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Semi-Autonomous Vehicle

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Abstract - *In the fashionable era, the vehicles are centre to be automated to grant human driver relaxed driving within the numerous aspects are thought of that makes a vehicle machine-driven. Google, the most important network has started working on the self-driving cars since 2010 and still developing new changes to grant an entire new level to the automated vehicles. The major causes of accidents on the national highways are due to vehicle design and condition, speeding, driving on the wrong side, road engineering, use of mobile phones, jumping the red lights, etc. The need of semi-autonomous vehicle is important which is significantly automated and thereby reduces the death ratio due to accidents.*

Keywords – Raspberry Pi, Arduino UNO, Open Computer Vision, Machine Learning, Image Processing, Autonomous Vehicle.

I. INTRODUCTION

In the recent years, there has been a major attention of research for autonomous vehicles in automotive engineering. One of the enormous technical challenges of autonomous vehicles is designing of dynamic path tracking, as a key component of the control system. The number of severe road accidents are increasing every year from 347 in 2020 to 389 in 2021. As a concern there is a need to automate the vehicle industry. The control method of trending autonomous vehicles which are based upon steering angle results in inaccurate tracking with respect to position onto the desired path, because as a vehicle moves in real-time, the steering wheel direction changes as per the way. Autonomous vehicle defines itself as a vehicle having extraordinary features that allows it to steer, brake and, accelerate with limited or no driver interaction. There are mainly two types of autonomous vehicles: semi-autonomous and fully-autonomous. Semi-autonomous cars are able to accelerate, brake and steer, and keep the distance from the car in front and also keep the lane at the speed of up to 130 km/h, but the need of driver is still required and is still in full command. Without any driver interaction, a fully autonomous vehicle is able to drive from one point to another. Recent research has proposed to construct the intelligent transportation systems, variable smarter suspensions, steering systems, torque distribution, steering by wire, and vehicle dynamic modelling improvement on designing more safer and intelligent vehicles. Varieties of studies are conducted about social impacts, regulations, human machine interfaces, and implementation methods of autonomous. The objective of Semi-Autonomous vehicle is to allow an algorithm to detect or learn various parts of a car such as wheels or other components of a car, objects/persons present around the self-automated car and as it has been exposed to much inputs, connections that has begun to develop to the endmost outputs and the steps to be provoked in the car in response.

II. LITERATURE SURVEY

Talking about autonomous vehicles (AVs) is a topic that has been discussed for several decades, but in the last decade the advances in computation, sensors and other hardware have allowed the development of this type of technology to be more real. All over the world, the evolution of self-automated vehicles has been observed, in cities such as Munich, Beijing, Paris, London, Boston, Singapore, San Francisco, Pheonix and New york, in companies such as Waymo, NuTonomy, Uber, Lift, Aurora, VW, BMW and others, just to mention a few. Driverless cars today sense their surroundings using radar, GPS, and computer vision, which could have an excellent margin for error, and the sensory information needs to be processed to navigate in pathways.

A. Levels of Automation

The Society of Automotive Engineers (SAE) stablished that there are six levels of vehicle autonomy:

1. Level 0 (No Automation): The driver has full control and always performs all driving functions.

2. Level 1 (Driver Assistance): The human driver has full control, but the vehicle helps with one or more driving functions, e.g., electronic stability control (ESC) and assisted braking.

3. Level 2 (Partial Automation): The human driver has primary control over the vehicle, but the vehicle can take

full control of more than one driving system, e.g., cruise control or automated parking.

4. Level 3 (Conditional Automation): Under certain conditions the automated driving system has primary control and performs all driving functions. in many driving modes, intervention of human driving is requested.

5. Level 4 (High Automation): The self-operated driving process has almost full control over the vehicle. The arbitration of human driver is desired in few driving modes only.

6. Level 5 (Full Automation): The full automated driving system has entire control over the vehicle. Intervention of human driving is negligible to zero.

Research demonstrates that most drivers take 700 ms to react to a dangerous situation by taking evasive or preventive actions. With the unit of 1 millisecond low latency, self-automated vehicles and Advanced Driver-Assistance Systems (ADAS) will be able to lower the risks and save lives by reducing the number of accidents. One High-Definition camera is mounted on the rear end of the vehicle connect to the system for relaying low latency real-time video of the pathways. The relevance and making process differed by some points based on technologies and components. The presented model takes a picture with the help of Pi camera linked with the Raspberry Pi on the vehicle. The Raspberry Pi and the laptop is connected to the same network, the Raspberry Pi sends the captured image and we are able to see the same on the laptop. An image is grey-scaled before passing it to the Neural Network. Upon prediction the model gives one of the four outputs i.e., left, right, forward or stop.

B. Hardware Environment

The car consists of two motors, L298N H-Bridge which is a motor driver that allows a full control of the two car motors at the same time, and Arduino UNO that simulate the car movement. The main component of the system is the Raspberry pi that is connected to the Arduino, and vision camera. The camera also recognizes the traffic signal and the stop sign. By connecting all of these hardware components together, the system is able to accurately recognize its whole surrounding environment. As shown, the two motors are being controlled by L298N motor driver based on the received signals from Arduino that is powered by an external 9volt battery, and Arduino transmits these signals which are based on the serials received from the Raspberry pi. These serials, thus, are being transmitted on a serial path which is connected between Arduino and raspberry pi. Furthermore, the algorithms take their input either as data readings or video frames from the cameras and sensors connected with the raspberry pi. The SD card used is also a part of the model as it has the Raspbian operating system of the raspberry pi.

We have trained the vehicle to move it according to the track.

Fig 1: Initial Setup

III. PRESENTED APPROACH

A. Block Diagram

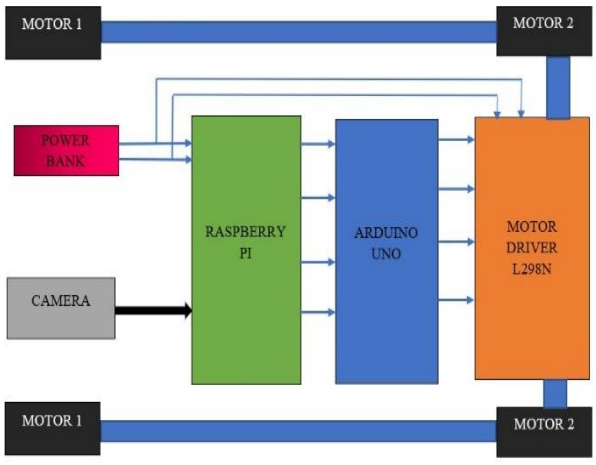

Fig 2: Block Diagram

B. Our Proposed Method

In order to implement the prototype, the main devices are Arduino and Raspberry Pi. The Raspberry Pi streams the video to Internet. It requires a bunch of processing power for both working simultaneously on running Computer Vision as well as video streaming. The Raspberry Pi 3 model B+ is a single-board computer with a powerful processing unit and serial and camera interface. In order to take high-quality video, The Raspberry Pi camera can be utilized. It can be accessed through the V4L (Video for Linux) APIs, and there are numerous third-party libraries built for it, including the Pi camera Python and C++ library which will be beneficial to the live streaming purpose. To access into the hardware, one only need to know the IP address of the Raspberry Pi and a username and password to log in. The vehicle requires to work on its own if there is any connectivity failure. It needs to keep itself safe from collision and abide by the traffic rules. The Arduino controls the motor driver circuit. The Arduino terminates the motor from running if there is any obstacle detected. Meanwhile the Raspberry Pi uses computer vision algorithms to detect the lane and traffic light signals. Python and C++ Open-Source Computer Vision (OpenCV) is a library of programming functions mainly aimed at real-time computer vision. We can use over 2500 optimized algorithms for detections, classification of actions, image processing, object identification, traces and other functions. The Raspberry Pi is interfaced with the Arduino with serial communication. It controls the Arduino to run the vehicle accordingly.

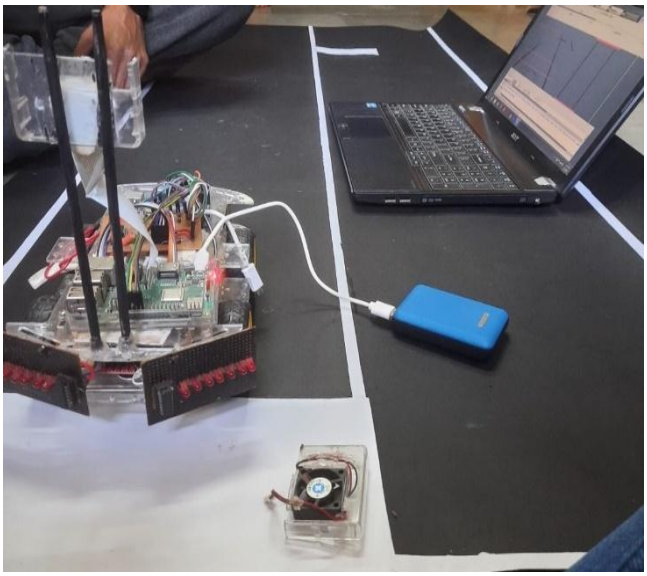

Fig 3: Proposed Model

C. Flowchart

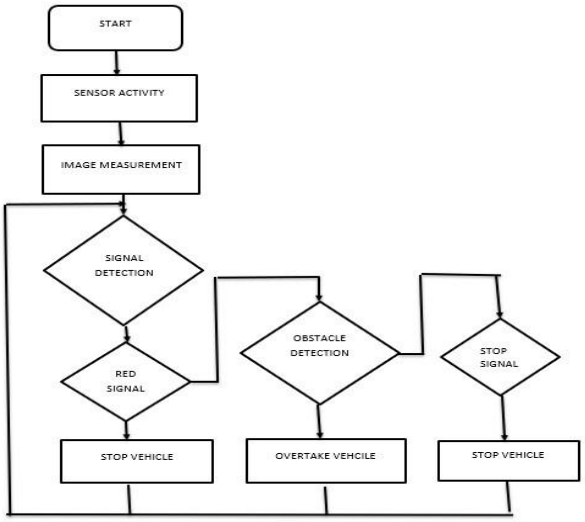

Fig 4: Flowchart

IV. RESULTS AND DISCUSSIONS

Autonomous vehicle uses hundreds of sensors to make vehicles faster and smarter. The sensors used are able to generate unparalleled amount of data. Controlling, purifying, and inspecting this amount of data demands a much faster connectivity.

Detections: In this journey of project, we experimented various types of detections on our model which makes it work in autonomous mode. These detections are as follows:

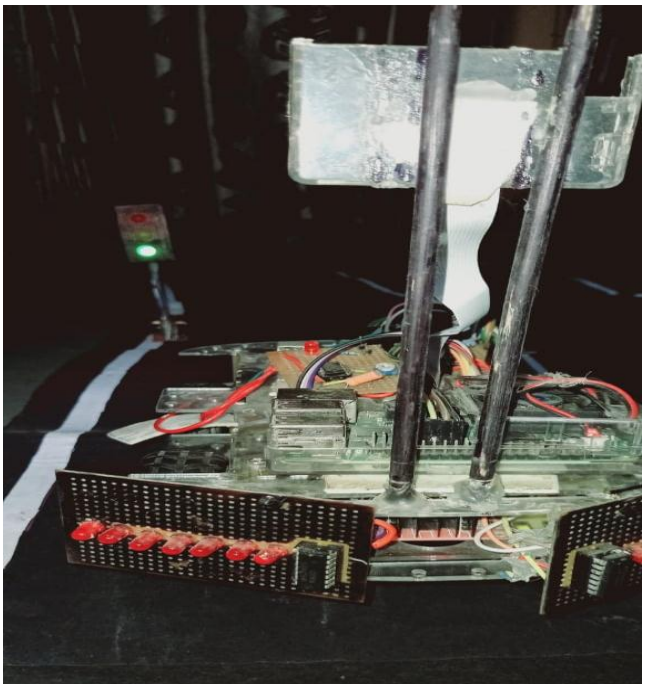

Fig 5: Traffic Light Detection

Fig 6: Obstacle Detection

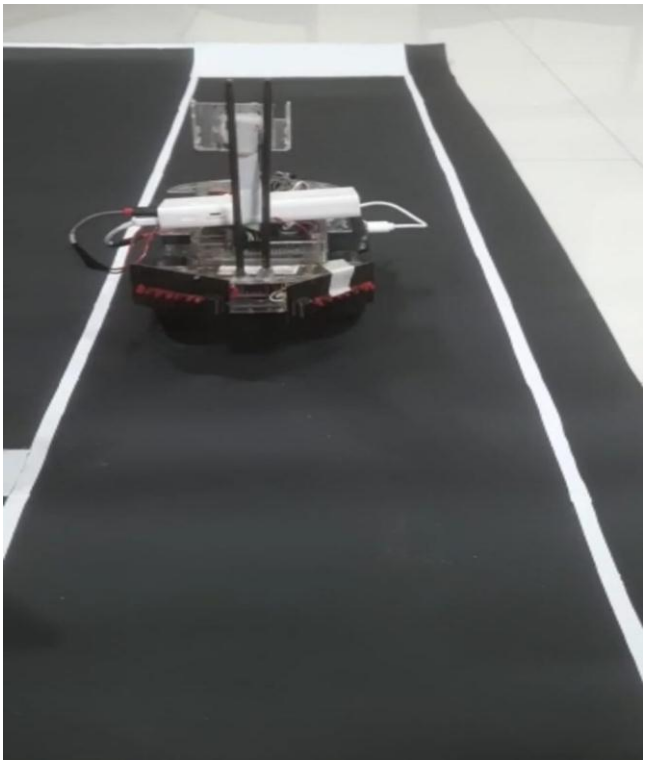

Fig 7: Lane Detection

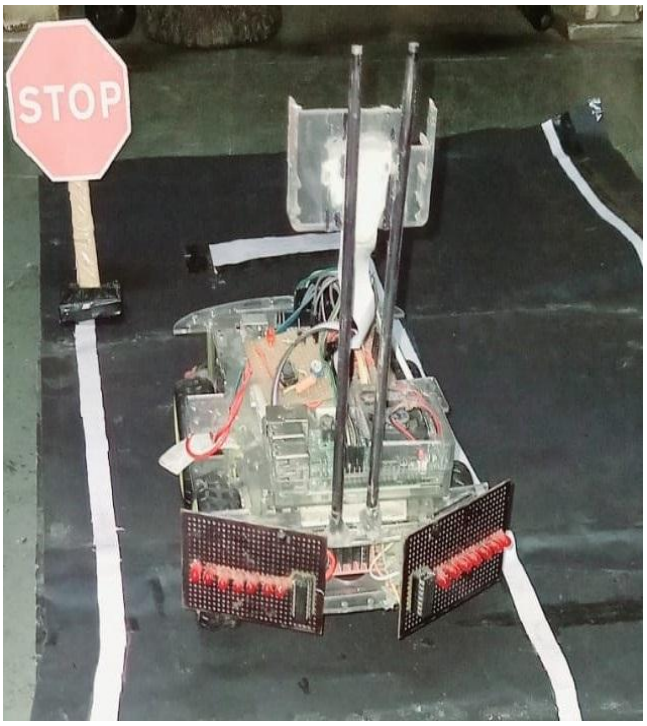

Fig 8: Stop Sign Detection

V. APPLICATIONS

- Trouble-free parking - Like self-parking Autonomous Vehicles do not involve open-door space for de-escalating the passengers when stopped, admitting them to settle the parking spaces which are 15 percent compact.
- AVs accelerate robotics development for consumer applications - These include remote advanced sensing, hyper precise positioning/GPS, image recognition, and advanced artificial intelligence.
- Traffic Jam Maneuvering system - Using cameras, predictive emergency brakes, radar technology and sensors the system has a faster reaction time than the human brain does.

VI. CONCLUSIONS AND FUTURE SCOPE

The calculations and results obtained currently have permitted us to observe and examine with certain simulations and executions of semi-autonomous driving. Future tests will lead us to do semi-autonomous driving experimentation in controlled conditions, emulating urban driving situations, focusing on the improvement of vehicle control, data collection and analysis of driver behaviour in front of these semi-autonomous driving systems. Since Autonomous Vehicles is the major upgradation in automatable industry in future, this project focuses on bring changes in road safety and commuting and significantly reduce accidents and human errors through

continuous learning by the system. The developed self-automated automotive is with success formulated, imposed, and assessed. The autonomous vehicle is efficiently trained with quite hundred to two hundred samples of pictures in numerous lighting conditions.

VII. ACKNOWLEDGEMENT

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