A simulation model for Crowd Evacuation of Fire Emergency Scenario

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Abstract— Human safety is an important issue when handling the crowd evacuation in order to avoid death and injuries. Human behavior changes from normal to panic behavior when they are in an emergency scenario such as building on fire. Modelling panic behavior on evacuee is a critical challenge as the human movement is unpredictable. Simulation (example: Discrete Event Simulation and Agent-Based Simulation) is a well-known method to investigate crowd evacuation. But the question here is: Which simulation method is suitable to model a realistic representation of crowd evacuation? Thus, in this paper, a simulation model based on Agent-Based Simulation (ABS) and Social Force Simulation (SFS) Model is proposed to improve on modelling fire evacuation in a closed space (building). To achieve the above research aim, three simulation models (ABS Model, SFS Model and a hybrid of ABS and SFS model) will be developed and compared. This paper will discuss on the development of conceptual model of these three simulation models. Later, the conceptual models will be used to represent the investigated simulation models

Keywords—crowd evacuation; simulation model; social force model; agent-based model; hybrid model; simulation optimization; conceptual model

I. INTRODUCTION

The research of simulation model has been widely conducted in entertainment, crowd planning and management, traffic flow, architectural design and other similar applications for several decades ago [1-4]. From the literature review, many parties like industries, researchers and academicians studied about the human behavior. [5]. Normally, a simulation model is look like the real system of the phenomenon or scenario[6]. It is usually with the basic rules and general principles. A simulation model is an instrument to represent the real system. It is also as a support tool for prediction and decision making [7].

Moreover the simulation model use for examining the space and flow of traffic during both normal and emergency crowd circumstances [5]. These simulation models can acquire the more understanding in a present framework through the testing situation based on the particular simulation tools. The challenge in this topic is the difficulty of modeling the crowd evacuation due to diversity of human behavior[8]. In addition, to modeling the human behavior as realistic as possible is crucial for a good design [9]. Other than that, the non-linear human interactions in panic scenario are under extreme conditions[10]. The crowd condition getting rise because of the capturing the collective, emergence and randomize individual behavior [11].

The goal of this work is to have an improved and effective simulation model which is mimicking the panic scenario as real life case study[12]. Despite the aim of this research is divided into two elements as follows. A hybrid technique is combinatorial of two or more techniques which provide a greater advantage and to carry out the improved simulation model for crowd evacuation [13] [14] [15]. The second goal is to focus on the safety element which is to minimize the human exposure risk as an important component of the crowd evacuation [16].

The proposed model for simulating the crowd evacuation is using Social Force Model (SFM), Agent-based Simulation (ABS) and hybrid of SFM & ABS. These models are capable to dealing with human behavior for emergency scenario which is in building on fire [8, 17, 18]. On the other hand, the significance of the safety crowd evacuation simulation model is for the accurate prediction of any modification, plan and changes[19]. In order to have a safety crowd evacuation, some elements should be considered in this work. This may affecting the evacuation plan for the emergency cases happen as stated by [20].

The main contribution in this paper is the theoretical and conceptual model. Other than that, the work leads to


