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Intelligence Transportation Safety Information System

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Abstract

These days the large-scale car accidents have often been occurred by overspeeding in disregard of sharp curve, foggy and freezing regions. This paper has proposed the algorithm to calculate the safety speed in real time that can protect the car accidents under these weather and road conditions using Fuzzy reasoning theory. Under raining and snowing, drivers have to slow down the traffic safety speed by 1/3 of the traffic safety speed indicated on the existing speed sign plate based on their decision. So it is difficult to calculate and then observe the safety speed. This paper has performed the simulation that provides the deivers with the optimal safety speed considering the road and weather conditions in real time to improve these problems. We have proved this method can improve more 25% than the existing one.

Keywords: *Traffic safety Speed, Fuzzy Reasoning System, Car accident, Protection system*.

1. Introduction

In this study, the algorithm that can calculate the real time safety speed under any road and weather conditions to protect the traffic accidents through DMB service using Fuzzy reasoning theory. We propose the algorithm that provides the drivers with the optimal safety speed considering the road and weather conditions in real time based on Web and perform the simulation for this algorithm. The car speed over the road has to be maintained in safety considering both weather and road conditions. In freezing and rainy roads, it is good for the distance between cars to be maintained 1.5 times longer than usual. Because in rainy

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situation. The drivers need more space to stop as well as have narrower visual field than usual. A heavy snowfall makes the several places of road frozen. Even though the weather is improved, the freezing area remained in the shaded lot accuses the large scale traffic accidents. In fact, in Yeong-dong Expressway, which had the snowfall lately, more than 10 car collision accidents per day on the slippery road were known [1-5].

In case of the traffic accidents, it is not easy to capture the drivers at fault who escape the car. So this paper has performed the simulation which the driver does not cause the traffic accidents because of the over speed and then can take the defensive driving in the foggy freezing area. We can calculate the optimum traffic safety speed using the fuzzy reasoning rules through this simulation [6-10].

2. The algorithm to calculate the traffic safety speed

In the case of light snow and rainy, the drivers have to reduce the car speed by about 20% slower than usual. And when the driver's visibility range is within 100m in the worst weather conditions, such as the rainy spell in summer, the strong freezing in winter, the heavy rain, and the thick fog, the drivers have to reduce the car speed by about 50% slower than usual. But it is difficult to calculate how much the driver reduces the car speed in real time by interworking the sign plate with the weather condition.

To improve these problems, we used the following rules to calculate the traffic safety speed by coping with the variable road situations.

(RULE 1) IF DPSV IS Positive Big
AND USPC IS Positive Big
THEN OPRG IS BIG
(RULE 2) IF DPSV IS Positive Big
AND USPC IS Negative Small
THEN OPRG IS MEDIUM
(RULE 3) IF DPSV IS Negative Small
AND USPC IS Negative small THEN OPRG IS SMALL

Where
DPSV : Speed in the traffic sign plate(E)
USPC : Degree of snowfall or raining Error variation(CE)
OPRG : The real-time optimum traffic speed limit for the road conditions

The process to calculate the optimum traffic limitation speed Oprg using Fuzzy reasoning rules is as follows:

(Rule 1)
[0.3/4, 0.5/5, 1/6] ^ [0.7/-3, 0.6/-2, 0.8/-1, 0.4/0, 0.1/1]
↑ ↑
^ [0.3/4, 0.5/5, 1/6]
= 0.3 ^ 0.7^ [0.3/4, 0.5/5, 1/6]
= [0.3/4, 0.3/5, 0.3/6]

(Rule 2)
[0.3/4, 0.5/5, 1/6] | ^ [0.3/-6, 0.2/-5, 0.8/-4, 0.5/-3,
↑ ↑
0.4/-2, 0.2/-1] | ^ [0.1/2,0.5/3,1.0/5,0.5/5,0.2/6]
= 0.3 ^0.5^[0.1/2, 0.5/3, 1.0/4, 0.5/5, 0.2/6]
= 0.1/2, 0.3/3, 0.3/5, 0.3/5, 0.2/6

(Rule 3)
[0.3/1, 0.9/2, 0.7/3, 0.3/4] | ^ [0.7/-3, 0.6/-2, 0.8/-1, 0.4/0,
↑ ↑
0.1/1] | ^ [0.3/1, 0.9/2, 0.7/3, 0.3/4]
= 0.3, 07^[0.3/1, 0.9/2, 0.7/3, 0.3/4]
= 0.3/1, 0.3/2, 0.3/3, 0.3/4

Non-fuzzy method:

$$U = \frac{\sum(\text{The large set having membership function value} \times \text{s function value})}{\text{membership function value}} \tag{1}$$

u'=[0.3/1, 0.3/2, 0.3/3, 0.3/4, 0.3/5, 0.2/6]
{0.3 *[1+2+3+4+5]}+0.2*[6]}/(0.3 * 5) + (0.2 * 1)=3.35

Therefore, we know it is most optimal for the driver to reduce the car speed through 3 levels. Also, due to the sudden breaking or the traffic signal violation in intersections, there are many traffic accidents. In this paper, to improve this problem, we propose the algorithm to prevent the traffic accidents by producing the traffic signal period considering the intersection capacity through Fuzzy reasoning rule.

3. Traffic accident information installation system

In the dry and even road, the formula to calculate the stop distance is as follows:

Stop distance = $V^2/100 \times 0.88$, V : Initial stop velocity(km / h) (2)

In 120 km / h,
Stop distance = $120^2/100 \times 0.88 = 126.72$m
In 100 km / h,
Stop distance = $100^2/100 \times 0.88 = 88$m
In 80 km / h,
Stop distance = $80^2/100 \times 0.88 = 56.32$m
In 60 km / h,
Stop distance = $60^2/100 \times 0.88 = 31.68$m.

For example, if the driver steps on the break to stop the car, which is driving by 100km/h, the stop distance is $100^2/100 \times 0.88 = 88$m. This means the car needs more 88m distance to stop the car completely after the driver step on the break. So if the cat driving speed is 100km/h, the safety distance between cars going in the same direction has to be maintained by about 100m.

In 120 km / h.
Safety distance = $120^2/100 = 144$m
In 100 km / h,
Safety distance = $100^2/100 = 100$m
In 80 km / h,
Safety distance = $80^2/100 = 64$m

In 60 km / h,

Safety distance = $60^2/100$ = 36m.

In snowy and rainy road, the safety distance has to be secured 2 or 3 times longer than one in the dry and even road. Also, it is desirable for the driver to drive the car half slower than the dry and even road.

1) Relationship between velocity and breaking instantaneous time.

It is the variation of breaking instantaneous time for the variation of velocity. if the breaking instantaneous time is average 0.43 ~ 0.45 seconds which does not exceed 0.1 ~ 0.16 seconds, it has an light effect on the initial operation velocity of car.

2) The breaking instantaneous time in the dry asphalt road and the humid asphalt road.

The breaking instantaneous time in the humid asphalt road surface is little slower than one in the dry asphalt road surface because the road surface friction coefficient of humid state is smaller than one of dry state.

3) The breaking instantaneous time in the paved road surface and the unpaved one.

We compare the breaking instantaneous time in the paved road (new asphalt road surface) and the unpaved one (dirt road). The breaking instantaneous time in the unpaved road surface is smaller than one in the paved road surface because the friction coefficient of the unpaved road surface is larger than one of the paved one.

In the simulation, it calculates the optimum safety speed in the freezing and fog areas. In this figure, the safety speed has to be reduced by above 20% by sensing the road situation automatically. In case of a heavy rain, this indicates 40 Km/hour safety speeds which reduce it by above maximum 50 %. So this shows the process which can prevent the traffic accidents.

4. Calculation of safety speed using Fuzzy Reasoning Rules

The two safety rules which the drivers have to keep while is driving on a rainy road is ensuring a safe distance and reducing the speed. In a rainy road, the distance between cars going in the same direction has to be maintained enough like in a snowy road. Also in a rainy road, because the car needs more space to stop than usual due to the slippery road when the unexpected situations broke out suddenly. Also, in a rainy day, if the drivers follow closely the preceding vehicle, the drivers cannot secure the enough visual field because of the cloud of spray raised by the tires of preceding vehicle. So the drivers have to maintain the enough distance between cars going in the same direction. Reducing the car speed is also as important as securing the distance between cars going in the same direction. The traffic law also specifies that the drivers have to reduce the car speed by 20~50% from the maximum speed permitted. The reason why the drivers have to reduce the car speed in the rainy road is that the rainwater reduces the frictional force between tire and road. Therefore, the breaking lengthens the space to stop, and secedes from the road easier than in sunny day when cornering.

In this paper, this informs the drivers of the traffic situation information under any traffic situations by perceiving this speed limit automatically. If the drivers do not reduce the car speed, the traffic disaster broadcasting and automatic reducing equipment reduce the car speed automatically by considering road and weather conditions. TPEG (Transport Protocol Expert Group)-The weather information application can be applied to the diverse type of TPEG terminals, such as TPEG terminal based on the digital map, GPS terminal without the digital map, and TPEG terminal for mobile or fixed receiver without both GPS and digital map. These terminals provide the users with the weather information through character, voice and graphics. Each weather information has the unique reference number (Message Identifier, MID), and each message has version number (VER).

For MID and Ver of this specification, First, Ver can have any number between 0 and 255 in ascending powers, and is not mandatory. But Ver can be assigned to maintain the same frame type as TPRG application specifications, such as TPEG-Road Traffic Message Application, TPEG-Public Transport Information

Application. Second, service providers assign MID beginning with 0 and then increase it by one. When it reaches the maximum size that is 65,535, it has to be initiated to zero. MID and Ver is an essential element included in all messages. These are used for the message management of TPEG decoder instead of the display of terminal. Once the receiver receives TPEG information regardless of TPEG transmission medium, TPEG decoder can identify the stream including many messages, and these messages can be applied to applications more than one.

5. Conclusion

In case of raining or snowfall, we install the safety speed sign plate considering the road conditions which indicate to reduce the driving speed by above 50%. But the safety speed sign plate of this fixed type cannot calculate and then indicate the safety speed suitable for the weather conditions. We confirmed that this system can calculate the exact safety speed by considering the several factors, such as weather, road conditions, the number of the driving vehicles on road, and the number of lanes on road. The several factors such as weather, road condition, and the number of the driving vehicles have to be considered for the safety speed sign plate which is a part of the intelligent road system through the fuzzy algorithm proposed in this paper. Therefore, this system can contribute to reduce the frequent traffic accidents and the road damage. Furthermore, it can save the energy and then improve the environment by improving the vehicle fuel economy.

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