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Key Aspects of Autonomous Driving Software

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ABSTRACT

In era of the automation, the autonomous car or the driverless car are often mentioned as a robotic car in simple language. The project implemented by providing the video picture for finding the path or lanes for driving a car using Anaconda environment and machine learning tools. This project is capable of sensing the environment, navigating and fulfilling the human transportation capabilities with none human input. It is an enormous step of advance technology. Our main objective in this project is to create and develop a software that can automatically find the lanes of the road and then accordingly predict the steering angle required to make the turn. This project is implemented using OpenCV by python. The key aspects of Self-driving car works on the basis of angle movement without interruption of human and after that the results of actual angle and moved angle of cars are compared. In the proposed work we are using video lanes for better finding of lanes or paths to move to predetermined destination over roads.

Keywords: *Autonomous driving software; OpenCV; Machine learning.*

1.0 Introduction

An autonomous car is a vehicle capable of sensing its environment and operating without human involvement. A human passenger is not required to take control of the vehicle at any time, nor is a human passenger required to be present in the vehicle at all. An autonomous car can go anywhere a traditional car goes and do everything that an experienced human driver does. AI technologies power self-driving car systems. Developers of self-driving cars use vast amounts of data from image recognition systems, along with machine learning and neural networks, to build systems that can drive autonomously. The neural networks identify patterns in the data, which is fed to the machine learning algorithms. That data includes images from cameras on self-driving cars from which the neural network learns to identify traffic lights, trees, curbs, pedestrians, street signs and other parts of any given driving environment. The benefits of self driving cars corresponds to soceities & individuals to minimize road accidents. So its providing solution to road accidents. In the resources mentioned Road safety Road accidents result in 1.25 million deaths and 20-50 million injuries worldwide[3]. The Society of Automotive Engineers (SAE) currently defines 6 levels of driving automation ranging from Level 0 (fully manual) to Level 5 (fully autonomous). These levels have been adopted by the U.S. Department of Transportation.

OpenCV is a cross-platform library using which we can develop real-time computer vision applications. It mainly focuses on image processing, video capture and analysis including features like face detection and object detection.

Computer Vision can be defined as a discipline that explains how to reconstruct, interrupt, and understand a 3D scene from its 2D images, in terms of the properties of the structure present in the scene. It deals with modeling and replicating human vision using computer software and hardware. Computer Vision overlaps significantly with the fields −

a) Image Processing − It focuses on image manipulation.
b) Pattern Recognition − It explains various techniques to classify patterns.

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c) Photogrammetry − It is concerned with obtaining accurate measurements from images.

2.0 Applications of Computer Vision

Here we have listed down some of major domains where Computer Vision is heavily used.

2.1 Robotics application

a) Localization − Determine robot location automatically
b) Navigation
c) Obstacles avoidance
d) Assembly (peg-in-hole, welding, painting)
e) Manipulation (e.g. PUMA robot manipulator)

Human Robot Interaction (HRI) − Intelligent robotics to interact with and serve people

2.2 Medicine application

a) Classification and detection (e.g. lesion or cells classification and tumor detection)
b) 2D/3D segmentation
c) 3D human organ reconstruction (MRI or ultrasound)
d) Vision-guided robotics surgery

2.3 Industrial automation application

a) Industrial inspection (defect detection)
b) Assembly
c) Barcode and package label reading
d) Object sorting
e) Document understanding (e.g. OCR)

2.4 Security application

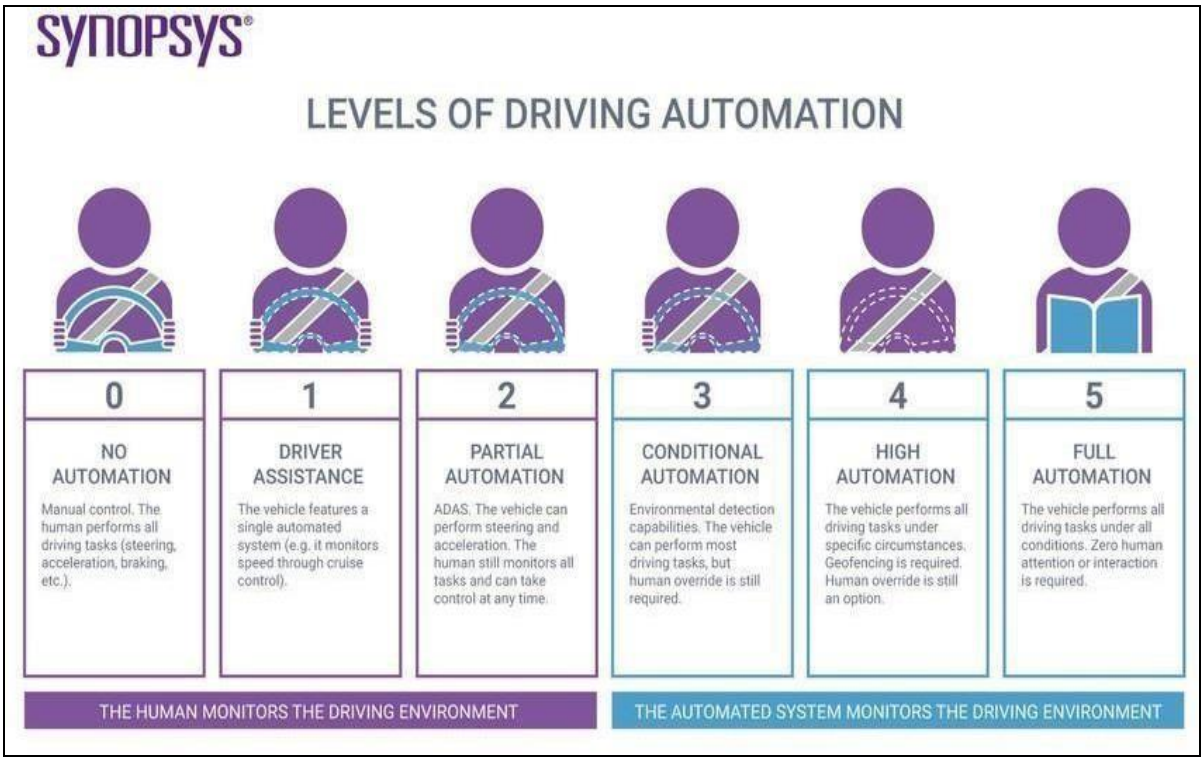
a) Biometrics (iris, finger print, face recognition)
b) Surveillance − Detecting certain suspicious activities or behaviors
c) Transportation Application
d) Autonomous vehicle Safety, e.g., driver vigilance monitoring

2.5 Automation levels

Different cars are capable of various levels of self-driving, and are often described by researchers on a scale of 0-5.

(i) Level 0: All major systems are controlled by humans
(ii) Level 1: Certain systems, such as cruise control or automatic braking, may be controlled by the car, one at a time.
(iii) Level 2: The car offers at least two simultaneous automated functions, like acceleration and steering, but requires humans for safe operation.

Figure 1: Automation Levels [3]



(iv) Level 3: The car can manage all safety-critical functions under certain conditions, but the driver is expected to take over when alerted.
(v) Level 4:The car is fully-autonomous in some driving scenarios, though not all.
(vi) Level 5: The car is completely capable of self-driving in every situation.

2.0 Literature Review

Though a truly driverless car is most likely still years away from being available to consumers, they are closer than many people think. Current Estimates predict that by 2025 the world will see over 600,000 self-driving cars on the road, and by 2035 that number will jump to almost 21 million. Trials of self-driving car services have actually begun in some cities in the United States. And even though fully self-driving cars are not on the market yet, current technology allows vehicles to be more autonomous than ever before.

Using intricate systems of cameras, lasers, radar, GPS, and interconnected communication between vehicles, some models of cars now offer features that can.[2]

The benefits of self driving cars involves:

1. Decreases in road accidents
2. Bicylists and pedestrians take benefits
3. Need of less parking in urban areas
4. Productive time increases
5. Emergency evacuations becomes more efficient and sucessful.

So these type of benefits will help the individuals and societies who are resticted for drivers and these make an impact in drverless technology.

3.0 Implementation and Proposed Work

This section is all about facilities required, in which generally facilities will be generally covered. In this scenario useing many technologies which play a big role in making this project. These are as follows:

3.1 Open CV

Open CV (Open Source Computer Vision Library) is an open source computer vision and machine learning software library. Open CV was built to provide a common infrastructure for computer vision applications and to accelerate the use of machine perception in the commercial products.Using OpenCV library, you can-

- Read and write images
- Capture and save videos
- Process images (filter, transform)
- Perform feature detection
- Detect specific objects such as faces, eyes, cars, in the videos or images.
- Analyze the video, i.e., estimate the motion in it, subtract the background, and track objects in it.

3.2 Python

Python is a general-purpose interpreted, interactive, object-oriented, and highlevel programming language. It was created by Guido van Rossum during 1985- 1990. Like Perl, Python source code is also available under the GNU General Public License(GPL).

3.3 Machine learning

Machine learning is an application of artificial intelligence (AI) that provides systems the ability to automatically learn and improve from experience without being explicitly programmed. Machine learning focuses on the development of computer programs that can access data and use it learn for themselves. The Machine Learning process starts with inputting training data into the selected algorithm. Training data being known or unknown data to develop the final Machine Learning algorithm. The type of training data input does impact the algorithm, and that concept will be covered further momentarily.To test whether this algorithm works correctly, new input data is fed into the Machine Learning algorithm.The prediction and results are then checked. Machine learning algorithms are used in circumstances where the solution is required to continue improving post-deployment. The dynamic nature of adaptable machine learning solutions is one of the main selling points for its adoption by companies and organizations across verticals.Machine learning algorithms and solutions are versatile and can be used as a substitute for medium-skilled human labor given the right circumstances.

All mentioned facilities allow to make an autonomous driving softare. In this paper we also focussed on new mthod on which vehicle turn according to their angle of movement. The key aspects of proposed work are:

1. Find the lanes or path
2. Movement of steering using an angle
3. On which angle car turns

The planning of work includes the following points.

1. Grayscale image conversion
2. GaussianBlur
3. Canny EdgeDetection
4. HoughLines
5. Creating ML model forTraining
6. Training the model on trainingData

4.0 Results and Discussion

The results of running project are shown below. This work showed the picture means video picture provided for finding paths and giving an angle for steering movement. It's important to remember that an image is nothing more than a bunch of pixels arranged in a rectangle. This particular rectangle is 960 pixels by 540 pixels.

Figure 2: Video Picture for Self-driving

Figure 3: Data Set for Angle

The value of each pixel is some combination of red, green, and blue, and is represented by a triplet of numbers, where each number corresponds to the value of one of the colors. The value of each of the colors can range from 0 to 255, where 0 is the complete absence of the color and 255 is 100% intensity.

Figure 4: Predicting Angle

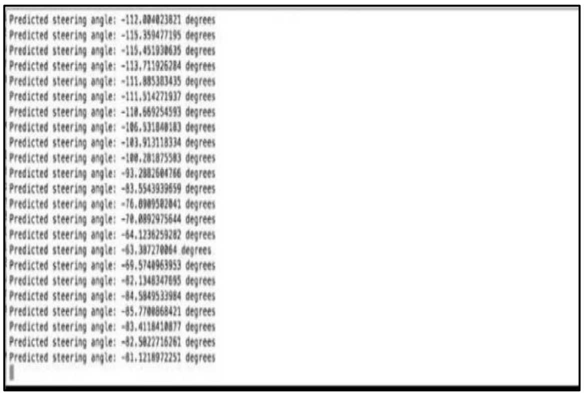


Figure 5: Steering View

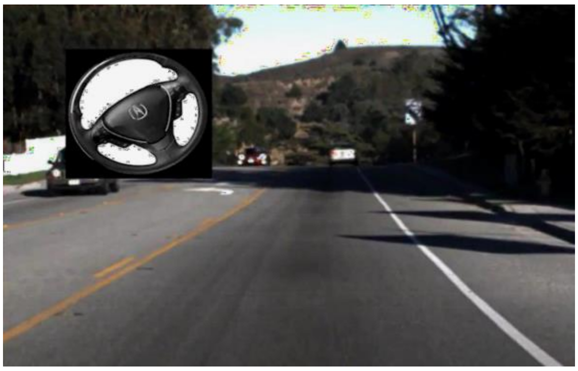


Figure 6: Car Running Result during Left Turn

Figure 7: Car Running Result during Right Turn

5.0 Conclusions

Developments in autonomous cars is continuing day by day and the software in the car is continuing to be updated for further improvements so that humans can trust in it. Though it all started from a driverless thought to radio frequency, cameras, sensors, more semi-autonomous features will come up, thus reducing the congestion, increasing the safety withfaster reactions and fewererrors.The motive of this paper provides how the working of driverless cars possibles and what are the key aspects. In future work will provide enhancement in this by providing speed control of car as well. These types of autonomous vehicles can also beused when a driver travels to the new areas. It is an improvednavigation system for autonomous vehicles.It helps to reduce CO_2 emissions in future.

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