

# Crowd Evacuation Behaviour Modeling and Simulation in 3D Platform

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**Abstract:** Crowd simulation is an active research domain and is crucial for simulating crowd behaviour in certain condition such as normal or panic situation. The simulation is to show the interaction between the individual in a crowd. Nowadays, there are many kinds of scenarios as well as simulation softwares that can be adapted to simulate a crowd simulation such as during emergency situation e.g. building evacuation. Crowd simulation in three-dimensional platform is fairly important in order to have a more realistic looks and movement of the crowd in one particular environment. The evacuation simulation is useful for the crowd in one confinement to seek for a safe exit path in shortest time possible and thus increase the occupant's safety. The evacuation time is said to be in safe condition if all the evacuees successfully can get through the exit in minimal time. To aid in minimal exit time, the concept of faster-is-slower (bottleneck) must be solved as it can lead to more waiting time or delay during evacuation process. In this paper, it will discuss about the crowd simulation behavior, crowd simulation based on agent-based model, existing crowd simulation tools and the result of simulating the three-dimensional (3D) crowd evacuation time based on a number of exits variation in panic situation. The tools used to carry out the experiment is Anylogic software whereby the results show that it adheres to shorter evacuation time when the number of exit increases. The 3D layout design was following the original layout the faculty's lower ground floor where the classrooms are mostly resided. The simulation is useful in order to estimate of evacuation time with different total number of exits to alleviate the faster-is-slower effect in case of any emergency situation happens at the faculty building.

**Keywords:** Crowd simulation modeling, crowd evacuation, 3D crowd simulation, realistic movement, agent-based

## I. INTRODUCTION

Human behaviour is a very complex phenomenon as there are many types of human behaviour especially in critical situation. For example, uncontrolled emotion will lead to angry, panic and stress that can affect the individual behaviour during emergency. Therefore, it is necessary to have a crowd simulation to simulate the dangerous situation and to ensure human can safely egress in real situation.

Dibble et.al [1] and Thorp et.al. [2] mentioned in their work that discuss by utilizing the third dimension to

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visualize and communicating between agent in agent-based model is to use advanced computer hardware, software and networked communication. The three-dimensional (3D) platform is seldom ventured into academic agent-based models. The simulation in the three-dimensional (3D) agent-based models is useful in order to simulate various aspects of life.

## II. LITERATURE REVIEW

To simulate a large number of entities that involved the entity's movement, simulation of crowd is considered as an important process [3]. By simulating these crowds, it can show the human interaction during the evacuation process. Thus, it will be able to replicate and produce the collective behaviour. The simulation of a crowd can enable a replication and reproduce the collective agent's behavior.

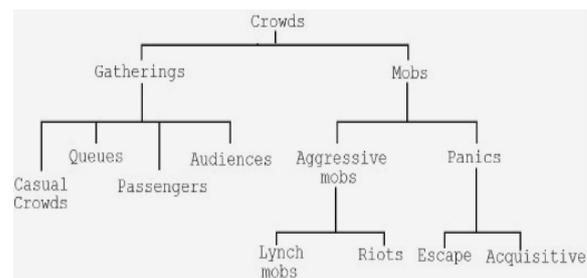


Fig. 1. Classification of crowds [4].

### A. Behaviour of Crowd in Normal and Panic Situation

According to Foudil and Djedi [5], the simulation of crowds is consisting of two main groups which is the both situations can be shown in the Figure 2.

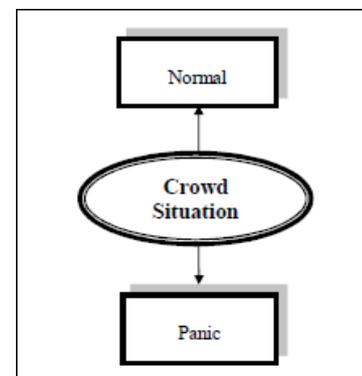


Fig. 2. Types of crowd situation.

Figure 2 shows that there are two classification in