Evacuation Guide System based on Massively Multiagent System

(Demo Paper)

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ABSTRACT

Using ubiquitous devices such as multifunctional cellular phones and PDAs, we can build a large-scale navigation system for evacuation in the metropolis. Although current navigation systems simply broadcast the same instructions over a large area, the required function is to provide individualized instructions to each user. Our approach is to build a navigation system based on multiagent system which assigns one guide agent to each user. In the system, a guide agent can provide personalized navigation instructions depending on its owner's surrounding circumstances. We implemented Mega-Navigation system using massively multiagent platform, called Caribbean/Q. Our Mega-Navigation system, which is currently able to work for evacuation in the city of Kyoto, can catch evacuees' position and offer instructions through GPS-capable cellular phone.

Categories and Subject Descriptors

I.2.11 [**Artificial Intelligence**]: Distributed Artificial Intelligence—*Intelligent agents, Multiagent systems*

General Terms

Design

Keywords

Massively multiagent system, Personal navigation, Evacuation guide

1. INTRODUCTION

The spread of rich mobile terminals like cellular phones and PDAs with Global Positioning System (GPS) is realizing a ubiquitous environment for city dwellers. In this environment, we can build a mega-scale navigation system by using a mobile terminal as a sensor to follow human's behaviors. Evacuation guide in the city is one example [1]. Although current navigation systems simply broadcast the same instructions over a large area, the required function is to provide individualized instructions to each user. Our approach is to build a navigation system based on multiagent system which assigns one guide agent to each user. In the system, the human commander gives rough instructions to guide agents. A guide agent can create individualized navigation instructions depending on each owner's surrounding circumstance.

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2. MEGA-SCALE EVACUATION GUIDE SYSTEM

2.1 System Overview

We implemented a mega-scale evacuation guide system. Figure 1 shows the overview of the system. In this system, guide agents, each of which is assigned to an evacuee in disaster areas, get locations of evacuees from their GPS-capable cellular phones. A commander gets aggregated information, then points out evacuation destinations, which are typically shelters, and the direction for evacuation through the control interface shown in the extreme right of the figure. The commander gives rough instructions to guide agents. Each guide agent provides individualized navigation instructions, *i.e.*, evacuation route. An evacuee gets instructions on his/her cellular phones.

2.2 Massively Multiagent System

We implemented the mega-scale navigation system using a massively multiagent platform which was built in the previous research [2]. To build the platform, we connected the scenario description language Q to a large-scale agent sever Caribbean. Figure 2 shows an overview of the platform (hereafter, Caribbean/Q). In this system, we implement agent internal models and protocol interpreter as event driven objects and let the agent server manage both of them. The interaction protocol interpreter first sends request messages for sensing/actions to an appropriate agent internal model and receives resultant messages from the agent internal model. Next, the interaction protocol interpreter loads the next state from the syntax tree created by translating the interaction protocol.

Our proposing architecture removes the communication bottleneck between an agent internal model and interaction protocol. Furthermore, we achieve separation of protocol design and agent development. Using this environment, experts of the intended domain (*e.g.*, traffic or protection against disasters) will design the agent interaction protocols while computer experts will develop the agent system.

Caribbean/Q limits the number of agents on the memory and controls the consumption of the memory, by swapping

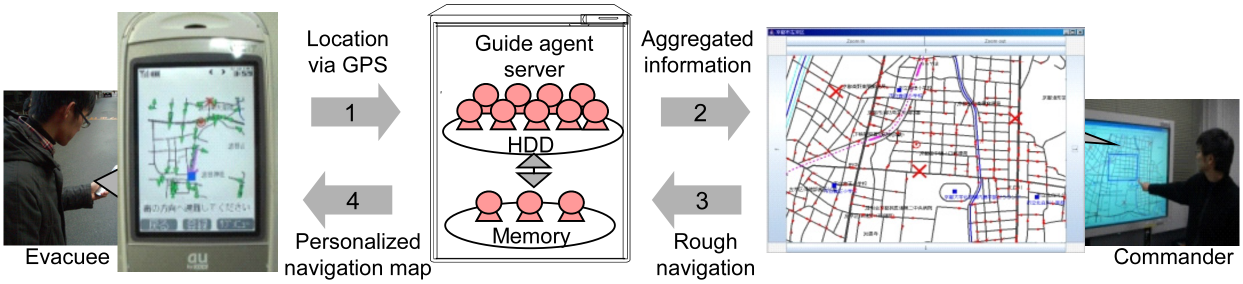

Figure 1: Overview of Evacuation Guide System

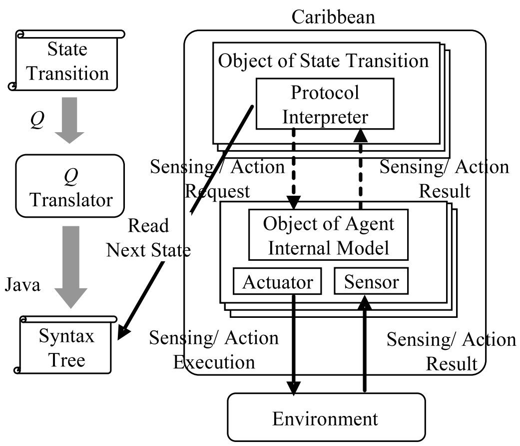

Figure 2: Overview of Caribbean/Q

objects between the memory and the auxiliary store. When a user accesses the system, Caribbean/Q loads the corresponding guide agent on the memory. When the number of agents on memory exceeds a limit, Caribbean moves agents that are not processing to the auxiliary store.

This evacuation system can handle 800 requests per second on Xeon 3.06GHz dual processors and 4GB memory PC. This is sufficient performance smoothly run the evacuation system.

2.3 Control Interface to Guide Agent

The control interface to guide agents enables transcendent communication, which is a method for navigation based on transcendent viewpoint [3]. On the control interface, the distribution of evacuees in the real space can be reproduced on the virtual space as human figures that mirror the positions of evacuees; the positions of the subjects are acquired by cellular phones. The current state of the disaster area is displayed in a birds-eye view, so that the commander could grasp how evacuees are behaving in the real world. In addition, the commander can instruct individual evacuees by clicking on the human figures on the screen. The system passes the instructions to the appropriate evacuees via their registered phone numbers or e-mail addresses.

In a large scale disaster, it is impractical that the commander provides detailed instructions to each evacuee. Therefore, the commander groups evacuees in certain areas and send rough instructions to them. The control interface has a function to provide just the direction to the shelter to many evacuees at the same time. In order to provide the instructions, the commander specifies the group of guide agent (evacuees in the real world) by surrounding them with a rectangle, and points out the direction to agents within the rectangle.

2.4 Navigation Process

After obtaining the rough instruction from the commander, guide agents create a route to a shelter from their assigned evacuee's position, then provide the route as the individualized navigation instructions to each evacuee using information of the evacuee's position, navigation targets set by the commander, and the environmental situation. An evacuee moves by reference to the map sent by his/her guide agent. The map centered on the evacuee's location shows the place of dangerous spots, shelters, and the direction to the shelter indicated by the commander. An evacuee can see the position/direction of movement of other evacuees on the map, so that he/she can grasp the situation of others.

3. CONCLUSION

We implemented a city-wide evacuation guide system using GPS-capable cellular phones based on massively multiagent system. The advantage of our system is (1) the scalability to use for the evacuation in the metropolis, and (2) the utilization of multiagent to decompose and individualize the rough indication.

It is hard to conduct an experiment that a large number of people actually evacuate in Kyoto city. We conducted the augmented experiment which can mix human subjects and software agents on the simulator in order to virtually simulate evacuation under the large scale disaster [1].

4. REFERENCES

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