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SMART AI BASED VIDEO SURVEILLANCE FOR WEAPON DETECTION AND SUSPICIOUS ACTIVITY DETECTION

Sapna B Patil[1]

[1]*Department of Computer Science Engineering, Hirasugar Institute of Technology, Nidasoshi, Karnataka, India*

ABSTRACT:

As crime rates raise at large events and possibly lonely places, security is always a top concern in every field. A wide range of issues may be solved with the use of computer vision, including anomalous detection and monitoring. Intelligence monitoring is becoming more dependent on video surveillance systems that can recognize and analyze scene and anomaly occurrences. Using SSD and Faster RCNN techniques, this paper provides automated gun (or weapon) identification. If the identification is positively true it will caution/brief the security personals to handle the circumstance by arriving at the place of the incident through IP cameras.

Keywords: *Computer vision, weapon detection, FasterRCNN, SSD, CCTV, Artificial Intelligence (AI).*

1. 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 [1][2]. Object detection uses feature extraction and deep learning algorithms or models to recognize instances of various categories of objects. Model proposed here provides a visionary sense to a machine to identify the unsafe weapon and can also alert the human administrator when a gun or firearm is obvious in the edge [3]. Moreover, the system is programmed with entryways locking framework when the shooter seems to carry appalling weapon. On the off chance conceivable, through IP webcams we can likewise share the live photo to approach security personals to make the move in meantime. Also, the information system has been constructed for recording all the exercises to convey impact activities in the metropolitan territories for a future crisis. This further ends up in designing the database for recording all the activities in order to take prompt actions for future emergency.

2. METHODOLOGY

2.1. Various resources and approaches that are used in this work.

2.1.1. Data Collection: The data collection phase is important phase in this work, as machine learning project is data hungry. The more the data the more the accuracy of the output. The data related to guns, Knives and rifles is collected.

2.1.2. Data preprocessing: Once the data is collected, it is preprocessed to make it ready for training the model. This involves train, test, split, scaling etc.

2.1.3. Framework selection: This phase involves selection of proper framework for the model. Different Frameworks are compared and proper framework is chosen for training the model.

2.1.4. Training the model: Once the data preprocessing is ready, the next step is training the model. Training the model by python and tensor flow is done which can implement the weapon detection system

2.1.5. Inference: After the model is trained the python code is developed for running inference on the model.

2.1.6. IOT surveillance application and SMS notification system: Cloud hosted IOT surveillance application gives the facility to visualize the live video stream by the concerned authorities as well as visualize the proof of detection. The SMS notification system is also developed which will be used to alert the concerned authorities in case the weapons are detected

2.2. System Architecture

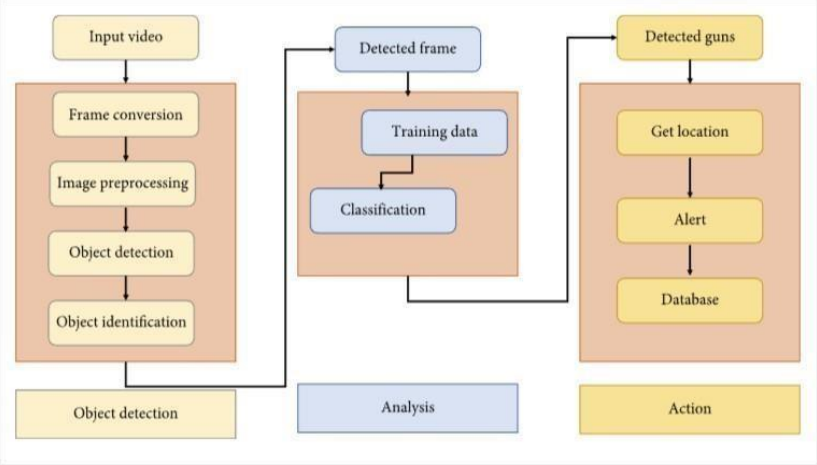

Fig.1. Block diagram of the proposed system

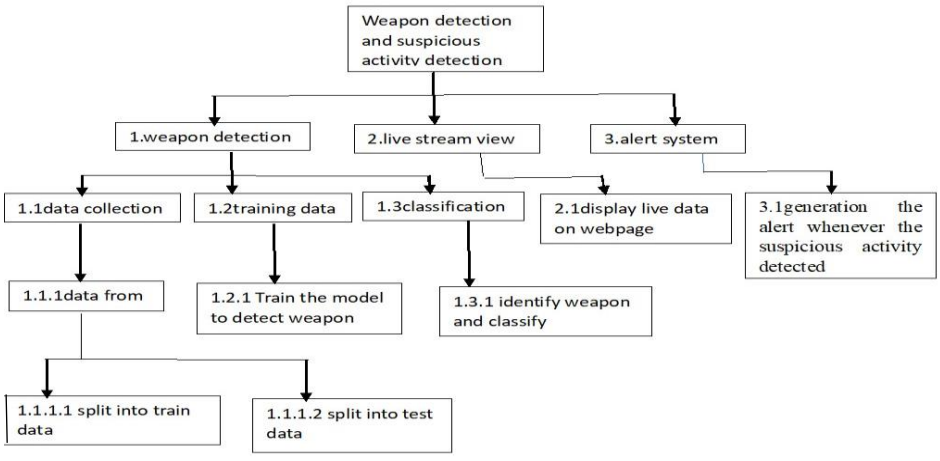

Fig.2. Decomposition Diagram

As shown in the above Fig.1 camera captures the video clips wherever it has been implemented, then it will be going to split the frames in order to convert the video clips to images and those images are used to detect weapons. An AI and IOT based system is developed which will detect the threat in live surveillance and automatically trigger the notification to the IOT panel Developed when the weapons are detected in public places. This work implements automatic gun (or) weapon detection using a convolution neural network (CNN) . Proposed implementation consists of collection of the dataset of the guns and weapons manually, annotating them for the purpose of ROI extraction, preprocessing the dataset to filter out unwanted data. The ROI is extracted and a model is trained after splitting the dataset. The trained model is then used for development and deployment of a system to detect the trigger weapons in public places.

3. DESIGN AND IMPLEMENTATION

3.1 Resources or components used for implementation

- Bracket Ide
- Spyder IDE
- Python Flask
- Python 3.5- High level programming language used for various image-processing applications.
- COCO Dataset- Dataset consisting of commonobjects with respective labels.
- Anaconda
- Arduino Microcontroller Board
- ESP32-CAM
- SD Card

3.2 Dataset Specifications

Case – I: Video specifications

- System Configuration- Intel i5 7th Generation (4Cores)
- Clock Speed- 2.5 GHz
- GPU- NVIDIA GeForce 820M
- Input Frames per Second- 29.97 fps
- Output Frames per Second- 0.20 fps
- Video Format- .mov
- Video Size- 4.14 MB
- COCO and self-created image dataset

Case – II: Image specifications

- System Configuration- Intel i5 7th Generation (4Cores)
- Clock Speed- 2.5 GHz
- GPU- NVIDIA GeForce 820M
- Input Image Size- 200-300 KB

- Training Time- ~0.6 seconds
- Training Time-~1.7 seconds(RCNN)
- Image Format - .JPG
- COCO and self-created image dataset
- Number of classes trained for- 5

3.3 Assumptions and Constraints made for implementation

- The gun is in line of sight of camera andfully/partially exposed to the camera.
- There is enough background light to detect the ammunition.
- GPU with high-end computation power were used toremove lag in the ammunition detection.
- This is not a completely automated system. Every gun detection warning will be verified by a person incharge.

3.4 Faster R-CNN

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.

3.5 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 labeled. 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.

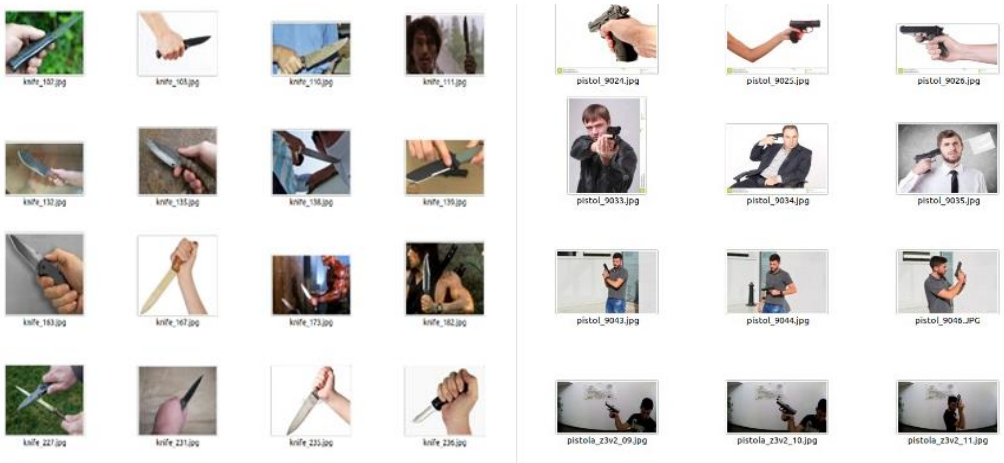

Fig.3 Data set for weapon detection

3.6 SSD (Single Shot Detector)

SSD algorithm reached new milestones in terms of precision and performance detection [4]. SSD speeds up the process by eliminating the need of region proposal network. To overcome the drop in accuracy SSD brings a few technology including default boxes and multi-scale features. These improvements allow SSD to match the Faster R-CNN's accuracy using lower resolution images, which further pushes speed higher.

3.7 Pseudo code

3.7.1 Procedure for Weapon Detection and Localization

Input: camera image

Output: Weapon Detection and Classification

Step 1: Read Camera Video

Step 2: Split video in frame

Step 3: Resize frames
Step 4: Image Enhancement
Step 5: Convert Image to numpy array
Step 6: Feed array to Trained Model
Step 7: Perform Inference
Step 8: Fetch result Dictionary
Step 9: Extract Detection ROI
Step 10: Classify Weapon
Step 11: Plot Results and Display Image
Step 12: Push Result Frame to Output Video
Repeat Steps 1-12
Procedure end

3.7.2 Procedure for Training a Weapon Detection Model

Input: Image Dataset

Output: Compressed NN GraphDef

Step 1: Collect Weapon Images from Google Images

Step 2: Resize Image to reduce Size
Step 3: Preprocess Images for Blurring and Enhancement
Step 4: Train Test Split
Step 5: Specify ROI in xml format
Step 6: Covert all image xml ROI to single CSV
Step 7: Generate Train Records and Test records with Labels
Step 8: Set Model Training Parameters
Step 9: Set Learning Rate and epochs
Step 10: Train Model
Step 11: Convert Model to compressed Graph Def
Step 12: Export model
Repeat Steps 1-12
Procedure end

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4. RESULTS AND DISCUSSIONS

4.1 Testing and Validation

There are many different testing levels which help to check behavior and performance for software testing. These testing levels are designed to recognize missing areas and reconciliation between the development lifecycle states. In SDLC models there are characterized phases such as requirement gathering, analysis, design, coding or execution, testing, and deployment. . In general, there are four levels of testing: unit testing, integration testing, system testing, and acceptance testing.

4.2 Results

The human interface is in the form of IOT panel webpage. Where the base station operator can check the live streaming from camera and can view the GPS location for the location where the threat or suspicious activity is detected. The UI and screen shot of the admin panel is as shown below in Fig.4. AK47, Smith and Wesson and Colt M1911 Gun's detected using Proposed method are Shown in Fig.5 , Fig.6 and Fig.7 respectively.

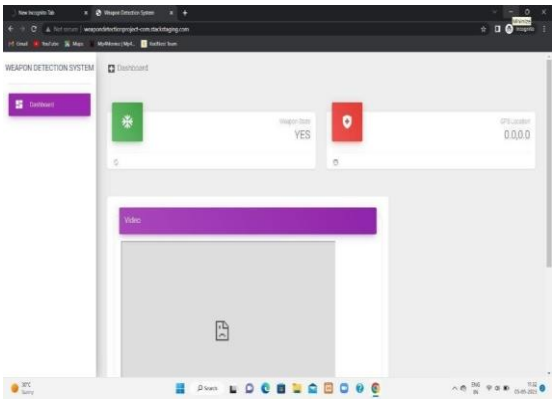

Fig 4. User interface of Admin panel

Fig.5 AK47 gun detection

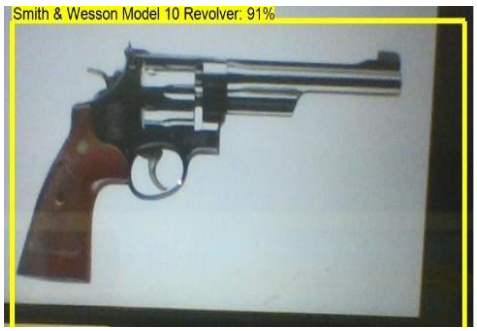

Fig.6 Smith and Wesson Gun Detection

Fig.7 Colt M1911 Gun Detection

5. CONCLUSION

The Smart AI Based video surveillance for weapon detection and suspicious activity detection is developed using IOT and AI to detect the weapons and suspicious activity in the CCTV feeds. The detection results are send to

the ADMIN panel developed which is hosted on cloud. The SMS notification system is implemented which will send the SMS notification immediately when the weapon is detected in the public areas. This Smart AI Based video surveillance for weapon detection and suspicious activity detection mainly focuses on avoiding crime before it happens by sending notification to the authenticated persons.

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