Intelligent Driver Assistance System

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Abstract— Use of embedded system demanded more day by day in Automotive Electronics sector for applications in car. Airbags, ABS, ESP, ECU, ESP, climate control & more are the common features of most luxuries cars. Providing full assistance to the driver for the distance from other vehicle and while lane detection is the main use of Intelligent driver assistance system. To detect the white lane and distance between obstacle and car Video Streaming is taken by camera in this system. SD card is used to store streamed video for processing by using Python. Image substraction method used to detect lane detection from the video. Small Robot is used as demo module and one is pilot car it acts as obstacle in all possible direction to design the system. Obstacle detector sensors are used to detect the obstacle in front and rear direction of the system Ultrasonic sensor it acts as the obstacle detector to detect the any obstacle within the range of 4 meters. In Driver assistance system provide the full assistance to the driver by detecting the white lane by processing the video using Python script and obstacle is detect by using Ultrasonic sensor module. Display that consist of TFT screen is used to display video and the distance between obstacle and car in meter. System implemented on the new platform Raspberry Pi Development Board having ARM1176-JFZS core & BCM Audio-Video Codec.

Keywords: USB 2.0 Webcam, Raspberry Pi, ARM1176EJ-FZS, Ultrasonic, Image substraction, Python, Robot

I. INTRODUCTION

Driver Assistance system is provides the assistance for the driver while driving the car. This system includes the white lane detection warning system. Ultrasonic sensors are used to detect distance from other vehicle in meter by sending the trigger and wait for response echo. This system based on Raspberry Pi with having ARM11 & BCM Audio-Video codec. This Raspberry Pi uses Raspbean operating system. To detect the white lanes of the road image substration is used. By using this algorithm streaming video is processed and display on the display screen. Python for GPIO's & USB 2.0 Webcam scripts are used to start the camera. Side lanes are detect by using the image substraction that warns to driver by detecting the lanes using Ultrasonic sensors. Streamed video is continuously process by using the image substraction. System GUI is designed by using the Python programming language. This system can be applicable for any type of vehicle like truck, buses, boat, and luggage carries and vehicles of the passengers. The fabrication cost of active vehicles is greater than passive trailers. This system used to provide the assistance to the driver that's why operation cost is much lower [2].

II. STRUCTURE AND PRINCIPLE

There are 2 ultrasonic sensors used in this system to detecting the obstacles in rear and front direction with distance taken range in meter. Video of the front direction is taken by camera which is mounted inform of the vehicle. DC motors and to increasing the current rating DC Motor driver L293D are used. DC motors are used to drive the demo Robot that can be move forward and reverse direction. Continuous video is taken by USB 2.0 webcam. This video display on TFT screen by using the Image subtraction. Raspberry Pi Development board having Rasp bean Linux operating system is used to control all system. User interface with great GUI possible in Python. Fig-1.shows all parameters are considered and the actual implementation of the system. To detecting the obstacle Ultrasonic sensor is acts as RADAR. Robot module consist this actual system. In the Robot module there 2 wheels running by using the DC motors and act as a 2 wheeler car. One 12V DC battery mounted Robot to provide supply to system.

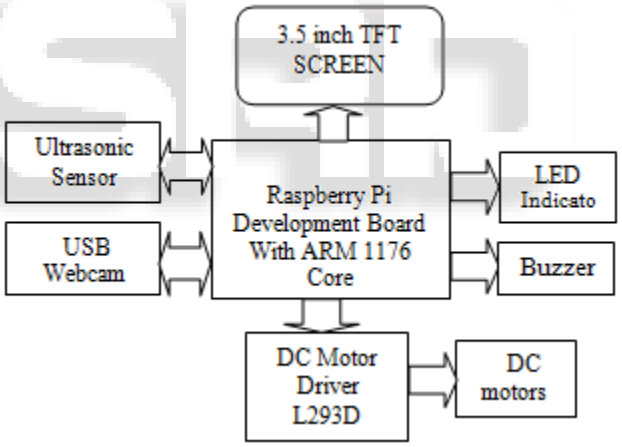


Fig. 1: Block Diagram of Driver Assistance System

III. HARDWARE DESIGN

A. Ultrasonic Sensor Modules:

Detecting the obstacle in all direction is done by ultrasonic module is used to detect the obstacles in all side. It can be detect the obstacle within 4 meters with very precise manner.

B. USB 2.0 Webcam Camera Module:

This module is used to take the continuous video in front as well as back side. This module takes the video with 30 frames per second. It is used for just capturing the images from the outside the world.

C. DC Motor Driver L293D:

DC motors are controls through program in all direction by using this module. Power supply to this module can be

control by using programmatically. It requires the 600mA current rating.

D. DC Motors 300 rpm:

In car module DC Motor is used to drive the wheels connected to the car module. Also it is possible to control the speed of the Dc motor by using L293D DC motor driver.

E. Inch TFT LCD Screen:

Complete graphical user interface with the system is provide by this module. This module also display the distance from the other vehicle in all direction from the car. Front and rear view also shows in the format of the video with 30 frames per second according to the change in direction.

F. Raspberry Pi Development Board:

This is the core part of the system it is used to control the system. It consists ARM 11 Core with BCM Audio-Video Codec used to provide the GPIO's with having operating frequency 700MHz.

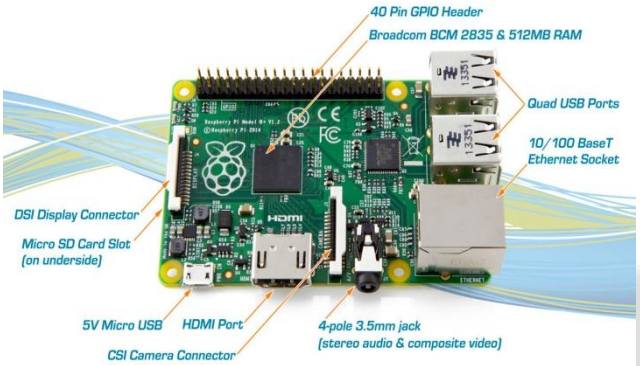


Fig. 2: Raspberry Pi Board

It having 512 MB LPDDR2-800 memory. 8GB SD Card is used to store operating system. This system support Linux OS. It is compatible with composite HDMI video. It is also compatible with stereo analog HDMI audio. It support 10/100 Ethernet Networking. It require 5V micro USB power supply.

IV. SOFTWARE DESIGN

A. Installation Tool Chain:

Python needs to be installed in raspberry for writing script in python, for Image capturing & video streaming it needs its own libraries by using following commands we get

$sudo apt-get install python
$sudo apt-get install ffmpeg
$sudo apt-get install fswebcam
$sudo apt-get install omxplayer
$sudo apt-get install gstreamer-0.10

after installing this we can take image by writing

$fswebcam –r 1280x720 cam1.jpg

$gstreamer-0.10 used by using gst-launch-0.10 plugin

$gst-launch-0.10 videotestsrc ! ffmpegcolorspace ! autovideosink
$gst-launch=0.10
videotestsrc ! pattern=11 !
ffmpeggcolorspace ! autovideosink

V. METHODOLOGY

A. Image Substraction Method:

1) Camera Position:

The In this system camera is mounted on the car towards the ground at 45 degree, for capturing images of the road only. Performance of the system is improved and the complexity of the processing is reduced by this technique called as the Bird's-Eye view mapping. MATLAB simulation software is used for the processing.

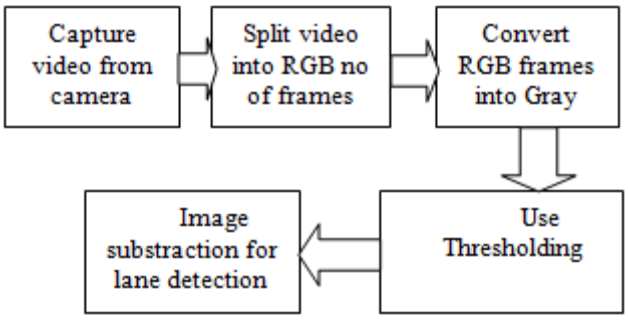


Fig. 3: Image Substraction Method

2) Color to Gray Image Conversion:

The processing time is depends on the color information and edge detection which is difficult ultimately affects the processing time. Color images are converted to the grayscale images that reduces the processing time. This function generates the 8-bit, single channel grayscale image from the 24-bit, three channel color image. The function formed weighted sum of the Red component of the pixel value × 0.2989 + Green component of the pixel value × 0.5870 +Blue component for the pixel value × 0.1140 and the output is the gray scale value for the corresponding pixel.

Sum weighted=0.2989×R+0.5870 G+0.1140×B

The 2D image is scaled in to (m x n) matrix. The scale of the matrix is determined by the resolution of the image. Thus 256×256 resolution of the image is represented as $0<x<255$ & $0<y<255$

Where x and y are function of 'f' which are pixels.

3) Median Filter:

Median filter is used to remove salt and paper noise present in the image by padding at the edge of the road image. Lane detection is very difficult in night and tunnel road surface as conditions of the illumination changes largely between night and tunnel region. Lane marking filter which were used previously is required to improve for these complex condition because of the changed that causes loss of feature information, shape distortion of objects, and false color tone. Median filter which is 15 x 15 matrix is used to filter the salt and paper noise in the image.

4) Threshold segmentation:

After analyzing histogram of the image threshold value is obtained. Threshold value that can be computed w.r.t. the estimated threshold. Intensity of the pixel is less than the threshold then the pixel is placed to a group G1. Else if intensity of the pixel is greater than T, the pixel is placed to group G2. A new uniform intensity μ1 and μ2 value assigned to the individual group by taking average intensity. The iteration is continued until the accurate values of μ1 and μ2 are not obtained. These values are used to compute new threshold by taking average of the uniform intensity values as shown below,

$$T0= ((\mu1+ \mu2))/2 \quad (1)$$

Where μ2 and μ1 are the new values of G1 and G2. The image segmentation depends on the present threshold value of *T0* as shown in Figure 4. If the intensity value less the *T0*, the image is assigns 0 and if the intensity value greater the *T0*, the image is assigned 0

5) Edge Detection:

The canny image segmentation operator is used because points and lines form the threshold segmented image was vital where the operator found the edge by analyzing the local maxima of the gradient of f(x,y) . The gradient was calculated using derivative of the Median filter. The filter used two parameters to detect strong and weak edges, and includes weak edges in the output if only they are interconnected to other strong edges. Therefore, this method is likely to detect true weak edges. The gradient of the 2-D function, *f(x, y)* was calculated using the vector; The magnitude of gradient operator is obtained as The angle of the gradient operator is obtained as After obtaining the strength and the direction of the point using the gradient operator gives rise to ridges in the gradient magnitude image. The algorithm then tracks along top of these ridges and sets to zero all pixels that are not actually on the ridge top so as to give a thin line in the output , this process is called as non-maximal suppression. Then the ridge pixels are then threshold using two thresholds, T1 and T2 with T1 < T2. Ridge pixel with value greater than T2 are strong pixels and pixels in between T1and T2 are weak pixels, and then the edge linking is subsidized by incorporating the weak pixels.

6) Morphological Operation:

After canny edge detection Morphological operation is applied to remove the external particles in the image, as they produced inaccurate results. The Morphological operation initially separate the closed rectangular objects form the open rectangular objects by adding pixels only to the closed rectangular objects. Thus, the objects with closed rectangular shape have higher threshold and objects with open rectangular shape have lower threshold. Eroding remove the objects with lower threshold, while leave the objects having high threshold. Thus as result the segmented image only have the required road lane.

VI. DEMO MODEL

Demo module consist of the actual the Raspberry Pi board with TFT screen connected to the all the peripherals with having the ultrasonic interface, Dc motor interface, camera interface , Battery interface with 4 wheel chasse system it like the on car module of the system . It having onboard peripherals like Ethernet port USB 2.0 port, 3 UART, GPIO pins, TFT screen interface connector, also it having onboard Raspbean operating system within it.

Having Boot mode & NVROM flash mode also. It supports all higher level languages like C, C++ also, so it is possible to write device driver program to control the speed of the DC motors as well as to control the Ultrasonic sensor modules.

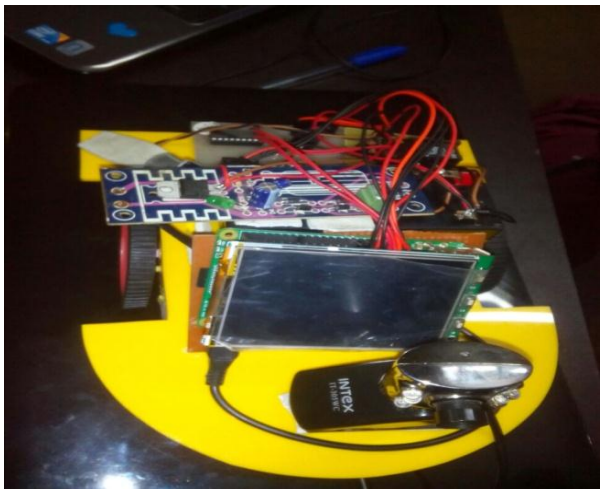
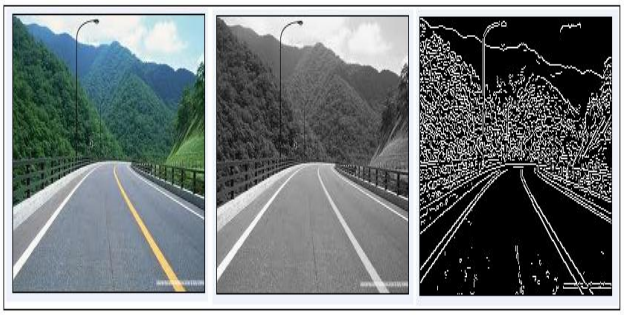


Fig. 3: Robot Model

Also implemented the TFT screen driver it is used to show all the parameters on the screen. So writing python script we can interface GPIO pins by importing library files of the raspberry pi development board.

VII. RESULT

Continuous video streaming getting from the camera it need to process the extract the raw images by using segmentation. Then getting the RGB image Fig a) Then need to convert RGB to gray by writing the script in the python it convert the RGB to gray Fig b) show the RGB to gray conversion . After that apply the image substraction for lane detection. Fig c) shows the lane detection.



a) RGB b) Gray c) image substr.

Fig. 4: Result

VIII. CONCLUSION

This system completely based on the ARM 11 core with Raspberry Pi platform. This Development Board capable to process the video streaming in as faster as other Microcontroller can't do. Because of the speed of the Raspberry pi it is in the 700 MHz. It fulfil the image processing part using python scripting using OpenCV Libraries based on the UBUNTU LINUX as well as on RASBEAN LINUX Kernel Raspberry Pi Development Board Operating System.

Lane detection successfully implemented using Image substraction because of this Algorithm is well suitable for the any shape detection using different functions like line & circle. By using image substraction function it achieve the actual project Goal. Ultrasonic sensor in this system given very precise value in the cm range. This system accurately measure the distance from other car or obstacle in front as well as rear direction.

Raspberry Pi to be best feature is it supports the Python scripting so it capable to do the programming of the GPIO. This feature added advantage in the system design to drive the Robot Module.

IX. ACKNOWLEDGEMENT

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