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Leveraging Threshold-Based Image Processing for Autonomous Vehicle Safety

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Abstract: *In the last two decades, most automobile companies have focused on developing driverless/automatic driving vehicles. A major challenge for these vehicles is detecting objects and other vehicles on the road. Image processing is one solution to address this problem. In this paper, the input images are obtained from an overhead-mounted camera. The noise in the input images is then removed, and the required information is extracted. We used SCILAB for image processing, along with a microcontroller interfaced with it for real-time processing and actuation of commands.*

Keywords: Automated Vehicle, Pre-Processing, Threshold, Bi-level Threshold Algorithm

I. INTRODUCTION

The "Global Status Report on The Global Status Report on Road Safety 2009 by the WHO states that over 1.2 million people die each year on the world's roads, and between 20 and 50 million suffer non-fatal injuries. In most regions, this epidemic of road traffic injuries is still increasing. Over the past five years, most countries have endorsed the recommendations of the World Report on Road Traffic Injury Prevention, which provides guidance on how countries can implement a comprehensive approach to improving road safety and reducing the death toll on their roads. One solution to improving road safety is increasing the use of autonomous vehicles capable of detecting obstacles on the road automatically. This detection can be achieved with the help of machine learning and digital image processing.

II. BACKGROUND MOTIVATION

In recent years, a lot of research has been conducted in the area of automated vehicles and automated highway systems (AHS). All this work shares a common goal: to make driving safer and easier. The need for safer driving becomes especially important when a driver has to drive long distances. It is essential for the driver to remain highly attentive in order to follow road signs and keep the vehicle within the lane. Several developments have been made in the area of cruise control systems, which relieve the driver from constantly adjusting the vehicle's speed.

III. PROPOSED MODEL

A. Video Acquisition

The real time images are captured form the vehicle camera which placed in the front of vehicle. The camera takes the continues images of the road and sends the captured images to processing unit for the next step.

B. Pre-processing

The pre-processing stage contain mainly three steps:

- RGB to gray scale conversion
- Noise removing
- Resizing

The acquired image form front mounted camera which present in RGB color. Before starting the processing the RGB color image to convert into gray scale image. This conversion is first step. The gray scale converted image may contains noise(error data). So in the pre-processing stage the noise in the images removed using the Mean filter. Another step in pre-processing is resizing which means changing the size of the image. 320x240 pixels has been used through this study.

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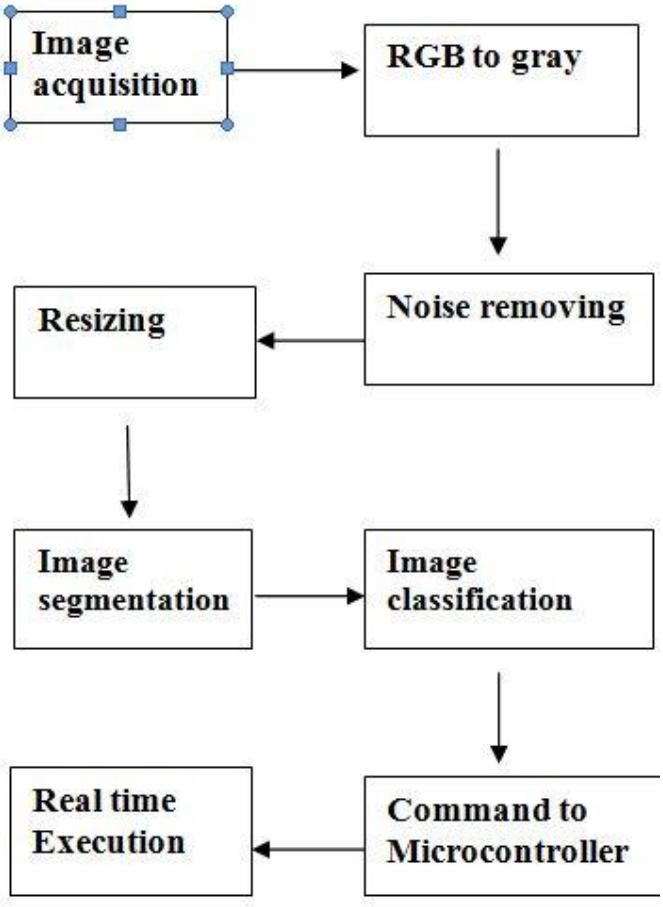
C. Extraction of the object

Extraction of obstacles: The preprocessed image is moved to the object identification or object detection. Detecting and locating object in digital image has become one of the most important. To achieve the objective, several steps and method had been taken into account in order to get the result such as show in fig 3.1.

Image Segmentation : In the process of object detection, targeted object which is obscured due to presence of other object is one of the main problem faces in image processing field. This is due to the object are not clearly expressing in the image and will assume and eliminated by the program. Besides that, objects which overlapping each other also made the process challenging where hidden object will be detected and counted and the total number will be no accurate. The light intensity on each object makes the background object have almost the similar color as the target object. To eliminate all these problem, a proper image segmentation process and technique must taken into account.

At the end image segmentation include two parts:

- Background elimination
- Object identification



Threshold algorithm Threshold algorithm is most popular and easiest algorithm for image segmentation. In this algorithm the images are segmented into background and foreground. Threshold techniques can be divided into bi-level threshold and multi-level threshold. **Bi-level thresholding** is a simple image segmentation technique used in image processing to convert a grayscale image into a binary image. It involves setting a specific threshold value, and based on this threshold, pixel values are divided into two categories: one for foreground (objects of interest) and the other for background. In this paper we segment the image into two classes(object or background)

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The algorithm steps are:

1. By selecting an adequate threshold value T.
2. Then all the gray level values below this T will be classified as black (Object).
3. and all the gray level values above T will be white (Background).
4. The segmentation problem becomes one of selecting the proper value for the threshold T.

After applying image processing techniques, objects detected will be represented by black pixels. If coordinates of an object are changing for different frames, If coordinates of an object are changing for different frames, it implies that a moving object is detected. Numbers of moving objects are detected for different frames by checking position of coordinates in different frames.

Speed Calculation : Change of coordinates of moving objects at different time intervals is calculated and stored in an array. Using these values, rate of change of speed is calculated for object around the vehicle.

D. Microcontroller

After object identification and speed detection the access moved to microcontroller. After calculated speed of vehicle the speed of the automated vehicle increased/decreased by the microcontroller

Fig 1. original image

Fig 2. Grayscale image

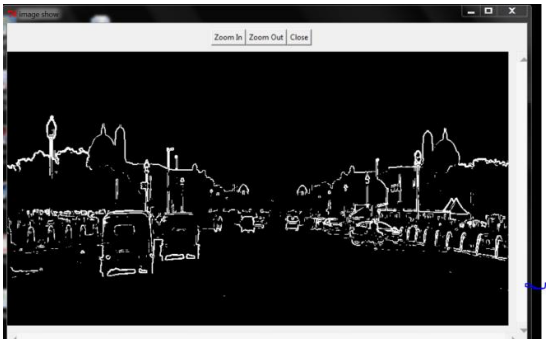

Fig 3.Edge detected

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Fig 4. segmented image

IV. CONCLUSION

The image processing algorithms used here have found a lot of practical applications and it is still one of the most extensively researched areas. A step has been taken to improve the current road traffic management scheme and provide with much cheaper and efficient results than the existing know-how. These results or their underlying principles can be deployed in different purviews like disaster mitigation management, defense etc. This algorithm can be further improved by training our dataset using machine learning algorithms which can lead to much better results with better efficiency due to reduction in processing time and output deliverance and with an up to date technology.

Research Technologies like corporative driving and inter-vehicle communication can be further included in order to enhance the efficiency. Grid cameras can be installed to achieve a clear and better resolution of images in case of fog, rainfall and other such undesirable environmental conditions

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