Autobot Evolution: A Futuristic approach

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***Abstract*: SCABOR is an approach for the 3-D lane detection and autonomous driving. Its main attribute is to diagnose the metrology of roads. It has a wide significance in determining the basic structure, the presence of humps and dips and gives a clear and cache information of the way .Our view on this paper is to apply SCABOR along with the application of the GLOBAL POSITIONING SYSTEM in autonomous driving system for safe and fast driving. Here the SCABOR technology's current application is outlined and its use has been extended to traffic system. We have suggested a unique method for flexible driving. We also suggest ways in which SCABOR technology can be enhanced for future applications. Among the significant advantages, these techniques perform well even in high risk zones and congested areas with up to 100% accuracy where many other techniques fail.**

Keywords: SCABOR, GPS, 3-D lane detection, autonomous driving.

I. INTRODUCTION

"The biggest asset of any nation is nothing but its human resource". In order to save this resource a lot of techniques has been adopted but still, there is a loop hole in these techniques i.e. loss of these resources due to traffic & such problems on the road. To overcome these problems image processing techniques can be applied.

SCABOR is Stereo CAmera Based Object Recognition system. SCABOR along with GPS (Global Positioning System) is the technique that we are going to use to overcome these kinds of loopholes. GPS can give the route in which the vehicle can travel and SCABOR technique gives the 3D lane detection of the road and the vehicles near it. When these techniques are combined together, we can make the vehicle choose the less traffic route and get its details automatically and can drive itself in maximum speed and reach the target say Hospital or Emergency sites in lesser time saving thousands of lives.

A. Why is SCABOR essential?

In knowing the position of our vehicle on the road, the estimation of the current lane's geometry is vital. The second most important piece of information about our position is the geometry of the neighbouring lanes and orthoguardrails and fences neighbouring the road. This knowledge becomes important because:

1. The driving assistance system will have a more detailed information about the environment, which otherwise will be composed only of the current lane and the detected obstacles. In a situation when a collision is imminent on the current lane (an obstacle is in front and the braking system reacts too slowly) the system must know if there is possible lane change, and where. Knowing about the neighbouring lanes and guardrails helps making the right decision.

2. In lane tracking, the situation of lane change will be better handled if the characteristics of the lane we switch to are known before we make the transition. In the absence of any information about neighbouring lanes, the new lane is predicted as having the same width, leading to a possible error.

3. Knowledge about neighbouring lanes will help the obstacle detection and tracking routines. Deciding to track objects that are only on our lane is not enough, because we may miss a lot of useful information. Knowledge about more lanes can help us identify all objects on the road, therefore all vehicles and tracking them reliably.

4. The guardrails are basically obstacles which must be detected and tracked. The obstacle detection / tracking routines, however, expect finite size obstacles, which can be modelled as cuboids and they will not output robust results when confronted to the continuous nature of the guard rails. Thus, a special detection technique must be developed.

Here comes the use of SCABOR system along with the use of GPS, sensors and Autonomous driving control.[1,7]

B. SCABOR

Automotive companies are investing a lot of money in intelligent systems which can assist the driving process. Radar and laser sensors based applications are dedicated for precise pose measurements but they cannot give a complete description of the driving environment due to their nature. Vision sensors can compensate this information but lack in measurements. Stereovision has been proved to be the only method which gives reliable results both for measurements and description of the driving environment.

Fig.1. Side lane on the road

Marginal conditions
• detection range: 100m
• maximum speed: 100km/h
• processing speed: 3m/s
Mean features
• stereo approach
• 3D lane detection on flat and non-flat roads with or without lane markings
• object detection and tracking (in terms of position, size and speed)
• Side lanes and driving area detection

II. 3D-LANE-DETECTION

An original and robust solution for lane detection using 3D road features, a model driven approach and Kalman filter tracking was developed. It uses non- flat road assumption, and works even in extreme conditions (absence of lane markings). Side lanes and driving areas are also detected. Detected lane parameters are: vertical and horizontal curvature, lane width, and lateral position of the car inside the current lane.

Many tasks needed in driving environment has to be developed for a system based on stereovision which is able to perform in real time. The system functions are integrated into a dedicated stereovision framework, which can be easily extended with other capabilities (e.g. image analyzing tasks) or to build a specific application for an active security or driving assistance system for automotive industry. [2,3]

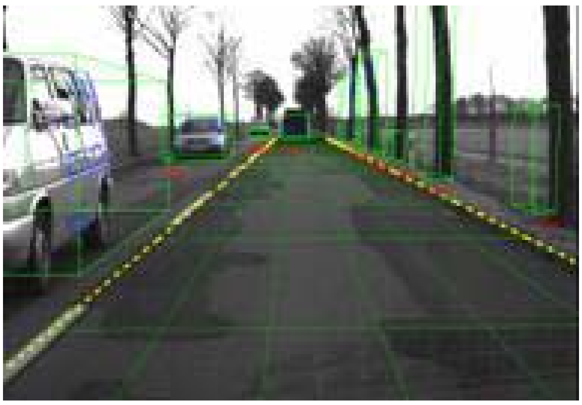

Fig.2. Lane detection on non-marked roads

III.METHODOLOGY

The acquisition system is composed of two digital black and white cameras mounted on a stereo-rig. The cameras and stereo-rig parameters are calibrated using a dedicated methodology, optimized for far-range stereovision requirements. Stereo reconstruction is performed on edge features. Features belonging to lane are classified and their 3D coordinates are used in the lane detection process. The 3D points above the detected road surface are grouped into objects, taking into account the vicinity criteria, density variation with the distance, and 2D image information such as similar texture and connecting edges. Tracking using Kalman filtering is used both for lane and objects parameters.

IV.GPS

GPS is Global Positioning System which uses 25 servers all over the world and provide us with crystal clear details of the roadways, railways, parks, hotels, hospitals nearby and so on .With the use of this GPS system, we can find the system's (say a car) details, its current location, the way in which it is preceding, the area it can reach while going in that particular way, the distance between the nearest landmark etc. [4]

V. SCABOR +GPS = SAFE DRIVING

Here we are introducing our new idea to make the driving safe for selected vehicles, such as that used for unavoidable and needy purposes. We can use this technology in the vehicles such as ambulances and fire forces. Now we can just look at the small demonstration of the technology in the vehicles, along with the application of SCABOR system and GPS. The system is optimized for highways but works well also on country roads or town scenarios.

Main features: stereo approach, 3D lane detection on flat and non-flat roads with or without lane markings, object detection and tracking (in terms of position, size and speed), side lanes and driving area detection. [4,5]

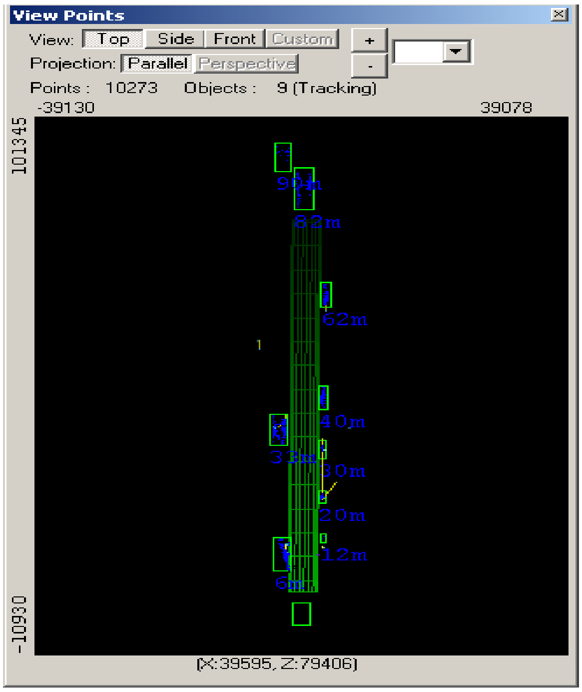

Fig. 3. Top view of the scene from fig. 2.

Here in the above diagram we can clearly see that there are lines which cover the object. If there are any obstacles we will get a clear and cache information about the roads and vehicles nearby. Now we can just take a situation how this technology works. We have already mentioned that this technology can be used for ambulances and fire forces. In case of emergency, the vehicle automatically identifies any obstacle or vehicle adjacent to it and automatically drives according to the current situation based on the programmed inputs. It also determines the speed at which the vehicle should move in each situation automatically. If there are any blocks in the road then by the application of GPS we can determine the shortest path for the safe and speedy travel. GPS will provide the shortest path for the travel; moreover the SCABOR system provides the overall view of the roads. With these applications along with the use of autonomous driving control through pre-assigned programs the vehicle can move through any roads, whether the road is congested or free. With the application of GPS we can find whether there is any block, so the vehicle automatically changes its path to reach the destination. The autonomous driving technology enables the smooth driving according to the preloaded inputs. It also includes, the over taking of the vehicles, parking etc.The signals which are shown by the other vehicles are recognized by the sensible camera placed along with the vehicle. Thus we can save the lives of humans if they get trapped in any dangerous situation or if they need an urgent medical treatment.

(SCABOR) application is able to perform online (onboard) and offline (on recorded sequences) processing. The edge-based stereovision engine delivers about 5000 reliable 3D points per frame (frame size is 640x480), which allows the detection, to operate very fast (the side lane detection routine takes less than 5 ms). The main target scenario is the highway (figure 4, 5), a structured environment with high-speed travelling velocities. The algorithm's performance is best in the designated target

Environment correctly recognizes the side lane width and the guardrail's position with about 10 cm errors. The system, produces dependable results also on rural roads, also marked or even non-marked (figure 6).

Here in the following diagrams, it clearly specifies the movement of the vehicles in the guard rail roads. In fact it clearly determines the path of the way it should choose; thereby maintains a smooth travel on the entire way.

Fig 4.Left corner and side lane detected on highway

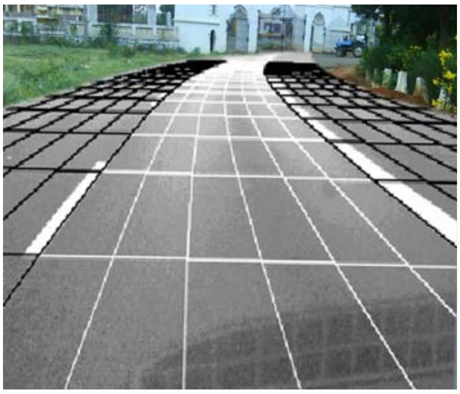

Fig.5. Both neighbouring lanes detected on highway

Fig.6. Left side lane detected on a rural road

Here in the above diagrams we can clearly identify the grids .These grids are only the feature of the stereo camera to identify the width and length of the road. Each box represents a certain length and width for the box. From these analysis the SCABOR detect the presence of the object. The distance of object from the vehicle is determined. From these calculations it sends an output to the preloaded autonomous driving technique. It detects the presence of the obstacle and automatically changes the path of the vehicle from the preloaded instructions. If any obstacles are lying on the path, then it automatically changes the speed to maintain the vehicle to keep in safer position and the vehicle reach the destination quicker and safer.

The quality of the side lane and guard rail results depends on the quality of the stereo reconstruction, which in turn depends on the quality of the camera calibration. The side structures, or guardrails, closer to the periphery of the image, are therefore subjected to a greater extend to radial distortion. They also tend to be more horizontal in the image, and thus more likely to be falsely matched. A careful calibration and a good image quality and resolution are the prerequisites for the algorithm's success.

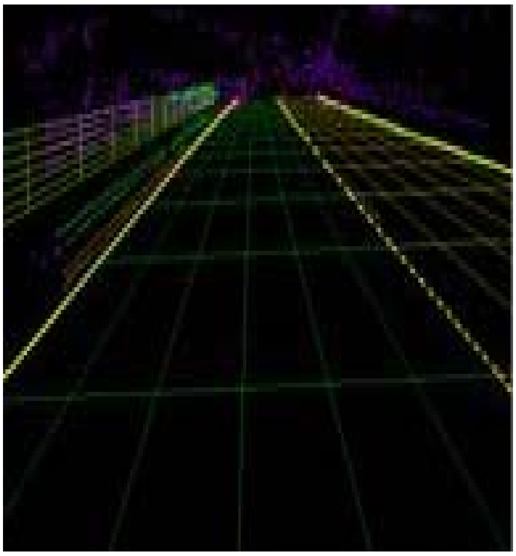

Fig.7. stereo lane detection

VI. STEREO-IMAGE ACQUISITION SYSTEM

Solutions and implementations for:
• Synchronous stereo image acquisition
• Image quality self checking and correction
• Automatic adaptation to the lighting conditions

VII. HIGH RESOLUTION AND FAR DISTANCE STEREOVISION

A stereo reconstruction method for high resolution and far distance stereovision, working in real time is implemented. Accuracy of the classical stereo reconstruction is improved by sub-pixel contour correlation.

3D-lane-detection -An original and robust solution for lane detection using 3D road features, a model driven approach and Kalman filter tracking is developed.

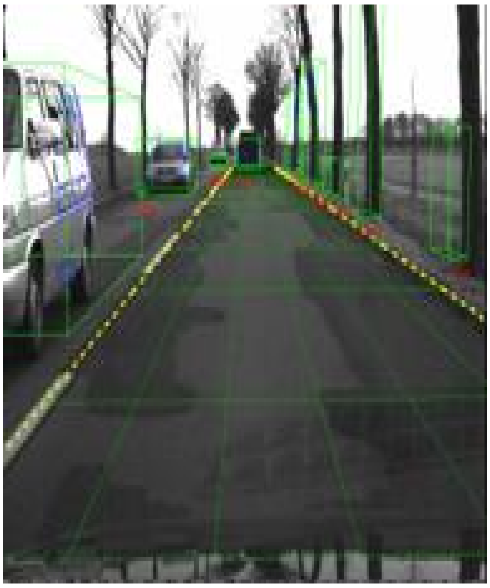

Fig.8. Lane detection on non-marked roads

It uses non-flat road assumption, and works even in extreme conditions (absence of lane markings .Side lanes and driving area (with delimiters) are also detected. Detected lane parameters are: vertical and horizontal curvature, lane width, and lateral position of the ego-car inside the current lane.[6,7]

VIII. OBJECT DETECTION AND TRACKING

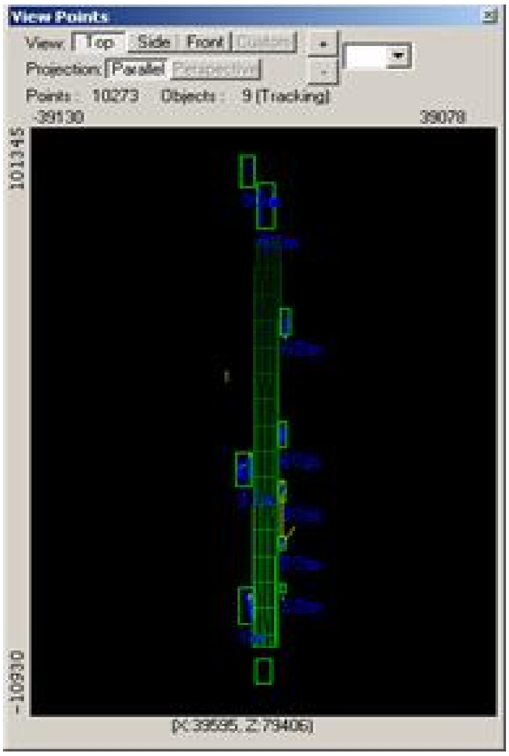

Fig. 9. Top view of the scene from fig. 2.

The equations of the road surface are used for obstacle/road point separation and therefore object detection works even on non-flat road scenarios. The over-rode 3D points are grouped into objects taking into account the vicinity criteria. The 3D density variation with the distance is taken into account. 2D image information such as similar texture and connecting edges are used to refine the grouping process. The object's position is tracked over successive frames using a mathematical motion model and Kalman filtering. Detected objects are described in terms of 3D position, size and speed.[6]

IX.CONCLUSION

We have presented a robust and straightforward method for detecting the side lane delimiters and the position of the guardrails and fences using stereovision. We have also mentioned about the safe autonomous driving with the use of SCABORS and GPS. The algorithm is based on the hypothesis that the side lane and the guardrails share the vertical and the horizontal profile (shape) with the current lane, which is already detected, and this allows the “straightening” of the 3D point set, making it suitable for a histogram-based analysis. The simplicity, accuracy and robustness of the approach are derived from stereovision-based system for lane and road detection. We have developed the system based on stereovision which performs well in real time.

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