Weapon Detection Using Deep Learning

Dhinesh M[1], Jegadeshwarn [2], Jancy Sickory Daisy S [3], Maheswari M [4], Dr. Roselin Mary S[5]

Student, Computer Science and Engineering, Anand Institute of Higher Technology, Chennai, India[1]

Student, Computer Science and Engineering, Anand Institute of Higher Technology, Chennai, India[2]

Assistant Professor, Computer Science and Engineering, Anand Institute of Higher Technology, Chennai, India[3]

Assistant Professor, Computer Science and Engineering, Anand Institute of Higher Technology, Chennai, India[4]

Head of Department, Computer Science and Engineering, Anand Institute of Higher Technology, Chennai, India[5]

Abstract: Gun violence has become a first-rate motive ultra-modern misery in the present society. the dearth state -of-the-art right mechanisms to stumble on and become aware of guns in advance outcomes within the increase modern -day the impact caused by gun-related violence. This idea paper offers a look at for concealed weapon detection in IR photographs using picture Processing and open CV and CNN.

The proposed device will perform the fusion today's IR photos with corresponding RGB pics accompanied by open cv detection models. Protection and safety is a massive situation for today's modern-day world. For a rustic to be economically robust, it ought to make certain a safe and comfy surroundings for investors and travellers . Having stated that, Closed Circuit television (CCTV) cameras are getting used for surveillance and to display sports i.e. robberies however those cameras still require human supervision and intervention.

Index Terms : Gun detection, deep studying, item detection, artificial intelligence, laptop imaginative and prescient.

I.   INTRODUCTION

Weapon detection plays a vital role in safety, security, and surveillance control. on this superior time of observation and safety the amount of Closed-Circuit tv (CCTV) conveyed out inside the open and personal locations, for instance, Cinemas, department stores has elevated exponentially. As of now, there are a massive number of CCTV cameras in operation. on this manner, the expanding density of research camera recording makes it a undertaking for a human administrator to look at, examine whether a conceivably unstable condition goes to occur. Gun detection with model and type popularity of the gun is displayed in this paper for each surveillance and manipulate functions, the method used is open CV. It makes use of the primary device getting to know classifier which is changed to be used in photographs and movies.

The crime price across the globe has accelerated especially due to the frequent use of handheld guns at some stage in violent interest. For a country to progress, the regulation-and order situation need to be on top of things .whether we want to draw traders for funding or to generate sales with the tourism enterprise, these kind of needs is a peaceful and secure environment. The crime ratio because of weapons could be very vital in numerous components of the world. It consists of in particular those nations in which it is felony to maintain a firearm .the world is a global village now and what we communicate or write has an effect at the human beings. although the news they heard is crafted having no reality however because it receives viral in a few hours because of the media and especially social media, the harm could be achieved. humans now have more despair and have much less control over their anger, and hate speeches can get those humans to lose their minds humans can be brainwashed and mental studies display that if someone has a weapon in this situation, he may also lose his senses and commit a violent hobby Gun detection in real-time is a very difficult undertaking.

As our preferred object has a small length so, detecting it in an photo is likewise very tough in presence of different gadgets, mainly those objects that can be pressured with it detection was performed the usage of different scenarios, first weapon best and then the usage of HOG and background subtraction methods for human before the favored object and claimed to have an accuracy Their device completed a check accuracy for their dataset.

II. RELATED WORKS

The hassle of detection and class of items in real time began after foremost trends within the CCTV field, processing hardware, and deep gaining knowledge of models. very little paintings has been performed in this field before and most of the previous effort become related to concealed weapon detection (CWD). beginning with concealed weapon detection (CWD), earlier than its use in weapon detection, it became used for luggage control and different safety purposes at airports and was based on imaging techniques like millimeter- wave and infrared imaging [8]. Sheen et .recommended CWD approach based totally on a 3 dimensional millimeter (mm) wave imaging method, for detecting hidden guns at airports and different safe locations within the body [13]. Z. Xue et al. counseled a CWD approach based totally on a fusion-primarily based approach of multi-scale decomposition, which combines coloration visual picture with infrared (IR) image integration [14]. R. Blum et al. recommended a CWD method based totally at the inclusion of visible photograph and IR or mm wave photo the usage of a multi-decision mosaic method to spotlight the hidden weapon of the goal photograph [15]. E. M. Upadhyay et. al. recommended a CWD method the usage of picture fusion. They used IR photo and visible fusion to detect hidden guns in a situation where the photograph of the scene changed into present over and beneath exposed area. Their methodology turned into to apply a homomorphic filter captured at awesome exposure situations to visual and IR pictures [16]. cutting-edge strategies achieve excessive precision with the aid of the use of various combos of extractors and detectors, either by using easy intensity descriptors, boundary detection, and pattern matching [9] or with the aid of the use of greater complicated strategies such as cascade classifiers with boosting. CWD even though had worked for some kind of instances however it had many barriers. these systems were primarily based on steel detection; non-metallic guns cannot be detected. They have been pricey to use in many locations due to the fact they want to be coupled with X-ray scanners and conveyor belts and responds to all metallic gadgets, so have been now not correct.

III. EXISTING SYSTEM

Rohith Vajhala et al. proposed the method of knife and gun detection in surveillance structures. they'd used HOG as a characteristic extractor along with returned propagation of artificial neural networks for classification purposes. The detection was performed the usage of different scenarios, first weapon best and then the usage of HOG and background subtraction methods for human before the favored object and claimed to have an accuracy Their device completed a check accuracy for their dataset. The aforementioned work uses the KNN along with non-linearity of ReLu, convolutional neural layer, absolutely linked layer, and dropout layer of KNN to reach a result for detection with multiple instructions and carried out their work the usage of the Tensor waft open-supply platform. Their machine accomplished a test accuracy for his or her dataset . proposed knives and firearm detection in CCTV snap shots. they'd implemented MPEG-7 and principle component analysis along with the sliding window approach, which made their work slower for real-time eventualities, although they claimed to acquire appropriate accuracy on their take a look at dataset.

IV. PROPOSED SYSTEM

On this paper, the approach used is open-cv libraries and haar cascade. OpenCV (Open source computer imaginative and prescient Library), the maximum used library for pc vision packages. It became usually constructed to boom the use of laptop imaginative and prescient and system perception in commercial products. This library become constructed to boost up using system belief and take it into commercial merchandise.

The gadget will consist of more than one levels of image processing and object detection. For ease of understanding the technique phase could be divided into three subsections. it's far an object Detection algorithm used to discover faces in an photo or a actual time video. here we are able to work with face detection. initially, the set of rules needs a number of nice photos (pics of faces) and poor photos (pics without faces) to train the classifier. Then we want to extract functions from it. In this paper, the method used is open-cv libraries and haar cascade. OpenCV (Open source computer vision Library), the most used library for laptop vision applications. It have become usually constructed to growth the usage of laptop vision and system perception in industrial merchandise. This library turn out to be constructed to reinforce up using system belief and take it into industrial merchandise.

The device will encompass a couple of tiers of photo processing and object detection. For ease of information the approach section may be divided into 3 subsections. it is an item Detection algorithm used to find out faces in an photograph or a actual time video. right here we are capable of work with face detection. to start with, the set of guidelines desires a number of best photographs (snap shots of faces) and negative images (pics with out faces) to educate the classifier. Then we need to extract capabilities from it.

V. IMPLEMENTATION

Deep studying is a branch of device learning inspired through the capability and structure of the human brain additionally called an synthetic neural community. The method adopted on this work features the country of art deep gaining knowledge of, mainly the convolutional neural networks due to their outstanding in line with formance on this area. [40]. The aforementioned techniques are used for both the category as well as localizing the precise object in a body so both the object classification and detection algorithms have been used and because our object is small with different item in history so after experi mentation we observed the fine algorithm for our case. Sliding window/class and vicinity concept/object detection algorithms had been used, and those strategies might be discussed later on this section. We had commenced by doing the class using different deep getting to know fashions and carried out excellent precision however for the actual-time situations, the low frame according to seconds of classifica tion fashions were the real trouble in implementation. Oxford VGG [41], [42], Google Inceptionv3 [43] and Inception Resnetv2 [44], [45] were educated the usage of the aforementioned technique.
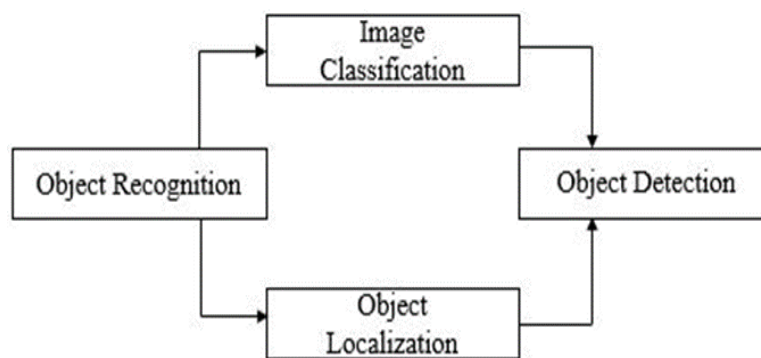

Fig. 1 Object Recognition to detection Hierarchy

1.Object Recognition

Because the name indicates, it's miles the technique of predicting the real elegance or class of an picture to which it belongs by means of making probability high simplest for that specific magnificence. CNN's are used to correctly carry out this process. Many state of the art classification and Detection algorithms makes use of CNN as a backend to carry out their obligations.

Fig. 1 depicts that type and localization come below the class of recognition and blended category and localization is finished to do item detection. let us have a quick overview of the item type, localization, and detection.

as the name indicates, it's miles the system of predicting the real magnificence or magnificence of an picture to which it belongs by way of making possibility excessive best for that precise elegance. CNN's are used to efficaciously carry out this technique. Many state of the artwork kind and Detection algorithms makes use of CNN as a backend to perform their duties. depicts that class and localization come below the category of recognition and blended type and localization is completed to do object detection. let us have a short assessment of the item class, localization, and detection.

A. Image Classification

The category version takes an photograph and slide the ker- nel/filter out over the complete photo to get the characteristic maps. From the characteristic extracted, it then predicts the label based totally at the probability. To perform picture class, a gadget learning model is educated on a huge dataset of 1142abelled pics. The version learns to become aware of patterns and capabilities within the pics which might be characteristic of every elegance, and uses this understanding to categorise new pix it has never seen earlier than. Convolutional neural networks (CNNs) are generally used for photo type obligations due to the fact they're capable of learn hierarchical representations of the photo information. CNNs consist of multiple layers of filters that observe convolution operations to the enter photograph, observed by using pooling operations to reduce the size of the characteristic maps. The output of the very last layer is then fed right into a classifier, such as a softmax layer, which produces the magnificence possibilities for the photo. photograph category has many realistic packages, which include object detection, facial reputation, and medical prognosis.

B. Object Localization

This approach outputs the real area of an object in an picture via giving the associated top and width at the side of its coordinates. item localization is a computer vision challenge that entails now not simplest spotting items in an photo however additionally figuring out their spatial places by using drawing bounding bins round them. The purpose of object localization is to train a machine gaining knowledge of model to as it should be detect and localize items within an picture. object localization is commonly completed the use of a deep studying technique, with convolutional neural networks (CNNs) being the maximum commonly used version architecture. in this approach, the CNN is trained on a dataset of categorised images wherein each photograph has one or greater items of hobby and the corresponding bounding packing containers that locate those objects.at some stage in education, the CNN learns to are expecting the elegance of every item in addition to the bounding box coordinates that excellent enclose the object in the photograph. The bounding field coordinates are normally represented as 4 values: the x and y coordinates of the pinnacle-left nook of the bounding box, and the width and top of the container.as soon as the version is educated, it can be used to come across and localize objects in new images by way of making use of the educated version to the photograph and predicting the magnificence and bounding box coordinates for each object detected.

C. Object Detection

This project uses the residences of the aforementioned algo- rithms. The detection algorithm tells us the bounding container having x and y coordinates with related width and top along side the magnificence label. Non-max suppression is used to output the box with our desired threshold [54]. This manner offers the following effects altogether:In past item detection turned into very limited because of less data and coffee processing energy of computers however with the passage of time the computing power of computer systems extended and world moved from CPU's to picture Processing units (GPU). GPU's were firstly made for increasing the picture first-class of the structures and for gaming however later GPUs have been used appreciably for deep studying. In ImageNet, competi- tions commenced and contained about one thousand training [55]. This became the evolution of system learning and deep gaining knowledge of. within the beginning, the fashions have been not very deep, method there were now not many layers as they're now in an algorithm. because of the aforementioned traits, in 2012 A.Krizhevsky offered a version called Alex net trained on ImageNet and got the primary function in that competition. This was the start- ning of item detection in deep mastering. It gave a manner to researchers and then each 12 months the algorithms and fashions keep on coming. these kind of algorithms comprise layers that paintings at the principle of the convolutional neural community (CNN).

D. Classification of Detection Approach

There are numerous approaches to generate vicinity proposals, but the most effective way of generating them is with the aid of using the sliding window technique. The sliding window approach is slow due to the fact filter out slides over the entire body and has obstacles, which have been tackled with the aid of the vicinity notion approach, so we've the following tactics utilized in our work for each class and detection models are:

o   Sliding window/Classification Models
o   Region proposal/Object Detection Models

1.Sliding Window Classification Model

Inside the approach to the sliding window, a field or window is moved over a photograph to select an area and use the object popularity model to discover each frame patch protected by using the window. it's far an exhaustive seek over the entire photo for items. no longer simplest do we want to search within the image for all viable locations, we also need to search on wonderful scales. that is due to the fact fashions are normally educated on a particular variety. The effects are in tens of thousands (104) of picture spots being categorised [56]. The sliding window method is com- putationally very steeply-priced due to the quest with diverse issue ratios and specially for each pixel of an photo if the stride or step cost is much less.

2. Region Proposal/Object Detection Model

This technique takes an photo because the bounding containers of enter and output proposals associated with all areas in a picture most probably to be the item. these local proposals can be noisy; coinciding no longer containing the object perfectly, however there may be a proposal among these location proposals associated with the original goal object. As this technique takes a image because the bounding boxes of input and output related to all patches in a picture maximum in all likelihood to be a class, so it proposes a place with the maximum rating as the region of an item. instead of thinking about all viable regions of the input body as possibilities, this approach uses detection concept strategies to pick regions

[57]. place-based totally CNNs (R-CNN) become the primary detection version to introduce CNNs below this technique [58]. The selective search method of this method produces 2000 packing containers having most chance.
Selective seek is a broadly used notion generation technique due to the fact it is very speedy having a terrific don't forget value. it's far dependent on the hierarchical calculation of desired regions installed at the compatibility of color, texture, size, and form [59].

Yolo series is some of the kingdom of the artwork item detection fashions. in contrast to the alternative location inspiration-primarily based techniques it divides the input photo into an SxS grid and then simulta- neously predicts the opportunity and bounding packing containers for an item with a middle falling into a grid cellular [49], [53].

3. Training Mechanism
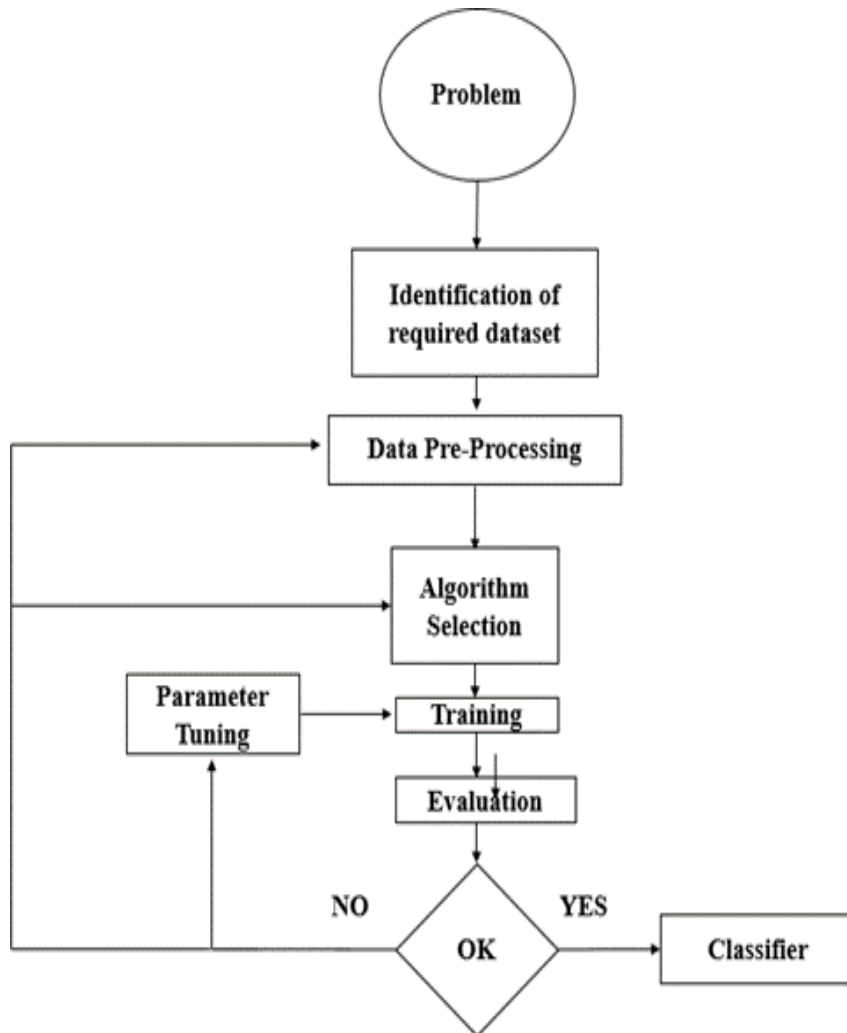
Fig.2 Training and Optimization Flow Diagram.

Fig. 2 describes the general methodology used in education and optimization. It begins with defining a problem, locating the required dataset, applying pre-processing strategies, after which subsequently training and comparing the dataset. If the evaluation is accurate then we store those weights as a classifier however if it's wrong then comes the system of backpropagation algorithm along side the gradient descent set of rules [60].
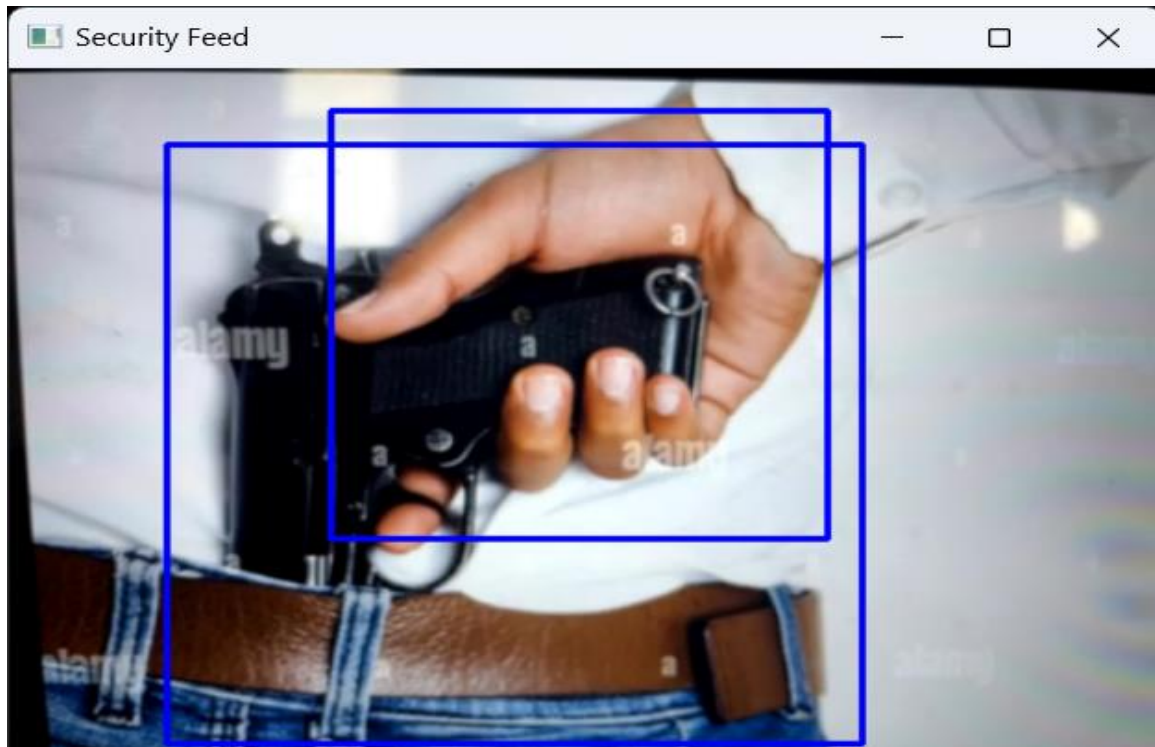
In backpropagation, weights are optimized by using subtracting thepartial by-product of cost characteristic J(O) with a multiplier of the learning fee alpha α from the old or preceding weight value. Gradient descent is the primary weight optimization algorithm. it's far used as a base in all optimizers used for the modling and it helps in converging the model and attaining the minima in which we get the high-quality and desired weights values.

VI. RESULTS AND DISCUSSION

Weapon detection refers to the technique of figuring out and classifying weapons or potential guns in images or movies using pc imaginative and prescient and system getting to know algorithms. There are numerous procedures to weapon detection, which includes conventional pc imaginative and prescient techniques, deep getting to know-primarily based strategies, and hybrid models that integrate each. recent research have shown that deep getting to know-based totally methods, particularly convolutional neural networks (CNNs), outperform traditional laptop imaginative and prescient techniques in phrases of accuracy and pace. in addition, the provision of huge-scale annotated datasets inclusive of COCO, Image Net, and Open pic has enabled the development of exceedingly accurate and strong deep gaining knowledge of models for weapon detection.one of the key challenges in weapon detection is the high diploma of variability in the appearance of guns, which can range greatly in size, form, coloration, and texture. furthermore, guns can be occluded, partially seen, or appear in cluttered and complicated scenes, making their detection even more challenging.to overcome these challenges, latest studies have explored numerous deep learning architectures, which includes YOLO, quicker R-CNN, and SSD, that can efficiently hit upon guns in actual-time whilst keeping excessive accuracy.

These models are usually educated on large-scale annotated datasets of weapons and non-guns, and can generalize well to unseen images and videos.in spite of the high accuracy and performance of deep studying-based weapon detection models, there are nevertheless several obstacles that need to be addressed. for example, these fashions may war to discover guns in low-light situations or whilst the weapon is partly occluded or concealed. moreover, there are ethical and criminal implications of the use of weapon detection structures, which need to be carefully taken into consideration and addressed.In conclusion, weapon detection the usage of deep gaining knowledge of and computer vision has proven great promise in recent years, with fantastically accurate and green models being evolved. however, in addition studies is wanted to cope with the remaining challenges and boundaries and make sure that these systems are used ethically and responsibly.

VII. CONCLUSION

Weapon detection plays a vital function in protection, protection, and surveillance control. in this advanced time modern commentary and protection the quantity present day Closed-Circuit tv (CCTV) conveyed out within the open and personal locations, have extended exponentially and this has caused a mission to humans to spot weapon in such a lot of cameras. This paper gives a actual-time framework and technique this is specially designed for protection and protection control purposes For each monitoring and control functions, this work has supplied a singular automatic weapon detection machine in real time. This work will indeed assist in improving the security, regulation and order state of affairs for the betterment and protection latest humanity, specifically for the countries who had suffered lots with those modern-day violent activities. this can convey a positive effect at the economy by means of attracting traders and vacationers, as

security and protection are their primary desires. we've centered on detecting the weapon in live CCTV streams and on the identical time reduced the false negatives and positives For both monitoring and manage functions, this work has presented a unique automatic weapon detection gadget in actual time. This work will certainly assist in enhancing the security, regulation and order state of affairs for the betterment and safety brand new humanity, especially for the nations who had suffered a lot with those present day violent sports. this will deliver a effective effect at the economy with the aid of attracting buyers and tourists, as security and safety are their primary needs.

REFERENCES

[1] Iqbal, Javed, et al. "Orientation Aware Object Detection with Application to Firearms." arXiv preprint arXiv:1904.10032 (2019).

[2] Thakare, Akanksha. "Concealed Weapon Detection Using Image Processing." International Journal of Electronics, Communication and Soft Computing Science & Engineering (IJECSCSE) (2018): 31-34

[3] Elsner, Jens, et al. "Automatic Weapon Detection in Social Media Image Data using a Two-Pass Convolutional Neural Network." European Law Enforcement Research Bulletin 4 SCE (2019): 61-65.

[4] de Azevedo Kanehisa, Rodrigo Fumihiro, and Areolino de Almeida Neto. "Firearm Detection using Convolutional Neural Networks." ICAART (2). 2019.

[5] Chen, Hua-Mei, et al. "Imaging for concealed weapon detection: a tutorial overview of development in imaging sensors and processing." IEEE signal processing Magazine 22.2 (2005): 52-61.

[6] Redmon, Joseph, and Ali Farhadi. "Yolov3: An incremental improvement." arXiv preprint arXiv:1804.02767 (2018).

[7] M. Nakib, R. T. Khan, M. S. Hasan, and J. Uddin''Crime scene prediction by detecting threatening objects using convolutional neural network,'' in Proc. Int. Conf. Comput., Commun., Chem., Mater. Electron. Eng. (IC4ME2), Feb. 2018, pp. 1–4.

[8] G. K. Verma and A. Dhillon, ''A handheld gun detection using faster RCNN deep learning,'' Proc. 7th Int. Conf. Comput. Commun. Technol. (ICCCT), 2017, pp. 84–88.

[9] R. Olmos, S. Tabik, and F. Herrera, ''Automatic handgun detection alarm in videos using deep learning,'' Neurocomputing, vol. 275, pp. 66–72, Jan. 2018.

[10] J. Iqbal, M. A. Munir, A. Mahmood, A. Rafaqat Ali, and M. Ali, ''Orientation aware object detection with application to firearms,'' 2019, arXiv:1904.10032.

[11] J. L. S. González, C. Zaccaro, J. A. Álvarez-García, L. M. S. Morillo, and F. S. Caparrini, ''Real-time gun detection in CCTV: An open problem,'' Neural Netw., vol. 132, pp. 297–308, Dec. 2020.

[12] Convolutional Neural Networks. Accessed: Aug. 15, 2018.

[13] K. Simonyan and A. Zisserman, ''Very deep convolutional networks for large-scale image recognition,'' 2014, arXiv:1409.1556.

[14] VGG16—Convolutional Network for Classification and Detection. Accessed: Dec. 19, 2018. [Online]. Available: https://neurohive. io/en/popular-networks/vgg16/