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IoT based Self Driving Car

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Abstract - *This paper aims to represent a mini version of self-driving car using IOT with raspberry pi and Arduino UNO working as a main processor chip, the 8mp high resolution pi camera will provide the necessary information and the raspberry pi will analyze the data(samples) and it will get trained in pi with neural network and machine learning algorithm which would result in detecting road lanes, traffic lights and the car will take turns accordingly. In addition to these features the car will overtake with proper LED indications if it comes across an obstacle.*

Key Words: Raspberry-pi, Pi-Camera, Machine learning, Image processing, neural network

1. INTRODUCTION

This paper introduces a research and educational project towards self-driving Cars and traffic issues, the project focuses on building a model of autonomous vehicle. The concept of self-driving isn't new or recent Leonardo tha vinci has theorised this concept of self-propelling cart in late 1500 century If we see history of traffic related issues. nearly 1.3 million people die in road crashes each year and talking about India the number of people who got killed in a road accident in 2017 alone were 1, 37,000. Meanwhile self-driving cars is the one of the most discussed technology of current scenario. Self-driving Cars technologically a reality and in the next decade they are expected to reach the highest level of automation. The brain of system is the Raspberry Pi which capable of exchanging data with the sensors and fast enough for calculate millions of data per second. Since our car will use deep learning it will need heavy parallel computing power for that reason the Raspberry Pi will useful here. The cars will be controlled by servo motor controller which is controlled by Arduino UNO, capable of reading its rotational speed. Camera will be used to find and detect objects that are then processed by the main controller (raspberry pi 3b+) within the car. Self-driving cars are technological development in the field of automobiles. Many companies throughout the world are making a serious and continuous effort to make driving a safe and risk free process.

2. LITERATURE SURVEY

1. The paper "Working model of Self-driving car using Convolutional Neural Network, Raspberry Pi and Arduino" by Aditya Kumar Jain. The proposed model takes an image with the help of Pi cam attached with Raspberry Pi on the car. The Raspberry Pi and the laptop is connected to the same network, the Raspberry Pi sends the captured image to the Convolutional Neural Network. The image is gray-scaled before passing it to the Neural Network. Upon prediction the model gives one of the four output i.e. left, right, forward or stop. When the result is predicted corresponding Arduino signal is triggered which in turn helps the car to move in a particular direction with the help of its controller.

2. The paper "Self-driving car ISEAUTO for research and education" presented by Raivo Sell, Anton Rassõlkin, Mairo Leier, Juhan-Peep Ernits, describes an ISEAUTO project, the first self-driving car project in Estonia is implemented at Tallinn University of Technology in cooperation with an Estonian automotive company. ISEAUTO works in research and educational project targeted on the design and development of a automated vehicle in cooperating with a private company and students.

3. The paper presented by T. Banerjee, S. Bose, A. Chakraborty, T. Samadder Bhaskar Kumar, T.K. Rana "Self Driving Cars: A Peep into the Future". This paper elaborates about a unique technique embedded controller design of a self-driving, electrified, accident proof and GSM destination guided vehicle. A GPS module accurately tracks the location of the car, source and destination, and mapping the co-ordinates provides navigation Speeds of the vehicle is automatically controlled by keeping a safe distance, which is a function of velocity, having the vehicle in front view. Distance of the front and side vehicle are continuously monitored by a stepper motor controlled rotating distance measuring sensor and the speed limit as well as track changing are done accordingly. It also

prevents collision due to an obstacle.8-megapixel pi-camera with image processing unit has been used to sense traffic signal and traffic density on road.

4. The paper "Self-Driving and Driver Relaxing Vehicle", presented by Qudsia Memon, Muzamil Ahmed, Shahzeb Ali, Azam Rafique Memon, Wajiha Shah In this paper they have designed two applications of an autonomous vehicle, which can help the driver to relax for the limited duration of time. It also presents a concept which focuses on modified concept of Google car, the Google car has to reach the static destination automatically; in this prototype, they made the dynamic destination. Here self-driving car will follows a vehicle which is moving on a certain route. This prototype will follow that vehicle.

5. The paper "The Issues and the Possible Solutions for Implementing Self-Driving Cars in Bangladesh" presented by Mohammad Faisal Bin Ahmed, Md. Saef Ullah Miah, Md. Muneef Anjum Timu, Shakura Akter, Md. Sarker.b. Some of the issues of Bangladeshi roads are highlighted in a paper published Organization in 2004. Google car among other things, can calculate the most efficient path, abide local traffic rules, park when necessary and change lane if required.

6. The paper "Real-time multiple vehicle detection and tracking from a moving vehicle", by Margrit Betke, Esin Haritaoglu, Larry S. Davis. They have included modules for detection of other vehicles on the road. The NavLab project at Carnegie Mellon University uses the Rapidly Adapting Lateral Position Handler to determine the coordinates of the road ahead and the appropriate steering direction. RALPH automatically steered a Navlab vehicle 98% of a trip from Washington DC to San Diego, California, a distance which is of over 2800 miles. They have added a module for car tracking. A module is used for detecting overtaking vehicles, and a trinocular stereo module (three view vision) for detecting distant obstacles were added to enhance and improvise the Navlab performance of vehicle.

7. The paper "Driver Assistance System for Lane Detection and Vehicle Recognition with Night Vision", by Chun-Che Wang, Shih-Shinh Huang and Li-Chen Fu, Pei-Yung Hsiao. It aims to improve driving, by creating an assistance system. To enhance driver's safety at night time the algorithm includes lane detection along with vehicle recognition system. It can detect Lane which helps to localize the markers. Operation like canny edge extraction is done to extract edge map to which matching technique is applied followed by the selection of potentials edge points. Finally linking is done to localize the lane lines.

8. The paper "Traffic Light Detection and Recognition for Self Driving Cars using Deep Learning", by Ruturaj Kulkarni, Shruti Dhavalikar, Sonal Bangar. There are several object detection architectures available like Single Shot Multibox Detector (SSD), Faster Region based Convolutional Neural Networks (R-CNN), Region based Fully (R-FCN) which incorporates feature extractors like ResNet-101, Inception-V2, Inception-V3, Mobile Net etc. The selection of architecture and feature extractor is trade-off between speed and accuracy that your application needs For the Traffic Light detection considering the application requirement and available computational resources, Faster R-CNN Inception-V2 model is used which serves the accuracy and speed trade-offs. The model is trained on the above mentioned dataset where loss is reported at each step of training. The model is trained on the NVIDIA GEFORCE 940M GPU using TensorFlow.

9. The paper "Driverless Intelligent Vehicle for Future Public Transport Based on GPS", by R.Mohanapriya, L.K.Hema, Dipesh warkumar Yadav, Vivek Kumar Verma. It involves equipping GPS and GSM system on a 4 wheeled robot. The GPS system steers the robot and is capable of reaching from one point to another without any human intervention. While in the former one with the help of GSM system they promise to report theft in case is there is any. An SMS alert is sent to the vehicle owner reporting about the issue and as a result of it, the owner of the car can switch the ignition off and in the latter one the project states that vehicle can only be turned on if the authorized person sends a predefined location to the car.

10. The paper presented by Giuseppe Lugano "Virtual assistant and self-driving cars", introduced us The virtual assistant is a specific software functionality originally conceived within the "desktop" computing environment to support the user in the learning and use of a specific software package (e.g. word processor, spreadsheet). The main purpose of

virtual assistants was to increase the productivity and efficiency of the user with a specific product.

11. The paper presented by Dong, D., Li, X., & Sun, "A Vision-based Method for Improving the Safety of Self-driving" gives detailed view about how they developed a simulator which is able to detect traffic signs and lanes and road segmentation.

12. The paper presented by Straub, J., Amer, W., Ames, C., Dayananda, K. R, A.Jones, Miryala, Shipman "An Internetworked Self-Driving Car System-of-Systems", proposed an efficient way of establishing communications between two or more cars in a particular system to keep the traffic less congested.

3. METHEDOLOGY

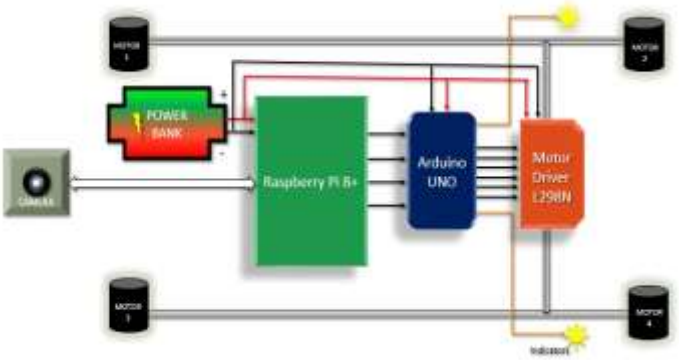


Figure 1: Block Diagram

Figure 2: Pi camera

3.1 Raspberry pi camera:

The pi-camera we are using is V2 version which comes with specifications like 8mp camera and supports upto 1080p30 resolutions along with IMX219 sensor and F2.9 aperture. This pi cam captures the images of surroundings and send them to the raspberry pi for further processing.

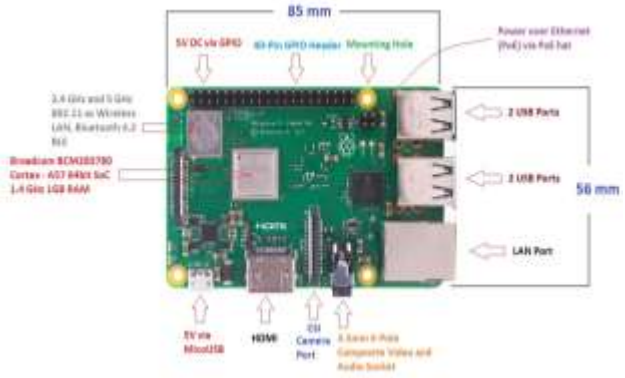


Figure 3: raspberry pi 3B+

3.2 Raspberry pi:

The raspberry pi is the main processor here. Popularly known as low cost single board computer. We are using raspberry pi 3B+ version for image processing. With the help of Open CV software, a machine learning algorithm is implemented and the images are trained in various lighting conditions using neural network technology. Further the decisions taken by the raspberry pi are sent as commands to Arduino.

3.3 Arduino UNO:

Arduino Uno is ATmega329P based microcontroller board. It is widely popular for mini projects. In our project Arduino is I used to control forward, backward, left and right movement of vehicle. All the functions are preprogrammed in Arduino using Arduino IDE. After getting command from pi, the Arduino will send signal to motor driver circuit to take the appropriate movement instructed by Arduino.

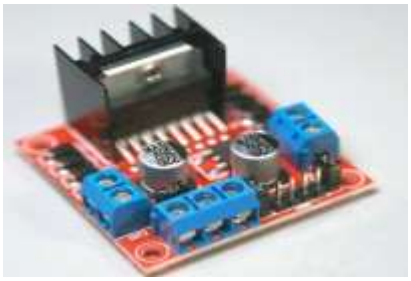


Figure 4: L298N Motor Driver:

3.4 L298N Motor Driver:

It is a basic motor driver module used to drive dc motors as well as stepper motors too. H bridge is used along with L298 IC to drive motors.h bridge is a circuit that can drive current in polarity and will be controlled by pulse width modulation (PWM)

3.5 LED indicators:

LED indicators are placed at the back of chassis. While taking U turn or if it detects an obstacle indicator will have lit up to give proper indications. Its programming will be dumped in IC 74LS164 and will be controlled through Arduino command.

4. FLOWCHART

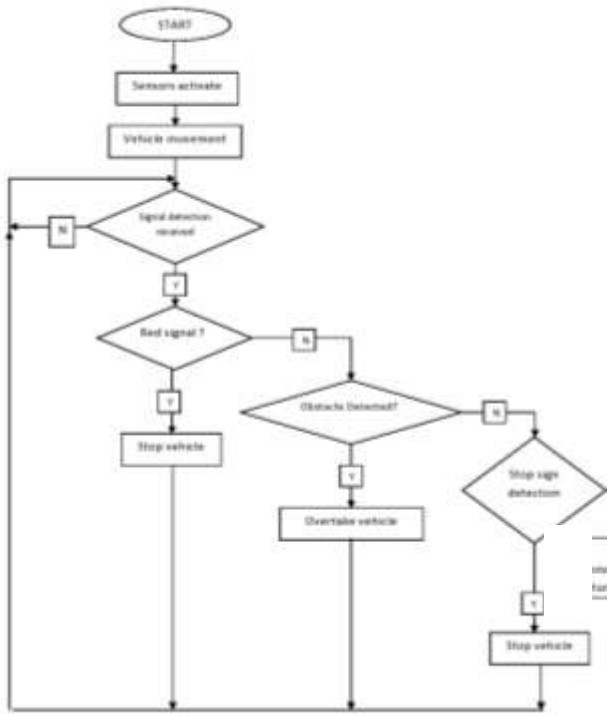


Figure 5: Flowchart

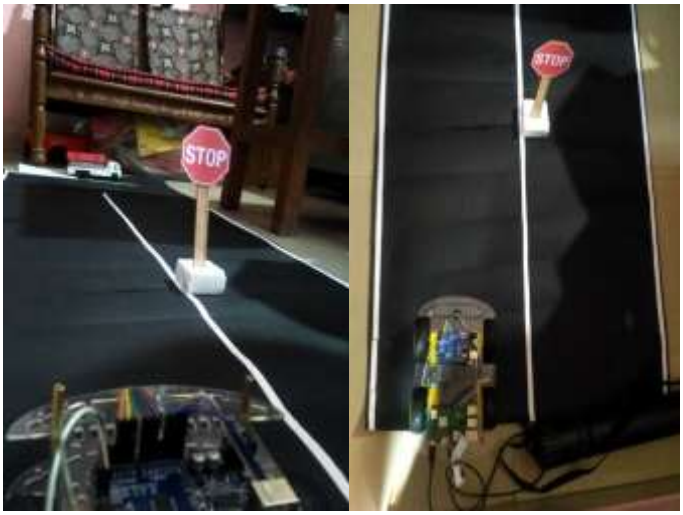
As the vehicle starts all the sensors and hardware components gets activated camera is capturing images raspberry pi starts working and car will start moving. While processor starts processing the images it will search for 3 things.

1. red traffic signal
2. obstacle
3. stop sign

If any one of this detected then raspberry pi sends appropriate signal to Arduino to work further. If red signal is detected raspberry pi gives command to Arduino Uno to stop the car until red is turned into green. If stop sign is detected, then car will stop for specified predetermined time limit if an obstacle is detected then vehicle will stop and overtake it by giving proper turning indications.

5. RESULTS:

Stop sign detection:



Lane detection

Obstacle detection:

Traffic Light detection:

6. CONCLUSION

The proposed self-driving car is successfully created, implemented and tested. The vehicle is trained with more than 200 samples of images in different lighting conditions. In various testing done by us it is found that despite of using high resolution V2 version of Raspbian camera lighting and different environmental conditions may affect the decision taken by the vehicle to overcome this minor issue the training should be done precisely with perfect frame rates. This paper clearly describes the working methodology of our autonomous vehicle.

7. FUTURE SCOPE

There is huge scope of self-driving cars in future, the various automobile companies are improving their autonomous cars rapidly making them more accurate and secured. By using multiple cameras and sensors, the accuracy can be improved. Designing a system where every car is interconnected to nearby cars will avoid traffic congestion in future.

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