

Review on Crowd Simulation : Psychological Effect of Flood Victims

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Abstract— Crowd simulation can be used to simulate emergency scenarios without the use of live human. This will allow crowd simulation to run multiple simulations under a variety of conditions which will save time and lower costs in planning, development, and testing of new situations or training. Since last year, East Coast areas in Malaysia have a crisis of flooding disaster caused by heavy rain. Hence, this paper discusses the review of crowd simulation for disaster recovery, in particular flood. It also discusses the psychological effects on the victim. The crowd evacuation simulation is conducted by the multi-agent system, because many factors will be influenced on the crowd simulation during flood. In addition, the psychological effects of flood victims would be considered to be incorporated into the simulation.

Index Terms— crowd simulation, crowd evacuation, crowd behavior, flood victim, psychological effect, PTSD

1 INTRODUCTION

CROWD simulation can be used to simulate emergency scenarios without the use of live human. This will allow crowd simulation to run multiple simulations under a variety of conditions which will save time and lower costs in planning, development, and testing of new situations or training. The application can also be adapted and expanded to other industries. The multi - agent system has been used for simulating the impact of individual human factors on crowd evacuations. Behavior for crowd simulation has also been researched in the context of agent-based modeling. Researchers have developed computational models for modeling and simulating human emotional behavior. AvatarSim has been developed which is an intelligent agent-based system that simulates human behavior during emergency situations [15]. Virtual Environments provide a good means of simulating real and imaginary world behaviors and places. Human behavior is very difficult to model and simulate in evacuation scenarios as there is uncertainty involved. Meanwhile, Kim, Guy, Manocha and Lin have introduced a method based on psychological theory of Generalized Adaptation Syndrome (GAS) to simulate the dynamic behavior of the crowd where they used linearization model of GAS in accordance to the theories involved [7]. The aim

of this study is to develop the crowd simulating changes in the human behavior during stressful events, so we decided to review on the psychological effects on flood victims to get the information about how the psychological and mental health of flood victims changes after a disaster.

The natural disaster is a situation where mainly caused by hazards like flood, earthquakes and tsunamis. They cause massive damage both to human beings and the other materials. At the end of the year 2014, Malaysia had been surprised by the major wrecked by the annual floods hitting the East Coast, where the most effect area is Kelantan, Terengganu and Pahang [1]. According to Bernama and Portal Bencana as reported total victims as at 26 December 2014 is 103,850 victims and Kelantan had the highest number of evacuees [21]. There are many effects after the flood such as tens of thousands of victims had to be evacuated from their homes to save their life, with many more incurring substantial losses. This affected their psychological and mental health without their known. Their psychological effect directly presumed that the victims might experience Post Traumatic Stress Disorder, which happened after the flood disaster. This paper is to review the crowd simulation of the dynamic behavior of flood victims and integrated with psychological effects on flood victims in the crowd simulation.

2 LITERATURE REVIEW

Crowd simulation is an invaluable tool for modeling emergency evacuations because it is cost effective, saves time, and ensures that no lives are put at risk. Crowd simulation makes it relatively easy to test a multitude of scenarios with a variety of environmental conditions. Crowd simulation can be used to observe the influence different behaviors such as calm, panic, and cooperation has on evacuation models. The aftermath caused by a natural disaster leads to psychological distress and where the victims feeling emotional signs such as anxiety,

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depression, and pain, as well as behavioral effects such as sleep and appetite changes. All these effects can be mild and transitory or can lead to Post Traumatic Stress Disorder (PTSD).

The crowd simulation has attracted much attention in recent years due to its remarkable applications in the entertainment industry, urban engineering, architecture, training, education and virtual heritage. There are many applications of computer animation and simulation is necessary to model virtual crowds of autonomous agents. Some of those applications include education, entertainment, training for the military and police and human factors analysis for building evacuation or other scenarios where masses of people gather such as sport events and concerts [8],[11]. Crowd simulation also refers to simulation of group dynamics and crowd psychology where the focused on the behavior of crowd not the visualism of the simulation [8]. Many researchers have focused on human behavior on the crowd simulation where they are varying the stressful situation for the model which can develop crowd controlling strategies under these situations. Disaster training with the realistic element of simulated disaster can be used in this principle of human behavior crowd simulation [10].

By using crowd simulation, the observation of human during panic or non-panic situation can be tested. There are disaster events such as hurricane Katrina, 9/11, and Tsunami where the humanity, social capability during disaster events are truly put to the test. In the military program and fire rescues also looking towards the simulated training which involving the emergency response where they can learn from virtual reality and transferred into the real world. Therefore, many developers of training simulator and game environments are beginning to envision a new era where psychosocio-physiological models could be integrated to enhance their environments simulation of human agents [19].

2.1 Psychological Effects on Flood Victims

Flood is one of the disaster that always happens end of the year in Malaysia for every year and it brings a lot effects in human lives. The flood aftermath always focuses on physical effect only, besides psychological effects of natural disaster also important needed much attention [12]. There are many researchers have shown that there were relationship between psychological effects and the disaster. Among different of people who were directly involved with the disaster such as the victims as well as those involved in rescuing them [12],[13] but the focused are more to the victims. Sandro Galea, Arijit Nandi, and David Vlahovin stated that at the beginning terms that were used to describe the psychological symptoms after traumatic events are nervous shock, shell shock, traumatic neurosis and rape-related fear and anxiety [3].

The psychological and physiological effects will be experienced by those who are dealing with stress. There are many types of research proved that the flood victims also experience Post-traumatic Stress Disorder (PTSD) [4]. For example, over the past few years there have been a

number of publications that have focused on the prevalence of PTSD in victim affected by severe flooding [14],[17],[18]. A study by Bhamani, where the flood disaster in America Midwest happened and the researcher been conducting interview with the adults from a flood victim by Tobin and Ollenburger had shown the 71% of them had PTSD symptoms after 3 months of extensive flooding [2]. On the other hand, Huang et al. carried out a survey amongst individuals affected by floods in China, 2 years after the event and found 9.2% of the subjects to be 'probable PTSD-positive' [5]. PTSD is a severe anxiety disorder that can develop after the exposure to any event that can result in psychological trauma such as extreme shock fear or [20].

2.1.1 Depression, Anxiety and Stress

There were evidences to show that apart from the direct trauma effects of hurt and pain, victims also experienced physical problems [9]. Fear, anxiety, sensitivity and anger are some of the common reactions of the victims. A study by Tapsell in 2001 prove that the effects on psychological health which included stress, anxiety, fainting, panic attacks, and depression due to the natural disaster on Easter Flood in UK 1998 [11]. The level of stress and anxiety of the flood victims will increase during the changes of the weather and more drastically increase during flooding. Thus the symptoms of depression, sadness, hopelessness, feeling overwhelmed with emotion will show due the failure and the inability to control the situation and lack of emotional and physical strength to handle the situation. The flood victims would develop the anxieties, depression and uncertainties because they find it difficult to focus their attention on the other things and always had the thinking about the whether their lives and the flood would ever be happening again [9]. Victims are regularly plagued by flooding that has happened before. This gives rise to stress and anxiety among flood victims. Residents expressed concern and pressure on natural events over a long period of heavy rain. As a consequence, their daily lives are always in a state of alert. Hence, they are worried of repeated flooding [6].

2.3 Triggered Events That Influence Flood Victim Cognition, Emotion And Behaviour

Every time during the heavy rain season in Malaysia, some flood victims started to worry. This is due to their experience from the past, where that heavy rain has resulted in flood which bring damage to their life, such as destroyed crops and livestock, damage to property, loss of a financial equity and also resulted in the loss of life of family members. So, they always alert with the rain in their daily life. Therefore, they are worried increased when thinking about the repeated of flooding [6]. From the observation of the past flood victims, they always in a state of fear and showing nervousness, especially with sudden rain and even during the raining season [25]. Trauma is related to stress, which causes the victim's perception towards reality and look at themselves changes. It is because the trauma and stress events make their perception towards rain or other events differently. The trauma will never disappear unless the stress that causes

trauma disappear [24]. Major disasters such as flood, earthquakes, landslides and tsunami have been shown to have a negative impact on the psychological and mental health of victims [23]. There is a relation psychological effect that affected and the flood victims in Malaysia after the disaster and their changes in cognition, emotion and behavior due to the flood events [22]. Figure 1 refers the connection between the flood victims and their psychological effects.

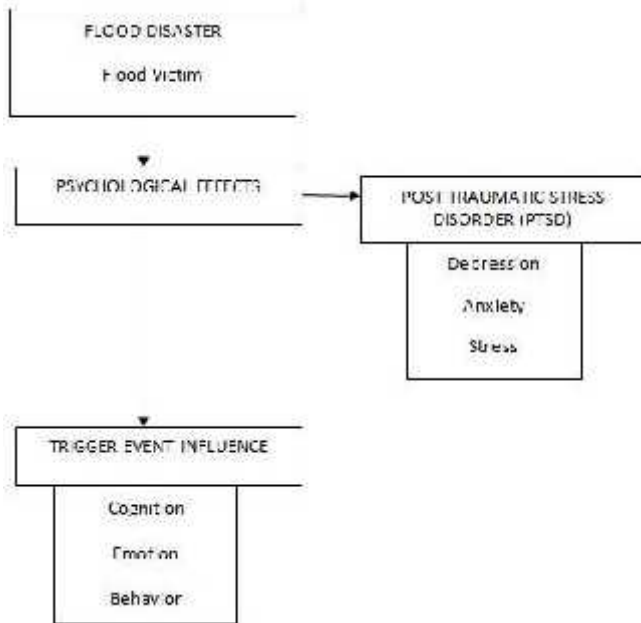


Fig. 1. Attributes of Flood Victims

According to Nasir et al, there is relation cognitive functioning or thinking, various behaviors and emotions felt by the victims when they would look at themselves, others and the event which caused trauma in a very different perspective. For example, in their cognition thinking always think the negative effect such as "Is it going to flood again? When they heard the thunder or see raining outside their house or they are going to think how to escape from flood again and how about their life is it going to okay or they are going to suffer from loss again. Thinking like this going to lead to their emotional changes, whereas they always feel the fear, anxious, sad, hopeless, depress and stress. The victims also showed their behaviour changes during this time where there are always looking alert around their surroundings, always look at the river, always look for the sound of thunder or rain, could not sleep, always worried, and cry. There is a direct link between the emotions, cognitions and behaviour of the victims [9].

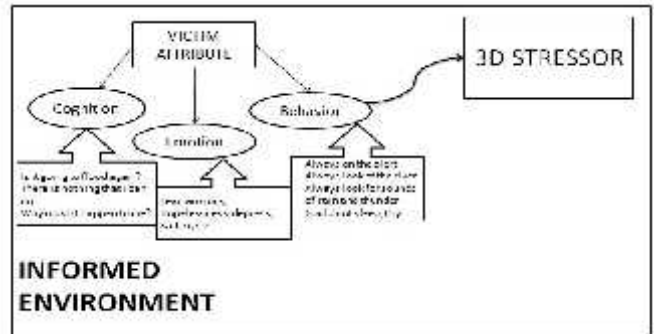


Fig. 2. Conceptual Model of Crowd Simulation during Flood Based in Psychological Effect

In 3D Stressor, the environment of flood event is the simulated object, which can implement in a virtual agent model which have the cognition, emotion and behavior attributes of the flood victims. The result of this crowd simulation to find out how the virtual agent response under stress event were used a flood as the environment (see Figure 2) as a conception model of crowd simulation during flood based on psychological effects.

3 RESULT AND DISCUSSION

In recent years, many researchers have studied in dynamic crowd simulation and agent-based model technologies. There is various simulation techniques have been developed and using virtual environment representations in order to create a dynamic crowd simulation. Most researchers such as Kim, Guy Monacha, Lin and Sharbini and Bade are focusing on how to stimulate the crowd simulation where the panic behavior or stressful are involved. There are studies of crowd simulation for Emergency Aircraft Evacuation, crowd refuge simulation from tsunami disaster, crowd simulation in emergency in the Shopping Mall and so on however, there is lacking on crowd simulation for flood victims inclusive of psychological effects. There are researchers that study on stress such as Kim, Guy, Mohacha, Lin and Sharbini using a psychological theory of Generalized Adaptation Syndrome (GAS) to simulate the dynamic behavior of the crowd and Kishi, Kitahara, and Kubo uses Dijkstra's algorithm to apply in refuges simulation for tsunami disaster have the similarities in the human behavior of the crowd simulation for flood victims evacuation that the author's attempt to do.

4 CONCLUSION

There are reviewed to relate the crowd simulation and the flood victims. In order to explain crowd simulation behavior during flood events, their attributes have been studied I the psychological effects on flood victims. There are researchers have studied the flood victims cognition, emotion and behavior during and after the event. Mostly, they experienced Post-traumatic Stress Disorder (PTSD) where PTSD, the severe anxiety disorder that can develop after the exposure to any event that can result in psychological trauma such as extreme fear or shock. It explains how the flood victims psychological and mental

health effects of the flood disaster. This study attempted to create the crowd simulation that involves victim psychological effects which would help in combating stress among volunteers of flood evacuation center.

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