ARTIFICIAL INTELLIGENCE AND DEEP LEARNING BASED WEAPON DETECTION

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Abstract:
Security is always a main concern in every domain, due to a rise in crime rate in a crowded event or suspicious lonely areas. Abnormal detection and monitoring have major applications of computer vision to tackle various problems. Due to growing demand in the protection of safety, security and personal properties, needs and deployment of video surveillance systems can recognize and interpret the scene and anomaly events play a vital role in intelligence monitoring. This paper implements automatic gun (or) weapon detection using a convolution neural network (CNN) based SS D and Faster RCNN algorithms. Proposed implementation uses two types of datasets. One dataset, which had pre-labelled images and the other one is a set of images, which were labelled manually. Results are tabulated, both algorithms achieve good accuracy, but their application in real situations can be based on the trade-off between speed and accuracy.

I.INTRODUCTION

Weapon or Anamoly detection is the identification of irregular, unexpected, unpredictable, unusual events or items, which is not considered as a normally occurring event or a regular item in a pattern or items present in a dataset and thus different from existing patterns. An anomaly is a pattern that occurs differently from a set of standard patterns. Therefore, anomalies depend on the phenomenon of interest [3] [4]. Object detection uses feature extraction and learning algorithms or models to recognize instances of various category of objects [6]. Proposed implementation focuses on accurate gun detection and classification. Also concerned with accuracy, since a false alarm could result in adverse responses [11] [12]. Choosing the right approach required to make a proper trade-off between accuracy and speed. Figure 1 shows the methodology of weapons detection using deep learning. Frames are extracted from the input video. Frame differencing algorithm is applied and bounding box created before the detection of object [7] [8] [14].

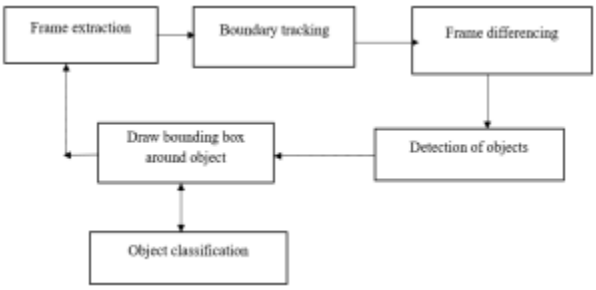


Fig.1.Methodology

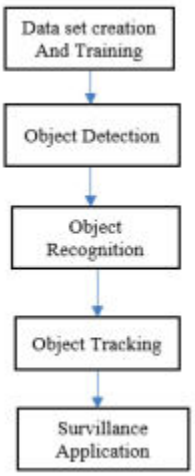


Fig.2. Detection and T racking

The flow of object detection and tracking as shown in figure 2. Dataset is created, trained and fed to object detection algorithm.

Based on application suitable detection algorithm (SSD or fast RCNN) chosen for gun detection. The approach addresses a problem of detection using various machine learning models like Region Convolutional Neural Network (RCNN), Single Shot Detection (SSD) [2][9][15].

II.LITERATURE REVIEW:

Security is always a main concern in every domain, due to a rise in crime rate in a crowded event or suspicious lonely areas. Abnormal detection and monitoring have major applications of computer vision to tackle various problems. Due to growing demand in the protection of safety, security and personal properties, needs and deployment of video surveillance systems can recognize and interpret the scene and anomaly events play a vital role in intelligence monitoring. This paper implements automatic gun (or) weapon detection using a convolution neural network (CNN) based SSD and Faster RCNN algorithms. Proposed implementation uses two types of datasets. One dataset, which had pre-labelled images and the other one is a set of images, which were labelled manually.

Most of these activities are happening due to handheld weapons mainly pistol and gun. Object detection algorithms have been used in detecting weapons like knives and handguns. Handgun and knives detection are one of the most challenging tasks due to occlusion, variation in viewpoint and background cluttering that occurs frequently in a scene. This paper reviewed and categorized various algorithms that have been used in the detection of handgun and knives with their strengths and weaknesses. This paper presents a review of various algorithms used in detecting handguns and knives.

Increasing crimes in public nowadays pose a serious need of active surveillance systems to overcome such happenings. Type of weapon used in the crime determines its seriousness and nature of crime. An active surveillance with weapon classification can help deciding the course of action while identifying the possibilities of any crime happening. This paper presents a novel approach for weapon classification using Deep Convolutional Neural Networks (DCNN). That is based on the VGG Net architecture. VGG Net is the most recognized CNN architecture which got its place in Image Net competition 2014, organized for image classification problems. Thus, weights of pre-trained VGG16 model are taken as the initial weights of convolutional layers for the proposed architecture, where three classes: knife, gun and no-weapon are used to train the classifier. To fine tune the weights of the proposed DCNN, it is trained on the images of these classes downloaded from internet and other captured in the lab achieved for weapon classification

III.SYSTEM ANALYSIS

3.1 EXISTING SYSTEM:

Weapon or Anamoly detection is the identification of irregular, unexpected, unpredictable, unusual events or items, which is not considered as a normally occurring event or a regular item in a pattern or items present in a dataset and thus different from existing patterns. An anomaly is a pattern that occurs differently from a set of standard patterns. Therefore, anomalies depend on the phenomenon of interest [3] [4]. Object detection uses feature extraction and learning algorithms or models to recognize instances of various category of objects.

3.2 Proposed System:

Proposed implementation focuses on accurate gun detection and classification. Also concerned with accuracy, since a false alarm could result in adverse responses [11] [12]. Choosing the right approach required to make a proper trade-off between accuracy and speed. Figure 1 shows the methodology of weapons detection using deep learning. Frames are extracted from the input video. Frame differencing algorithm is applied and bounding box created before the detection of object.

IV.SOFTWARE MODELS:

Waterfall Mode:

The Waterfall Model is a linear sequential flow. In which progress is seen as flowing steadily downwards (like a waterfall) through the phases of software implementation. This means that any phase in the development process begins only if the previous phase is complete. The waterfall approach does not define the process to go back to the previous phase to handle changes in requirement.

In this article, we will discuss the advantages and disadvantages of the waterfall, should we avoid it? when to use it? and the waterfall model pitfall, and why I see it as the father of the SDLC models.

Waterfall Model Phases

Waterfall Model contains the main phases similarly to other process models, you can read this article for more information about phases definitions.

When to use Waterfall Model?

Due to the nature of the waterfall model, it is hard to get back to the previous phase once completed. Although, this is can be very rigid in some software projects which need some flexibility, while, this model can be essential or the most suitable model for other software projects' contexts.

The usage of the waterfall model can fall under the projects which do not focus on changing the requirements, for example:

1. Projects initiated from a request for proposal (RFP), the customer has a very clear documented requirements
2. Mission Critical projects, for example, in a Space shuttle
3. Embedded systems.

We can notice some similarities of these types of projects that they cannot be delivered in iterative, incremental, or agile manner, for example, in embedded systems for the elevator, you cannot deliver an elevator who can go up only without going down, or handling only users requests from inside and ignore outside calls for the elevator.

Validation and Verification Model –V-Model

V-Model is mostly known as the validation and verification software development process model (The Vee Model), and It is one of the most know software development methodology. Although it is considered as an improvement to the waterfall model and it has some similarities as the process also based on sequential steps moving down in a linear way, it differs from the waterfall model as the steps move upwards after the coding phase to form the typical V shape. This V shape demonstrates the relationships between each phase of the development life cycle and its associated phase of testing.

The V-Model

This means that any phase in the development process begins only if the previous phase is complete and has a correspondence related testing phase which is performed against this phase completion. Similar to the Waterfall model, the V-Model does not define the process to go back to the previous phase to handle changes in requirement.

The technical aspect of the project cycle is considered as a V shape starting with the business needs on the upper left and ending with the user acceptance testing on the upper right.

V-Model Model Phases

The V-Model Model contains the main phases similarly to other process models, you can read this article for more information about SDLC phases definitions.

Moreover, it breaks down the testing phase into detailed steps to ensure the validation and verification process. So, it contains the below testing phases:

Unit Testing

The Unit testing is the testing at the code level and helps eliminate issues at an early stage,

mainly the developer is responsible to perform the unit test for his code while not all the defects cannot be discovered at the unit testing.

Functional Testing

Functional testing is associated with the low-level design phase which ensures that collections of codes and units are working together probably to execute new function or service.

Integration Testing

Integration testing is associated with the high-level design phase. Integration testing ensures the integration between all system modules after adding any new functions or updates.

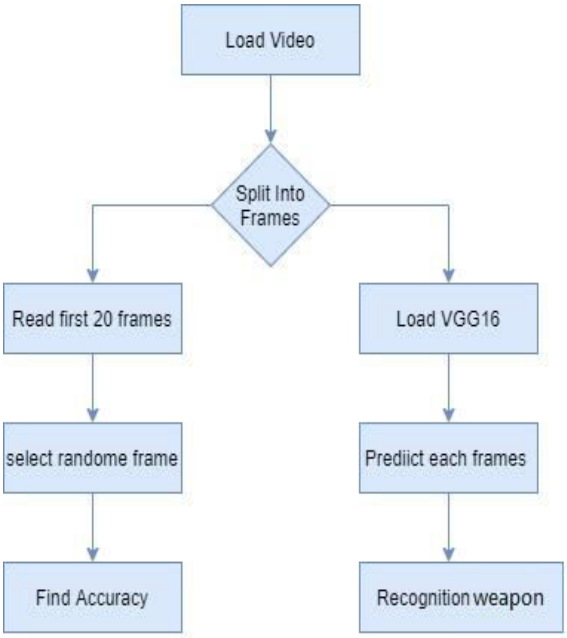
System Testing

System testing is associated with the system requirements and design phase. It combines the software, hardware, and the integration of this system with the other external systems.

User Acceptance Testing

User Acceptance testing is associated with the business and operations analysis phase. The customer users are the main performers of this testing based on test cases and scenarios that cover the business requirements to ensure that they have delivered the right software as per the specifications.

V.SYSTEM ARCHITECTURE:



5.1IMPLEMENTATION:

MODULES:

- **User**
- **FASTER R-CNN**
- **VGG16**
- **Object Detection and Recognition**

MODULES DESCRIPTION:

User:

The User can start the project by running mainrun.py file. User has to give –input (Video file path).The open cv class VideoCapture(0) means primary camera of the system, VideoCapture(1) means secondary camera of the system. VideoCapture(Videfile path) means with out camera we can load the video file from the disk. Vgg16, Vgg19 has programitaically configured. User can change the model selection in the code and can run in multiple ways.

. **FASTER R-CNN**

Layers of CNN and faster RCNN architecture depicted in respectively. It has two networks RPN to generate region proposals and network for object detection. To generate region proposals it uses selective search approach. Anchors or region boxes are ranked by RPN network. Dataset Creation and Training Images are downloaded in bulk using Fatkun Batch Image Downloader (chrome extension) which can download multiple Google Images at once. Then the downloaded images are labelled. 80% of total images used for training and 20% images for testing. The created ammunition dataset was then trained using Single Shot Detector (SSD) model and made 2669 iterations/steps on the model to ensure that the loss is less than 0.05 in order to increase the accuracy and precision. Figure 5 shows folder with test and train images. Figure 6 shows image with labels

VGG16:

VGG16 is a convolutional neural network model. Deep Convolutional Networks for Large-Scale Image Recognition". The model achieves 92.7% top-5 test accuracy in ImageNet, which is

a dataset of over 14 million images belonging to 1000 classes. It was one of the famous model submitted to ILSVRC-2014. It makes the improvement over AlexNet by replacing large kernel-sized filters (11 and 5 in the first and second convolutional layer, respectively) with multiple 3×3 kernel-sized filters one after another. VGG16 was trained for weeks and was using NVIDIA Titan Black GPU's.

Object Detection and Recognition

To make sure object is detected, changes are made in the label map and tf_record file. Label map is the file which stores the total number of types of objects that will be detected. weapon is added in the label map. It is a popular approach in deep learning where pre-trained models are used as the starting point on computer vision and natural language processing tasks given the vast compute and Object recognition is refers to a collection of related tasks for identifying objects in digital photographs.

Region-Based Convolutional Neural Networks are a family of techniques for addressing object localization and recognition tasks, designed for model performance. You Only Look Once, or YOLO, is a second family of techniques for object recognition designed for speed and real-time use.

VI.CONCLUSION

SSD and Faster RCNN algorithms are simulated for pre labeled and self-created image dataset for weapon (gun) detection. Both the algorithms are efficient and give good results but their application in real time is based on a tradeoff between speed and accuracy. In terms of speed, SSD algorithm gives better speed with 0.736 s/frame. Whereas Faster RCNN gives speed 1.606s/frame, which is poor compared to SSD. With respect to accuracy, Faster RCNN gives better accuracy of 84.6%. Whereas SSD gives an accuracy of 73.8%, which is poor compared to faster RCNN.SSD provided real time detection due to faster speed but Faster RCNN provided superior accuracy.

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