Pre-crash Sensing and Warning on Curves: A Review

Pranay D. Saraf
M. E. Scholar, Dept. of CSE, GHRCE, Nagpur

Nekita A. Chavan
Assistant Professor
Dept. of CSE, GHRCE, Nagpur

Abstract- As the number of vehicle in transportation system are widely increasing; so it has been a major concern for highway authorities to facilitate effective control of traffic for collision avoidance. For various highways, these rising demands cannot be counteracted by further extending the existing road infrastructure giving a special importance to the efficient use of the existing network. In this respect, digital signals are vital factor since it is visible from long distance which is often capable of improving the traffic flow. For efficiently predicting the other end traffic from the blind curve, a digital approach is taken into account. The distance between two vehicles with a signal indication between them will assist the driver to adjust the speed of vehicle at the curve end to cross it without any collision. The traffic density is estimated using the speed sensors and the vehicle with maximum value greater than threshold speed will get assisted using actuators to slow down its speed to avoid the collision on the curves.

Keywords - Collision Avoidance, Curve Roads, Digital Signals, Sensors.

I. INTRODUCTION

The provision of safety in the traffic is the major concerning issue in the recent years, as the number of accident rate is increasing continuously which is leading to the loss of human power. As the number of vehicle in transportation business is ever increasing, it has been a major concern for highway authorities also to facilitate effective control of traffic for collision avoidance. As the most traffic is on the highways for transportation, leads to requirement of more safety. The main objective of this study is to further improve road safety by providing real-time alerts to drivers about hazards in their projected path and their immediate area [1]. This is made possible through the intercommunication of the vehicles and roadside units. The vehicles are transmitting their information for the purpose of road safety parameters. This road safety information includes the information regarding the parameters which includes lane merge warning, blind spot warning, and curve speed warning, etc.

The real time data from many countries cannot be compared because of lack of unification in data collection and data handling as the traffic rules and its violation rate is vastly differing. Furthermore, it may leads to challenges for the comparisons of the results from different analyses on these data are obscured by the use of different techniques for analysis. A wide variety of techniques has been applied in different countries for the driving regarding the traffic rules, traffic signals, traffic signals provisions, sign boards on the roads, etc. The aim of the present work is to determine if inducing a mood would result in a decrease or elimination of the positive illusory perception of driving skill and perceived invulnerability to accidents.

II. BACKGROUND

The Intelligent Transport System (ITS) is having a primary goal of a road safety. It is providing a promising way to alleviate traffic accidents giving ability for vehicles to communicate with each other. As the human reactions are taking much more time to response any sudden activity. The ITS is trying to overcome these problems by providing a systems to reduce the response time. In Addition, the complications that are present ahead are also taken into consideration. As the information regarding the future complications is the need of the drivers. This is needed the driver assistance so as to induce sudden breaking or limiting the vehicle speed for further accidents, especially in the high alert zone or at the blind curve or S-curve roads which are prone to accidents. Such roads, we mostly found in the hill areas where the roads are designed by extracting the hills.

The road architecture in the hill area is also not having much more space to extend the road infrastructure as concerning to the geological parameters such as soil conditions, rock type, etc [2]. The highways are the most contributing for this work, as the number of accidents in our country are mostly found on the highways. These include the National highways which are joining the metro cities of our country. The survey has been presently done for the curve roads present in the Dhanaulti (Uttarakhand), Pachamadhi (Madhya Pradesh) and Chikhaldara (Maharashtra). While visiting to those places, the roads which are available are having very tedious combinations of S-curve roads and Blind-curve (i.e. U-curve). Due to such a road structures the proning to accidents are more as the drivers who are exiting are having very limited visibility for both the directions.

Earlier the blind curves area has been negotiated as the worst case scenario in the mind while designing the roads as well as traffic rules for the region of curve roads in our country. This is the main reason for increasing the number of accidents on the hill area, blind curve and S-curve roads. Also the main causes for those accidents are the present sign boards system. It is found that at most of the places those boards are not present and if present, it is not in the proper condition to assist the driver for the next occurrences of the road diversions. These sign boards present are not been providing a proper information to the driver. This is because they are just placed at a distance of 10-50 meters from the cliff edge of the turns. Because of such provision of information the driver with relatively high speed (e.g. vehicle coming from upper side of hill) having more chances to meet the accident. Thus we are trying to propose such a system which will be a digital display. The provision of digital display will might give result in less number of accidents. This is because it is visible from longer distance, so as the driver get assisted properly before visiting to the curve road or blind spot. In the display board we are trying to provide the parameters like direction, speed and distance of nearer vehicle coming from opposite side (at least 50 meters/feet's) and the density of the vehicle in the particular area (at least 300 meters). This might be reducing the accident chances on the blind curves and blind spots. The existing work for the blind spot detection with the contribution of ITS is discussed in section III.

III. RESEARCH BASED ON MONITORING

As the blind curves are the most concerning issue due to its high accidents rate, a lot of work has been done. Depending on the work they are categorized and literatures as concerned with the following categories like image, video, speed, etc.

Research on Image Processing

Byoung-Ki Jeon, et. Al. [3] proposed a technique for detection of the road using genetic algorithm (GA). Their technique is using the spaceborne synthetic aperture radar (SAR) image to accurately detect the roads. The technique is detecting the curve segments and grouping those curve segments as a concept of region growing. Due to this grouping, the image for the next 30 meters road is generated.

C.T.Chen, et. Al. [6] uses the real time video to detect the all kinds of vehicles on the curve roads. They categorized, detect and locate the vehicles as the object. They implemented the system in Automotive Research and Testing Center (ARTC, Taiwan) which is based on low-cost DSP platform for lane information, blind-spot information, etc. they proposed the system for LMV's as well as for heavy vehicles.

Research on Autonomous Systems

Qing Li et. Al. [4] presents a survey on the present working of the Springrobot which is the autonomous vehicle. It is featured with safety warnings and driver's assistance with the combination of various sensors and highly precise decision map which helps to get detection about the lane marking on the curved roads. They tested the results on the 3-D parametric space of the curve with experimental and practical road scene.

Hess et. Al [13]

3.3. Research on Vehicle-Infrastructures Parameters

M. Tanelli, et. Al. [5] worked on the real time identification between friction and road. The friction characteristic of tire-road is deeply interlaced with dynamic control system present in the vehicles. They used the techniques based on maximum likelihood approach and recursive last squares. Thus in addition to anti-lock breaking system (ABS), such real time information regarding vehicle parameter is much more reliable.

3.4. Research based on Kinematics

Carsten Hasberg et. Al [7] proposed all the kinematics for the various vehicles to give the correct information about the accurate localization of the vehicle on the curve path. The probabilistic curve map obtained from the curve coordinator is modeled from its coordinates in 1-D. To overcome the uncertainties, the probabilistic treatment is

validated through simulations and real-world experiments. Thus from the literature, we came to our Problem definition of provision of such a system which can overcome the problems regarding collisions on the blind curves.

IV. RESEARCH BASED ON ROAD PARAMETERS

The research has been carried out for the survey in India at the various places, mostly including hill stations. It is related with the study of existing systems present in the particular area for the collision avoidance on the curve roads. The most common system found during the survey is the sign boards that are present just before the curves. They are not properly visible from long distance. Thus, the accident chances are more due to such a provision which is not prominent at such dangerous places. At most of the places either they may not be present or in not proper infrastructure conditions. This the main trouble with the system.

S.K. Mathur et. Al. [2], works on the geological conditions across Pir Panjal range in Jammu & Kashmir, India, where they proposed the tunnel of 8.4 Km to be handled with the rock and sand conditions present. The tunnel is providing the road connection throughout the year between the Jammu plains and the Kashmir Valley. It is maintained on Hydrogeological conditions to avoid steep gradients, landslide and avalanche prone zones and blind curves.

In the research at Dhanaulti (Uttarakhand) most infrastructure of the road is made by breaking the huge hills, which leads to most of the blind turns and also it is not possible to increase the road infrastructure also. At Pachamadhi (Madhya Pradesh), the roads are provided with the sign boards but they are placed at very nearer to the blind curves. Thus, the driver will not get assisted at proper time during the night and the possibility to meet the accidents is increased. And at Chikhaldara (Maharashtra), no such provision is present there at all. Thus the accident rate is found to be more at the most of the blind spots, leading to make the road to be danger. It is also found that the roads are also not in the proper conditions to drive, and most of them are damaged more near the blind area. This is lead to the over-sliding of vehicle or damaging to vehicle. For such area of the roads, we are trying to propose a system depending on the survey which will be the possible contribution will discuss in the section V.

V. ELEBORATION OF CONTRIBUTION

The contribution to the proposed work is elaborated by taking the few parameters into considerations which will be the useful to work on its various phases. These parameters are included in our proposed system work because if a rider is approaching to the situation they are observing and riding accordingly, there will be enough time to react. Or else, he will be facing and might be suffer from a nasty surprise as rider merely seeing the curvy road and not observing the true implications on it. The various phases are taken into considerations according to their parameters and by considering every vehicle as a node they are discussed as:

1. Tracking Phase: In this phase, we are trying to get the information about the vehicle size and categorized it. This is because it is found that the most number of accidents are faced or happened due to LMV (i.e. cars) which are crossing the lanes at the curves with relatively high speed resulting into the over sliding [8]. This will be done by using the pressure sensors deployed at the distance of at least 50-120 meters from the curve.

At the same place, we are providing with the actuators which are deployed in a group. These actuators will be in work for the vehicles that are exceeding the speed limit of the road at the particular curve due to which the chances of accidents are increased [9]. These actuators will track the information of the vehicle speed. If it is above some threshold value (e.g. 22-27 km/hr), the actuators will come above the road surface and give vibrating effect to the driver. So that he has to less down his speed before he will visit to the blind spot on the curve road.

2. Neighbors Discovery Phase: In this phase, distance between the two vehicles is the main parameter to concern. The status of the sensors is having a vital role in this phase [10]. The sensors will give the distance between the two nearest vehicles that are coming in opposite direction. This information is also made available so as to warn the drivers if they are having exceeded high speed [11]. This contribution will help in making the rules for the traffic system in the rural as well as urban area.

VI. CONCLUSION AND FUTURE SCOPE

The study has been concluded as to incorporate the complex traffic flow and its network characteristics for broadcasting the communication on highway travelling of vehicles in both directions [12]. Our road detection technique can be utilized to create the information in the form of a single map by considering the distance between vehicles. This will assist the driver to know the traffic density in the particular area. The accuracy and robustness of the system is depends on the road boundary detection, road pavement types, noises, lane structures and weather conditions.

Future work is to provide the assistance to the driver further reducing the running time in the blind spot or curve road detection. And to detect and recognize vehicles machine learning approach may be taken into considerations by designing the special prototype for the area of Intelligent Transportation System.

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