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Prototype of Autonomous Car Using Raspberry Pi

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Abstract: **- In the modern era, the vehicles are focused to be automated to give human driver relaxed driving. In the field of automobile various aspect has been considered which makes vehicle automated. In this paper, considering the different features and the cost, on a small scale a three-wheel vehicular robotic prototype has been designed that will follow the lane and avoid obstacles. Autonomous cars are a developing technology which may prove to be the next big evolution in personal transportation. This report begins by describing the landscape and key players in the self-driving car market. Current capabilities, as well as limitation and opportunities of key enabling technologies, are reviewed, along with a discussion on the impact of such advances on society and the environment. Most impact, including reduced traffic and parking congestion, independent mobility for poor people, increased safety, and energy conservation and pollution reductions will only be significant when autonomous vehicles become common and affordable to common people. Raspberry Pi is the central processor of our Autonomous car. Various images are captured by the camera module, on this images various Image processing techniques are used to achieve Artificial Intelligence.**

***Index Terms*— Artificial Intelligence, Camera Module, Image Processing, Raspberry Pi.**

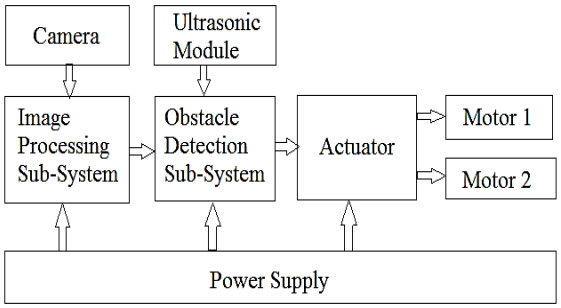
I. INTRODUCTION

Automated vehicles are technological development in the field of automobiles. Now a days, due to inconvenience of public transportation peoples are using their private vehicles. Due to such a large number of vehicles, the traffic problem has been occurred. To resolve this traffic problem, traffic rules are designed. But disobey of such traffic rules causes accidents. And maximum accidents will be occurred due to human error. To reduce these accidents and to improve safety transportation we require Autonomous Vehicle. Autonomous drive technology is one of the most important innovation in the automative industry. If we will able to implement this technology and have total control over it, then it can result in large benefits for both individuals & society. Members of IEEE predicts that in 2040, Autonomous cars will consist of up to 75% of the cars on the roads. Tens of millions of people have lost their lives or have become disabled worldwide in the last 10 years as a consequence of traffic accidents, the purpose of this project is to create a safe self-driving car that could help millions of people each year. Almost all the traffic accidents are caused by human mistakes. Unfortunately, according to statistic, in the next 10 years the number of lives lost each year will likely be doubled. To avoid such problems we are moving towards Autonomous Car.

II. METHODOLOGY

A. Block diagram

Here is simple block diagram of prototype of autonomous car which describe the actual structure of project and command flow between the various sub-systems. As shown in figure, there are two sub-system. That are Image processing sub-system and obstacle detection sub-system. Camera attached to image processing sub-system which capture the image and provide system. System extracts the data from the image and generates the command about turn. Mainly image processing is used here to detect the road lane. Generated commands are forward to obstacle detection subsystem. Obstacle detection sub-system is detect the obstacle in front of car and also calculate the distance between the obstacle and the car. And if sufficient distance is available to move car forward the command from Raspberry pi is forwarded to motor driver else this command are rejected.



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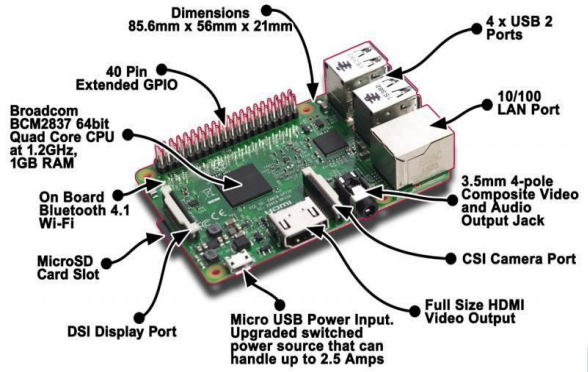
B. Component Description

1. Hardware Description

Raspberry pi:-

Raspberry pi small size computer which having its Raspbian OS. It's able to do multiple function simultaneously. It has 1.2 Ghz quad core ARM cortex A-53 and RAM 1 GB.[1] It required power upto to 5V, 2.5 amp which is negligible with respect to PC.[1]



Pi-camera:-

Camera used in this project having 8MP resolution with fixed lens. It is capable to capture picture 3280x2464 pixel size. [2]

Ultrasonic Module:-

To measure distance purpose ultrasonic module is commonly used because it not affected by environmental distraction.[3] The module used here having working frequency of 40 Hz and capable to measure from 10 cm to 400 cm.[4] This module have measuring angle of 15 degree.[4]

Ardiuno board:-

Ardiuno is a single board microcontroller kit for building digital devices and interactive objects in the physical and digital world. It allow to program in C language. It has internal analog to digital convertor.

2. Software Description

Raspbian OS:-

Of all the operating systems Arch, Risc OS, Plan 9 or Raspbian available for Raspberry Pi, Raspbian comes out on top as being the most user-friendly, best-looking, has the best range of default software's and optimized for the Raspberry Pi hardware [8]. Raspbian is a free operating system based on Debian (LINUX), which is available for free from the Raspberry Pi website [8].

Python:-

Python is a widely used general-purpose, high-level programming language [7,9, 10]. Its syntax allows the programmers to express concepts in fewer lines of code when compared with other languages like C, C++or java [9, 10].

GPIO Python Library:-

The RPi.GPIO Python library allows you to easily configure and read-write the input/output pins on the Pi's GPIO header within a Python script [7, 9]. This package is not shipped along with Raspbian.

OPEN CV:-

It (Open Source Computer Vision) is a library of programming functions mainly aimed at real-time computer vision. It has over 2500optimized algorithms, including both a set of classical algorithms and the state of the art algorithms in Computer Vision, which can be used for image processing, detection and face recognition, object identification, classification actions, traces, and other functions [10]. This library allows these features be implemented on computers with relative ease, provide a simple computer vision infrastructure to prototype quickly sophisticated applications [9, 10]. The library is used extensively by companies like Google, Yahoo, Microsoft, Intel, IBM, Sony, Honda, Toyota, and startups area as Applied Minds, Video Surf . It is also used by many research groups and government [10]. It is based on C++ but wrappers are available in python as well. In our project is used to detect the roads and guide the car on unknown roads [10].

Arduino Language:-

The Arduino IDE supports the languages C and C++ using special rules of code structuring. The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures.

C. Flow Chart

1. Image processing sub-system algorithm

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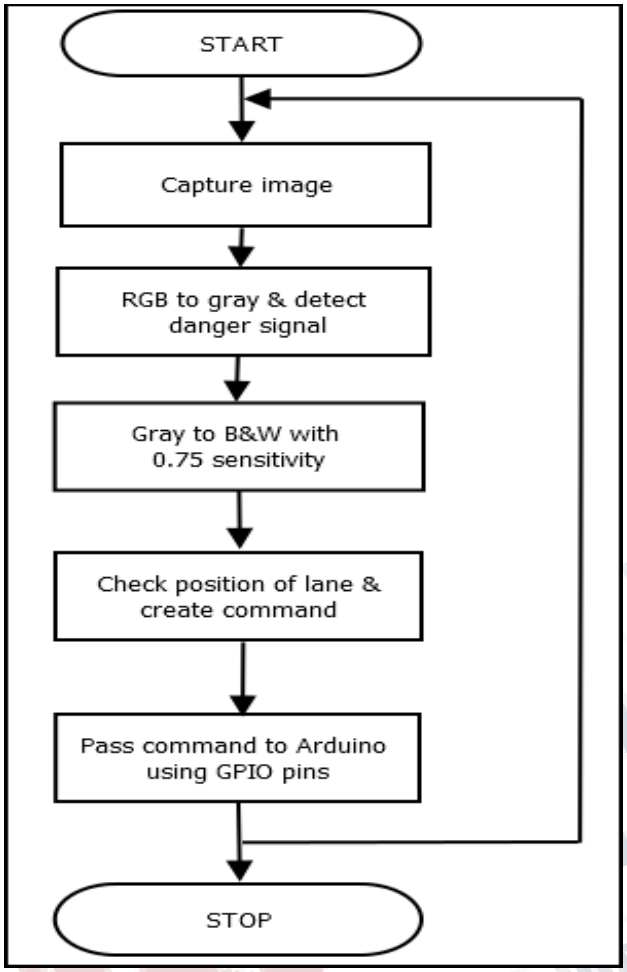
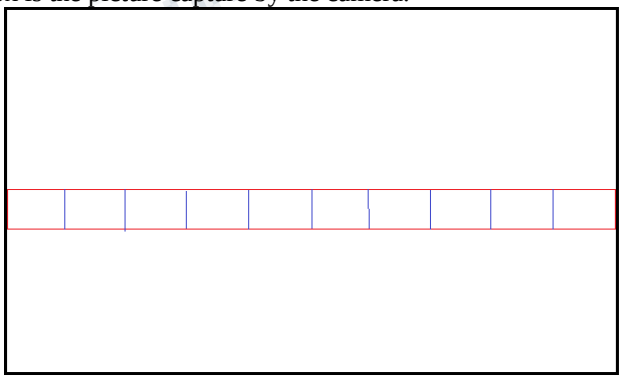


Here in this algorithm Lane detection is done in region of interest only as described below. Region given in red mark is our region of interest and the columns are helpful to decide the position of lane and also decision of turn is also carried out on the basis of this. Consider the given box is the picture capture by the camera.

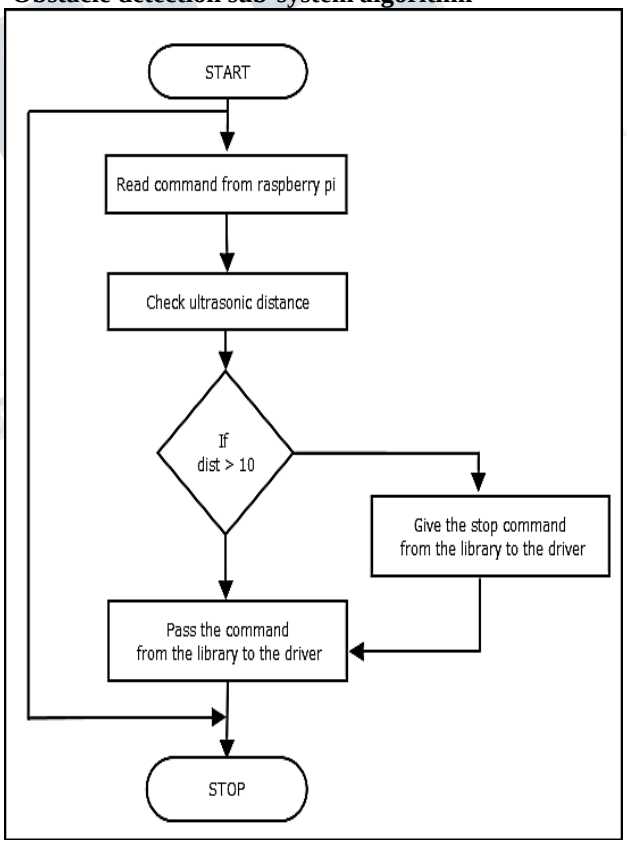


Numbers of white pixel in each block with respect to dark pixel are calculated respectively. This number decides the command for the car.

After the image analysis the image, raspberry pi generate the command as described above in block diagram. These generated commands are forwarded to arduino board through GPIO pin. For forwarding this command following table is referred.

COMMAND	GPIO pin 1	GPIO pin 2
STOP	LOW	LOW
FORWARD	HIGH	HIGH
LEFT	HIGH	LOW
RIGHT	LOW	HIGH

2. Obstacle detection sub-system algorithm



III. RESULT

A. Image processing sub-system result

It is important to detect the LANE from the image of road. And check their position in the form of pixel co-ordinates for the decision of turn. Following picture shows the image captured by the camera.

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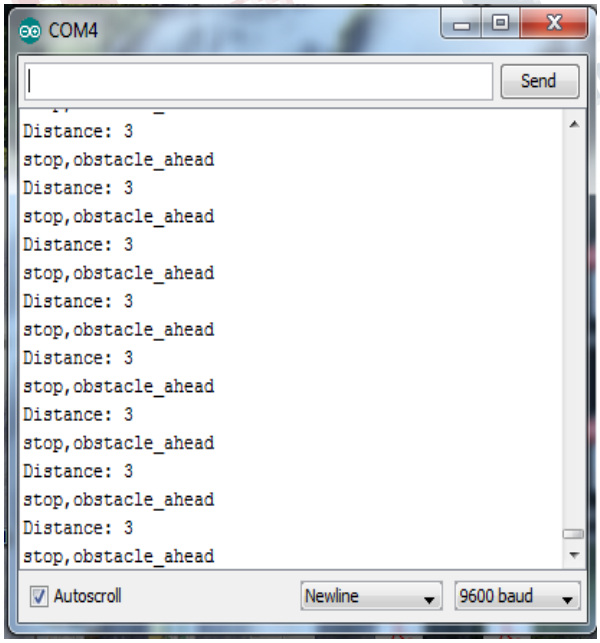
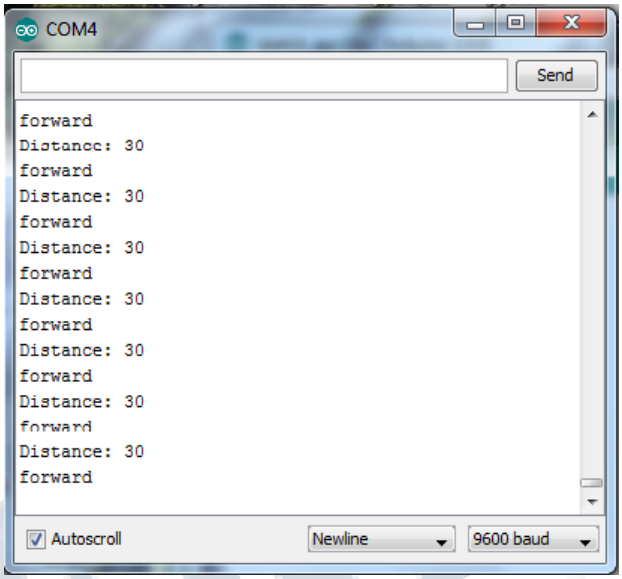
To perform the LANE detection operation it is important to convert image into gray scale as follow. After detection of lane, image look like below picture. That is lane in image marked is total white due to thresholding of image. The white pixels from the region of interest are considered only. Count of this image will give the position of lane on the road. The region of interest is slide vertically with respect to speed of car.

B. Obstacle detection sub-system result

The distance between two objects is provide by Ultrasonic module. Arduino's serial communication gives us result about the distance and also gives stop command to the vehicle as shown in figure below. Here are the screenshots of serial mode of arduino and distance display in cm. There are two cases.

Result if distance less that 10 cm





Result if distance greater than 10 cm

IV. CONCLUSION AND FUTURE WORK

A. Conclusion

Driverless car revolution which aims at the development of autonomous vehicles for easy transportation without a driver. For the economy, society and individual business this autonomous technology has brought many broad implications. In this paper, a method is determined for marked road edges are explained in detail relying upon OpenCV. Cars that drive themselves will improve road safety, fuel efficiency, increase productivity and accessibility; the driverless car technology helps to minimize loss of control by improving vehicle's stability as they are designed to minimize accidents by addressing one of the main causes of collisions: Driving error, distraction and drowsiness. The algorithm mention in this paper has been successfully implemented in prototype of Autonomous car.

B. Future work

The work could be enhanced by improving the algorithm by adding advanced machine learning to it. Using advanced algorithm we can improve Image processing algorithms. Multi layered processors can be used for fast processing. The present obstacle detection algorithm just detects the obstacle and stops, but in future it can be improved by the avoiding the obstacle, and go through another way using advanced obstacle detection algorithm.

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