Forecasting approach for Blind Spot Collision Alert

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ABSTRACT

Every year many accidents involving all categories of road users. However, some accidents are related to the blind spot, due to the deficiency of visibility in this zone, also lack of information or negligence. In this work, we focused on the road safety applications. The main of our researches is to alert the risk of blind spot collision. For this we designed a new approach , namely FBSCA, Forecasting Blind Spot Collision Alert, the driver alerts his neighbors for a possible accident related to the blind spot. The most interesting scenario testing includes the case where the vehicles need to exchange information in real-time in order to avoid traffic collisions when their visibility is hindered by road obstacles. For the implementation and testing of our approach we used popular network simulation tools such MOVE, SUMO and Ns2, we provided an assessment of proposed solution in order to alert the blind spot collisions for all neighboring vehicles.

CCS Concepts

• Networks → Network performance evaluation →Networks simulations

Keywords

Blind spot, Safety application, V2V communication, Alert, VANET Network

1. INTRODUCTION

Advancement of embedded technologies in automotive industries makes human life safer and more secure, the vehicles are produced with new innovative mechanical and electronic features installed to enhance drivability and safety. Advanced vehicle safety systems (AVSs) are designed to help avoid vehicle crashes or reduce the severity of crashes by providing warning signals to drivers or automatic actions for vehicles when vehicles are facing potential collision circumstances [3]. Blind spot monitoring systems (BSMs) are an example of this type of feature. BSMs use sensors to detect one or more vehicles in adjacent lanes that may not be directly observable by the driver.

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The system warns the driver of the approaching vehicle's presence to help facilitate safe lane changes. Some systems warn when the BSM sensors detect that one or more vehicles have entered either of the driver's two rear blind zones, and some warn only when other vehicles are in a driver's blind zone at a time when the vehicle's turn signal is activated [1]. If all passenger vehicles had been equipped with lane departure warning, this technology designed to help prevent drivers from unintentionally straying from their lanes and running off the road or colliding with another vehicle, or equipped with blind spot detection systems, which provide a visual alert when an adjacent vehicle is in the driver's blind spot, lowered the rate of all lane-change crashes by 45 percent and the rate of all bind spot collisions avoidance by 53 percent, these technology cut the rate of relevant crashes nearly in half [2].

M.Hang et all describe the major causes due to the vehicles drivers as: Failing to look properly , Turning Improperly , Backing Carelessly, Failing to Keep the Safe Side Gap, and Changing Lane Improperly.

Not all BSMs have the same detection capabilities or operating conditions. In vehicle owner's manuals, many automobile manufacturers state that their systems are designed to detect only highway vehicles, not other objects such as bicycles, motorcycles, humans, or animals.

Various systems have a threshold speed where if the speed of the equipped vehicle is below the threshold speed, typically ranging from 5 to 20 mph, the system is inactive.

Some systems will not detect vehicles passing through blind zones at speeds substantially higher or lower than that of the equipped vehicle. Other systems may not operate when reversing.

The two main goals of the work described in this article were: To describe our alert model (FBSCA), evaluate the performance of contemporary FBSCA, and To develop and validate objective test procedures.

2. BLIND SPOT OPERATION

There are several methods that are available currently to assist drivers in avoiding rear end collisions. These systems falls into two main categories- the first use the human observer i.e. the drivers are presented with data, and driver based on this information will take the decision. the second category is automated monitoring systems. This uses sensors to determinate the position of objects around the car, and warns the driver in the event of impending collisions.

The blind spot is a key concept in driver assistance applications, that this option provides safe and comfortable divining. And for good reason ! This is an area inaccessible to the field of vision for the driver of a vehicle. Blind Spot Monitoring is a driver assistance system that detects the presence of motion in the blind spot when changing lanes [5]. When activated, it indicates this potential danger to the driver by a light directly in the rearview mirror or audible. In this way, we make sure that it is taken into account.

2.1 Blind Spot Monitoring System

Please How does the Blind Spot Monitoring System work? In the same way as the parking aid, that is to say with radars able to identify obstacles. Except that the latter this time scrutinize the sides, from the outside mirrors or the shield, to cover an area difficult to see, along the vehicle slightly behind. Figure. 1 below presents the surface of the vision of a driver according to the speed of the car on both sides.

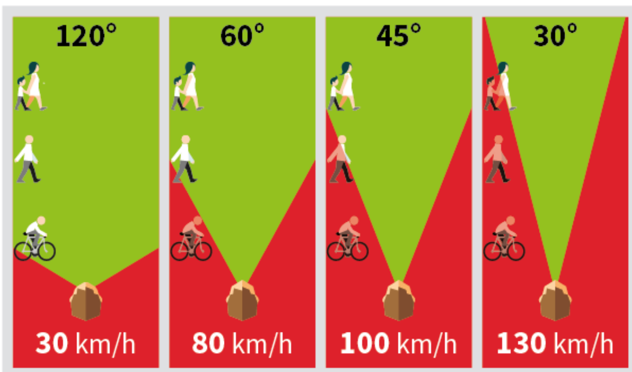

Figure 1. Correlation between velocity and vision angle.

2.2 Blind-Spot Detection

When you sit in a car, every part of the car that isn't glass creates a blind spot. That means vehicles with larger window pillars have larger blind spots, vehicles with smaller rear view windows have larger blind spots, and both cargo and passengers can also create additional blind spots. Blind spots are relatively small close to a vehicle, but they cover larger areas further away. At even moderate distances, a blind spot caused by an A-pillar can obscure large objects such as cars and people, Rajendra and kumar describe several methods for detecting the blind spot obstacle such as panoramic imaging [8].

Another type of vehicular blind spot exists in the space between the driver's peripheral vision and the area reflected by the rear-view mirrors. This type of blind spot can swallow up entire vehicles, which is why it's so dangerous to change lanes without looking to the left or right. How Can Technology Help Remove Blind Spots [5] ?

Mirrors can help remove blind spots behind a driver, but they typically leave large dead areas to both sides of a vehicle. The addition of a convex blind spot mirror can allow a driver to see objects that fall into that type of blind spot, but those images are distorted and can make it difficult to judge distances. It is also illegal to even install a blind spot mirror in some jurisdictions.

there are vehicles in those blind spots. Some also emit active alerts if the driver attempts to change lanes anyway as illustrated in Figure. 2 bellow .Blind-spot detection systems generally don't come standard in cars, but rather as options that are often bundled with other sensor-based safety features such as lane-departure warning and rear-collision avoidance.

A blind-spot detection system monitors a car's flanks – the areas behind and to either side that a driver is least likely to be able to see in their mirrors. Such systems passively inform the driver if

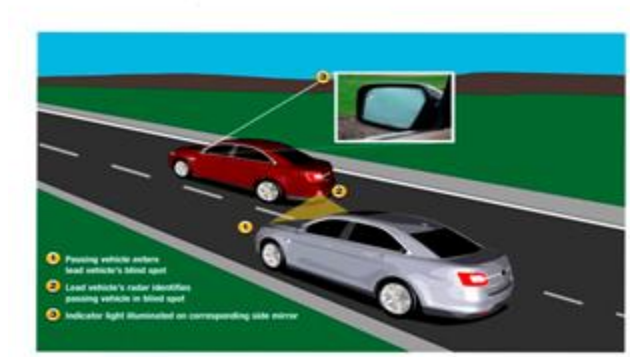

Figure 2. Operations of blind spot detection [6]

How Does It Work? Blind-spot systems depend on radar sensors mounted in the right and left sides of the car's rear bumper. The sensors identify traffic and the car's onboard computer calculates the speed of oncoming vehicles. The driver gets a visual notification, usually in the form of an orange or yellow light on the relevant side of their vehicle, when traffic is detected in a blind spot. Many automakers put these lights within the side-view mirrors themselves. If the driver somehow doesn't see the visual notification and signals a lane change regardless, a beeping audio alert warns them of the danger [4].

3. FORECASTING BLIND SPOT COLLISION ALERT MODEL (FBSCA)

Our proposed method uses After providing the necessary background in details on blind spot detection we are now ready to describe in this section the proposed model, namely Forecasting Blind Spot Collision Alert (FBSCA) , and how it excels in accident avoidance. In the first we describe the fundamentals components of our proposed architecture.

3.1 Design of our approach FBSCA

The Our network is divided into two components, the first contains just only one vehicle namely subject vehicle (SV) and the second represents other vehicles (OV) that are in the same range with the subject vehicle. the vehicle is considerate as SV, if it has one of its two rear blind zones occupied, in this case an alert will be display in the rearview mirror of the driver, then the BSD becomes enable with value equal 1 and takes 0 if it is disable as according to the formula 1. If the incident is occurred, the SV immediately triggers the blind spot alert message to the others vehicles via communication module V2V as shown in Figure. 3 else an warning is broadcast to all neighbors. we assume that vehicles are equipped with a GPS receiver, a Dedicated Short Range Communications (DSRC) transceiver, and in-vehicle sensors. For the rest of this paper, (SV) refers to the subject vehicle and (OV) represent the other neighboring vehicle.

The equations for the BSD model are as follows:

$$\mathrm{f(BSD)} = \begin{cases} 1, & BSD\ \ is\ enable \\ 0, & BSD\ \ is\ \ disable \end{cases} \quad (1)$$

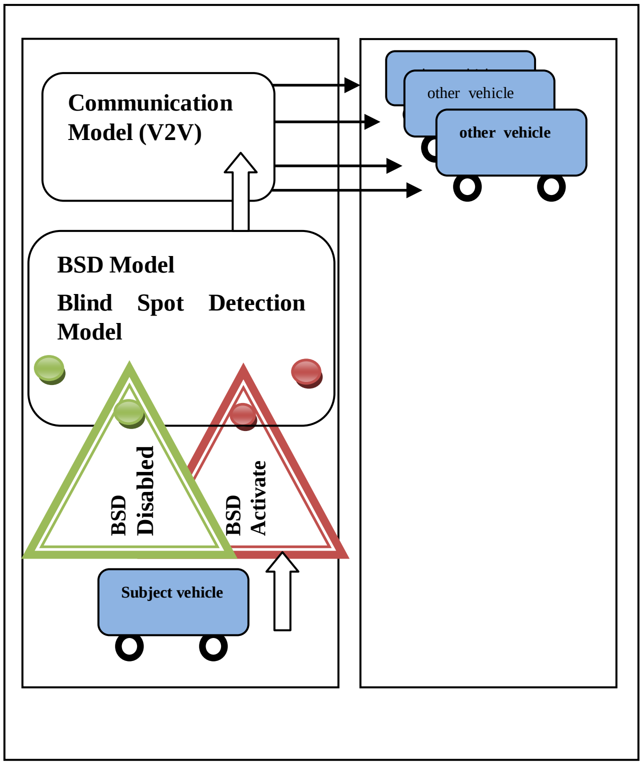

Figure 3. Components of our architecture FBSCA

3.2 Scenario Description

Our model, standing for blind spot Collision Alert, aims to reduce accidents caused in cases where driver visibility is impeded by other vehicles causing blind spots.

The basic idea of our scenario is to use the subject vehicle [7], that has the blind spots alert to inform other drivers if they are about to get involved in a collision.

Before going into more details, it is for the reader's best interest that we present here some examples that illustrate our scenario. It should first be noted that our proposed model applies in the case of a highway where accidents caused by the blind spot are frequent and just only one accident causes several others because the speed of the vehicle does not less months of 80 Km / h, it is for this reason that our objective is to avoid the existence of this collision but if the collision is occurred, Our goal is to try to avoid other accidents by sending by the sending an alert to the neighborhood.

Assuming a network of four (4) vehicles that is in the same range as shown in figure 4 , the communication is done in a direct point-to-point through the DSRC protocol (Dedicated short rank communication), the rang of this protocol can be up to 800 m and we do not need to forward messages.

The white vehicle noted B enters the blind zone of the subject vehicle red noted A, this detection is guaranteed by the sensors installed on the rear wings of the vehicle SV.

The vehicle A is the subject vehicle makes a right maneuver to change the lane, the BSD module will be triggered as a visual alert on the mirror of the driver's rear view mirror A. In this case, the vehicle in A broadcasts a warning message to the other vehicle to be careful.

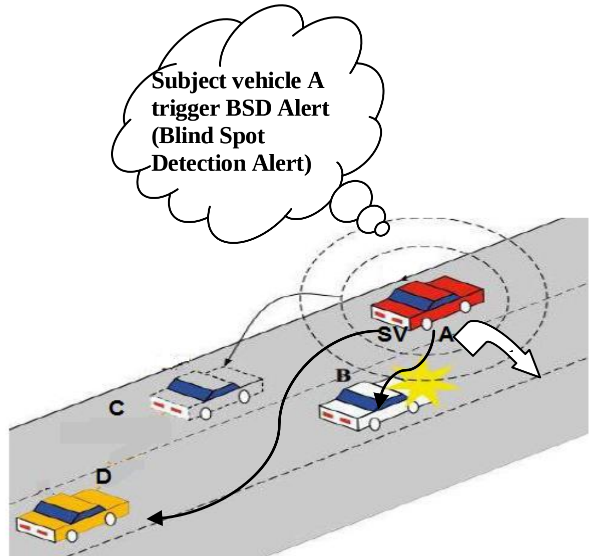

Figure 4. Scenario description

3.3 Algorithm Description

Algorithm 1: Algorithm Initialization

INPUTS: The network, Subject Vehicle (SV)

OUTPUT: Updated the network, communication V2V with Other Vehicle (OV)

1. Initialize Network:

- Set SV(id)= 1; // select the id of SV.
- Set R= 1 km; // Range sensor = 1km

For all vehicles

If distance (VS(id) , OV(id)) <= R….according to (1)

Set OV(id)=1;

End If

This make SV start communication at time t=0

Function of Blind Spot Detection

Void Alert (BSD)

{

- BSD = 0; // BSD Disable
  - ○ SEND_Message_SV(‘Warning to turn’);

  // Alert_Message on the mirror rear driver

  - ○ SEND_Message_OV(‘Warning to happen accident’);

  // Alert_Message to all OV(id) =1

}

Algorithm 2: FBSCA Algorithm

INPUTS: The network, SV and OV position, V2V Communication.

OUTPUT: Updated the network, The BSD State

1. Start the Network and V2V Communication:
1.1. Set SV(id)_Turn = 0; // SV not yet turned
1.2. Set SV(id)_Sens_R = 0; // SV right sensor is disabled.
1.3. Set SV(id)_Sens_L = 0; // SV left sensor is disabled.
1.4. While (SV(id)_Turn = 0) {//Wait SV turn}
1.5. If (SV(id)_Turn = 1) Then //Turn to the right
1.5.1. If (SV(id)_Sens_R = 1) Then // Right Sensor Detected an OV
1.5.1.1. Set BSD = 1; // Blind Spot Detection is Enable;
1.5.1.2. Alert(BSD); // Call to the void Alert
End IF
End IF
1.6. Else // Turn to the Left
1.6.1. If (SV(id)_Sens_L = 1) Then //
1.6.1.1. Set BSD = 1; // Blind Spot Detection is Enable;
1.6.1.2. Alert(BSD, SV(id)_Sens_R = 1); // Call to the Void Alert
End IF
End Else
2. If SV stopped Then
2.1. STOP
Else
2.2. Go to (1)

4. IMPLEMENTATION

4.1 V2V Communication

V2V communications offer the opportunity for cooperative driving and enable safety applications. Vehicles can broadcast now, through beacons mostly, information regarding their position, their speed or any other information about other vehicles nearby. In this way, each node in a VANET is now able to know its surrounding environment in real time. The challenge now, is to find a way to process this kind of information, decide which to keep and then efficiently exchange it in order to help discover or even prevent accidents.

DSCR or IEEE 802.11p operates in the licenced ITS 5.9GHz (5.85-5.925 GHz) band and involves data exchange between high-speed vehicles and V2V communications (vehicle-to-vehicle). Moreover, WAVE offers stability, data is spread in high speed and immediate mode, and it manages to maintain the security of the transmitted messages[7]. provide a theoretical transmission range about 1000m which is more than enough. This scenario could be implemented with the same logic in the case highway.

4.2 Simulation Tools

Before we can proceed to the simulation of our proposed approach, we must describe the simulation tools used. In order to integrate, develop and finally test our V2V communication structure to alert collisions on highways, we used SUMO [10] and MOVE [11] in the creation of traffic and the mobility model, then for simulution of our network we have used Network simulator (NS2) [9].

First, we define the mobility model using MOVE (MObility model generator for VEhicular network) that is rapidly generate realistic mobility models for VANET simulations. The .nod.xml file is used. It is a description of our network nodes and junctions. However, to describe their connections, as illustrated in the Figure. 5 the edges of the network, we should use the .edg.xml file.

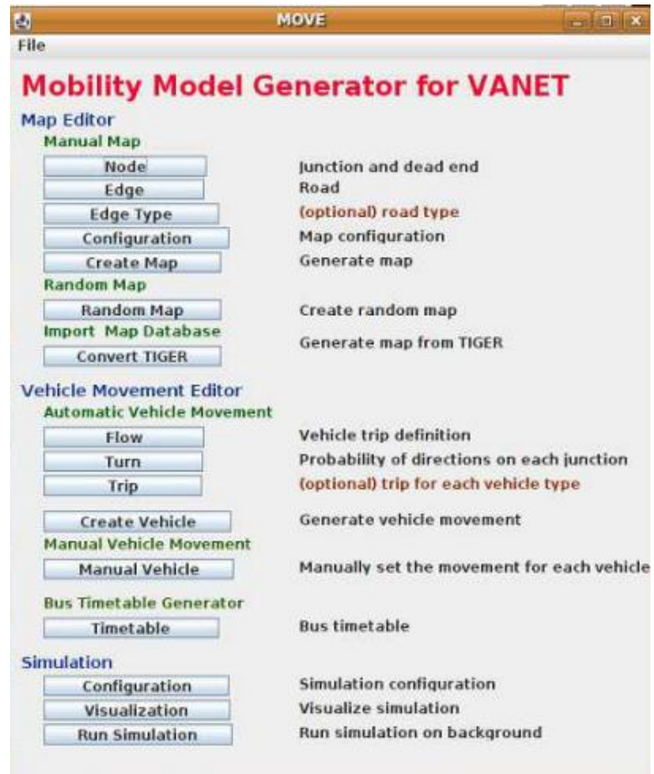

Figure 5. Mobility model of our network

Other formats are also supported. For example, OpenStreetMaps as well, since it will be converts to the property sumo description files. The output is a network description file in .net.xml format.

To create vehicles, we define traffic flows and vehicle movements (mobility model), and we select "Flow" from the main menu as shown in Figure 5.

This editor will specify the groups of vehicle movements on the flow simulation. The movements of the vehicles are generated between the two determined edges. To generate the automatic movement of vehicles, we define the movement of the vehicle as a file Flow.xml.

we select our file from the previously created map ex_Map.net.xml, we specify the output, that is, the location of the file named ex_ROU.rou.xml. We set the start and end time and duration of the simulation.

After generating the map, the vehicles and the movements, we will specify the configurations of the simulation. Select "configuration" at the main menu (see Figure 5).

The location of the two files previously created ex_Map.net.xml and ex_ROU.rou.xml, the start and end time of the simulation must be specified. The output name ex_sumo.sumo.tr must be indicated. To see vehicle movements on the SUMO simulator as Fig. 7 shows, we will select "Visualization".

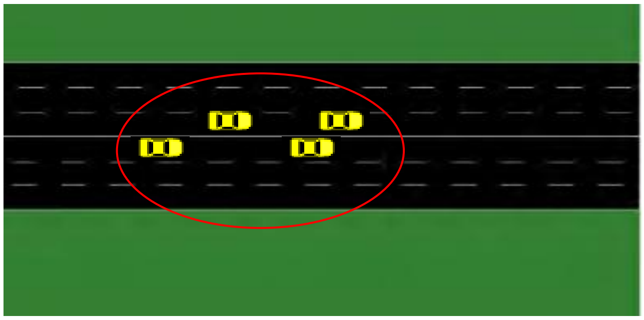

Figure 6. The highway scenario (SUMO environment)

MOVE [11] is built on top of an open source micro-traffic simulator SUMO [10] as shown in Figure. 6. The output of MOVE is a mobility trace file that contains information of realistic vehicle movements which can be immediately used by popular simulation tools such as ns-2 [9], as in the figure 7 illustrated.

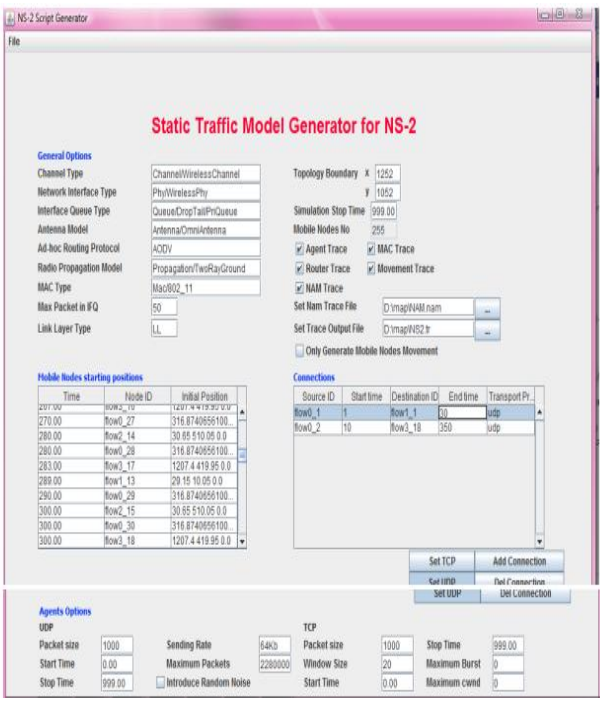

Figure 7. Traffic model for generator(TCL script) for Ns2.

5. CONCLUSION

In this work, motivated by the raise number of accidents caused by the blind spot, we have used the V2V communication to alert accidents both in highways when vision is hindered by road obstacles, we designed a novel road safety application, namely the FBSCA application for this purpose. We addressed the challenges in the design, modeling and simulation of V2V communication network applications, which are highly ad hoc especially in case of a highway. For the implementation and testing of our algorithm we used popular network simulation tools such as NS2, MOVE, and SUMO . We assessed its performance by the number of vehicles alerted relative to the number of vehicles generated, in the case of highway.

As a future work, we plan to make some optimizations by tackling different aspects of our algorithm. For example, we want to add approach for the collision avoidance. To this end we also plan to examine the above cases experimentally. Finally, we will also study the case of V2I communications in order to involve infrastructures in our study case.

6. ACKNOWLEDGMENTS

Our thanks to ACM SIGCHI for allowing us to modify templates they had developed.

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