A Review Paper on Traffic Sign Detection and Manage Speed Limit

Manish Kumar Bharti[1], Dr.Amit Chandak[2]
1.M. Tech Student-IPS Academy Institute of Engineering & Science College Indore MP
2.Asso. Prof.- IPS Academy Institute of Engineering & Science College Indore MP

Abstract -Nowadays, road accident problems are growing, which can reduce road traffic problems by solving proper vehicle speed monitoring systems. Deep learning and machine learning work propagate and complex calculation use in traffic signs detection are essential part of the road system and are used to convey information, regulate traffic, and provide guidance to drivers, pedestrians, and other road users. Accidents are associated without any sign and breakers and navigation. These signs use standardized symbols, colors, and shapes to ensure that their meaning is easily understood regardless of the language spoken; however, the TSR systems in vehicles can identify speed limits, stops, and signs. Artificial intelligent and machine learning already works on it. For each region where the rules must be observed, different sections are mentioned. Prepare the collected data by applying preprocessing techniques such as resizing, normalization, and augmentation. Preprocessing helps to enhance the quality and consistency of the data and improves the performance of the machine learning models. Choose a suitable camera to capture real-time video or images of the road. Many modern vehicles come equipped with built-in cameras for driver assistance systems, but if you are building a custom setup, you can use a USB camera or a camera module compatible with your platform. The IOT platform is used to attach a Wi-Fi and Bluetooth connection to the system to recognize the traffic speed control of the system. the objective of some improvement features is to detect the traffic sign speed limit change on board to regulate the pace

Keywords- Deep learning, IOT, TSR (traffic sign recognition), machine learning, and artificial intelligence for traffic sign identification

INTRODUCTION

The number of road accidents is increasing every year, and most traffic accidents are caused by disobeying traffic sign boards. The human factor plays a significant role in road safety, contributing to a substantial number of accidents worldwide. Distracted driving impaired driving, speeding, aggressive behavior, and non-adherence to traffic regulations are some primary factors leading to road accidents. The collected data will be processed using computer vision and machine learning algorithms to identify and recognize obstacles in real-time. This step is crucial for accurate and reliable obstacle detection. Traffic accidents involving vehicles are a significant problem on the road, often caused by factors such as distracted driving, speeding, impaired driving, reckless behavior, or adverse weather conditions

The automatic recognition of these signs and, however, is not simple due to weather conditions, blur ensuing from moving vehicles, and lighting conditions. To handle these challenges, researchers suggest the use of image processing and machine learning techniques. The quality of the camera or sensor used, and the robustness of the overall system in handling various environmental conditions and scenarios on the road. Additionally, it's crucial to consider legal and ethical implications when implementing such systems on public roads. Traffic signs have many distinctive options such as colors, shapes symbols. Within the detection stage, the input pictures are preprocessed increased so metameric in step with their color or pure mathematics

Image processing-The annotation of images is a crucial stage in the development of view images to add decent color images and contrast ratios. Detection uses deep learning process images to be a valuable component of deep learning for object recognition in a real-world environment, and datasets must be useful components of deep learning. We used the image lab labeling tool to help us with the implementation of our application,

Fig. 1 IMAGE LAB LABLING

(A) Image pyramids are multiscale representations used for efficient object detection, while feature pyramids are hierarchical representations extracted using convolutional Neural Networks for improved localization and accuracy. (B) Modern detection systems often use feature pyramids to efficiently handle objects at multiple scales, ensuring better overall detection accuracy. However, using a single scale characteristic can limit performance and may not be suitable for real-world scenarios with varying object sizes. (C) Convolutional neural Networks (ConvNets) learn hierarchical features at different levels, efficiently extracting meaningful features from input images for object detection, enabling performance on various object scales beyond training objectives.

Data Processing- It appears that the text describes the configuration and settings for YOLOv4-tiny, a variant of the YOLO (You Only Look Once) object detection model. Below is an explanation of the mentioned attributes and settings:

1. Batch Size: The batch size is set to 64, which means that during each training iteration, the model processes 64 images together. This helps in parallelizing the computation and using the GPU efficiently.
2. Divisions: There are 16 divisions in the data, but without further context, it is unclear what these divisions refer to. They might be related to data partitions or some other aspect of the dataset or training process.
3. Learning Rate: The learning rate, also referred as the "pace of learning," is set to 0.001 ms per second. The learning rate determines how quickly the model updates its parameters during training.
4. Input Image Size: The input images from the dataset are resized to 416 x 416 pixels. YOLOv4-tiny takes these images as input during training and detection.
5. Detection Layers: Layers 139, 150, and 161 of the YOLOv4-tiny model are designated as the detection layers, where object detection is performed. These layers are responsible for predicting bounding boxes and class probabilities.
6. Maximum Batch Size: The maximum batch size is calculated using a formula: (Number of classes) x 2000. The value is not explicitly given in the text, but it is used to set a limit on the batch size during training.
7. Iterations: The number of training iterations is determined based on the maximum batch size. It is specified as a range between 80 to 90% of the maximum batches.
8. Filters: The number of filters for the detection layers is calculated using the formula:{ 3 x (Total number of classes + 5)}. Filters are the number of channels in the convolutional layers in the detection head of the YOLOv4-tiny model.
9. Hardware Setup: The hardware configuration used for training the model consists of an Intel Core i3-8700 CPU, NVIDIA TITAN Xp GPU, and 8 GB RAM. These specifications determine the computational resources available for the training process.
10. Software Setup: The software environment includes TensorFlow 1.13.1 and Keras 2.1.5, which are the deep learning frameworks used for implementing YOLOv4-tiny on Windows 10.
11. Visualization: The mention of blue outlines representing feature maps and larger outlines suggesting semantically stronger features is likely a reference to visualizations used to understand the internal representations and activations of the model's layers.

Overall, YOLOv4-tiny is a lightweight version of the YOLOv4 model, designed to achieve real-time object detection with reduced computational requirements. The provided information outlines the fundamental settings and configurations for training YOLOv4-tiny on the given hardware and software setup.

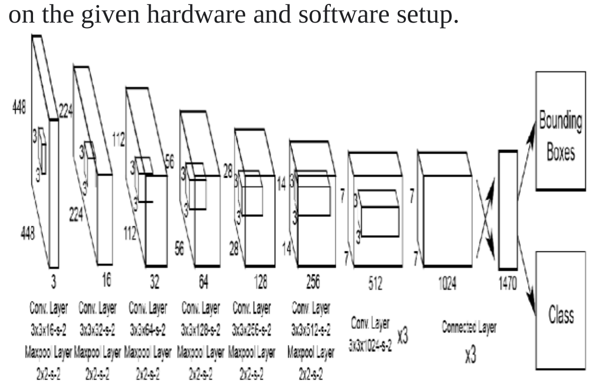

Fig.2 YOLO OBJECT DETECTION ALGORITHM USE

Microcontroller- The ATmega328P microprocessor, an 8-bit AVR microcontroller, lies at the core of Arduino Uno. It includes digital I/O pins, analog-to-digital converters (ADCs), timers, serial communication interfaces (UART, SPI, and I2C), and other features. The ATmega328P has a clock speed of 16 MHz. The ATmega328P contains 32 KB of Flash memory, which may be used to store the Arduino sketch (the code you write) and any data it requires. Static Random-Access Memory (SRAM) of 2 KB is available on the microcontroller. During the program execution, SRAM is used to temporarily store variables and data.

The ATmega328P additionally has 1 KB of EEPROM (Electrically Erasable Programmable Read-Only Memory). The Arduino Uno provides 20 GPIO (General Purpose Input/Output) pins that can be used for various input and output operations in your projects. Six pins (3, 5, 6, 9, 10, and 11) enable Pulse width modulation (PWM), allowing analog-like output using digital pins. Also six analog input ports designated A0 through A5. The Arduino Uno may be powered through USB or by connecting an external power source (7-12V) via the power jack ATmega16U2 or CH340, which enables programming and communication with the board through the USB connection. A reset button on the board resets the microcontroller, allowing you to upload fresh drawings or reset the program execution.

Literature Review: Various types of project make and sign detection of project and mechanism are used to vehicle proper recognition but I have talked about the project seen the sign of vehicle control the speed self it improve the road safety with regard to, work automatic to control speed

The deep learning based vehicle detection model YOLOv3 is used for vehicle detection and counting, which is a highly efficient and accurate algorithm. This paper offers a neural network-based method for gathering pedestrian traffic statistics from street surveillance cameras. One of the most significant aspects of smart city development is the collection and processing of pedestrian traffic. A contemporary real-time object detection technology, YOLOv3, was employed to overcome the challenge of gathering pedestrian traffic statistics. [1]

A successful strategy is presented for assigning each vehicle label to its corresponding one in the vehicle's trajectories and accurately counting it using the information from the detected and tracked locations. The suggested approach surpassed the other techniques used when assessing content presenting challenging conditions, with average detection and counting precision of 97.3 percent and 96.8 percent, respectively. [2]

Transforming RGB images to the IHLS (Intensity, Hue, Lightness, Saturation) color space and using new algorithms to extract the colors of road signs is a common approach in computer vision and image processing. The algorithms have been tested on hundreds of outdoor photographs under various lighting conditions and have proven to be quite durable. This study is part of the ITS research being conducted at Dalarna University in Sweden. [3]

- The microcontroller unit is also linked to the wireless module, which can identify any other transceiver. When we install transmitters that provide data frames with fields specifying the maximum speed and period for which this speed limitation is to be applied, the car can now be controlled at the desired locations. [4]

The purpose of this study is to develop a PID controller to monitor and regulate the speed response of a DC motor, and the MATLAB software is used for calculation and simulation. Because of its simplicity and resilience, PID controllers are frequently used in industrial operations. Industrial processes are sensitive to parameter changes and disturbances. We are selecting PID parameters and discussing them. [5]

Remote areas often face accidents due to drivers' negligence or speeding. A new system developed using processor technology and microcontrollers uses an electronic display controller to reduce road accidents caused by speeding vehicles losing control at speed breakers or driver negligence. The controller warns drivers to reduce speed based on the signal, and waits for their response. [6]

It can also be valuable for warning drivers about temporary hazards, construction zones, or sharp turns on winding roads. The wireless system delivers road signs and information to commuters, aiming to improve road safety, reduce dependency on static signs, and improve traffic law and order implementation. [7]

This paper presents a revolutionary approach for remotely managing the speed of an automobile for a set amount of time. The electronic control unit (ECU) in an automobile typically manages the throttle position largely depending on input from the pedal position sensor. In the proposed mode, however, a separate microcontroller unit receives the pedal position from the sensor rather than the ECU, and then the microcontroller 20 interaction of the microcontroller. [9]

Road sign recognition is a driver support function that alerts drivers of potential restrictions on a road. This investigation focuses on real-time recognition of Malaysian road and traffic signs using digital cameras and vision-only information. The system uses a hybrid color segmentation algorithm, a robust custom feature extraction method, and a multilayer artificial neural network (ANN) for recognition and interpretation. [10]

Benefits

Traffic sign detection offers numerous benefits in various applications, particularly in the context of driving assistance, autonomous vehicles, and intelligent transportation systems. Some key benefits of traffic sign detection include:

1. Enhanced Road Safety: One of the primary advantages of traffic sign detection is improved road safety. By accurately detecting and recognizing traffic signs, the system can alert drivers to crucial information, such as speed limits, stop signs, yield signs, and other regulatory signs. This helps drivers to be more aware of their surroundings, adhere to traffic rules, and make informed decisions, reducing the likelihood of accidents.
2. Real-Time Awareness: Traffic sign detection systems can provide real-time information to drivers about changes in speed limits, construction zones, detours, and other dynamic road conditions. This ensures that drivers are aware of any temporary changes in traffic regulations and can adjust their driving behavior accordingly.
3. Driver Assistance: Traffic sign detection is an essential component of advanced driver assistance systems (ADAS). These systems can provide visual or auditory alerts to drivers when they exceed speed limits, mistop signs, or encounter other traffic signs. ADAS can help prevent human errors and provide valuable assistance, especially in complex driving scenarios.
4. Autonomous Vehicles: In the context of autonomous vehicles, traffic sign detection is critical for safe navigation. Autonomous cars rely on traffic sign recognition to understand and follow traffic regulations, adjust their speed, and make appropriate driving decisions based on the detected signs.
5. Improved Traffic Flow: Traffic sign detection, combined with intelligent transportation systems, can help optimize traffic flow. By detecting congestion or accidents and providing real-time information to drivers, the system can suggest alternative routes, manage traffic lights more efficiently, and reduce overall traffic congestion.
6. Reduced Energy Consumption: ADAS and autonomous vehicles equipped with traffic sign detection can optimize speed and acceleration, leading to more fuel-efficient driving and reduced carbon emissions.
7. Assistance for Special Cases: Traffic sign detection can assist drivers with certain medical conditions or impairments that may affect their ability to perceive or respond to traffic signs effectively. ADAS can provide additional support to ensure their safety on roads.
8. Adapting to Local Regulations: In regions with varying traffic regulations, such as different speed limits or signs in different languages, traffic sign detection systems can be trained to adapt to local road conditions, making them more versatile and usable worldwide.

Overall, traffic sign detection technology plays a vital role in making driving safer, more efficient, and less stressful for both human drivers and autonomous vehicles. As the technology advances and becomes more widespread, its potential to improve road safety and optimize traffic management will continue to grow.

Types of traffic sign detection

Traffic sign detection is a crucial task in the field of computer vision and autonomous driving. There are several types of traffic sign detection methods, and they can be broadly categorized into the following approaches:

1. Color-Based Detection: This method relies on the color information of traffic signs, as many signs have distinct colors that set them apart from the surrounding environment. For example, stop signs are usually red and white, while yield signs are red and white with a red triangle. Color-based detection algorithms use color thresholds to identify regions in the image that match the color characteristics of traffic signs.
2. Shape-Based Detection: Traffic signs often have unique shapes that help in their recognition. For instance, stop signs are octagonal, and speed limit signs are usually rectangular. Shape-based detection algorithms use techniques such as edge detection and contour analysis to identify shapes corresponding to traffic signs.
3. Machine Learning-Based Detection: This approach involves training machine learning models such as SVMs or more commonly CNNs on a large dataset of annotated traffic sign images. These models learn to detect traffic signs based on the features and patterns in the training data.
4. Feature-Based Detection: Feature-based methods extract specific features from traffic signs, such as edges, corners, or other distinctive attributes, and then use these features to identify signs in the image. These techniques often combine the feature extraction with machine learning algorithms for classification.
5. Deep Learning-Based Detection: Deep learning methods, particularly CNNs, have shown significant success in traffic sign detection tasks. CNNs can learn hierarchical patterns and features directly from raw image data, making them well suited for complex recognition tasks such as traffic sign detection.
6. Real-Time Detection with YOLO: YOLO is a real-time object detection system that can be adapted to detect multiple traffic signs simultaneously. YOLO-based architectures enable efficient and fast detection in video streams or live camera feeds.
7. Hybrid Approaches: Many advanced traffic sign detection systems employ a combination of the above methods. For example, a system may use color-based detection to pre-filter potential regions of interest and then use a CNN to perform a fine-grained classification of the detected regions.

Each of these approaches has its strengths and weaknesses, and the choice of method depends on factors such as computational resources, accuracy requirements, and real-time processing constraints. The goal of traffic sign detection is to provide accurate and reliable information to assist human drivers or autonomous vehicles in navigating safely and efficiently on roads.

CONCLUSION

Road safety is a safety precaution designed to limit the risk of road accidents and roadside injuries caused by human error while driving on the road. In today's setting, road safety is the most important problem relating to public safety on roadways. Millions of lives are lost each year due to traffic accidents across the world, resulting in massive financial and resource losses for individuals and the nation. Intelligent sensing plays an important role in driving vehicles, which obtains road target information for decision-making control Mage analysis is often divided into three steps: detection, segmentation, and classification. The edge of the sign is recognized, and segmentation is used to separate it from the backdrop. We present a simple feature selection extraction method using two GTSRB and GTSDB data sets for traffic sign detection and recognition. These files contain several difficult traffic signs, including sign tilt, uneven illumination, and traffic signs with distraction. This project uses less energy. This technology is simple to integrate into this system, ensuring increased safety for drivers, passengers, and pedestrians. In this manner, the motorist may obtain information from the sign boards without being distracted or disturbed. Even in adverse weather, conditions, such as smoggy, this prototype is ideal.

REFERENCE

[1] “Vehicle Counting for Traffic Management System using YOLO and Correlation Filter” C. S. Asha et al., IEEE International Conference on Electronics, Computing and Communication Technologies (CONECCT), Bangalore, India, pp. 1-6,2018.

[2] “Robust Vehicle Detection and Counting Algorithm Employing a Convolution Neural Network and Optical Flow,” A. Gomaa, et al., Sensors, vol. 19, no. 20, 2019

[3] “Color detection and segmentation for road and traffic signs,”H. Fleyeh, presented at 2004 IEEE Conf. on Cybernetics and Intelligent Systems, Singapore
[4]A Design Model for Automatic Vehicle Speed Control, International Journal for Computer Applications, volume-35, No.9, December 2011
[5]“Speed Control of DC Motor using Pid Controller Based on MATLAB” Aditya Pratap Singh, Udit Narayan, Akash Verma, International Conference on Recent Trends in Applied Sciences with Engineering Applications (2013).-
[6] “Automatic Vehicle Speed Control With Wireless In-Vehicle Road Sign Delivery System Using ARM 7”, 1. Gummarekula Sattibabu, 2. B.V.V. Satyanarayan 3. VV Satyanarayana Kona
[7] “Design and Prototype of an In-Vehicle Road Sign Delivery System using RFID”, 2012 12th International Conference on ITS Telecommunications.
[8] “Design of RF based Speed control system for vehicles”, International Journal of Advanced Research in Computer and Communication Engineering Vol. 1, Issue 8, October 2012.
[9] “A design model for Automatic vehicle speed Control International Journal for Computer Application”s, volume-35, No.9, December 2011.
[10]“Real-Time (Vision-Based) Road Sign Recognition Using an Artificial Neural Network. *Sensors.”* Islam K.T., Raj R.G. 2017;**17**:853. doi: 10.3390/s17040853.
[11] “A design model for Automatic vehicle speed Control”, International Journal for Computer Applications, volume-35, No.9, December 2011.
[12].“Vehicle Speed Control using R.F. Technology”, 5704017, June 2006, SRM institute of Science and Technology.
[13]. “Electronic Speed Control” “Follower, W. C.”(1974). SAE Tech. Paper # 740022.
[14] Vehicle Speed Control using R.F. Technology, 5704017, June 2006, SRM institute of Science and Technology
[15] “Design of RF -based Speed control system for vehicles”, International Journal of Advanced Research in Computer and Communication Engineering Vol. 1, Issue 8, October 2012.
[16] “Detection And Classification Of Speed Limit Traffic Signs” IEEE 2014 Rubel Biswas, Hasan Fleyeh,Moin Mostakim.
[17] “Android Based Signboard Detection using Image and Voice Alert System” Sanchita Bilgaiyan, Sherin James, Sneha. S Bhonsle, Shruti Shahdeo, Keshavamurthy IEEE International Conference On Recent Trends In Electronics Information Communication Technology, May 20-21, 2016, India
[18] “Automatic Speed Control of Vehicle Using Video Processing” Thombare, R.D. & Sawant, P.M. & Sawant, P.P. & Sawant, P.A. & Naik, V.P.(2018).. 919-924. 10.1109/ICICCT.2018.8473149.
[19] “RFID” David Hanny, Manuel Panchano, Les G. Thompson – , John Wiley and Sons. Applied – 2007 Jerry Banks.