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An Application Of A Deep Learning Algorithm for Automatic Detection Of Unexpected Accidents Under bad CCTV Monitoring Conditions in Tunnels

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ABSTRACT:

In this paper, Object Detection and Tracking System (ODTS) in combination with a well-known deep learning network, Faster Regional Convolution Neural Network (Faster R-CNN), for Object Detection and Conventional Object Tracking algorithm will be introduced and applied for automatic detection and monitoring of unexpected events on CCTVs in tunnels, which are likely to (1) Wrong-Way Driving (WWD), (2) Stop, (3) Person out of vehicle in tunnel (4) Fire. ODTS accepts a video frame in time as an input to obtain Bounding Box (BBox) results by Object Detection and compares the BBoxs of the current and previous video frames to assign a unique ID number to each moving and detected object. This system makes it possible to track a moving object in time, which is not usual to be achieved in conventional object detection frameworks. A deep learning model in ODTS was trained with a dataset of event images in tunnels to Average Precision (AP) values of 0.8479, 0.7161 and 0.9085 for target objects: Car, Person, and Fire, respectively. Then, based on trained deep learning model, the ODTS based Tunnel CCTV Accident Detection System was tested using four accident videos which including each accident. As a result, the system can detect all accidents within 10 seconds.

The more important point is that the detection capacity of ODTS could be enhanced automatically without any changes in the program codes as the training dataset becomes rich.

Key words: GBM, boosting algorithm, Heart performance.

I INTRODUCTION

1.1 Motive:

- Object detection technology has been successfully applied to find the size and position of target objects appearing on images or videos. Several applications have appeared mainly in self-driving of vehicles, CCTV monitoring and security system, cancer detection, etc. Object tracking is another area in image processing to be achieved by unique identification and tracking the positions of identified objects over time. However, to track objects, it is necessary to define object class and position first in a firstly given static image by object detection. Therefore, it can be said that the results of object tracking should be deeply dependent on the performance of the object detection involved. This object tracking technology has been successfully utilized for tracing of targeted pedestrian and the moving vehicle, a ccident monitoring in traffic camera, criminal and security monitoring in the certain local area of concern, etc. In the traffic control field, a case study on analysis and control of traffic conditions by automatic object detection has carried out in this paper. The summaries are given as follows. According to [1], an on-road vehicle detection system for the self-driving car was developed. This system detects vehicle object and classifies the type of vehicle by Convolutional Neural Network (CNN). The vehicle object tracking algorithm tracks the vehicle object by changing the tracking center point according to the position of the recognized vehicle object on the image. Then, the monitor shows a localized image like a bird's viewpoint with the visualized vehicle objects, and the system calculates the distance between the driving car and the visualized vehicle objects. This process of the system enables to objectively view the position of the vehicle object so that it can help assistance of the self-driving system. As a result, it can localize the vehicle object in vertical 1.5m, horizontal 0.4m tolerance at the camera. In [2], another deep learning-based detection system in combination with CNN and Support Vector Machine (SVM) was developed to monitor moving vehicles on urban roads or highways by satellite. This system extracts the feature from the satellite image through CNN using the satellite image as an input value and performs the binary classification with SVM to detect the vehicle BBox. Besides, Arinaldi, Pradana, and Gurusinga [3] developed a system to estimate the speed of the vehicle, classify vehicle type, and analyze traffic volume. This system utilizes BBox obtained by object detection based on videos or images. The algorithm applied to the system was compared with the Gaussian Mixture Model + SVM and faster RCNN. Then it appears that faster R-CNN was able to detect the position and type of vehicle more accurately. In other words, it could be said that the deep learning-based object detection approach is superior to the algorithm based object detection system. As a conclusion, all of the development cases in this paper deal with object detection based monitoring system to obtain traffic information, showing outstanding performance with deep learning. However, they all were hard to assign unique IDs to the detected objects and track them by keeping the same ID over time. Therefore, in this paper, an attempt is made for generate an object detection & tracking system (ODTS), that can obtain moving information of target objects by combining object tracking algorithm with the deep learning-based object detection process. The full ODTS procedures (Figure 1) will be described in details in the following section. Also, the tunnel accident detection system in the framework of ODTS will be taken into consideration [4,7]. This system is used for detecting accident or unexpected events taking place on moving object and target local region on CCTV.

II LITERATURE SURVEY

In the paper "Smart health prediction system using data mining"[1] the author has discussed many topics related to data mining techniques such as Naive Bayes, KDD(Knowledge discovery in Database). The Bayesian statistics can be applied to economic sociology and other fields. This checks the patients at initial level and automatically suggest the possible diseases. The system uses Naive Bayes classifier for the construction of the prediction system. The advantage of this system is that the initial consultation cost of doctor fees can be avoided. Eclipse IDE is used for creating the front end Graphical User Interface and NavicatMysql is used for backend database purpose. Here java is used as a programming language to connect the database and GUI purpose. The only disadvantage of the system the efficiency in detecting the symptoms or symptom mapping. The paper "A Smart Health Prediction Using Data Mining" [2] is explaining the similar topics to the paper [1]. But there is detailed explanation of the internal algorithms used in the system. The Naive Bayes algorithm can be used for developing models that are used to assign class labels of different format. Naive Bayes algorithm is not a single, but a group of algorithm based on common principle. The steps involved in the Naive Bayes algorithm include (i) Division of segments, (ii) Comparing the first character of pattern until match occurs, (iii) Comparing the last character of pattern, (iv) Perform each character comparison. Also the hardware requirements used are processor of 2.0 GHZ and Ram of 2GB. The software requirements are JAVA programming language, Mysql 5.0 database and Tomcat server. In the paper “Smart E-Health Prediction System Using Data Mining” [3] most of the topics covered are on the system architecture. In this paper the design aspects of the system are primarily focused. In this paper the author has given a detailed framework to beat the downside of existing system. The smart health framework is used to implement the design aspects of the project.

III EXISTING SYSTEM

Experiments with the developed system in this study are divided into two parts: the learning performance measurement of deep learning and the accident detection performance of the entire system. The SORT used in ODTS is greatly affected by object recognition performance. Therefore, to complete this system, high performance of object detection through proper learning of deep learning object detection network was required. Then, based on the trained deep learning model, the entire system was tested to see if it can detect the targeted four accident events. In this case, since both the object detection performance of the deep learning model and the discriminative ability of the CADA were both required, the system was tested for each image to determine whether it is possible to detect each situation.

IV PROPOSED SYSTEM

The process of object detection and tracking by the ODTS over time[7]. It is assumed that ODTS has been trained enough to perform object detection properly on a given image frame. ODTS receives selected frames of video at specified time interval c and gains sets of coordinates, n BBoxs are detected of objects on the given image frame at the time T, from the trained object detection system. The corresponding type or class of each detected object is simultaneously classified by the object detection module. Then, based on the detected object information, a dependent object tracking module is initiated to assign the unique ID number to each of the detected objects, and predict the next position of each of the objects, The number of tracking BBox u is different from n. But If past tracked BBox is 0, the number of tracking BBox equals to the number of the detected objects. For example, in time T+c, if u is 0, u' equals to n'. In other words, when the past tracking BBox did not exist, the current tracking BBox takes from the detected objects per each class. This object tracking module was composed by introducing an object tracking algorithm called SORT algorithm[5], which uses a concept of Intersection Over Union (IOU) to trace the same object with the same ID number and also uses Kalman filter and Hungarian algorithm for prediction of the next position of the detected objects.

V METHODOLOGY:

5.1 Concept

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5.2 Tunnel accident detection system

Driving in a road tunnel is dangerous because it is inadequate space to evacuate compared to a general highway, and should inform the drivers if an emergency occurs in the tunnel[7]. Therefore, in South Korea, Person, Fire, Stop, and Wrong Way Driving(WWD) are the target objects and events to be monitored in the national regulation[4]. Driving in a road tunnel is dangerous because it is inadequate space to evacuate compared to a general highway. Therefore, drivers should be informed as soon as possible when an emergency occurs in the tunnel[7]. In South Korea, The objects or events: Person, Fire, Stop, and WWD should be detected and monitored according to the Korean national regulation [4].

Meanwhile, The monitoring of the target objects and unexpected events are undertaken through CCTVs in tunnels. And an automatic object detection system for the targets would be adopted for the purpose with an excellent performance outside of tunnels. However, the system doesn't work at all in a tunnel. It is because: (1) In the tunnel video has low Illuminance, so the video was greatly influenced by the tail light of the driving vehicle or the warning light of the car in operation. (2) The tone of the tunnel video was a dark color. In other words, it has a different color compared to the road of the tunnel outside. Since the above two reasons, the video monitoring system developed on the roads outside of the tunnels was likely to fail to operate appropriately in the tunnel. Therefore, an automatic accident detection system specialized for road tunnel is required. To overcome the problems above, deep learning-based Tunnel CCTV Accident Detection System was developed in [7]. A deep learning model of Faster R-CNN was used for training. And this model was based on a model that learns image datasets that include some accidents in tunnels. Then, ODTS uses an object tracking function only with Car object, and the tracking information of the target Car object is used for determining Stop and WWD events by using Car Accident Detection Algorithm(CADA) periodically.

VI RESULTS EXPLANATION

Load and Generate the Model: This is the model of detecting an accident through CCTV. This model consists of specific button called Load and Generate CNN which can load the live monitoring files.

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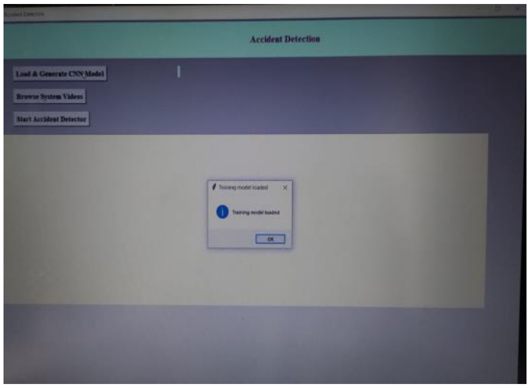
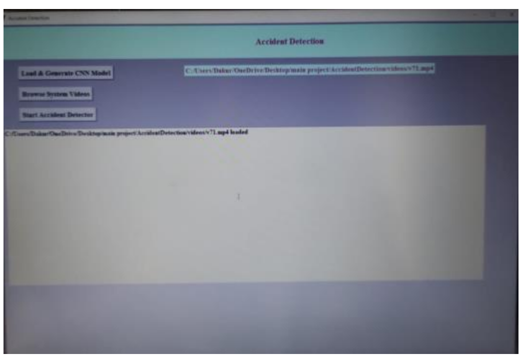
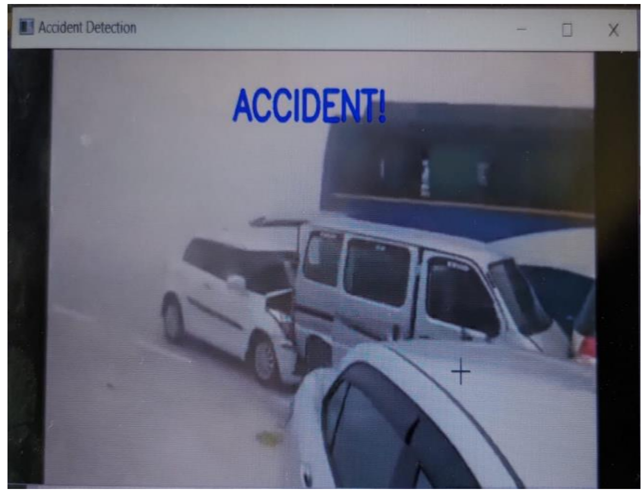


Browse System Videos: This option helps us to browse the Recorded or System Videos for detection of accident which can be accessed through the button called Browse System Videos.



Start Accident Detector: On clicking the button Start Accident Detector, it starts detecting the accident either through the uploaded files or live streaming. In case an accident has been detected the system automatically beeps and shows an alert as an indication.



VII CONCLUSION

This paper proposes a new process of ODTS by combining deep learning-based object detection network and object tracking algorithm, and it shows dynamic information of an object for a specific object class can be obtained and utilized. On the other hand, the object detection performance is important because SORT used in ODTS object tracking uses only information of BBox without using an image. Therefore, continuous object detection performance may be less needed unless the object tracking algorithm is relatively dependent on object recognition performance. And Tunnel CCTV Accident Detection System based on ODTS was developed. The experiments on training and evaluation of deep learning object detection network and detection of an accident of the whole system were conducted. This system adds CADA that discriminates every cycle based on dynamic information of the car objects. As a result of experimenting with the image containing each accident, it was possible to detect the accidents within 10 seconds. On the other hand, training of deep learning secured the object detection performance of a reliable Car object, and Person showed relatively low object detection performance. However, in the case of Fire, there is a high probability of false detection in the untrained videos due to the insufficient number of Fire objects. Nonetheless, it is possible to reduce the occurrence of false detections by simultaneously training objects that are No Fire. The fire object detection performance of the deep learning object detection network should be improved by securing the Fire image later. Although the ODTS can be applied as an example of a Tunnel CCTV Accident Detection System, it is also used to fields that need to monitor the dynamic movement of a specific object such as vehicle speed estimation or illegal parking monitoring will be possible.

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