Multi-agent based Crowd Model to Simulate Emergency Situations

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Declaration

I declare that this dissertation does not incorporate, without acknowledgment, any material previously submitted for a Degree or a Diploma in any University and to the best of my knowledge and belief, it does not contain any material previously published or written by another person or myself except where due reference is made in the text. I also hereby give consent for my dissertation, if accepted, to be made available for photocopying and for interlibrary loans, and for the title and summary to be made available to outside organization.

B.W.S. Perera

Name of Student

Signature of Student

Date:

Supervised by

Prof. Asoka S. Karunananda

Name of Supervisor(s)

Signature of Supervisor(s)

Date:

Dedication

To my parents . . .

With love and gratitude

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Abstract

Crowd simulation is listed under many practical applications in computer industry; such as safety modelling, pre-planning building architectures, urban modeling and entertainment software. Most of these current simulations are created by extending deterministic models such as particle systems, cellular automata and fluid motion. However, extending a crowd simulation model to support an emergency situation still remains as a key challenge. The reason lies behind the difficulty of simulating the unpredictable nature of crowd behaviour during panic; since a computer algorithm approaches a solution by parameterizing predictability within a problem.

It is evident from literature that multi-agent technology has proven success in modeling complex systems interacting among many entities that are distributed and operated under lot of uncertainty. Therefore it is postulated that multi-agent systems technology can model the uncertainty of a scenario such as crowd behaviour raised during a panic situation.

The proposed solution provides an agent-based framework to simulate crowd behaviour during an emergency situation. By considering evacuation of a crowd from a building during fire as a sample input scenario; each individual is modeled as an agent associated with a local ontology. The local ontology of an agent is a collection of simple rules, representing the knowledge known to each individual; prior to occuring the emergency. The knowledge embedded within these rules is exchanged (i.e. shared) among individuals as they communicate with each other during the emergency. As a result unpredictable global behaviour patterns emerge within the crowd; which is similar to observations of a real crowd facing a real emergency situation. Output of the system is a visualization of crowd behaviour during the emergency along with statistics recorded per each simulation session, indicating evacuation related information for each individual. The solution is evaluated by implementing a prototype and comparing the statistics recorded from the prototype with statistics recorded from real world crowd behaviour during panic. Hence it is concluded that a multi-agent based knowledge sharing approach is well suited for modeling a crowd in panic.

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