Driving Safety Support System for Senior Society

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ABSTRACT

The next generation system UTMS 21 (Universal Traffic Management System for the 21st century) is a new initiative to be developed by the Universal Traffic Management Society of Japan. UTMS 21 can be developed by adding the DSSS (Driving Safety Support System) to the existing UTMS. This system makes sure of the safety of driving and pedestrian crossing, and it must be a core program of the UTMS 21. The essential components such as infrared beacon and driver's license IC card (Integrated Circuit) will be used for increasing the safety of senior drivers and pedestrians as well as decreasing traffic accidents.

INTRODUCTION

In Japan, a nationwide traffic control system has been established since the beginning of 1970th, which has been followed by UTMS since the beginning of 1990th for the purpose of better road traffic safety and efficiency. In this paper, a new initiative called UTMS 21 is presented, which is a next generation traffic management system in Japan to improve safety, efficiency and environmental quality of road traffic in the coming senior society. In addition, driving and pedestrians crossing safety support system which would be a core of the UTMS 21 is also presented. The conceptual design of this system is new and unique from the stand point of driver's license IC card.

SOCIAL NEEDS FOR THE 21ST CENTURY : SENIOR SOCIETY

Recently, in Japan, the population of senior people has been remarkably increased at peerless speed in all over the world. It is sure high aged society will come in the 21st century where a quarter of people are older than 65 years old. Therefore, in the view of the future traffic society, it is indispensable to consider about senior people and it is very important that all sort of policies for 'friendly traffic society for senior people' will be made. There are nearly 70 million licensed drivers, and senior drivers over 65 years old are 4.8 million, which correspond to 8% of all. Table 1 shows the current status of traffic accidents in Japan.

Table 1 Current Status of Traffic Accidents in Japan

Year	1990	1995	Rate of increase
Number of licensed drivers	61,000,000	69,000,000	13%
Number of senior drivers of all	2,800,000	4,800,000	71%
Number of traffic accidents	640,000	760,000	19%
Number of traffic accidents caused by senior drivers of all	20,500	40,900	100%

The characteristics of the traffic accidents caused by senior drivers are followings;

(1) Nearly 10,000 people die caused by traffic accidents in a year, and senior people occupy 32% of them. The number of traffic accidents caused by senior drivers and pedestrians is increasing year by year.

(2) 36% of total traffic accidents occurred at non-signalized intersections.

(3) Head-on collisions are occurred quite often. Senior drivers occupy 32% of 402 dead persons caused by violation of stop sign. It shows the highest ratio compared with other generations.

(4) A great deal of accidents are caused by driving mistakes and happen at intersections. In particular accidents in right-turn and a rear-end collision are markedly.

It is assumed that it is too difficult for senior drivers whose response speed become lower due to age to make complex judgment at intersections. Therefore it is indispensable on-coming society to deploy traffic safety facilities to support driving and to lighten the burden for senior drivers.

NEXT GENERATION TRAFFIC MANAGEMENT SYSTEM

UTMS 21 consists of eleven sub-systems including UTMS and ITCS (Integrated Traffic Control System) which is the core system of all. Fig.1 shows the concept of UTMS 21. In order to realize these sub systems, UTMS 21 makes use of existing facilities and infrared beacon which is the key component. It has the special abilities of vehicle detection and interactive two-way communication between infrared beacons and in-vehicle units equipped with vehicles. The former function can measure traffic volume and time occupancy similar to conventional ultrasonic vehicle detectors. Using latter function, infrared beacons can collect vehicle identification numbers and transmit detailed traffic information to each in-vehicle units.

In R&D and experiments about DSSS, making sure of the safe and free mobility for senior drivers and pedestrians is studied as main theme, and the effective methods of decreasing traffic accidents are researched making use of analysis of actual traffic accidents. In order to realize it, the methods of decreasing traffic accidents by the harmony of the intelligent vehicles and advanced infrastructure are studied communication technologies between infrastructure and such road users as drivers and pedestrians.

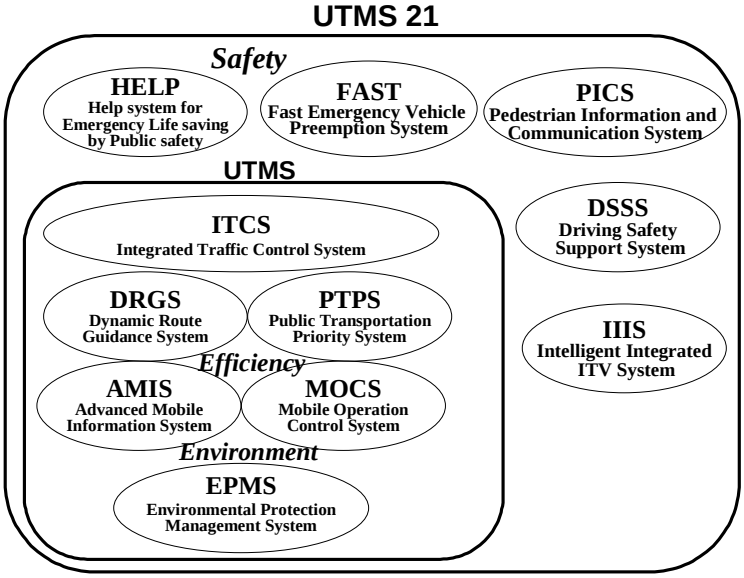

Fig. 1 Concept of UTMS 21

SUBSYSTEMS IN DSSS

HAZARDOUS **Z**ONE **A**VOIDANCE **S**IGNAL **C**ONTROL **S**YSTEM

The purpose of this system to avoid hazardous zone is to prevent drivers from rear-end and/or head-on collisions, or collision between a straight going vehicle and a right-turning vehicle, which are often taken place at a signalized intersection especially when a traffic signal light is switched into amber. Therefore, based upon information such as timing to enter an intersection of approaching vehicle, this system would provide actuated traffic signal control in order to guide approaching vehicles to intersection not to drive in a hazardous zone. In case of that green signal time was extended beyond the maximum time, variable message boards and in-vehicle units are to offer information for motorists to speed down.

STOP **R**EGULATION **W**ARNING **S**YSTEM

This system aims at improvement of safety at non-signalized intersection. When the vehicle approaches the stop line at a non-signalized intersection, infrared vehicle detectors detect this on-coming vehicle, and in-vehicle unit informs the driver of distance data to a stop line. If the vehicle is running over the safe speed limit, the mobile unit would warn the driver the speed slower to prevent head-on collision.

HEAD-ON **C**OLLISION **W**ARNING **S**YSTEM

When two or more vehicles simultaneously approach to a non-signalized intersection, infrared vehicle detectors detect the speed of each vehicle to inform drivers of other vehicle's coming so as to prevent head-on collision.

INFORMATION **S**UPPLY SYSTEM **O**N **H**AZARDOUS **C**URVE **A**ND **O**N-COMING **V**EHICLE **I**N **N**ARROW **P**ATH

This system provide drivers with information on on-coming vehicle and appropriate speed to approach each curve before entering a hazardous curve.

PROTECTION **S**YSTEM **F**OR **R**IGHT-TURN **A**CCIDENTS

The accidents between a right-turn vehicle and a motorcycle run out from the behind the queue of vehicles occur frequently. This systems inform the existence of the vehicles and motorcycles at dead angle to the drivers in advance. This system inform that the intersection is high accidents-frequency place and warm the existence of go-straight vehicles to the drivers by way of in-vehicle unit with voices.

PEDESTRIAN **A**SSISTANCE **S**YSTEM

Driver's license IC cards for senior pedestrians and white IC cards for senior people, handicapped people and children without driver's license would be prepared. According to the information stored in the IC card, the green time of the traffic signal would extend enough longer for them to cross the street safety. And also the read unit installed near crosswalk reads out the information stored in the IC card, and transmits the information to the up stream infrared vehicle detectors. Then it can give the warning of existence of crossing pedestrians to the approaching drivers.

DRIVING **C**HARACTERISTICS **S**UPPORT **S**YSTEM

The system makes sure of the safety by operating vehicle driving support function according to the driving characteristics of the drivers especially for senior drivers. Using the driving simulator, the data of driving characteristics of the senior driver is stored into the

driver's license IC card. When the driver starts to drive, he should insert his own driver's license IC card. Then the driving support unit reads out the driving characteristics information of the driver and the support functions are carried out according to the information. While he is driving, his daily driving characteristics would be added in the IC card. It would be used at renewing his license.

EXPERIMENTS FOR THE HAZARDOUS ZONE AVOIDANCE SIGNAL CONTROL SYSTEM

CONTENTS OF EXPERIMENTS

Details of the experiment are as follows. Fig.2 shows the experimental intersection.

(1) Location: Hon-isshiki intersection on ring road 7 in Tokyo
(2) Date: Pre-test survey: March 2 and 4, 1999,
Post-test survey: March 16 and 18, 1999
Time: 10:00-14:00 and 22:00- 2:00
(3) Installed equipment (signals, vehicle detectors for speed measurement:)
-Variable message signs (VMS) ... 1 unit, and
-Infrared beacon ... 1 unit.

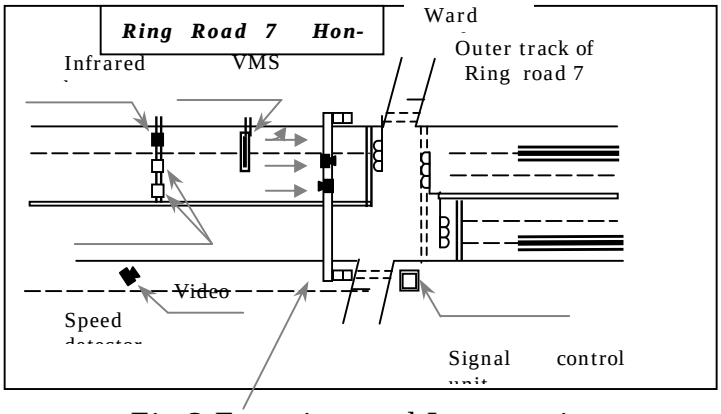

Fig.2 Experimental Intersection.

EXPERIMENTAL RESULTS

Results of the experiment are as follows.

(1) Feasibility and performance: It was verified that the functions of the system are feasible and the transaction speed has no trouble.
(2) Information indication by using in-vehicle unit: The existing type of in-vehicle unit takes a long transaction time, i.e., time from the time point of receiving to that of indicating information, which depends upon each model. It is required to shorten time for drivers to recognize that he/she is approaching to a hazardous zone by making a good use of both written message and voice, in addition to standardize the varied warning timings of in-vehicle units.
(3) Influence upon vehicular behaviors: The number of vehicles driving into a hazardous zone showed no change. There was a difference, however, in the number of vehicles that made a stop; i.e., of all vehicles provided with information, forty percent of normal vehicles made a stop prior to entering an intersection whereas only eight percent of large vehicles stopped. It could be considered as a reason that there was a large sized road sign just in front of a variable message sign, which might cause it difficult to see information on message board from a large size vehicle. Besides, information was indicated in a gentle manner for the safety of traffic, which could be the other reason. It should be noted that there was no harmful secondary effect such as

sudden speed up or down. It is expected that this system would greatly improve the safety of traffic flows in a good visibility, with information indicated in a manner encouraging drivers to slow down, and in a long-term operation.

CONCLUSION

In this paper, the conceptual design of safety support system which would be a core program of UTMS 21 is presented and some applications are also proposed based on the traffic accidents status in Japan. Above all, application of infrared beacon and driver's license IC card to DSSS is very important for defining a driver as one of the system components of DSSS. Thus this system has potential to increase the safety of senior drivers and pedestrians. DSSS in UTMS 21 is now under research and development by the Universal Traffic Management Society of Japan in cooperation with National Police Agency of Japan, Ministry of Transport, universities and industries. DSSS should be also a global challenge toward the 21st century.

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