ISSN (Online) 2394-6849

International Journal of Engineering Research in Electronics and Communication Engineering (IJERECE)
Vol 3, Issue 8, August 2016

Traffic Sign Recognition Using Hough Transform

[1] Mahaboob Shaik [2] Dr.Omprakash,
[1] Research scholar Dept of ECE, JJT University, Jhunjhunu, Rajasthan, India
[2] HOD, Department of ECE,JJTU, JHUNJHUN Rajasthan, India

***Abstract*— This paper describes the design and implementation of a robotic car that can detect traffic signs in real environment and perform maneuvers accordingly. A web cam mounted on the car captures live images of the environment which are then processed using an locally available laptop where a simple template matching algorithm is used for the detection of these signs. Upon a successful match, an appropriate steering command is issued to the car. A single input single output fuzzy logic controller running on an 8 bit AT89C52 microcontroller ensures the tracking of these steering commands. A number of experiments are performed in corridor environments and successful results are obtained.**

I. INTRODUCTION

This work is initiated as a part of campaign to raise the awareness of following traffic rules and regulations amongst resident s of Lahore city and is one of the several frameworks which we have developed to serve our community[1]-[4]. According to a study presented in [5], the lack of awareness to traffic regulations is contributing towards major cause of road accidents in the country with drug usage during driving, poor road conditions, and use of cell phones being the secondary causes. Due to the poor literacy rate in the country and owing to the fact that majority of the drivers cannot even study the traffic safety booklets, there is a need to educate people about the traffic regulations along with their positive socioeconomic impacts. The present study is a step towards providing a visual form of teaching the traffic principles and serves to support the positive aspect of technology for betterment of humanity. A RC car is modified to carry vision sensor, computing resources and essential electronics for the purpose of demonstration. A few traffic signs are used to explain the proof of concept in this brief. These signs are detected by a template matching image processing algorithm running on a laptop and appropriate motion commands are generated which are tracked by a feedback controller to run the robotic car. The outcomes for employing such a demonstration platform turn out to be quite remarkable as the people not only learned the traffic fundamentals but also commented to expand the horizon of this initiative.

In the following sections, we present the robotic car design, image processing algorithm, fuzzy feedback controller design and results.

II. ROBOTIC CAR DESIGN

A RC car is employed in this work which is modified to include sensors and computing elements. The designed car is shown in Fig.1. This section explains the car design in detail.

A. Sensory System

The sensory system of the car comprises of a webcam and a potentiometer. The web cam is used to capture live images of the environment while the potentiometer provides the position feedback from the car steering. The web cam is mounted on an L-shaped stand whose height can be adjusted in proportion to height of the sign boards while potentiometer is mounted vertical to the shaft axis in the plane of car base with one end fixed to the auto base such that the rotating part moves in proportion to the shaft angle.

Fig.1 (a) Robotic car

(b)
Fig.1 (b) car circuitary

B. Computing System

The signals from the sensors are processed using an on-car computing system. A laptop is used to process the images from the web cam while a micro controller is deployed to provide low level control of car which involves the implementation of steering feedback control system. AT89C52 micro controller is used in this study due to its low cost and availability of development tools.

Drive system:

To drive the pre -installed 6VDC steering and rear motors on the auto, two H-span circuits are composed. The H-Bridge is designed to provide not only the desired current amplification but also provides seclusion between computing elements and the actuators. N-channel (IRF540) and P-Channel (IRF9630) MOSFETs are used as power switches while opto-coupler (4N25) is used as isolator
Communication Interface:

USB and serial communication interfaces are used in the design of car. Webcam is interfaced to laptop through a USB interface while the communication between laptop and microcontroller is made possible using the serial link. A USB-2-Serial converter is utilized for the provision of serial link

C. Power Sources

Two lead acid batteries are used as power sources. The motor drive circuit is powered by a 6V battery while all other circuitry is powered by 12V battery source. The grounds of the two power sources are kept separate and only optical link is available via opto-coupler. The interconnection of the various car components showing flow of information is depicted in Fig.2.

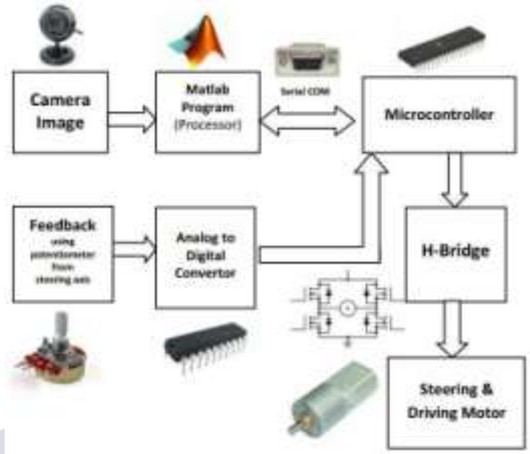


Fig.2.Interconnection of robotic car components

III.IMAGE PROCESSING AND COMMUNICATION

Software consisting of MATLAB routines [6] is developed to process images from webcam for the detection of traffic signs and communicating with microcontroller. This section describes the program modules in detail.

Sign Templates:

Red colored traffic signs are stored as templates in binary form. The template data base used in this study consists of four signs namely Left, Right, Slow and Stop as shown in Fig.3. Captured images are processed to detect the presence of each of these signs through the process of correlation.

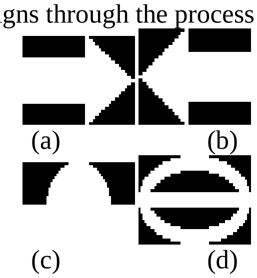


fig. Templates (a)Right (b) Left (c)slow (d)stop

A. Image Acquisition

MATLAB image acquisition toolbox functions namely 'video input(adaptorname,deviceID,format)' and 'Frame Grab Interval' are used to capture continuous sequence of live images from webcam with a fixed resolution and frame grab interval. Following this, 'get

ISSN (Online) 2394-6849

International Journal of Engineering Research in Electronics and Communication Engineering (IJERECE)
Vol 3, Issue 8, August 2016

snapshot (vid)' function is employed to get video frames for further processing.

B. Image Processing

The captured frame is an RGB image. Since the signs are red in color, the camera image is subtracted from the image of the same resolution for the detection of signs. This step is performed using 'imsubtract' function. The resulting image is converted into binary form using 'im2bw' function which fills the red spots in the image by ones while all other colors are marked with zeros. A filtering operation is then performed to remove objects containing less number of connected pixels using 'bwareaopen' function. The remaining objects in the image are labeled using 'bwlabel' function.

Correlation:

The pre-processed image in above step is correlated with the sample objects in the database. For the purpose of the correlation, the objects in the pre-processed image are rescaled using 'imresize' function .MATLAB function 'corr2(A,B)' is then used to find similarity between the templates and the objects in the pre-processed image. The image is declared to contain the template object if the level of similarity returned by the function exceeds70%.

The Hough Transform:

The Hough change is a procedure which can be utilized to detach elements of a specific shape inside a picture. Since it requires that the coveted components be determined in some parametric structure, the traditional Hough change is most usually utilized for the identification of consistent bends, for example, lines, circles, ovals, and so on. A summed up Hough change can be utilized in applications where a straightforward investigative depiction of a feature(s) is unrealistic. Because of the computational unpredictability of the summed up Hough calculation, we limit the fundamental center of this examination to the traditional Hough change. In spite of its space confinements, the established Hough change (from now on alluded to without the traditional prefix) holds numerous applications; as most produced parts (and numerous anatomical parts explored in medicinal symbolism) contain highlight limits which can be depicted by consistent bends. The primary favorable position of the Hough change procedure is that it is tolerant of crevices in highlight limit portrayals and is generally unaffected by picture clamor.

***Serial Communication*:**

A value corresponding to the detected sign is sent to the microcontroller via serial link. Serial communication between the laptop and microcontroller takes place at a rate of 9600bps. A control algorithm running inside the microcontrollers makes sure of performing the desired action corresponding to the received value. Figure4 shows the sample program's flowchart.

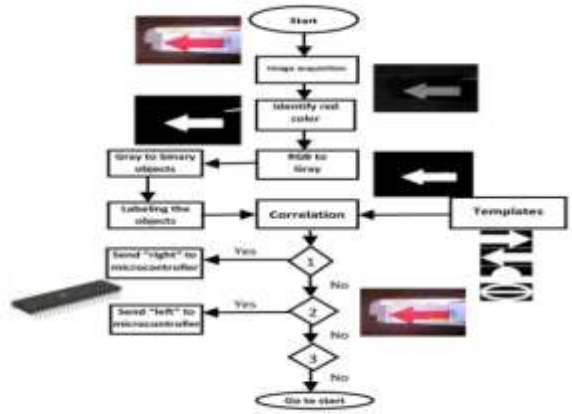


fig4. Sample program flow chart

IV. FUZZY FEEDBACK CONTROLLER DESIGN

A single input, single output fuzzy logic controller is designed to track the desired steering commands. Since no sensor is deployed to measure the speed of the car, open loop control is used for following the speed commands. This section describes the design of fuzzy feedback controller for steering axis.

A. Fuzzification

We first define an error signal as the difference between the commanded steering position and the current steering state. This continuous error signal is then re scaled in the range[-100,100] corresponding to steering angle [-450,450]. The scaled error signal is fuzzified after wards using seven fuzzy sets with triangular membership functions namely Negative Large (NL), Negative Medium(NM), Negative Small(NS), Zero(ZE), Positive Small(PS), Positive Medium(PM) and Positive Large(PL). The error membership functions are shown in Fig.5(a).The output from the fuzzy logic controller ,which is a duty cycle value 'is represented by seven singletons namely Large Left(LL), Medium Left(ML), Small Left(SL), Zero (ZE), Small Right(SR),Medium Right(MR) and Large

ISSN (Online) 2394-6849

International Journal of Engineering Research in Electronics and Communication Engineering (IJERECE)
Vol 3, Issue 8, August 2016

Right(LR),as shown in Fig.5(b).These singletons are uniformly positioned on the universe of discourse[-100,100].

B. Rule Base

The mapping between the input and output fuzzy sets is achieved by defining seven rules as follows:

Rule'1': IF 'error' is NL THEN 'steering' is LL

Rule'2': IF 'error' is NM THEN 'steering' is ML

Rule'3': IF 'error' is NS THEN 'steering' is SL

Rule'4': IF 'error' is ZE THEN 'steering' is ZE

Rule'5': IF 'error' is PS THEN 'steering' is SR

Rule'6': IF 'error' is PM THEN 'steering' is MR

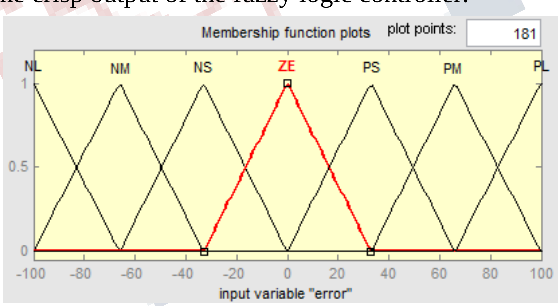
Rule'7': IF 'error' is PL THEN 'steering' is LR

Defuzzification

Takagi-Suge no fuzzy inference mechanism is used to generate the final steering command. After the rules are evaluated in sequence, a normalized weighted output is transformed into pulse width modulated signal by the micro controller to drive the steering motor. The process can be expressed mathematically as :

$$s(t) = \sum h_i(e(t)) S_i$$

Where, h(e(t)) is the normalized firing strength of 'i' rule, s is the signal to an associated with 'ith' rule and s(t) is the crisp output of the fuzzy logic controller.



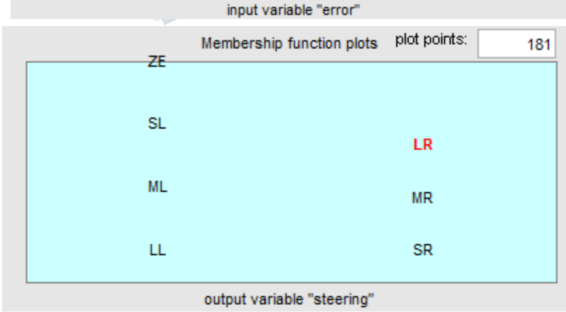
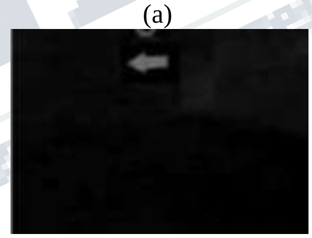


Fig.5. Fuzzy (a)Input and (b) Output membership functions

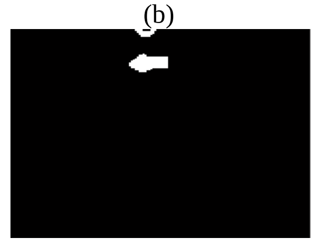
V. EXPERIMENTAL RESULTS

A number of experiments are performed in the corridor environments to verify the validity of the designed car in detecting traffic symbols and performing maneuvers accordingly. One of the results is shown in Fig.6. After the left arrow is successfully detected by MATLAB program, Medium Left command is issued to the micro controller with a delay time interval. This interval corresponds to the relative distance of the car with respect to the sign board and was adjusted experimentally. The steering commands were successfully tracked by the fuzzy controller in the experiments.

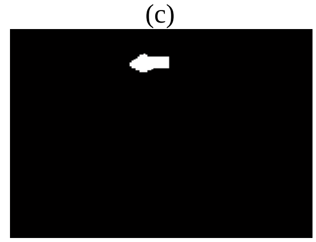
(a)



(b)



(c)



(d)

International Journal of Engineering Research in Electronics and Communication Engineering (IJERECE)
Vol 3, Issue 8, August 2016

(e)

Fig.6. (a)-(e) Detection of traffic sign by the car

VI. CONCLUSION

The design of a robotic car to recognize traffic signs is presented. High level control of the car to detect traffic symbols in live images is implemented in MATLAB programming environment while low level control is accomplished by AT89C52 microcontroller where a fuzzy feedback controller is implemented to track the commands initiated by high level control. Successful results are obtained in corridor environments which validate the design approach. This work was initiated as a part of campaign to raise the awareness of following traffic regulations amongst the citizens of Lahore and will be expanded in future to encompass the whole set of traffic signs along with desired actions as gave in the street safety booklets.

REFERNCES

1) Umar Farooq, Tanveer ul Haq, Muhammad Amar, Muhammad Usman Asad, and Asim Iqbal"GPS-GSM integration for enhancing public transportation management services," Proc. International Conference on Computer Engineering and Applications, 2010, pp.142-147.

2) Asim Iqbal, Umar Farooq, Hassan Mahmood, Muhammad Usman Asad, Akram Khan and Hafiz Muhammad Atiq, "A self teaching image processing and voice recognition based intelligent and interactive system to educate visually impaired children," Proc. International Conference on Digital Image Processing, Feb28-30, 2010.

3) Umar Farooq, Hafiz Muhammad Atiq, Muhammad Usman Asad, Asim Iqbal, and Zeeshan Azmat, "Design and development of an image processing based adaptive traffic control system with GSM interface," Proc. International Conference on Machine Vision, Dec28-30, 2009, pp. 166-171.

4) Asim Iqbal, Umar Farooq, Hassan Mehmood, and Muhammad Usman Asad, "A low cost artificial vision system for visually impaired people," Proc. International Conference on Computer and Electrical Engineering, Dec28, 2009,pp. 474-479.

5) Abdul Manan Khan,and Ansa Tehreem, "Causes of road accidents in Pakistan," Journal of Asian Development Studies, vol.1, no.1,2012,pp. 22-27

6) MATLAB Documentation, MathWorks, Inc.Available [Online]: www.mathworks.com/help/matlab/