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Vehicle Warehousing Support System Based on Safe Human Cooperation Mobility System in Collaboration with Cyber City

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Abstract **- Recently, the aging society is a serious problem; we paid attention to the welfare and a disaster prevention cyber city. In this research, we propose the validity of Safe Human Cooperation Mobility System in Collaboration with Cyber City, and show Vehicle Warehousing Support System as an example.**

I. INTRODUCTION

Now, in our country, the aging society is progressing rapidly by extension of a life expectancy, and decrease in birthrate. Moreover, when it says from a pace of expansion, the number of elderly drivers is increasing very fast. If suitable correspondence both technical and social sides is not taken, it will cause an increase in automobile traffic problems and produce a great influence on our essential life. On the other hand, there are 3 millions of handicapped people in Japan, the half of them are physically handicapped. These people have limitation of transport. The purpose of building up a true normalization to support their social life, we believe that cars will play a very important role.

II. HUMAN VEHICLE IN WELFARE AND DISASTER PREVENTION CYBER CITY

According to the above conditions and the trend of society, Human Vehicle can become more and more indispensable for elderly and handicapped people. Furthermore, most of the vehicles are used to travel short distances and usually with only few people. If the most of these vehicles can fill the requirement, we can decrease environmental burden and use parking space efficiently. Of course, we do hope that the Human Vehicle can play a greater role and be applied to other situation, such as in disaster prevention. But in case of emergency situations in a time of a disaster, Human Vehicle will not disturb evacuation routes. Therefore, for both applications, life convenience and disaster prevention, we believe that Human Vehicle support system must be suited. In this research, we proposed a safe human cooperation mobility system in collaboration with welfare and disaster prevention cyber city .Try to construct a cyber city that focuses on welfare and disaster prevention into our real life, from an ordinarily support up to an emergency support.

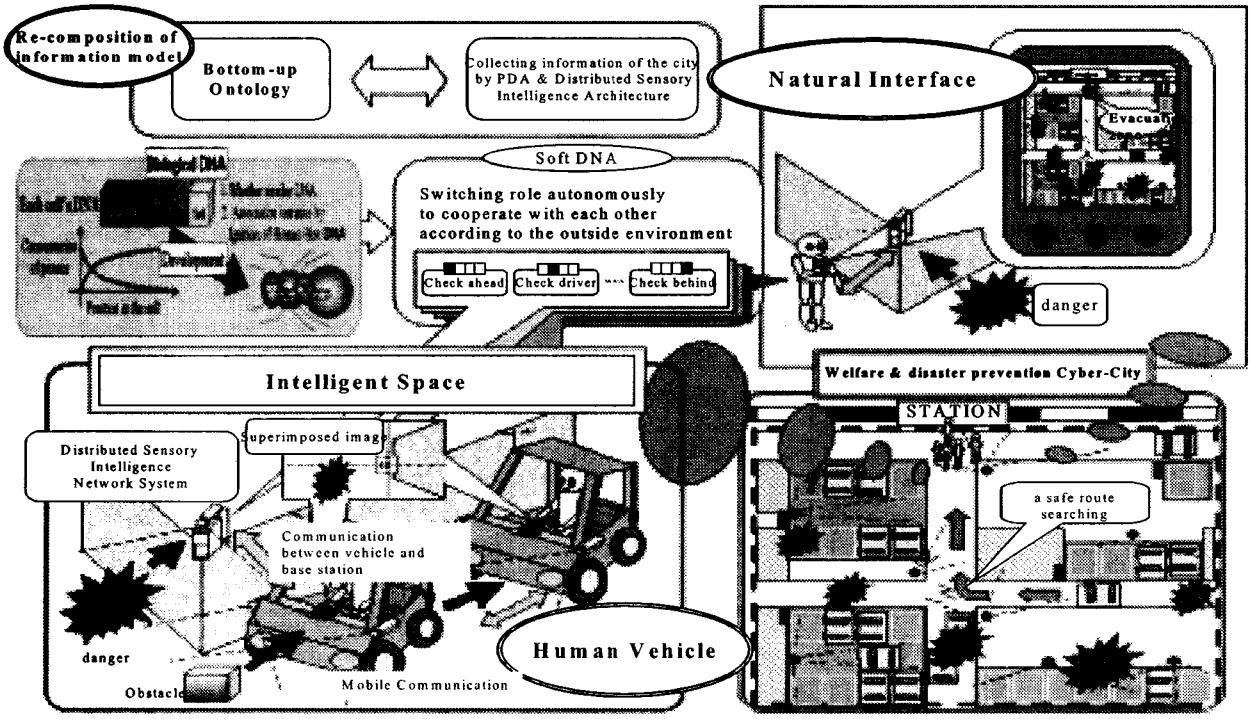


Fig1. Welfare and Disaster Prevention Cyber City

III. THE STRUCTURE OF SYSTEM MODEL

In this research, we achieve garage parking support system as an example of human cooperation mobility system. According to introduction, considering that the most important stage is collecting real time multi-information of traffic and surrounding. Our approaching is,

1) Distributed sensory intelligence architecture[1][2];
2) Soft DNA[3][4];
3) Re-composition of information model by attention[5];

In this section, we proposed "Distributed Sensory Intelligence Architecture" for vehicle warehousing support system based on safe human cooperation mobility system in cooperation with Cyber city. We explained how to re-compose distributed information and abstract useful information from fusion information to support driver.

A. Distributed sensory intelligence architecture

Intelligent Space is based on distributed sensory intelligence architecture. This architecture distributes sensory intelligence and connects each other by network. The sensory intelligence has a sensor (such as CCD camera) and intelligence (such as processing processor). They share and compensate information each other. The each sensory intelligence can switch their role autonomously by environmental information. In this way, Intelligent Space is a space as if the whole space has high intelligence.

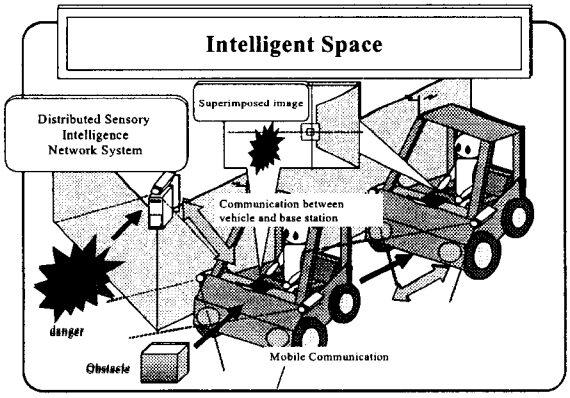


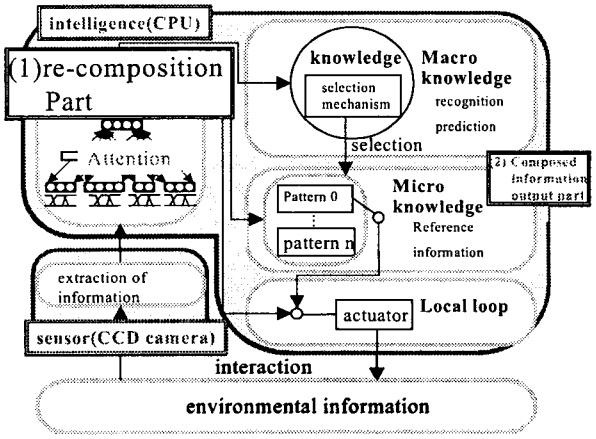
Fig2. Intelligent Space

Aiming at realizing safe and comfortable driving support by showing information if need for a driver's by re-composing environmental information based on this distributed-sensory-intelligence architecture.

Therefore, we assume a hierarchical intelligent agent model which extends the hierarchical model of Rasmussen[6]. (Fig.3) The hierarchical model of Rasmussen is known as an effective model which builds an intelligent model. The model is composed with three hierarchical structures called macro knowledge (which is the highest order) evaluates, micro knowledge corrects, and the local loop (which is the lowest order) control, further more, the hierarchy becomes a high order, it treats abstract useful information we need.

The sensor part in the sensor-intelligence model of Fig.3 extracts environmental information from color information (CCD camera). Using below-mentioned "attention"[5][7], the intelligence part performs intelligent processing of 1) re-composing environmental information, and outputting optimum driver support from the re-composed environmental information.

Fig.3 Sensory intelligent model



B. Autonomous role switching function: Soft DNA

Each agent in Intelligent Space needs to switch their role autonomously and cooperates with each other according to the outside environment. Fig.4 shows the image of "Soft computing oriented data driven functional scheduling Architecture" (i.e. Soft DNA) with the mechanism which switches role.

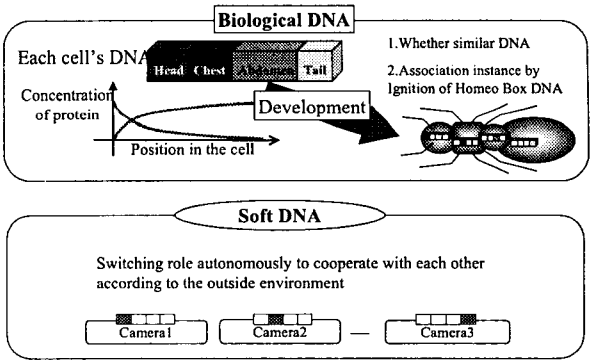


Fig.4 Biological DNA and Soft DNA

Soft DNA aims to imitate the idea of the developmental process, such as the body plans in actual life based on biological Deoxyribo Nucleic Acid (biological DNA). In biological DNA, genes called "Homeo box genes" dynamically control the body development of an individual in actual life based on the concentration of protein which is influenced by itself and the outside. Similarly, Soft DNA has Homeo box genes (such as camera in Fig.4), and collects them into one. Each agent has common Soft DNA and can know their role because of information of the outside environment. In this way, each agent in Intelligent Space can switch their role autonomously and cooperate with each other according to the outside environment.

In the Soft DNA, when individual agent with the role gathers, an agent group is made. When the group gathers, a still big group is made. In this way, Soft DNA is a fractal structure, and extendibility of Soft DNA is high.

C. Re-composition of information model by attention

In the intelligence part of Fig.3, the re-composition of information in Intelligent Space has each sensory intelligence's integrating of environmental information which were acquired in the sensor part itself and information from the other sensory intelligence, updating. In this way, the information on a wide range is able to be re-composed.

A hippocampus is one of the memory of the brain in connection with cognition, consciousness, etc. , of man. The neocortico-hippocampal model[5] in Fig.5 modeled the hippocampus. The neocortico-hippocampal model is very effective in recognizing and learning using multiple elements.

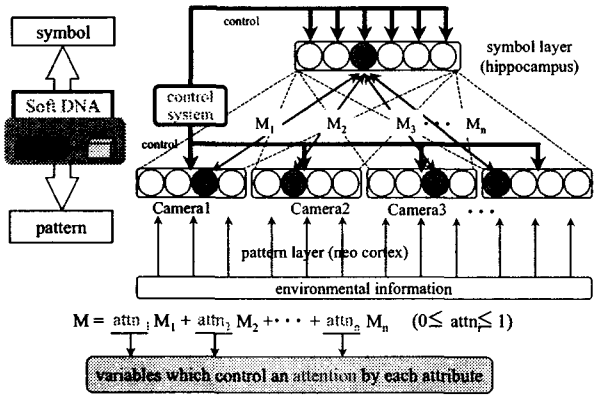


Fig.5 Re-composition of information model by attention

This model consists of two layers: a pattern layer and a symbol layer. It is expressed in the pairs of the element expression of the pattern layer and the sign expression of the symbol layer. When certain things and concepts are recollected, the cell group of both the pattern layer and the symbol layer will be stimulated. At this time, an attention vector controls the pattern layer in order to use only a part of the element or checks retrieval of a part of the symbol layer. Although there are various functions in the attention, "Attention " in this paper is a function which controls the pattern layer and the symbol layer.

IV. THE STRUCTURE OF INTELLIGENCE

Human vehicle is controlled by structure model including Soft DNA (Fig.6). In the Intelligent Space, This model gets location information that are re-composed with environmental information from cameras, and control information from human vehicle. Running courses are formed by re-composed information, send control command to human vehicle, human vehicle parks at the garage.

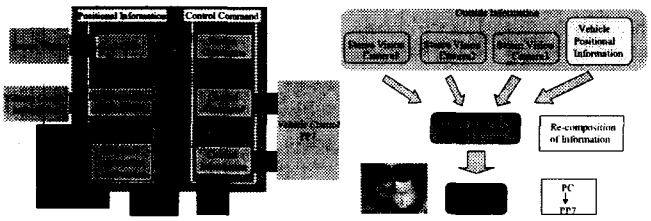


Fig.6 Structure of intelligence

V. EXPERIMENT SYSTEM

A. Garage parking

We executed experiment of garage parking and assumed Fig.7 as ideal courses. To park at the garage, Human vehicle takes 3 courses. First, it takes straight course; the distance is 6(m). Second, it takes left turn course, and takes back course 7.5(m).

The right side of Fig.7 shows that we organized 3 sensory-intelligences consisting of a camera and a personal computer. They get location information of human vehicle by stereo vision. Camera1 was in front of the garage, Camera2 was on the backside of the garage, Camera3 was set up on the vehicle, the target of the stereo vision is a pole behind Human vehicle.

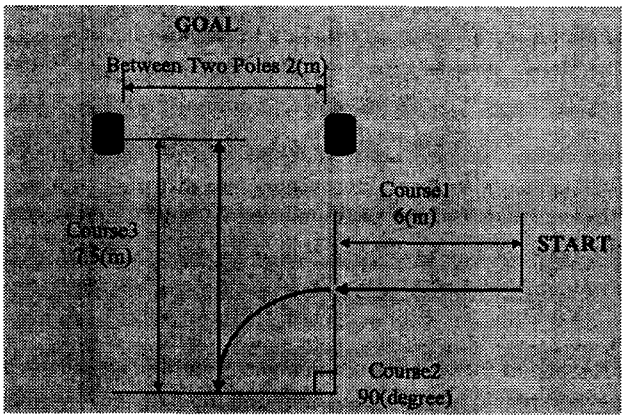


Fig.7 Ideal Course

These cameras obtain environmental information, and control signals from Human vehicle. At the same time, according to this limited information, distributed sensory intelligence re-composes the information and control Human vehicle to manage the situation well and complete garage parking.

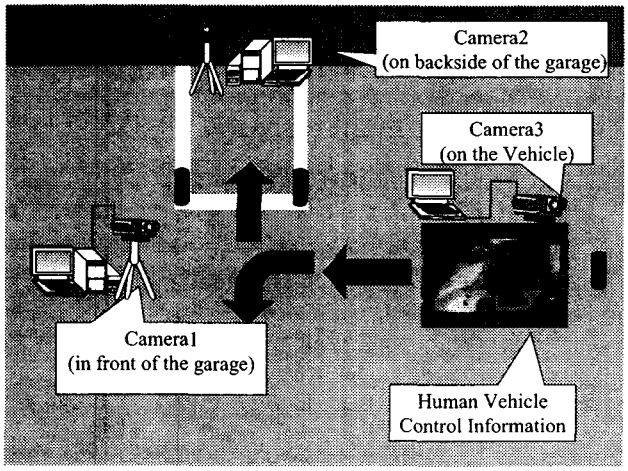


Fig.8 Structure of experiment

During garage parking, drivers can see information depending on the situation all the time to understand how well or how bad the parking is progressing. When something

like human or obstacle blocking the parking are found, drivers can notice it by danger sign from a display on the vehicle, even if drivers couldn't see obstacles out of view.

Also, display shows a driver safety level and confidence level, namely distributed sensory intelligence determines how high the reliability of information from Camere1, Camera2, or Camera3 at the stage of 1(white) to 4(blue), and then the display shows the safety level after re-composing information.

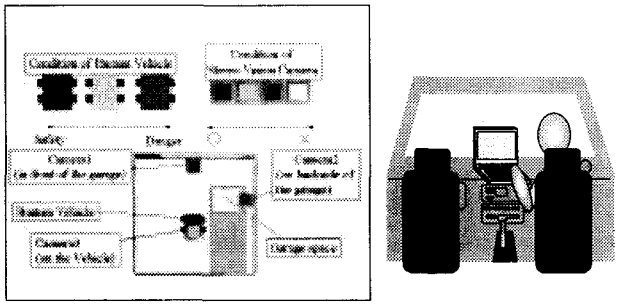


Fig.9 Display for driver

Fig.10 Scene of experiment

5. Result of experiment

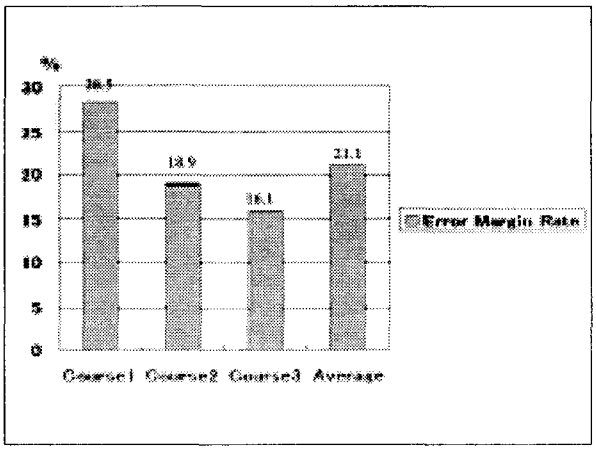


Fig.10 Error margin rate of course

Fig.10 is result of garage parking experiment. It shows error margin rate between actuality course and ideal course.

Error margin rate:

Course1: 28.5%
Course2: 18.9%
Course3: 16.1%

Average of error margin rate is 21%.

VI. CONCLUSION

We made Vehicle Warehousing Support System as an example of Safe Human Cooperation Mobility System by using Re-Composition information model. On the basis of this model, we executed experiment to put a car in a garage with agents, which are distributed sensory intelligences in this research. These agents have switching roles function that works autonomously. In the experiment, we achieved unimpeded garage parking by collecting information from each agent and re-composing it. Hereby, we showed effectiveness of Re-composition of information in an experiment.

It shows possibility that Human cooperation mobility system can work in Cyber-city.

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