Progress of V-I Cooperative Safety Support System in Kanagawa, Japan

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ABSTRACT

Although the death rate of traffic accidents is decreasing in Japan, the number of people injured remains at a high level. While on-board mechanism has been developed and actualized, there are still collision types which are difficult to be solved by the vehicle alone. To solve this difficulty, Vehicle-Infrastructure communication safety support, the DSSS (Driving Safety Support System), using Infrared Beacon is taking an active role in Japan. Here, we will introduce the progress of FOT (Field Operational Test) from October 2006 taken by the Kanagawa DSSS Analysis WG. which is one of the DSSS activities.

TRAFFIC ACCIDENTS IN JAPAN

During these two decades the death rate of traffic accidents has been decreasing. Meanwhile, the number of traffic accidents is increasing. In order to help reduce social loss due to traffic accidents, not only serious accidents causing death and injury but also the whole number of accidents itself must be reduced. (Fig. 1) In order to reduce crossing vehicle collisions at intersections or pedestrian collisions, where these obstacles are hard to be seen, and in order to reduce traffic signal/sign oversight, Vehicle to Infrastructure (V-I) communication technology will be effective.

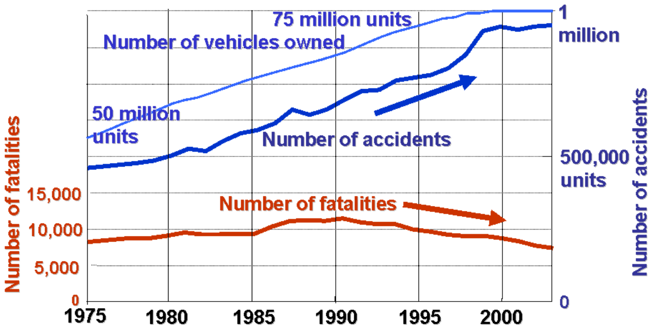

Fig 1 Grasping the Effect by Fixed Quantity

THE UTMS and THE KANAGAWA DSSS

The UTMS (Universal Traffic Management Systems) is a National Police Agency system which aims for the actualization of a "safe, comfortable and environment-friendly traffic society" by using an advanced information communication technology such as interactive communication between traffic control systems and each vehicle using an Infrared Light (IR) Beacon. These systems are being utilized by the UTMS Japan (Universal Traffic Management

Society of Japan), which was established in 1996.

Kanagawa Prefecture is located next to Tokyo ---a metropolitan city in Japan. The capital city, Yokohama, is the second largest city in Japan. (Tokyo is the largest). In Kanagawa, the number of traffic accidents is the third worst nationwide and accidents resulting in injury or death per traveling distance is the worst nationwide. Kanagawa DSSS started from January 2005 as one of the DSSS actions with the participation of several firms related to automobile, traffic infrastructure, communication and car navigation systems. The aim is to contribute to the local society and the nation by developing technologies to help solve the above mentioned issues to hold FOT and to make early actualization.

MEASURES of KANAGAWA DSSS

FOT by 2,000 of general users has started from October 2006. The test will continue until March 2008. Test items are as follows:

(1) Stop sign violation avoidance support at intersections without traffic signal.
(2) Information supply to a main stream vehicle about a merging lane vehicle at an intersection without traffic signal.
(3) Red light violation avoidance support at intersections with traffic lights.
(4) Right turn vehicle existence information supply.
(5) Right turn collision avoidance support.

(1)-(3) use IR beacon as a V-I communication tool.
(4), (5) and a variation of (3) are done by IR beacon and DRSC (Dedicated Short Range Communication) using the each communication media merits.
Figure 2 is an example of the application and Figure 3 shows one of the test spots.

An on-board unit is based on the current generation car navigation system of NISSAN and "the 3 media VICS beacon" that is widely sold in Japan. The current generation car navigation system has been sold since the beginning of 2004, and we can get the test vehicle only by re-programming this car navigation software. It takes only 15 minutes for the re-programming at NISSAN car dealers.

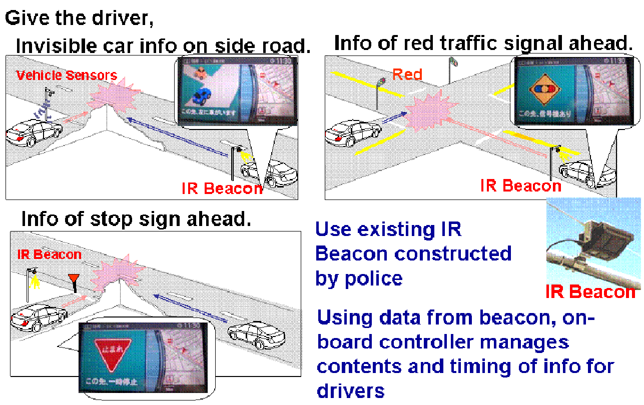

Fig2 Applications - Intersection Collision Avoidance

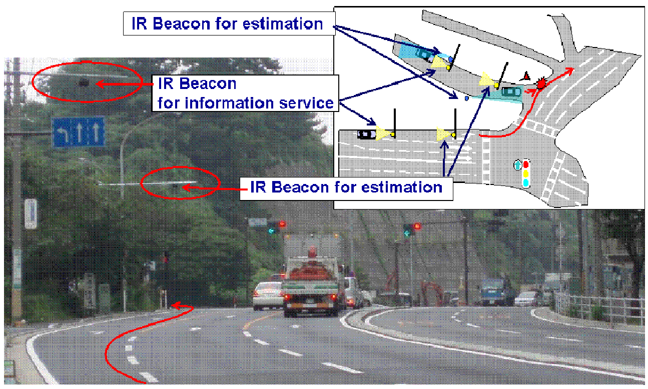

Fig3 Test spot (An example)

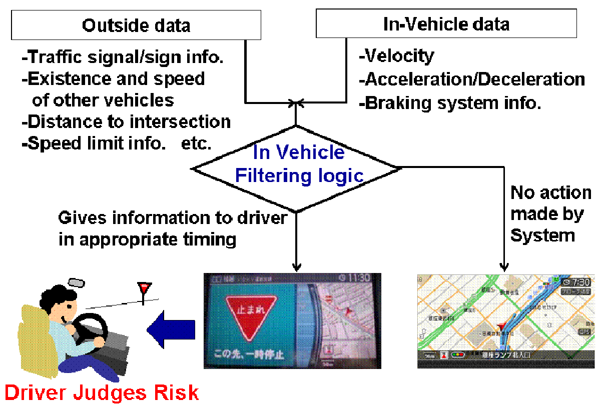

Fig4 Test Spot (An Example)

The system has a function that enables a vehicle to judge the timing to supply the information, to judge if/if not to supply information by considering the brake condition and speed that is based on the data received from the outside world. The system also has a function to estimate change in behavior of the driver who is supported/non-supported by the information. (Fig. 4)

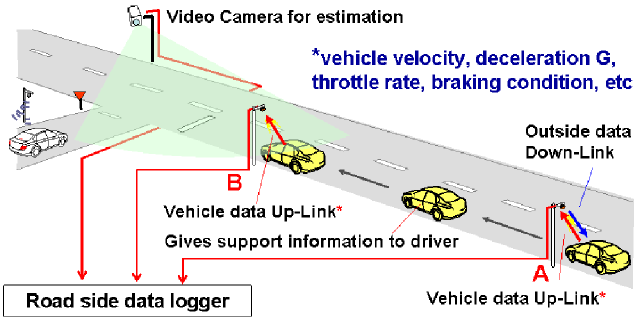

Fig 5 Grasping the effect by fixed qantity

Figure 5 shows the estimation system using Up-Link of the vehicle real time running data as the example of Red light violation avoidance. Road side data logger stores the UP-Linked data of Point A and B. And traffic flow and speed change data of vehicles which have no function of Kanagawa DSSS will be also measured. Using the stored data, statistical analysis may show whether or not there is some difference between the data with/without safety support information.

PROGRESS of FOT

2,000 general users will evaluate the system receptivity ---how information is supplied, etc. ---through every day car life without being conscious of the test. 1980 vehicles have already been running in the city as of the end of April 2007. (Fig.6)

The continuous test lasting for more than one year will also enable us to grasp the influence of the users' habituation to the system.

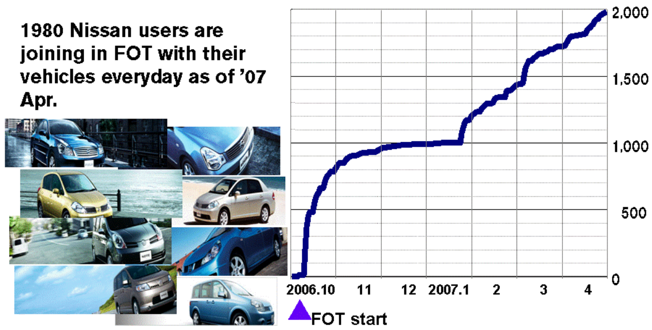

Fig 6 Number of Participants

Part of the test results is shown as follows with regard to the invisible vehicle information support for the main stream vehicle. Fig7 shows the number of the test vehicles on the main stream that passed through under the beacons at one of the test site. The total number of the test sample is over 600 from January 2007 through April. Test vehicles are divided into 3 groups. Group1 is the number of vehicles that the system gave information to the driver.

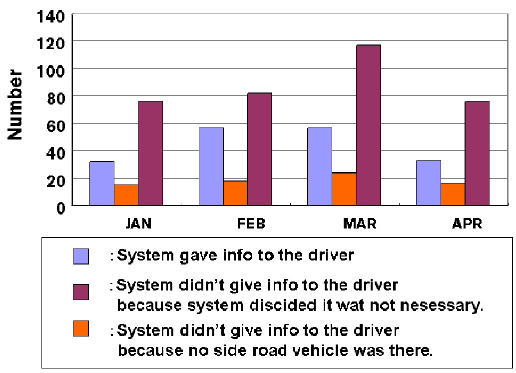

Fig.7 Number of logged data

Group2 is the number of vehicles that the system did not give information to the driver since the system decided that the information for the driver was not necessary since the vehicle speed was low enough, etc. Group3 is the number of vehicles that the system did not give information to the driver since no side road vehicle was there.

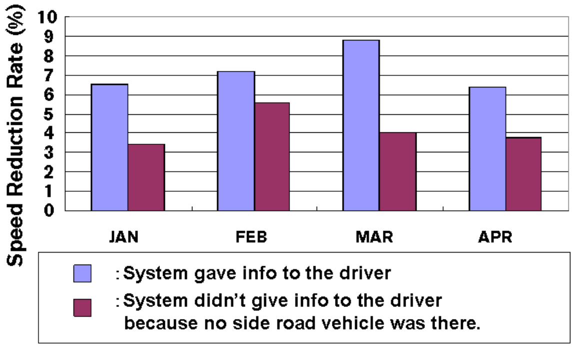

Fig.8 Speed reduction between beacon A and B

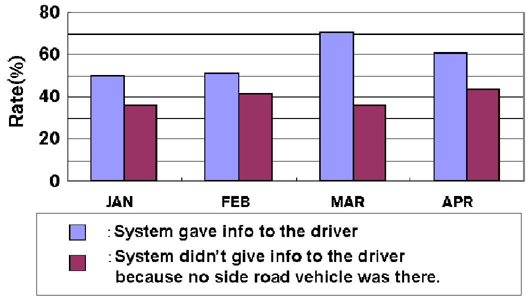

Fig.9 Rate of the driver who used brake between beacon A and B

Fig.8 shows the vehicle speed change. The vehicle speed of the group that got information decreased more than the group that got no information. Fig.9 also shows the rate of the driver who used a brake. The group that got information used a brake more than the group that got no information. This result shows that the driver responded to the information and the driver's behavior changed to a safer side.

We will continue the test until the end of March 2008 in order to get more samples. By obtaining a large number of the samples, vehicle speed change and driver behavior change can be analyzed quantitatively. The continuous test lasting for more than one year will also enable us to understand the influence of the users' experience with the system.

ACTUALIZATION

One of the articles in the latest New IT Reform Strategy announced in January 2006 by the Japanese Government proposed an actualization and action plan of the intersection collision avoidance system using V-I and V-V communication in order to make the safest road society in the world. The success of Kanagawa DSSS will contribute to make the V-I cooperative safety support system and a common specification.

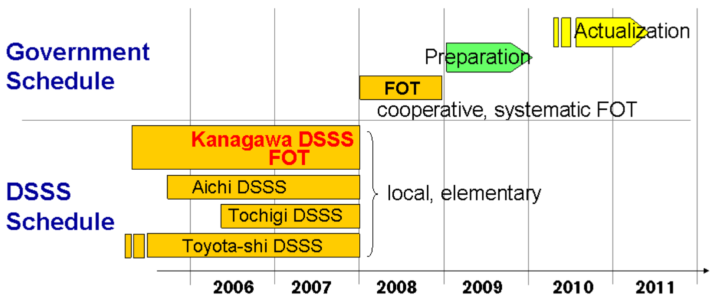

Fig.10 Time Schedule

SUMMARY

Here we have introduced the Kanagawa DSSS project's challenges, through a new technology field as follows, to help reduce traffic accidents and congestions which current technology could not solve.

-Intersection collision avoidance using infrastructure-vehicle communication
-Strong points
1) The system is built on existing structure and hardware in order to make continuous deployment possible

2) Information is filtered by the vehicle.
3) A test by general users enables an objective evaluation of the influence from system receptivity
and the influence of habituation to the system.
4) A structure that grasps the investment effect by using the Up-Link of real-time traveling condition of vehicle is added

We hope that the success of Kanagawa DSSS will contribute to materialize such a safe and environment-friendly world.

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