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TEXT EXTRACTION BASED ON OBJECT DETECTION IN 2D IMAGES USING DNN

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Abstract

Artificial Intelligence becomes a crucial field when robots can perform tasks that require a human skills. It incorporates Machine Learning, which enables robots to acquire skills without the intervention of humans. Deep Learning is a subset of Machine Learning in which vast amounts of data are used to teach artificial neural networks and algorithms modelled after the human brain.One of the most challenging and intriguing issues in the field of computer vision is object detection, a crucial application of AI. The prediction of a target item's class within an input image is known as image classification. The process of determining where a large number of items are located within an input picture is referred to as object localization. Combining these two processes, object detection makes it possible to locate numerous objects within an image. The two types of object detection techniques are classification methods and regional proposal methods. An approach to real-time object identification known as YOLO (You Look Only Once) recognizes predetermined items in videos, live feeds, and photos. YOLO uses deep learning techniques like OpenCV and Keras to implement features learned by a deep convolutional neural network for object identification. The alternative version of YOLO, YOLOV3, is much better at identifying objects than YOLO.

Keywords: Artificial Intelligence, Machine Learning, Deep Learning, Object detection, Image classification, YOLOV3.

Introduction

A growing number of people are involved in accidents as a result of the increased use of two-wheeled vehicles for transportation. The use of helmets is an important factor in terms of safety that the majority of people avoid because the number of accidents in our country is increasing at an alarming rate. In 2016, approximately 28 motorcycle riders perished on Indian roads each day, and in 2017, 98 motorcycle riders perished daily because they did not wear helmets. According to the survey, nearly 20% of those who died in accidents did not wear helmets—a total of 10,135 in 2016 and 36,000 in 2017 [2]. The primary safety device for riders is the helmet; However, many drivers do not make full use of it. The United Nations Road Safety Collaboration produced a road safety manual that explains the significance of wearing helmets [3]. Additionally, the reader is provided with a deeper comprehension of the helmet's actual function in the manual [3]. The primary purpose of a helmet is to guarantee the safety of the driver. According to a 2015 United Nations study, wearing a helmet increased one's chance of surviving an accident by 42%.

Even though helmets are necessary for riders' safety, the majority of them avoid them for a variety of reasons, including that they "it obstructs my peripheral vision," "it feels uncomfortable," or "it spoils my hairstyle." The loss of a life is not comparable to these reasons. We understood that making new and high level procedures to find the defaulters will assist with lessening the quantity of mishaps, increment security, and make an acknowledgment in the personalities of individuals about the requirement for wearing a protective cap. A checkpoint set up by police or other personnel to manually check each rider is the current method for determining whether or not a rider is wearing a helmet. Riders may try to get around checkpoints in this system.

The creation of an automated system for helmet detection through the application of machine learning algorithms is the primary objective of our study. The extraction of patterns from datasets is the focus of the subfield of artificial intelligence known as machine learning. The process of using algorithms to sort through information, learn from it, and then make a prediction or expectation about something in the world is known as machine learning. We employ the methods of deep learning, a subset of machine learning algorithms that makes use of intricate artificial neural networks, in our new system. The application of convolutional neural networks (CNNs) to pre-trained real-time object detection and image classification models is one of our proposed innovation's primary research areas. The goal of using CNNs for image classification is to classify an input image based on its visual content. There are numerous models, including CaffeNet, GoogleNet, VGGnet, and InceptionV3. have been developed over time, and because of their high performance, some of them are quite popular. On the ImageNet dataset, InceptionV3 is a well-known model with an accuracy of almost 78%. The model is the result of combining the concepts of numerous researchers. We use the InceptionV3 model for transfer learning in our system. We can automate the process of helmet detection using a real-time surveillance system by employing such machine learning models.

Implementing this automated system may increase riders' awareness of the need to wear helmets in order to avoid being caught and avoid fines. A system of this kind will make it easier to levy fines on people who break the rules, and the constant levying of fines will force people to wear helmets. The reasons for not wearing a helmet previously mentioned will gradually disappear. Accidents will be less likely to occur as a result of the use of automatic detection. The police department will be able to find those who broke the law and save lives by incorporating an automatic model. The number of accidental deaths caused by not wearing helmets can be reduced with the new innovative system.

Literature Survey

A. Object Detection Using Convolutional Neural Networks

Reagon L.Galvaz, Argel Bandala, Elimer P. Dadios, Ryan Rhay P. Vicerra, “Object detection using convloutional neural networks”, published in the year 2018[1].

The object detection problem in artificial intelligence is one of the most difficult and intriguing problems. Convolutional Neural Networks (CNNs) are utilised in deep learning to classify images and locate objects inside them. This article uses convolutional neural networks (CNNs) to recognise things. Object detection may be useful for robot navigation, imaging in the medical field, and video surveillance. These kinds of operations have been carried out using a variety of techniques, including background subtraction, temporal differencing, support vector machines, optical flow, etc. Convolutional Neural Networks (CNNs) have been touted as being superior to the other techniques mentioned above for the task of object identification. Using this approach, they were able to provide a forecast that was more accurate than any of state-of-the-art models. Convolutional Neural Networks are a form of artificial neural networks that are frequently used in computer vision applications like object recognition and image classification to produce accurate results. Convolutional neural networks (CNNs) and more traditional neural networks share a lot of commonalities. Convolutional Neural Networks use a three-dimensional arrangement of neurons. They used the Tensorflow Object detection API to implement the task of detecting objects using convolutional neural networks. This API is nothing more than an open-source platform used for building, training, and deploying object detection models. For this study, the testing images were collected from the internet while the training images were taken from home movies and photos. This dataset only includes persons and the quadrator. In order to save the time for training the network, they adopted one of the most powerful deep learning techniques called Transfer Learning. It is mostly used for object identification, segmentation, and image classification. The databases of datasets like ImageNet and COCO were used to train the models used in this study. Hence, using the Convolutional

Neural Networks technique, the detection of objects was effective.

B. Faster R-CNN

Towards Real-time object detection with region proposal networks.

Shaoqing Ren, Kaiming He, Ross Girshick and Jian Sun, "Faster R-CNN: Towards Real-Time Object Detection with Region Proposal Networks", published in the year 2016[2].

Technology advancements have made it possible to identify objects using region-based proposal methods and even region-based convolutional neural networks. Rapid region-based Convolutional Neural Networks employ the graphics processing unit, while area proposal networks use the CPU when comparing runtimes (GPU). In this study, the authors use deep convolutional neural networks to show that by modifying the algorithm and computational techniques, the problem of object recognition and picture classification can be solved effectively and elegantly. At the study's conclusion, they also introduced the Region Proposal Networks (RPNs) to help in object identification. Rapid R-CNN and other convolutional feature networks are utilised to produce the necessary region recommendations for locating objects of interest. Nonetheless, they continued to develop on area proposal networks, which have additional features like the addition of convolutional layers to simultaneously regress the boundaries of the region and the objectness scores at each and every grid point. This review work shows that faster R-CNN is segregated into two independent modules. The first module, which suggests applications for these networks, focuses on deep convolutional networks. The second module, which utilises the regions produced in the first, is centred on the Fast R-CNN detector. The Region proposal network analyses a picture as input and outputs each rectangle object suggestion together with its objectness score. The Microsoft COCO dataset, which has been widely used for item identification and is freely available online, was utilised to capture these photos. The 80 different categories used to organise the images in the Ms COCO collection. They used 80,000 images from the training set, 20,000 images from the test-dev set, and 40,00,000 images from the verification set to test the algorithms. The efficient identification of objects was achieved by using a quicker R-CNN method, which has been demonstrated to be more effective at object recognition than the R-CNN family.

C. Tiny SSD

A Tiny Sngle shot detection deep convolutional neural network forreal-time embedded object detection

Alexander Wong, Mohammad Javad Shafiee, Francis Li, Bredan Chwyl, "Tiny SSD: A Tiny Single-shot Detection Deep Convolutional Neural Network for Real-time Embedded Object Detection", proposed in the year 2018[3]

Technology advancements have made it possible to identify objects using region-based proposal methods and even region-based convolutional neural networks. Rapid region-based Convolutional Neural Networks employ the graphics processing unit, while area proposal networks use the CPU when comparing runtimes (GPU). In this study, the authors use deep convolutional neural networks to show that by modifying the algorithm and computational techniques, the problem of object recognition and picture classification can be solved effectively and elegantly. At the study's conclusion, they also introduced the Region Proposal Networks (RPNs) to help in object identification. Rapid R-CNN and other convolutional feature networks are utilised to produce the necessary region recommendations for locating objects of interest. Nonetheless, they continued to develop on area proposal networks, which have additional features like the addition of convolutional layers to simultaneously regress the boundaries of the region and the objectness scores at each and every grid point. This review work shows that faster R-CNN is segregated into two independent modules. The first module, which suggests applications for these networks, focuses on deep convolutional networks. The second module, which utilises the regions produced in the first, is centred on the Fast R-CNN detector. The Region proposal network analyses a picture as input and outputs each rectangle object suggestion together with its objectness score. The Microsoft COCO dataset, which has been widely used for item identification and is freely available online, was utilised to capture these photos. The 80 different categories used to organise the images in the Ms COCO collection. They used 80,000 images from the training set, 20,000 images from the test-dev set, and 40,00,000 images from the verification set to test the algorithms. This was accomplished by using a quicker R-CNN strategy, which has been demonstrated to be more successful at identifying objects than the R-CNN family. The Single Shot multibox detection macroarchitecture has been one of the most widely used item identification systems since it was first developed. They can recognise objects of various sizes more readily thanks to the network design's Convolutional predictor and auxiliary Convolutional feature layers. The primary goal of the construction of the additional Convolutional feature layers based on Single Shot Identification is to reduce the model's size without compromising the performance of object detection. As a result, the results of the investigations discussed above show that even very small deep neural network architectures may be developed for the identification of real-time objects, which is especially suitable for embedded situations.

D. Survey of Deep Learning based object detection.

Liceng Jiao, Fan Zhang, Fang Liu, Shuyuan Yang, Lingling Li, Zhixi Feng, Rong Qu, " A survey of Deep Learning

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based Object detection", published in the tear 2019[4].

The survey in this base work focuses on describing and analysing R-CNN-based deep learning-based object detection tasks. R-CNN is an acronym for region based convolutional neural networks. It is one of the most typical methods for locating things. One of the most crucial and challenging aspects of computer vision is object detection. It has been used to locate instances of semantic items that fall under a particular class in many different aspects of people's lives, including security monitoring and self-driving cars. Object detectors are now far more effective at what they do thanks to the rapid development of deep learning algorithms for detecting jobs. In this study, we first examine the techniques used with current benchmark datasets. Then, in order to properly and deeply comprehend the primary state of development of the object detection pipeline, we provide a systematic overview of a wide range of object detection techniques, including both one-stage and two-stage detectors. We also mention both conventional and contemporary usage. Furthermore examined are some of the key domains of object detection. R-CNN is a region-based detector that can be used to find things. It uses a selective search method to find the objects. Finally, they discussed how to create an effective and efficient system using various object detection techniques. They also discussed key development trends that will enable them to stay current with the best algorithms and conduct further research. drone identification using CNN-based single object tracking and detection in videos. Dong-Hyun Lee, "CNN- based Single object detection and tracking in videos and its application to drone detection", published in the year 2019. This paper focuses on object detection and tracking algorithms using Convolutional neural networks in a single shot. Videos cannot be used with CNN methodology methods for object detection. Instead, only static images can be used. When using approaches like model-free visual tracking for objects, we must first provide the target's ground truth bounding box before the objects can be detected. Moreover, training for both the visual trackers and the object detectors is necessary for various annotated video datasets of the object that needs to be detected. In order to combine the most advanced visual trackers and object detectors effectively, where just a few static images of the target may be available for training, they suggested three straightforward and efficient object recognition and tracking methods, primarily for videos. The effectiveness of the suggested algorithms has been evaluated using the more effective drone detection tasks.

Problem identification

The majority of individuals use two-wheelers because there aren't any public transportation options. As a result, the number of people utilising two-wheelers is fast rising day by day. Also, the number of traffic accidents is continuously rising. If we look at the statistics for traffic accidents, two-wheelers alone account for the majority of them. Teenagers make up the majority of those who are losing their life. To a certain extent, helmets can reduce the probability of traffic accidents. Nonetheless, very few riders of two-wheelers may be seen donning helmets. According to World Health Organization data, simply wearing a helmet properly and correctly can cut the risk of road fatalities by 47% and the risk of brain injuries by 69%. Thus, we built a system that captures people riding two-wheelers without helmets and extracts the licence plate of the moving cars in order to lower the danger of traffic accidents and save lives. Our system will immediately generate an e-chalan with the fine that needs to be paid by the offender for breaking the traffic laws as soon as the number plate is extracted. Finally, people will start wearing helmets in order to avoid paying the fine, which will help us save countless lives.

Methodology

The main concept we used in this project is DNN. Deep Neural Network, often known as artificial neurons, is a sort of neural network architecture made up of numerous layers of interconnected neurons. DNNs are employed in a variety of tasks, such as speech recognition, machine translation, natural language processing, and image and image recognition. Due to the network's numerous layers and ability to learn and represent complex characteristics and patterns in the input data, deep neural networks (DNNs) are referred to as such. The output from the preceding layer is processed by each layer of the DNN, and the last layer produces the final output. Backpropagation is a supervised learning algorithm that modifies the weights and biases of the neurons in DNNs to reduce the discrepancy between the expected output and the actual output. During training, the network is given a sizable dataset of labelled instances, and the weights and biases are incrementally changed until the network can correctly predict the labels for brand-new, unlabeled examples. DNNs have been demonstrated to perform at the cutting edge on a variety of tasks, but they also need a significant quantity of training data, processing power, and careful tweaking to prevent overfitting.

This project has two different sectors to proceed with. One is object detection and the other one is text extraction. To detect the object the methodology used is YOLOV3 and to extract the text from the given image the methodology used is EasyOCR.

A. YOLOV3

YOLOV3 is thought to be one of the most widely used approaches for object detection, in contrast to region-based algorithms like R-CNN, which we previously evaluated. As implied by its name, YOLOV3 stands for You Only Look

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Once Version 3. The best real-time object detecting system is YOLO. YOLO is regarded as a sophisticated convolution neural network for real-time object recognition. YOLO is more efficient than the Faster R-CNN algorithm because of its more straightforward architecture. A trained YOLO can perform bounding box regression and photo classification almost simultaneously. Using the YOLO algorithm, you can quickly and accurately identify objects in all kinds of videos, live telecasts, and images. Deep convolutional neural networks are used by YOLO to learn and use features for object detection. Convolutional layers directly learn the features used in detectors, which are subsequently provided to a classifier that can make an accurate prediction. Its name, You Only Look Once, refers to the fact that the prediction of the object is based on 1x1 convolutional layers, which imply that the size of the prediction map is equal to the size of the feature map. YOLOV3 is thought to be one of the most widely used approaches for object detection, in contrast to region-based algorithms like R-CNN, which we previously evaluated. YOLOV3 stands for You Only Look Once Version 3, as the name suggests. The best real-time object detecting system is YOLO. YOLO is regarded as a sophisticated convolution neural network for real-time object recognition. YOLO is more efficient than the Faster R-CNN algorithm because of its more straightforward architecture. A trained YOLO can perform bounding box regression and photo classification almost simultaneously. Using the YOLO algorithm, you can quickly and accurately identify objects in all kinds of videos, live streams, and images. Deep convolutional neural networks are used by YOLO to learn and use features for object detection.

Convolutional layers directly learn the features used in detectors, which are subsequently provided to a classifier that can make an accurate prediction. Its name, You Only Look Once, refers to the fact that the prediction of the object is based on 1x1 convolutional layers, which imply that the size of the prediction map is equal to the size of the feature map. A Convolutional Neural Network called YOLOV3 is able to recognise objects in real time with just one glance. Convolutional Neural Networks are classifier-based systems that can understand the input images as structural arrays of data and attempt to find patterns between them by only looking at the input once. The YOLO algorithm has the advantage of being both quicker and more precise than any other network already in use. The network can view the entire input image at once thanks to the YOLO method, and the image also sheds light on the algorithm's predictions. Similar to the YOLO approach, convolutional neural networks assign scores to regions based on how closely they correspond to specified categories. The YOLO algorithm is exceptional in a wide range of applications.

Two-wheeler use has increased in India as a result of the absence of public transit. Moreover, there has been a rise in the amount of traffic collisions. Motorists who don't wear their helmets properly are responsible for the majority of traffic collisions that result in fatalities. According to a World Health Organization study, wearing a helmet may reduce fatal injuries by 47% and brain injuries by around 69%. A single police officer finds it difficult to monitor all of the traffic in a city. More human engagement is therefore required, which is virtually impossible. In order to identify two-wheelers who are not wearing helmets and record the license plate of the cars, we need technology that can do this. An increasing number of people are interested in artificial intelligence, which aims to teach computers to have intellect comparable to that of human brains. An algorithm called YOLOV3 was created to provide a more precise means of identifying two-wheelers who were not wearing helmets. YOLOV3 is one of the most extensively used object recognition techniques in the world and is a well-known method in the field of artificial intelligence. Performance-wise, YOLOV3 will deliver outstanding outcomes for a wide range of input resolutions.

B. EasyOCR

EasyOCR is a Python package that enables computer vision developers to perform Optical Character Recognition with ease. When it comes to OCR, EasyOCR is by far the easiest way to use Optical Character Recognition. A single pip command will install the EasyOCR package. The EasyOCR package has few dependencies, making it simple to set up your OCR development environment. Once EasyOCR is installed, importing the package into your project requires only one import statement. To perform OCR, you only need two lines of code: one to initialize the Reader class and another to OCR the image using the readtext function. Python and the PyTorch library are used to implement EasyOCR. If you have a CUDA-capable GPU, the underlying PyTorch deep learning library can significantly improve text detection and OCR speed. EasyOCR can currently OCR text in 58 languages, including English, German, Hindi, Russian, and others. The EasyOCR developers intend to add more languages in the future.

Implementation

This project is implemented in python. Libraries used to implement are cv2 for analyzing video, numpy to use arrays, tensorflow to load the build model, matplotlib to assign boxes, easyocr for text extection, streamlit to provide an interface to the application.

Firstly, we take some input file. The code to do this is

```
video_file = st.file_uploader("Upload a video file", type= ["mp4"])
```

Later prebuilt model is loaded.

```
net = cv2.dnn.readNet("yolov3-custom_7000.weights", "yolov3-custom.cfg")
```

Now the bikes detection should be done. Once the bikes are detected the frame which includes only bike should be croped.

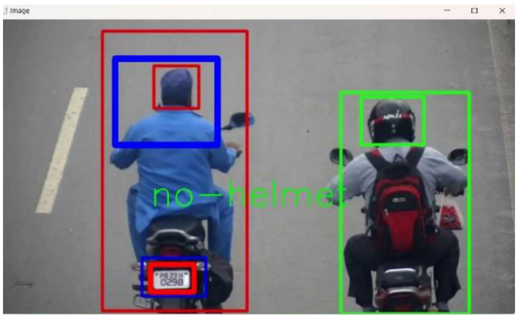
```
cropped_image = img[y1:y2, x1:x2]
```

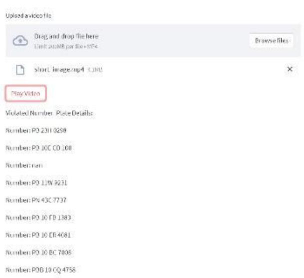
And know finally the text extraction should be done.

```
reader = easyocr.Reader(['en'])
output = reader.readtext(image_file)
```

Result and Conclusion

Output Screens of detection and text extraction are shared below.





The criteria chosen for categorizing the collected frames is a person operating a two-wheeler while wearing a helmet or not. We intend to extract pictures that have a rider of a two-wheeler who is both wearing and not wearing a helmet. First, we categorize photos that show a person riding a two-wheeler or not. The dataset based on the condition is then obtained by analyzing the photos that have been categorized. The acquired frames will be rejected or not taken into consideration if they contain images that do not meet the criteria given above. We use a video file as the model's input and draw a bounding box around the frames that contain a human and a motorcycle. Cropped frames that include both a person and a motorcycle are preserved in a directory. Caffe model is the one employed for the detection and extraction. The accuracy rating for the suggested model is 86%. Images of both helmet-wearing and helmet-less people are included in the dataset used to train this new suggested model. For this specific binary classification problem, the image classifier was previously trained. Inception V3 model is the categorization model in use. The validated accuracy score for the suggested model was around 74%. Despite the fact that this model produces good results, we are constantly looking for ways to improve it. In order to evaluate the accuracy and select the best model, we will use a variety of models.

Limitations

1. Limited to detecting helmets only: The system is limited to detecting helmets only, which means it cannot detect other safety equipment or objects like triple ride etc.

2. Real-time processing limitations: Although the system is designed for real-time processing, there may be some delays due to the time taken for image preprocessing and post-processing.

3. Cannot extract number plate details in real-time: The system can extract number plate details but only after processing the entire video. It cannot extract number plate details in real time.

4. Text extraction errors: The system may encounter errors while extracting text from number plates due to factors such as poor image quality, occlusions, or font sizes and style variations. These errors can lead to incorrect or incomplete text extraction, which may affect the system's overall performance.

Future Scope

1. Integration with other traffic violation detection: The system can be integrated with other traffic violation detection systems, such as triple ride detection, wrong way detection, and speeding detection, to provide a comprehensive traffic monitoring and violation detection system.

2. Improved accuracy and performance: The system can be further improved using advanced deep learning techniques like attention mechanisms, ensemble models, or improved training data augmentation techniques to achieve better accuracy and performance.

3. The system can be further enhanced to provide real-time violation detection and notification by displaying the number plates of violated vehicles in the live stream itself and sending notifications to vehicle owners through email or other means regarding the fine or penalty associated with the violation and assist concerned authorities in issuing a challan or ticket

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