LOOP-IN(SELF DRIVING CAR USING RASPBERRY PI)

Submitted in partial fulfillment of the
requirements for the award of
Bachelor of Engineering degree in Computer Science and Engineering

By

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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **Tharagesh C(39111026) and Peramuthan T(39110769)** who carried out the Project Phase-2 entitled **"LOOP-IN(SELF DRIVING CAR USING RASPBERRY PI)"** under my supervision from December 2022 to April 2023.

Internal Guide

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Submitted for Viva voce Examination held on 24-04-23

InternalExaminer **ExternalExaminer**

DECLARATION

I, **Tharagesh C(Reg.No- 39111026),** hereby declare that the Project Phase-2 Report entitled **"SELF DRIVING CAR USING RASPBERRY PI"** done by me under the guidance of **Dr. S. Jayanthi, M.E.,Ph.D** is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering degree in **Computer Science and Engineering**.

DATE:24.04.23

PLACE:Chennai **SIGNATURE OF THE CANDIDATE**

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ABSTRACT

The project aims to represent a prototype of a monocular vision self driving car model using latest technology of OpenCV2. Self-driving cars are autonomous vehicles that would minimize human intervention thereby minimizing the risk of accidents and make transportation safer, comfortable and that which can be done anytime. The car model will be able to detect the lane path, sign boards and respond to real time traffic.

Raspberry Pi is the central processing unit used along with peripheral devices such as raspberry pi, L298 driver circuit and the raspi Cam2 to bring about the desired control needed for our car. Algorithms like Lane Detection, Object Detection, Canny Edge Detection, Harr Cascade Classifier are amalgamated with Computer Vision to provide the necessary functionalities in the car.

INTRODUCTION

Driving error is one of the most dangerous and causes loss of lives and leads to traffic. The common error that humans make like talking on the phone while driving or by loud entertainment systems in cars the accidents are more likely. Apart from these errors mental and physical disabilities are also a factor in driving failure. These errors are increasing day by day and have become more important to reduce them by today’s technology.

Self-driving cars are the solution not just to minimize these errors but also to new possibilities of our driving and efficient road management systems with the rapid change in technology, scientists are coming up with new ideas in the field of self-driving cars. These cars are autonomous cars that can drive by themselves without human interference. This is basically a miniature model of self-driving car in best available resources. The self driving car would eradicate human intervention in the field of driving making driving safer and comfortable.

LITERATURE SURVEY

AN IMPROVED DEEP NETWORK-BASED SCENE CLASSIFICATION METHOD FOR SELF-DRIVING CARS

A self-driving car is a hot research topic in the field of the intelligent transportation system, which can greatly alleviate traffic jams and improve travel efficiency. Scene classification is one of the key technologies of self driving cars, which can provide the basis for decision-making in self driving cars. In recent years, deep learning-based solutions have achieved good results in the problem of scene classification. However, some problems

should be further studied in the scene classification methods, such as how to deal with the similarities among different categories and the differences among the same category. To deal with these problems, an improved deep network-based scene classification method is proposed in this article. In the proposed method, an improved faster region with convolutional neural network features (RCNN) network is used to extract the features of representative objects in the scene to obtain local features, where a new residual attention block is added to the Faster RCNN network to highlight local semantics related to driving scenarios. In addition, an improved Inception module is used to extract global features, where a mixed Leaky ReLU and ELU function is presented, to reduce the possible redundancy of the convolution kernel and enhance the robustness. Then, the local features and the global features are fused to realize the scene classification. Finally, a private dataset is built from the public datasets for the specialized application of scene classification in the self-driving field, and the proposed method is tested on the proposed dataset. The experimental results show that the accuracy of the proposed method can reach 94.76%, which is higher than the state-of-the art methods.

AUTHOR : Jianjun Ni , Yinan Chen X. Yang

PUBLISHED IN :IEEE TRANSACTIONS ON INSTRUMENTATION AND MEASUREMENT, VOL. 71, 2022

POTHOLE AND PLAIN ROAD CLASSIFICATION USING ADAPTIVE MUTATION DIPPER THROATED OPTIMIZATION AND TRANSFER LEARNING FOR SELF DRIVING CARS

Self-driving car plays a crucial role in implementing traffic intelligence. Road smoothness in front of self-driving cars has a significant impact on the car's driving safety and comfort. Having potholes on the road may lead to several problems, including car damage and the occurrence of collisions. Therefore, self-driving cars should be able to change their

driving behavior based on the real-time detection of road potholes. Various methods are followed to address this problem, including reporting to authorities, employing vibration-based sensors, and 3D laser imaging. However, limitations, such as expensive setup costs and the danger of discovery, affected these methods. Therefore, it is necessary to automate the process of potholes identification with sufficient precision and speed. A novel method based on adaptive mutation and dipper throated optimization (AMDTO) for feature selection and optimization of the random forest (RF) classifier is presented in this paper. In addition, we propose a new adaptive method for dataset balancing, referred to as optimized hashing SMOTE, to boost the performance of the optimized model. Data on potholes in different weather conditions and circumstances were collected and augmented before training the proposed model. The effectiveness of the proposed method is shown in experiments in classifying road potholes accurately. Eleven feature selection methods, including WOA, GWO, and PSO, and three machine learning classifiers were included in the conducted experiments to

measure the superiority of the proposed method. The proposed method, AMDTO+RF, achieved a pothole classification accuracy of (99.795%), which outperforms the accuracy achieved by the other approaches, WOA+RF of 97.5%, GWO+RF of 98.6%, PSO+RF of 98.1%, and transfer learning approaches, AlexNet of 86.8%, VGG-19 of 87.3%, GoogLeNet of 90.4%, and ResNet-50 of 93.8%. In addition, an in-depth statistical analysis is performed on the recorded results to study the significance and stability of the proposed method.

AUTHOR : AMEL ALI ALHUSSAN 1 , DOAA SAMI KHAFAGA 1 , EL SAYED M. EL-KENAWY

PUBLISHED IN : IEEE ACCESS 2022

ATTENTION FOR VISION-BASED ASSISTIVE AND AUTOMATED

DRIVING: A REVIEW OF ALGORITHMS AND DATASETS Driving safety has been a concern since the first cars appeared on the streets. Driver inattention has been singled out as a major cause of accidents early on. This is hardly surprising, as drivers routinely perform other tasks in addition to controlling the vehicle. Decades of research into what causes lapses or misdirection of drivers' attention resulted in improvements in road safety through better design of infrastructure, driver training programs, in-vehicle interfaces, and, more recently, the development of driving assistance systems (ADAS) and driving automation. This review focuses on the methods for modeling and detecting spatio-temporal aspects of drivers' attention.

AUTHOR : Iuliia Kotseruba and John K. Tsotsos

PUBLISHED IN : IEEE TRANSACTIONS ON INTELLIGENT TRANSPORTATION SYSTEMS

CAMERA SELF-CALIBRATION: DEEP LEARNING FROM DRIVING SCENES

Prior to driving, cameras embedded in an autonomous driving system need to be calibrated intrinsically. Calibration is crucial to ensure that safety-related perception functions can reliably perceive the environment. Vehicle cameras are also exposed to mechanical perturbations requiring periodic re-calibration with regular uses. The current widely-accepted calibration approaches are based on robust but potentially demanding target-based methods. Such methods require a car to be taken offline and rely on static infrastructure and operators. Targetless online calibration approaches exist but remain largely unadopted due to the accuracy gaps compared to the classical methods. We propose a deep-learning-based self-calibration strategy for the vehicular camera that learns from driving scenes—they make an inherently large-scale dataset—and is validated

back-to-back against checkerboard reprojection error. Our approach results in a 2.5% decrease in subpixel reprojection error compared to the existing deeplearning-based approaches. We also demonstrate its practical application in the automotive domain.

AUTHOR:Arya Rachman, Jurgen Seiler , and Andre Kaup

PUBLISHED IN: 2022 IEEE

LEARNING AN ALTERNATIVE CAR-FOLLOWING TECHNIQUE TO AVOID CONGESTION WITH AN INSTRUCTIONAL DRIVING SIMULATOR

This paper addresses the problem of traffic congestion through a learning perspective, highlighting the capabilities of Information and Communication Technologies to transform society. Recent physical and mathematical analysis of congestion reveals that training drivers to keep a safe distance systematically contributes to the emergence and

maintenance of interference congestion (so-called phantom traffic jam). This paper presents the WaveDriving Course (WDC), a simulated learning environment designed to help drivers progress from the traditional Drive to-keep-Distance (DD) technique to a new carfollowing (CF) principle better suited for wave-like traffic, Driveto-keep-Inertia (DI). The WDC is based on the ordinary knowledge of the driver (e.g., going through a series of traffic lights), and presents this situation in terms of two possible simultaneous behavioral strategies. The driver has the opportunity to verify that it is possible to achieve the same objective with different consequences. Finally, the WDC checks to what extent this learning generates transfer patterns in the analogous case of CF. The paper focuses on results concerning the first WDC module: the traffic-light analogy. Forty-two participants followed the whole learning procedure for about 30 min. An evaluative CF test was administered before and after visioning the tutorial and practicing on the simulator. Overall, transference

from this traffic-light analog to the CF situation (posttest) was successful. Results confirm the adoption of the expected DI strategies (speed variability decreased, distance and distance variability to leader increased, fuel consumption decreased, platoon elongation decreased etc.). The need to improve the WDC teaching of the appropriate CF distance is discussed.

AUTHOR: Antonio Lucas-Alba, Sharona T. Levy, Óscar M. Melchor, Ana Zarzoso-Robles, Ana M. Ferruz, Maria T. Blanch

PUBLISHED IN: IEEE Transactions on Learning Technologies

PROPOSED SYSTEM:

In this project we are having a raspberry pi controller connecting with camera module. The images captured in the camera module are sending to controller and are used to detect the lanes from the image. These images are processing by controller using open cv method to detect a path. Based on these results controller gives necessary instructions to the driver circuit for operating motors.

SYSTEM ARCHITECTURE:

BATTERY

CAMERA

RASPBERRY PI

CONTROLLER

DRIVER

CIRCUIT

MOTOR

HARDWARE

REQUIREMENTS: ·

RASPBERRY PI

· CAMERA

· DRIVER CIRCUIT

· BATTERY

· MOTOR

SOFTWARE

REQUIREMENTS: ·

PYTHON IDE

· OPEN CV

HARDWARE DESCRPTION

BATTERY

In electricity, a battery is a device consisting of one or more electrochemical cells that convert stored chemical energy into electrical energy. Since the invention of the first battery (or "voltaic pile") in 1800 by Alessandro Volta and especially since the technically improved Daniell cell in 1836, batteries have become a common power source for many household and industrial applications. According to a 2005 estimate, the worldwide battery industry generates US$48 billion in sales each year, with 6% annual growth.

There are two types of batteries: primary batteries (disposable batteries), which are designed to be used once and discarded, and secondary batteries (rechargeable batteries), which are designed to be recharged and used multiple times. Batteries come in many sizes from miniature cells used to power hearing aids and wristwatches to battery banks the size of rooms that provide standby power for telephone exchanges and computer data centers.

A battery is a device that converts chemical energy directly to electrical energy. It consists of a number of voltaic cells; each voltaic cell consists of two half-cells connected in series by a conductive electrolyte containing anions and cations. One half-cell includes electrolyte and the electrode to which anions (negatively charged ions) migrate, i.e., the anode or negative electrode; the other half-cell includes electrolyte

and the electrode to which cations (positively charged ions) migrate, i.e., the cathode or positive electrode. In the redox reaction that powers the battery, cations are reduced (electrons are added) at the cathode, while

anions are oxidized (electrons are removed) at the anode. The electrodes do not touch each other but are electrically connected by the electrolyte. Some cells use two half-cells with different electrolytes. A separator between half-cells allows ions to flow, but prevents mixing of the electrolytes.

Batteries are classified into two broad categories, each type with advantages and disadvantages.

- ***Primary* batteries** irreversibly (within limits of practicality) transform chemical energy to electrical energy. When the initial supply of reactants is exhausted, energy cannot be readily restored to the battery by electrical means.
- ***Secondary* batteries** can be recharged; that is, they can have their chemical reactions reversed by supplying electrical energy to the cell, restoring their original composition.

Some types of primary batteries used, for example, for telegraph circuits, were restored to operation by replacing the components of the battery consumed by the chemical reaction. Secondary batteries are not indefinitely rechargeable due to dissipation of the active materials, loss of electrolyte and internal corrosion.

Primary batteries

Main article: Primary cell

Primary batteries can produce current immediately on assembly. Disposable batteries are intended to be used once and discarded. These

are most commonly used in portable devices that have low current drain, are used only intermittently, or are used well away from an alternative power source, such as in alarm and communication circuits where other

electric power is only intermittently available. Disposable primary cells cannot be reliably recharged, since the chemical reactions are not easily reversible and active materials may not return to their original forms. Battery manufacturers recommend against attempting recharging primary cells. Common types of disposable batteries include zinc-carbon batteries and alkaline batteries. In general, these have higher energy densities than rechargeable batteries, but disposable batteries do not fare well under high-drain applications with loads under 75 ohms (75 Ω).

Secondary batteries

Main article: *Rechargeable battery*

Secondary batteries must be charged before use; they are usually assembled with active materials in the discharged state. Rechargeable batteries or *secondary cells* can be recharged by applying electric current, which reverses the chemical reactions that occur during its use. Devices to supply the appropriate current are called chargers or rechargers.

The oldest form of rechargeable battery is the lead-acid battery. This battery is notable in that it contains a liquid in an unsealed container, requiring that the battery be kept upright and the area be well ventilated to ensure safe dispersal of the hydrogen gas produced by these batteries during overcharging. The lead-acid battery is also very heavy for the amount of electrical energy it can supply. Despite this, its low manufacturing cost and its high surge current levels make its use common where a large capacity (over approximately 10 Ah) is required or where the weight and ease of handling are not concerns.

USB CAMERA

USB Cameras are imaging cameras that use USB 2.0 or USB 3.0 technology to transfer image data. USB Cameras are designed to easily interface with dedicated computer systems by using the same USB

technology that is found on most computers. The accessibility of USB technology in computer systems as well as the 480 Mb/s transfer rate of USB 2.0 makes USB Cameras ideal for many imaging applications. An increasing selection of USB 3.0 Cameras is also available with data transfer rates of up to 5 Gb/s.

Edmund Optics offers a variety of USB Cameras suited to meet many imaging needs. EO USB Cameras are available in both CMOS as well as CCD sensor types making them suitable across a larger range of applications. USB Cameras contain out-of-the-box functionality for quick setup and software is available to download for most models. USB Cameras using low power USB ports, such as on a laptop, may require a separate power supply for operation.

DRIVER CIRCUIT:

The ULN2003 is a monolithic high voltage and high current Darlington transistor arrays. It consists of seven NPN Darlington pairs that feature high-voltage outputs with common-cathode clamp diode for switching inductive loads. The collector-current rating of a single Darlington pair is 500mA. The darlington pairs may be paralleled for higher current capability. Applications include relay drivers, hammer drivers, lamp drivers, display drivers (LED gas discharge), line drivers, and logic buffers.

The ULN2003 has a 2.7kW series base resistor for each Darlington pair for operation directly with TTL or 5V CMOS devices. **FEATURES**

* 500mA rated collector current (Single output) * High-voltage outputs: 50V

* Inputs compatible with various types of logic. * Relay driver application

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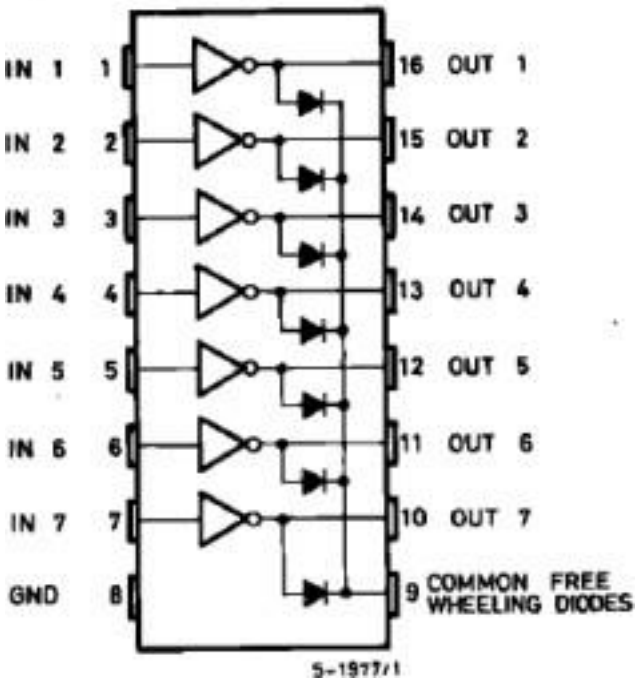

The ULN2003 series input resistors selected for operation directly with 5 V TTL or CMOS. These devices will handle numerous interface needs particularly those beyond the capabilities of standard logic buffers. The ULN2003 have series input resistors for operation directly from 6 V to 15 VCMOS or PMOS logic outputs. The ULN 2003 is the standard Darlington arrays.

The outputs are capable of sinking 500mA and will withstand at least 50 V in the OFF state. Outputs may be paralleled for higher load current capability. The ULx2823A/LW and ULx2824A/LW will withstand 95 V in the OFF state.These Darlington arrays are furnished in 18-pin dual in-line plastic packages (suffix ‘A’) or 18-lead small-outline plastic packages (suffix ‘LW’). All devices are pinned with outputs opposite inputs to facilitate ease of circuit board layout. Prefix ‘ULN’ devices are rated for operation over the temperature range of -20 C to +85 C; prefix ‘ULQ’ □ □ devices are rated for operation to -40 C.□

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DC MOTOR:

GENERAL DESCRIPTION

The relationship between torque vs speed and current is linear as shown left; as the load on a motor increases, Speed will decrease. The graph pictured here represents the characteristics of a typical motor. As long as the motor is used in the area of high efficiency (as represented by the shaded area) long life and good performance can be expected. However, using the motor outside this range will result in high temperature rises and deterioration of motor parts. A motor's basic rating point is slightly lower than its maximum efficiency point. Load torque can be determined by measuring the current drawn when the motor is attached to a machine whose actual load value is known.

PRODUCT DESCRIPTION

Geared dc motors can be defined as an extension of dc motors. A geared DC Motor has a gear assembly attached to the motor. The speed of motor is counted in terms of rotations of the shaft per minute and is termed as RPM .The gear assembly helps in increasing the torque and reducing the speed. Using the correct combination of gears in a gear motor, its speed can be reduced to any desirable figure. This concept where gears reduce the speed of the vehicle but increase its torque is known as gear reduction. A DC motor can be used at a voltage lower than the rated voltage. But, below 1000 rpm, the speed becomes unstable, and the motor will not run smoothly.

FEATURES

· Supply voltage: 12VDC

· Speed: 60rpm

· Long Lifetime, Low Noise, Smooth Motion ·

Equipped with high efficiency

APPLICATIONS

· Coin Changing equipment

· Peristaltic Pumps

· Damper Actuators

· Fan Oscillators

· Photo copier

· Ticket printer

SOFTWARE DESCRIPTION

PYTHON

Python is a widely used high-level programming language for general purpose programming, created by Guido van Rossum and first released in 1991. An interpreted language, Python has a design philosophy that emphasizes code readability (notably using whitespace indentation to delimit code blocks rather than curly brackets or keywords), and a syntax that allows programmers to express concepts in fewer lines of code than might be used in languages such as C++ or Java. The language provides constructs intended to enable writing clear programs on both a small and large scale.

Python features a dynamic type system and automatic memory management and supports multiple programming paradigms, including object-oriented, imperative, functional programming, and procedural styles. It has a large and comprehensive standard library.

Python interpreters are available for many operating systems, allowing Python code to run on a wide variety of systems. C Python, the reference implementation of Python, is open source software and has a community based development model, as do nearly all of its variant implementations.

C Python is managed by the non-profit Python Software Foundation. **FEATURES**

- Beautiful is better than ugly
- Explicit is better than implicit
- Simple is better than complex
- Complex is better than complicated
- Readability counts

OPEN CV:

OpenCV (Open source computer vision) is a library of programming functions mainly aimed at real-time computer vision. Originally developed by Intel, it was later supported by Willow Garage then Itseez (which was later acquired by Intel). The library is cross-platform and free for use under the open-source BSD license.

OpenCV supports some models from deep learning frameworks like TensorFlow, Torch, PyTorch (after converting to an ONNX model) and Caffe according to a defined list of supported layers. It promotes OpenVisionCapsules, which is a portable format, compatible with all other formats.

Applications

OpenCV's application areas include:

· 2D and 3D feature toolkits

· Egomotion estimation

· Facial recognition system

· Gesture recognition

· Human–computer interaction (HCI)

· Mobile robotics

· Motion understanding

· Object identification

· Segmentation and recognition

· Stereopsis stereo vision: depth perception from 2 cameras ·

Structure from motion (SFM)

· Motion tracking

· Augmented reality

To support some of the above areas, OpenCV includes a statistical machine learning library that contains:

- Boosting
- Decision tree learning
- Gradient boosting trees
- Expectation-maximization algorithm
- k-nearest neighbor algorithm
- Naive Bayes classifier
- Artificial neural networks
- Random forest
- Support vector machine (SVM)
- Deep neural networks (DNN)

Programming language

OpenCV is written in C++ and its primary interface is in C++, but it still retains a less comprehensive though extensive older C interface. There are bindings in Python, Java and MATLAB/OCTAVE. The API for these interfaces can be found in the online documentation. Wrappers in other languages such as C#, Perl, Ch, Haskell, and Ruby have been developed to encourage adoption by a wider audience.

Since version 3.4, OpenCV.js is a JavaScript binding for selected subset of OpenCV functions for the web platform.

All of the new developments and algorithms in OpenCV are now developed in the C++ interface.

Hardware acceleration

If the library finds Intel's Integrated Performance Primitives on the system, it will use these proprietary optimized routines to accelerate itself.

A CUDA-based GPU interface has been in progress since September 2010.

An OpenCL-based GPU interface has been in progress since October 2012, documentation for version 2.4.13.3 can be found at docs.opencv.org.

OS support

OpenCV runs on the following desktop operating systems: Windows, Linux, macOS, FreeBSD, NetBSD, OpenBSD. OpenCV runs on the following mobile operating systems: Android, iOS, Maemo, BlackBerry 10. The user can get official releases from SourceForge or take the latest sources from GitHub. OpenCV uses CMake.

CONCLUSION:

In our project we aimed at making the travelling and transportation a safer and comfortable mode. The car was able to move from one point to another point automatically on the provided road. Thus, the car was able to overcome all the obstacles and drive safely on the road track.

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