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Review Paper on Computer Vision Based Lane Keeping Assistance System: A Design Approach

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***Abstract*:** *In this paper we presents a lateral control method for Automatic Lane Keeping System on road. Lane keeping is the component of Advanced Driver Assistance System (ADAS). It is an advanced part of Lane Departure Warning System (LDWS). Three main techniques are proposed for road Lane Keeping Assistance System (LKAS). First, we proposed lane marking detection. Second, lane markings tracking and third we approach to steering wheel angle control based on the position of detected lane markings.*
A Lane Detection and Lane Tracking system is an important element of many Intelligent Transportation Systems (ITS). Lane detection and tracking system has been an active research area in the past twenty years in the field of Driver Assistance Application. The lane detection and lane tracking is a complicated problem in Lane Keeping Assistance System (LKAS). The lane detection process is used to detect the lane marking and lane tracking process is used to track the position of road lane markings.
Lane Keeping Assistance System (LKAS) is an advanced safety system, which uses a front mounted camera to detect lane lines and find out lateral deviation. The system, when there is an unintentional departure from driving lane and then responsively steer automatically turn the vehicle and back to the driving lane. In this project, a webcam and computer are connected and mounted on a small robotic car where the car movements are controlled by an Arduino. The images from webcam are processed by the OpenCV software. The main objective of this paper is to provide a better safety on roads and reduce the accidental deaths and also reduce the driver's workload.

Keywords: *Lane Keeping Assistance System, Lane Detection, Lane Tracking, Lane Departure Warning.*

I. Introduction

Each year 1.2 million people die worldwide due to traffic accidents. In this world everybody is concerned regarding safety. The people those who go out from one place to other, expect to reach safely without any sudden incident which may occur through externally by road accident. In order to increase safety and reducing road accidents, people are spending lots of money for the advancement in driving techniques which ensure the safety.

Autonomous vehicles are expected to enhance driving safety and to reduce the driver's workload so that can reduce accidents on highway. Autonomous vehicles are vehicle that are capable of sensing and navigating and an environment without direct driver input. Avoiding accidents and saving lives are one of great interest that all researchers and Automobile companies work on. Most of these transportation deaths and injuries occur on the national highways. Therefore, a system that provides a means of warning the driver to the danger has the potential to save a considerable number of lives. One of the main technologies involves in these tasks is Advanced Driver Assistance System (ADAS).

There are three types of Advanced Driver Assistance System:

- Lane Departure Warning System
- Lane Keeping Assistance System
- Lane Changing Assistance system

Lane Departure Warning System (LDW) aims at providing a warning scheme for drivers when the vehicle crosses prohibited edge lines in an inappropriate moment, which usually functions based on lane detection results. A Lane Detection and Tracking system is a mechanism designed for localizing and tracking lane boundaries for road lanes[7]. This project is focussed on the Lane Keeping Assistance System (LKAS).

The Lane Keeping Assistance System (LKAS) is a further development of the modern Lane Departure Warning System (LDWS). This means it combines the features of a convenience system with those of a warning

system. The Lane Keeping Assistance System is able to support the driver in staying within a lane that means it first warns the driver and if no action is taken by the driver, then automatically take steps to ensure the vehicle stays in the lane. The system usually assists the driver through electronic assistance with the steering force.
A robotic car was used to stay in the centre of the lane as it drove along the road by integrating an optical sensor with motors controlled by a computer and strategy planning/coding. The vehicle platform was built from scratch. It used an Arduino nano board with a high current motor driver to control the car's forward, reverse, and turning movements. The computer LKS controls the car via a USB cable connected to the Arduino board. The proposed system can detect road lane markers in the video stream and an unintended departure from the lane. Camera based system relying on computer vision and image processing is one of the most desirable method used to carry out this functions. The algorithm receives the input image from camera, it get converted into HSV (grey) scaled to detect colors in the image. The detected lane marks and vehicle positions are used to determine whether the vehicle stays on its lane or stays out of the lane.

II. Literature Review

Chanho Lee and Ji-Hyun Moon[1](2018): This paper describe, Robust Lane Detection and Tracking for Real-Time Applications. In this paper, a robust and real-time vision based lane detection algorithm with an efficient region of interest is proposed to reduce the high noise level and the calculation time.

Deok-Kwon Lee, Ju-Seok Shin, Je-Han Jung, Sang-Jun Park, Se-Jin Oh, In-Soo Lee[2](2017): This paper describes, Real-Time Lane Detection and Tracking System Using Simple Filter and Kalman Filter to develop a Lane Departure Warning System(LDWS) which can be implemented in an embedded system. This paper shows the experimental results at Nighttime and Daytime. The lane detection rate is 97% for daytime images and 95% for nighttime images.

Hui Zhou, Han Wang[3](2017): This paper propose the vision-based lane detection and tracking for simple applications like driver assistance systems. The approaches diverse from traditional computer vision techniques to machine learning including deep neural network methods.

Manoj Demde, Dr. Prashant Sharma, Dr. R.V. Kshirsagar[5](2016): This paper describes Intelligent Lane Departure Warning System for Driver Assistance using Hough Transform and Hybrid Kalman and Particle filter on different curved and straight roads. Also in different environmental conditions like sunny day, foggy day, rainy day etc.

Manisha Lande[6](2016): This paper describe, optimization of Lane Tracking using Hybrid Kalman and Particle Filter Algorithm. This tried to merge algorithm of two navigation filter i.e, kalman and particle filter. In this paper video are taken to validate the effectiveness of system even under some difficult environment and various lighting conditions. And, the frame rate of this proposed system is roughly 20fps and it is ready for real-time application.

Sayanan Sivaraman[9](2013): This paper describes Integrated Lane and Vehicle Detection, Localization, and Tracking: A Synergistic Approach. This paper proposes and improved the performance of the lane tracking system to low density traffic scenario. But to high density traffic scenario the performance of lane tracking will be poor.

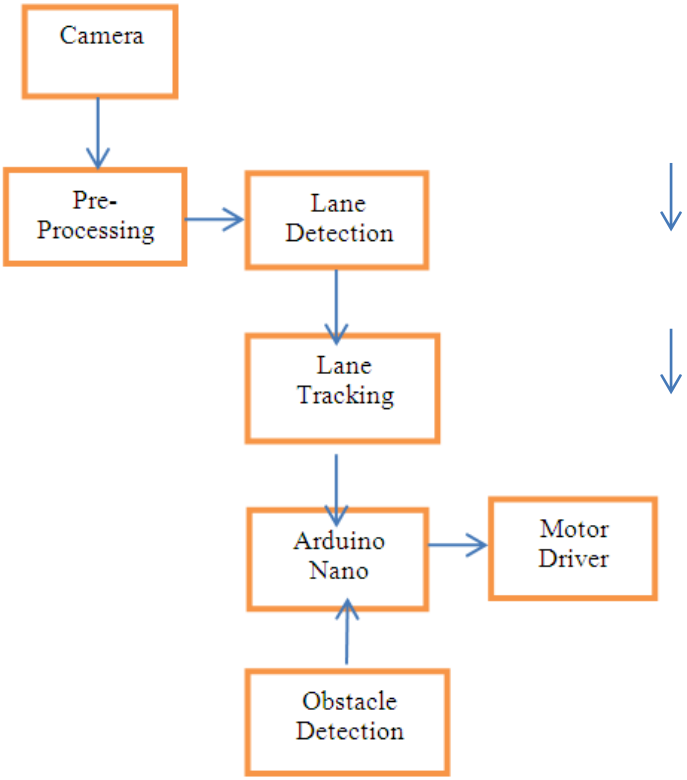

Fig. 1. Block Diagram of Lane Keeping Assistance System

A. Pre-Processing

The stream of input images are captured by the camera mounted on a dashboard. The images from camera are given to a computer for further processing. The input images are used to extracts the features of road i.e. region of interest by the lane detection. Then after apply color segmentation in the color models such as HSV or YUV instead of the RGB model.

B. Lane Detection

The second stage, i.e., detection, extracts lane markings Second, the processing time is slow for vehicle tracking on detected objects, derived from the estimated ground plane.

III. Existing Work

Lane detection and lane tracking has been an active area of research for over a decades. In previous literature lane detection and tracking has been implemented by using Hough Transform, Kalman filters and Particle filters which work well for continuous structured roads. The survey has shown that the existing methods provides good accuracy for high quality images but sometimes provide poor results for poor environmental conditions.

The proposed system should work on lane keeping assistance system by using OpenCV. The system should be able to identify and track the present lanes. The system should also be able to alert the driver in any difficult situation.

IV. Proposed Work

The implementation of Lane Keeping Assistance System (LKAS) consists of the lane detection module, lane tracking module and departure decision module. The structure of the system is shown in Fig. from the ROI using feature extraction methods and refinement approaches. Three main feature extraction approaches can be categorized in the literature: edge-based methods, color-based methods and hybrid (edge and color) methods. Lane lines are always yellow and white. Yellow can be a tricky color to isolate in RGB space, so convert it instead to Hue Value Saturation or HSV color space. Then using the color based methods in which RGB to HSV scaled image pixels are classified as either the lane marking class or the road background class. Then it extracts the white pixels from the image which are the white lane markings by using color extraction method. In color extraction method we need something called a “lower range” and an “upper range” for the hue that we are searching for. The lower range is the minimum shade of white that will be detected, and the upper

range is the maximum shade of white that will be detected. Then the extracted white color is the needed white lane markings.

Fig. a) Sample Input Image

Fig.b) Resultant output image RGB to HSV

Fig: c) Resultant thresholding image

Fig: d) Resultant masking image

Fig: e) Detected Output Image

C. Lane Tracking

This stage has the ability to decrease false detections and to predict future lane markings in the image [7]. Here in the LKA system lane tracking is done by detecting the position of lane markings in the frame. Region of Interest (ROI) over the lane markings are cropped for detecting the right and left movement of lane markings. In the cropped frame it finds the shape or area of detected lane markings by using contour function. The centroid formula is applied to find the center of area. When center of the lane is move towards right then vehicle over correct itself to the center of lane and when center of the lane is move towards left then vehicle over correct itself to the center of lane.

When vehicle faced out of the center of the lane then the lane departure warning is generated in the form of sound or vibration.

D. Hardware Implementation

In this section, hardware implementation of LKAS based on the proposed algorithm has been realized using Arduino nano board. The Arduino is used to control the vehicle movements by receiving the signals from software running on computer. Then according to the received signals Arduino operates the DC motors via motor driver board. Motor driver board uses the L293D H-bridge driver IC.

V. Conclusion

In this paper, we discuss the design of Lane Keeping Assistance System (LKAS) regarding the following stages: pre-processing, detection and tracking. The Lane Detection and Lane Tracking techniques play a significant role in intelligent transport system. In lane detection process we have extracted white lane markings from image. Secondly we have tracked the position of lane markings in frame. Also we proposed the lateral control of the vehicle based on the detection and tracking of the lane.

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