**Obstacle Detection in Low Visibility Condition**

**A Dissertation**

***Submitted in partial fulfillment for the award of the degree of***

**BACHELOR OF TECHNOLOGY**

**IN**

**Computer Science Engineering**



***by***

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**School of Engineering and Technology**

**ITM UNIVERSITY, GWALIOR - 474026 MP, INDIA**

**(May-2016)**

# CERTIFICATE

This is to certify that the work titled **“****Obstacle Detection In Low Visibility Condition”** submitted by **“Kushagra Rohatgi , Himanshu Verma** and **Akash Kumar ”** in partial fulfillment for the minor project report of degree of B. Tech. ( CSE ), ITM University, Gwalior has been carried out under my/our supervision.

To the best of my knowledge and belief, the dissertation

(ii) Is original piece of work of Candidate himself.

(ii) Has duly been completed.

(iii) Is up to the standard both in respect of contents and language.

(iv) Free from plagiarism

(v) Work has not been submitted partially or wholly to any other University or Institute for the award of this or any other degree or diploma.

**Signature of Guide Signature of Co-guide**

**Designation Designation**

**Date Date**

**Head of the Department**

**Dean, School of Engineering & Technology**

# DECLARATION

I hereby declare that the work entitled “**Obstacle Detection In Low Visibility Condition”**” submitted to the Department of Computer Science Engineering, School of Engineering and Technology, ITM University, Gwalior (M.P.) is my own work done under the supervision of Dr. Pallavi Khatri & Dr Shashikant Gupta. The dissertation doesn’t contain any part which has been submitted for award of any degree either in this University or in any other University.

I further declare that the work is free from any plagiarism.

1. .
2. .
3. .

(Signature of the candidate)

1. Kushagra Rohatgi
2. Himanshu Verma
3. Akash Kumar

(Name of the candidate)

(Roll Number of the candidate)

Verified by guide

**Acknowledgement**

Firstly, I give thanks to the Almighty God for making it possible for me to complete this work. My appreciation also goes on to my main guide in this work; Dr. Pallavi Khatri and Dr Shashikant Gupta. Their humongous experience in the field and their leadership qualities, made it easier for me to complete my work in time. I also thank my project coordinator, Mr. Rahul Yadav for his assistance by giving useful ideas throughout the completion of this work. The B.Tech. CSE class of 2016 deserves a special mention by being able to support me anytime I wanted help. I would like to thank the Chancellor, Vice Chancellor, Dean SOET, HOD CSE and all the faculty members of CSE department for providing an enabling environment for me to complete my work. Last, but most importantly, I thank our parents for providing us valuable support and confidence in making the project successful. Thank you, for taking care of me and for your love to me. May the grace, love and favor of the Almighty God in heaven be with you all.

# Abstract

This thesis is a proposed work, named **Obstacle Detection In Low Visibility Condition**. The main aim of this project work is to detect the moving vehicles or the living and the non-living things which comes in the way while riding the vehicles but due to low visibility conditions such as fog, we are unable to view those obstacles clearly which leads to accidents and cause casualties. We give the complete description of the hardware, algorithm design ,software, implementation and simulations of different scenarios of our proposed work. The parameters taken into consideration are: low visibility conditions, obstacles,

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# List of Abbreviations

CSE – Computer Science Engineering

HOD – Head of department

AODV – Ad-hoc on-Demand distance vector

ROI - Region of interest

IPM - Inverse Perspective Mapping

# 

# Introduction & Objectives

## INTRODUCTION:

***During winters, we face the problem of fog in metropolitan cities, sometimes the problem is more severe which is called smog. Foggy and Smoggy conditions occur when in low temperature, the water vapors in the air condenses over dust/smoke particles and form air suspended water droplets. These water droplets acts as a prism and deflects the wavelength of light lying in the visible spectrum of electromagnetic waves (visible light).*** In this document, a real-time fog detection system

using an on-board low cost b&w camera, for a driving applica-

tion, is presented. This system is based on two clues: estimation

of the visibility distance, which is calculated from the camera

projection equations and the blurring due to the fog. Because

of the water particles ﬂoating in the air, sky light gets diffuse

and, focus on the road zone, which is one of the darkest zones

on the image. The apparent effect is that some part of the sky

introduces in the road. Also in foggy scenes, the border strength

is reduced in the upper part of the image. These two sources of

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Index Terms—Fog detectio

## During winters, we face the problem of fog in metropolitan cities, sometimes the problem is more severe which is called smog. Foggy and Smoggy conditions occur when in low temperature, the water vapors in the air condenses over dust/smoke particles and form air suspended water droplets. These water droplets acts as a prism and deflects the wavelength of light lying in the visible spectrum of electromagnetic waves (visible light). Through this project we are trying to curb this problem by using EM waves of higher wavelengths which do not get deflected due to fog such as Infrared. Using this we will create a module that will consist of sensors and a monitor for display of information. As this project can be implemented in low visibility areas thus, we can use it on fully access or semi access-controlled highways .As in winter seasons due to fog the visibility goes very less so we can use this project module to detect the vehicles or any other obstacle which is present on the road.

In this document, a real-time fog detection system using an on-board low-cost b & w camera, for a driving application, is presented. This system is based on two clues: estimation of the visibility distance, which is calculated from the camera projection equations and the blurring due to the fog. Because of the water particles floating in the air, sky light gets diffuse and, focus on the road zone, which is one of the darkest zones on the image. The apparent effect is that some part of the sky introduces in the road. Also, in foggy scenes, the border strength is reduced in the upper part of the image. These two sources of information are used to make this system more robust. The final purpose of this system is to develop an automatic vision-based diagnostic system for warning ADAS of possible wrong working conditions. Some experimental results and the conclusions about this work are presented. Real-time fog detection from a b &w on-board camera has been lightly covered in the literature. Most important works can be found . Light gets diffuse because of the particles of water floating in the air. Using this effect, gray level variation in the horizon is used to measure the amount of fog in the image and then give an estimation of the visibility distance. Recently, single image fog detection has made significant progresses. The success of these methods lies in using a stronger assumption and they cannot be computed in real-time. The foggy-free image must have higher contrast compared with the input foggy image. The results are visually compelling but may not be physically valid. The view of the scene and then infers the medium transmission, under the assumption that the transmission and surface shading are locally uncorrelated. This approach may be failed in heavy foggy cases, where the assumption is broken. We propose a simple but effective image prior, to detect fog using a fix color camera. It is based on a key observation: most local patches in foggy-free images contain some pixels which have very low intensities in at least one -color channel. The dark channel prior may be invalid when the scene object is inherently similar to the air light over a large local region and no shadow is cast on the object.

**Objectives:**

Advanced Driver Assistance Systems (ADAS) have become

powerful tools for driving. In fact, applications based on this

concept are nowadays widely extended in vehicles, added as

extras to make driving more safety and comfortable. Some ex-

amples of this kind of applications are parking-aid, automatic

cruise control, automatic switching on/off beams, etc.

Computer vision plays an important role in the development

of these systems to cut off costs and provide more intelligence.

There are some problems to be solved in the ADAS based in

computer vision technologies. One of these problems is the

fog detection, which depends on different kinds of weather

(cloudy, foggy, rainy, sunny, etc) and also illumination environ-

ment conditions. Automatic fog detection can be very useful

to switch on-off ADAS when fog makes that these systems do

not work properly. Also it can complement intelligent vehicle

based applications such as the ones described in [1], [2], since

a simple output for turning on/off the fog beams, and even

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Fog detection is a challenging problem because it depends

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Fog Detection System Based on Computer Vision

Techniques

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Abstract—In this document, a real-time fog detection system

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Index Terms—Fog detection, visibility distance, computer vi-

sion, growing regions.

I. INTRODUCTION

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Fog detection is a challenging problem because it depends on unknown information as: depth, weather and lighting conditions. The problem is under-constrined if only an b & w onboard camera is used or real-time computation is needed. Many methods have been proposed in the literature by using multiple images or additional information, without taking into account real-time constraints. Polarization based methods use two or more images taken with different degrees of polarization. In more constraints are obtained from multiple images of the same scene under different weather conditions.

Recently, single image fog detection has made significant progresses. The success of these methods lies in using a stronger assumption and they cannot be computed in real-time. On observation the foggy-free image must have higher contrast compared with the input foggy image. The results are visually compelling but may not be physically valid. estimates the of the scene and then infers the medium transmission, under the assumption that the transmission and surface shading are locally uncorrelated. This approach may be failed in heavy foggy cases, where the assumption is broken. propose a simple but effective image prior, to detect fog using a fix color camera. It is based on a key observation: most local patches in foggy-free images contain some pixels which have very low intensities in at least one-color channel. The dark channel prior may be invalid when the scene object is inherently similar to the air light over a large local region and no shadow is cast on the object.

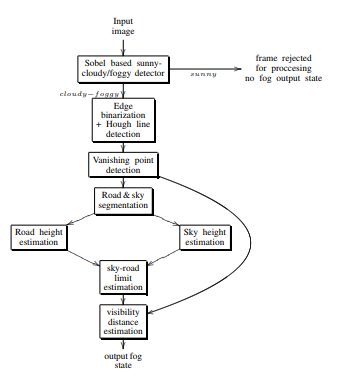
Based on the explained idea, we found out some other characteristic effects that are present on the images under fog conditions. In order to robust fog detection the two main characteristics we notice in a foggy image are the decrease of the visibility distance on the image, and the scene blurring due to the loss of high frequency components. Then, as difference with other works existing in the state of the art, our algorithm has to comply with the following conditions:

• Results have to be accurate, i.e. all foggy situations have to be detected properly, whereas the false alarm probability (i.e. determine fog when the image is not foggy) has to be zero.

• The algorithm has to be fast and able to work under real.

**ARCHITECTURE :**

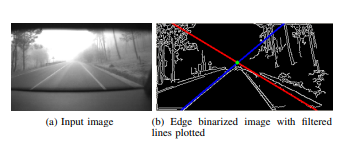
This section provides general information about the proposed algorithm. First of all, a general task diagram of the implemented algorithm is shown in Fig. 1. Then the most important tasks will be described :

****

1. **Fog Detection:**

One of the most important effects of fog presence on a image is the reduction of high frequency components, that can be properly measured using edge detection methods, based on Sobel filtering. Foggy images are blurrier and have lower contrast than the sunny ones. It means that information in the higher frequencies is lower in foggy images, rather than in sunny ones. Furthermore, this effect is more significant in the top half of the image. In order to reduce processing time in the whole algorithm, the original B&W images captured from the micro-camera are resized to 320 x 240 pixels. It is not necessary to have a higher resolution for fog detection. In typical ADAS applications, where a micro-camera is mounted in the car’s windshield area looking up the road, vehicles can be located at different areas of the image. It is more probably to find preceding vehicles in the central area of the image (just in front of the windshield), but also incoming vehicles can be found in lateral areas of the image. Besides, fog effect is not uniformly distributed in the image. For this reason, a ROI is defined in the image, and different areas of analysis are considered. Edge information does not provide enough resolution to differentiate between moderate fog (about 200 m of visibility distance) and high fog (less than 100 m of visibility distance) states because the difference between these two cases is not straightforward doing a simple edge analysis. An example of these two states is shown in Fig. 8. Therefore, the use of visibility distance is necessary to complement this deficiency. Also, visibility distance estimation, as it will be shown in next section.

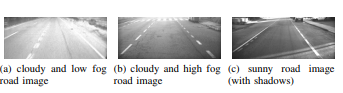
1. **Vanishing Point Calculation:**

If there is some fog in the image, an optimal binarization is applied to the sobel image to enchance the most clear edges. Parameters for this edge detector are fixed in order to have the same reference values for all the sequences. Then, these edge images are computed with a Hough line detector , used to estimate edge lines of the road. Filtering the lines found by the Hough detector to get them enough separated and obtaining its parameters as it was explained before, the vanishing point of the image is found. Figure depicts the result of this process:

The vanishing point of an image is the point where parallel lines which are not perpendicular to the optical axis cross in a image. Road lines are taken as a reference of lines which are parallel and not perpendicular to the optical axis. As a consequence, the vanishing point is easy to find.

1. **Road and Sky Segmentation :**

After the vanishing point is found, a segmentation process is applied using a growing regions approach based on seeds, to find the limit between the sky and the road. Sky is easy to find, if it is present, because most of sky pixels have pure white color, the segmentation process very fast. A single seed point is selected as a random pure-white pixel on the supposed sky area. To segmentate the road, a seed point is placed in an area where is highly probable to find the road. Some parameters are automatically adapted depending on road’s characteristics, for instance, the average value of gray level in a neighborhood of a road pixel. Depending on this average level, the upper difference limit goes up when road gets brighter. This is because the brighter the road is, the greater variation of gray level the pixels in a neighborhood is obtained. Some road image samples from the tested sequences are depicted in Fig. 4 to show the different conditions that the growing regions algorithm has to deal with.



To make the process of finding the sky-road limits easier to the rest of the algorithm, dilate operator is applied in order to full some small holes in the sky blob. The same process is applied for the road blob. In order to find the limit between the sky and the road, these two segmented images are treated separately. Sky and road image limits are searched from bottom to top, but there are some differences in the procedure. Taking the average of these two limits, the limit between sky and road is found. If the sky is not present, like in some of the test sequences, only the road limit is taken. In the case of the sky image, the most common effect is that the part of the sky over the ground is narrow and the part in the sky is wider. In this case, there is an abrupt transition that can be easily located. On the other hand, considering the road segmented image this abrupt transition is not significant. If the road is well segmented, it is limited by the gray zone in which it is located, but if the scene is very foggy a bad segmentation or an erroneous limit can be obtained. In both cases, if the obtained limit is not logical, i.e. it is above the vanishing point, the vanishing point height will be used as the limit for that frame.

1. **Visibility Distance Measurment :**

Visibility distance depends on the relative sky-height. This concept means that, when there is some fog in a scene and road is segmented, some part of sky gets into the road part, and the limit between the sky and the road go down. If the image is not foggy, sky and road height on the image are both the same and equals to the vanishing point height, but in a foggy image, apparent sky height is lower than the vanishing point**.**

**Requirements of the Project Work :**

The hardware requirements of the project are as follows:

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• Arduino microcontroller

(it will be used to make co-ordination between the camera module and LASER module)

• IR Camera module

(a camera with a capability to produce clear images even in fog.)

• Laser ranger(40 m)

(this module will be used to calculate the distance of the obstacle)

• Raspberry pi

(this single board computer will act as the brain of our module where data collected from all the sensors will be brought and processed and result will be sent to the monitor.)

The software requirements of the project are as follows:

• Python(for coding in Raspberry pi )

• Raspian

• Arduino IDE(for coding of Arduino microcontroller)

**CHAPTER 2**

**LITERATURE AND REVIEW**

Accidents caused by poor weather conditions happen every year and a solution to increase driver safety in such conditions of low visibility is needed. Videos and images that are captured during poor weather suffer terrible contrast. When capturing images during adverse weather conditions, the light conditions impact the quality of the image such as resulting in poor contrast and at times complete obstruction of view due to heavy snow, rain and fog. Poor weather effects continue to increase as view depth distances increase from the sensor. Streetlights and drivers’ headlights are usually turned on in poor weather conditions in an effort to increase visibility, however, they can add to the complex degradation of the captured image. It is not possible to remove these effects from images using the traditional state-of-art restoration techniques. Research efforts to enhance some of the weather degradations to improve image quality proposed several algorithms that in general can be divided into model-based and non- model-based methods. The non-model method uses the information located in the image for further processing. Model based methods use image a degradation method. Others tried to classify weather conditions as steady or dynamic conditions which are based on the distinct physical characteristics of the weather such as fog versus heavy rain.

**Effects of Low visibility on National highways and Expressways:**

Several researches, reports have been prepared which give information regarding the no of the accidents and casualties which are caused due to fog or low visibility on the express ways or the national highways.

* The report of calendar year 2017 reveals that there were 464910 unfortunate incidences of road accidents during 2017 which claimed 147913 lives and cause injuries to 470975.
* The national highway which constitute approximately 2% of the total road network of the country accounted for 30.04% of the total road accidents 36.0% of deaths in 2017.Among vehicles categories two-wheeler accounted for the highest share (33.9%) in total road accidents and fatalities(29.8%) in 2017. Most unfortunately, young adults in the age group 18-45 comprise of 72.1% of road accident death victims.

**RELATED WORK:**

Detection of interesting objects from image scenes is an important step in the model. Errors made at this abstraction level will considerably impact higher level processing. There exists an extensive literature concerning the application of object detection. Exhaustive reviews can be found. All of these methods may generally be divided into five perspectives.

* The first is the optical flow method . Because background motion is different from that of moving objects, the motion flow vectors can be used to extract moving objects. However, the computational complexity of optical flow is very high, so real-time implementation is difficult or expensive.
* The second is the space-time continuity method , which extracts objects by detecting the surface generated by motion boundaries in the spacetime domain. This method can immediately recognize the objects through the sequence, but it is also computational complex and requires storage of many frames in memory.
* The third is temporal differencing . A frame is pixel-wise compared to an adjacent frame, and then everything exceeding a threshold is considered to be a moving object. This method is a simple and less computational algorithm, but in the case of uniformly colored objects, only the edges of moving objects can be detected.
* The fourth is background subtraction , which detects objects by building a background model and then finding the difference between this model and each incoming frame. This is a very popular detection approach. An important disadvantage of this method is the trade-off conflict of background update speed: on the one hand updating should be performed fast to deal with changes in illumination and changes in the background;
* On the other hand, updating should be performed slow to avoid learning slowly moving objects as background. This makes algorithms using only one model sensitive to setting the update speed. The final perspective is the learning-based method such as, which detects objects through a feature classifier that is trained by the object’s feature.

Although this learning-based method can accurately detect objects, it requires a huge number of samples to enable a discriminative classifier, and manually labeling sufficient training samples also requires significant manpower. More exhaustive reviews for these object detection methods can be found. All of these approaches can get satisfying results under clear weather conditions. When it comes to bad weather, such as on foggy days, they generally fail to correctly detect objects due to the low scene visibility. In order to overcome the adverse influence of bad weather, proposed a method of detecting an object on a foggy day with a two -step method. In the first step, they utilize a ”de-haze” algorithm to restore the foggy image. After enhancing the visibility of the weather degraded image, an object detection algorithm is implemented to extract the object in the second step. As an active research topic in computer vision, considerable work has been done in recent years on haze removal techniques. Early approaches to defogging weather-degraded images have focused on taking multiple images under different weather conditions in order to estimate parameter values related to the atmospheric particles or the scene depth. The polarizers use polarizing filters to restore the degraded image. This approach exploits two or more images of the same scene that have different degrees of polarization (DOP), which are obtained by rotating a polarizing filter attached to the camera. Methods proposed also require multiple exposures of the same scene to achieving the image decomposition with additional observations or scene information. While the multiple images-based method can significantly enhance visibility, their requirements leave them unable to immediately calculate the restored results for scenes that have never been encountered before. In order to solve this disadvantage, However, this method need troublesome parameters entry by user. For more convenient implementation, recent works that operate on single images have made significant progresses. For instance, removes the haze by maximizing the local contrast of the restored image based on the theory that the haze free image must have higher contrast compared with the input haze image. Work imposes locally constant constraints of values together with decorrelation of the transmission and surface shading in local areas, then estimates the depth value and infers the medium transmission from the result. Similarly, recent independent work imposes constraints only on the depth structure induced by an empirical observation made on the possible values of scene within a local region. Also made a significant contribution to single image haze removal. However, all these algorithms are computationally expensive when it comes to the process of haze removal. If an algorithm implements an object detection algorithm after the de-haze processing, the high computational complexity of the whole algorithm will be further increased.

**PRE-PROCESSING:**

Pre-processing is always mandatory as the initial stage of image processing. The purpose of pre-processing stage is to enhance the input image in order to increase the likelihood of the successful delivery of areas with useful information to subsequent stages. Conventionally, pre-processing consists of image smoothing and segmentation, which will be introduced as follows. Additionally, for the purpose of lane Detection, extraction of Region of Interest (ROI) and Inverse Perspective Mapping (IPM) are usually added into pre-processing steps.

**IMAGE SMOOTHING:**

Aiming at lane marking detection, image smoothing can be done by applying two main filters, Median Filter and Gaussian filter or both to blur the noisy details. Different from those who mostly use 2D-Gaussian filters, Shih et al. only uses a 1D-Gaussian filter in which respectively takes x-direction and y-direction into account and significantly smooths the details of input images. Apart from Median and Gaussian filters, other filters are also used by researchers. Dilation and erosion filters are used in 2D high-pass filter is used in to weaken the effect of shadow on road. A temporal blurring is deployed in to make lane markings appear long and continuous, also to blur noisy details on road surface.

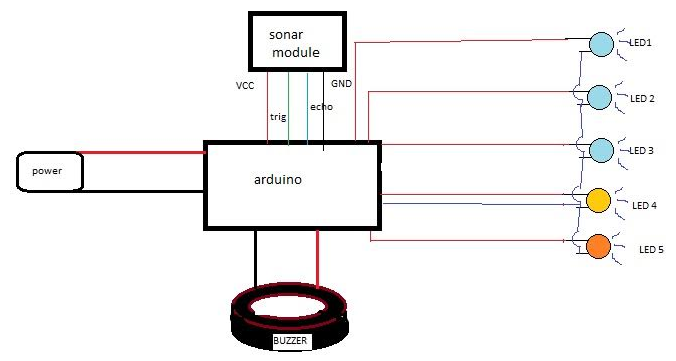
**REGION OF INTREST:**

The extraction of region of interest (ROI) is an important task of pre-processing stage, aiming at reducing the computational cost due to the processing time. It is unnecessary to process the entire pixels of images. Computation should be focused on regions which contain important information. To get the ROI, three main approaches can be found in literature, which are vanishing point detection, perspective analysis and projective model, and sub-sampling.

CHAPTER 3

**SYSTEM ARCHITECTURE**

**CIRCUIT DIAGRAM OF THE MODEL**

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Apart from a comprehensive module, a simplified module with different segmentation scheme has been proposed. Because of the different segmentation methods used for comprehensive and simplified module, the setting of parameters in terms of detection and tracking algorithms are different. This yields the implementation of both modules should be separately conducted **.**

The comprehensive module is organized as following:

• preprocessing

• lane detection and tracking (LDT system)

• lane marking recognition (LMR system)

**PREPROCESSING**

LANE RECOGNITION

Roadway users (drivers, motorist and pedestrian) can read important information from pavement markings, which can be divided into three categories: word-marking, pictogram marking and line-marking. Word-markings are usually used to deliver a text message to 59 drivers, for example, the word BUS. To express messages for drivers, Pictogram-markings are well designed ideogram and present as understandable graphics, e.g. bicycle lanes or bus lanes. Line markings have very essential shapes which can be used to manage the traffic. Along road edges and between lanes, line markings are used to guide traffic, keep vehicles in line and avoid collisions. Marking colors (i.e., yellow or white) and forms (solid or dashed) deliver important messages together. For instance, Yellow lines indicates opposite directions of two lanes. Switching from one lane to adjacent lanes is prohibited if a solid yellow line exists between two lanes, while a dashed yellow line allows drivers to switch between lanes if they need to. On the other hand, white lines are usually painted on a multi-lane roadway, which separate vehicles moving in the same direction. Solid (sometimes in double) white line forbids switching between lanes, while lane switching is permitted to across a dashed white line. In the comprehensive module, TRM combines the detection and recognition of lane markings together, by making use of color information.

LANE MARKING RECOGNITION

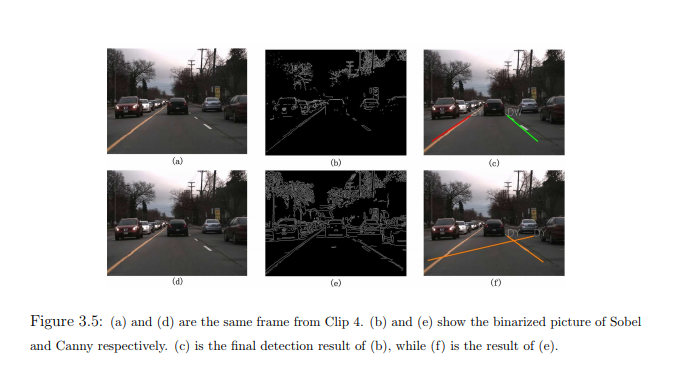
Recognition of lane markings is another very challenging task. It is notable that, the differentiation between lane marking colors and types are barely suggested in the literature, nor in the commercial systems. To recognize yellow and white lines on the road, there existed some patents on lane colour recognition. Besides, when it comes to lane type recognition (distinguish between solid and dashed lane markings), Project determines the lane type by monitoring the lane marking occurrence within a given number of frames. If the ratio of the number of frames containing lane markings over the entire number of frames is equal or greater than a threshold, the lane markings can be regarded as solid lines, otherwise dashed lines. Although marking recognition is not as important as other components of DAS (Driving Assistant System), it is of great significance for Autonomous Driving Systems. In this thesis, an algorithm that recognizes and distinguishes between both lane marking types (dashed or solid) and colors (yellow or white) is proposed in order to provide possible recognition.

**LANE DETECTION:**

After preprocessing stage, detection stage is initialized by Hough transform (in this thesis we use Probabilistic hough transform, which is refered as PHT). Because of the benefit of preprocessing stage based on MSER segmentation, the simplified module performs well with Hough transform without refinement afterwards. While for comprehensive module, two refinement steps need to be conducted sequentially, which are angle thresholding and segment linking (ATSL) and trapezoidal refinement method (TRM). It is noticeable for the comprehensive module, where edge segmentation is used for preprocessing, that PHT is applied on bird’s eye view. Hence, there are some works to be done between PHT and 41 ATSL, which is to transform the bird’s eye view into real world plane (this transformation is very straightforward to get by applying inverse perspective mapping on bird’s eye view) After getting real world plane image, the novel schemes of ATSL and TRM is proposed for the sake of refining PHT results.

EDGE DETECTION

After getting birds’ eye view, some classical edge segmentation methods, such as Sobel, Prewitt, Robert or Canny operator, can be used to detect edges. It is common to know that Canny operator outperforms other operators such as Sobel and prewitt, for the general edge detection tasks. However, the authors in have revealed that, for the purpose of lane detection, Canny filter is very sensitive to irrelevant objects as well as lane markings, which rapidly increases the number of false positives. We compared Sobel and Canny as shown in fig. It is obvious to find out from figure. that Sobel performs better than Canny because of having much less noise.

 Also comparing to other edge detection algorithms, the Canny operator stands out because of its high computational expensiveness. Conversely, the Sobel operator is less sensitive to noise and less complex than Canny, and it is able to detect the main edge points of markings. Hence Sobel operator is comprehensively better than the other methods as the edge detector for the proposed lane detection system.

About the Project requirements:

1. **Lidar**

LiDAR utilizes laser light to quantify separations. It is utilized as a part of numerous courses, from assessing climatic condition, shooting a laser bar to getting speeders in road activity with a handheld laser-speed locator. There are some laser-checking innovation which are spent significant time in various field for instance flying machine based sort of LiDAR that gives to a great degree precise, nitty gritty 3-D estimations of the ground, vegetation and structures. In open, level territories, ground shapes can be recorded from an airplane flying overhead giving exactness inside 6 inches of real height. In steep, forested zones precision is regularly in the scope of 1 to 2 feet and relies on upon numerous components, including thickness of shade cover and the separating of laser shots. The speed and exactness of LiDAR made it attainable to guide huge regions with the sort of detail that before had just been conceivable with tedious and costly ground review crews, LiDAR basically take a shot at the principal of speed and distance: Distance = (speed of light ∗ Time taken)/2.

1. **RAS PI:**

The Raspberry Pi launched in 2012, and there have been several iterations and variations released since then. The original Pi had a single-core 700MHz CPU and just 256MB RAM, and the latest model has a quad-core 1.4GHz CPU with 1GB RAM. The main price point for Raspberry Pi has always been $35 and all models have been $35 or less, including the Pi Zero, which costs just $5.

All over the world, people use Raspberry Pi to learn programming skills, build hardware projects, do home automation, and even use them in industrial applications.

The Raspberry Pi is a very cheap computer that runs Linux, but it also provides a set of GPIO (general purpose input/output) pins that allow you to control electronic components for physical computing and explore the Internet of Things (IoT)**.**

1. **Aurdino Microcontroller**

Arduino’s processor basically uses the Harvard architecture where the program code and program data have separate memory. It consists of two memories- Program memory and the data memory. The code is stored in the flash program memory, whereas the data is stored in the data memory. The At mega328 has 32 KB of flash memory for storing code (of which 0.5 KB is used for the bootloader), 2 KB of SRAM and 1 KB of EEPROM and operates with a clock speed of 16MHz.

1. **IR CAMERA**

A camera is a non-contact gadget that recognizes the light falling on its lenses and converts it into an electronic signal, which is then handled to deliver a picture or a video screen and perform diverse calculation. Camera will take picture from moving vehicle and it will send that picture to the central handling unit utilized as a part of this system. If the processor will find that the picture is not clear because of the mist then it will apply some calculation to make it clear. Basically camera is significant segment of our fog debluring framework.

Infrared cameras photograph heat rather than objects. The camera is a heat-sensor that registers different temperature levels and converts them into a film or video image. Most cameras use digital imaging, but some use chemical infrared film. Cameras range from simple point-and-shoot types to expensive models with detailed, higher-resolution imagery.

**CHAPTER 4**

**EXPERIMENTAL RESULTS**

This chapter is organized in 4 sections, which covers the experimental platform, experiment overview and all the relevant performance evaluation.

**EXPERIMENTAL PLATFORM**

Both comprehensive and simplified modules are implemented with OpenCV library and Python, under the environment of UBUNTU MATE, using BROADCOMM quadcore CPU and 1G DDR2 RAM. The testbed used for experiment

**CONCLUSION**

In this project we have made a model combining the different technologies to detect and measure distance of obstacle when it is not visible due to low visibility.

In this project we have used Short Wave Infrared Waves to overcome the effect of the fog particles as infrared waves have large wavelength and hence the refraction is very less.

Poor visibility on the road causes serious accidents on highways and expressways every year. Our model is able to clearly see through as well as detect the distance of the obstacles lying ahead. Using this, the accidents on the roads can be decreased significantly.

**References/Bibliography:**

* <https://en.wikipedia.org/wiki/Expressways_in_India>
* <https://economictimes.indiatimes.com/news/politics-and-nation/400-deaths-a-day-are-forcing-india-to-take-car-safety-seriously/articleshow/62439700.cms?from=mdr>
* <https://sites.ndtv.com/roadsafety/important-feature-to-you-in-your-car-5/>
* <https://timesofindia.indiatimes.com/city/lucknow/lucknow-agra-e-way-has-100-more-traffic-than-projected/articleshow/62534106.cms>
* <http://www.indiaenvironmentportal.org.in/files/file/road%20accidents%20in%20India%202017.pdf>
* <https://www.cbinsights.com/research/autonomous-driverless-vehicles-corporations-list/>
* JOSEF PODZIMEK[DROPLET CONCENTRATION AND SIZE DISTRIBUTION IN HAZE AND FOG] *MO 65409-0430, USA*
* Lv, X., Chen, W., & Shen, I. (2010). *Real-Time Dehazing for Image and Video. 2010 18th Pacific Conference on Computer Graphics and Applications.*doi:10.1109/pacificgraphics.2010.16
* Literature survey on the various methods of object detection in video surveillance systems Mrs Poonam Khare M.Tech NIT, Bhopal Associate Professor, Department of Information Technology MLR Institute of Technology, Hyderabad, Telangana, India
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