**Title:** Predictive Lane Departure Warning System: A Machine Learning Approach for Enhanced Road Safety**.**

**Abstract:**

This research theme focuses on leveraging machine learning techniques to develop a predictive lane departure warning system with the help of image/video processing. Lane detection becomes a hot issue in the field of intelligent transportations. The number of deaths in traffic accidents across Japan in 2023 increased by 68 from the previous year to 2,678[1]. In India, 153,972 persons were killed in road crashes in the year 2021, corresponding to 11.3 deaths per 100,000 population [2]. In order to solve this kind of problem affecting public health and life, So we plan to develop Lane detection warning system that will alert the driver when the driver may be veering off the road. At present, many algorithms for this problem have been proposed by researchers such as the Support Vector Machine, Hough Transform, Template Matching, and so on. However, these methods are still difficult to apply in all situations. We introduce a robust lane detection method based on the combined Convolutional Neural Network (CNN) with Random Sample Consensus (RANSAC) algorithm. RANSAC is a supervised machine learning iterative outlier detection algorithm.

(2) **Research plan（研究計画）**

**1) Introduction:**

Lane departure is a leading cause of road accidents worldwide. According to the National Highway Traffic Safety Administration (NHTSA), lane departure is responsible for about 50% of vehicle collision accidents approximately, This research seeks to contribute to the advancement of road safety measures and the reduction of lane departure accidents globally, with the help of Lane Departure Warning System (LDWS) using the RANSAC machine learning algorithm to detect and warn drivers of lane departures.

**1.1) Problem Statement:**

The problem this research aims to address is the alarming rate of road accidents caused by lane departure incidents, which pose a significant threat to public health and safety worldwide. Despite various efforts to improve road safety, the number of fatalities resulting from these accidents continues to rise, as evidenced by the increase in traffic-related deaths in both Japan and India, and worldwide. Lane departure accidents are a leading contributor to these fatalities, highlighting the urgent need for effective preventive measures**.**

**1.2) Objectives of the Study:**

In this research plan, our objective is to present a vision-based lane detection system which consists of Canny edge detection [3], Inverse Perspective Mapping (IPM), morphology operations [4], K-Means algorithm [5] for division of regions of left and right lanes, and RANSAC [6]. A labeling-based RANSAC algorithm is proposed and utilized in the lane detection process.

**2) Plan/Methodology:**

I plan to conduct the following research in Japan to improve the lane detection system using machine learning algorithms. The methodology involves implementing a three-step phase processing for lane detection from real-world driving videos:

(i) The first step includes setting up a camera video setup.
(ii) The second step entails blurring and edge detection to remove environmental noises as a preprocessing step.
(iii) The third step involves road lane detection based on RANSAC combined with CNN processes for accurate lane detection.

**2.1) Phase 1:**

The initial phase of our research focuses on advancing lane detection technology. We will strategically place a camera behind a room mirror to capture images of the road ahead, where lane shapes will be distorted based on the camera's position and orientation. To enhance accuracy, we will implement Inverse Perspective Mapping (IPM), which will transform the input image into a top-view representation. This technique will allow us to more accurately estimate lane parameters by aligning the lane shapes in the image with their real-world counterparts. Through this innovative approach, we aim to revolutionize lane detection systems, contributing to safer and more efficient road navigation experiences.

**2.2) Phase II:**

In the second phase of our research, we will focus on labeling lanes and eliminating noise. Here, we will apply two mathematical morphology operations, including closing and erosion. Unlike traditional RANSAC, our method will pre-determine labels for edge points, thereby improving accuracy. The proposed labeling-based RANSAC parameters will be estimated iteratively until every combination is explored. These processes will be performed iteratively until every combination is investigated.

**2.3) Phase III:**

In the final phase, the IPM image will only display the forward area, primarily featuring two lanes: one left and one right lane. Edge points will be divided into two groups using the K-Means algorithm for subsequent processing, RANSAC sampling. The number of edge pixels will accumulate along the vertical axis. Through the application of the K-Means algorithm (K=2) to the histogram, the boundary will be determined to segregate the two groups, representing the left and right lane candidates. Even after the morphology operations remove some noise, there will still be edge points not directly related to the lane. These remaining edge points will then be regrouped into distinct labels, which in turn will be utilized to estimate lane parameters via the RANSAC algorithm. The proposed RANSAC will select samples based on label unit.

**3) Expected Outcomes:**

The research plan involves the development of Lane Detection Warning System (LDWS), mainly focusing on the vision-based lane departure warning system. In this paper, we propose a labeling-based RANSAC algorithm that can estimate lane parameters more efficiently. Through simulations, we demonstrate that the proposed method exhibits greater robustness compared to conventional RANSAC in various environments, including road brightness changes. However, we observe limited detection performance of the proposed method in highly complex environments.

**Literature Cited:**

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