TEMPORARY HOUSING DESIGN AND PLANNING SOFTWARE FOR DISASTER RELIEF DECISION SUPPORT SYSTEM

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Abstract. There is a continuous and urgent need for disaster relief in Thailand and countries suffering from floods and tsunami impact. Based on this issue, design and planning software for temporary housing project has been developed, as well as the process and guideline for implementation. This paper describes a unique coupling of interactive 3D virtual environment with parametric designing in order to manage disaster relief project more efficiently. Architects and planners can use the functionality of software on both design simulation and project evaluation aspects. We need to provide correct information to help people making decision when they are in disaster. So the disaster relief decision support system must offer proper information of crisis management focused on people, place, and process. One of the main features of software is the relationship modeling of essential factors such as number of people, houses, budget, time, and space. This automatic temporary houses generation and space planning is simulated for land use and layout plan design with cost estimation analysis. The system components were proposed to a new disaster relief system in alternative approach. Using community-based development will not cost budget but required people participation. Our software's space coordination will start and centered from available space in school or temple with sufficient infrastructure. After essential factors are inputted, appropriated number of temporary houses, public facilities, and management guideline will be generated to support further planning decision. Our core system was developed on Java and Swing Technology, empowered by real-time 3D rendering CAD engine. In addition, "Virtools" as our Authoring Tools was applied to improve design interaction and explore rapid software prototyping. At the end, we discuss the comparison between real situations in Thailand and appropriate design standardization, which should be reconsidered how to manage crisis with the limitation of time and budget from government.

1. Introduction

Every year, natural disasters and other emergencies result in great amount of budget from government and donations. A significant proportion of this humanitarian aid is intended to cover temporary housing requirements for disaster-affected populations, ensuring protection and safety from elements and other dangers.

While relief should reach the victims of disasters in emergencies as swiftly as possible, it is essential that the aid provided is adequate and useful. Very often in case of Thailand, the response to temporary housing can not reach to people, and take too much time in disaster relief planning and construction.

Because of the complexities of heirachical organization in Thai Society, there are some difficulties in communication and cooperation in disaster time. To make more efficiency in the emergency management, we tried to develop special CAD software which should be useful on both information management and decision support system aspects.

2. Background

Although a large number of studies have been made on Disaster Relief & Response or Temporary Housing Design, this paper concerned in different aspect about how to integrate technology to manage disaster more efficiency.

To understand the importance and background of this study, we tried to review related literatures with giving analysis how we adopt or diffentent from past research. Over a considerable number of studies in the past decades, we will classified related research papers into three main groups.

2.1. COLLABORATIVE EMERGENCY MANAGEMENT

Disasters are on the increase, especially in underdeveloped countries. They argue that a new approach to disaster is needed, one which emphasizes the continuing man-environment relationship. Within this approach, many emergency response agencies were established by government.

Eventhough a number of disaster response centers were established in both Central Government and Local Government (Basolo, 2006), the relief still can not be well managed in emergency time.

2.2. DEVELOPMENT OF MODELING AND SIMULATION TOOLS

An important set of technologies – modeling, simulation and visualization – offers the opportunity of effectively improving emergency response through applications that can be used at the planning stage and in real-time after an incident. (Jane, 2003)

2.3. COMMUNITY-BASED DISASTER RESPONSE

Because of insufficient aid from central government, in some cases local government has to make their own people manage disaster by themselves. In this time, community-based disaster response (Weir, 2006) will be one of good solutions which is preferred methodology characterized by a highly-participatory process that engages local resouces and seeks to build up local decision-making and multi-sectoral participation. The study of community-based disaster response in this paper will be considered in the point from emergency management aspect.

3. Problem Analysis

We are confronted by two difficulties. The first is about disaster relief and emergency management. The second is there are not enough information and database system supported for decision making. And the question which we

must consider next is how to construct temporary housing as soon as possible.

3.1. INSUFFICIENT COMMUNICTION WITH LOCAL GOVERNMENT

Based on our observation on emergency management from disaster response centers, we will discuss the problem of the decision making which involved in directing relief operations after a disaster. Mass emergencies involve the contribution and interaction of several to many emergency management disciplines and local government to central government, resulting in distributed communications that require rapid adaptation to the numerous problems of the emergency. Several large organizations have different goals and cultures cause insufficient communication working in emergency time.

3.2. HOW TO MANAGE SITUATION & PEOPLE IN DISASTER

We would like to lay special emphasis on how to manage people in disaster situation as emergency management. (Schaafstal, 2001) The nature of mass emergencies requires emergency management teams to conduct decision making in stressful situations involving information overload and a significant level of uncertainty. Such situations often call for non-routine, complex problem solving. A lack of distributed team training makes it difficult to build up a good expertise. Emergency management requires good coordination and communication not just within, but also among the various organizations. Coordination among multiple, complex teams in emergency management should, therefore, be a key focus for team training.

3.3. HOW TO RELIEF HOUSING PROBLEMS AFTER DISASTER

The problems of mass-homelessness created by disaster will be tackled by the government in two phases, respectively involving resettlement of the survivors in temporary prefabricated homes and reconstruction of permanent housing. But without enough information for decisions, temporary housing planning and construction will be extended from disaster relief system.

4. Requirement Analysis

4.1. COLLABORATIVE PLANNING SYSTEM FOR GOVERNMENT

System shoud break hierachical work flow to collaborative planning from various points of view, and numbers of emergency management related factors have to be considered and we can represent this collaborative planning system for both local and central government diagrammatically as follows:

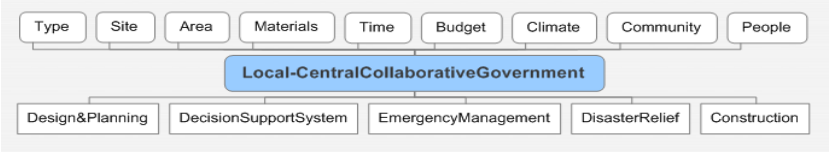

Figure 1. Factors related to local and central collaborative government.

4.2. MODELING AND SIMULATION FOR EMERGENCY RESPONSE

Modeling and simulation tools can be useful in planning and decision making in emergency management. A number of modeling and simulation tools have been developed and more are being developed for emergency response applications. The simulation tools addressing different aspects of an emergency situation need to be integrated to provide the whole picture to planners, trainers, and responders. Current technological developments allow us to envision a system approach that includes modeling of all major aspects of the disaster event, its impact on population and resources and the response by involved agencies.

4.3. DECISION SUPPORT SYSTEM FOR TEMPORARY HOUSING PLANNING

The temporary housing design and planning application will include tools for determination of appropriated construction area, and the tools for aiding development of site planning and zoning analysis.

5. System Design

In each system will suffice to show the main usages and benifits of our dedicated system design.

5.1. NEW USER INTERFACE SYSTEM FOR NON-CAD USERS

It is important to consider about how to develop powerful features, but we must not forget that the target user of this software development is non-CAD users. So, in this software requirement analysis, we would like to lay special emphasis on user friendly system into our Graphical User Interface Design.

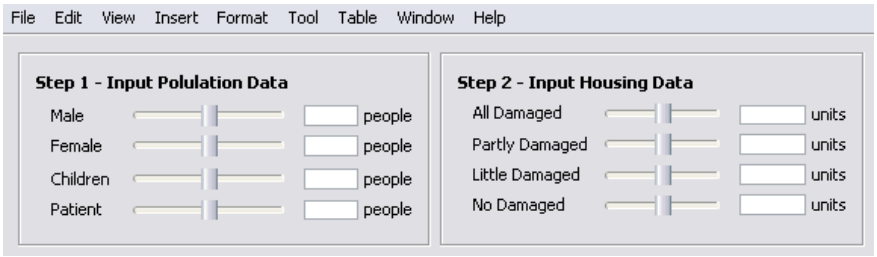

Figure 2. Steps and slider-bars were applied for easy usages and simplified interface.

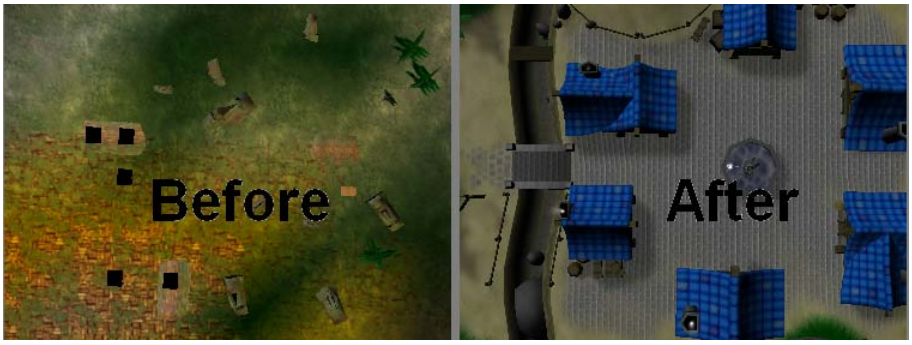

Figure 3. Two of real-time 3D rendering screen show before-after comparative planning.

5.2. ARCHITECTURAL DESIGN STANDARD INTEGRATED SYSTEM

To raise the reliability of system, architectural design standard was applied to design and planning features to maximize practical usages.

5.3. PUBLIC PARTICIPATION WITH MILITARY AGENCY

From our observations, the special workgroups from military agency will be the first team reached to emergency situations. So, military model was applied (Sariego, 2006) in disaster, but here we limited about how to develop public participation from local people to military agency.

5.4. INTERACTIVE COST ESTIMATION CAD

In order to help decision makers can determine an appropriated number of temporary housing units. We integrated real-time cost estimation feature to our CAD engine which construction materials can be added and modified.

6. Software Development

6.1. INTEGRATE 3D GAME ENGINE TO JAVA-BASED CAD SYSTEM

3D Game Engine is integrated to Java and Swing software development.

Figure 4. Virtools Authoring Application for 3D Game Engine.

7. Conclusion & Future Works

This paper tried to show that information management is one of the important factors in disaster relief situation. So far, we have seen how to develop our 3D game engine integrated CAD software. The important addition to be made to what we have said about system design is how to concern with community-based disaster relief planning. It is not to be denied that participation from local people is the key factor of disaster relief system.

For the present, it may be useful to look more closely at some of the more important features of temporary housing design and planning. We come now to the point at which it is necessary to deal more carefully with decision support system both in cost estimation and space planning aspects, and the next step is to integrate and implement all features to real situations. We have only limited information on data from simplified observations. System we mentioned here is only the software framework and has to be more considered about the practical usages and further software implementation in aspects of emergency management, emergency response, disaster relief, temporary housing design and planning, and decision support system.

References

Basolo, V. Steinberg, L. and Gant, S.: 2006, E-government and the preparation of citizens for disasters, *Proceedings of International Conference on Digital Government Research*, ACM, California

Brady, T. F.: 2003, Capability analysis of critical incident response, *Proceedings of Winter Simulation Conference*, ACM, Louisiana

Jain, S. and McLean, C.: 2003, a framework for modeling and simulation for emergency response, *Proceedings of Winter Simulation Conference*, ACM, Louisiana

Kyng, M. Neilsen, E. T. and Kristensen, M.: 2006, Challenges in designing interactive systems for emergency response, *Proceedings of Symposium on Designing Interactive Systems*, ACM, Pennsylvania

Loper, M. L. and Presnell, B.: 2005, Modeling an emergency operations center with agents, *Proceedings of Winter Simulation Conference*, ACM, Florida

Pollak, E. et al.: 2004, Operational analysis framework for emergency operations center preparedness training, *Proceedings of Winter Simulation Conference*, ACM, Washington

Sariego, J.: 2006, CCATT: A Military Model for Civilian Disaster Management, *Journal on Disaster Management & Response*, Elsevier

Schaafstal, A. M. Johnston, J. H. and Oser, R. L.: 2001, Training teams for emergency management, *Journal on Computers in Human Behavior*, Elsevier

Turoff, M.: 2002, Past and future emergency response information systems, *Communications of the ACM*, ACM, New York

Weir, S. and Kessler, E.: 2006, Community-based Disaster Response: Only one Component of an Effective Shelter Framework, *World Urban Forum III*, IHC, Vancouver.