Implementation of Driverless Car Using Haar Cascade Algorithm

"Harshada Kashid[1]", "Ashwini Pujari [2i]","Farheen Mujawar[3]","Hafsa Majgaonkar[4]"

[123]" Student, Department of Computer Science Engineering, Jaywant College of Engineering and Polytechnic, K.M.Gad, Sangli, Maharastra, India "

[4]"Assitant Professor, Department of computer Science Engineering, Jaywant College of Engineering and Polytechnic, K.M.Gad, Sangli, Maharastra, India"

---***---

Abstract: *The project aims to make a sight autonomous automotive epitome victimization Raspberry Pi as a process chip and aurdino as a hardware interface. Associate degree HD camera plus associate degree unhearable device is employed to facilitate needed information from the $64000 world to the automotive. Avoiding prospects of accidents and alternative human errors, the automotive will commute from one place {to associate degree other|to a different} in an intelligent and safe manner. Several existing algorithms like neural networking, deep learning and machine learning square measure combined along to produce the required management to the automotive. the most reason to use machine-learning algorithms during this project is to involve the essential functions and methodologies of AI. Here, skill in AI and engineering science can become as crucial as classic skill like reading or writing. By implementing similarity with this method, we have a tendency to developed a brand new AI idea so as to uphold AI skill. The idea includes modules completely different|for various} age teams on different academic levels. elementary AI/computer science topics self-addressed in every module square measure, amongst others, downside finding by search, sorting, graphs and information structures.*

Keywords: Autonomous Cars, Open CV Python, Driverless Car, Raspberry Pi, Object Detection, Traffic Light Detection, Haar Cascade Classifier.

1. Introduction

Globally speaking, nearly 1.3 million people die in road crashes each year, on average 3,287 deaths a day .And talking about India the number of people who were killed in a road accidents in 2013 alone were 1, 37,000 .Speeding, talking over phone, drunk driving and breaking traffic rules are the root causes behind these accidents and the statistics are rising day by day which is now becoming a major concern. No matter how hard we try to create awareness regarding traffic rules and safety that has to be followed while driving, accidents are still occurring and aren't showing a sign to stop. Though human errors can never be eliminated, but accidents can definitely be stopped. And in this case technology has surely come to our rescue. Starting from the very early radar based collision detection to present day's technology, the advancement and improvement in this technology had seen an exponential growth in recent years.

Self-driving cars is the one of the most discussed technology of current scenario. What was once imagined is a reality now. The definition Self-driving cars is a car which promises to take the traveler to their destination with minimal human control while taking safety as its first priority. Many companies throughout the world are making a serious and continuous efforts to make driving a safe and risk free process and have started building prototypes for the same. Amongst these companies are Google, Tesla Mercedes and many more who have built successful and functioning prototype and are planning to release a model in the upcoming years. Self-driving cars are expected to have faster reflexes than humans, make more reliable judgments, thus avoiding mere faults which causes accidents at the first place. Apart from saving precious lives, other advantages these technology gives is better traffic flow regulation because unlike humans these cars ride with proper traffic rules, making rides smooth and congestion free.

Self-driving cars can also help in tackling parking space issues by allowing to create a taxi/pooling service for the unused cars and by unused car we mean to say the car that is either staying for few hours while the owner is at work or the car that is in the garage while the owner is out for a vacation. Thus we could make better use of land instead of using it for parking space. The basic model of any Autopilot system involves radar, a front-facing camera, a digitally-controlled digital braking system, and long range ultrasonic sensors located around the car. Radars enables the detection of vehicles and other moving objects around the car, front facing camera helps to detect and recognize objects like cars, trees, driving lane, humans, traffic signals and other important data. All these information are taken in real-time environment and are fused into a learning network which then predicts the car's response accordingly.

1.1 Project objective

The main objective of this project is to provide a solution to increasing road accidents, traffic jams and fuel consumption by providing a driverless car that is capable to driving on its own, detect the signal, start and stop on presence of green/red lights respectively& collision avoidance using the ultrasonic sensor .It also makes the end user capable of not just monitoring the movements but also be able to control the vehicle's movements and directions using sensors..

2. Literature Survey

In the past, five years, autonomous driving has gone from "maybe possible" to "definitely possible" to "inevitable" to "how did anyone ever think this wasn't inevitable?" to "now commercially available." In December 2018, Waymo, the company that emerged from Google's self-driving-car project, officially started its commercial self-driving-car service in the suburbs of Phoenix. The details of the program—it's available only to a few hundred vetted riders, and human safety operators will remain behind the wheel—may be underwhelming but don't erase its significance. People are now paying for robot rides.[3]

And it's just a start. Waymo will expand the service's capability and availability over time. Meanwhile, its onetime monopoly has evaporated. Smaller startups like May Mobility and Drive.ai are running small-scale but revenue-generating shuttle services. Every significant automaker is pursuing the tech, eager to rebrand and rebuild itself as a "mobility provider" before the idea of car ownership goes kaput. Ride-hailing companies like Lyft and Uber are hustling to dismiss the profit-gobbling human drivers who now shuttle their users about. Tech giants like Apple, IBM, and Intel are looking to carve off their slice of the pie. Countless hungry startups have materialized to fill niches in a burgeoning ecosystem, focusing on laser sensors, compressing mapping data, setting up service centers, and more.[3]

It's worth remembering that when automobiles first started rumbling down manure-clogged streets, people called them horseless carriages. The moniker made sense: Here were vehicles that did what carriages did, minus the hooves. By the time "car" caught on as a term, the invention had become something entirely new. Over a century, it reshaped how humanity moves and thus how (and where and with whom) humanity lives. This cycle has restarted, and the term "driverless car" will soon seem as anachronistic as "horseless carriage." We don't know how cars that don't need human chauffeurs will mold society, but we can be sure a similar gear shift is on the way.[3]

3. Methodology

A set of sensors like ultrasonic sensor, And Pi-Camera and the L293D H-bridge motor driver are connected to Raspberry Pi 3 controller through its General Purpose Input Output (GPIO) pins. A Raspberry Pi board (model B+), attached with a pi camera module and an HC-SR04 ultrasonic sensor is used to collect input data.Python programs run on Raspberry Pi for capturing images from Pi-camera and detect objects in it i.e. determine red or green signal as well as determine lanes using deep neural network (DNN).Ultrasonic sensor used to detect obstacles in path. During Signal Detection, first each frame is cropped and transfrom to a numpy array. Then the train image is coupled with train label (human input). Finally, all coupled image data and labels are collected into a npz file. Once training is done, weights are inserted into a xml file. To create predictions, the same neural network is constructed and loaded with the trained xml file. For Object Detection, we are going to use Haar cascade algorithm for object detection. Since each object requires its own classifier and follows the same process in training and detection, this project only concentrated on stop sign and traffic light detection. OpenCV supplies a trainer as well as detector. Positive samples were obtained using a cell phone, and were cropped that only desired object is visible. Negative samples on the other hand, were collected randomly. In particular, traffic light positive samples involves equivalent number of red traffic lights and green traffic light. The same negative sample dataset was abused for both stop sign and traffic light training. The bounding box is assumed as a region of interest (ROI). Secondly, Gaussian blur is applied inside the ROI to decrease noises. Thirdly, search the brightest point in the ROI. Finally, red or green states are decided simply based on the position of the brightest spot in the ROI. In order to build a hardware model of self-driving car, a chassis is selected as the base on which all boards are mounted and 4 wheels are joined - two wheels in front and two wheels in back, to the chassis. Anterior wheels are connected with two dc motors . H-bridge driver circuit controls the motion of these motors in clockwise or anticlockwise direction upon receiving control signals from Raspberry Pi controller. Ultrasonic sensor in the front and Haar cascade algorithm used for detect obstacles around the car and measure the distance.

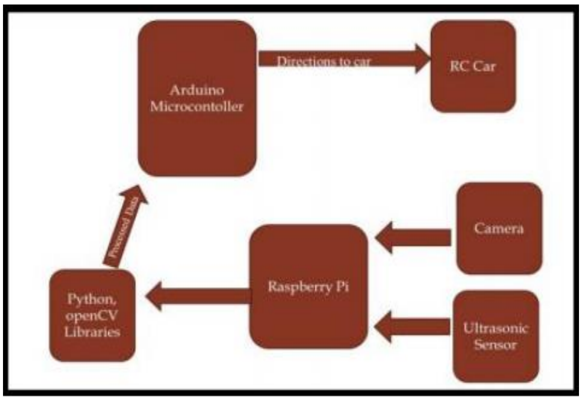


Fig. System Architecture

4. System Design and Implementation.

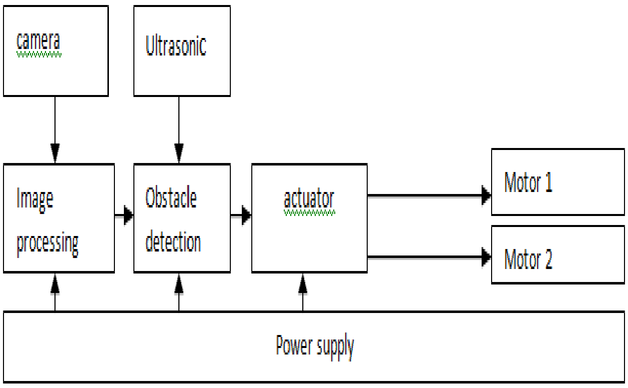


Fig. System design

Implementation-

- Traffic Light Detection
  To identify and track red, yellow and green colors of the traffic light system, fundamentals of computer vision are used. The process flow diagram of Traffic Light Detection System., illustrates how self-driving car knows traffic light and reply to it. When user enters input 2 in his mobile, all sensors get started , web camera starts catching the video, motor turns on, and the car starts moving ahead. Frames captured by a camera from nonstop video streaming is transmitted to Raspberry Pi controller. The controller processes the traffic lights, located on image processing and traffic light detection algorithm. If any color is identified , then the color is detected.. If color detected is red, car stops until it detects yellow or green. When yellow is detected, car moves bit ahead and stops until green is detected. When green color is detected, the car moves ahead guided by computer vision algorithm, .The input frames obtained from the camera is in BGR format which is converted from BGR color space to equivalent Hue Saturation Value . In OpenCV, range of values for Hue is 0 - 179, range of values for Saturation . it is 0 - 255, range of numbers for value is 0 – 255.

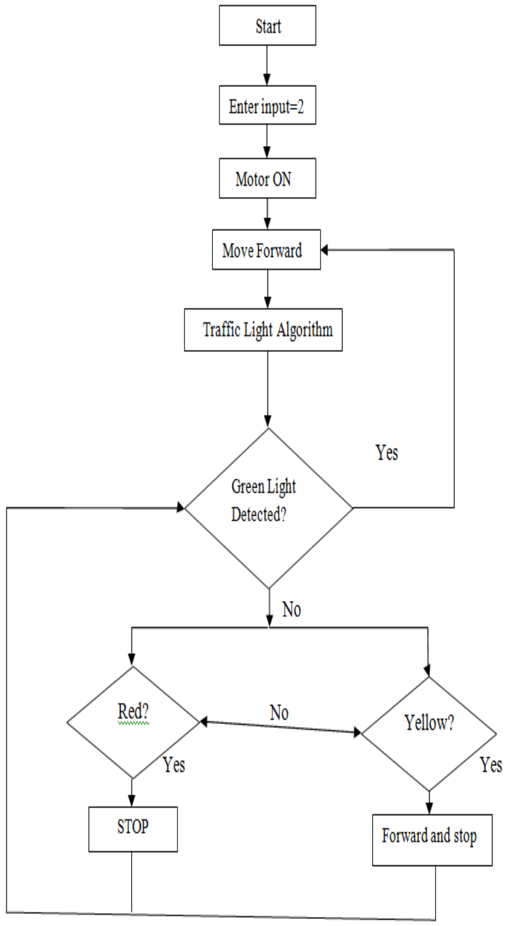


Fig .Traffic Light Detection

- Object Detection
  Object detection is at the core of no. of applications such as autonomous cars, security, surveillance and industrial applications. Selection of a right object detection method is critical based on the nature of the problem to be solved. Single Shot Detector is a great choice as it is able to run on a video and brings a good tradeoff between speed and accuracy. Real-Time Object Detection System is started containing all the sensors and camera by inserting input = 3 in the mobile application. Raspberry Pi controller obtained captured images from the webcam as input. On the obtained image, Raspberry Pi controller runs real-time object detection algorithm and transmitted the control signal to H-bridge which in turn drives the motor. Car starts moving ahead , if any animal/person/objects are identified, car paused for 10 seconds and verify for the

presence of objects, if no object is detected, the car starts moving ahead.

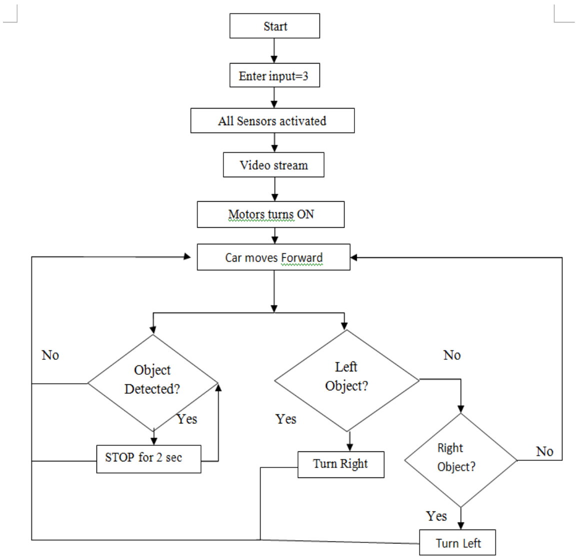
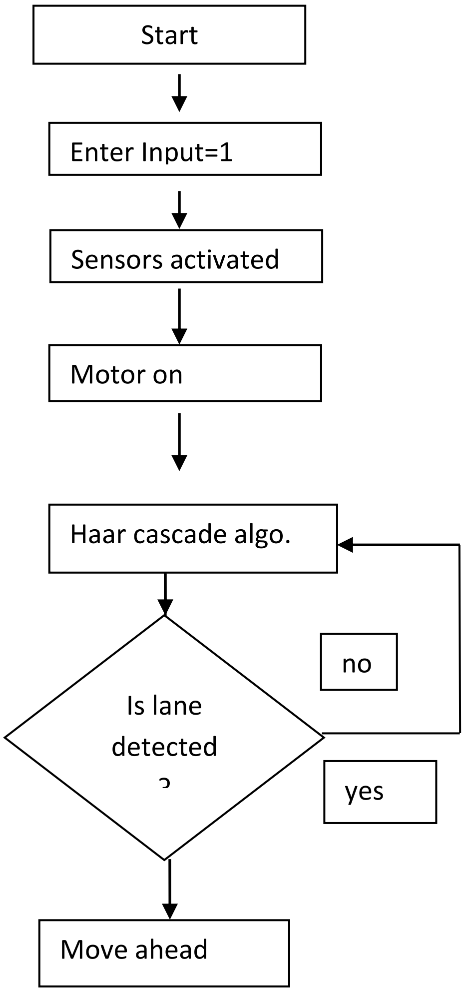


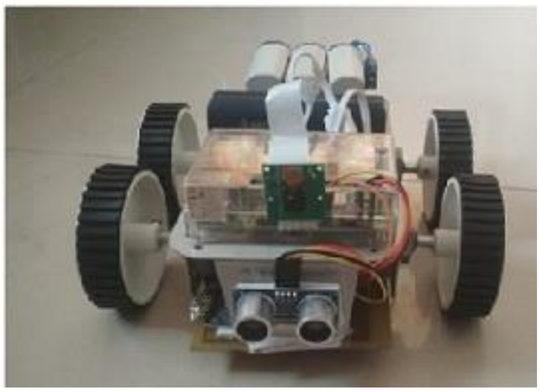
Fig. Object Detection

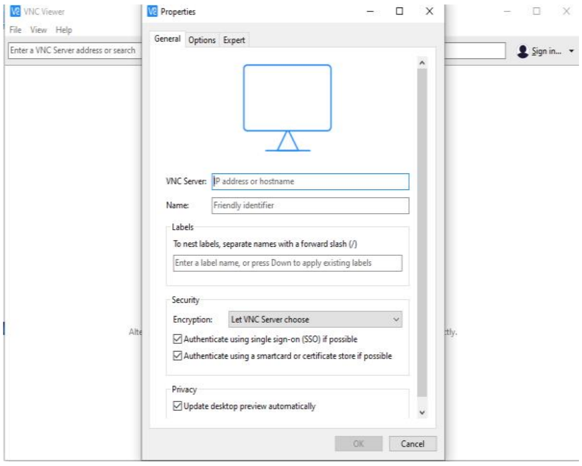
Lane Detection

In order to obtain the main objective of lane detection and tracking, a self-driving car should be able to detect, track and differentiate various roads for its proper motion on road. The LDFS consists of Haar cascade algorithm used to self-driving car and connected to the Raspberry Pi controller to detect the position of the car relative to the yellow line marked at the center of the road. The process flow of LDFS is as shown in the Fig.. In the proposed self-driving car, The mobile of the user is programmed act as the control device to start and control the motion of car. The user enters the car and keys in '1' on his mobile and all the sensors on the car get activated and the motor turns on After that algorithm starts working and car moves ahead.Thus car is self correcting mode to be at the center of the lane and keeps moving ahead as long as road is indentifing.



5. Images





traffic_objects.py

```python
from threading import Timer
import logging


class TrafficObject(object):

    def set_car_state(self, car_state):
        pass

    @staticmethod
    def is_close_by(obj, frame_height, min_height_pct=0.05):
        # default: if a sign is 10% of the height of frame
        obj_height = obj.bounding_box[1][1]-obj.bounding_box[0][1]
        return obj_height / frame_height > min_height_pct


class RedTrafficLight(TrafficObject):

    def set_car_state(self, car_state):
        logging.debug('red light: stopping car')
        car_state['speed'] = 0
```

traffic_objects.py

```python
class StopSign(TrafficObject):
    """
    Stop Sign object would wait
    """

    def __init__(self, wait_time_in_sec=3, min_no_stop_sign=20):
        self.in_wait_mode = False
        self.has_stopped = False
        self.wait_time_in_sec = wait_time_in_sec
        self.min_no_stop_sign = min_no_stop_sign
        self.no_stop_count = min_no_stop_sign
        self.timer = None

    def set_car_state(self, car_state):
        self.no_stop_count = self.min_no_stop_sign

        if self.in_wait_mode:
            logging.debug('stop sign: 2) still waiting')
            # wait for 2 second before proceeding
            car_state['speed'] = 0
            return
```

6. Acknowledgement

It gives tremendous pleasure to bring out this project named as "Implementation of driverless car using Haar cascade algorithm". We wish to express our profound thanks to all those helped us in making our project reality. We are especially grateful to our project guide Prof.Hafsa Majgaonkar for her time and valuable guidance. We also thankful to our Principal Dr. Sutar sir, Hod ,college and staff members of our department for their facility provision and encouragement.

7. Conclusion

A low cost framework of autonomous car model is designed, invented and all functionalities are successfully illustrate. The car is able to follow lane efficiently using Haar cascade algorithm and the traffic colors are detected and decisions are made by the car using image processing techniques to follow real- time traffic rules.

8. Future Scope

While the lane following function of the proposed self – driving car model can be implemented using GPS, used to track the live location of self – driving car continuously for safety.

9. References

1. OpenCV Documentation – Haar Feature based Cascade Classifier for Object Detection.
2. OpenCV Documentation - Cascade Classifier Training.
3. The Wired guide of self driving car –Alex Devies
4. Mochamad Vicky Ghani Aziz, Hilwadi Hindersah, Ary Setijadi Prihatmanto. "Implementation of Vehicle Detection Algorithm for Self-Driving Car on Toll Road Cipularang using Python Language", 4 th international conference on Electric Vehicular Technology 2017.
5. Qing Rao,Jelena Frtunikj. "Deep Learning for Self-Driving Cars: Chances and Challenges". Proceedings SEFAIS'18 Proceedings of the 1 st International workshop on software engineering for AI in autonomous Systems.
6. Pascale-L. Blyth, Milos N. Mladenovic, Bonnie A. Nardi, Norman M. Su, Hamid R. Ekbia "Driving theSelf-Driving Vehicle".IEEE 1 International Symposium on Technolog