Study for Cooperating Control System of Traffic Safety Oriented to Preventing and Avoiding of Accident

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Abstract: Aim at the characteristic of freeway traffic safety accident and in order to realizing prevented and avoided of traffic Accident, the method for integrated of intelligent safety ensuring technology in freeway and vehicle as well traffic controlled management have been studied. And the integrated model has been established for cooperating warning and controlling of traffic safety. At the same time, the key technique have been studied, such as safety information collected in real time, transmitted each other, and safety correspond controlling method. The mode of cooperating safety controlled is put forward by using ITS and GIS/GPS and information system of safety cooperated controlled. The integrated architecture of safety cooperated controlled is made up. That is realized each factor for affected safety is inspected and controlled in real time.

Key words: Traffic safety; Safety technology; Integration; Cooperating control system

1. Preface

Transportation is basal industry of country economy and society development. Along with the fast development of our country national economy, the freeway course also grew swiftly and violently. To 2005 year's end, the total mileage of our country freeway has achieved 41005 kilometers. At the same time, the freeway traffic safety question is also stern day by day. Seeing from the Figure 1, the accident dead people assumes obviously ascending trend from 1995 to 2005.

Figure 1  The column diagram of freeway traffic accident in 1995~2005 year

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At present the death toll per year and the mortality rate per ten thousand vehicle of our country freeway traffic accident occupy the first in the world. The significant accident cannot be under the active control. Therefore, the research to highway traffic safety question, the prevention and the reduction for traffic accident is an important issue of transportation profession, also is an urgent need of our country transportation enterprise sustainable development.

The research in the recent years indicates that: In our country freeway traffic accident, because driving with excessively quickly speed or improper speed and driving after liquor as well as weary driving are account for above 90%. The freeway traffic accident is happening under the effect of specific transportation environmental, because human and vehicle and road as well as environment are maladjustment. The influencing factors of freeway safety drive speed are these: vehicles structure, performance and service condition; path linearity, road surface quality, transportation organization and control mode; the transportation environment and badly weather such as the wind, the rain, the snow, the fog and so on.

The freeway traffic safety question urgently desiderates to study thoroughly the solution. Therefore, aim at the reason and characteristic of freeway traffic safety accident, using the intelligent principle and advanced technology based on the ITS, the integrated model has been established for cooperating warning and controlling of traffic safety. There is ital practical significance for traffic safety, it can active control the vehicle driving speeds and enhances the safeguard as well as prevents and avoids the traffic accident. This article take the safety driving speed as the primary control goal, has studied the cooperating control system of freeway traffic safety oriented to preventing and avoiding of accident.

2. The cooperating control system based on safety driving speed

2.1. The function composing of the cooperating control system based on safety driving speed

The highway safety driving speed is refers to the suitable moving speed under the usual traffic condition, usually it is confirmed by design speed according to the automobile characteristic which goes on the road and the road geometric design request. The limitative rate of existing freeway safety driving speed all is generally fixed, but cannot dynamic change according to characteristic of the different vehicles, the environment situation of the road, the combination of the road linear as well as climatic conditions. Therefore, if the weather situation and the traffic condition change, the limitative rate of existing freeway safety driving speed is unreasonable. On the other hand, at present our country lacks the effective monitor and the initiative control method to the highway vehicles driving speed.

The cooperating control system of traffic safety oriented to preventing and avoiding of accident namely considers the different condition such as road environment, vehicles type, weather and so on, confirms the safety driving speed of the different vehicles on different road section in different condition, also real-time
detects and controls the driving of the vehicle, insures the vehicle move at the safety speed. Therefore, the function composing of the cooperating control system based on safety driving speed is shown in Figure 2.

![Figure 2 The function composing of the cooperating control system based on safety driving speed](image)

2.2. The architecture of the cooperating control system based on safety driving speed

The architecture of the cooperating control system based on safety driving speed takes the ITS and the GIS/GPS as well as INTERNET as the support.

ITS (Intelligent Transportation System) is established through effective fuse the advanced information technology, the data communication technology, the automatic control technology as well as the information processing technology, and utilized in the entire traffic control system, has the characteristic of information and integration as well as intellectualization, it omni-directional displays function in wide range, also it is real-time, accurate, highly effective transportation synthesis intelligence control and management system. The ITS service domain mainly includes the advanced traffic control system, the advanced journey information system, the advanced public traffic system, the advanced vehicle control system, the business vehicles dispatch management system, the electronic toll collection system, the emergency management system and so on. Therefore, the ITS system may provide the cooperating control system based on safety driving speed for the basal technology support.

Using the GIS technology, through configure data network layout, establish the GIS space database of road environment and map essential factor attribute database, and integrated with the road traffic environment real-time information system
including the vehicles type database and real-time weather information system. It can
dynamic input or output the road traffic environment real-time information.

Using the digitized vehicles tracing positioning system including the GPS, the
GSM and the GIS technology, using the computer network to track and go to the
vehicles, real-time gather the driving speed, also achieve communications function
with the moving vehicle.

Then effectively integrate the GIS, the GPS and the GSM, has constructed the
safety driving speed cooperating control system based on the INTERNET. Its
architecture is shown in Figure 3.

**Figure 3**  The architecture of the cooperating control system based on safety driving
speed

### 3. The technology frame of the cooperating control system

The cooperating control system takes the transportation geographic information
system, the vehicles localization technology, the wireless communication as the main
technical support, The GIS may be the basal information system platform, has the
superiority including the visualization, the geography analysis and the spatial
analysis, the database unification management and so on. The vehicles localization
technology may real-time gain catches the positional information of goal vehicles
according to the concrete application need. The wireless communication may achieve
the data transmission in wide range, also achieve system direction, dispatch,
monitoring, management, etc.
Through the technical integration, may effectively achieve the goal such as the real-time and dynamic transportation information, the monitoring, the analysis and the intelligent control.

3.1 The common information platform based on GIS

The cooperating control system based on safety driving speed mainly includes the vehicles real-time driving speed gathering system, the vehicles safety speed dynamic information issue system, the overspeed early warning and the intelligence control system and so on. Between each subsystem has the massive information exchange, each subsystem information need complex and diverse, but some information is may share. The cooperating control system through use the common information platform to unification memory, organization, processing the entire information, can guarantee effectively the data relates accuracy, the intelligibility and avoid the data redundancy, enhance the using rate and the transmission speed of the system information.

The information is important fundamental element of the cooperating control system, also is linking ligament each subsystem. The information of the cooperating control system based on safety driving speed including static information and dynamic information. The static information is including the road linetype, the typical vehicles information, the transportation attached facility information and so on, there is change small along with the time. The dynamic information mainly refers to the information which is real-time gathered, such as real-time vehicle speed, real-time road environment condition, meteorological condition, vehicles positional information and so on.

Because geographic information system (GIS) is took as one kind of technical system which processes synthetically and analyzes the spatial data, can effectively carry on gathering, memory, searches, modelling, analysis and output to the spatial data of road environment. Its unique merit lies in that can unifies organically the geographical position and the correlation attribute information. Because the road traffic information and the geographical position close correlation, using the GIS technology as the common information platform for the cooperating control system based on safety driving speed. Not only direct-viewing show the traffic information in the space, but also offer support for digging deep information and the following information service as well as the assistance decision-making. Therefore, aim at the information requirement characteristic of control system, has established the exclusive dynamic geography information database, builds the GIS platform through the network interconnection and the distributional database system, achieves coordination and application in overall system.

According to the general frame of the information platform, and considering the request which the GIS uses in common the platform as the traffic safety coordination control system, the system uses three architectures:

3.2 The technical frame of system
According to the general frame of the information platform, and considering the request when taking the GIS as the common platform of the cooperating control system, the system uses three architectures:

1. Client level. It is the user who uses the information platform, including the vehicles driver, the freeway safety superintendent, the public safety responsible department and so on.

2. Application service level. It takes the GIS as the information platform of the traffic safety cooperating control system, gathering data through each subsystem, and returning these primary datas with stipulated form, then dealing with these datas such as classification, extraction, excavation and fusion and so on. While data storage, the different information according to the standard agreement issued gives the corresponding application subsystem.

3. Data management level. The level memories the foundation data, provides information connection between the platform and various subsystems.

3.3 The basic function of the GIS common information platform

The GIS common information platform is the hinge of wholly traffic safety cooperating control system, it shoulders the responsibility of information gather, amalgamation and transfer. Its basic function exhibits at:

1. Information gathering function. Various subsystems according to the stipulation form distill sharing data, complete to the static information and the dynamic information reorganization, also guarantee the data accuracy and readability, avoid the mass datas redundancy.

2. Information fusion function. According to the function request and the inner link among each subsystem, dealing with gathered datas such as classification, statistic, connection under certain criterion, digging deep information, and integrating information in order to be used to the cooperating control system.

3. Information issue function. According to the request of each subsystem, transfers the need information to the subsystem with the stipulation form; According to the request of service and demand popedom, transfers the client with information such as datas, graph, picture, etc.

4. The structure research of the traffic safety cooperating control system

At present, ITS has many safety technology, on the one hand its goal is in order to prevent and reduce traffic accident rate, on the other hand is in order to reduce the accident casualties rate. In order to better control the freeway traffic safety, must carry on the integration to the existing many traffic safety technology, in view of the request of preventing and avoiding the traffic accident. According to the flow of information, the integrated system may be divided into the information gathering system, the information analysis system, the information issue system; Saying from the function, the integrated system generally makes up of the computer system, the traffic inspected system, the accident early warning system, the communications system, the electrical power distribution system, the closed circuit television video
management system, the whole system is composed by the software and the hardware, as shown in Table 1.

<table>
<thead>
<tr>
<th>Subsystem</th>
<th>Safety technology</th>
<th>Safety function</th>
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<tbody>
<tr>
<td>Traffic detector System</td>
<td>vehicle detector, video detector, weather detector, urgent telephone, patrol car, camera, GPS, etc</td>
<td>Promptly gains and feeds back the transportation information, the weather information, the accident and the vehicles breakdown information the entire road as well as the special road section (including big bridge, tunnel, multi-fog road section, traffic hinge)</td>
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<tr>
<td>Computer system</td>
<td>computer network hardware, the GIS, the electronic map, the analysis software of traffic information, etc</td>
<td>Judge the present traffic situation, forecast the trend of accident development, propose the control plan, and make the commensurable analysis according the historical data</td>
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<tr>
<td>Accident warning system</td>
<td>analysis and issue accident system, the alterable information board, the alterable limited speed sign, the terminal control module carried at the vehicle, etc.</td>
<td>Analysis the accident which possibly occurs according the transportation condition, prompt the driver to take the corresponding preventive measure through control equipment.</td>
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<tr>
<td>Video supervisory system</td>
<td>CCTV, computer display.</td>
<td>Reflect clear the vehicle running situation, real-time track vehicle</td>
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<tr>
<td>Communication system</td>
<td>Wireless communication, line-wire communication</td>
<td>It is the entrance that the traffic information enter the system, also is the exportation that system send instruction to the outfield equipment.</td>
</tr>
<tr>
<td>electricity system</td>
<td>supply and transmit electric equipment</td>
<td>Ensure the system to run reliably</td>
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According to the flow direction of traffic information as well as the structure and the function of various subsystems, the traffic safety integrated mode which
includes accident forewarning system and cooperating control system faced to the prevention accident and avoidance accident is shown in the Figure 4.

![Figure 4](image.png)

5. **Conclude**

Along with the unceasing development of social economy and the continually growth of traffic volume, enhances the freeway safety rate using intelligence transportation system (ITS) that has become the development direction of the future transportation. Because the condition of our country to carried out ITS research still not to be mature, but the traffic safety infrastructure construction has yielded certain result. Therefore this article analyzes our country freeway traffic accident in the characteristic and in the origin, in order to realizing prevented and avoided of traffic accident, the integrated model has been established for cooperating warning and controlling of traffic safety. The mode of cooperating safety controlled is put forward by using ITS and GIS/GPS and information system of safety cooperated controlled. Rational distributes the traffic safety technology function and harmonizes the relation of these various subsystems. The integrated architecture of safety cooperated controlled is made up, that is realized each factor for affected safety is inspected and controlled in real time.
Reference: