Human Support Network System Using Friendly Robot

Masako Miyaji[1], Toru Yamaguchi[1], Eri Sato[2], and Koji Kanagawa[1]

[1] Tokyo Metropolitan University, 6-6 Asahigaoka, Hino, Tokyo 191-0065 Japan
[2] Tokyo Metoropolitan Institute of Technology, 6-6 Asahigaoka, Hino, Tokyo 191-0065 Japan

Abstract. Because the traditional driver support system warns unilaterally by a display and a sound, it often addles a driver. If you feel burden about a present system using keyboard, mouse and so on, you might feel familiar with a system using a pet-robot. A Pet-robot, which pleases, helps and stays close to human, is called Friendly robot. So we construct a warning system using Friendly robot. In the evaluative experiment 1, we compare the understandablity, the familiarity, and the ability of the notification between Friendly robot and the traditional system. Furthermore, from the result of the evaluation experiment 1, we improve the driver support system about "easy to notify" using several time warnings by Friendly robot. We show the effectiveness of the driver support system using Friendly robot.

1 Introduction

A various types of information tools are used with advancement of information society. Moreover, robot technology is progressing and pet-robots at home are becoming more popular. We think that pet-robots are capable of becoming nonverbal interface tool that doesn't require keyboard or mouse pointer and so on [1]. As the pet-robots are often used for animal therapy, pet-robots have a high affinity for human. Meanwhile, in the automotive industry, the car navigation system is becoming popular. But current driver support system warns unilaterally by a display and a sound, it could be addle a driver.

If you feel burden about a present system such as using keyboard, mouse and so on, you might feel familiarity with a system using a pet-robot [2]. It is same for the driver support system, so the pet-robots could be used as the interface of the support system A Pet-robot, which pleases, helps and stays close to human, is called Friendly robot. We use Friendly robot for warn system to a driver. Moreover, a high affinity system should be like an interpersonal communication.

We construct a warning system, which is easy to use and to avoid confusion for drivers using Friendly robot.

2 Human Support Network Robot System

In this study, we use i-spot for detecting cars or pedestrians as shown in Fig. 1. We set i-spot for each street and in a car [3]. i-spot is composed camera, wireless

B. Gabrys, R.J. Howlett, and L.C. Jain (Eds.): KES 2006, Part III, LNAI 4253, pp. 725–732, 2006.

LAN device and PC. Each i-spot connect wireless LAN, and share information. At first, when camera of i-spot on the street catches a car or pedestrians in certain distance, warning is transmitted to a server on the car in several patterns, according to its circumstance. i-spot is able to detect a driver's face direction using a camera inside the car.

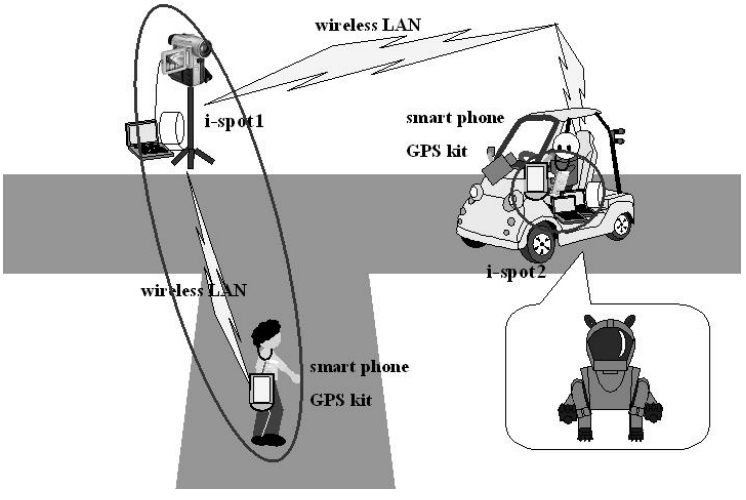

Fig. 1. Human support network robot system

Next, I explain inside a car system. PC of i-spot is main PC of car. Additionally, we set three PCs inside a car as show in Fig. 2. The middle PC assists warning. The Left and the right PC display a condition of backside, and transmit a presence of obstacle to the main PC. Display of middle PC and Friendly robot's motion caution a warning for a driver. This warning is decided by main PC.

In this experiment, we use these PCs. In the future, it is expected to use the car with backward monitoring. In addition, GPS kit is not well developed yet, it will be incorporated mobile telephone.

This system doesn't warn a danger in same direction of a driver's face to prevent overabundance of information. By using driver's face direction, main PC decides whether the system warns the danger or not. Using location information of an obstacle on the street from i-spot and location information of the car from GPS data, the main PC choose Friendly robotfs motion.

Friendly robot's motions are made in advance. We made nine different motions that 'an obstacle to the left', 'an obstacle to the right', 'an obstacle in front', 'stop', 'slow', 'keep out', 'confirming right display', 'confirming left display' and 'Accidents when turning left (at pedestrian crossing)'. In addition, when we make Friendly robot's motions, we use the method of individualized expression [4].

We use i-space in this system [3]. i-space is a software that is able to track movement and position of an object by color information as shown in Fig. 3.

3 Experiment

3.1 Primary Experiment

We experimented on some situations using above nine motions. We show one of the experiments, 'an obstacle to the left'. In this experiment, we use two motions that 'an obstacle to the right' and 'stop'. First, Friendly robot points out the left direction to the driver. This motion means that there is an obstacle on the left. Next, Friendly robot sticks out both hands slowly, this motion means stop. It is shown in Fig. 4 and Fig. 5.

3.2 Evaluation Experiment 1

We use warning of display as a metaphor for current driver support systems. We made a comparative experiment between display and Friendly robot with ten participants. In this experiment"there is an obstacle to the left", when assuming display as a standard, Friendly robot's 'Easy to understand', 'Feel familiar' and 'Easy to notify' are evaluated in five rankings as shown in Fig. 6. 1 is 'very bad' and 5 is 'very good'.

"Easy to understand": 1:0, 2:2, 3:5, 4:1, 5:2
"Easy to understand" average is 3.3.
"Feel familiar": 1:0, 2:0, 3:1, 4:2, 5:7
"Feel familiar" average is 4.6.
"Easy to notify": 1:0, 2:0, 3:4, 4:2, 5:4
"Easy to notify" average is 4.0.

It means Friendly robot is more familiar than using display. The average of rating "Easy to understand" was not good. The reason is that the caution system using display was easy to understand in the first place.

3.3 Evaluation Experiment 2

In the second experiment "there is an obstacle to the left", we developed information presentation system which Friendly robot warns several times according to the circumstance. And we did a comparative experiment with this. First, Friendly robot warned a driver when the system detects a danger, and then Friendly robot warns concretely that an obstacle is coming. When assuming using display as a standard, Friendly robot's 'Easy to understand', 'Feel familiar' and 'Easy to notify' are evaluated in five rankings as shown in Fig. 7.

"Easy to understand": 1:0, 2:0, 3:6, 4:2, 5:2
"Easy to understand" average is 3.6.

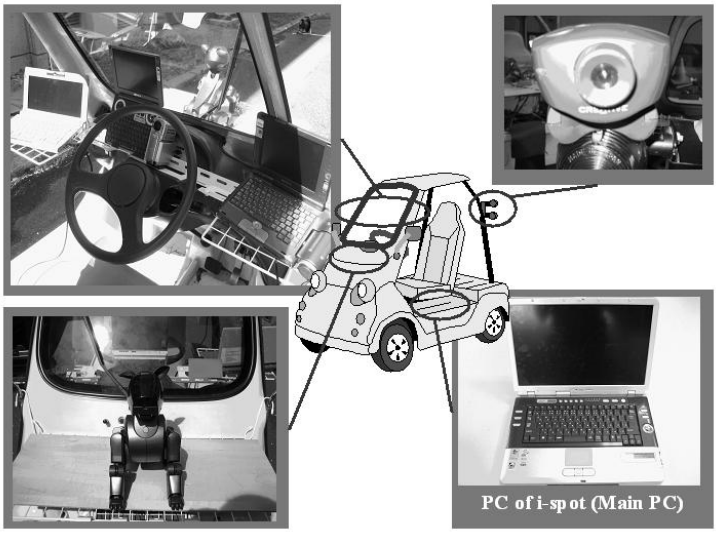

Fig. 2. The middle PC assists warning. The Left and the right PC display a condition of backside, and transmit a presence of obstacle to the main PC.

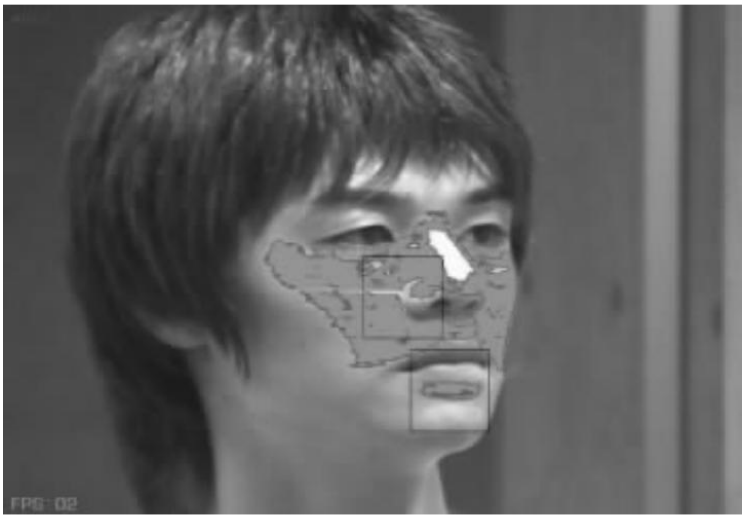

Fig. 3. This is the appearance of tracking using I-space

"Feel familiar": 1:0, 2:0, 3:1, 4:2, and 5:7
"Feel familiar" average is 4.6.
"Easy to notify": 1:0, 2:0, 3:1, 4:4, 5:5
"Easy to notify" average is 4.4.

Fig. 4. This image shows Friendly robotfs instruction that "there is an obstacle to the left". Friendly robot points to the left of the driver, this means there is an obstacle on the left.

Fig. 5. This image shows Friendly Robot's instruction that "stop". Friendly robot sticks out both hands slowly, this means stop.

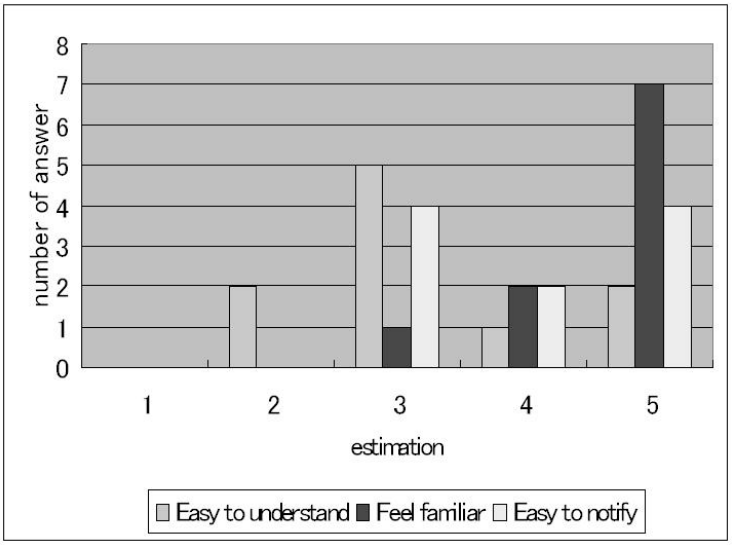

Fig. 6. This is a result of the evaluation questionnaire1. Gray is Friendly robot's 'Easy to understand', Black is 'Feel familiar' and white is 'Easy to notify'.

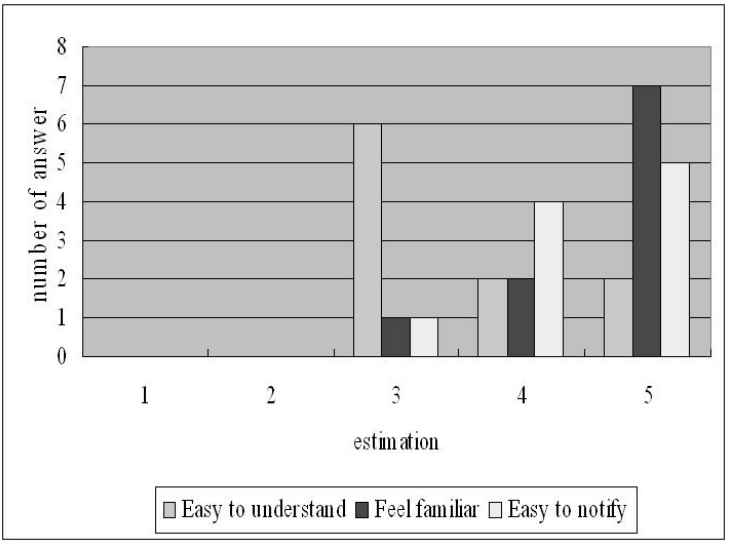

Fig. 7. This is a result of questionnaire2 Gray is Friendly robot's 'Easy to understand', Black is 'Feel familiar' and white is 'Easy to notify'

Comparing with experiment 1, average of "Easy to notify" increased. From this result, drivers can pay more attention to Friendly robot's warning easily, that is, the drivers' judging abilities have been risen. In these circumstances, the

Fig. 8. Friendly robot points out to PC's display

result of evaluation experiment 2 shows that Friendly robot warns several times better than caution only once.

4 Conclusion

In this paper, we showed three experiments. In the primary experiment, we constructed driver support system using Friendly robot. The result of evaluation experiment 1 and 2 showed the effectiveness of warning system.

In evaluation experiment 1, the driver support system using Friendly robot was felt more familiar than current driver support. But average of "Easy to notify" was not good. So we developed our system to warn several times. In evaluation experiment 2, average of "Easy to notify" rose. The result shows that Friendly robot warns several times better than caution only once.

In the future, we will experiment about driver support system under more realistic circumstances.

In addition, it will construct a system based on the interpersonal communication in order for more familiar system. We will construct driver support system based on joint attention. Joint Attention is a process of sharing observing an object or event, by following others gaze or pointing gestures.

For example there is an obstacle in front of the car. If the driver doesn't see, Friendly robot points to the obstacle. And Friendly robot changes angle of shoulder by the obstacle's location information from GPS data. There is an

obstacle in back of the car. An obstacle is captured by cameras connected to two PCs. At the same time, this system finds an obstacle. If an obstacle is caught by PC's display, Friendly robot points out to PC's display as shown in Fig. 8. We will construct a system, which responds according to the circumstances.

References

[1] Toru Yamaguchi, Eri Sato, Yasufumi Takama: Intelligent Space and Human Centered Robotics. IEEE Transactions on Industrial Electronics. **50** No.5 (2003) 881–889

[2] Yamasaki, N. and Anzai, Y.: Active Interface for Human-Robot Interaction. Proceedings of IEEE International Conference on Robotics and Automation. **3** (1995) 3103–3109

[3] Kunihiro Ohashi, Toru Yamguchi, Ikuo Tamai: Humane Automotive System Using Driver Intention Recognition. SICE Annual Conference 2004. CD-ROM (2004) 1164–1167

[4] Kouji Kanagawa, Eri Sato, Toru Yamaguchi, Masako Miyaji: Acquisition of Kansei expression by study of mimicry and application to human support network robot system. The 6th International Symposium on Advanced Intelligent Systems (ISIS2005) (2005) 171–174