# Electronic treasure  hunt: Real-time cooperation type game that uses location information

Jun Munemori [1], Shunsuke Miyai [2], and Junko Itou[1]

[1] Department of Design and Information Sciences, Faculty of Systems Engineering,
Wakayama University
930 Sakaedani, Wakayama 640-8510, Japan
{munemori, itou}@sys.wakayama-u.ac.jp
[2] Graduate School of Systems Engineering, Wakayama University
930 Sakaedani, Wakayama 640-8510, Japan
s055056@sys.wakayama-u.ac.jp

**Abstract.** The electronic treasure hunt developed this time uses location information and operates avatar. The participant competes for the point looking for the treasure arranged virtually. The feature of this game is that the treasure cannot be obtained if two people do not cooperate. From the experiments the following points became clear that participants evaluated highly the avatar operation system that used GPS location information. The cooperation system by which each player's position became a point allowed location information to be used well.   **Keywords.** GPS, PDA, treasure hunt, cooperation, location information.

## 1   Introduction

Research utilizing location information has grown [1],[2]. There are numerous models of cellular phone equipped with GPS, and present location retrieval services and applications that make the best use of portability are being provided [3] in Japan. The electronic treasure hunt developed this time uses location information and operates avatar. The participant competes for the point looking for the treasure arranged virtually. The feature of this game is that the treasure cannot be obtained if two people do not cooperate. The interest of this system was evaluated from various angles. In this paper, the outline, experiment, and results of the developed electronic treasure hunt are described.

## 2   Electronic treasure hunt

The system of this game consists of a movable system and a server. Moreover, the movable system is composed of a PDA (SONY PEG-NZ90), a PHS (NEC, AH-N401C) and a GPS unit (SONY GU-BT1).
    This game uses location information and real-time two-way communication acquired from GPS, and is a treasure hunt game for two or more people. The purpose of

the player is to find the virtual treasure arranged in the university. There are two kinds of treasure, the usual treasure (ten pieces) and special treasure (three pieces). When the special one is acquired, the cooperation of the other players is needed. He looks for the treasure concealed on the map by actually moving in the university, and operating the avatar displayed on the screen through a concrete search method. It is repeated during the time limit. Points are allotted to each treasure. We placed a limit of 5 pieces on the number of treasure to possess. The order is displayed in real time on the main screen while playing the game. When the time limit is up, the person with the most points is the winner.

This game is chiefly composed of eight screens (Initialization screen, main screen, search screen, treasure acquisition screen, treasure list screen, reduction map screen, avatar change screen, result announcement screen). In the game, the main screen (Fig.1) is an important screen. Avatar and various information on each player are displayed in the map of the university that is the stage of the game. Avatar is operated on this screen.
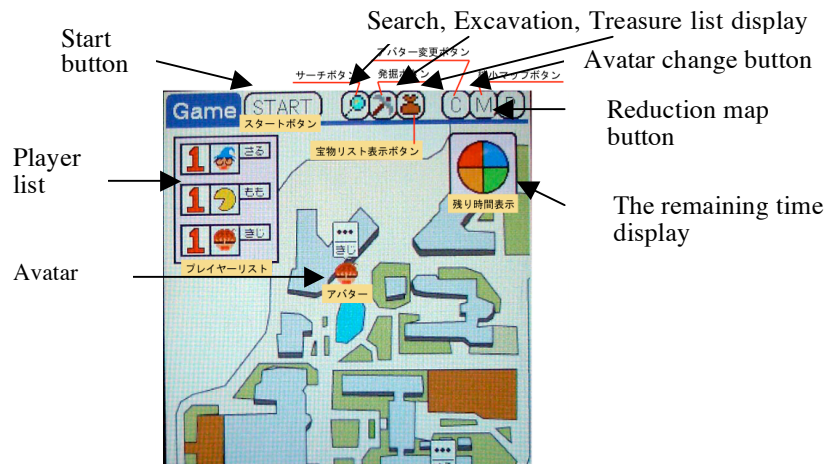


Fig.1 Main screen

The cooperation request is a function to call for one to approach other players when a special treasure is acquired. Cooperation can be requested to a player away by the use of the message transmission function when there is no player that can cooperate nearby. In the emoticon list transmitted by the message, there is a pick mark (Fig. 2). The pick mark transmits to the other party who wants to request this cooperation. On the other hand, the other party replies with a message of "OK (O)" or "NO (X)". These correspond to consent or refusal. At this time, the player comes to think about his strategy from a position with each other party and present order, and to select the other party who complies with the request for cooperation.

Fig.2 Message transmitting function

## 3  Experiment

Experiments were conducted on the Wakayama University premises. Four people participated in one experiment, which were done five times every four days. One experiment was about 30 minutes. The experimental subjects were seven in total. Two subjects participated in five experiments (Subject A and B), one person participated four times (Subject C), one three times (Subject D), and three people participated one time. For the subject of B, this was the very first time. The questionnaire was given with each experiment (The five-stage evaluation).

## 4  Results and discussion

(1) First experiment
First of all, it is the first evaluation. Seven subjects responded. The evaluations for the operation system of avatar were high (4.3~4.6). The cooperation function seems not to be used easily (3.4) the first time. One of the reasons to add the cooperation function is use of the location information. A high evaluation of the use of the location information was obtained (4.3~4.4). We think that we were able to give the meaning of a position to each other by having added the cooperation function. We think there is no load with the cooperation request using the message transmission function (4.1). However, there is an opinion of not noticing the reception of the message easily, and it seems that it is necessary to improve this. The overall evaluation of enjoyment was 3.9 and it is thought that it was possible to build it in the game well as a new function. The overall evaluations of the game were high (4.4~4.6). Moreover, when interest was evaluated by the rental charge, it was 286 yen on average. It was an evaluation for each verge of the attraction in the game center and the amusement park.
(2) Continuous experiment
Next, we show the results of the continuous experiment that four subjects did (Table 1), followed by a discussion. The cooperation function is considered. The evaluation went up in about the third time in A and B in Q3 and Q4 in Table 1. Concerning the

cooperation frequency, the frequencies tended to increase more beginning in the middle. It was stated, "The interest of the game was felt again because we cooperated" at the third time from the description type questionnaire of A. It is understood from Q1 and Q2 in Table 1. The evaluation temporarily rises the third time. The cooperation frequency increased from two or three times. Perhaps, it seems that it is because the usage of this function was understood from acquiring this experience. We think that we can slow down getting tired by adding the function (element) for which time is necessary by mastering the game.

Table 1. Results of Questionnaire (multiple experiments)

| Question | A | B | C | D | Mean value |
|---|---|---|---|---|---|
| Q1.Was this game enjoyable? | 3→3→4→3→2 | 5→5→5→5→5 | 5→3→4→4 | 5→4→4 | 4.5→3.8→4.3→4.0→3.5 |
| Q2.Do you want to play this game in the future? | 3→2→4→2→2 | 5→5→5→5→4 | 4→3→3→3 | 5→4→4 | 4.5→3.5→4.0→3.3→3.0 |
| Q3.Is it easy to use the cooperation system? | 3→1→4→4→3 | 3→3→5→4→5 | 4→3→4→4 | 5→5→4 | 3.8→3.0→4.3→4.0→4.0 |
| Q4.Was cooperation enjoyable? | 3→2→4→3→4 | 5→5→5→5→5 | 5→4→4→4 | 5→4→5 | 4.5→3.8→4.5→4.0→4.5 |
| Q5.Did the position of each other make you anxious while you were playing the game? | 4→4→4→5→4 | 5→5→5→5→4 | 3→5→4→4 | 5→5→4 | 4.3→4.8→4.3→4.7→4.0 |
| Q6.Was the character operation that used GPS interesting? | 4→3→3→4→3 | 5→5→5→4→5 | 4→3→4→3 | 4→4→4 | 4.3→3.8→4.0→4.0→4.0 |
| Q7.Was there a sense of presence? | 4→3→4→3→2 | 5→5→5→5→5 | 5→4→3→4 | 4→4→5 | 4.5→4.0→4.3→4.0→3.5 |
| Reference:Numbers of collaboreation. | 0→1→5→?→0 | 0→3→6→3→1 | 1→1→3→2 | 1→3→? | |

# 5  Conclusion

We have developed a game that used location information and operated avatar. This game has the feature that participants cooperate in real time. From the experiments the following points became clear.
(1) Participants evaluated highly the avatar operation system that used GPS location information.
(2) The cooperation system by which each player's position became a point allowed location information to be used well.  Moreover, it was found that in addition to the fact that it should be used several times until the subject comes to be able to master it, there is the possibility of delaying subjects' getting tired.

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