RASPBERRY PI BASED AUTONOMOUS CAR

Lokesh M. Giripunje [1], Manjot Singh[2], Surabhi Wandhare[3], Ankita Yallawar[4]
[1,2,3,4] Department of Electronics and Telecommunication Engineering,
[1,2,3,4]Dr. D. Y. Patil Institute of Engineering, Management and Research, Sector No. 29, PCNTDA, Nigdi, Pradhikaran, Akurdi, Pune - 411044

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ABSTRACT: *This project deals with building an autonomous car that is capable of travelling safely and intelligently avoiding the risk of human errors. This raspberry Pi based project is able to detect the obstacles & traffic light. It is able to compare the data processed with the data provided to it and is able to take an intelligent decision whether to stop or continue on its present path. Important components involved in this project are - the hardware platform which includes raspberry pi board, all the hardware like pi camera and the ultrasonic sensor for improved efficiency & the camera used along with an ultrasonic sensor to provide necessary data from the world for real time processing and application. Second being the cloud platform which will be basically used to train our raspberry pi board for real time applications. Cloud helps us to test as well as train better tracking and decision models & helps in providing the offline computing and storage capabilities for vehicle. Basically it will be usedto train the processor to differentiate between positive(green signal) and negative (red signal) images using various thousands of such signal images as an example .The third and most important part includes the algorithms for perception ,control, localization and recognition.*

Key Words: *Raspberry Pi, Ultrasonic sensor, Pi camera, autonomous, openCV, L293D motor driver*

I. INTRODUCTION

Due to the increasing economy of a developing country like India there is a drastic increase from total vehicle population of 55 million in year 2001 to that of 210 million in year 2015(Sources: https://community.gov.in) .With increase in the number of vehicles on streets, increasing are the problems like accidents, traffic jams etc. .Our project aims to solve this problem .Autonomous (driverless car, self-driving car) car is capable of sensing its environment and navigating without human input .It is able to detect the traffic lights, compare it with predefined data, process the data and take decisions accordingly .This driverless vehicle stops on detection of red traffic signal and start and continue its journey once the red light turns off. Presence of the ultrasonic sensor increases the efficiency and reliability by enabling the vehicle to detect an approaching object before it and thus stop the vehicle. Often a human can take time to take a reflex action in case a person or animal crosses the path accidently and this can prove to be quite fatal for the driver as well as the pedestrians, thus adding the ultrasonic sensor can help overcome such situation as on detection of any obstacle on its path the data will be sent to the processor and processed immediately thus stopping the car. Adding to this we have included remote mode selection in our project along with the autonomous mode so that we can monitor our car ,its movements as well as control them using a remote desktop/mobile .Mainly we have provided this provision to the end user, who can control the movement of car using forward ,back ,left ,right and stop .

Figure I: Future advancement to a normal vehicle due to the concept of automation

II.PROBLEM STATEMENT

80% of car crashes are caused by driver error .Often in case of accidents a person or animal crosses the path accidently and the normal human is unable to take immediate action or respond at that instant.

People who are disabled or even the old, children and those who have difficulties in driving a car are dependent on other to travel.

Careless and rash driving methods are the main reason behind the traffic jams leading to wastage of lot of time, fuel and the reason can prove to be fatal at times when there is an emergency.

III. OBJECTIVE OF THIS PROJECT

The main objective of this project is to provide a solution to increasing road accidents, traffic jams and fuel consumption by providing a driverless car that is capable to driving on its own, detect the signal, start and stop on presence of green/red lights respectively& collision avoidance using the ultrasonic sensor .It also makes the end user capable of not just monitoring the movements but also be able to control the vehicle's movements and directions using remote mode.

IV. PROJECT WORK

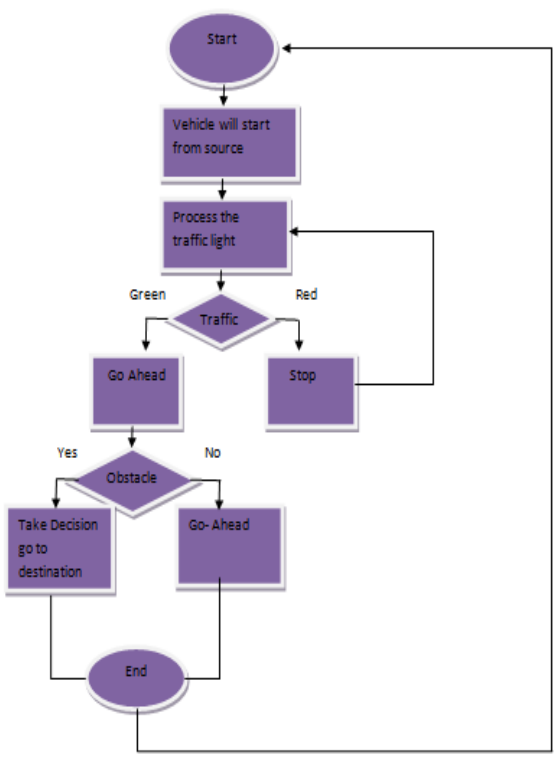

Fig IV (1): Flowchart of the working prototype

Description of Flowchart: Car will start from source .On detection of traffic light the camera will capture signal's image and process it.If the traffic signal is red, it willstop for some time and wait for signal to become green if, green it will be in motion.

If green it will continue its path. If there is an obstacle it will detect obstacle and it will stop and change its path. If not, then it will continue its normal path and reach the destination.

Work Done :The work done for this project includes the total hardware assembly, testing for the proper working of interfaces between the camera, ultrasonic sensor andthe raspberry pi , installation of open CV which is required for image detection, processing and recognition Implementation of the remote mode. The hardware consists of the acrylic fiber base. Two permanent type DC motors are connected at the back and a ball castor wheel is connected in the front side for movement of the prototype .On the base- a power supply, a raspberry pi board, motor driver circuit, a camera for capturing images and a ultrasonic sensor for measurement of distance between the model and any obstacle, are the various components that have been mounted.

For the remote mode different programming languages like HTML and PHP were used to create different direction buttons like right, left, forward, backward and stop which will be visible to user on the domain purchased and he/she will be able to monitor on desktop/mobile as well as control the car movements using the buttons .These commands will be given to processor which is programmed using python to take the different actions to make the motors rotate and thus make the vehicle move in the user defined direction.

For the autonomous mode processor in the prototype has been trained to distinguish between negative &positive images & accordingly stop or continue..

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V .SYSTEM ARCHITECTURE

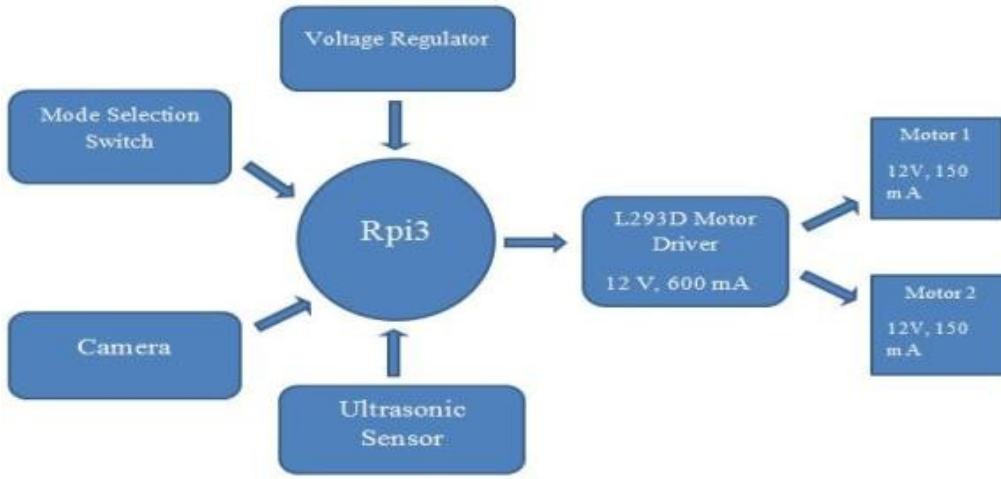

Figure V (1): Autonomous Mode

Description of autonomous mode –This is the autonomous mode of our car where raspberry Pi will be used mainly to process the images of the signal lights that will be captured by the camera and to measure the distance from obstacles using ultrasonic sensor and thus control its movementsusing motor driver L293D according to the predefined program .

Mode Selection Switch: This will enable us to select the operating mode of our vehicle .There are two mode of operation i.e., the autonomous mode and the remote mode.

Autonomous mode –Here the images captured will be processed and decision will be taken by the processor regarding the further movement of our vehicle

The camera will capture traffic images and process it.

The ultrasonic sensor will measure the distance of obstacle.Iffound less than 2m, then the car will stop.

The motor driver will make the motor move in resultant directions. It provides 12V, 600 mA to the two motors.

Voltage regulator: We will use Lm7805 as voltage regulator to provide 5V to Rpi3

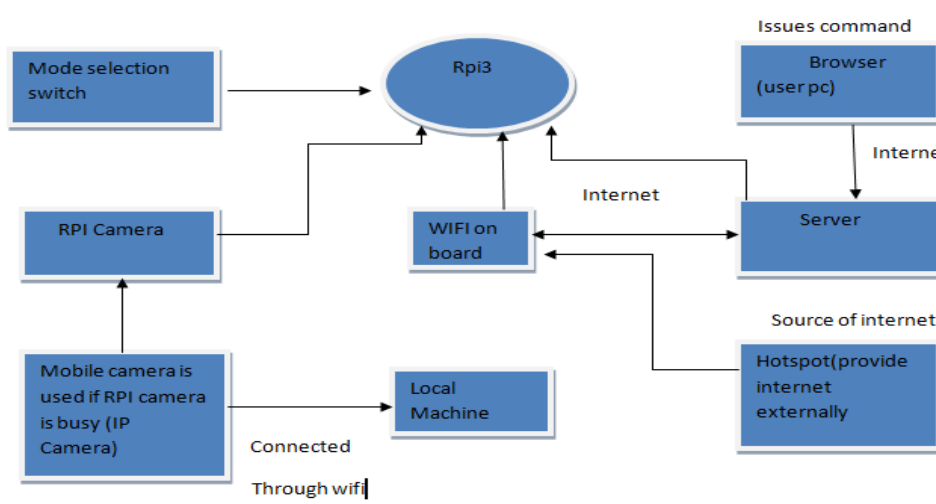

Figure V (2): Remote mode of autonomous car

Description of remote mode –In this mode we can control the operation of our car and also its movement using remote mode of operation where all the collected information will be sent to a device like personal cellphone or laptop using IoT .Also it will enable it to control motions like left, right, front ,back and stop.

Also wifi is used, that is on board connected to

server through internet and provides internet through hotspot to the wifi on board. User will be able to control the directions of the car if the car is distracted from its actual path .Alsoif the pi camera is busy in processing camera connected to local machine i.e., mobile and mobile camera for processing will be used.

VI. COMPONENTS USED

VI (i) HARDWARE USED

A] Power Supply: In the power supply circuit, additional two pins for connecting a transformer have been provided which will be mainly used to charge the battery that will be used .Also it will provide the DC voltage to the bridge rectifier (1n4007) (PIV Rating=1000V).The pulsating DC is then given to capacitor (1000uF, 25V) which is used to get a smooth DC.This is further given to the ICs 7805 which gives 5V as a output & 7812 which gives 12V as a output. Also a 470 ohm resistor has been provided which is a current controlling resistor.

B] Raspberry pi: This is the main component used in the project .It is credit card-sized single-board computer which is trained to recognize images, compare and finally implement the algorithm to take immediate action most suitable for the input image.

Figure VI (i): Raspberry Pi board

C] Motor Driver: This circuit is used to drive the two DC motors which will be responsible for the movement of our model. The motor driver used here is L293D, which has the capability to drive two dc motors at a time .It gets the input from the GPIO pins 12, 16 & 20, 21.

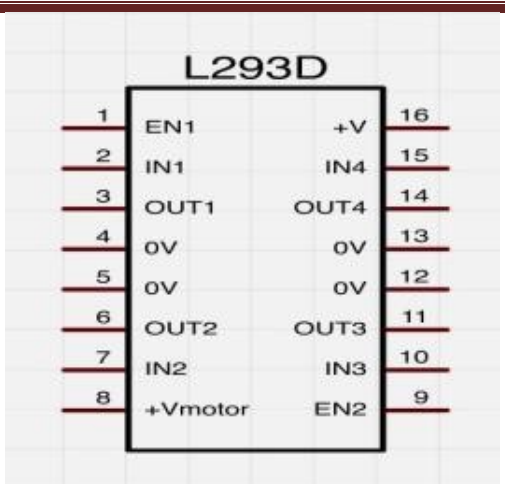

Figure VI (ii):L293D Motor driver

D].Ultrasonic Sensor: It is used to measure the distance .The trig& echo pin of the ultrasonic is connected to the raspberry Pi GPIO pin number 17& 18 respectively.

Figure VI (iii): Ultrasonic Sensor

E] Camera: The camera is connected to the raspberry pi through USB connectivity and will capture images from the surrounding and provide it to raspberry pi for further processing.

VI (ii) SOFTWARE USED

A] OpenCV: **OpenCV** (*Open source computer vision*) is a libraryofprogramming functions mainly aimed at real-time computer vision. The library is cross-platform and free for use under the open source BCD license. It has been used in our project to train the processor to distinguish between positive and negative images. The library has more than 2500 optimized algorithms. These algorithms can be used to detect and recognize faces, identify objects, classify human actions in videos, track camera movements, track moving objects, extract 3D models of objects, produce 3D point clouds from stereo cameras, stitch images together to produce a high resolution image of an entire scene, find similar images from an image database, remove

red eyes from images taken using flash, follow eye movements, recognize scenery and establish markers to overlay it with augmented reality, etc. OpenCV is mainly used in our project to distinguish between traffic images and this data is further used by processor.

VII. SYSTEM ADVANTAGES AND APPLICATIONS

Autonomous car will be capable of fulfilling the main transportation capabilities of a traditional car without human input. It will allow for more productive use of time spent in a vehicle and reduce crashes.

Also it will help in reducing accidents,traffic jams, and the costs of congestion, energy consumption, and pollution. Autonomous means having the power for self-governance and thus anyone whether senior citizens, specially abled people or those who can't drive can travel safely without dependence on anyone.

VIII.CONCLUSION

The project in total uses convenient and affordable ways to provide a safe, driverless journey with the help of raspberry Pi, ultrasonic sensors,camera.

It also provides the mode selection provisions making it safe and efficient way to tackle today's increasing problems on streets. This can be further improved by using new technologies and can be applied not only in private but also public sector.

Human drivers naturally create stop-and-go traffic, such as when someone makes a lane change or merges, or because of natural oscillations in human driving .Autonomous cars can help reduce the traffic jams to a large extent as they can control the traffic flow by dissipating the stop-and-go waves so that traffic does not oscillate as it does when cars are driven by humans and also reduction in fuel consumption

Even a small percentage of autonomous cars can have a significant impact in eliminating waves and reducing the total fuel consumption by up to 40 % and the braking events up to 99%.

IX.FUTURE SCOPE

Introduction of machine learning can help to improve the performance to quite an extent as efficiency will be increased, if the algorithm starts learning by itself and start avoiding unnecessary calculations at the places already familiar.

Also the vehicle can keep track of locations and obstacles faced when it is travelling & save the data so that it can be used as a reference the next time for similar circumstances.

Figure IX (i): Features that can be added in future to upgrade the autonomous vehicles

REFERENCES:

1. Indian Journal of Science and Technology April - May Jun 2016 '' Vision Based Object Detection And Tracking Using Multi Rotor Unmanned Aerial Vehicle '' Sarthakkaingade, Vikrant More, Dhirajdhule, Pradeepgaidhani, Nitin Gupta
2. International Journal Of Trend In Research And Development, Volume 3(3), Issn: 2394-9333 Www.Ijtrd.Com Ijtrd May - Jun 2016 Available.Online@Www.Ijtrd.Com 31 '' Object Tracking Robot By Using Raspberry Pi With Open Computer Vision (Cv)'' M. Karthikeyan,.
3. D. Bajpayee And J. Mathur, "A Comparative Study About Autonomous Vehicle," In Innovations In Information, Embedded And Communication Systems (Iciiecs), 2015 International Conference On, March 2015
4. Vandung Nguyen, Oanh Tran Thi Kim, Tri Nguyen Dang, Seung Il Moon And Choongseon Hong .Department Of Computer Science And Engineering, Kyung Hee University "An Efficient And Reliable Green Light Optimal Speed Advisory System For Autonomous Cars". Ieice,2016
5. Poojakharade, Laxmimandalollu, Pooja A.S, Poojasavadatti, Mr. Kotreshmarali."Prototype Implementation Of Iot Based Autonomous Vehicle On Raspberry Pi "Bonfring International Journal Of Research In Communication Engineering, Vol. 6, Special Issue November 2016 .
6. Hordur K. Heidarsson And Gaurav S. Skhatme, "Obstacle Detection And Avoidance For An Autonomous Surface Vehicle Using A Profiling Sonar" Ieee May 9-13, 2011.
7. Gary Bradski, Adrian Kaehler, Learning Opencv: Computer Vision With The Open Cv Library, "O'reilly Media, Inc.". Copyright.September 2008, 1st Edition, Book Isbn:
8. Ch. Krishnaveni , Ms. A. Siresha , Mr. B. J. Premprasana Kumar & Mr. K. Sivanagireddy,

Implementation Of Embedded Systems For Pedestrian Safety Using Haar Features, Ijec: International Journal Of Electrical Electronics And Communication,Isn 2048 – 1068,Volume: 06 Issue: 20 L Oct -2014, Pp. 761-766

9. Tan-Hung Duong, Sun-Tae Chung, Seongwon Cho, Model-Based Robust Lane Detection For Driver Assistance, (Iciiecs) 2005
10. W. Maddern, A. Stewart, C. Mcmanus, B. Upcroft, W. Churchill, & P. Newman, Illumination Invariant Imaging: Applications In Robust Vision-Based Localization, Mapping And Classification For Autonomous Vehicles, Proceedings Of The Visual Place Recognition In Changing Environments Workshop, Ieee International Conference On Robotics And Automation (Icra), Hong Kong, China, 2014.
11. Trifan, A., Neves, A.J.R. & Cunha, B, Evaluation Of Color Spaces For User-Supervised Color Classification In Robotic Vision.17th International Conference On Image Processing, Computer Vision, & Pattern Recognition, Las Vegas, Nevada, Usa (July 2013).
12. R. Cucchiara, C. Grana, M. Piccardi& A. Prati, Detecting Moving Objects, Ghosts, And Shadows In Video Streams, Ieee Transactions On Pattern Analysis And Machine Intelligence(Pami), Vol. 25(10), 1337 - 1342, 2003.