Secom Science and Technology Foundation
Research Grant Report - Executive Summary
FY2007 to FY2009

Title: Proposal and Implementation of Synergetic Interfaces
For Broad Area Natural Disasters

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(Summary)

The Great Hanshin Earthquake revealed many problems on broad area natural disasters. Although many researchers have been working on the problems, insufficient countermeasures were still seen in the JCO accident in Tokaimura and in the Great Niigata-Chuetsu Earthquake. We can say that the problems are not still solved at the current moment. In this research, we focus on the following three functions for broad area natural disasters: (i) the prompt support of situation recognition, (ii) the appropriate support to the suitable stations, and (iii) the support of flexible actions. We define specifications of these functions concretely and develop core technologies. We call the framework integrating these functions as "synergetic interfaces" and aim to establish the detailed implementation methodology.

For the prompt support of situation recognition, the most important thing for broad area natural disasters is that the operators in the disaster-prevention center grasp what is happening in the real-world as soon as possible and determine the action to take using the limited resources. In this research, we focus on information filtering and visualization interface to support operators to recognize the situation. In information filtering, the system selects important information for grasping the situation from a lot of information which occurred in the event of the disaster and after the event. In visualization interface, the system shows the selected information in the manner that will allow operators to grasp the situation intuitively. We implemented a prototype system of the above functions and conducted a user experiment to see the effectiveness of the functions. We expect that our developed functions will realize the adequate support of operators to grasp the situation in the real world.

Regarding the second subject "the appropriate support to suitable stations", we have developed a support method for the volunteer coordination (VC) in broad area natural disasters since the activities self-organized by rescue volunteers get important after the initial rescue activities for lifesaving. The assignment of volunteers to victim's needs has been done by experts called volunteer coordinators so far. However, the work was not always good enough because of the unbalance or mismatch between volunteers and victim's needs. In this research, we have designed and implemented a system which consists of 3 parts: visualization of status of human resources, evaluation of compatibility between volunteers and victim's needs and a support of the volunteer coordination based on VC evaluation criteria. Communication between volunteers was easily implemented since we employed a SNS (Social Networking Service) as a platform of the system. We also carried out user testing for the evaluation of our system. And we confirmed that our system effectively worked.

In case of broad area natural disasters, it is frequently observed that the situation changes very quickly, and the decision determined at some moment has to be changed at the next moment. Here we focus on the third function, "the support of flexible actions" in broad area natural disasters. To realize the support of flexible actions, we proposed and implemented two functions; one is to provide "Semi-fixed terminals with camera and Visible Light Path Laser Projector" to enhance remote collaboration, and another is to provide "By-pass information channel through the Internet as

communication HUB". The semi-fixed terminals have the capability of information acquisition in disaster-field and direct instruction to disaster-field-workers. It is expected that, smooth remote collaboration between decision-makers in disaster prevention center and disaster-field-workers is realized by the function. On the other hand, By-pass information channel is expected to speed up decision making by compensating communications-bottle-neck derived from the lack of man power in the middle layer of the hierarchy. We evaluated both functions by experiments, and it is confirmed that the system worked effectively.

The "synergetic interface" framework is proposed to realize coordination among the above three proposed functions, "the prompt support of situation recognition," "the appropriate support to suitable stations" and "the support of flexible actions". The SRK (Skill, Rule and Knowledge) model is introduced as a basic model for the integration. Human behavior in disaster is classified into three types of behavior in the model. Skill-based behavior is defined as unconscious and routine one, rule-based behavior is defined as one based on manuals and rules, and knowledge-based behavior as one based on trial-and-error problem solving. A prototype system is designed, is implemented on the PC, and is evaluated by the local government. Furthermore the hierarchical multi-agent architecture is proposed as system architecture, .in which each support function is implemented as a software agent. The architecture is also evaluated through computer simulation, and its effectiveness is confirmed by applying the architecture to the Kyoto City case.

(Research Organization)

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