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# Use of Bird's Eye View for Lane Navigation in Autonomous Cars

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**Abstract.** Autonomous car research has been conducted for a long time. One of the most important systems in an autonomous car is the navigation system. One of the most commons ways to navigate is by detecting the lanes of the road the cars are going through. It can be done using computer vision using canny edge detection and Hough Lines Transform. However, problems occur when the car is going to make decisions on where to turn because of the perspective of cameras that are usually put in front of the car. One of the ways to solve this problem is by transforming the image into Bird's Eye View perspective. By using Bird's Eye view perspective, we can see the environment surrounding the car from above. This will help on making the decision-making algorithms because now the car can have a broader view of the environment, such as turning left or right and also detecting obstacles in front of the car.

**Keywords:** Bird's Eye View, Autonomous Cars, Lane Detection

## 1 Introduction

Autonomous Cars are cars that can be driven without steering. In other words, cars that can navigate through roads by themselves without the need of human driving/controlling the car. One of the competitions of autonomous cars is the Autonomous Cars Competition in FIRA Challenge.

The main purpose of Autonomous Cars research is to build a system where cars can move by themselves and navigate through roads and obstacles. One of the most popular ways to do this is by using a camera sensor that is put in front of the car and computer vision. The easiest way to do this is by detecting lines in roads and using the processed image to estimate the position of car in road and make decision based on the calculation done by the system.

However, this camera-on-car perspective is not without its flaws. The problem occurs when there is a junction in the road. It will be difficult to make decision because it will be harder to detect If there's a junction if the camera is positioned in front of the

car. This is why we propose an idea to use a method called Bird's Eye View to help detect the shape of the road.

# 2 Methods

## 2.1 Bird's Eye View

One of the problems of lane detection using camera-on-car perspective is the difficulty of processing the image will be harder hence makes it hard to do lane navigation using this perspective. We propose an idea where the image will be transformed into the Bird's Eye View perspective.

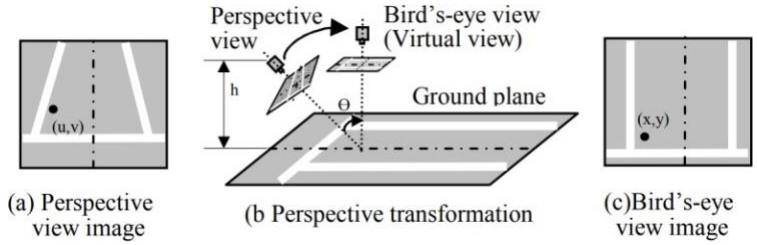


**Fig. 1.** Illustration of a transformation of a perspective from Camera-on-car to Bird's-eye View perspective [1]

We can formulate the relationship between the Camera-on-car view (x,y) with the bird's eye view projection (u, v) with these matrices:

$$\begin{matrix} x' \\ [y'] \\ z' \end{matrix} = \begin{matrix} a_{11} & a_{12} & a_{13} \\ [a_{21} & a_{22} & a_{23}] \\ a_{31} & a_{32} & a_{33} \end{matrix} \begin{matrix} u \\ [v] \\ w \end{matrix} \; where\; x = \frac{x'}{w'} \; and\; x = \frac{y'}{w'}$$

## 2.2 Lane Detection

Once the system has got the bird's eye view of the image, it will continue to process the image to find the lane of the road. To find the lane we used canny edge detection and Hough Line Transform to find the lane of the road.

Canny edge detection is indeed an edge detection algorithm developed by John F. Canny in 1986. It is widely used in image processing and computer vision applications to detect edges in digital images. The Canny edge detection algorithm involves several steps. Gaussian smoothing, Gradient calculation, non-maximum suppression, Double thresholding, and Edge tracking by hysteresis. The Canny edge detection algorithm is known for its ability to accurately detect edges while reducing noise and producing thin, continuous edges. It has been widely adopted in various applications such as image segmentation, object recognition, and feature extraction.

The second part of the Lane Detection is the lines detection. For this we are using the Hough Line Transform. Hough line transform is a computer vision algorithm which proposes an efficient way for detecting lines in pictures [2]. It also can be used to detect other objects in an image as well.

# 3 Experimental Results

## 3.1 Bird's Eye View Transform

The testing was done in simulation using ROS Gazebo, where we simulate a view of a camera being put in front of a car.

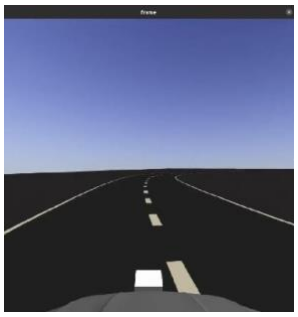

**Fig. 2.** Simulation of Camera-on-car view

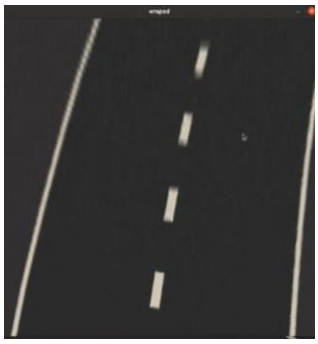

**Fig. 3.** The road image after transformed into Bird's Eye View

## 3.2 Edge dan Lanes Detection Process

After the image is transformed into Bird's Eye View perspective, the lane detection process can be done. The image would be blurred first and then the image would be processed using canny edge detection. After getting all the edge processed, it would go through the Hough Lines Transform process.

**Fig. 4.** Detected Lanes

With that image the algorithm to determine the way the car should move would be easier and it will be easier also to navigate the roads and discover junctions of the road and make decisions on where to go.

## 4 Conclusions

The method of transforming image into Bird's Eye View can help a lot in making a decision-making system of an autonomous car. Bird's Eye View makes the image perspective broader hence it's easier to process the surroundings of the car.

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