Raspberry Pi and Arduino Based Autonomous Car

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Abstract— *In, the recent development and trend most of the organizations are now utilizing Artificial intelligence to do autonomous tasks. Self-driving cars are one of the milestones of AI (Artificial intelligence). The mentioned method is used to reduce the human interference and takes decisions based on the surrounding environment, objects/obstacles present with the help of Convolutional neural network. These vehicular systems are now being deployed in Highways and extensively tested with worst case conditions. The system proposed here will be utilising two microcontrollers such as Raspberry Pi and Arduino, where Raspberry Pi acts as the master device which performs all the Image processing and neural networks tasks, Arduino acts as the slave device which takes the commands from the Raspberry pi, it's purpose is to control the dc motors and help in the movement of the entire system. This system is designed in such a way that it takes autonomous decisions based on the detection of animals crossing the road, traffic light, stop sign.*

Keywords— *Raspberry Pi, Arduino, Microcontroller, Artificial intelligence, Neural Networks.*

I. INTRODUCTION

Self-driving car (also known as a robot car, autonomous car, or driverless car) is a robotic vehicle that is designed to travel between destinations without human intervention. It is capable of sensing environment and navigate without human input. Autonomous cars must have control systems that are capable of analysing sensor data to distinguish between different cars on the road.

The potential benefits of autonomous cars include reduced mobility and infrastructure costs, increased safety, increased mobility, increased customer satisfaction and reduced crime. Specifically, a significant reduction in traffic collisions; the resulting injuries; and related costs, including less need for insurance. Autonomous cars are predicted to increase traffic flow; provide enhanced mobility for children, the elderly and disabled; review travellers from driving and navigation chores; lower level fuel consumption; significantly reduce needs for parking space; and facilitate business models for transportation as a service, especially via the sharing economy. This shows the vast disruptive potential of the emerging technology.

In spite of the various potential benefits to increased vehicle automation, there are unresolved problems, Such as safety, technology issues, disputes concerning liability, resistance by individuals to forfeiting control of their cars, customer concern about the safety of driverless cars, implementation of a legal framework and establishment of government regulations; risk of increased suburbanization as travel becomes less costly and time consuming. Many of these issues arise because autonomous objects, for the first time, would allow computers to roam freely, with many related safety and security concerns.

Autonomous prototype cars appeared in the 1980s, with Carnegie Mellon University's Navlab and ALV projects funded by DARPA starting in 1984 and Mercedes- Benz and Bundeswehr University Munich's EUREKA Prometheus Project in 1987. Since then, numerous Companies and research organizations have

developed prototypes. In 2015, the US states of Nevada, Florida, California, Virginia, and Michigan, together with Washington, D.C., allowed the testing of automated cars on public roads.

In 2017, Audi stated that its latest A8 would be automated at speeds of up to 60 kilometres per hour (37 mph) using its "Audi AI." The driver would not have to do safety checks such as frequently gripping the steering wheel. The Audi A8 was claimed to be the first production car to reach level 3 automated driving, and Audi would be the first manufacturer to use laser scanners in addition to cameras and ultrasonic sensors for their system.

In November 2017, Waymo announced that it had begun testing driverless cars without a safety driver in the driver position; however, there is still an employee in the car. In July 2018, Waymo announced that its test vehicles had travelled in automated mode for over 8,000,000 miles (13,000,000 km), increasing by 1,000,000 miles (1,600,000 kilometres) per month.

II. LITERATURE SURVEY

It is very much important to discuss about the recognition of the pedestrian direction in order to avoid collision with the pedestrian. Here the implementation proposes the usage of convolutional neural networks in detecting the movement of the pedestrian, the dataset was acquired by capturing the images at the broad walks, sidewalks, zebra walks [1]. Videos were taken at 30fps with 640x480 resolution. The detection of the pedestrian will be done using the techniques such as HOG and linear SVM, also the captured image will be resized. ResNet was the best performing CNN that was available with 94% accuracy. The arrival of self-driving cars will play an important role in intelligent transportation systems. The implementation of the algorithms on a commercial vehicle and under various environments [2].

There is usage of 2D LIDAR's sensors, cameras for local map building and they will use IMU, DGP's for helping in navigation. The local map building and navigation system is used for path planning, also there will be usage of User Datagram Protocol (UDP) Ethernet network. The image detection is used for finding object or events on the road such as obstacles, lanes, traffic lights, crosswalks etc. Image based techniques will be used such as HOG and SVM detectors present in Open CV. From today's technological implementations, cars have advanced equipment such as more sophisticated sensors and cameras and act as mobile sensors carrying useful traffic information, implementation present here discusses about vehicular cloud service for route planning [3]. A framework called vehicular social networking is used, which is an integration of social and vehicular networks, where a virtual social community is established where two commuters travelling on the same roads can share information. SVN is another application of VSN that is also used. The process will use an android application, Google api's, SVN engine server and server database.

A generalized prediction system which is a recurrent self-evolving fuzzy neural network is used for addressing electroencephalography (EEG) regression problem in brain dynamics due to fatigue driving [4]. The establishment of a virtual reality, based on highway environment was done with the help of twenty right handed healthy young adults, to get more information about driving fatigue paradigm. The young drivers were asked to drive the steering wheel according to the instructions provided, based on the experiments conducted the brain dynamics of each participants is recorded. It transforms the EEG spectra and extracts features, then a drowsiness prediction model is established and finally the result will provide the RMSE estimation. Generally, cyber-attacks causes very dangerous situations for everything and everyone, the implementation discusses about the cyber-attacks on the autonomous cars, the description of the attack performed is talked about, feasibility of the attack(FA), ease of detection of the attack by the driver, ease of

detection by the system, consequence of the attack [5]. The highest threats are caused by fake safety messages and map database poisoning. The medium threats can be a Denial of service (Dos) can cause a vehicle to not process any new incoming message because the system is overloaded with messages to process, the messages received can be important information from the sensors. The entire wireless technology threats and safety for the vehicle is talked about.

For the smooth driving of the self-driving cars in the real environment it must be able to recognize and respond to exceptional road conditions. The execution will be done using a camera to perform a computer vision method such as localize, detect and classify work zone signs in video data [6]. All of these were experimented and demonstrated on the highway. Pixel wise classification along with tracking and removal of background is done and the corresponding output is given to the self-driving car. Defence mechanism of any system must be very strong such that it can be protected from any attacks, for the improvement and betterment of the Defensive advanced research project agency opened grand and urban challenges competition in the USA. The implementation discusses about using AUTOSAR software, which was a standard developed for an automotive embedded and it does not support the general systems such as PC [7]. The execution utilizes the FlexRay network protocol, in achieving the successful development of the distributed system in the autonomous car.

III. OBJECTIVES

The objectives of our project are:

- To detect the pedestrian crossing the road.
- To detect the end of road.
- To detect the color of the traffic signal.
- To execute the prediction algorithm based on what was detected.
- To perform an action based on the results of the executed algorithm.

IV. METHODOLOGY

The purpose for this project is to provide the maximum safety for the person sitting inside the vehicular system, as well as to avoid the unnecessary obstacles present on the road. Using this proposed system one can develop a safe, autonomous and accurate recognition system which can detect animals, traffic lights, lanes and so on to minimize the number of accidents on any type of roadways.

The system which has been proposed will have raspberry pi as the master device, it takes care of all the image processing and neural networks operations and it is considered as the heart of our system. The movement of the system can be implemented on different roadways using the DC motor for the movement of the robot in all four directions. Motor requires a driver for movement therefore a motor driver circuit is used which is constructed using L293D H-bridge circuit used for the motor control which in turn used for the robot to move in the required direction. L293d is an MOSFET H-bridge circuit which consists of 4 MOSFETs connected in the form of H shape. Arduino uno is the second microcontroller that is used in this system which is used as a slave device, it is used for controlling the DC motors and it takes decisions by taking command signal from raspberry pi.

The Raspian camera is used for real time video capturing of the environment, it used for detection of pedestrian, cars, traffic lights and end of the lanes. The L298D H-bridge driver motor is used for driving two motor's at a time, it provides sufficient supply voltage to the DC motors. The GPS module is used for tracking of the system, it sends the location of the entire system and makes it easy to find if it goes out of

bound. The ultrasonic sensor is used for the detection of the object as well as monitor the environment to avoid collision with the other cars.

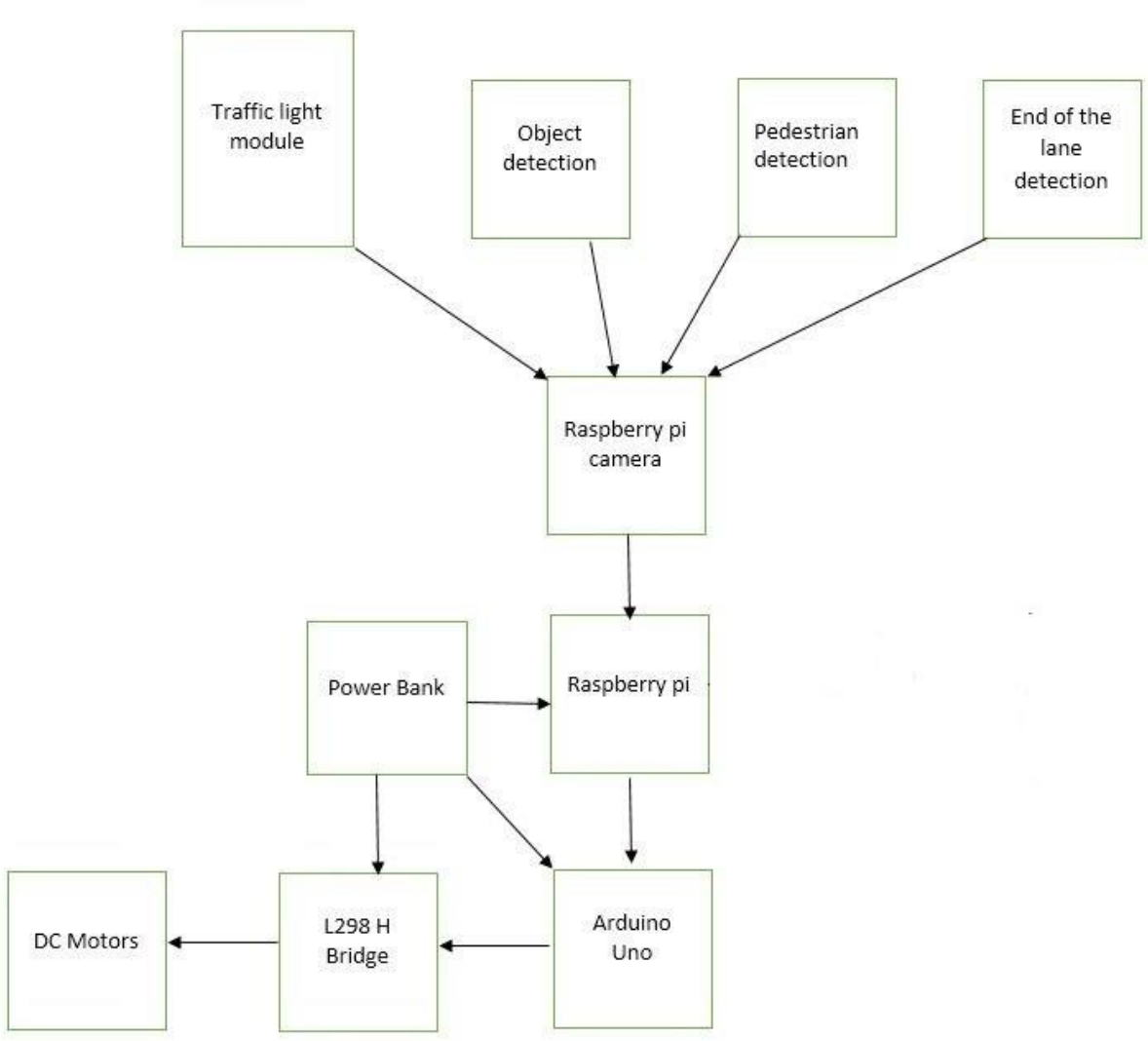

Fig. 1 Block diagram of proposed system

V. HARDWARE COMPONENTS

The Hardware components involved in this project are Raspberry Pi, Pi camera, Arduino microcontroller and dc motors.

A. Raspberry Pi

The Raspberry Pi is a small low cost single board computer having a processor speed ranging from 700 MHz to 1.2 GHz for the Pi 3.The on-board memory ranges from 256 MB to 1 GB RAM. The boards supports

up to 4 USB ports along with HDMI port. Along from all this it has number of GPIO pins which support protocols like I²C.Moreover it also supports Wi-Fi and Bluetooth facility which makes device very compatible with other devices. It supports Scratch and Python programming languages. It supports many operating systems like Ubuntu MATE, Snappy Ubuntu, Pidora, Linutop and many more out of which Raspbian is specifically designed to support Raspberry Pi's hardware.

Fig. 2 Raspberry Pi 3 Model B+

B. Pi camera

Pi camera is great gadget to capture time-lapse, slow motion with great video clarity. It connects to Raspberry Pi via a flexible elastic cord which supports serial interface. The camera image sensor has a resolution of five megapixels and has a focused lens. The camera provides a great support for security purpose. Various characteristics of the camera are it supports 5MP sensor, Wide image, capable of 2592x1944 stills, 1080p30 video on Camera module v2.

Fig. 3 Pi camera v2

C. Arduino Microcontroller

This microcontroller is based on ATmega329P, which has 14 digital input/output pins available out of which 6 can be used a PWM outputs. It also supports 6 analog inputs. It has 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It has 32 kb of flash memory and 2 kb of SRAM and weighs around 25g. Apart from all these features Arduino IDE is very user friendly and uses

basic C as its programming language. There are various plugins and libraries that are present for the Arduino which helps to interface many hardware components such as the LCD display very easily.

Fig. 4 Arduino Microcontroller

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