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# BLUME: BEHAVIOURAL LEARNING AND UNDERSTANDING IN MALFEASANCE EVALUATION CRIME IDENTIFICATION & REPORTING APPLICATION

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***Abstract:*** The Crime Identification & Reporting Application is a powerful software tool that enables the detection and reporting of criminal activities. Its advanced algorithms and data analysis techniques identify anomalies (illegal and dangerous weapons) in live feed. The application also provides real-time alerts on identification of the anomalies. Proposed BLUME approach runs on the live feed of the surveillance cameras that are connected to it and then it reads the data in real-time. While doing so it uses a single shot detection technique to identify the anomalies in the live feed and report it back to the user.

***Index Terms*** **- Clustering, Classification, Crime, Data Preprocessing, CNN.**

## I. INTRODUCTION

CCTV surveillance systems are technology-based systems that are used for monitoring as well as recording actions that are happening live in a particular area. They are used in diverse scenarios namely housing, schools, banks, departmental stores, etc. They are a standalone type of system that can be integrated with other devices to have extra functioning. The main components of a CCTV or a surveillance camera are the camera, the video management system, some storage modules and network equipment. The CCTV's capture the video footage live from the area it is surveilling and then transmits it over to the location where the storage modules are present for evaluation/investigation/study. The investigation/study/evaluation can be done according to the extra software attached to the CCTV storage modules for certain functioning.

In recent times the use of CCTV's has increased by many folds due to the sudden development in the technology field as well as the increase in-demand for security and privacy. CCTV surveillance has many benefits including but not limited to security and safety, decreased incident response and investigation time and reduced crime rates. Proposed BLUME approach comes into play here by providing additional functioning of reading the feed live from the area rather than storing it as a video and sending it to the storage module. This software analyzes the live feed and depending on dangerous objects being present at the location captures an image of the live feed while the dangerous object is visible. It then sends a notification to the user that has placed it for their safety notifying them of danger in their neighborhood. This article discusses the usage of object detection in the Indian cities for illegal/dangerous weapon identification and reporting using deep learning techniques. We have divided our approach into six different modules named as: Data Extraction (DE), Data Preprocessing (DP), Clustering, Convolution Neural Networks (CNN), Classification, Implementation

Though due to the sudden increase in the deployment of CCTV surveillance it does bring up the ethical and legal concerns about privacy and freedom of speech and expression. It is important to see to it that CCTV surveillance is used in a proper ethical manner that considers the privacy and security of others in consideration. Along with this there are some ethical and legal considerations that the user needs to contemplate while using it so that CCTV's do not limit a common person's rights. So, at the end we can say that the benefits that the CCTV surveillance can provide are a massive boon to the society but at the same time the repercussions related to it are something that needs to be illuminated at all times so that it does not become a bane.[7]

## II. LITERATURE SURVEY

Crime in India is increasing at a frightening rate, and criminals are opting for bizarre methods to execute them. Newspapers, Web blogs, etc. are daily filled with various criminal incidents that are happening around us. According to the National Crime Records Bureau (NCRB), the overall crime rate in our country has been increasing in the recent years. In 2021 alone a total of 60,96,310 crimes (comprising 36,63,360 of Indian Penal Code (IPC) crimes and 24,32,950 of Special and Local Laws (SLL) crimes) were recorded nationwide. It is significantly higher from 385.5 in 2019.

Some factors responsible for the increase in the criminal activity of India are due to poverty, migration, unemployment, illiteracy, corruption, inflation to name a few. The influence of these has caused the society to focus their attention towards the criminal investigation

agencies and security agencies that keep the criminal activity in check. At present, the physical investigations that happen have a decent probability to ignore and neglect the supportive criminal activities and its features. Table 1 shows a few recent articles towards the use of machine learning and deep learning in this particular area.

table 1: recent literature

| Author's Name (Year Of Publication) | Title Of The Paper | Methodology Used | Data-Set Used | Limitation |
|---|---|---|---|---|
| Meghna Raj Saxena Akarsh Pathak Aditya Pratap Singh Ishika Shukla [1] (2019) | REAL TIME OBJECT DETECTION USING MACHINE LEARNING AND OPENCV | HAAR FEATURES And CASCADE CLASSIFIER | public images from internet as the source | Haar cascades are notoriously prone to false-positives |
| Chandan Gupta Ayush Jain Harsh Jain Mohana [2] (2018) | Real Time Object Detection and Tracking Using Deep Learning and OpenCV | Single Shot Detector algorithm and MobileNets algorithm | Live video footage. | Shallow layers of Single Shot Detector in a neural network may not generate enough high level features to do prediction for small objects |
| Dr.V. Geetha Dr.C.K. Gomathy [3] (2022) | A STUDY ON REAL TIME OBJECT DETECTION AND TRACKING SYSTEM | Single Shot Detector algorithm As well as TensorFlow APIs. | COCO DATASETS | tensorflowapis limitations - No windows support, slow, gpusupport, Architectural limitation, Inconsistent |
| Parag Tirpude Pooja Girhepunje Sagar Sahu Sweta Zilpe Prof. Harshita Ragite [4] (2022) | REAL TIME OBJECT DETECTION USING OPENCV-PYTHON | Single Shot Detector Algorithm and Mobile Nets Algorithm | Live video footage. | Shallow layers of Single Shot Detector in a neural network may not generate enough high level features to do prediction for small objects |
| M.Hemasri Ranjith M.Sacratees M.Vidhyasagar N.Shimmar Rahim [5] (2022) | REAL TIME OBJECT DETECTION AND TRACKING USING OPENCV | Single Shot Detector and portable Nets | homomorphic histology files | Shallow layers of Single Shot Detector in a neural network may not generate enough high level features to do prediction for small objects |
| ShriyaAkella Priyanka Abhang Vinit Agrharkar Dr. Reena | CROWD DENSITY ANALYSIS AND | MobileNet algorithm and single shot detection | COCO dataset | Shallow layers of Single Shot Detector in a neural network |

| | | | | |
|---|---|---|---|---|
| Sonkusare[6] (2020) | SUSPICIOUS ACTIVITY DETECTION | algorithm | | may not generate enough high level features to do prediction for small objects |

After reading the multiple research papers related to crime/image detection we were able to see that there were three mainly used are haar features and cascade classifier,mobilenet algorithm and single shot detection algorithm. Out of these three the single shot detection is the best as it provides a decent speed as well as precision as compared to the other two.Haar features and cascade classifier can show false positive so is not recommended nowadays and for the mobilenet algorithm it is not able to generate prediction for small images.

## III. PROPOSED METHODOLOGY

The oldest and most used type of algorithm we have observed in the literature survey is haar cascade algorithm that detects objects in images, irrespective of their scale in image and location. The shortcoming in this is that it tends to be susceptible to false-positive detections due to the algorithm not being as accurate as the "modern" equivalents. Convolutional neural network is a way that specialises in grid based topology structures for data analyses. It is of three forms namely: R-CNN(regions with convolutional neural networks), FAST R-CNN and lastly faster R-CNN. The drawbacks in these are that it takes a long time to train the network as it might make you classify 2000 regions per image as well as it is a fixed algorithm therefore no learning is happening at this stage. The You only look once algorithm that we are going to use is a very fast algorithm that processes an image at the rate of 155 frames per second which is much faster than the above two proposed algorithms but at the same time it also has a higher error rate than the other algorithms. The single shot detector detects multiple objects present in the image using a multibox. The single shot detector uses a base VGG 16 for high quality image classification but without the final classification layers. The lower layers of the neural network may not generate enough high level features to do prediction for the upcoming or the following images for smaller objects. So it does worse for smaller objects than bigger objects but is more precise than the others with a good standard of time usage.

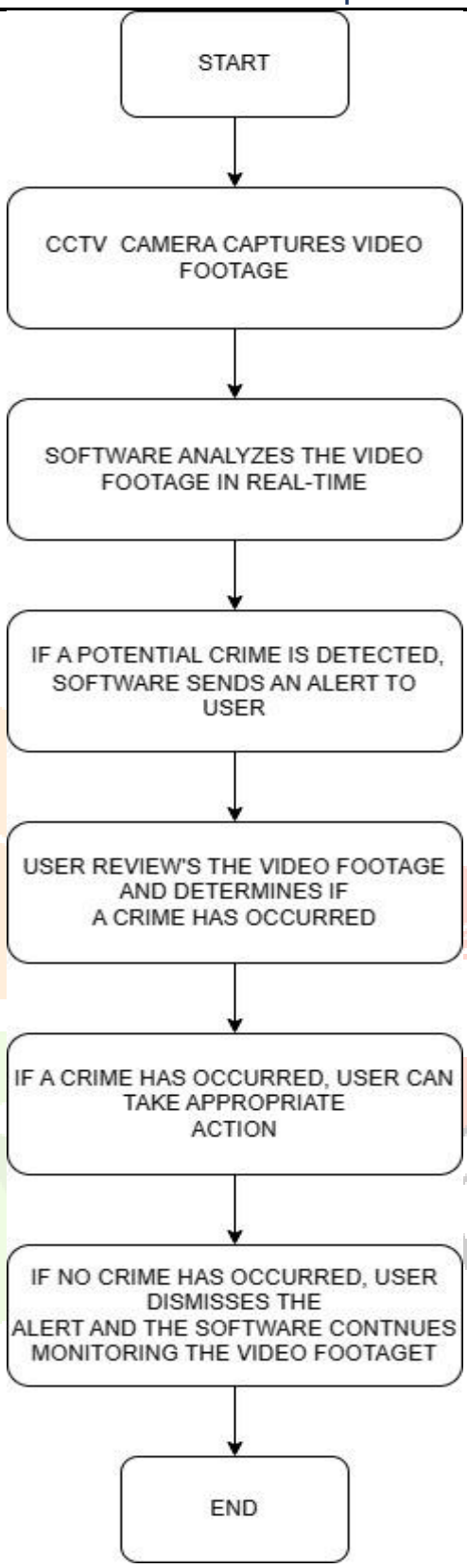


figure 1: proposed methodology

## IV. System Architecture

TensorFlow is a powerful tool for building and training machine learning models. One of the key benefits of TensorFlow is its ability to save models in a format called a "frozen graph," which can be used for transfer learning in object detection tasks.A frozen graph is essentially a serialized TensorFlow graph, which has all of the variables, operations, and metadata required to run the model.One of the main advantages of using frozen models for transfer learning in object detection is that they can be easily integrated into other frameworks, such as OpenCV or PyTorch.

SSD (Single Shot Detector) Mobilenet is a popular deep learning model used for object detection and image classification tasks. It combines the speed and efficiency of the Mobilenet architecture with the accuracy and robustness of the SSD framework. The latest versions of the model, SSD Mobilenet v3 and v2, have further improved the performance of the model and made it even more efficient. One of the main advantages of the SSD Mobilenet models is their speed and efficiency.

SSD MobileNet V2 specifically is a state-of-the-art deep learning model for object detection, developed by Google. It is a combination of two powerful techniques in computer vision: Single Shot Detection (SSD) and MobileNetV2. MobileNetV2 is a neural network architecture

that is specifically designed for mobile devices, where memory and processing power are limited SSD is an object detection technique that uses a single neural network to predict the class and location of multiple objects in an image. SSD MobileNet V2 combines the strengths of both MobileNetV2 and SSD to achieve state-of-the-art performance in object detection tasks.

## V. SYSTEM SPECIFICATION

table 2: system specification

| SPECIFICATION | DESCRIPTION |
|---|---|
| CPU | RYZEN 5 3550H |
| GPU | 12GB VRAM |
| RAM | 8 GB |
| SSD Version | SSD MOBILENE VERSION 1 FPN 640-640 |
| Custom Dataset Size | Custom data set of 600 images |
| Augmentation Data | 90 degrees Clockwise, Anti-Clockwise, 50 Percent Positive Brightness, 50 Percent Negative Brightness. |
| Training set | Approximately 1584 images were used for validation that are 88 percent of the total images |
| Validation set | Approximately 144 images were used for validation that are 8 percent of the total images. |
| Testing set | Approximately 72 images were used for testing that are 4 percent of the total images. |

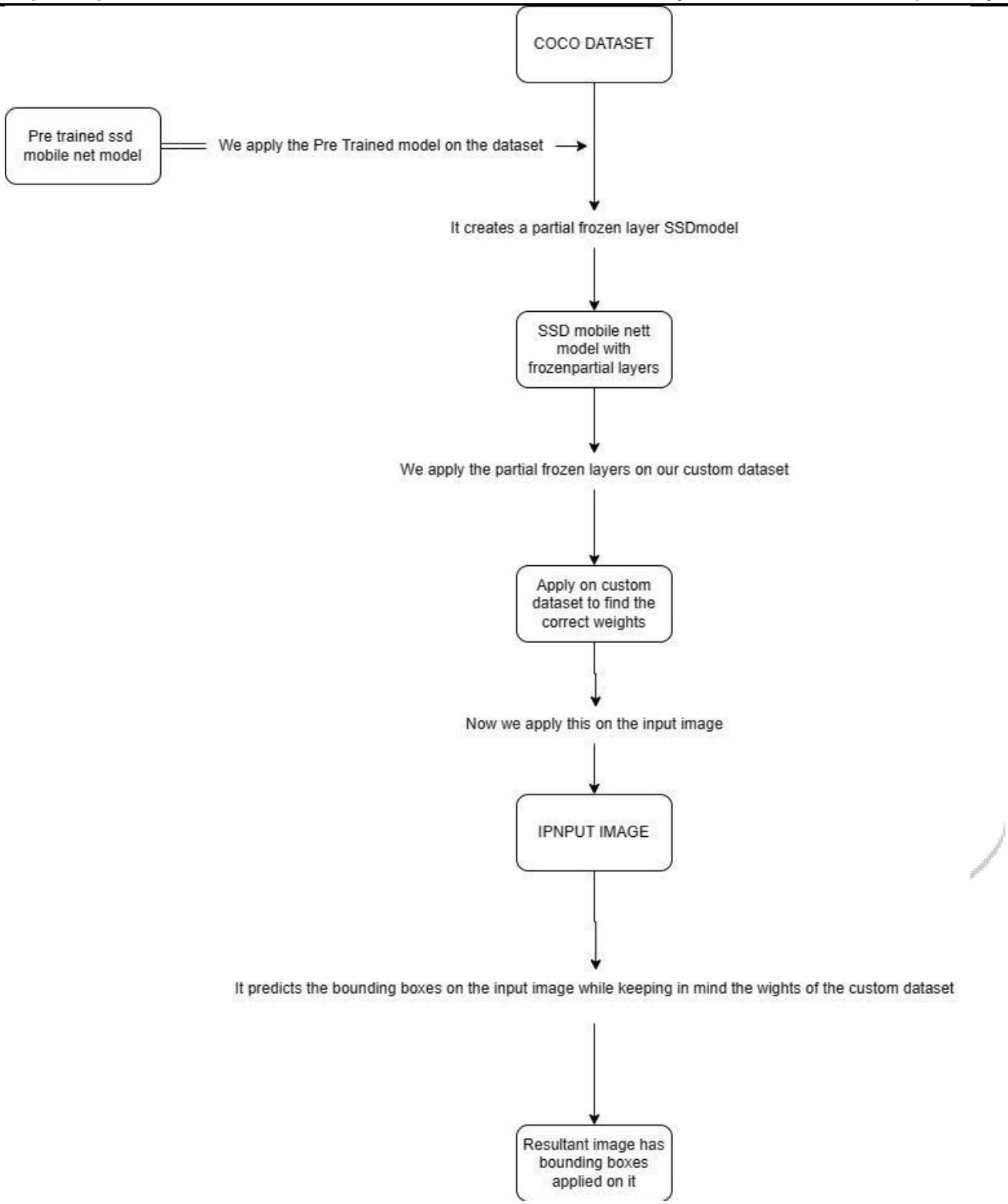


figure 2: system architecture

Steps involved in project are:

1. The first step is to select a dataset on which we will apply the pre-trained model.
2. On applying the pre trained model a ssd mobile net model with frozen partial layers will be made.
3. We will apply the frozen partial layer model after removing the lower layers on our custom data set to find the correct weights as the lower layers are for specific tasks.
4. Then we will apply the corrected weights trained model on an input image, it will result in an output image containing the bounding boxes applied to the specific object.

## VI. Result And Analysis

The goal of this research paper was to assess the efficacy of a crime identification and reporting application. The app was created to enable people to report any crimes they witness or come across to law enforcement. The application aims to improve both law response to crime and community participation in crime reporting.


figure 3: video detection

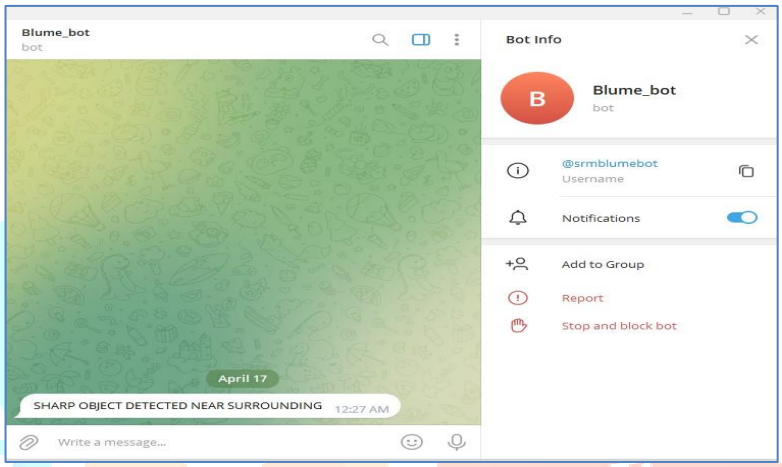


figure 4: laptop telegram message


figure 5: phone telegram message

table 3: comparison between yolo v2 and ssd v2

| Attribute | YOLO V2 | SSD V2 |
|---|---|---|
| Architecture | Darknet-19 | CNN |
| Accuracy | Low | High |
| Speed | Fast | Slowe than YOLO |

It can be verified after seeing the result that the application is able to identify and then report the presence of illegal/harmful weapons to the user. Then depending on the respective user's situation, he/she can report the incident to the concerned authorities. The graph depicts the training progress of an object detection model over a certain number of epochs. The x-axis represents the number of epochs, while the y-axis shows the values of the training loss and validation loss. The training loss, denoted as TRAINING-BOX_LOSS, represents the bounding box regression loss incurred during the training process. It is calculated using the Mean Squared Error technique and measures how well the model fits the training dataset. Similarly, the validation loss, denoted as VALIDATION-BOX_LOSS, represents the bounding box regression loss on the validation dataset. It indicates how well the model generalizes to unseen data. The OBJECTNESS_LOSS represents the confidence of object presence, which is another component of the overall loss function in object detection models. PRECISION is a measure of how accurately the model predicts the correct localization of objects, calculated as the ratio of true positives to the sum of true positives and false positives. The mAP_0.5 is the mean Average Precision (mAP) at an Intersection over Union (IoU) threshold of 0.5, which is a commonly used threshold for object detection evaluation. It measures the accuracy of the model in detecting objects with a minimum overlap of 50% between the predicted bounding box and the ground truth bounding box. Lastly, the mAP_0.5:0.95 represents the average mAP across different IoU thresholds, ranging from 0.5 to 0.95, providing a comprehensive evaluation of the model's performance at varying levels of overlap between predicted and ground truth bounding boxes.

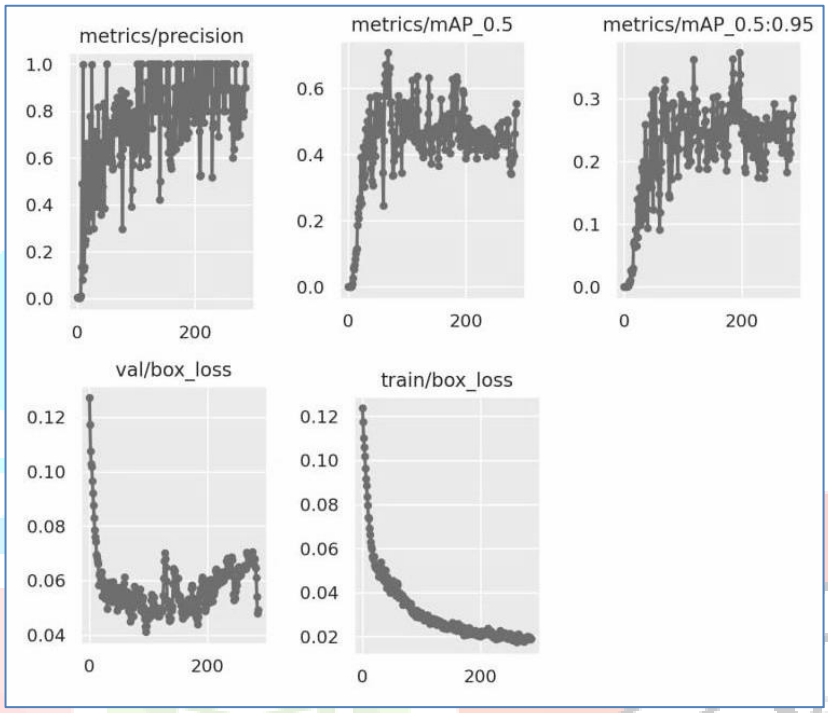


figure 6: result and analysis graphs.

## VII. Conclusion

To sum up, a detection and reporting surveillance system can be an effective instrument for seeing and reporting security concerns in a variety of settings. The system can be altered to recognize particular dangers, such as trespassers, fires, or dangerous goods. It is feasible to recognize potential security concerns as soon as possible and take necessary action by using a detection and reporting surveillance system. Security staff or emergency services can be automatically alerted by the system, giving them important information that can improve their ability to respond. Remembering that a detection and reporting surveillance system should be implemented in a responsible and morally sound manner is essential. The system must take into account privacy issues, and users' online conduct cannot be tracked without their knowledge or violated in any way. A detection and reporting surveillance system may ultimately prove to be a helpful instrument for security and safety, but it should be used with caution and with consideration for people's privacy. Designing an ethical and effective system that can aid in protecting persons and property requires careful consideration of the unique demands and requirements of each area.

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