Design of Driver Helping System Using Raspberry Pi

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Abstract

In this paper, a design of driver helping system using Raspberry Pi has been proposed. The main concept of this paper is to do both automation and manual process to reduce road accidents and traffic jam. This system robustly detects important road signs placed on the road with high accuracy and efficiency. Detection of road signs is done with the help of SURF algorithm, which works based on feature description matching. SURF algorithm helps in the identification of the road signs which will compare the features of the detected image with the database image. After the detection, the vehicle will vary the speed and make the turns automatically based on the detected road sign. A switch will be present which can be used by the driver to cancel the automation process or it can be used to control the vehicle manually.

Keywords- *SURF, Road signs, Automation, Manual.*

1. INTRODUCTION

Generally, Road signs are viewed by drivers while driving and actions are performed according to that Road sign. In Recent years, accidents are increased in numbers. The accidents are mainly due to drivers hurry to reach the destination or drivers less attention to the road while driving. Some drivers will not follow the road signs placed on the road which leads to accidents, traffic jam and damage to properties. In order to avoid this kind of situations, road signs must be followed strictly by the drivers.

The main objective is to detect the road sign automatically while driving and control the speed or makes the turn according to that Road sign. Road sign recognition is used to warn the distracted driver, and prevent his/her actions that can lead an accident.

The goal is to avoid accidents by both manual and automation process in which all the actions will be performed based on the detected Road signs. A real-time automatic speed sign detection and recognition can help the driver, significantly increasing his/her safety.

To avoid accidents and traffic jam road signs are generally placed near curved areas, hospital zones, school zones etc. Driver has to view the road signs and control the speed or makes the turn according to it. Due to various issues, drivers are less attentive to road signs which lead to accidents.

In Existing System, an idea is proposed to avoid accidents in which road signs are recognised automatically by web camera using Image processing techniques and Raspberry Pi. For Image processing techniques algorithms like

k-Nearest Neighbour algorithm (kNN) and Tesseract Optical Character Recognition (OCR) is used which will detect the road signs.

This Existing System will only recognise the road signs and it will be shown to the driver. Driver has to make adjustments based on the detected Road signs. The drawbacks in this system are only limited signs can be recognised, accuracy and processing speed is low. Only Characters in the road sign will be accurately measured due to the use of these algorithms.

2. PROPOSED SYSTEM

There are increased cases of Road accidents. One of the major causes for this is the drivers less attention to road signs while driving. This system is manual and has a lot of errors due to drivers less attention which leads to accidents, traffic jams. The main objective of our system is to done automation process which will help the driver's safety.

To achieve this goal, a system is developed which will capture the road sign image from the camera attached to the car and then perform image processing techniques on Raspberry Pi with the help of SURF algorithm. This developed system has lot of advantages over the existing system. As existing system can only recognise the road sign and then show it to the user. Driver has to make adjustments such as reducing the speed or making the turn according to the sign showed.

The Proposed system is based on both manual and automation, in which once the signs are detected, adjustments are made automatically. If the driver wants to take the control manually, a switch will be present which can be pressed to take the control or cancel the automation process. Switching concept is mainly considered for emergency situations where the driver may be in hurry to reach the hospital. SURF algorithm plays a major role in identification and detection of road signs which replaces Tesseract OCN (Optical Character Recognition) and kNN (k-Nearest Neighbour) algorithm in the existing system.

3. BLOCK DIAGRAM

The Block diagram shown in Fig 1 is for Road Sign Recognition system. It consists of L298 motor and web camera interfaced with ARM 11 through GPIO and USB port. Flash is an external memory which has road sign images already stored in it. RAM is used for storage purposes. Laptop is connected through Ethernet port present in Raspberry pi.

Web camera is used to capture the Road images from the Laptop. L298 is the dual bridge driver which will act as a motor for the robot. GPIO (General Purpose Input/Output) is a generic pin on computer board which can act as Input or Output. ARM 11 is the processor used which provides high range of performance.

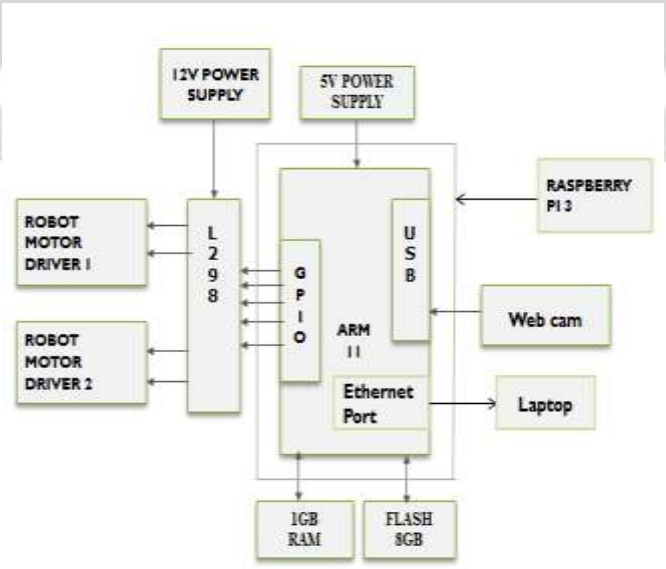

Fig -1: Block diagram of proposed system

Power supplies are initially given to ARM 11 and L298. Road signs are initially stored in the flash memory (8GB) and RAM (1GB) is used for accessing the data and also for storage purposes. ARM 11processor is interfaced with web camera through USB port and L298 motor driver through GPIO. Web Camera will continually monitor the road once the vehicle is started. Forty pins are present in GPIO, in which 27 pins can be used. Out of 27 pins, 4 pins are chosen to act as an input port and one pin is chosen for a switch.

When an image is captured, it will be recognized by the processor with the help of image processing using SURF algorithm. Image processing is used for the detection of road signs. Once the road sign is detected, it will be shown in a laptop that the particular sign is detected and the automation process will take place such as reducing the speed or making the turn. Automation process is done by sending PWM process through the I/O pins. Based on the duty cycle of the PWM process for that particular road sign, the speed of the robot motor driver 1 and 2 will vary or make the turn which can be seen by observing the robot. To cancel the automation process, the switch can be pressed and the driver can take the control manually.

4. SURF FLOW PROCESS

Fig 2 shows the process involved in SURF. Initially set of road sign images are stored in the database and it is converted into gray scale images. Gray scale images have many shades of gray in between. Once the Gray scale image is obtained, SURF feature description is found by using Interest point detection which is done by approximating the determinant of Hessian matrix. Approximation of the determinant of Hessian matrix is found by using Integral images and Box filters. Integral images can be found by summing all the pixels value in the rectangular region of an image. Box filters can be found by summing all pixels values and multiplying with image coefficients.

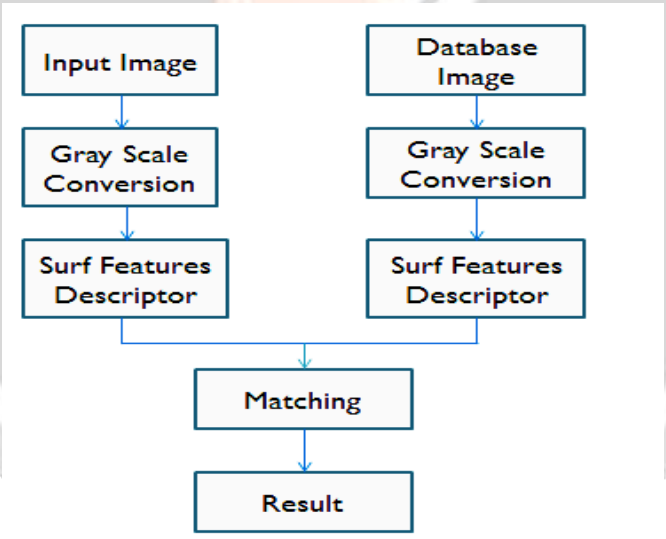

Fig -2: SURF flow process

Once the interest points are detected, it is characterized with Haar Wavelet features to obtain feature description points. These feature description points are calculated by the above method is entirely based on the calculation. The same process is again repeated for Input image and the SURF feature description points are obtained from it. Then both the descriptor points are compared to check whether any matching is present. Lines are used to identify the descriptor points present in both the images. If the matching is present, it is considered that the sign has been detected.

ADVANTAGES

The advantages of proposed system are accuracy, speed, increased number of sign detection and automation process.

APPLICATIONS

Its main idea is to be used in automobiles such as cars, trucks to avoid accidents. It can be installed in low range price vehicles to high range price vehicles.

5. RESULTS

The process that is performed in this system is shown through the below snapshots. This paper is based on embedded system. MATLAB is included to show the feature detection of an image (which internally occurs in the Raspberry pi using Open CV) and the output will be indicated in the monitor. Hence images from both the domains have been included. SURF algorithm is used for the detection of an image. It involves interest point detection, feature point extraction and matching process. The reason for using SURF algorithm is that, it results in improved accuracy than other algorithm techniques.

Fig -3: Results of matching

Fig 3 shows the feature matching process between the database and original image which is used to indicate that the road sign image has been detected.

The above process is occurred internally inside the Raspberry Pi using Open CV during the image processing which is shown using MATLAB. Once the images are captured, interfacing of ARM 11 with L298 (dual bridge driver) and camera takes place where the detection of road signs takes place.

Fig -4: Image capture

Fig 4 shows the image capture using web camera where the feature description matching process with the already loaded feature extracted database image will be performed.

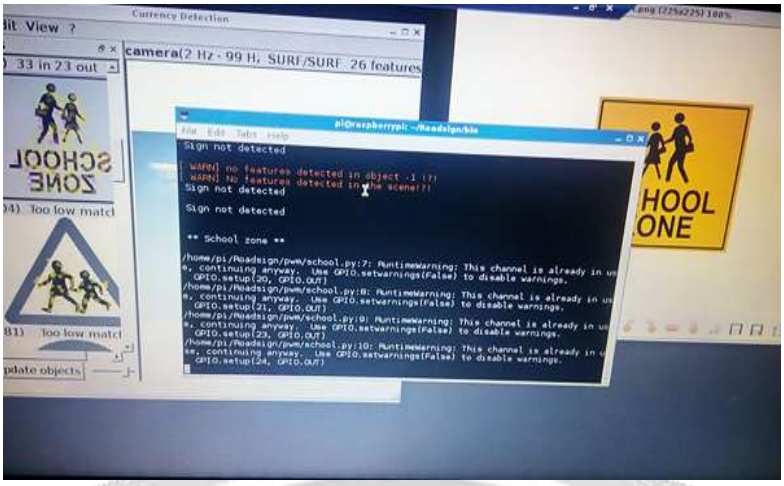

Fig -5: Sign detection

Fig 5 shows the sign detection where the detection of the sign is based on the results of the feature descriptor matching process. Once the signs are detected automation process will be performed based on the detected road sign.

A. Mechanical model

The mechanical model for the proposed system is implemented using Raspberry Pi 3, L298 dual bridge driver, web camera, autotransformer, voltage regulator which can be shown in Fig 6.

Fig -6: Prototype model

Thus with this system, we can largely avoid the human errors which are the major cause of road accidents. The system is implemented effectively and it has a high accuracy rate.

6. CONCLUSION AND FUTURE ENHANCEMENT

The driver helping system has been presented in this paper. The basic idea is to recognize and classify the traffic signs from an input image. The image processing technique used in this paper is based on the SURF algorithm. Finally, the recognition and classification of these potential road signs is done according to a database of road sign patterns and controls the speed according to it. The performance of this idea depends on the quality of the input image, in relation to its size, contrast and the way the signs appear in the image. This project is fully based on automation process which replaces the existing manual operation. Automation process, in turn decreases the human error, increases the accuracy, processing speed and reliability.

For future enhancement, more advanced resolution camera and advanced processors can be used in order to detect the sign perfectly and quickly. A System should be developed to monitor the rear end vehicle during the turnings so that the automation process will ensure more safety.

7. REFERENCES

[1] Bahlmann. C, Zhu. Y, Ramesh. V, Pellkofer. M and Koehler. T, (2005) 'A system for traffic sign detection, tracking and recognition using color, shape, and motion information' Proceedings of the IEEE Intelligent Vehicles Symposium, pp. 255–260.

[2] Desaraju. V, Ro. H. C, Yang. M, Tay. E, Roth. S and Del Vecchio. D, 'Partial order techniques for vehicle collision avoidance: Application to an autonomous roundabout test-bed,' in Proc. IEEE Conf. Robot. Autom, pp. 82–87.

[3] Escalera. A, Armingol. J and Mata. M, (2003), 'Traffic sign recognition and analysis for intelligent vehicles,' Image and Vision Computer., vol.21, pp. 247-258.

[4] Forghani. M, McNew. J. M, Hoehener. D and Del Vecchio. D, (2015), 'Design of Driver-Assist Systems under Probabilistic Safety Constraints Near Stop Signs: Proofs of Technical Results,' MIT, Tech. Rep.

[5] Fletcher. L, Apostoloff. N, Petersson. L and Zelinsky. A, (2003), 'Vision in and out of vehicles,' IEEE Intelligent Systems.

[6] Hafner. M, Cunningham. D, Caminiti. L and Del Vecchio. D, (2013) 'Cooperative collision avoidance at intersections: Algorithms and experiments,' IEEE Trans. Intell. Transportation Syst, vol. 14, no. 3, pp.1162–1175.

[7] Levinson. J, Askeland. J, Becker. J, Dolson. J, Held. D, Kammel. S, Kolter. J. Z, Langer. D, Pink. O, Pratt. V, Sokolsky. M, Stanek. G, Stavens. D, Teichman. A, Werling. M and Thrun. S, (2011), 'Towards fully autonomous driving: Systems and algorithms,' in Intelligent Vehicles Symposium (IV) IEEE.

[8] McCall. J. C and Trivedi. M. M, (2007) 'Driver behavior and situation aware brake assistance for intelligent vehicles,' Proc. IEEE, vol. 95, no. 2, pp. 374–387.