"Design and Control of Vehicle Detection in Fog"

THESIS

Submitted

By

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Department of ECE

In partial fulfillment of the Requirement For the

Award of the degree of

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IN

Embedded system

Under the Esteemed Guidance of

Er. SOMEET SINGH

TOPIC APPROVAL PERFORMA

School of Electronics and Electrical Engineering

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PROPOSED TOPIC : Design and Control of Vehicle Detection in Fog.

Qualitative Assessment of Proposed Topic by PAC		
Sr.No.	**Parameter**	**Rating (out of 10)**
1	Project Novelty: Potential of the project to create new knowledge	8.33
2	Project Feasibility: Project can be timely carried out in-house with low-cost and available resources in the University by the students.	8.00
3	Project Academic Inputs: Project topic is relevant and makes extensive use of academic inputs in UG program and serves as a culminating effort for core study area of the degree program.	8.00
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Final Topic Approved by PAC: **Design and Control of Vehicle Detection in Fog.**

Overall Remarks: Approved

PAC CHAIRPERSON Name: 11211::Prof. Bhupinder Verma **Approval Date:** 15 Oct 2016

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CERTIFICATE

This is to certify that the Thesis work titled “Design and Control of Vehicle Detection in Fog” that is being submitted by “Rahul singh” is in partial fulfillment of the requirements for the award of MASTER OF TECHNOLOGY DEGREE, is a record of bonafide work done under my /our guidance. The contents of this Dissertation-I, in full or in parts, have neither been taken from any other source nor have been submitted to any other Institute or University for award of any degree or diploma and the same is certified.

Er. Someet Singh

(Assistant Professor)

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Lovely Professional University

CANDIDATE'S DECLARATION

I hereby certify that the work which is being presented in the synopsis entitled “DESIGN AND CONTROL OF VEHICLE DETECTION IN FOG” by RAHUL SINGH in partial fulfillment of requirements for the award of degree of M.Tech. (ECE) submitted in the Department of (ECE) atLovely Professional University jalandhar Phagwara, is an authentic record of my own work under the supervision of Mr. SOMEET SINGH the matter presented in this report has not been submitted by me in any other University / Institute for the award of M.Tech Degree.

Signature of the Student
(RAHUL SINGH)

This is to certify that the above statement made by the candidate is correct to the best of my / our knowledge.

Signature of the Guide
(Mr. SOMEET SINGH)

ACKNOWLEDGEMENT

I would like to place on record my deep sense of gratitude to Mr. Someet singh, Deptt. of Electronics and Communication Engineering, Lovely Professional University, for his generous guidance, help and useful suggestions without which this work would not have been possible.

RAHUL SINGH

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CHAPTER-1

INTRODUCTION

As per a review in view of NHTSA information [1] more than 10 years (2002-2012), in the US just three percent (3%) of climate related accidents happened within the sight of mist. Despite the fact that accidents brought on by this sort of visibility problem speak to a little rate of aggregate mishaps on expressways, they are for the most part disastrous and savage: 9% of climate related fatalities. One of the many difficulties confronted by vehicle vision applications is the effect of antagonistic conditions through sensors disability, particularly cameras. Enhancing ADAS execution by alleviating the impacts of climate on the roadways requires precise, convenient, and solid data on current climate and visibility conditions. Mist recognition and observing is however frequently inclined to the unusual way of haze with sudden changes and neighborhood varieties.
Vehicle identification is a point that has picked up importance recently as independent vehicles have picked up footing. In order to guarantee that self-ruling vehicles can securely driven situations with people in them, the vehicle must have the capacity to distinguish and maintain a strategic distance from vehicle in short and long ranges, during day and night, keeping in mind in movement. Contingent upon the vehicle's speed, identifications as far out as 50 meters and past might be essential. Lately, various research ventures have been completed in creating Driver Assist Systems (DAS). The reason for a DAS is to watch the earth out and about and help drivers get movement data with high exactness and proficiency. ADAS can likewise be reached out to computerized driving undertakings. One of the key undertakings of a DAS is identifying and following the encompassing autos around the DAS-prepared vehicle. As far as sensors, one of the more famous detecting procedures is utilizing PC vision framework.

1.1 working principle of vehicle detection system

The vehicle recognition framework is for the most part intended to give wellbeing and make the vehicle self-governing. This framework is utilizing a Camera and a LIDAR for identification of vehicle both of these sensors identify the vehicle, protest, person on foot and so forth and give

data to the fundamental control unit and it settles on the choice as indicated by it and control the vehicle or give the notice to the driver.

1.2 LIDAR

Lidar utilizes laser light to quantify separations. It is utilized as a part of numerous routes, from evaluating environmental mist concentrates by shooting a laser skyward to getting speeders in road activity with a handheld laser-speed finder. Airborne laser-filtering innovation is a particular, air ship based kind of lidar that gives to great degree exact, definite 3-D estimations of the ground, vegetation, and structures. Created in simply the most recent 15 years, one of lidar's first businesses utilizes as a part of the United States was to study power line halls to distinguish infringing vegetation. Extra uses incorporate mapping landforms and seaside territories. In open, level territories, ground forms can be recorded from an air ship flying overhead giving exactness inside 6 creeps of real rise. In steep, forested zones precision is normally in the scope of 1 to 2 feet and relies on upon many variables, including thickness of shade cover and the dividing of laser shots. The speed and precision of LIDAR made it doable to guide expansive regions with the sort of detail that before had just been conceivable with tedious and costly ground overview groups.

Distance =(speed of light * Time taken)/2

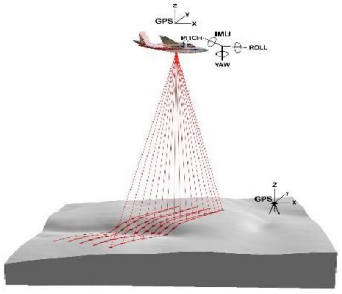

Fig 1.1 Lidar projection on land from air craft

1.3 Camera

An infrared camera is a non-contact gadget that identifies infrared vitality (heat) and proselytes it into an electronic flag, which is then handled to deliver a warm picture on a video screen and perform temperature estimations. Warm detected by an infrared camera can be unequivocally evaluated, or measured, permitting you to screen warm execution, as well as recognize and assess the relative seriousness of warmth related issues.

Fig. 1.2 IR Camera

CHAPTER-2

LITERATURE REVIEW

2.1 INTRODUCTION

In this chapter, results of an extensive literature research in the field of control system enhancement with more emphasis on the use of VEHICLE DETECTION SYSTEM are presented. Various sensors and circuits are also presented. This chapter presents the detail of work undertaken by different scientists and engineers in the field of vehicle automation. The review includes theoretical as well as the experimental work undertaken from time to time along with the development of the VEHICLE DETECTION SYSTEM for safety and security of human life.

Hua-Tsung Chen et.Al [IEEE 2016] : Propelled vehicle security is an as of late rising issue advanced from the unstable populace of auto proprietors. Expanding driver help frameworks have been created for notice drivers of potential risks by dissecting the surroundings with sensors and additionally cameras. Issuing vehicle deceleration and potential crash, brake lights are especially essential cautioning signals, permitting of no disregard. In this paper, we propose a dream based daytime brake light recognition framework utilizing a driving video recorder, which has a tendency to be across the board utilized. At daytime, visual elements, movements, and appearances of vehicles are exceptionally noticeable. Notwithstanding, brake lights, unexpectedly, are difficult to see because of low differentiation between the brakes lights and situations. Without the noteworthy normal for light dispersing as around evening time, the proposed framework extricates going before vehicles with taillight symmetry confirmation, and after that incorporates both luminance and outspread symmetry components to identify brake lights. A recognition refinement handle utilizing worldly data is likewise utilized for miss recuperation. Investigations are led on a test information set gathered by front-mounted driving

video recorders, and the outcomes check that the proposed framework can successfully recognize brake lights at daytime, demonstrating its great plausibility in true environments.[6]

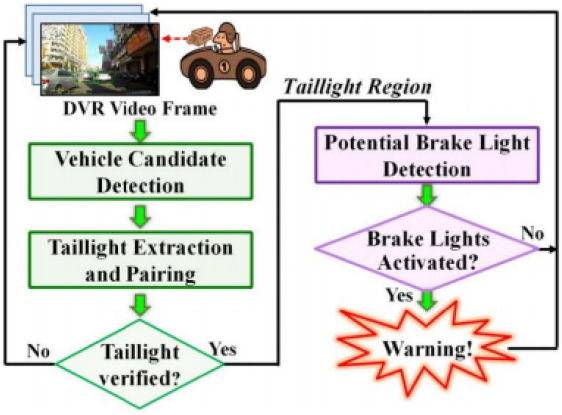

Fig. 2.1 - Schematic flowchart of the proposed daytime brake light detection scheme.

Feng Yuxi et. Al. [ICCIA 2016] : With respect to constant changes in the light and outer environment in indoor organized environment, this paper proposed a progressed moving hindrance discovery calculation in view of monocular vision. It cut the picture with a monocular camera, then connected dark scale transformation and middle sifting, consolidated the foundation subtraction strategy for Gaussian blend display and between edge subtraction technique, then led morphological handling and availability investigation on binarized contrast picture with the region data included, which viably tackled the gap issue, and got finish data on moving targets. The outcome demonstrated that this strategy can rapidly and precisely identify moving snags inside the area saw, of good ongoing execution and vigor, ready to adjust to light and different changes in outer conditions. [18]

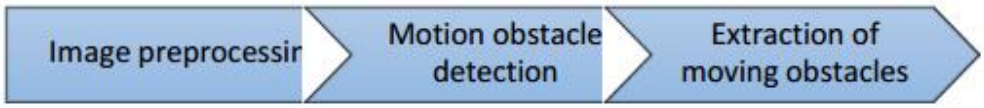

Fig. 2.2 - Obstacle detection process

(a) original image (b) after detecting an image

Fig 2.3 – Detection result

Mirko Meuter et. Al [IEEE 2016] : Measuring outright separations in monocular vision is testing and can't be explained specifically. Expectedly, presumptions like a from the earlier width of the objective protest or geometric requirements are made to beat the issue. In this paper they have depict a probabilistic arrangement that coordinates separate estimation in a vehicle following environment. This is gotten by utilizing a ground plane point based estimation together with a width interim requirement using a vehicle classifier. Moreover the data from a path takeoff cautioning framework is combined. We join width and rakish data together using a Bayes estimator. For testing a substantial video information set with separation ground truth got from a radar has been created. We demonstrate that utilizing this estimator upgrades the separation estimation in a Kalman channel based vehicle tracker environment contrasted with the standard limitations generally utilized. The introduced probabilistic mix is exceptionally time effective and has been effectively tried on the web. [21]

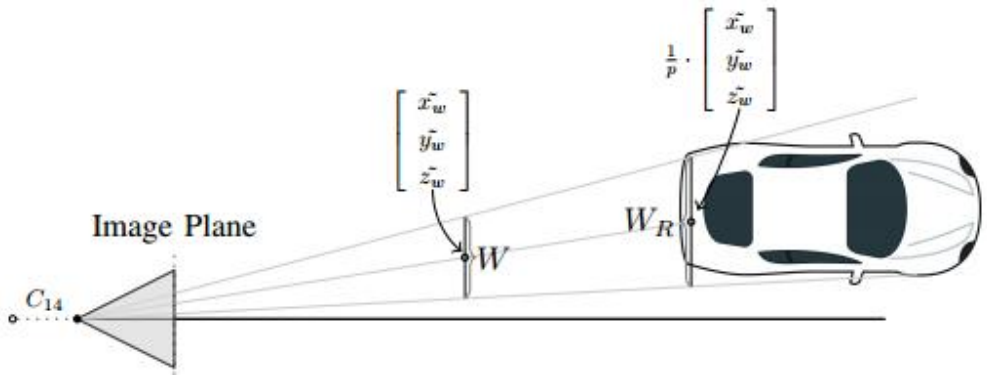

Fig. 2.4 – Distance estimation using monocular camera

Hermann Kopetz et. Al.[IEEE 2016] : Considering the specialized advances and financial points of interest of incorporated architecturesand cloud computingwe guess that the acknowledgment of a continuous cloud, called a fog that furnishes solid electronic administrations with fleeting certifications on board a vehicle proficiently and adaptably will be the coherent next stride in the improvement of a car electronic engineering. In this paper we present the idea of a time triggered virtual machine (TTVM) that gives an accurately determined virtual interface between a constant programming part and its basic equipment framework. The adaptable allotment of TTVMs on various hub PCs gives the way to execute adaptation to internal failure, advancement and on-line approval viably in such a period activated dispersed engineering. In this paper this new engineering and the related plan procedure are disclosed by alluding to a case of a driver help framework locally available an auto. [22]

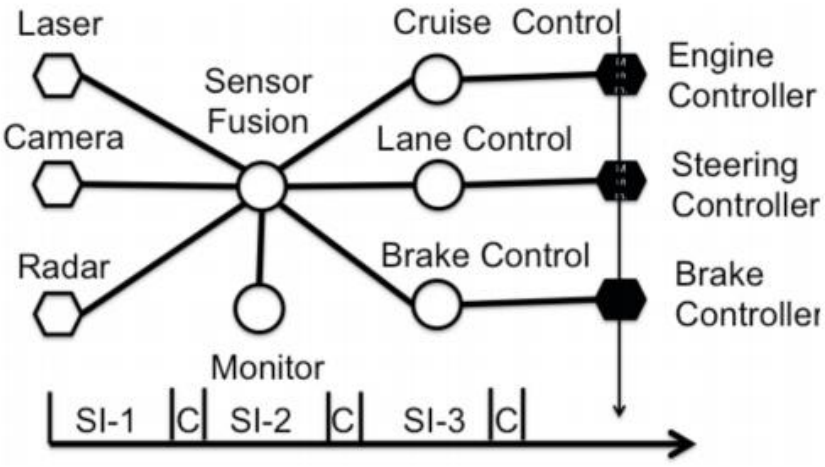

Fig. 2.5 - Time-Triggered Data Flow Diagram

Wenfeng Wang et. Al [IEEE 2015]: This paper presents a basic and proficient separation estimation technique in light of the monocular vision and tag. Consolidated with tag area and P4P system, their calculation can register camera natural parameters and the separation between tag and the camera. Be that as it may, the calculation is just tried in the Windows framework, yet not tried in the DSP stage. [17]

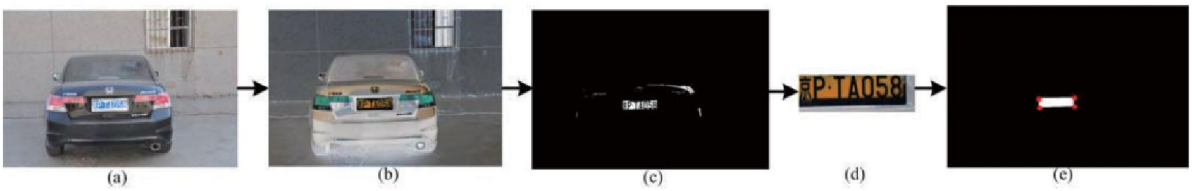

Fig. 2.6- Licence plate detection

Feihu Zhang et. Al. [IEEE 2014]: In this paper they have utilized Camera and LIDAR for recognition of vehicle. This paper introduces a sensor combination based vehicle location approach by melding data from LIDAR and camera. The proposed approach depends on two part (a) Hypothesis era (b) Hypothesis confirmation. Speculation era stage is to create position that speak to vehicles and Hypothesis confirmation stage is to arrange the comparing object. As a confirmation they have utilized a SVM preparing process. They have given 5000 preparing pictures with 1893 protest are physically named to prepare the classifier and 2000 test pictures for the evaluation.Here achievement rate for vehicle and Non-vehicle grouping was 91%. [10]

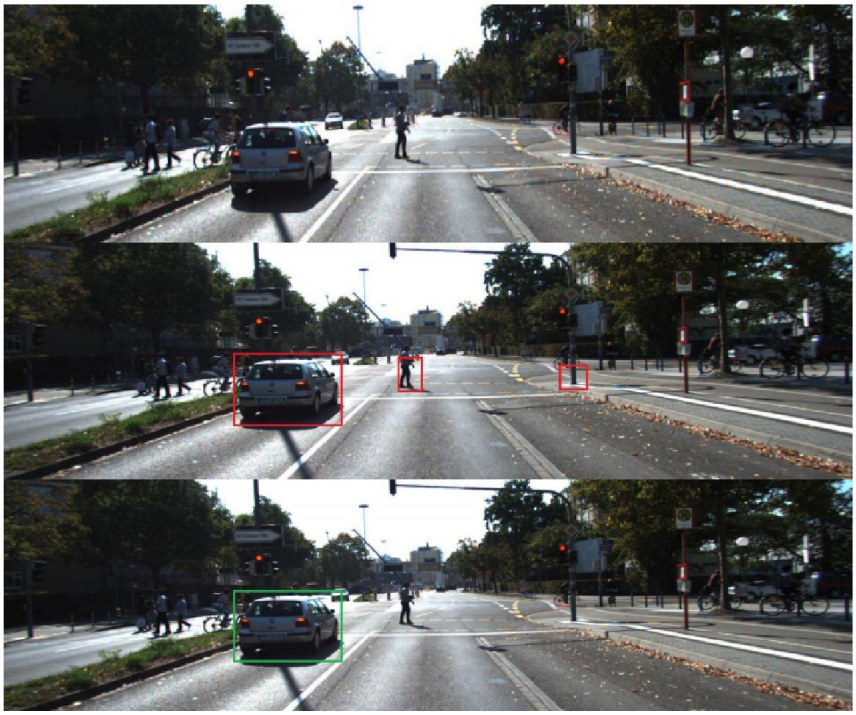

Fig 2.7- Vehicle and pedestrian detection

Clemens Dannheim et. Al. [IEEE 2014]: In this paper they have utilized Camera and Lidar to get information about climate all around the vehicle. They have talked about how information is gathered, examined, and converged to help the arrangement of moving vehicle in settling on self-sufficient choice. Here first they are taking Fourier change of the picture which contains the data about frequencies in the picture. At that point highlights from the picture is separated utilizing the Gabor inspecting and Principal part Analysis(PCA). At that point these components are nourished to the classifier(SVM mind RBF portion utilized) which has been prepared on mist and mist free pictures. Utilizing this strategy they got 96% exactness in identification of climate utilizing this framework. [12]

Sheng Zhao et. Al. [IEEE 2013]: This paper presents strategy to use 2D LIDAR for Inertial Navigation System helping to enhance 3D vehicle position estimation precision In this paper, 2D LIDAR supporting is completed without forcing any presumptions on the vehicle movement. To accomplish this, a shut shape equation is inferred to anticipate the line estimation in the LIDAR's edge. This makes the element affiliation, lingering development and GUI show conceivable. With this recipe, the Extended Kalman Filter (EKF) can be utilized in a direct way to combine the LIDAR and IMU information to evaluate the full condition of the vehicle. Preparatory test comes about demonstrate the adequacy of the LIDAR helping in diminishing the state estimation vulnerability along certain directions.[15]

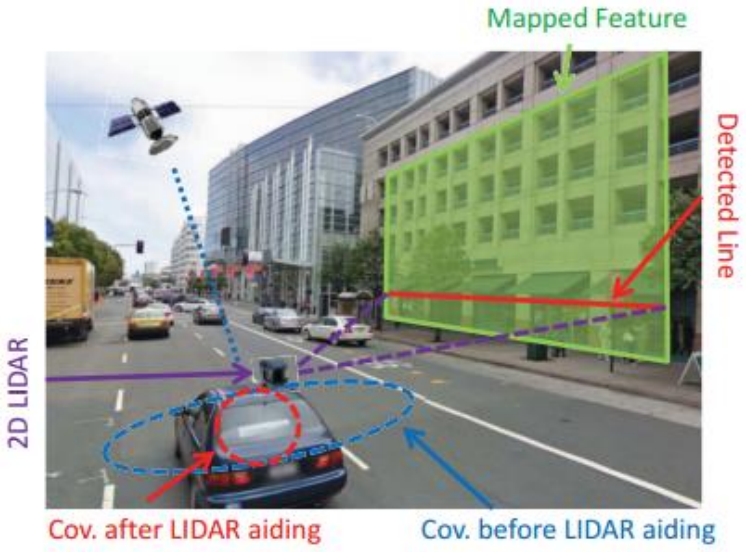

Fig. 2.8 - The typical use of 2D LIDAR aiding for vehicle positioning in urban environments.

Zsolt Kira et. Al. [IEEE 2012]: The researcher Zsolt Kira have utilized different sensors to enhance the identification rate of person on foot. sensor they have utilized are LIDAR and IR camera. The info originating from various sensor is send to course of classifiers, first depends on 'quick convolution arrange classifier' and second is a 'Hoard classifier'. These classifiers take choice in view of the information gave by the sensor and further control the diverse actuators, for example, alert, ringer, streak light and so forth. At long last they have tried their framework on a Toyota Highlander vehicle. Both the Stationary and Dynamic(40 kmph) conditions were tried. [1]

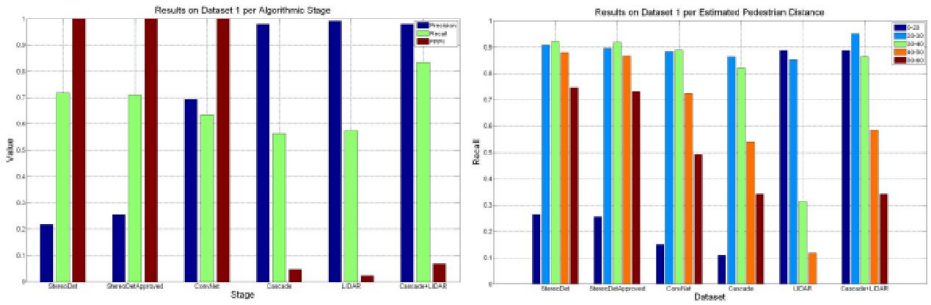

Fig. 2.9 - Results on dataset, showing the precision, recall, and false positives per frame (FPPI) for multiple stages.

Heidrun Belzner et. Al [IVS 2012] : Cutting edge vehicles are outfitted with numerous cameras and their utilization in numerous commonsense applications is broad. Distinguishing the nearness of haze from pictures of a camera mounted in vehicles is an extremely difficult undertaking with the possibility to be utilized as a part of numerous pragmatic applications. Approaches presented as of not long ago break down properties of neighborhood questions in the picture like path markings, activity signs, backdrop illuminations of vehicles in front or head lights of moving toward vehicles. By differentiation to all these related works we propose to utilize picture descriptors and an arrangement method so as to recognize pictures with haze show from those free of haze. These picture descriptors are worldwide and depict the whole picture utilizing Gabor channels at various frequencies, scales and introductions. Our trials showed hight capability of the proposed technique for haze discovery on daytime pictures. [20]

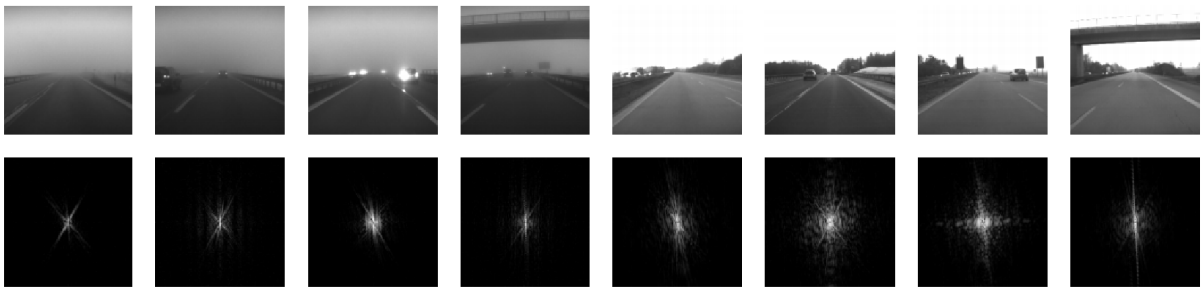

Fig 2.10 - Images of fog and fog free scenes and the corresponding power spectra.

Nicolas Hautière et.Al [IEEE 2010] : In antagonistic climate conditions, specifically, in sunshine haze, the difference of pictures got by in-vehicle cameras in the unmistakable light range is radically debased, which makes ebb and flow driver help that depends on cameras exceptionally delicate to climate conditions. A locally available vision framework ought to consider climate impacts. The impacts of light mist fluctuate over the scene and are exponential concerning the profundity of scene focuses. Since it is unrealistic in this setting to process the street scene structure in advance, as opposed to settled camera observation, another plan is proposed. Haze thickness is initially assessed and after that used to reestablish the complexity utilizing a level world supposition on the sectioned free space before a moving vehicle. A scene structure is assessed and used to refine the reclamation procedure. Results are introduced utilizing test street scenes under foggy climate and evaluated by processing the perceivability level improvement that is picked up by the technique. At last, we demonstrate applications to the upgrade in sunlight mist of low-level calculations that are utilized as a part of cutting edge camera-based driver help. [7]

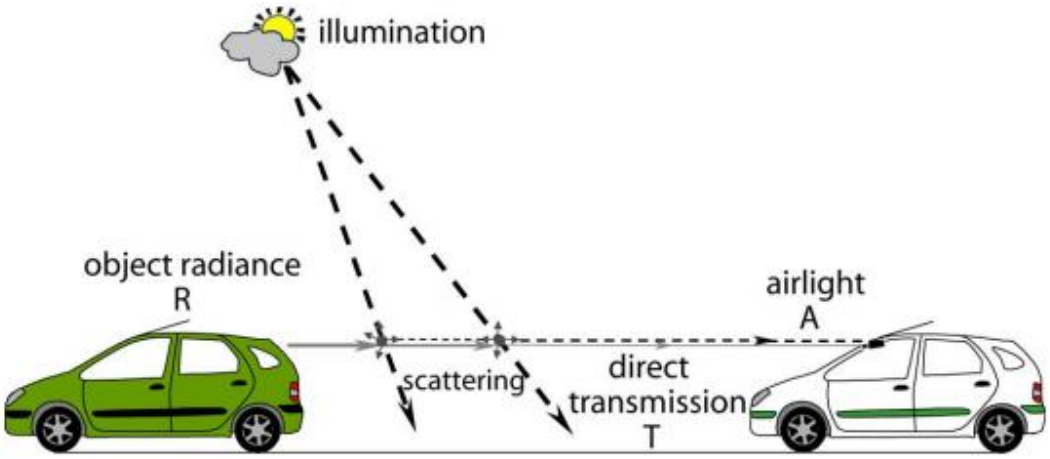

Fig. 2.11 - Fog or haze luminance due to the scattering of daylight.

Lili Huang et. Al. [IEEE 2009]: In this paper they are dealing with the Driver help framework (DAS). They have utilized LIDAR and Computer vision sensor to make their framework more shrewd. Data discharged from both the Lidar and camera are melded and nourished to classifier to recognize protest and take decision.Here they are utilizing the Adaboost classifier to arrange the object,vehicle ,pedestration and so on. Theit exploratory outcomes have shown that, when contrasted and picture based and great sensor combination based vehicle recognition systems,This framework is very valuable for demonstrating and forecast of the activity conditions over an assortment of roadways. In this way it might be utilized as a part of future self-ruling route frameworks. [14]

Martin Roser et. Al [IEEE 2008] : Present vision based driver help frameworks are intended to perform under amiable climate conditions. However , restricted perceivability brought about by overwhelming precipitation or mist unequivocally influences vision frameworks. To enhance machine vision in terrible climate circumstances, a solid location framework is essential as a ground base. They have introduce an approach that can recognize various climate circumstances in view of the order of single monocular shading pictures, with no extra suppositions or earlier information. The proposed picture descriptor unmistakably beats existing descriptors for that

assignment. Trial comes about on genuine activity pictures are described by high exactness, productivity, and flexibility concerning driver help frameworks. [19]

Fig 2.12 – Sample images in different climatic conditions

Mohan Manubhai Trivedi et. Al [IEEE 2007] : This paper presents examinations concerning the part of PC vision innovation in creating more secure autos. We consider vision frameworks, which can't just watch out of the vehicle to distinguish and track streets and abstain from hitting impediments or walkers yet all the while peer inside the vehicle to screen the mindfulness of the driver and even foresee her goals. In this paper, a frameworks situated structure for creating computervision innovation for more secure autos is introduced. We will consider three principle segments of the framework: environment, vehicle, and driver. We will talk about different issues and thoughts for creating models for these principle segments and exercises connected with the perplexing errand of safe driving. This paper incorporates an examination of novel tactile frameworks and calculations for catching not just the dynamic encompass data of the vehicle additionally the state, plan, and movement examples of drivers. [9]

Wannes van der Mark [IEEE 2006] : Stereo vision is an alluring detached detecting method for getting three-dimensional (3-D) estimations. Late equipment propels have offered ascend to another class of constant thick divergence estimation calculations. This paper analyzes their

appropriateness for astute vehicle (IV) applications. With a specific end goal to pick up a superior comprehension of the execution and the computationalcost tradeoff, the creators made a structure of ongoing usage. This comprises of various deliberate parts in view of single direction numerous information (SIMD) procedures. Besides, the subsequent algorithmic varieties are contrasted and other openly accessible calculations. The creators contend that current freely accessible stereo information sets are not exceptionally reasonable for the IV area. Subsequently, the creators' assessment of stereo calculations depends on novel practically looking reproduced information and also genuine information from complex urban activity scenes. Keeping in mind the end goal to encourage future benchmarks, all information utilized as a part of this paper is made freely accessible. The outcomes from this review uncover that there is a significant impact of scene conditions on the execution of every single tried calculation. Approaches that go for (worldwide) inquiry enhancement are more influenced by this than different methodologies. The best general execution is accomplished by the proposed various window calculation, which utilizes neighborhood coordinating and a left–right check for a hearty blunder dismissal. Timing comes about demonstrate that the easiest of the proposed SIMD variations are more than twice as quick than the most complex one. By the by, the last still accomplishes ongoing handling speeds, while their normal exactness is in any event equivalent to that of freely accessible non-SIMD algorithm.[3]

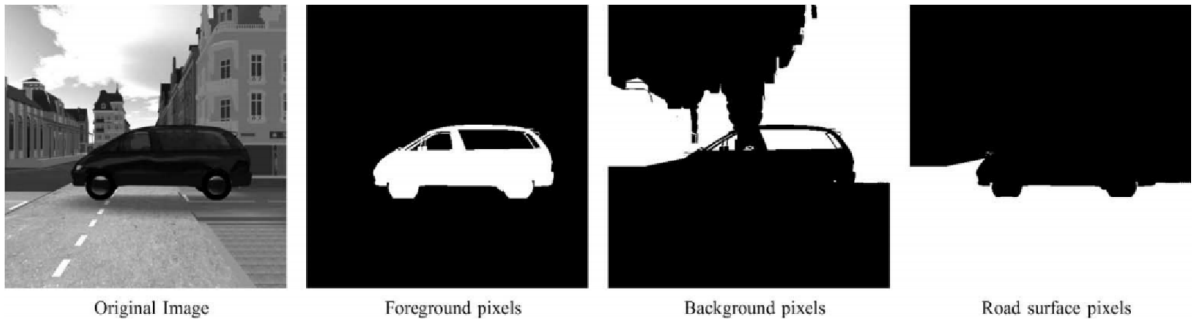

Fig. : 2.13- Different pixel classes used for evaluation.

Nicolas Hautière et. Al [IEEE 2006] : An environmental perceivability estimation framework fit for evaluating the most widely recognized working scope of locally available exteroceptive sensors is a key parameter in the formation of driving help frameworks. This data is then used to

adjust sensor operations and preparing or to alarm the driver that his locally available help framework is immediately broken. Besides, a framework able to do either distinguishing the nearness of haze or assessing perceivability separations constitutes in itself a driving help. In this paper, the creators show a strategy to evaluate the assembled perceivability separate through an utilization of locally available charge-coupled gadget cameras. The last speaks to the separation to the most far off question out and about surface having a difference over 5%. This definition is near the meaning of the meteorological perceivability remove proposed by the International Commission on Illumination. The strategy joins the calculations of neighborhood complexities over 5% and of a profundity guide of the vehicle environment utilizing stereovision inside 60 ms on a present day PC. In this paper, both strategies are depicted independently. At that point, their blend is definite. The technique is agent night and day in each sort of meteorological condition and is assessed; because of video groupings under sunny climate and foggy climate.[4]

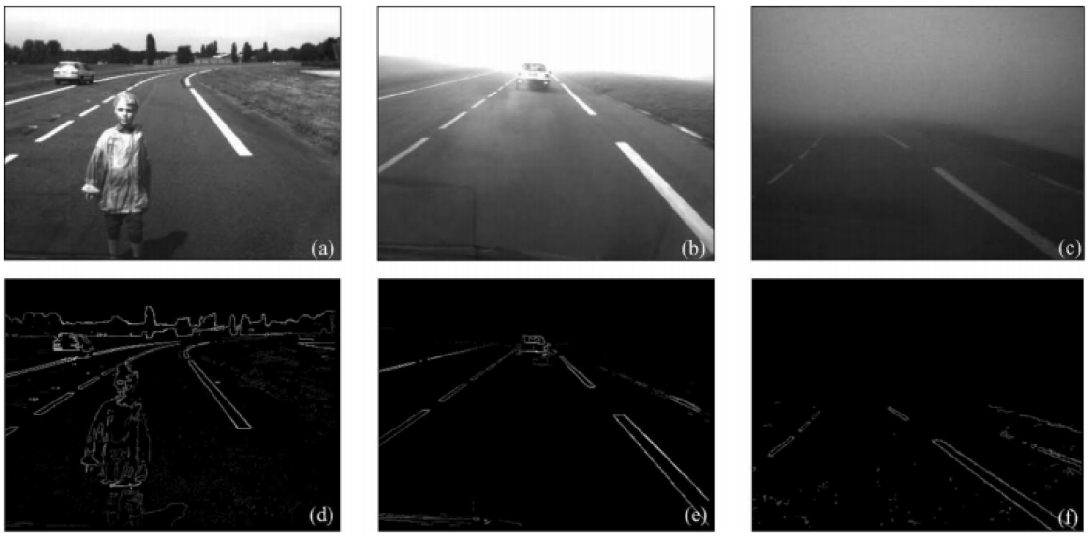

Fig.-2.14- Images captured in the vehicle (a) under sunny weather, (b) under foggy weather, and (c) under dense foggy weather before nightfall. Examples of computation of contrasts above 5% on the whole images (d) for image (a), (e) for image (b), and (f) for image (c)

Joel C. McCall [IEEE 2006] : Driver-help frameworks that screen driver aim, caution drivers of path flights, or help with vehicle direction are all being effectively considered. It is thusly vital to investigate key parts of these frameworks, one of which is path position following. It is for these

driver-help destinations that propel the improvement of the novel "video-based path estimation and following" (VioLET) framework. The framework is planned utilizing steerable channels for strong and precise path checking location. Steerable channels give an effective strategy to distinguishing roundabout reflector markings, strong line markings, and divided line markings under fluctuating lighting and street conditions. They help in giving heartiness to complex shadowing, lighting changes from bridges and passages, and street surface varieties. They are effective for path checking extraction on the grounds that by registering just three divisible convolutions, we can remove a wide assortment of path markings. Ebb and flow recognition is made more vigorous by fusing both visual signals (path markings and path surface) and vehicle-state data. The analysis outline and assessment of the VioLET framework is demonstrated utilizing different quantitative measurements over a wide assortment of test conditions on an extensive test way utilizing a remarkable instrumented vehicle. A defense for the selection of measurements in view of a past review with human-elements applications and in addition broad ground-truth testing from various circumstances of day, street conditions, climate, and driving situations is likewise displayed. Keeping in mind the end goal to plan the VioLET framework, an up and coming and exhaustive investigation of the ebb and flow best in class in path discovery research was initially performed. In doing as such, an examination of a wide assortment of techniques, calling attention to the likenesses and contrasts between strategies and additionally when and where different strategies are most helpful, is introduced. [8]

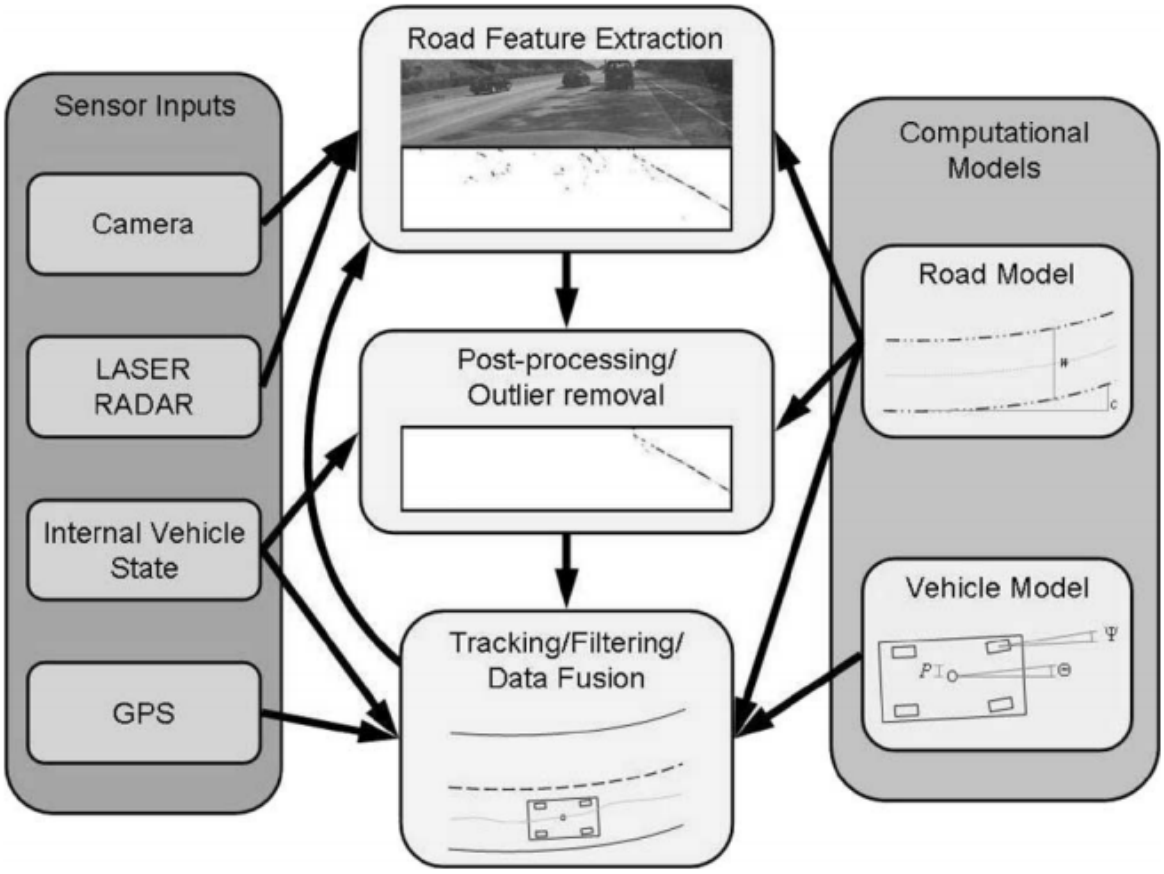

Fig. 2.15 - Generalized flowchart for lane-position-detection systems combining multiple modalities, an iterative detection/tracking loop, and roadand vehiclemodels.

Kiyokazu Takagi et. Al [IEEE 2006]: In this paper they have just utilized LIDAR to recognize Road paths and vehicle. They additionally demonstrate the coordination of LIDAR and GPS for high exact route. For the most part Lidar utilizes 3 miror to recognize the protest yet they have utilized 6 mirror to identify all forward question including the path check. They have identification calculation in three stages first they perceive the forward protest then they perceive the path stamp lastly Road environment is perceived by coordinating these two sections. To discover the consequence of their framework they contrasted diverse pictures got by framework and unique picture and presumed that the LIDAR can distinguish different protests all the more precisely as a result of its light discharge in both day and night. [11]

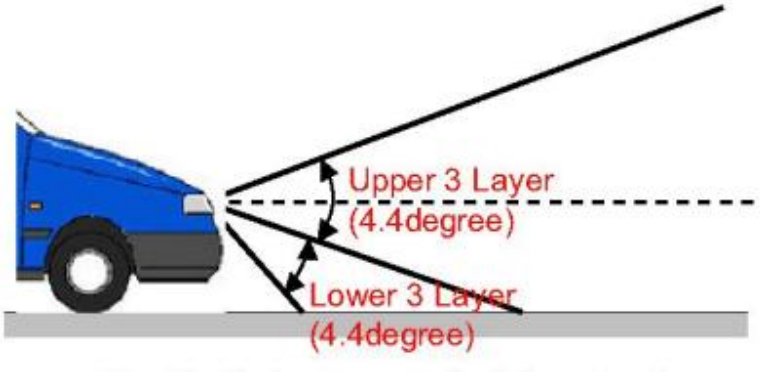

Fig. 2.16 – Detection angle elevation

Guang Lu et. Al. [IEEE 2006]: This paper portrays another vehicle discovery framework in light of a laser imaging, identification, and running (LIDAR) sensor, and behaviors an exploratory review to research the sensor's part in the vehicle sidelong direction frameworks. The LIDAR sensor is introduced on a controlled vehicle and it can gauge the relative separation of the vehicle from a former vehicle, by checking the flat plane with laser shafts. Here ecological mess turns into the principle challenge in information handling, when LIDAR tries to track the wanted target. A probabilistic information affiliation based calculation has been produced to tackle this issue,

which has been confirmed progressively tries utilizing two Buick LaSabre vehicles. The test contemplate likewise uncovers the connection between the LIDAR yields and the attractive reference framework broadly utilized by the present PATH sidelong control frameworks, and the outcomes give the rules on how this new sensor framework might be utilized for vehicle parallel direction. [16]

Fig. 2.17 - LIDAR mounted on top of the vehicle.

NICOLAS HAUTIERE et. Al. [IEEE 2005]: In this paper, they have present a measurement framework of different visibility distances using onboard CCD cameras, Such as: meteorological visibility, obstacle visibility, mobilized visibility. The methods to estimate these different visibility distances are explained in this paper. They have used Koschmieder's law to determine the fog effects on atmospheric visibility.[13]

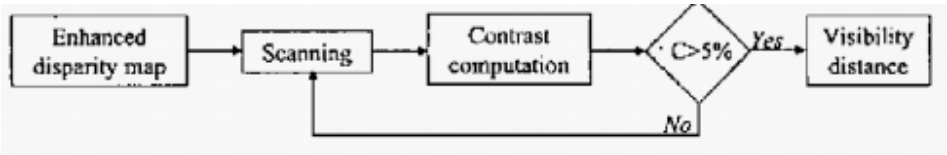

Fig. 2.18- Algorithm overview

Chu Jiangwei et. Al. : This article depicts systemically the technique for recognizing going before vehicle in view of monocular camera. The principle substance are as taking after: First, an essential zone of fascinating is found by the path fringes that are identifed in a camera picture, and a probability target vehicle is looked by the dark contrast between the objective vehicle and foundation. Second, a distinguishing zone of intriguing is discovered again in view of the range of probability target vehicle, an objective vehicle is certified by a symmetry character of the vehicle layout and a place of the vehicle symmetrical pivot is found out. Third, the protest vehicle is followed by Kalman estimate standard in the arrangement pictures. Fourth, a technique for identifying separation in a casing of picture is presented, and the adjustment of camera's inside parameters and the consequences of a few examinations are given. [23]

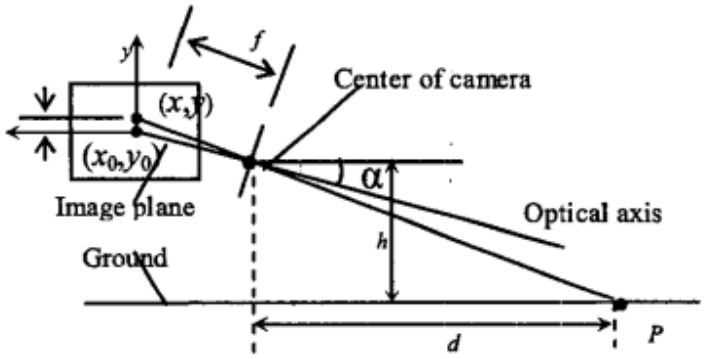

Fig. 2.19 - The geometry model of detecting distance in image

Rita Cucchiara et. Al [IEEE 2000] : The paper introduces an approach for recognizing vehicles in urban activity scenes by method for run construct prevailing upon respect to visual information. The quality of the approach is its formal partition between the low-level picture preparing modules (utilized for extricating visual information under different enlightenment conditions) and the abnormal state module, which gives a universally useful learning based structure for following vehicles in the scene. The picture preparing modules separate visual information from the scene by spatio-transient examination amid daytime, and by morphological investigation of headlights during the evening. The abnormal state module is planned as a forward tying creation control framework, taking a shot at typical information, i.e., vehicles and their characteristics (territory, example, heading, and others) and misusing an arrangement of heuristic principles tuned to urban movement conditions. The cooperative energy between the manmade brainpower methods of the abnormal state and the low-level picture investigation procedures furnishes the framework with adaptability and vigor. [5]

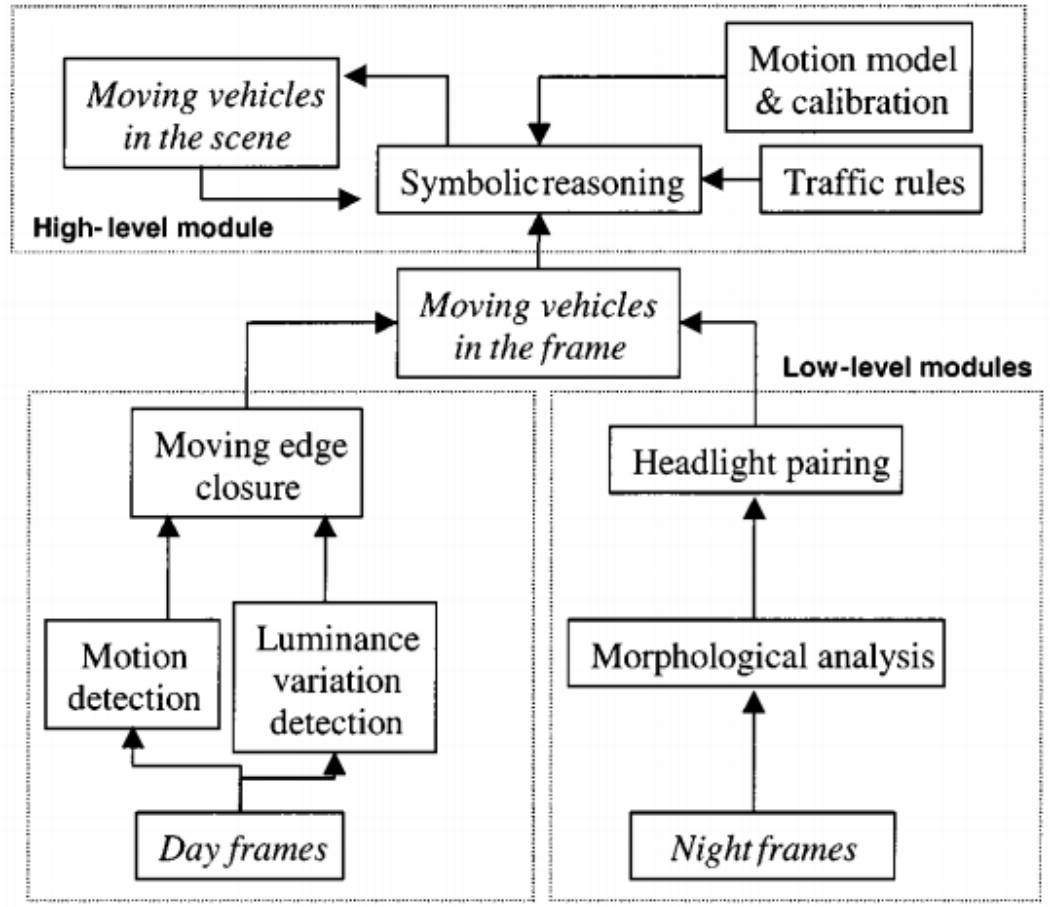

Fig. -2.20- The VTTS system architecture.

John P. Oakley et. Al [IEEE 1998] : In daytime visibility conditions, picture differentiation is regularly essentially debased by air pressurized canned products, for example, cloudiness and mist. This paper presents a strategy for lessening this debasement in circumstances in which the scene geometry is known. Difference is lost since light is scattered toward the sensor by the airborne particles and on the grounds that the light reflected by the landscape is lessened by the vaporized. This corruption is roughly described by a straightforward, physically based model with three parameters. The technique includes two stages: initial, an opposite issue is tackled keeping in mind the end goal to recuperate the three model parameters; then, for every pixel, the relative commitments of scattered and reflected flux are evaluated. The evaluated dissipate

commitment is just subtracted from the pixel esteem and the rest of scaled to make up for vaporized lessening. This paper portrays the picture preparing calculation and presents an examination of the flag to-commotion proportion (SNR) in the subsequent upgraded picture. This investigation demonstrates that the SNR diminishes exponentially with range. A worldly channel structure is proposed to tackle this issue. Results are introduced for two picture arrangements taken from an airborne camera in murky conditions and one succession in clear conditions. An attractive assention between the model and the test information is appeared for the fog conditions. A critical change in picture quality is exhibited when utilizing the complexity upgrade calculation as a part of conjuction with a worldly channel.[2]

Fig.-2.21- Processed image

2.2 CONCLUSSION OF LITRATURE SURVEY

Finally concluding the literature review I will say that by going through different papers and ideas presented by different scientists and researchers, I found that the foggy condition is very dangerous for driving, recently we have seen that in Delhi and Haryana numbers of people died due to the accident caused by the degraded visibility condition due to the fog and mist. Different Authors and scientists have presented different ideas and algorithm to improve the picture quality and enhance the contrast of the dull image.

Different techniques such as fast convolution network classifier[1] , HOG classifier[1], rule-based reasoning[5], refine the restoration process[7], VioLET[8], sensor fusion[10], LIDAR[11], Fourier transform[12], Gabor sampling[12], Principal component Analysis[12],SVM classifier[12], Koschmieder's law[13], Adaboost classifier[14], Extended Kalman Filter[15], P4P technique[17], Gaussian mixture model[18], morphological processing and connectivity analysis [18], Kalman forecast principle[23],Distance measurement using monocular vision[23] are used to enhance the quality of image, to detect the upcoming vehicle, to find the density of fog, to estimate the visibility condition and visibility level, to find the distance from other vehicle.

These are the most appropriate methods to find our goal in the field of "vehicle detection in fog" and this is very vast field to work and improve the work done by these researchers and scientists. Out of these techniques we found that the thresholding techniques are most efficient and fast as compare to the other algorithm which are deployed to enhance the contrast of received image. Other than this to measure the distance there are different techniques but using laser and monocular camera the measured distance is more accurate and faster but with this approach there is one limitation that it is fixed for only one line this is also the area where we will work to make this system more efficient and generic.

CHAPTER-3

WORKING OF VEHICLE DETECTION IN FOG

Keeping our objective “to detect the vehicle in foggy environment”, We have designed a system which is able to detect the upcoming vehicle by enhancing the received image contrast, according to other objective to measure the distance also we have to design another system which will measure accurate distance and inform to the system and finally we will combine these two inputs and according to it our system will take decision and provide warning signal to the driver/user.

To design this system we will need a strong processor/platform which is capable of processing image very fast, beside this a good quality camera which will take image from real world and provide to the processor.

Beside this to measure distance we will need another camera and laser, here laser will emit a narrow beam of light and it will be received by a camera and using the basic trigonometry rule we will calculate the distance.

We will take a look of our system by block diagram:

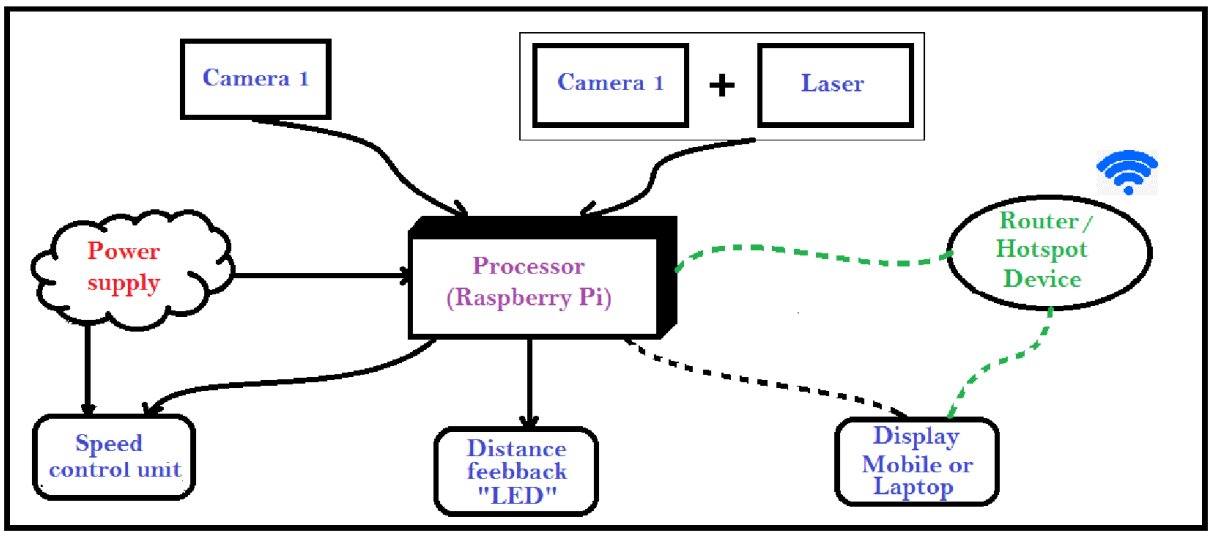

Fig. 3.1 – Basic block diagram of proposed work

My complete project is composed of three main part first is to take image from camera apply some algorithm on the received image and make is clear so that the content of received image become clearly visible to the driver after this the second part is to find out the distance of upcoming vehicle using camera and laser using the basic trigonometry rules and final part is to control the speed of our vehicle if the upcoming vehicle approaching to us and it is in predefined range (2.5 meter) to avoid the collision, In this step we will provide the feedback to user in the form of LED lights, Beep and Display. Now we will take a look on each and every part in detail and finally we will discuss about the hardware part and component used to design this project.

3.1 Algorithm used: I am using the "Adaptive Gaussian Thresholding" technique to process the received image and make it clear. So, first of all we will take a look what a thresholding is??? The matter is straight forward. If pixel value is greater than a threshold value, it is assigned one value (may be white), else it is assigned another value (may be black). If we take an example of OpenCV the function used is cv2.threshold have this functionality. First argument is the source image, which should be a grayscale image. Second argument is the threshold value which is used to classify the pixel values. Third argument is the maxVal which represents the value to be given if pixel value is more than (sometimes less than) the threshold value. In the simple thresholding, we use a global value as threshold value. But it may not be good in all the conditions where image has different lighting conditions in different areas. In that case, we go for adaptive thresholding, And in the Adaptive thresholding, the algorithm calculate the threshold for a small regions of the image. So we get different thresholds for different regions of the same image and it gives us better results for images with varying illumination. In adaptive threshold unlike fixed threshold, the threshold value at each pixel location depends on the neighboring pixel intensities.

Example:

To calculate the threshold T(x, y) i.e. the threshold value at pixel location (x, y) in the image, we perform the following steps –

1. A bxb region around the pixel location is selected. where b is selected by the user.
2. The next step is to calculate the weighted average of the bxb region. OpenCV provides 2 methods to calculate this weighted average. We can either use the average (mean) of all the

pixel location that lie in the bxb box or we can use a Gaussian weighted average of the pixel values that lie in the box. In the latter case, the pixel values that are near to the center of the box, will have higher weight. We will represent this value by WA(x, y).

3. The next step is to find the Threshold value T(x, y) by subtracting a constant parameter, let's name it param1 from the weighted average value WA(x, y) calculated for each pixel in the previous step. The threshold valueT(x, y) at pixel location (x, y) is then calculated using the formula given below -

$$T(x, y) = WA(x, y) - param1$$

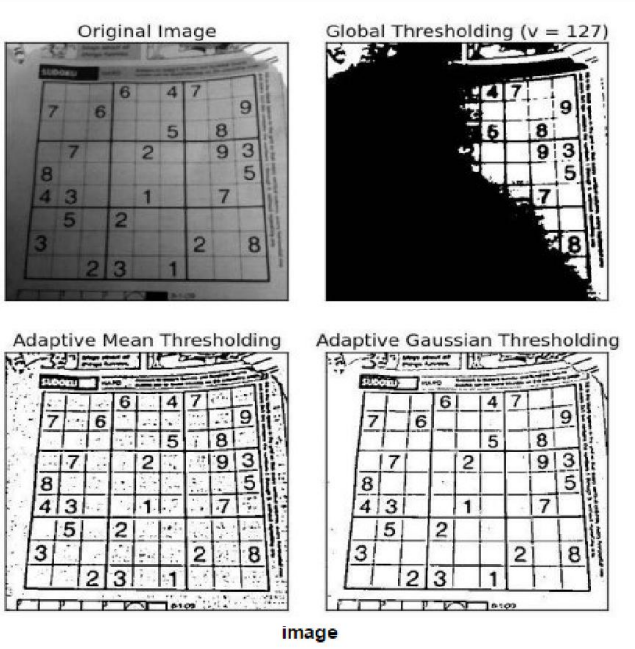

Fig. 3.2 : Adaptive thresholding

Sample python code : Here we will discuss the coding part of our algorithm.

```
import cv2
from numpy import  *
import math
```

Fig. :3.3 Header files

I have done complete coding of my project in python language, In above image we can see that these 3 header files are imported and they hold the complete functionality of the image processing technique.

```
ret,img=cam.read()
gry=cv2.cvtColor(img,cv2.COLOR_BGR2GRAY)
gaus=cv2.adaptiveThreshold(gry,220,cv2.ADAPTIVE_THRESH_GAUSSIAN_C,cv2.THRESH_BINARY,115,1)
```

Fig. : 3.4 Thresholding Function

In the above code we "cam.read()" function is returning the image frame "img" which is received from the camera. In second line function "cv2.cvtColor()" is used to convert the received image into the gray scale and the output is stored in the "gray". And in the last line function "cv2.adaptiveThreshold()" is used to apply the thresholding to our image.

3.2 Distance measurement: To measure the distance we are using the combination camera and a laser adjusted at fixed distance to calculate the distance. The reason for using camera and laser is because using an ultrasonic sensor does not provide precise readings of gaps due to its large viewing angle, the Sharp IR sensor is another option but it produces a noisy output. This can be filtered out in code, but it still does not offer the precision and range needed for doing something like making a 2d map of a room. So take a look on this diagram it will become more clear to you, how the things are adjusted in the setup.

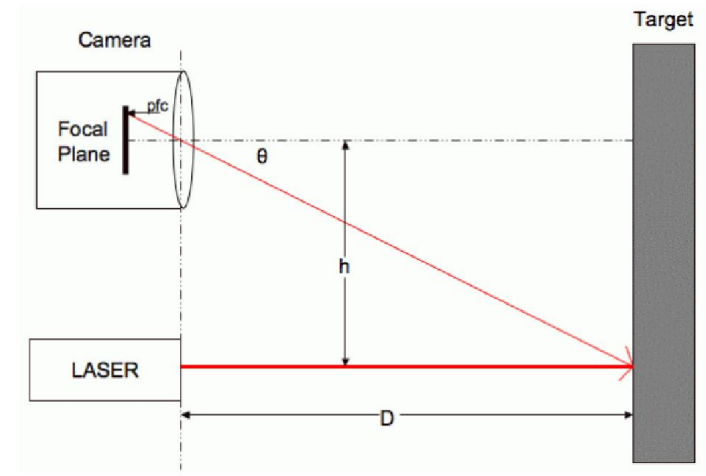

Fig 3.5: Adjustment of camera and laser.

In this figure we can see that camera and laser are fixed at the distance of "h" centimeter. The target is situated at the distance "D" centimeter which is variable. And constant "θ" is fixed for

every camera. Here our aim is to measure the distance "D" up to our target which is given by the Formula:

$$D = \frac{h}{\tan\theta}$$

Where the "θ" is given by :

$$\theta = pfc * rpc + ro$$

Where:

pfc = Number of Pixels From Center of Focal Plane

rpc = Radians per pixel pitch

ro = Radian offset (compensates for allignment errors)

After adjusting everything, Now it comes turn to calibrate our system to measure the accurate distance for this first of all we have to adjust the position of camera and laser in such a way that the red dot of laser must be at the center of the image received by the camera we can monitor this by running the code in our system. When the dot comes at the center of image then fix everything at that point. Now take the pen and paper to take the reading for "x" distance from center of image, "d" Actual distance and calculate the value of "θ" theta for every reading you have taken, we have to calculate "θ" using this formula:

$$\theta_{actual} = \arctan\left(\frac{h}{D_{actual}}\right)$$

Where:

θ_{actual} = Actual angle

D_{actual} = Actual distance to target (measured)

Take at least 3 reading so that you can plot the graph between "θ" and "x". Your reading table will look like this:

Distance from center "x" cm	**Actual distance "d" cm**	**Theta "θ" rad**
41	135	0.0835
66	100	0.1125
80	87	0.1563

Finaly you will get a straight line in the form of :

$$y = mx + c$$

And your graph will look like :

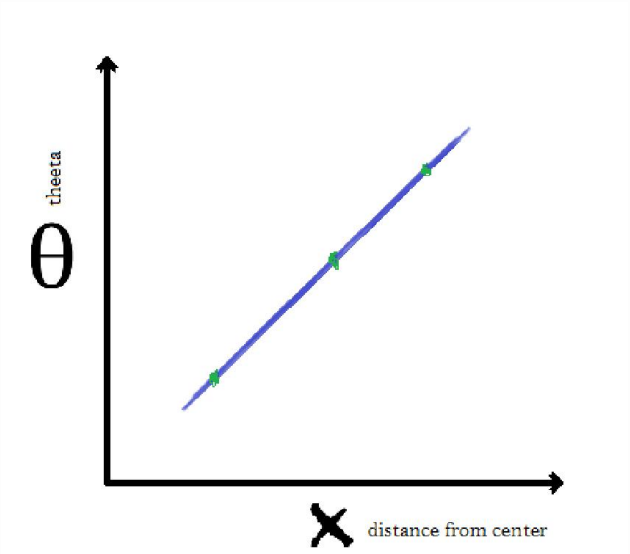

Fig 3.6 : Graph Plotted between "θ" and "x"

Finally you have to take the value of "m" and "c" and put into the program and your system will able to measure the accurate distance up to the point to which you have calibrated.
Sample Python Code: In this section we will discuss the about the code which is responsible for calculating the distance.

```
import cv2
from numpy import  *
import math
```

Fig. : 3.7 Header Files

These are the header file which I have imported for capturing the image processing it and calculating the distance.

```
ret,img=cam.read()
num = (img[:,:,2] > 236)
xy_val =  num.nonzero()
y_val = median(xy_val[0])
x_val = median(xy_val[1])
dist = abs(x_val - 320) # distance of dot from center x_axis only
#dist = abs(y_val - 320)
#dist = ((x_val - 320)**2 + (y_val - 240)**2 )**0.5

print " dist from center pixel is " + str(dist)

theta =0.00133*dist + 0.01733
tan_theta = math.tan(theta)

if tan_theta > 0: # bit of error checking
    obj_dist =  int(12/ tan_theta)
    print "the dot is " + str(obj_dist) + "cm  away"
```

Fig. : 3.8 Code for Distance measurement

This is the second part of the code which is responsible for the distance measurement. Here first of all we are finding the position of red dot of laser in the received frame of image and then we are finding its distance from the center of image and with this information we can calculate the value of theta and which is further used to find the actual distance.

3.3 Controlling the speed and feedback : To control the speed of our vehicle at small level we can use PWM that stands for the pulse width modulation, But at the higher level means if we are dealing with the actual vehicle we can use hydraulic braking system which can be easily controlled by a controller. In my project, I have used a servo motor to control the speed of the DC motor rotating. To control the position of servo motor I have used PWM which is generated by the raspberry pi at GPIO 18. And also to provide the feedback according to distance I have used red and green LED. Red led will glow when the distance get decreased up to 2.5 meter, otherwise Green led will glow means there is no problem. To display the processed image which is in thresholded form we can use TFT screen but instead of this I have used my Smartphone as the display of my system which is easily available, it is completely wireless.
Sample python code: In this section I will discuss about the code which is responsible for the controlling of servo motor and the LED feedback.

```
import wiringpi
import time
wiringpi.wiringPiSetupGpio()
wiringpi.pinMode(17, wiringpi.GPIO.OUTPUT)
wiringpi.pinMode(27, wiringpi.GPIO.OUTPUT)
wiringpi.pinMode(18, wiringpi.GPIO.PWM_OUTPUT)
wiringpi.pwmSetMode(wiringpi.GPIO.PWM_MODE_MS)
wiringpi.pwmSetClock(192)
wiringpi.pwmSetRange(2000)
delay_period = 0.01
```

Fig. ; 3.9 Header files and setup for Controlling

This code is for the initial setup of the controlling subsystem. Here first I have imported some required module “wiringpi” and “time” for controlling the digital and PWM output of the GPIO with required delay.

```
def stop():
        wiringpi.pwmWrite(18, 150)
        time.sleep(delay_period)


def full_stop():
        wiringpi.pwmWrite(18, 153)
        time.sleep(delay_period)

def release():
        wiringpi.pwmWrite(18, 120)
        time.sleep(delay_period)
```

Fig. : 3.10 Functions for controlling the Servo motor position.

This code has three functions which maintain the servo motor at different position according to the condition satisfied by the calculated distance to control the speed of vehicle.

```
if(obj_dist>=250):
    release()
    wiringpi.digitalWrite(17,wiringpi.HIGH);
    wiringpi.digitalWrite(27,wiringpi.LOW);
    print "RELEASING"
else:
    stop()
    wiringpi.digitalWrite(27,wiringpi.HIGH);
    wiringpi.digitalWrite(17,wiringpi.LOW);
    print"STOPING"
```

Fig. : 3.11 Decision making according to distance calculated

This part of the code is making the decision according to the distance measured by the system "obj_dist". There are two condition if distance is less than 2.5 meter the the "stop()" function will be called and at the same time Red led will glow and green led will turn off. Similarly when the distance will more than 2.5 meter then the "release ()" function will be called and red led will be turned off while the green led will glow now.

3.4 Hardware used: In this section we will take a look on the complete list of the hardware used in my project we will start from our control board and go through each and every component used up to the nut/bolt and screw.

3.4.1 Raspberry pi board: A Raspberry Pi is a credit card-sized computer originally designed for education, inspired by the 1981 BBC Micro. Creator Eben Upton's goal was to create a low-cost device that would improve programming skills and hardware understanding at the pre-university level. But thanks to its small size and accessible price, it was quickly adopted by tinkerers, makers, and electronics enthusiasts for projects that require more than a basic microcontroller (such as Arduino devices).The Raspberry Pi is slower than a modern laptop or desktop but is still a complete Linux computer and can provide all the expected abilities that implies, at a low-power consumption level. Now we will disccuss some features of raspberry pi :

A. CPU: Quad-core 64-bit ARM Cortex A53 clocked at 1.2 GHz
B. GPU: 400MHz VideoCore IV multimedia
C. Memory: 1GB LPDDR2-900 SDRAM (i.e. 900MHz)
D. USB ports: 4
E. Video outputs: HDMI, composite video (PAL and NTSC) via 3.5 mm jack
F. Network: 10/100Mbps Ethernet and 802.11n Wireless LAN
G. Peripherals: 17 GPIO plus specific functions, and HAT ID bus
H. Bluetooth: 4.1
I. Power source: 5 V via MicroUSB or GPIO header
J. Size: 85.60mm × 56.5mm
K. Weight: 45g (1.6 oz)

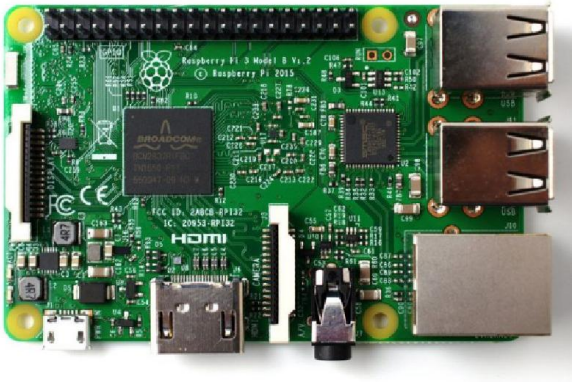

Fig. : 3.12 Raspberry pi board

3.4.2 Logitech camera: This is the camera which I have used in my project. This is an USB camera which can be easily interfaced with our raspberry pi board. First of all we should know what a webcam is, A webcam, short for 'web camera' – is a digital camera that's connected to a computer. It can send live pictures from wherever it's sited to another location by means of the wire or wirelessly. Many desktop computer screens and laptops come with a built-in camera and microphone.

Fig. : 3.13 Logitech USB web cam

3.4.3 Simple Laser: Laser is a device that generates an intense beam of coherent monochromatic light (or other electromagnetic radiation) by stimulated emission of photons from excited atoms or molecules. Lasers are used in drilling and cutting, alignment and guidance, and in surgery; the optical properties are exploited in holography, reading barcodes, and in recording and playing compact discs. In my project I have used a simple laser which emits the red colored beam.

Fig. : 3.14 Simple laser

3.4.4 Cardboard sheet: Cardboard is a generic term for a heavy-duty paper of various strengths, ranging from a simple arrangement of a single thick sheet of paper to complex configurations featuring multiple corrugated layers. I have used cardboard as the enclosure of my project and different component. It is simple to cut and join the cardboard sheet. It has very light weight and good strength as compared to other material.

Fig. : 3.15 Cardboard sheet

3.4.5 Screw Nut/Bolt: I have not used the Glue or Gum to join the different parts of cardboard sheet, because I have to open it many times when I am working on my project for testing and programming. Instead of this I have used Nut/Bolts and screw. Which have provided better strength to my project and by using this my project become more modular and portable.

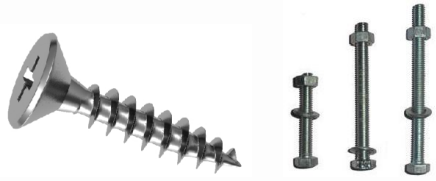

Fig. : 3.16 Screw and Nut/Bolt

3.4.6 Led: A light-emitting diode (LED) is a semiconductor device that emits visible light when an electric current passes through it. The light is not particularly bright, but in most LEDs it is monochromatic, occurring at a single wavelength. The output from an LED can range from red (at a wavelength of approximately 700 nanometers) to blue-violet

(about 400 nanometers). Some LEDs emit infrared (IR) energy (830 nanometers or longer); such a device is known as an infrared-emitting diode (IRED). I have used LED's in my project as a feedback device. When the distance between front vehicle will become less than 2.5 meter then Red LED will glow otherwise green LED will glowing continuously.

Fig. : 3.17 LED

3.4.7 Jumper wires: Jumper wires are used to connect the different parts of the board to the external peripheral components such as motor, LED etc. They are most widely wsed in the different electronics projects. I have used jumper wires to connect the LED with raspberry pi, to connect servo motor and DC motor to power port.

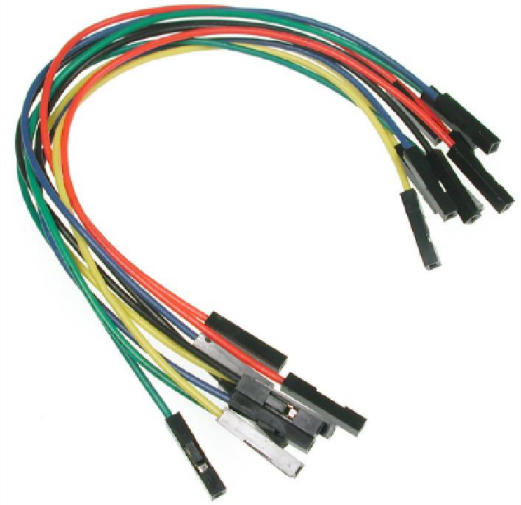

Fig. ; 3.18 Jumper wires

3.4.8 Simple DC Motor: A DC motor is any of a class of rotary electrical machines that converts direct current electrical energy into mechanical energy. The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic, to periodically change the direction of current flow in part of the motor. I have used DC motor just to demonstrate the controlling the speed of vehicle. The DC motor will rotate continuously without any logic. When the distance will become less than 2.5 meter then, It will be interrupted by the servo motor so that its speed will be reduced.

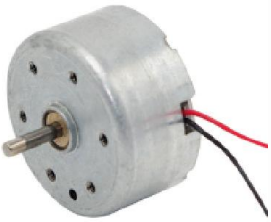

Fig. : 3.19 Simple DC motor

3.4.9 Servo motor: A servomotor is a rotary actuator or linear actuator that allows for precise control of angular or linear position, velocity and acceleration. It consists of a suitable motor coupled to a sensor for position feedback. It also requires a relatively sophisticated controller, often a dedicated module designed specifically for use with servomotors. I have used servo motor to apply brake on rotating DC motor when upcoming vehicle approaches to us.

Fig. : 3.20 Servo motor

3.4.10 PCB soldering wire, Soldering iron: A printed circuit board (PCB) mechanically supports and electrically connects electronic components using conductive tracks, pads and other features etched from copper sheets laminated onto a non-conductive substrate. and soldering is the use of a conductive substance with a low melting point (solder) to electrically connect components together. It is frequently used to join wires to leads of components such as switches or to join components of all kinds to a printed circuit board. The primary tool used for applying solder is a soldering iron, a device whose metal tip heats to temperatures well above the melting point of solder. This is used to melt the solder and allow it to flow into a joint.

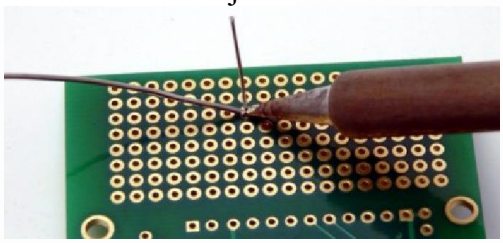

Fig. : 3.21 PCB, Soldering wire, Soldering Iron

3.4.11 USB data cable as Power cable: To power any electronics device which runs on 5 volt we cal use USB port which is available on our Laptop and Desktops USB runs at 5v. The max current you can draw is 500ma. Therefore the max load is 5v x 0.5A=2.5. Watts. (W=V*I) If you try and draw more than 500mA, you may overload the port which will cause it to damage. And to connect our device to USB port to give power we have used an USB data cable.

Fig. : 3.22 USB data cable.

3.5 Price list of different components: In this section we will discuss about the price of different components used in this project. And finaly we will discuss the total cost spent on this project.

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Component	**Price (INR)**
Raspberry Pi	2,842.00
Camera	1,248.00
Cardboard sheet	100.00
LED	1.00 Rs. per piece 2.00
Jumper wires	5.00 Rs. per piece 50.00
DC motor	30.00
Servo motor	180.00
PCB + Soldering material	180.00
USB data cable	150.00
Laser	50.00
Screw + Nut/Bolt	45.00
Other	450.00
TOTAL COST	5327.00

TABLE 3.1 Price of different components.

CHAPTER-4

RESULTS AND ANALYSIS

My objective was to "detect the vehicle in foggy environment", under which if there is fog, mist, or any hazy condition outside the vehicle which are not suitable for driving, then our system will give warning to user about distance of front vehicle and try to clarify the received foggy image and make visible to user up to some extent so that the driver can perceive that there is any vehicle or not to avoid the accident.

After successful implementation and testing of the system Results were very satisfactory.
When we tested the visibility condition of driver while driving in the foggy environment, it was extremely low. And the chances of the accident were very high because there were no indication and warning about the distance and nothing was visible in front. So to overcome this problem we designed, implemented and tested this system. When we tested our system in real environment then it was providing us the distance feedback, and presenting us the improved and clear thresholded image, and helped the driver a lot while driving in the foggy environment. We have tested our code on different platform and conditions, out of which the raspberry pi was well suited and stable. Though the speed was not so fast in Raspberry pi as compare to the Intel CPU, But it have some additional features which brought us to choose this platform. Now we will see some comparison between different platform on which I have tested my setup.

Fields	Arduino	Laptop/Intel CPU	Begal board	Raspberry Pi
OS	No	Yes	Yes	Yes
CAMERA	No	Yes	Yes	Yes
GPIO	Yes	No	Yes	Yes
OPENCV	No	Yes	Yes	Yes
DELAY	Very High	Very less	High	Less
SPEED	Very low	Fast	Low	Moderate

Table : 5.1 Comparision between different Platform

From the table we can conclude that only Raspberry Pi is the plat form which have all features, but the Speed is not fast much which is not compatible for the real-time operation this can be harm full also. To overcome this problem we can go for other processors by keeping other specifications as it is.

CHAPTER-5

SUMMERY AND FUTUTE SCOPE

6.1 Summary: It is a great challenge to detect vehicles under various foggy climatic scenarios. Surrounding objects such as pedestrians, trucks, trees and bicycles distract the system and cause the results to deviate from the actual scenario. LiDAR are often used to detect objects and find distance, whereas a vision based detection is responsible for real object verification and final classification. As compared with others, the benefit of this approach is to utilize the structural information to help vision based techniques for vehicle detection and classification. In this approach we are using low cost LiDAR model which is made up of the combination of a camera and a laser. It is accurate and of low cost as compared to the LiDAR.

Proposed system is very helpful for the people who are going to drive their vehicle in foggy environment, it provide the distance and improve the visibility of driver to avoid the road accident. The life of a person is very important asset. We can say that this is a life saving system.

6.2 Future Scope: In the previous chapter we have seen that the response of the system is not real time which is very dangerous, so this is a field where we have to focus and work on it. Other than this, here we are working on 2D model, all the images collected and utilized are based on 2 dimensional approach. In future work we will concentrate on modeling the contour parameters from 2D models to 3D models. Also we can make our laser and camera setup movable, movable in the sense that it will able to map the distance in all direction. Which will make our system more accurate and reliable.

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