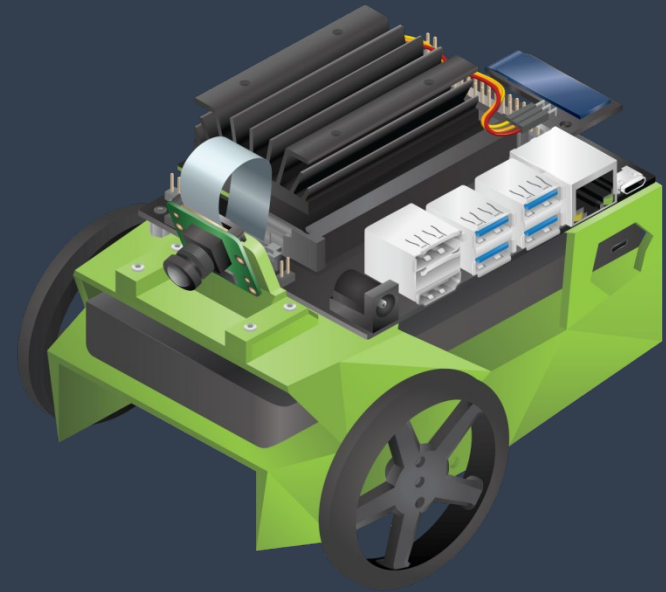# Autonomous Car

1. What is an Autonomous Bot ?

- An autonomous bot is a vehicle that can guide itself without any human input.This kind of vehicles has become a concrete reality and may pave the way for future system where computers take over the art of driving.

- An autonomous car is also known as driverless car, robot car, self driving car or autonomous vehicle.

2. Absract

The project aims to build a monocular vision autonomous car prototype using Raspberry Pi as a processing chip. An HD camera along with an ultrasonic sensor is used to provide necessary data from the real world to the car. The car is capable of reaching the given destination safely and intelligently thus avoiding the risk of human errors. Many existing algorithms like lane detection, obstacle detection are combined together to provide the necessary control to the car.

3. How Do They work?

1. Gather Sensory information of surroundings:

- Making use of GPS to obtain coordinates of a given path and the coordinates of bot.
- Input from video camera & Ultrasonic sensors.

2. Analyse information:

- The Raspberry Pi 3 interface is used to perform and implement algorithms of ML concepts for object detection and avoidance feature to it by making use of camera and avoiding obstacles if any. Combines input from various sensors (camera,gps,ultrasonic sensor) and control dc motor as output(steer).

3. Choose appropriate pathway:

- Geared Dc motors control the movement of the wheels, steering the robot to travel along the Path smoothly

4. Software Required

• 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 softwares 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

• Python:

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

• RPi.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 . This package is not shipped along with Raspbian.

4. Software Required

- OpenCV:

  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 as well. In our project is used to detect the roads and guide the car on unknown roads

5. Hardware Required

- Raspberry Pi 3 (Model B+)

- Camera (Raspberry Pi Camera V2)

- Geared Dc Motor (geared 100 rpm)

- Motor Driver (L293D)

- Wheels

- Caster ball

- GPS Module

- Ultrasonic sensor

- Battery (2x 5V/3A output, 10,000mAh)

- USB cable pack(Type A to Micro, right angle)

- Power supply (Micro USB, 5V, 2.5A)

6. Hardware Description

1.Raspberry Pi 3 (Model B+):

   The processor used in this model is the Raspberry Pi 3 b+ model with a 1.4GHZ 64-bit quad-core processor. It possesses 1 GB of RAM and has 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.

Features:-

•Brand: Raspberry Pi

•Style: Single board

•Number of cores: Quad core

•Video port: DisplayPort, HDMI

•Installed memory: 1 GB RAM

•Processor speed: 1.4 GHz CPU

2. Motor Driver (L293D IC):

L293D IC is a typical Motor Driver IC which allows the DC motor to drive on any direction. This IC consists of 16-pins which are used to control a set of two DC motors instantaneously in any direction. It means, by using a L293D IC we can control two DC motors.Can be used to run Two DC motors with the same IC.Speed and Direction control is possible

Features:-

- Motor voltage Vcc2 (Vs): 4.5V to 36V

- Maximum Peak motor current: 1.2A

- Maximum Continuous Motor Current: 600mA

- Supply Voltage to Vcc1(vss): 4.5V to 7V

- Transition time: 300ns (at 5Vand 24V)

- Automatic Thermal shutdown is available

- Available in 16-pin DIP, TSSOP, SOIC packages

3. Camera (Raspberry Pi Camera v2):

The Raspberry Pi Camera v2 is the new official camera board released by the Raspberry Pi Foundation. The Raspberry Pi Camera Module v2 is a high quality 8 megapixel Sony IMX219 imagesensor custom designed add-on board for Raspberry Pi, featuring a fixed focus lens.5MP colour camera module without microphone for Raspberry Pi Supports both Raspberry Pi Model A and Model B.

Features:

- MIPI Camera serial interface
- Omnivision 5647 Camera Module
- Resolution: 2592 * 1944
- Supports: 1080p, 720p and 480p
- Light weight and portable (3g only)

4. Ultrasonic sensor:

It work by emitting sound waves at a frequency too high for humans to hear. They then wait for the sound to be reflected back, calculating distance based on the time required. This is similar to how radar measures the time it takes a radio wave to return after hitting an object.

- Operating voltage: +5V
- Theoretical Measuring Distance: 2cm to 450cm
- Practical Measuring Distance: 2cm to 80cm
- Accuracy: 3mm
- Measuring angle covered: <15°
- Operating Current: <15mA
- Operating Frequency: 40Hz

5. GPS Module:

GPS receiver module gives output in standard (National Marine Electronics Association) NMEA string format. It provides output serially on Tx pin with default 9600 Baud rate.This NMEA string output from GPS receiver contains different parameters separated by commas like longitude, latitude, altitude, time etc. Each string starts with '$' and ends with carriage return/line feed sequence.

7. Working

- The raspberry-pi which is the central controller would be mounted on the car. The ultrasonic sensors would be placed on the front bumper of the car, while the pi-camera module would be placed on the roof of the car. The motor-driver ICs are responsible for the operation of motors and thus the motion of the car.

- The ultrasonic sensors placed at the bumper of the vehicle would be used to detect any obstacle in front of the car and take according actions. Whenever there is any obstacle in front of the car and lies within the pre-determined distance from the car, the raspberry-pi orders the motor driver ICs to stop supplying power to the wheels and hence stops the motion of the car depending upon the proximity of the obstacle. The distance measured is also displayed on the output window of the program. The next step is detection of lane and traffic signs. For these, we use the principles of image processing. For detection of the traffic signs, HAAR- cascade classifier was used in Open CV. As we know, Open CV provides classifier a well as a detector.
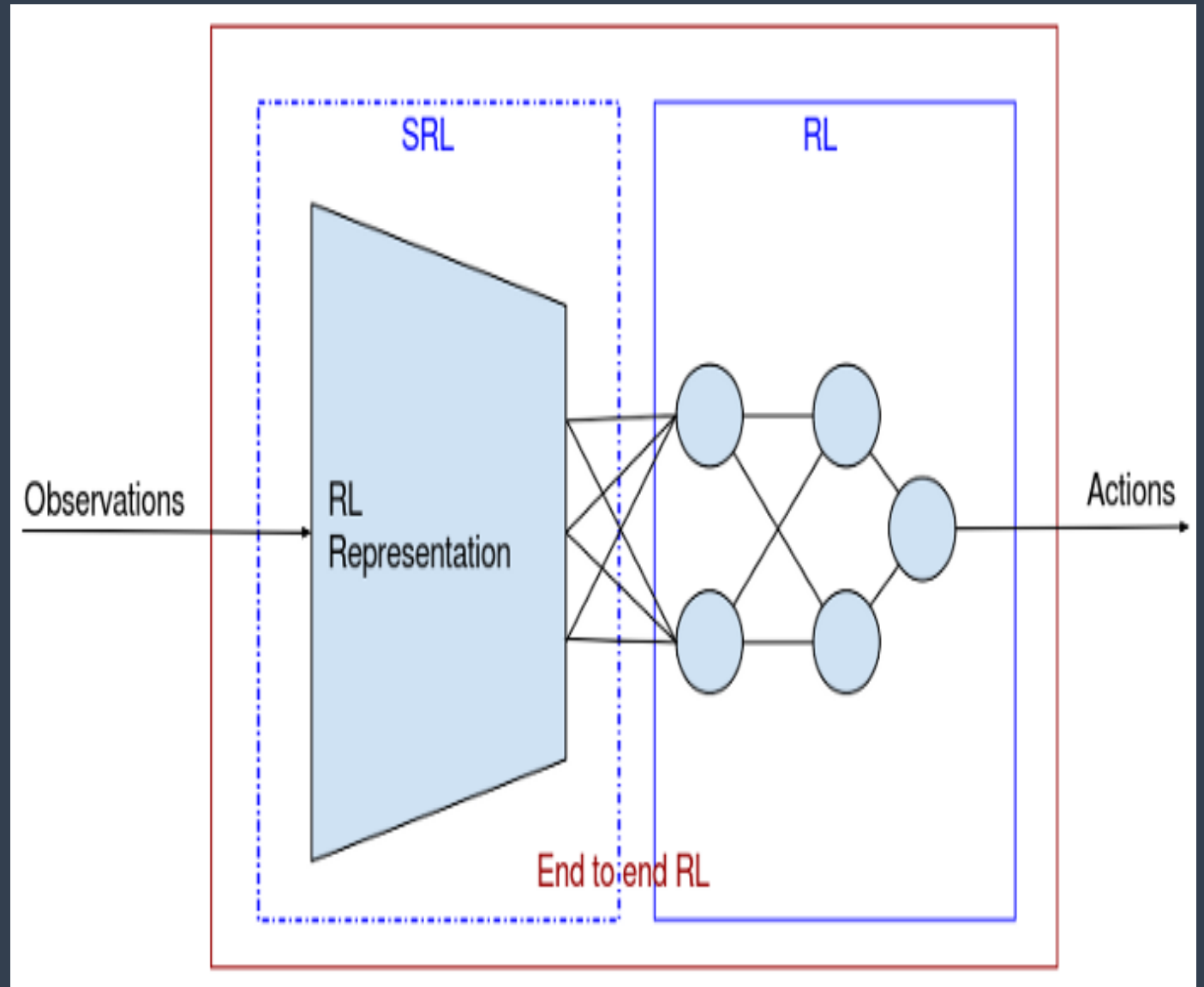
8. Flowchart for location coordinates
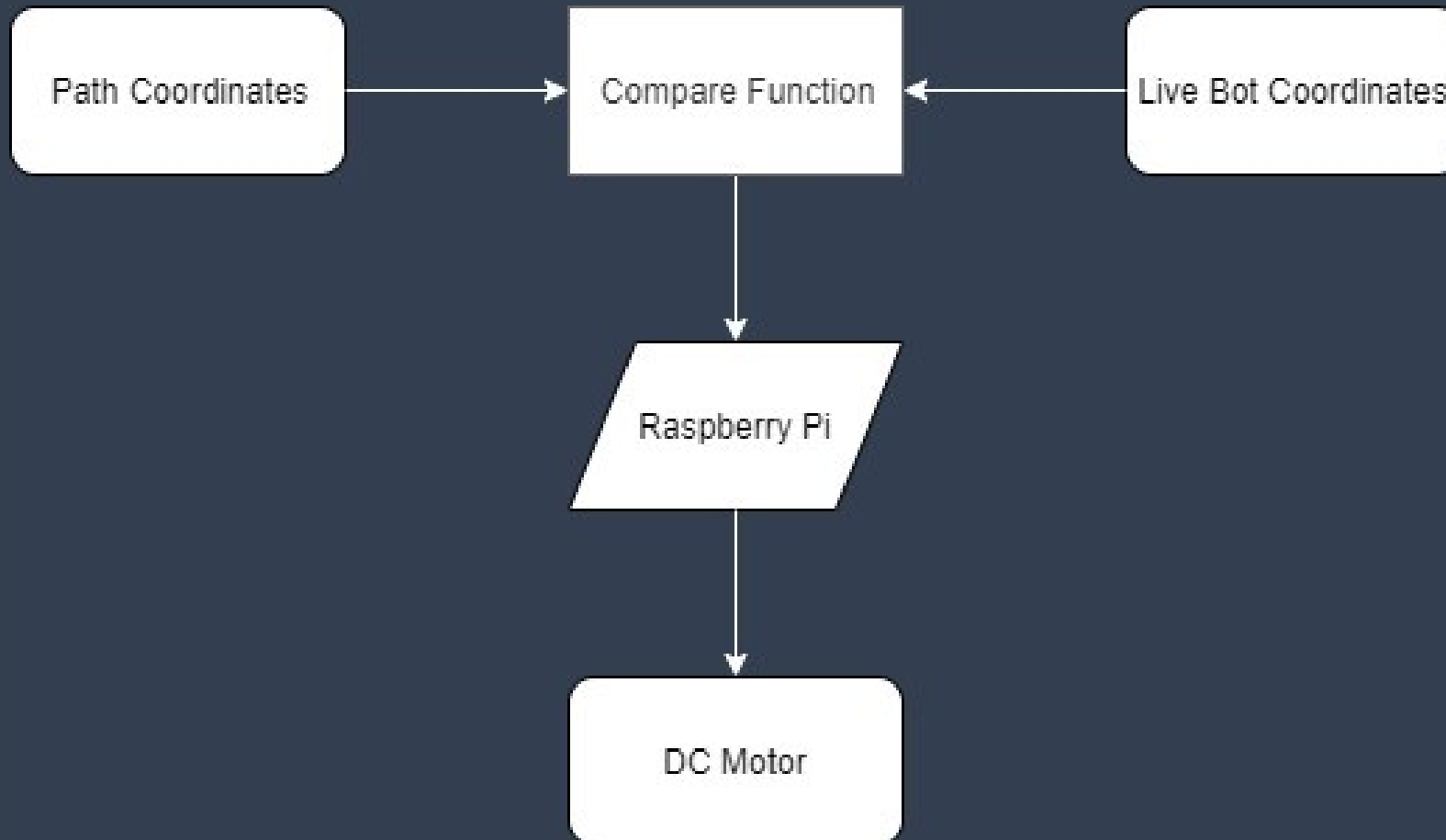
8. Flowchart for ML concept

- SRL stands for supervised reinforced learining

- RL stands for recurrent learning

  Both the layers are used in training the AI system

9. Impact

PROS

- Accidents would become less frequent
- Through self driving thechnology will decrease pollution and oil demand
- Launch of self driving car will provide jobs for software designers and car manufacturers for design updates
- Much safer and easier
- more efficient
- better for the environment

CONS

- Beneficial for consumers through detrimental to businesses such as car repair shops and insurance companies
- Secondary automobile industries (taxis,buses,rental cars) would lose business profits
- People will need to adapt to a new developing job market.
- Hackers:cars computer could be compromised
- Unreliable

10. Applications

1. Transportation in hazardous place:
   The complete real time decision making capability and sensor guided navigation will leads
   to replace the human drivers in hazardous place transportation.

2. Military applications:
   Automated navigation system with real time decision making capability of the system makes
   it more applicable in war field and other military applications.

3. Public transport:
   The driver would no longer be needed as the system would be able to perform all of the
   required tasks. It is a simple job of following a specific route and stopping at designated
   point

11. References

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THANKS