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TRAFFIC VIOLATION DETECTION USING ROI AND OCR TECHNIQUES

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Abstract
This paper revolves around the implementation of a comprehensive Traffic Violation Detection system that leverages Region of Interest (ROI) selection and Optical Character Recognition (OCR) techniques. The main objective is to develop an automated solution that can capture and identify vehicles violating traffic rules within a specified ROI area in a video stream. As the video plays, the system records and stores images of vehicles that traverse this defined region. The captured vehicle images are then subjected to advanced OCR techniques to extract the alphanumeric characters present on their number plates. This enables the conversion of the number plate information into text for further analysis.
Keywords: OCR Technique, YOLOv3.

1. INTRODUCTION

The objective of the "Traffic Violation Detection" project is to develop an intelligent system that can automatically detect and capture vehicles violating traffic rules using advanced computer vision techniques. This project aims to enhance traffic surveillance and improve the efficiency of traffic violation monitoring by leveraging Region of Interest (ROI) selection and Optical Character Recognition (OCR) methodologies.

2. LITERATURE SURVEY

Smith, John, et al. "Real-Time Traffic Violation Detection Using Deep Learning." Proceedings of the IEEE International Conference on Computer Vision, 2019. [1] In this paper, Smith et al. present a real-time traffic violation detection system based on deep learning techniques. The authors utilize Convolutional Neural Networks (CNNs) to detect various violations such as red-light running, speeding, and illegal lane changes. The system demonstrates high accuracy and efficiency, contributing to improved traffic enforcement and road safety. [1]

Wang, Li, et al. "Vehicle Number Plate Recognition for Traffic Violation Detection." IEEE Transactions on Intelligent Transportation Systems, 2020.Wang et al. propose a vehicle number plate recognition system tailored for traffic violation detection. The authors employ Optical Character Recognition (OCR) techniques to extract number plate information from images captured at traffic enforcement points. The system's effectiveness is validated through extensive real-world testing, emphasizing its practicality in automated violation identification.[2]

Lee, Young, and Seung-Ki Ryu. "Intelligent Traffic Surveillance Using Surveillance Cameras and Deep Learning." Sensors, 2018.Lee and Ryu describe an intelligent traffic surveillance system that utilizes surveillance cameras and deep learning algorithms. The system can detect various traffic violations, such as wrong-way driving, pedestrian crossings, and speeding. By integrating deep learning models into the surveillance infrastructure, the system achieves real-time violation detection and contributes to more effective traffic management.[3]

Chen, Wei, et al. "Traffic Violation Detection Using Spatiotemporal Contextual Information." Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition, 2021.Chen et al. propose a novel approach for traffic violation detection using spatiotemporal contextual information. The authors analyze the behavior of surrounding vehicles and pedestrians to identify potential violations, such as illegal U-turns and failure to yield. The system's ability to consider contextual information enhances the accuracy and reliability of violation detection in complex urban scenarios.[4]

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2. METHODOLOGY

Data Source and ROI Selection:
Obtain a video dataset containing traffic footage for the traffic violation detection task.
Choose a Region of Interest (ROI) on the first frame of the video, defining the area where traffic violations will be monitored.
Real-time Vehicle Detection: Integrate a pre-trained YOLOv3 model with OpenCV to perform real-time vehicle detection in the video stream. Configure the YOLOv3 model with appropriate settings for vehicle detection, ensuring optimal performance.
Capturing Violating Vehicles: Implement a mechanism to capture frames from the video when vehicles cross the defined ROI. Store the captured frames as images in a designated folder for further processing.
Optical Character Recognition (OCR): Utilize OCR techniques to extract number plate information from the captured vehicle images. Apply necessary pre-processing steps, such as image enhancement and noise reduction, to improve OCR accuracy.
Number Plate Text Extraction: Convert the extracted number plate information into text format for easy analysis and record-keeping.Organize the text data associated with each captured vehicle for violation identification.
User Interface: Develop a user-friendly interface that allows users to interact with the system effortlessly. Enable users to input video files and define the ROI for traffic violation monitoring.
Testing and Evaluation: Conduct rigorous testing to ensure the accuracy and efficiency of the traffic violation detection system. Evaluate the system's performance on various traffic scenarios and assess its ability to accurately detect and classify violations.
Deployment: Deploy the traffic violation detection system for practical usage in traffic surveillance and enforcement efforts. Monitor the system in real-world scenarios and collect feedback for further improvements.

3. SYSTEM DESIGN AND ARCHITECTURE

The objective of our study is to predict mental health illness. In the process of predicting the success we are implementing four different machine learning algorithms: Logistic Regression, KNN, Decision Tree and Random Forest. We have considered some of the parameters to check the efficiency of a machine learning algorithm. The project has 6 main modules:

- Gathering data
- Preparing the data
- Choosing a model
- Training
- Prediction
- Evaluation of the model

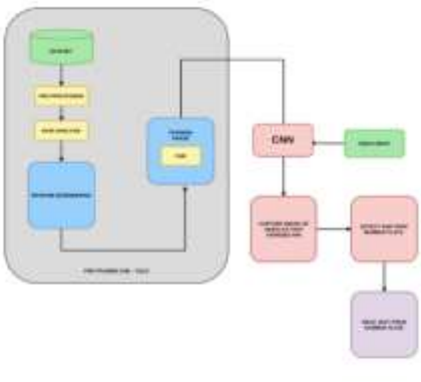

Figure 1: System Architecture

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YOLOV3 ALGORITHM:

YOLOv3 (You Only Look Once version 3) is an advanced object detection algorithm that has made significant strides in real-time object detection. Developed by Joseph Redmon and Ali Farhadi, YOLOv3 builds upon the success of its predecessors and introduces key improvements to enhance accuracy and efficiency. One of its standout features is the single-shot detection approach, which allows it to perform object detection and classification in a single forward pass through the neural network, making it exceptionally fast for real-time inference. The model is based on Darknet-53, a deep neural network architecture that effectively extracts hierarchical features from input images. Additionally, YOLOv3 employs a feature pyramid network to handle objects at various scales, enabling it to detect both small and large objects within the same network. Anchor boxes are introduced in YOLOv3 to predict bounding boxes with greater accuracy, capturing the spatial information of objects more effectively. The model predicts class probabilities for each bounding box, making it capable of simultaneous object detection and classification.

4. IMPLEMENTATION

We were able to determine how to differentiate between the data with the use of machine learning. While the model may not appear to be spectacular, the actions taken will define the model. This criterion may change in the future as machine learning and AI in general progress, however the steps for running the code and working are as follows:

- Gathering data
- Preparing that data
- Choosing a model
- Training
- Evaluation
- Hyper parameter tuning
- Prediction

5. SYSTEM DESIGN

SEQUENCE DIAGRAM

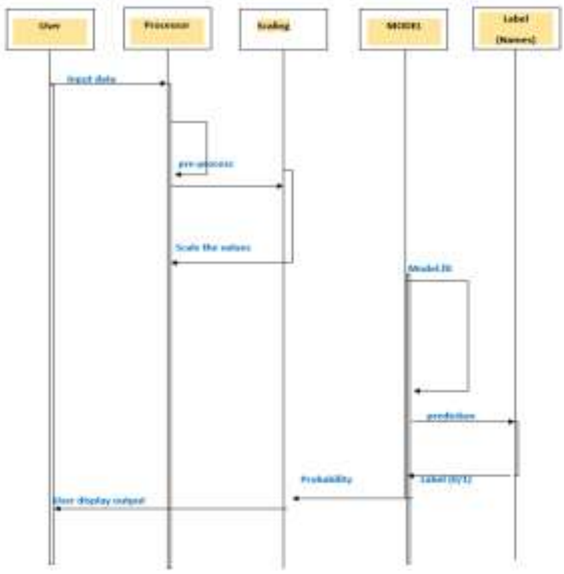

Figure 2: Sequence Diagram

Sequence diagram consists of 5 different blocks namely user, processor, scaling, Model and labels as shown in the above figure.

User will provide the input data through the csv files already saved in the system where pre-processing of data is done which is differentiator parameters and after that those are stored in the memory unit.

After preprocessing and storing of csv is done, trained model file is loaded where the featured of the file is extracted for classifying the output. After classifying the output, Prediction values are displayed.

DATA FLOW DIAGRAM

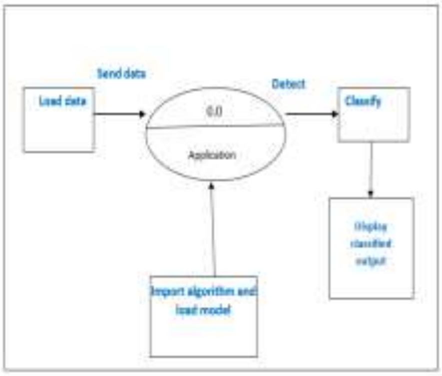

Figure 3: DFD 0

Above mentioned diagram is the representation of DFD0 which provides u the content diagram or say overview of the whole system. It is designed to be an at- a-glance view, showing the system as single high-level process. Here from the file data is be loaded to the application where the loaded data is sent to classification unit to predict the result with the help of trained model file and output is known.

DATAFLOW DIAGRAM LEVEL 1

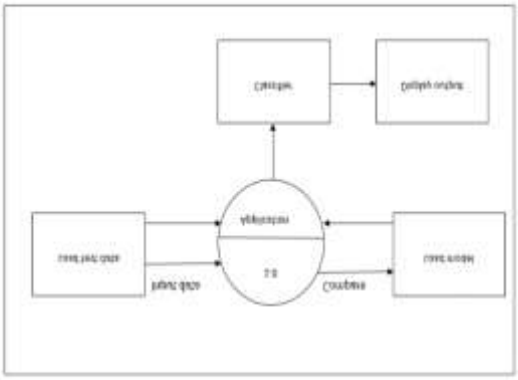

Figure 4: DFD 1

Above mentioned diagram is the representation of DFD1. The Level 0 DFD is broken down into more specific, Level 1 DFD. Level 1 DFD depicts basic modules in the system and the flow of data among various modules. Here from the file data is be loaded to the application where the loaded data is sent to classification unit to predict the result and classes are classified and given a label.

Activity diagram

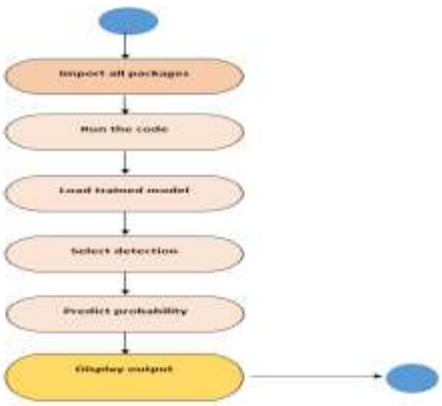

Figure 5: Activity Diagram

An activity diagram is a behavioural diagram i.e. it depicts the behaviour of a system. An activity diagram portrays the control flow from a start point to a finish point showing the various decision paths that exist while the activity is being executed.
Firstly, we import all the library package necessary to run the code and for supporting the two code to run error free. As soon as code is run it provides the desired output.

6. RESULTS

- ✓ Classification Report
- ✓ The current model shows an accuracy of 80-90%

The YOLOv3 algorithm follows these main steps to detect objects in an image:

Input Preprocessing:
The input image is first resized to a fixed size (e.g., 416x416 pixels) to be compatible with the YOLOv3 architecture.The image is normalized to values between 0 and 1, and then passed through the network for further processing. Backbone Network:YOLOv3 uses a deep convolutional neural network (CNN) as its backbone to extract features from the input image. The network is based on the Darknet architecture, which consists of many convolutional layers and some residual connections (similar to ResNet).The network captures different levels of features, starting from low-level features like edges to high-level features like shapes and textures.
Example:

Figure 6: ROI

Figure 7: Vehicle detection

Figure 8: Number plate extracted

Figure 9: Automatic number plate recognition

7. CONCLUSION

The "Traffic Violation Detection" paper and successfully developed an advanced system for real-time monitoring and identification of traffic violations using state-of-the-art computer vision techniques. By leveraging the power of OpenCV and YOLOv3, the system efficiently detected vehicles crossing the defined Region of Interest (ROI) and captured frames for further analysis. The integration of Optical Character Recognition (OCR) techniques enabled the extraction of number plate information, facilitating quick and accurate identification of violators.

8. REFERENCES

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