where emergent behaviours, such as the proposed by Musse and Thalmann (2000) and flock behaviours, as per Reynolds (1987), will provide realism.
- Creation of 3D models of the real venues where massive events will be held.
- Creation of realistic humanoid models to enhance immersion.
- Generation of a virtual environment where people can interact during the simulations, providing for collaborative learning.
- Distributing the processing requirements of the simulation, so that the burden of processing is taken by the High Performance Computing (HPC) platform.

APPROACH

For the purpose of analyzing this problem, we start with the construction of an artificial brain that effectively describes the behaviour of normalized nondescript, as opposed to specific individuals, during an emergency evacuation in a serious game. We have decided to classify our virtual actors as trained professionals -such
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