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Effective Detection of Weapons in Video Surveillance

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ABSTRACT- Surveillance cameras also known as Closed Circuit Tele-Vision (CCTV) play a major part in the enforcement of the law and the administration of justice. The present level of industrial production technology cannot differentiate between a good and a bad, or even a bit worse, situation. As a consequence, additional crime scene investigation or law order maintenance work is needed, which takes a lengthy time. The suggested work is being utilized for a number of purposes, including surveillance, weapon monitoring and classification, live tracking, and more. Video input is permitted as a type of raw input in this project for monitoring and detecting abnormal events utilizing real-time detection techniques such as You Look Only Once Version 3 (YOLO V3). The proposed project's operations make use of a processing module for object recognition using convolutional neural networks such as YOLO V3, which predicts classes and bounding boxes for the entire image in a single run of the algorithm. The circular area will be watched by CCTV, which will automatically execute all operations and be controlled. Before implementing in such a setting and delivering optimal results, numerous samples and datasets will be examined to find accuracy in detection and classification. The planned effort aims to significantly reduce crime rates while simultaneously providing improved protection in specific areas and decreasing the time it takes to capture a criminal.

KEYWORDS- Classification, Deep Learning, Faster R-CNN, Object Detection, Object Recognition, Surveillance, Weapons, X-Ray, YOLO V3.

I. INTRODUCTION

Arms of a smaller size are weapons used in small-scale warfare to large-scale wars/conflicts, and their only purpose is to defend law enforcement personnel. People have lately taken to having their own set of arms for a number of reasons, including self-defense, show and tell, and so on[1][2][3][4]. The abuse of these weapons and their powers, which is the dark side of this bright idealism, is what troubles the civilization. Robbery, murder, and other crimes are perpetrated with the help of these, and law enforcement organizations use a range of methods to fight them. As a consequence, researcher's effort aims to help society by detecting such anomalies in advance and enabling monitoring experts to take necessary action. Still photos are slow proof, but live photography provides for a better understanding of a continuous event, allowing for better administration and the maintenance of community harmony and peace [5].

On the primary domain, the project "Effective Detection of Weapons in Video Surveillance" is based on image processing and deep neural networks technology. The main idea is to build a prototype that will operate on a stand-alone system that has been specially built for it. If there is a possible commercial application, this approach will help us comprehend the distinction between stand-alone and commercial requirements [6][7][8][9].

The demand for automated surveillance algorithms is increasing, with the primary aim of automated surveillance being to notify CCTV operators when a hazardous situation occurs. A risky situation happens when a person or a group of individuals utilize hazardous weapons such as knives or guns to attack, intimidate, or disturb others in public places. Object recognition techniques from the areas of computer vision and image processing may be combined with cameras to generate the concept of automated surveillance. Object recognition algorithms have been used in software processing of video footage in security cameras in recent years, and they are now extensively deployed in intelligent transportation systems for traffic monitoring.

Until far, there has been a small number of algorithms created to detect guns from surveillance cameras. Furthermore, these proposed algorithms only detect one kind of weapon, either a gun or a knife. The thesis' aim is to build an item identification algorithm capable of identifying a knife in a security camera image. Although the algorithm cannot prevent crime from happening, it may help a security camera operator who monitors many screens by alerting him when a possible knife is detected[10][11][12][13].

A. Existing System and Drawbacks

After establishing competence in the fields of CCTV, deep learning models, and processing hardware, researchers were confronted with the problem of real-time object identification and classification. Very little effort and study has been done on this subject of weapon detection, as most prior research has concentrated on concealed weapon detection (CWD) (CWD). Previously, concealed weapon detection (CWD) was utilized for security reasons at airports for baggage handling, using imaging technology such as infrared and millimeter wave imaging to identify hidden weapons in advance while monitoring or in places where exposure relies on limit. Current methods are advanced, utilizing multiple splitters and detectors, using simple magnitude descriptors, or using more complicated techniques receive a rise. The CWD method utilizes standard filters shot at various exposure settings for visible and infrared pictures [14][15].

While CWD works well in some cases, it has some limitations, including the inability to detect non-metal weapons because it is based on metal detection and the cost of using it when needed. The use of X-ray scanners and carriers reacts to all metal objects that can be harmful to your health [15][16][17][18].

II. LITERATURE SURVEY

A. Jha et al. presented the research which offers a new technique for forecasting future plan and angular coordinates of the mobile robot utilizing two-wheel differential mode odor measurement. Distance measurement is provided utilizing two independent wheels with accompanying encoders. The variation is determined by the difference in speed between the two wheels and the rotation of the two wheels is independent. The angle encoder determines the rotation speed of the two wheels. Mathematical models are given to assist the mobile robot accomplish its objective correctly. The real displacement of the mobile robot is measured by the odor measurement of the mathematical model given using the estimated data from the two encoders. The suggested odometer utilizes displacement to determine the plane coordinates and the next angle of the mobile robot. The findings of a simulated experiment are reported using the resultant odor measurement. The final outcome is optimum odor measurement with minimum variation from the real route [19].

III. METHODOLOGY

A. Design

Deep learning is a subset of a broader family of machine learning methods based on representation learning and artificial neural networks. There are three kinds of learning: supervised, semi-supervised, and unsupervised. Because of its exceptional performance in this sector, researcher used the YOLO V3 method. Because researcher's item is smaller than the items in the backdrop, Engineers tried the aforementioned methods for both categorization and object detection. After a lot of testing, researchers found the optimum technique for the instance, which was Sliding window/classification and area recommendation. First, individuals utilized deep learning algorithms to begin the classification process. The scientists were also able to obtain excellent accuracy, but subsequently found that the low frame rate in the classification model was a significant implementation problem for real-time applications. The researchers resorted to object identification and domain suggestion methods to obtain high accuracy, higher frames per second, and better localization. Engineers trained and tested various recognition then compared the results for accuracy, measures - the newest MobileNetv1 SSD based on deep learning, YOLO V3 [20].

B. Instruments

Researcher proceeded through the following modules to complete the implementation:

1) Object Recognition

Object Recognition is the process of anticipating the true category or class to which a picture belongs, and only that class has a high probability. People mostly utilize YOLO V3 to accurately recognize the category.

2) Image Classification

The classification model will take a picture and apply a filter to the whole picture in order to generate feature maps. The image's label is then predicted using the feature map and likelihood.

3) Object Localization

This function specifies the exact placement of an item in an image by specifying its height and width, as well as its coordinates.

4) Object Detection

The qualities of the aforementioned algorithms are used in this work.

5) Data Collection

The bounding box (see Figure 1) includes x and y coordinates, as well as related width and height and a class name, according to the object detection technique. The box with researcher's chosen threshold is output using non-max suppression. This procedure also yields the following outcomes:

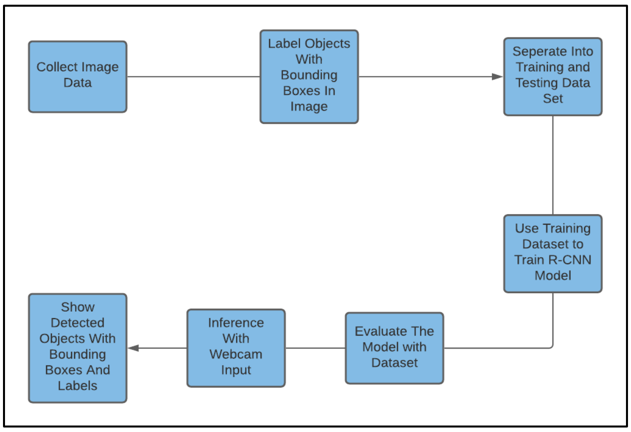

Figure 1: According to the Object Detection Methodology, the Bounding Box Probability Contains X - Y Coordinates, As Well As Linked to Width - Height and A Class Name

C. Data Analysis

1) Classification as well as Detection Approach

The various methods for getting space ideas exists, but the simplest choice is to use a sliding window strategy. Sliding window methods have many disadvantages, such as being slow, but researcher may solve this by utilizing a region proposal strategy, thus people use the following two approaches in the study work for both classification and detection models [21].

2) *Models of Classification/Sliding Window*

Researchers use object recognition to determine patches for window-covered frames, such as sliding windows, drag areas on the image to select areas, and use object recognition to cover. decided on a patch for the broken frame. Window (see Figure 3). It's an in-depth study of the big picture [22].

3) *Object Detection/Region Proposal Models*

This technique accepts an image as a bounding box then makes any recommendations regarding the area of the image most likely to be an object, as well as the area with the highest score as the element's location. (see Figure 2).

4) *Training Mechanism*

The training process begins with significant the delinquent, discovery the appropriate info, using preprocessing. Then add some extensions. If the evaluation is correct, the weights are saved as a classifier. However, if the assessment is incorrect, the reverse propagation method is used in combination with the steeper descent method. The weights are optimized by the back-addition method from the old or previous weights using the alpha learning rate multiplier [23].

5) *Confusion Object Inclusion*

This phase is completed by adding appropriate confounding elements to reduce the number of false positives and false positives. In addition to weapons, any objects or guns such as cell phones, metal detectors, selfie sticks, notebooks, etc. and weapons include any objects or firearms such as pistols, shotguns, revolvers, etc. they have all increased [24].

6) *Object Detectors as well as Classifiers*

Classifier used: RCNNInceptionResNetV2YOLOV faster than SSDMobilNetV1YOLOV3.

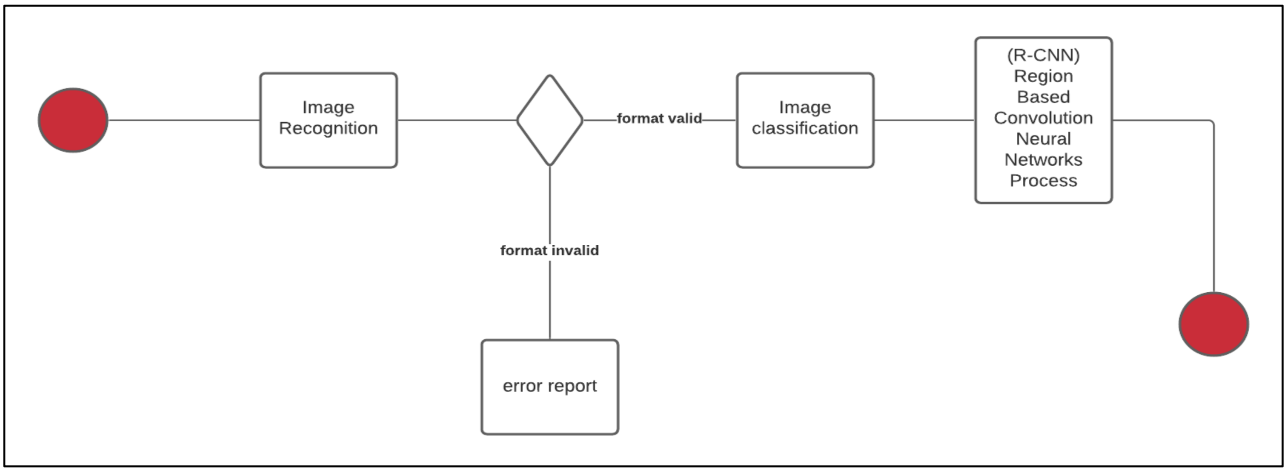

Figure 2: Activity Diagram Illustrates Method Which Takes an Image as A Bounding Box Besides Generates All Ideas For The Area In The Picture That Is Most Likely To Be The Object, As Well As The Position Of The Item In The Region With The Highest Score

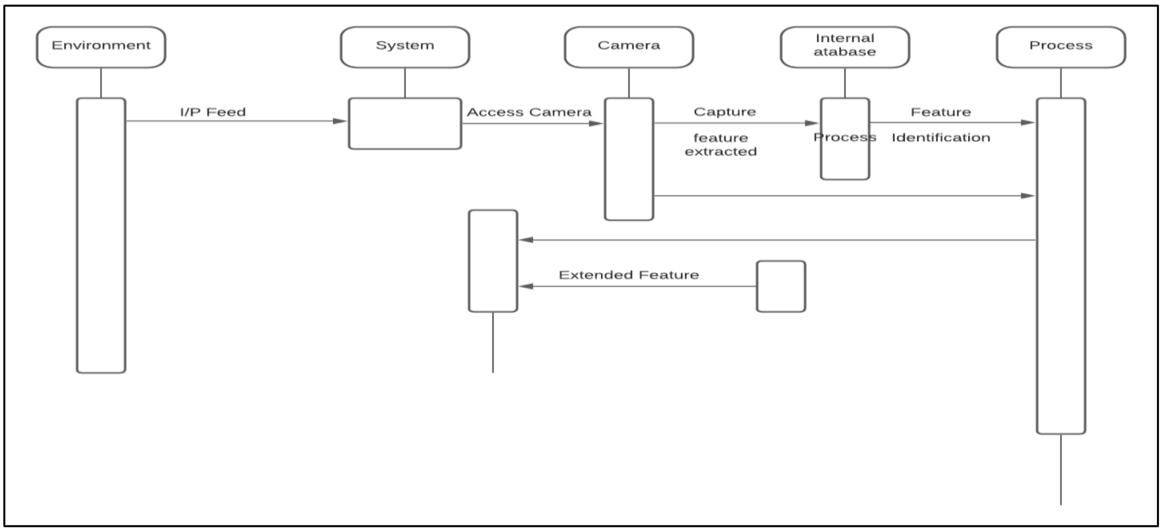

Figure 3: Diagram for the Object Recognition Sequence Technique to Recognize the Frame Patch That Is Enclosed by the Window in This Way of Sliding Windows

IV. RESULT AND DISCUSSION

After some trial and error, we've arrived at the desired result. To begin, images may be retrieved from robbery recordings or any other criminal recordings, as well as datasets of photos depicting weapons, photos generated by applying different Open CV filters, and photos with a dark background and low resolution added to enable for real-time detection. This dataset was used to train and evaluate the following object detection models: SSD ResNetV2 YOLO V3 MobilNetV1 Faster RCNN-Inception MobilNetV1 Each kind has its own set of benefits and drawbacks. In terms of processing frames per second, SSD-Mobile Net is good. The recall and precision of the FasterRCNNInceptionResNetv2 are excellent, but the processing speed is not. There are many models in the YOLO family. For the aim of detection, it requires a different technique. It divides the input picture into S×S grids and, unlike prior area recommendation algorithms, forecasts the probability and bounding boxes of items whose centers are within grid cells. Researchers trained in real-time detection utilizing the newest YOLO V3 and a unique 3-weapon dataset, and YOLO V4 provided the greatest results in processing speed and accuracy. Some classification models worked well, but they were not ideal for a real-time scenario because they were slow, inadequately accurate, and sluggish when compared to object detection models, which performed well and achieved high accuracy and recall (see Figure 4). (See Figure 4).

Figure 4: Outlook Of An Effective Detection Of Weapons In Video Surveillance Using Deep Learning Techniques

V. CONCLUSION

Object detection methods have a broad variety of applications in robotics, medical image analysis, surveillance, and human-computer interaction, to mention a few. YOLOV3 has been chosen as the most suitable and efficient deep learning model after evaluating the performance of these algorithms on a typical image data set. Many violent events continue to occur in public and crowded areas. Automatic image analysis using artificial vision may assist video surveillance. Based on YOLOV3 methods, this research shows the deployment of multiple weapon detectors for video monitoring. For training, pistol and knife pictures from the work of researchers and COCO dataset have been utilized. To improve the datasets, various modifications such as rotations, scaling, and brightness were employed. Also, this proposed model would feature a community website that users can easily access, and users will be able to submit photos as input to the model, which will return things with proper labelling as output.

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