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A Road Sign Detection and Recognition Robot using Raspberry-Pi

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Abstract - *At present situation the human beings are faced many accidents during the road ways transportation. At the same time they lose our life and valuable properties in those accidents. To avoid these problems the system designed with the help of Raspberry pi. The Digital image processing plays important role in the sign capturing and detection system. The image processing algorithms to takes the necessary action for resizing the captured signs. The Raspberry pi camera port used to capturing the road signs with image enhancement techniques. The embedded system small computing platform studies the characteristics of speed signs. In that daylight vision time to take the shape analysis for recognizing the signs using edge detection algorithms. The objective of the proposed work is to implement the available technique to traffic signal with the help of raspberry pi3 board.*

Key Words: **Raspberry pi3, Traffic signal detection, Python, L298N, Amplifier, DC Motors, Speaker**

1. INTRODUCTION

Every person, whether a passenger, driver, pedestrian would have noticed along the roadside various sign board that serve important purposes. These important road paraphernalia help us as route guides, warnings and traffic regulators. As control devices for traffic, signs need full attention, respect and appropriate driver's response. With the advent of motorized traffic and its increasing pressure on road, many have adopted pictorial signs and standardized their signs to facilitate international travel, where language differences would create barriers. In adverse traffic conditions, the driver may not notice traffic signs, which may cause accidents. In such scenarios, automatic road sign detection comes into effect [1].

The main objective of proposed system 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 recognized automatically by web camera using Image processing techniques and Raspberry Pi [2, 3].

Our worked focused on a low cost, off the shelf solution, specifically, a mini embedded computer Raspberry Pi. In order to provide fast processed results, this system aimed to demonstrate use of simple shape recognition algorithms and open source optical character recognition (Tesseract OCR) on Raspberry Pi. Tesseract OCR is an open source optical character recognition module for various operating systems. And its development supported by Google since 2006.

1.1 Previous research work

According to, the first work on automated traffic sign detection was reported in Japan in 1984. This attempt was followed by several methods introduced by different researchers to develop an efficient TSDR system and minimize all the issues stated above. An efficient TSDR system can be divided into several stages: preprocessing, detection, tracking, and recognition [5]. In the preprocessing stage the visual appearance of images has been enhanced. Different color and shape based approaches are used to minimize the effect of environment on the test images. The goal of traffic sign detection is to identify the region of interest (ROI) in which a traffic sign is supposed to be found and verify the sign after a large-scale search for candidates within an image. Different color and shape based approaches are used by the researchers to detect the ROI. The popular color based detection methods are hsi/hsv transformation, region growing, color indexing, ycbcr color space transform.

Greenhalgh and Mirmehdi [6, 7] showed a comparison between SVM, MLP, HOG-based classifiers, and Decision Trees and found that a Decision Tree has the highest accuracy rate and the lowest computational time. Its accuracy is approximately 94.2%, whereas the accuracy of the SVM is 87.8% and that of MLP is 89.2%. Neural Network is flexible, adaptive, and robust. Hechri and Mtibaa [8] used a 3-layer MLP network whereas Sheng et al. used a Probabilistic Neural Network for the recognition process. Support Vector Machine (SVM) is another popular method used by the researchers which is robust against illumination and rotation with a very high accuracy. Yang and Garcia- Garrido [9, 10] used SVM with Gaussian Kernels for the recognition whereas Park and Kim used an advanced SVM technique that improved the computational time and the accuracy rate for gray scale images. For improving the recognition rate of the damaged or partially occluded sign. Principal Component Analysis (PCA) is used by Sebanja and Megherbi [11] in which have a very high accuracy rate. In Prieto and Allen used a self-organizing map (SOM) for recognition whose main idea was to apply SOM at every level of RSs with a hit rate of 99%. In our approach, for reducing the processing time RGB segmentation and shape matching based detection and SVM with bagged kernel are used for recognizing the red traffic

signs. Grey-scale images are used to make our detection and recognition algorithm more robust to changes in illumination.

2. SYSTEM DEVELOPMENT

The main work of proposed system is to detect the sign boards like stop board. For this, system will always trying to determine between the lower and upper range of the red color and a rectangle be formed on the red signals. The rectangle formed on the red light signal has a fixed area by the use of that area system creates a signal that control the GPIO pins of the raspberry pi. For the detection of the stop board sign system used cascade classifier in which it compare the xml file of different size of stop word with the input available from real world of traffic signboards using camera. After match found it generates a signal so the raspberry pi sends a control signal to the L298 to control the motors of the chassis.

2.1 Block Diagram

The block of proposed system is as follows:

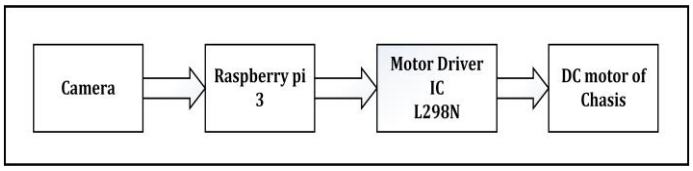

Fig. 1 – Block Diagram of System

2.2 Hardware & Software Requirement:

2.2.1. Raspberry pi3

Raspberry pi is a small chip of single board computer .There are various model of raspberry available in the market i.e. the Raspberry Pi1 Model B, Raspberry Pi1 Model B+, Raspberry pi2,Raspberry Pi3 Model B. These all are differ in memory capacity and hardware features like Raspberry pi3 has inbuilt Bluetooth and wifi modules whereas in previous versions these modules were not available .It has 1.2 GHz 64-bit quad core ARMv8 CPU with 1 GB of RAM [12, 13].

Fig. 2 – Raspberry Pi 3 Model B Board

2.2.2. Camera

Camera is used to take the continuous images to get the traffic signs and signals from the real world. According to the images available through the camera we can send these images to the raspberry pi to perform car's control action.

2.2.3. Motor Driver IC L298

L298 is known as a dual bidirectional motor driver which is based on dual H-Bridge Motor driver IC. This circuit allows you to control two DC motors independently in either direction. It is a commonly used component for prototypes and hobbyist projects, as it is easy to use and interface the L298 with a Raspberry Pi or an Arduino. Other than its minimal design, it also provides an onboard 5V regulator that you can use to power your 5V circuits very conveniently. In this, locally available L298 based motor drivers (L298 breakout board) are used because they all are essentially the same which makes setup a little easier and Controlling a DC Motor is easy with a Raspberry Pi [14, 15].

Fig 3. Motor Driver IC L298

2.2.4 Python software

Python is a high level, general purpose programming language used widely in industries and research work also used in making general purpose projects. It`s software comes in various version i.e. IDLE python 2, python 3 also in these two types different version of python IDLE are available for programming the python language.

2.2.5 Open CV

It stands for Open Source Computer Vision .It has a library of programming function mainly for real time computer visions. It has over more than 2500 optimize algorithms for set of classical algorithm as well as for the state of art algorithms in the computer visions is basically used for image processing in which we used it for the face detection, object detections, image recognition, traces and also for other functions.

2.3 Flow Chart

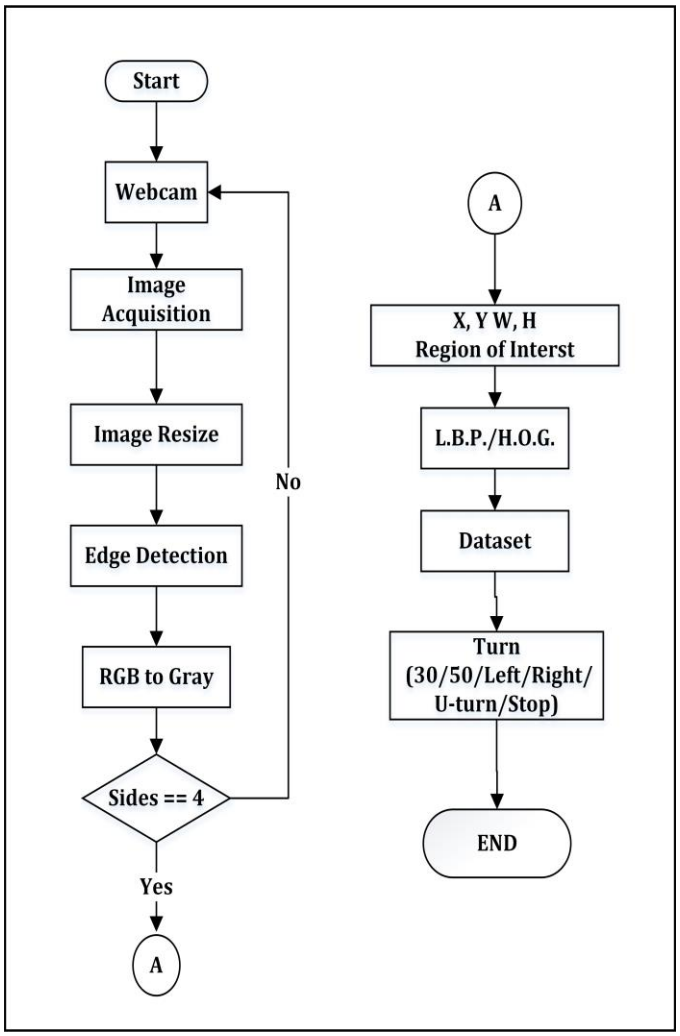

Chart -1: Flow Chart of System

2.4 Working of System:

The 2 wheels of chassis connected with two motors .Motor driver IC l293d is used to control the motor, one motor driver IC can control only two motors .So the proposed system used one l293d that is enough to control the motors. So the input for motor driver IC is given by the Raspberry pi and the output pins of the motor IC are connected to the motor of the chassis.

For movement of the car in forward and backward direction system will rotate the wheels in equal speed whereas to move left or right system will slow down the one wheel as compare to the other one according to the turning points i.e. if system need to rotate the turn in left direction system have to slow down the left wheel and if there is need to turn in right direction system have to slow down the right wheel. In the proposed system the input to the motor driver IC from is given from the GPIO pins(2,3) for driving the left motor and GPIO pins(4,17) is used to drive the right motor from L293d.

3. PERFORMANCE ANALYSIS

3.1 Actual Assembly of System

The figure below shows actual assembly of system

Fig 4: Road Sign Detection Robot

3.2 Road Sign and Corresponding Actions

Table 1: The table below illustrates the different road sign and the corresponding action to be performed by the robot

Road Signs	Action to be performed
	As a starting indication. Performs the forward movement of robot.
	As a stop indication. Performs the stop operation and halts robot.
	As a left turn indication. Performs the left turn movement operation of robot.
	As a U turn indicator. Performs the U turn movement through left side.
	As a right turn indicator. Performs the right turn movement operation of the robot.

3.3 Execution of Signs

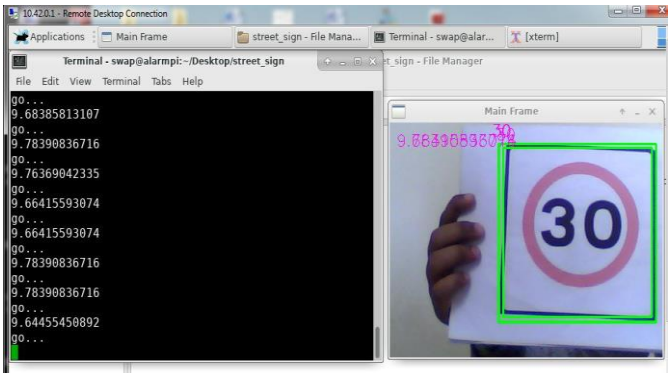

Fig 5: Forward movement of robot

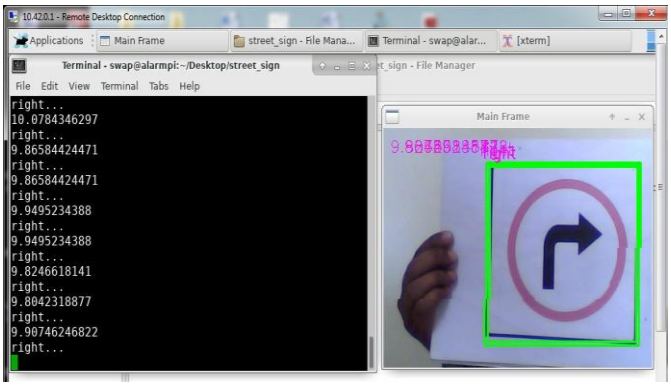

Fig 6: Right turn movement of robot

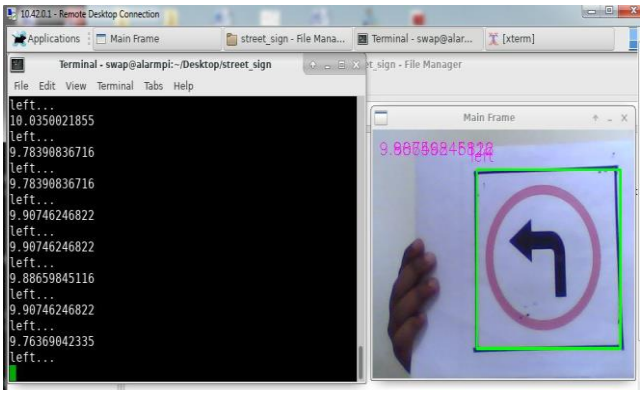

Fig 7: Left turn movement of robot

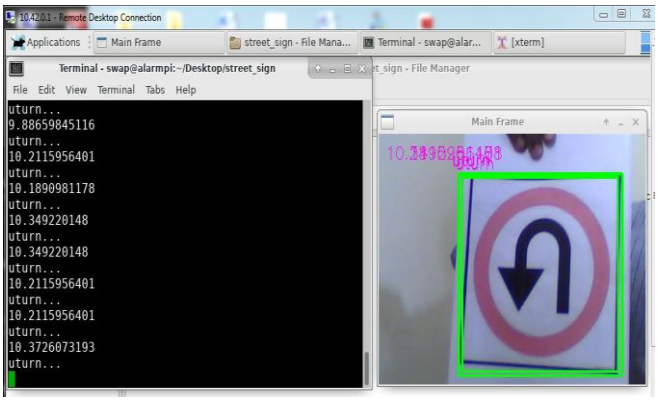

Fig 8: U-turn movement of robot

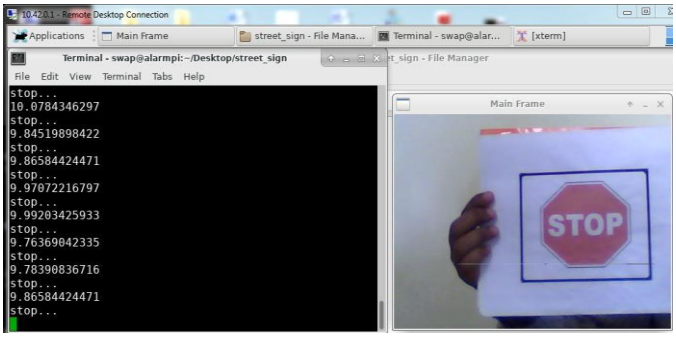

Fig 9: Stop the movement of robot

4. CONCLUSIONS

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 system 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 system 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. In this report, a method to make a self-responding robot car is represented .Working of different hardware components are described .A way to find the stop signs board and red signals have been defined and also way to detect the obstacles .All methods and algorithm mentioned in this paper are successfully implemented in a robot car of chassis having two wheels.

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.

To enhance it more in the future machine learning algorithms can be used so it can be able to determine each objects .The current performance is good but to make it more efficient it is necessary to implement it using machine learning and other algorithms so it will understand more things .So in future to make it more advance it.

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