Augmented Reality for Blind Spots

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ABSTRACT
In this paper, we survey some of the existing techniques to avoid blind spots in vehicles and propose an efficient and low cost method of using augmented reality to reduce accidents caused due to blind spots and improve visibility during nights and rains.

Keywords
Augmented Reality, Blind spots, Night vision, Panorama, Video.

INTRODUCTION
Blind spots are a common problem while driving cars and are one of the major reasons for accidents. The chance of hitting a vehicle while changing lanes just by using the mirrors is high. Also there is a high probability of crashing into the vehicle in front while turning back. In this paper we propose to use AR to resolve this problem. This method also improves vision during night by avoiding headlight glares and also enhances visibility during rains.

In traffic, drivers cannot merge onto a freeway or change lanes safely with standard equipment side view mirrors due to the hazardous blind spot on side view lane change mirrors. There are an estimated 500 plus million automobiles on the planet and around 150 million cars in the United States. This does not include trucks and other kinds of vehicles. The Automobile Safety Foundation (ASF) states there are over 500 Million vehicles that need safety, modernization and modifications.

ASF reports, "In traffic, drivers cannot merge onto a freeway or change lanes safely with standard equipment side view mirrors due to the hazardous blind spot on side view lane change mirrors". The National Highway Transportation Safety Administration and U.S. Department of Transportation report that blind spot mirror lane change accidents, such as side-swipes, damage more than 826,000 vehicles and injure more than 160,000 people each and every year. Additionally, it should be noted that these accidents are avoidable.

In this paper we survey some of the existing techniques to avoid blind spots, describe their short falls and propose a new method that overcomes these short falls.

EXISTING METHODS

Adjusting your Regular Mirrors
The most common and widely used method is to use the car’s existing mirrors. We can maximize the mirror’s capacity to cover a wider zone. There are some better ways to set the rearview mirrors on any car. Essentially, most people have a huge overlap between the side and center rearview mirrors, which is unnecessary. By spreading the side mirrors one can gain valuable insight into what’s beside the vehicle. The image below describes exactly the same. The left side image is the most common mirror setup that one can find today. Adjusting the mirrors as shown on the right side helps avoid blind spots to some extent.

![Figure 1-1 Regular mirror setup](image)

Additional Mirrors:
Currently different blind spot mirrors are available in the market which has an extra mirror mounted on the existing mirror in order to detect blind spots. But this method has problem in case of night driving because the reflection of the head lamp light from the cars behind will make it difficult for the driver to change lanes.
Head-up display (HUD) technology.

HUDs take icons and texts that are usually found on the dashboard of a car and display them in the windshield, helping drivers to keep their eyes on the road. Combined with the sophisticated sensing technology of modern cars, HUDs enable Augmented Reality (AR) visualizations for the driver. For example, three-dimensional visualizations can be generated in the HUD to alert drivers and to guide their attention to dangerous situations.

The disadvantage of this method is that it is expensive and is sometimes distractive as the projection happens on the windshield.

Extra Wide Rear View Mirror

Regular standard rear-view mirror only gives about a 52 degree field of view, which is fine for seeing what’s behind the vehicle, but not what’s next to it. On the other hand this extra wide rear - view mirror, which is apparently used by police officers and race car drivers, expands the field of view to 180 degrees. That means one can see all the traffic that’s behind and adjacent to the vehicle across a 5 lane highway. In fact any vehicles that are alongside and attempting to pass the car will be visible in the mirror until they enter the driver’s peripheral vision, effectively eliminating the blind spot.

Using Cameras and projectors

This method captures video using six cameras (three cameras on the left side and three cameras on the right side) placed on top of the car. The feed from the right cameras are combined and fed to a right projector. Similarly the feed from the left cameras are fed into the left projector. The projector projects the video on the inside of the car, thereby creating an invisible layer effect. The main disadvantage of this method is that it needs two projectors for two different sides and the driver has to turn back.

Short falls of the existing methods

Most of the above methods would not help during fog, rains and nights due to reduced visibility. The methods using additional mirrors increase headlight glares thereby giving a poor reflection of the actual scenario. The existing method using cameras is expensive and still needs the driver to turn back.

PROPOSED METHODOLOGY

The proposed method tries to avoid the short comings of the existing methods in a simple, efficient and cost-effective manner.
Cameras have become a common entity in today’s cars. Rear view cameras help during parking and while reversing the car. Night vision cameras help improve visibility during the nights. Thermal imaging cameras help to see obstacles during fog and reduced visibility.

We extend this concept of using different types of cameras to reduce blind spots. In general most cars have a camera that displays the rear view. We intend to use two additional cameras alongside this existing camera. In cars without a rear view camera three cameras should be used as described below. The cameras are placed strategically – In addition to the center rear view camera, one at the front top right of the car facing backwards and one at the top left is placed. They are angularly placed such that there is a very small line of overlap.

**Figure 1-6 Methodology**

The camera feeds are fed to a panoramic video stitcher which stitches these videos together producing a single image as shown in [Figure 1-7]. The image is displayed on a screen placed in a convenient location.

**Ideal spots and number of cameras**

The ideal spots to fix the cameras are chosen in such a way as to get a clean panoramic view of the view on the back and on the sides. Hence in addition to the rear view camera one camera is fitted on the top right corner and one on the top left corner of the car. The rear camera as the name suggests gets the exact rear view behind the car. The left view camera provides a left side parallel view to the car and similarly the right side camera provides a right side parallel view to the car. Hence totally there are three cameras being used in our method.

**Combining the camera views**

The views obtained from the central rear camera, the right side camera and the left side camera is fed to a panoramic stitcher which combines it into a single continuous feed so that the driver has a clear rear view along with the view of the blind spots. Figure 1-7 explains this clearly.

![Figure 1-7 Combining inputs from the three cameras](image)

This gives the driver a clear idea of the location of the vehicles that are on the blind spots which helps avoid collision.

**Ideal spots to place the display**

The display which will provide the panoramic camera view of the rear and blind spots can be placed either close to the odometer, on the dash board, on the rear view mirror or be combined as part of the existing navigation system. The advantage of keeping the display on the dash board is that it does not distract the driver but still provides a better panoramic view to the driver. It not only avoids the need for the driver to turn back but also removes the necessity to even look at the mirror while driving.

![Figure 1-8 Ideal spots to place the display](image)

**Cost Estimation**

Table 1-1 is a comparison between the projector method explained in the previous section and the proposed method. The comparison clearly shows that the proposed method is less than half the cost of some of the best existing methods.

Cars that have a rear view camera will definitely have a display screen. In such cases the cost is even cheaper. The quality of the camera and the efficiency of the panoramic stitcher determine the quality of the video. It is simple, easier to setup and more convenient with just a single display.
### References


