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Automated E-Vehicle for Agriculture

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Abstract: These days a number of automated self-driving vehicles and robots are created for various purposes. The most challenging task to develop an automated vehicle is to achieve low cost, low power consumption and should possess multiple features. The vehicle will navigate through the well-defined tracks in the fields and overtake the small obstacles (if any) using image processing. The vehicle consists of four wheels which will help the vehicle to change direction and navigate along the tracks. The wheels consist of DC motors controlled by the motor driver and powered by a power source. The motor driver is controlled using the slave device and the master device makes decisions by processing the data received from camera and slave device. Camera is an important element of this vehicle which is used to detect the navigation path and obstacles. The master-slave configuration helps to reduce the burden over the processor and thus reduces efforts and heat dissipation by the master device. Thus the power consumption can be managed significantly.

Keywords: Raspberry Pi 3B+, Arduino UNO, L298N Dual H-Bridge Motor Driver, Camera 5MP, Image Processing using OpenCV4.

I. INTRODUCTION

The primary objective to create this vehicle is to reduce the labour work in the fields. It may be used to do tasks like ploughing, seed rowing, transportation with just a little more advancement in technology. The concept of automation will help in the modernization in agricultural technology.

In this project, Raspberry Pi 3B+ is used as the main controller which processes the information received from the camera and the slave device that is Arduino UNO. The Arduino UNO is connected to the L298N Dual H-Bridge motor driver which controls the DC motors of the wheels. The motor driver is powered using a 9V power source and the Arduino UNO is given power using the power bank. The Raspberry Pi is interfaced by a camera of 5MP which is used to detect the lanes in the field. Raspberry Pi is also powered using power bank.

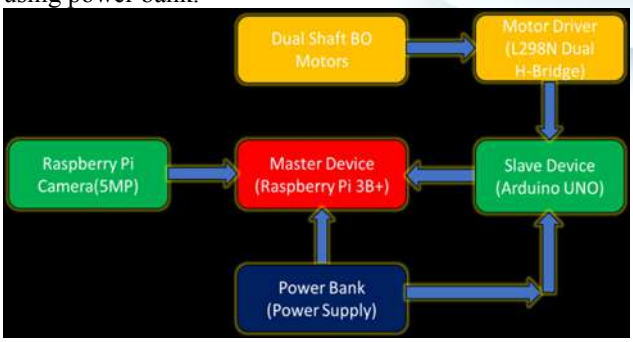

Figure 1:- Schematic for Proposed Vehicle

II. WORKING AND METHODOLOGY

Since the vehicle is an automated one, we just have to place this vehicle in fields along one of the lanes(tracks) which are predefined. The vehicle will start moving along the tracks and will work accordingly as per the path defined by the tracks. The camera will continuously capture the video and scan images along the tracks. The FPS captured by the camera will depend on the WiFi connection to the Raspberry Pi.

In this project, we have created a region of interest near to the front end of the vehicle. Thus the lanes and the objects which will come in front of the vehicle will be easily detected by the camera and the decisions will be made accordingly by the master device.

We have also kept a bird eye view on the tracks to make proper judgement of track's width and curvature. We have applied some threshold operations and canny edge detection algorithm to maintain a good camera perspective.

The size of the frame is 400 × 240 pixels captured by the camera. But since our region of interest is the front end area of the vehicle, we will select a frame of 400 ×100 pixels. Thus narrowing the perspective area helps in proper judgement of lanes and obstacles in front.

The vehicle will automatically detect the lane end and will move the next lane accordingly.

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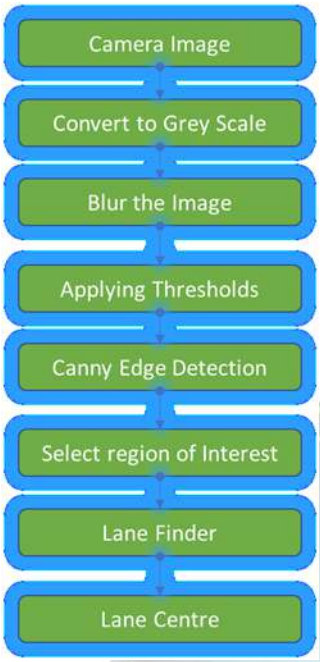

Figure 2:- Flow Chart for Lane Tracking

III. FUTURE SCOPE

Since this is an automated vehicle, there are many applications available for this project. Just a bit of customization or modification can help us to innovate some new product out of this vehicle. These types of vehicles will bring a revolution in the Agriculture Sector since the demand for advancements in this particular field is of utmost importance. Automated vehicles will help to reduce the human labour and thus help to reduce production costs. Moreover it will help to reduce the time required for ploughing, seed rowing and transportation. Ultimately more production can be done by applying a little efforts and time.

Apart from agricultural use, these vehicles can also be used in industries for transportation, product allocation and distribution, etc. This widens the scope of this vehicle hereafter. Modifications to this vehicle will help to achieve ultimate outcomes from this project.

Can also be used in Malls, Showrooms, Dispensaries for product handling and distribution.

IV. HARDWARE DESCRIPTION

1) Raspberry Pi 3B+

The development board used in this project is Raspberry Pi 3 B+. It acts as the controller and processing unit for the vehicle. It is a single board computer based on the Broad Com BCM2837. It has 40 GPIO pins, HDMI video output, 4-pole composite output jack for video and audio, USB 2.0 ports, CSI camera port, micro USB power input, Ethernet port, DSI display port, microSD card slot, on board Bluetooth 4.1 and on board Wi-Fi. It is used to control the hardware components used in this project.

2) Arduino UNO

The Arduino UNO R3 is a Micro-controller board based on a removable, dual-inline-package (DIP) ATmega328 AVR Micro-controller. It has 20 digital input/output pins (of which 6 can be used as PWM outputs and 6 can be used as analog inputs). Programs can be loaded on to it from the easy-to-use Arduino IDE. The Arduino is used as a slave device in this project which controls the motor driver and coordinates with Raspberry Pi.

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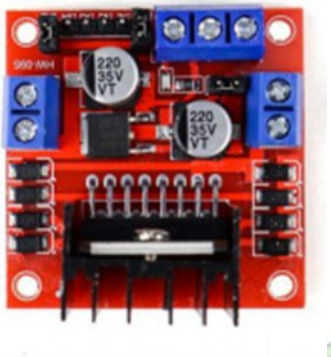
3) L298N Dual H-Bridge Motor Driver



The L298N Dual H-bridge Motor Driver can drive one 2-phase stepper motor, one 4-phase stepper motor or two DC motors.To avoid damage the voltage stabilizing chip, we use an external 5V logic supply when using more than 12V driving voltage. In this project, it is used to control dual shaft BO motors which are basically DC motors. Arduino UNO is used as the controller for motor driver.

4) Raspberry Pi Camera

The camera module uses OmniVision company's 1/4 inch OV5647 chip. It is able to deliver a crystal clear 5MP resolution image or 1080p HD video recording at 30fps. This camera is capable of capturing static images of 2592 × 1944 pixels. In this project, it is used to detect the tracks and for image processing.

V. HARDWARE MODEL AND PROJECT OUTPUTS

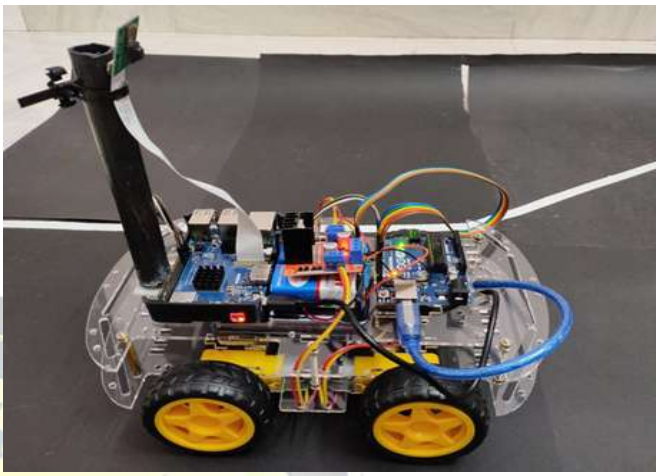


Figure 3:- Side View of Vehicle

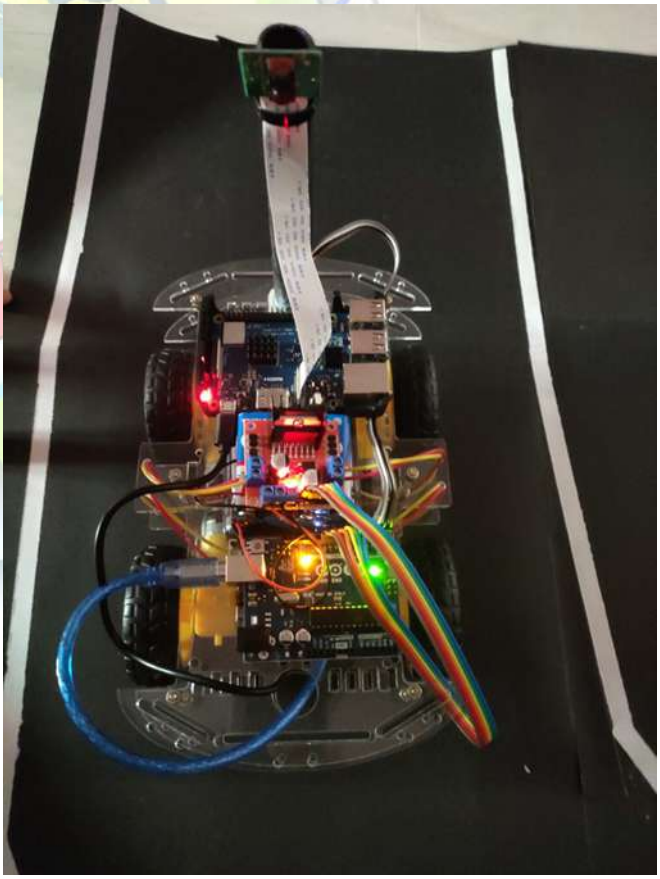


Figure 4:- Front View of Vehicle

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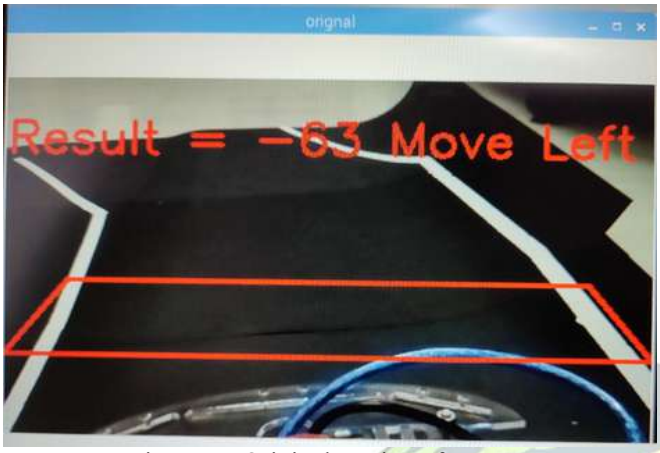

Figure 5:- Original Region of Interest

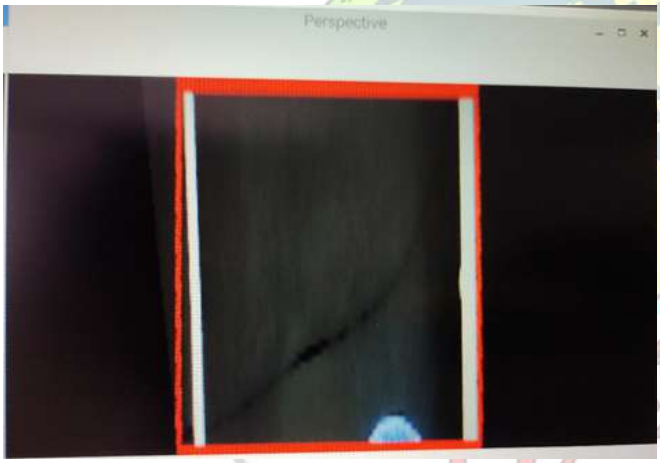

Figure 6:- Bird's Eye Perspective

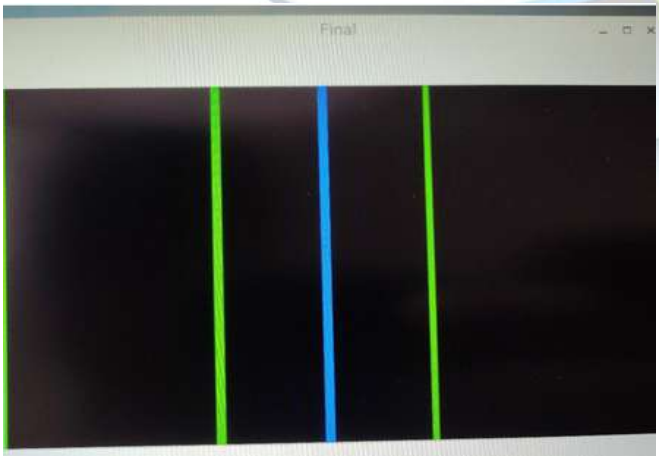

Figure 7:- Lane Centre and Calibrated View

VI. CONCLUSION

The vehicle is based on image processing using OpenCV4. There is a scope of improvement and modification in future by using the emerging techniques in Machine Learning and Artificial Intelligence. Thus these vehicles will revolutionize the future in Agricultural Sector. There will be no human labour required and every domain will be automated.

This vehicle is having its roots in technologies used by Google cars. Google self driving vehicles are using the same technology but with more advance features and protection systems.

These days many E-vehicles are being launched by various companies since there is a need to conserve resources and fuels and to overcome pollution. Moreover human driving causes accidents and loss of life and property. Automated vehicles will help to overcome all these drawbacks too. Thus this project is of great significance from future point of view.

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