MIXED REALITY TRAFFIC EXPERIMENT SPACE UNDER INTERACTIVE TRAFFIC ENVIRONMENT FOR ITS RESEARCH

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ABSTRACT

In this paper, we show the outline of our research on interactive traffic environment, under which we are developing mixed reality traffic experiment space. In order to develop sophisticated ITS applications, it is very important to analyze human factor, but there is few method to obtain human factor, thus, we have decided to create interactive traffic environment under which we can obtain human factors. As the first stage of our research, we have developed Mixed Reality Traffic Experiment Space. It consists of Real Observation Laboratory Part and Virtual Experiment Laboratory Part. In the former part, we gather various real raw data to retrieve real environment model. In the later part, we present users more realistic driving environment based on the model. Based on this experiment space, we are going to proceed to the next stages, in which we will design and evaluate sustainable ITS applications. For this purpose we have started Sustainable ITS Project at the university of Tokyo, collaborated among industry, government, and university.

INTRODUCTION

In the field of ITS, it is very important to collaborate among different fields, such as traffic engineering, machine engineering, electronic engineering, computer vision, economics, psychologies and so on. On the other hand, it is also important to collaborate among industry, government and academia; otherwise it is impossible to serve needs-oriented advanced ITS applications.

April 2003, We have started Sustainable ITS project under Public-Private-Academia Partnership on inter-disciplinary research environment of various engineering fields in order

to make mixed reality traffic experiment space under interactive traffic environment. It is true that one of our purposes is to develop and provide new ITS technologies, but we also aim to create new ITS industries and educate ITS expert with wide-vision.

THE PURPOSE OF THE PROJECT

The project is started by eight companies and one university in cooperation with three ministries, two public companies, two private companies, four universities. Under this cooperation, we mean "Sustainable ITS" as follows:

1. It is widely accepted by users and it is one of business.
2. It contributes to sustainable traffic society.

Throughout the project, we have the following expectations:

1. Intersecting different fields, researches will find new concept of values.
2. People in industry and those in academia can make collaboration research to make more effective research and development.
3. According to collaboration, it is possible to make basic research with several companies.
4. As a result, it would be new opportunities to make new alliances of companies or make new ITS business model.
5. It would be possible to educate researchers or developers, who will lead their own company in the field of ITS.
6. Various data owned in the collaboration will be shared, hence, it would be easy to make various investigations.
7. There are a lot of foreign researchers, including visiting researchers in the project, in the university of Tokyo, thus, it is easy for the companies to have communication with them. In particular, this situation offers good environment for internationalization.

THE STRUCTURE OF THE PROJECT

From the view of technology, one of our main research theme is human factor. In order to realize the situation that "ITS is widely accepted by users", it is very important to investigate and analyze human factor.   ITS applications should be such service that it provides suitable information according to each user depending on the situation, not provides broadcasting the same information. In order to design and evaluate the service, we have decided to develop "Mixed Reality Traffic Experiment Space" at first. In this space, we can investigate and analyze human factors. Based on the result of investigation and analyze, we can design new
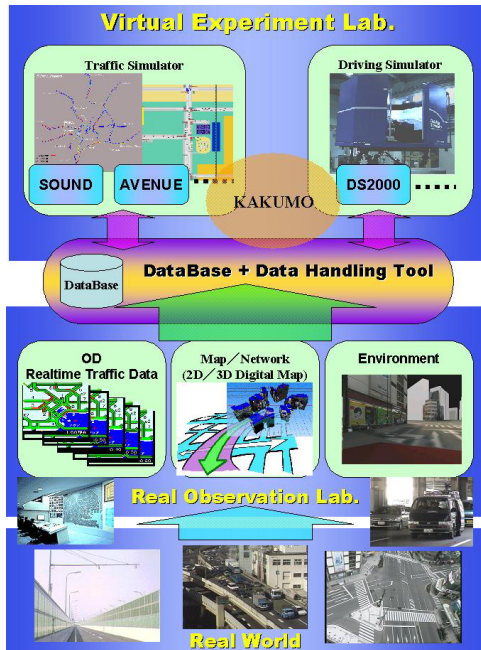
Fig.1 Outline of our system

ITS services, and implement them on the space. Finally we can be evaluate them in the space, and going back to investigation stage, we can re-design the services of ours, and evaluate re-designed them.

In this project, we call the first stage the construction of "Mixed Reality Traffic Experiment Space", the second stage the investigation and analysis of human factor and the third stage the creation of new ITS services.

We are in the first stage now, thus we introduce the outline of the first stage, Mixed Reality Traffic Experiment Space, in this paper.

THE FIRST STAGE - Mixed Reality Traffic Experiment Space -

The figure 1 shows the outline of the Mixed Reality Traffic Experiment Space. This space consists of two parts. One is named "Real Observation Laboratory"(ROL) and the other
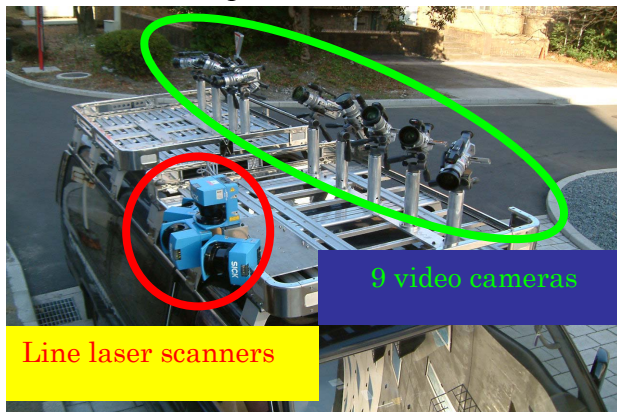

Fig.2: Data collection vehicle

"Virtual Experiment Laboratory"(VEL). From real world, ROL collects a lot of data, such as real-time traffic data, statistical traffic data, 2D/3D map data, and so on. It puts the collected data into the database, which is shared with VEL. In short, the role of ROL is to make realistic model of actual world. Fig 1 shows our experiment vehicle with which we can obtain 3D map (geometry with texture) of town.

Virtual Experiment Laboratory

Based on the model created by ROL, VEL provides experimental space in which we can investigate and analyze human factors. VEL consists from three parts. The first one is Traffic

Simulator (TS), the second one is Driving Simulator (DS) and the third one IMage Generator (IMG).

TS creates traffic flow based on the data obtained in ROL. DS provides interface for a user (driver) to drive in the virtual town created by ROL. IMG provides view of DS to the user.

Our issues in VEL are as follows:

1. TS comes from the field of traffic engineering, whereas DS comes from the field of mechanical engineering. There are deep gap between them. For instance, in TS time scale is 1 second or so, but in DS, time scanning interval is 1/60. In TS, network is usually managed in links and nodes, but DS has very detailed 3D map of simulation area.
2. Related with issue 1., DS does not consider any actual traffic situation treated in TS, and TS does not consider any behavior of specified vehicle (derived by a user on DS). But in the view of human factor, TS and DS should cooperate each other.
3. In DS, human factors can be recorded, but such data should be linked with other events in TS. In short we need to discuss how to obtain human factors further.
4. IMG was a part of DS and depends on 3D map of DS, which is manually created and customized for each DS. Hence it is very hard to run DS in the area where a customer would like to make simulation.

In order to solve the issues, we have decided to take the following approaches:

1. We develop a new microscopic traffic simulator named KAKUMO, which serves as bridge between TS and DS.
2. We need to develop KAKUMO so that it can treat human factors synchronized with DS.
3. We develop a new IBR-based viewing method to provide photo-realistic view to users.

The detail information of each item is described in other papers of ours.

Current Situation

Thanks to previous solutions, we now have the following environment.

1. We can make traffic simulation on part of express way in Tokyo area
2. In the simulation, basic traffic parameters are provided by TS.
3. We can put one special vehicle operated by DS, which can drive in the actual traffic situation realized by KAKUMO.

4. Realistic image taken by video camera, can be shown.   It is not composed with DS yet, but it will be soon.

As a result, in part of highway at Tokyo, we can collect human factors of drivers in DS. Please refer the references for details of each component (1),(2),(3).

CONCLUSION

We have started "Sustainable ITS Project" under Public-Private-Academia Partnership on inter-disciplinary research environment of various engineering fields in order to make mixed reality traffic experiment space under interactive traffic environment. We are now in the first stage, and currently we have an experiment space in which we can collect human factors in part of express way in Tokyo area.

We will advance to the second and third stage to design and evaluate new human-oriented ITS applications.

Reference

(1) T.Shiraishi et al, "Development of a microscopic traffic simulation model for interactive traffic environment," ITS World Congress 2004, Nagoya.
(2) Y.Suda et al, "Development of driver model using driving simulator with interactive traffic environment," ITS World Congress 2004, Nagoya.
(3) S.Ono et al, "Image generation system for mixed reality traffic experiment space," ITS World Congress 2004, Nagoya.