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Real-Time Detection of Littering from Vehicles in Traffic Surveillance Videos

Prakash K*[1], Manimozhi S*[2]

[1]MCA Student, Department of Computer Science & Applications, Periyar Maniammai Institute of Science and Technology. Thanjavur. kaviprakash203@gmail.com

[2]Associate Professor, Department of Computer Science & Applications, Periyar Maniammai Institute of Science and Technology. Thanjavur. manimozhi@pmu.edu

ABSTRACT:

In recent years, traffic volume and its management have become a significant concern for many cities worldwide, leading to a decline in the quality of life in urban areas. Littering while driving is a common practice globally and is a criminal offense that burdens the municipality and can even lead to accidents. In this paper, we propose a machine learning-based technique to identify and prevent this type of behaviour, which is illegal and punishable under section 279 of the Indian Penal Code. The proposed system is an automatic decoration garbage detection system based on the improved YOLOv2 network and narrowband Internet of things (NBIoT). The system can not only prevent littering but also aid in traffic management and monitoring road. conditions, creating a more sustainable and resilient transportation. system that enhances public safety and improves the quality of life in modern cities.

INTRODUCTION:

With the increase in urbanization, the volume of traffic on roads has also increased, leading to a decline in the quality of life in urban areas. Littering while driving is a widespread issue worldwide and is a criminal offense. It burdens the municipality and can even lead to accidents. Therefore, there is a need to develop a system that can

detect and prevent this type of behaviour. In this paper, we propose an automatic decoration garbage detection system based on the improved YOLOv2 network and narrowband Internet of things (NBIoT) that can identify and classify vehicles engaging in this type of behaviour. The proposed system can aid in traffic management and monitoring road conditions, creating a more sustainable and resilient transportation system that enhances public safety and improves the quality of life in modern cities.

LITERATURE REVIEW

In today's world, the use of intelligent transport systems (ITS) and location intelligence planning has become increasingly important, necessitating precise vehicle classification and tracking. Deep learning (DL) and computer vision are advanced methods used to achieve this objective, though real-time accuracy is a challenge. Another important issue is littering from vehicles (TWV), which poses a threat to the environment and sanitation workers who clean up roads. Therefore, using intelligent methods to detect instances of TWV in real-time traffic surveillance footage is imperative.

Furthermore, in the construction industry, estimating the generation of construction and demolition (C&D) waste is crucial. This can be achieved by utilizing a methodology based on waste generation rates (WGR) through regression analysis. Additionally, recycling C&D waste offers economic benefits and should be further investigated.

Video surveillance systems are used to monitor traffic, and they consist of three main modules: the segmentation module, vehicle classification module, and vehicle counting module. The segmentation module utilizes the Codebooks method for background subtraction to identify regions of interest corresponding to vehicles. The vehicle classification module uses histograms of oriented gradient in conjunction with support vector machine to classify vehicles according to their type. The overall goal of the video surveillance system is to accurately detect and count vehicles in the surveillance footage.

METHODOLOGY:

The proposed system is based on the You Only Look Once (YOLO) object detection algorithm, which is renowned for its ability to detect objects quickly and accurately. It segments the input and searches for potential objects to detect using an end-to-end neural network. VGG16 is a convolutional neural network (CNN) architecture that achieved success in winning ILSVR (ImageNet) and is considered one of the best vision model architectures to date.

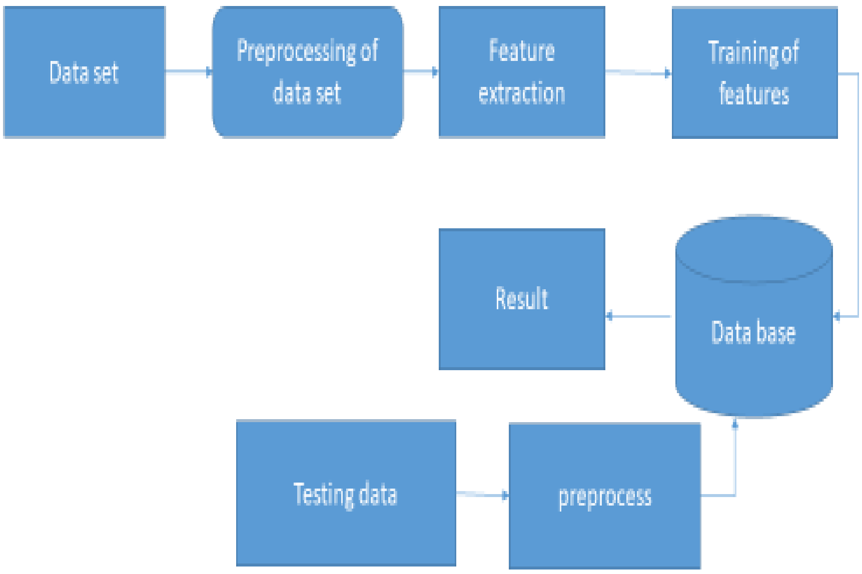
The architecture of VGG16 is characterized by its simplicity and uniformity in the number of layers and filters used in each layer. Specifically, the convolutional layers of VGG16 are composed of 3x3 filters, and the number of filters increases as the network goes deeper.

The proposed system uses the deep-residual network-leveraged vehicle-thrown waste identification method (DRN-VTWI) to identify littering while driving. DRN-VTWI is an innovative method that inspects the real-time traffic video stream in frames. Specially, it first splits one video frame into multiple small images corresponding to the location boxes of all suspected objects obtained using the Selective Search algorithm. Selective Search combines the

strength of both the graph segmentation and exhaustive search

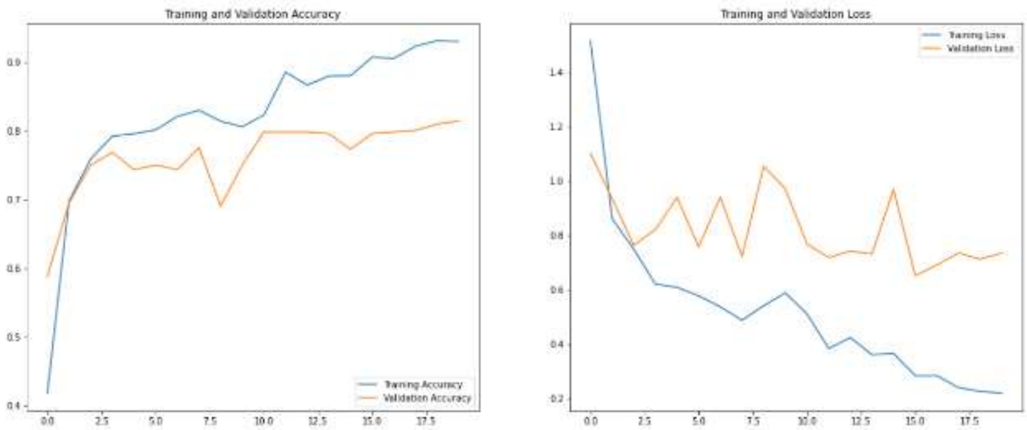
to address the problem of generating possible object locations for use in image object recognition. The system then uses the improved YOLOv2 network to classify the objects in the images.

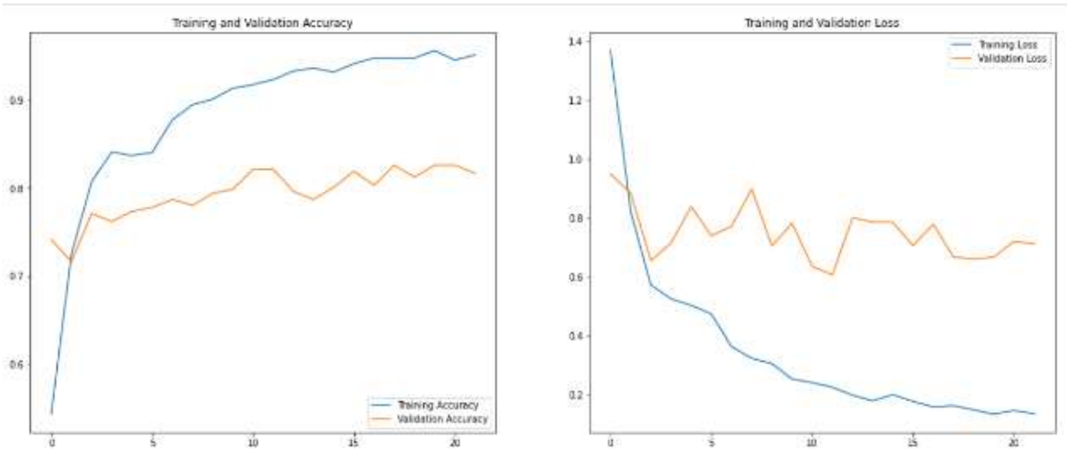
The proposed system also uses narrowband Internet of things (NBIoT) technology to send notifications to authorities when littering is detected. NBIoT is a low-power, wide-area network (LPWAN) technology that allows for the connection of low-power devices over long distances. It is ideal for applications where low power consumption, low data rates, and long battery life are essential.



SCREEN SHORT

(Accuracy of training)



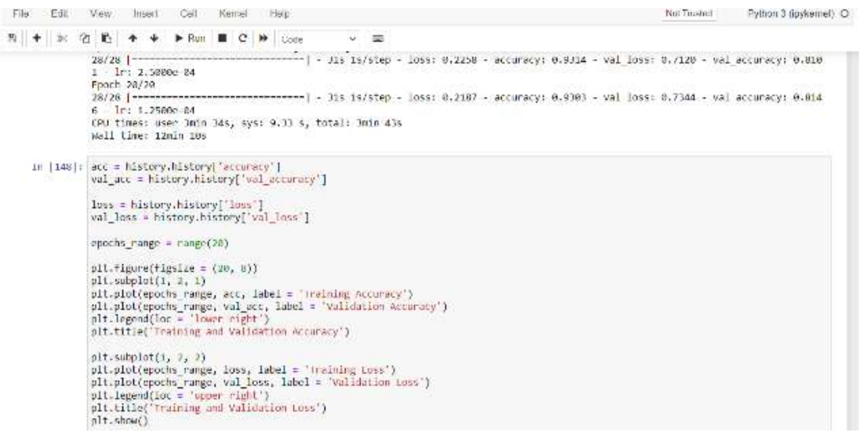


Accuracy: 9.6

DATASET

The data collection for this model is collected from the online third-party website called Kaggle.

SAMPLE CODE



```
28/28 [==============================] - 31s 1s/step - loss: 0.2258 - accuracy: 0.9314 - val_loss: 0.7120 - val_accuracy: 0.810
1 - lr: 2.5000e-04
Epoch 20/20
28/28 [==============================] - 31s 1s/step - loss: 0.2187 - accuracy: 0.9303 - val_loss: 0.7344 - val_accuracy: 0.814
6 - lr: 1.2500e-04
CPU times: user 3min 34s, sys: 9.33 s, total: 3min 43s
Wall time: 12min 10s

In [148]: acc = history.history['accuracy']
val_acc = history.history['val_accuracy']

loss = history.history['loss']
val_loss = history.history['val_loss']

epochs_range = range(20)

plt.figure(figsize = (20, 8))
plt.subplot(1, 2, 1)
plt.plot(epochs_range, acc, label = 'Training Accuracy')
plt.plot(epochs_range, val_acc, label = 'Validation Accuracy')
plt.legend(loc = 'lower right')
plt.title('Training and Validation Accuracy')

plt.subplot(1, 2, 2)
plt.plot(epochs_range, loss, label = 'Training Loss')
plt.plot(epochs_range, val_loss, label = 'Validation Loss')
plt.legend(loc = 'upper right')
plt.title('Training and Validation Loss')
plt.show()
```

CONCLUSION:

For the purpose of effectively detecting the uncivilized behaviour of TWV for intelligent traffic management, we first propose the dedicated deep network — Nov-ResNet-20. Then, combining Nov-ResNet-20, Selective Search, and NMS, we put forward the desirable DRN-VTWI method for identifying TWV n real-time traffic videos. The framework of our DRN-VTWI method includes three modules. Module I generate the waste identification model, VTWIM, via Nov-ResNet-20. Module II

runs the Selective Search algorithm on one video frame and obtains several small, identification-needed image regions that contain all suspected objects both waste-contained and non-waste-contained. Module III identifies all of the waste-contained regions via VTWIM and eventually in the video frame it helps to keep the best location box for each recognized vehicle-thrown waste, removing all redundancies using NMS. Our experimental studies verified the effectiveness as well as superiority of our proposed method.

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