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Designing and implementation of autonomous car and smart traffic system using Raspberry Pi

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ABSTRACT
The Project aims to build a monocular vision autonomous car prototype using Raspberry Pi as a processing chip. An HD camera and an ultrasonic sensor are used to provide necessary data from the real world to the car. The car can reach the given destination safely and intelligently, thus avoiding the risk of human errors. Many existing algorithms like lane detection, obstacle detection are combined to provide the necessary control to the car. This would Prove out to be a boon in the automobile industry. It would help reduce the concentration required and strain put up on the brain while also minimizing accidents due to careless or disobedient driving.
KEYWORDS: *Raspberry-Pi, Pi-Camera, Machine Learning, Image Processing.*

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I. INTRODUCTION

Automated vehicles are technological development in the field of automobiles. Nowadays, due to the inconvenience of public transportation, peoples are using their private vehicles. Due to such a large number of vehicles, the traffic problem has occurred. To resolve this traffic problem, traffic rules are designed. But disobey 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 critical innovations in the automotive industry. If we can implement this technology and have total control over it, it can result in immense benefits for both individuals & society. Members of IEEE predict 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 traffic accidents are caused by human mistakes. Unfortunately, according to statistics, 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.
The Following Technologies will be used in the Project.

1.1 Open CV:

It (open-source Computer vision) is a library of Programming Functions mainly aimed at real-time computer vision. It has over 2500 optimized 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. It is based on C++ but wrappers are available in python well. In our Project is used to detect the roads and guide the car on unknown roads

1.2 Raspbian OS:

Of all the operating system 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, and optimized for the Raspberry Pi hardware. Raspbian is a free operating system based on Debian (LINUX), Which is available for free from the Raspberry Pi website.

1.3 Block Diagram

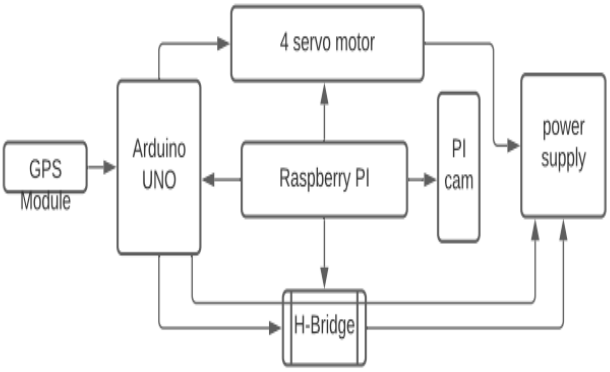


Fig.1 Block Diagram of working of a modeled car

II. HARDWARE USED

1.Raspberry Pi 3 B+
2. LN293 Motor Driver IC
3. Pi Camera module
4. Arduino

2.1 Raspberry Pi 3 B+

The processor used in this model is the Raspberry Pi B3+ model with a 1.4GHZ 64-bit quad-core processor. It possesses 1 GB of RAM and has an extended 40 pin GP I/O header. It bears 4 USB 2.0 ports and a power input port of 5V 2.5A. It is used here as the main central processor to coordinate the functions, take appropriate inputs, and then the decisions accordingly.

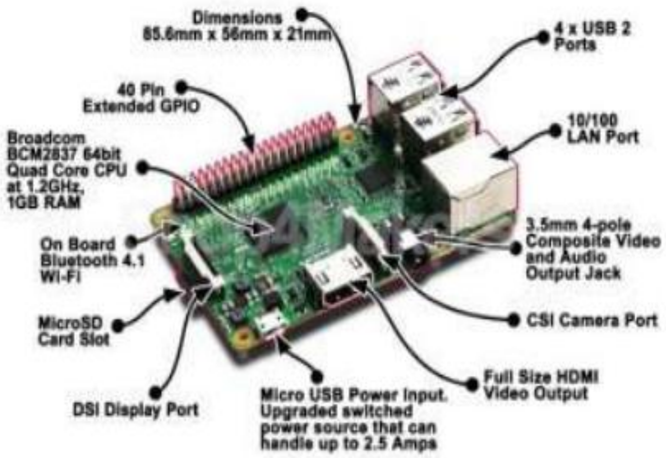


Fig.2 Raspberry Pi

2.2 LN293 Motor Driver IC

The LN293 is the motor driver IC that is used to bridge the gap between the Raspberry Pi and the motors of the car. The motor- driver IC receives signals from the Raspberry- Pi and then takes action on the motors accordingly and facilitates their start-stop motion.

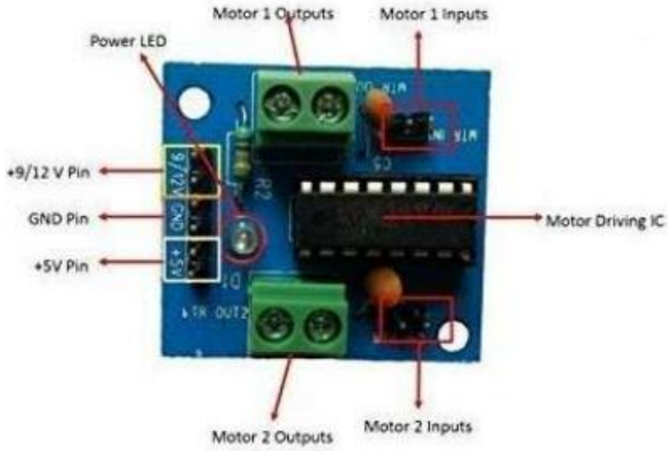


Fig.3 LN293 IC

2.3 Arduino UNO

A microcontroller board, contains the onboard power supply, USB Port to communicate with PC, and an Atmel microcontroller chip.

It is Simplify the Process of Creating any control system by providing the standard board that can be Programmed and connected to the system without the need for any sophisticated PCB design and implementation.

It is open-source hardware, anyone can get the details of its design and modify it or make his own one himself.

Fig.4 Arduino UNO

2.4 Pi- Camera Module

It is used for the live streaming of the feed in front of the vehicle and to capture images of the traffic signs and signals over which processing is done by the Raspberry Pi later. It uses a Sony IMX219 8-megapixel sensor. It is connected to the Raspberry Pi via a 15cm ribbon cable. It supports videos of 1080p30, 720p60 and VGA90 modes.

Fig.5 Pi Camera

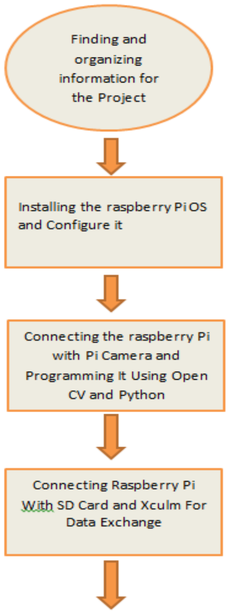
Features:-
- MIPI Camera Serial Interface
- Omnivision 5647 Camera Module
- Resolution 2592*1944
- Supports: 1080p, 720p, 480p
- Light Weight and Portable

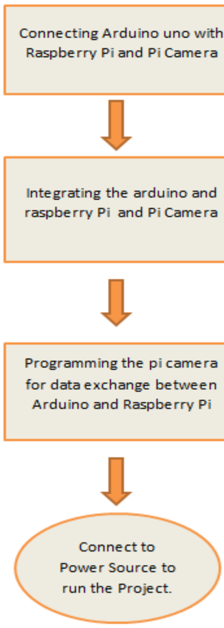
2.5 Servo Motor
A Servomotor is a device that allows angular rotation.it is a rotary actuator. It consists of a suitable motor coupled to a sensor for position feedback.
A servo motor is a rotary actuator or linear actuator that allows for precise control of angular or linear position, velocity, and acceleration. It consists of a suitable motor coupled to a sensor for position feedback.

Fig.7 Servomotor SG90

Features:-
- Motor voltage Vcc2(Vs): 4.5V to 36V
- Maximum Peak motor current:12A
- Maximum Continuous motor current: 600mA
- Supply Voltage to Vcc1(Voss): 4.5V to 7V
- Transition time: 300ns (at 5V and 24V)
- Automatic Thermal shutdown is available
- Available in 16 pin DIP, TSSOP, SOIC package.

III. PROJECT EXECUTION PLAN





IV. WORKING

The L293D H-bridge motor driver is connected to the Raspberry Pi 3b+ controller through its General Purpose Input Output (GPIO) pins. The PI camera is connected to the USB port of the Raspberry Pi board. To build a hardware model of the self-driving car, a chassis is selected as the base on which all boards are mounted and 4 wheels are attached - 2 wheels in front and 2 wheels in back, to the chassis. Front wheels are powered with two dc motors running at 30 RPM. H-bridge driver circuit controls the movement of these motors in a clockwise or anticlockwise direction upon receiving control signals from the Raspberry Pi controller. PI camera in the back sides of the car to detect obstacles around the car and measure the distance. PI camera at back is responsible for lane following. Arduino UNO is mounted on top of the car is connected to the controller through IC L293D H-bridge, and the camera is set to detect the tilt of the driverless car. The PI camera is used for image processing along with the Python library and open cv to detect real-time objects and to follow traffic rules. All the programs, written in open cv, to implement image processing algorithms are dumped into the Raspberry Pi 3b+ model.

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All functionalities of the self-driving car like Lane Detection and Following System (LDFS), Traffic Light Detection System (TLDs), Real-Time Object Detection System (RTODS), Accident Alert System are selected by raspberry pi 3b+ model and PI camera and its AI configuration in addition with aurdino uno implemented in the Project.

V. CONCLUSION

A low-cost prototype of a Self-Driving Car model is designed developed and all functionalities are successfully demonstrated. The car can follow lanes efficiently using the PI camera module and the traffic colors are detected and decisions are made by the car using image processing techniques to follow real-time traffic rules. The car can differentiate between real-time objects and is responding to the given instructions precisely and is detecting and overcoming obstacles. Accident Alert System is designed and an alert message is sent to the mobile of a user in the event of an accident

The major conclusion of this Project is that it uses the least component and low/no sensor are used in this Project which built it cheap and more efficient

As India is not the hub of electronics so well come up with this conclusion.

Future Scope

- Live GPS tracking system
- Wireless Charging
- Automatic rebooting systems

- Controlling the car by web-based/android based application

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