IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

# DESIGN THINKING BASED ON TRAFFIC SIGN DETECTION AND SPEED LIMIT REDUCTION

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**Abstract**: This research presents a novel approach for real-time traffic sign detection using the YOLOv5 algorithm in the context of autonomous vehicle control. With the increasing demand for intelligent transportation systems, the accurate and rapid detection of traffic signs is crucial for ensuring safe and efficient autonomous navigation. The proposed system employs the YOLOv5 deep learning architecture due to its efficiency in object detection tasks, particularly in scenarios demanding low latency and high accuracy. A dataset comprising diverse traffic signs and signals from various environmental conditions is curated and utilized for training and validation purposes. The methodology involves pre-processing of camera images to extract pertinent features related to traffic signs. The YOLOv5 architecture is then trained on this dataset to recognize and classify different traffic signs (such as speed limits, stop signs, yield signs, etc.). Evaluation of the model's performance includes metrics such as precision, recall, and F1- score, ensuring reliable and robust detection capabilities. The proposed system aims for real-time inference, enabling quick and accurate decision-making for autonomous vehicles. The implementation demonstrates promising results in terms of both detection accuracy and computational efficiency. The system's ability to promptly identify and interpret traffic signs and signals contributes significantly to enhancing the safety and autonomy of vehicles in dynamic traffic environments. In this research contributes to the advancement of intelligent transportation systems by offering a fast and reliable solution for traffic sign, paving the way for safer and more efficient autonomous driving.

**Keywords :** Yolo V5 Algorithm, Object Detection, Python Code, Arduino Board, Etc

# I. INTRODUCTION

In recent years, the evolution of autonomous vehicles has driven the quest for intelligent systems capable of comprehending and responding to complex traffic environments. Central to this pursuit is the swift and accurate detection of traffic signs and signals, which serves as a fundamental pillar for safe and efficient autonomous navigation. Conventional approaches to traffic sign and signal detection have faced challenges in meeting the stringent requirements of real-time processing and precise recognition in diverse environmental conditions. However, the emergence of deep learning techniques, particularly the YOLOv5 algorithm, has sparked immense interest due to its prowess in object detection tasks. This research endeavors to leverage the capabilities of YOLOv5 to develop a high-speed and robust system for traffic sign detection in the context of automotive applications. The primary objective is to design an intelligent system that enables vehicles to rapidly interpret and react to traffic signs and signals, facilitating enhanced safety and efficiency in autonomous driving scenarios. The significance of this work lies in its potential to address critical challenges faced by autonomous vehicles, including the need for quick decision-making in dynamic traffic environments. By harnessing the power of deep learning and real-time processing, the proposed system aims to elevate the performance standards of traffic sign and signal detection, contributing to the broader landscape of intelligent transportation systems. The subsequent sections of this paper will delve into the methodology employed, the dataset utilized for training and validation, the architecture and workings of YOLOv5, the evaluation metrics for assessing detection performance, and the implications of this research on advancing the capabilities of autonomous vehicles in real-world traffic scenarios. In this study embarks on a path toward optimizing traffic sign detection, fostering safer and more efficient autonomous driving experiences through the integration of cutting-edge deep learning techniques within automotive applications.

# II. RESEARCH METHODOLOGY

## 2.1 HARDWARE REQUIREMENTS

- WEB CAM
- POWER SUPPLY CIRCUIT
- NODEMCU
- LIQUID CRYSTAL DISPLAY
- BUZZER
- DC MOTOR

## 2.2 HARDWARE DESCRIPTION

### 2.2.1 WEB CAM

An image from a webcam is fed or streamed in real time to or via a computer-to-computer network. After being "captured" by the computer, the video stream can be viewed, saved, or shared via email attachments and other networks. It is possible to save, view, or send the video feed to a remote site.

In contrast to IP cameras, which are typically connected by Ethernet or Wi-Fi, webcams are typically connected using USB cables or other comparable cables, or they are integrated into computer hardware like laptops. Instead of referring to a clipped compound, the term "webcam" can alternatively refer to a video camera that is continuously connected to the Web for an indeterminate amount of time.

### 2.2.2 POWER SUPPLY CIRCUIT

A power source is referred to as a "power supply." A power supply unit, or PSU, is a device or system that provides electrical or other forms of energy to an output load or set of loads. The phrase is most frequently used in reference to electrical energy sources; mechanical and other sources are mentioned less frequently.

There are two main types of power supply for electrical devices: switching power supplies and linear power supplies. For high current devices, the relatively simple design of the linear supply is progressively heavier and bulkier; low efficiency might arise from the linear supply's lack of voltage regulation. For a given rating, a switched-mode supply that is more complex will be smaller and typically more efficient than a linear supply.

### 2.2.3 NODE MCU

Based on the ESP8266 Wi-Fi module, the NodeMCU is a multipurpose microcontroller board intended for Internet of Things (IoT) applications. Its main objective is to combine Wi-Fi capabilities into a small and easily portable platform to enable connectivity and control in a variety of electrical applications. Both novice and expert developers will find the NodeMCU relatively simple to work with as it runs on a firmware based on Lua and can be programmed using the Arduino IDE. Functionally, the NodeMCU's integrated WiFi connectivity allows for smooth communication with other devices and the internet. It is equipped with a potent 32-bit microcontroller unit that can run code and issue commands to communicate with other peripherals like actuators and sensors. GPIO (General Purpose Input/Output) pins on the board let users communicate with external

**PIN CONFIGURATION**

**GPIO Pins (General Purpose Input/Output):**

**GPIO0 to GPIO15:** These pins are multipurpose and can be used for digital input/output, PWM (Pulse Width Modulation) output, I2C, SPI, and more. Some pins have specific functionalities or limitations, so it's essential to refer to the board's pinout diagram or documentation for details.

**Power Supply Pins:**

**VIN:** This pin is used to supply voltage to the board. It can typically handle a range of voltages, but it's recommended to provide a stable 5V power source.

**3.3V and GND:** These pins are for supplying power at 3.3 volts and ground respectively. USB-to-Serial Interface:

**TX and RX:** These pins are used for serial communication with the computer or other serial devices. TX stands for transmit,

and RX stands for receive. Reset and Flash Buttons:

**RST:** This is the reset pin, which, when pulled LOW, resets the microcontroller.

**FLASH:** Used for putting the board into flashing mode for firmware updates.

**Analog Pins:**

**A0:** Some NodeMCU boards have an analog pin labeled as A0, allowing for analog input functionality.

**Special Purpose Pins:**

**D0 (GPIO16):** This pin has a special purpose related to deep sleep functionality in the ESP8266.

### 2.2.4 LIQUID CRYSTAL DISPLAY

A liquid crystal display, often known as an electronic visual display or video display, is a flat panel display that makes advantage of liquid crystals' ability to modulate light. Light is not directly emitted by liquid crystals. A digital clock's seven-segment display, preset words, and numerals are examples of fixed graphics that can be shown or hidden on LCDs. They can also display arbitrary images, like those found on a general-purpose computer display. The only difference between them is that although other displays have larger parts, arbitrary images are composed of many tiny pixels. An LCD is a cheap, tiny display. The dark blob on the rear of the board is an integrated controller, which makes it simple to interact with a microcontroller.

Since this controller (HD 44780) is common to many displays, libraries for numerous micro-controllers, like the Arduino, make displaying messages as simple as writing one line of code.

LCDs are utilized in many different applications, such as signage, instrument panels, computer monitors, televisions, and cockpit displays in airplanes. They have mostly supplanted cathode ray tube (CRT) displays in consumer electronics, including video players, gaming consoles, clocks, watches, calculators, and phones. In addition to having a larger selection of screen sizes than CRT and plasma displays, they don't experience image burn-in because they don't utilise phosphors. Unfortunately, LCDs might suffer from image persistence.

### 2..5 BUZZER

A buzzer, sometimes known as a beeper, is a type of electrical signaling device that is commonly seen in cars, home appliances like microwaves, and game shows. It typically consists of several switches or sensors that are connected to a control unit that detects whether a button was pressed and which button it was, as well as whether a predetermined amount of time has passed. It then typically turns on a light at the relevant button or control panel and emits a warning sound, which can be either continuous or sporadic, in the form of a beeping or buzzing sound. This device's original electromechanical foundation was the same as that of an electric bell sans the metal gong. These devices frequently served as sounding boards by being fastened to a wall or ceiling.

Another way to use some AC-connected devices was to build a circuit that would generate enough noise from the AC current to power a loudspeaker when connected to an inexpensive 8-ohm speaker. These days, using a ceramic-based piezoelectric sounder— such as a Sonalert—that produces a high-pitched tone is more common. These were typically connected to "driver" circuits that pulsed the sound on and off or changed the pitch of the sound. Because it prevents others from signaling when one person "buzzes in," it is sometimes referred to as a "lockout system" in video game shows. Huge buzzer buttons labeled "plungers" can be found on a number of game shows.

The buzzing sound that buzzers produced when they were electromechanical devices running at 50 or 60 cycles on stepped-down AC line voltage is where the word "buzzer" originates. A ring or beep are two additional noises that are frequently used to show that a button has been pressed.

### 2.2.6 DC MOTOR

An electro-mechanical device that transforms electrical energy into rotational or mechanical motion is a DC motor. It uses the interplay of magnetic fields to create motion in accordance with the electromagnetism principle. A DC motor's stator and rotor are its two primary constituents. The stationary component that produces a magnetic field when an electric current flows through it is called a stator. The rotor is positioned within this magnetic field and mounted on an axle, typically taking the shape of a coil or permanent magnet. An electromagnetic force is produced when the motor is given a direct current (DC), and this force interacts with the magnetic field within the stator. The rotor rotates as a result of this interaction producing a torque. The motor's speed is determined by the strength of the current, whilst the direction of the current dictates the direction of rotation. DC motors are widely used in diverse applications owing to their controllability, simplicity, and capacity to deliver a steady torque at varying speeds. They are used in a variety of industries, including robotics, manufacturing, automotive systems, and home appliances. Because the motor's voltage or current may be readily adjusted to alter its speed and direction, these motors are very adaptable and frequently used in a variety of contexts.

## 2.3 SOFTWARE REQUIREMENTS

### 2.3.1 PYTHON IDLE

**Python Technology:**

Python is a high-level, general-purpose programming language that interprets code. It is compatible with several programming paradigms, such as functional, object-oriented, and procedural programming. Because of its extensive standard library, Python is frequently referred to as a "batteries included" language.

**Python Programing Language:**

Python is a computer language with multiple paradigms. Many of its features allow functional programming as well as aspect- oriented programming (via the use of met objects and meta programming, among other magic ways), and both object-oriented and structured programming are fully supported. Extensions support many different paradigms, such as logic programming and design by contract.

Python packages with a wide range of functionality, including:

- Easy to Learn and Use
- Expressive Language
- Interpreted Language
- Cross-platform Language
- Free and Open Source
- Object-Oriented Language
- Extensible
- Large Standard Library
- GUI Programming Support
- Integrated

Python handles memory by utilizing a cycle-detecting garbage collector in conjunction with reference counting and dynamic typing. Additionally, during program execution, method and variable names are bound via dynamic name resolution, often known as late binding.

The goal of Python was to be highly extendable, rather than having all of its features built into it. Adding programmable interfaces to existing applications has been made possible by its compact modularity, which has led to its popularity.
ABC advocated the opposite strategy, and Van Rossum's frustration led him to envision a compact core language with a huge standard library and an easily expandable interpreter.The goal of writing Python is to make it simple to read. Although other languages utilize punctuation, English terms are frequently used in its visually simple layout.

It does not utilize curly brackets to separate blocks like many other languages do, and semicolons are not required after statements. Compared to C or Pascal, it features fewer syntactic exceptions and special circumstances.

## PROJECT DESCRIPTION

### 3.1 WORKING OF PROPOSED SYSTEM

The YOLO technique, which is used in the project to perform quick traffic sign identification using deep learning, has a wide range of possible applications in the automobile industry.

By offering real-time traffic sign identification and interpretation, this technology meets a crucial demand in the field of road safety. Its range extends beyond merely identifying typical signs to include the ability to identify dynamic or atypical road conditions, improving overall safety protocols for both vehicles and pedestrians.Furthermore, this concept is scalable to different geographical areas with different traffic laws. It is a flexible global solution that can be trained to identify certain signs in accordance with the traffic rules of other countries.

The foundation for more sophisticated applications is laid by the system's interaction with the vehicle control mechanisms. This involves enabling semi-autonomous driving functions, in which the car can react to indications it detects by changing lanes, changing speed, or carrying out other safety procedures.

The project's scope also includes potential advancements in the automobile sector, specifically in the field of completely autonomous vehicle development. A key component in the development of self-driving automobiles, the system's real-time, accurate detection and interpretation of traffic signs greatly enhances the vehicles' dependability and safety.

All things considered, the use of YOLO-based deep learning for traffic sign detection in automotive applications has a wide range of applications, covering not only current road safety issues but also creating the foundation for future developments in autonomous driving technology and transforming the transportation landscape.

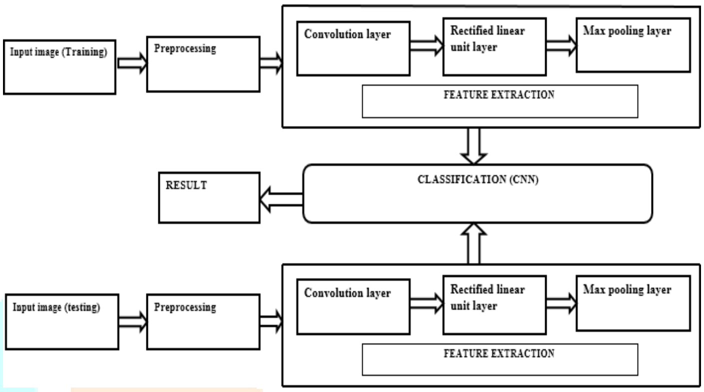


**Fig. 3.1 ARCHITECTURE OF PROPOSED SYSTEM**

## IV. RESULTS AND DISCUSSION

### 4.1 Results of Descriptive Statics of Study Variables

The outcomes have Acquire a picture dataset labelled with speed limit and traffic sign information. Make sure the dataset is reflective of the many scenarios you hope to identify and is varied.To annotate the photos with bounding boxes around the signs and provide appropriate class labels, use a programme such as LabelImg.Use a deep learning framework like PyTorch or TensorFlow to train a YOLO model. An existing pre-trained YOLO model may be adjusted using your dataset. Following training, fresh pictures with speed restrictions and traffic signs may be used to evaluate the model.To forecast bounding boxes and class labels for the items in the photos, apply the trained model.

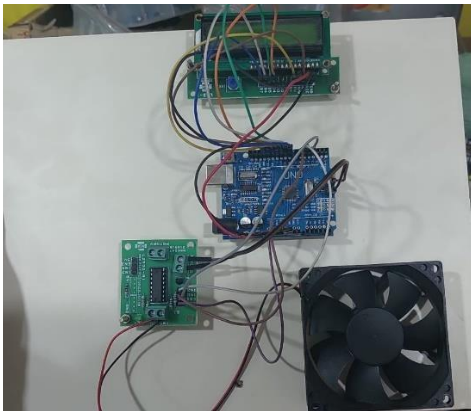

**Fig:4.1**

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