



IJITCE

ISSN 2347- 3657

International Journal of Information Technology & Computer Engineering

www.ijitce.com



Email : ijitce.editor@gmail.com or editor@ijitce.com

AN EFFICIENT DEEP LEARNING FRAMEWORK FOR FIREARMS DETECTION IN SECURE SMART CITY INFRASTRUCTURE

¹*Aluvala Guna, MCA Student, Department of MCA*

²*Dr.M.Veerasha, Ph.D, Professor, Department of MCA*

¹²*Dr KV Subba Reddy Institute of Technology, Dupadu, Kurnool*

ABSTRACT

Our civilised world cannot tolerate violence in any shape or form. Still, many innocent lives are lost every year due to the pervasiveness of violence in our culture, especially in the current day. One of the conventional means of violence is using a firearm. Deaths caused by firearms are a worldwide problem right now. Both society and law enforcement authorities face this difficulty. Cities and semi-urban regions account for a disproportionate share of these crimes. Today, CCTV surveillance is widely used for both prevention and monitoring by both public and private organisations. Nevertheless, human-based monitoring is error-prone and consummately resource-intensive. However, when it comes to violent behaviours, automated smart surveillance is better suited to scale and dependability. Demonstrating the integration of deep learning-based approaches for weapon detection is the primary goal of this study. In order to identify firearms and people, this study employs a variety of detection methods, including most recently developed EfficientDet-based architectures and Faster Region-Based Convolutional Neural Networks (Faster RCNN). After using post-processing methods such as Weighted Box Fusion, Non-Maximum Weighted, and Non-Maximum Suppression,

an ensemble (stacked) approach enhanced the detection performance for both human faces and firearms. In this work, we have presented and compared the findings of many detection methods and ensembles. It aids law enforcement in gathering incident information quickly so they may take preventative actions as soon as possible. It is also possible to use the same method to recognise movies on social media that include firearms. Mean average precisions of 77.02% for mAP0.5, 16.40% for mAP0.75, and 29.73% for mAP[0.500.95] are provided here by the Weighted Box Fusion-based Ensemble Detection Scheme. The outcomes outperform all of the alternatives that were tested. An extensive battery of tests using random test photos and video clips has been conducted on the model. Consistently outperforming main models, the resulting ensemble methods are adequate.

1. INTRODUCTION

A COVID-19 epidemic has broken out over the globe, killing thousands of people in countries all over the place [1, 2]. Other major causes of mortality in our culture get very little attention from the general public. Every year, many innocent lives are tragically lost due to homicide and road accidents [3, 4], [5]. The use of firearms was integral to the American Civil War in the

<https://doi.org/10.62647/ijitce.2025.v13.i2.pp746-753>

nineteenth century, and many nations' regular army and police forces adopted this practice. However, a pistol is also employed by the rioters and criminals for their personal benefit or to intimidate the commoners [6], [7]. After WWII, mass shootings were often associated with gun violence [8]. There were 36,252 fatalities in the United States due to gun violence in 2015 [9]. Since it remains a danger to US national health, it poses a significant risk to public health. A whopping 1.4 million persons were murdered globally by gun violence between 2012 and 2016 [10]. Some of the most prominent mass shootings in history are: the 1987 Hoddle Street Massacre [11] in Hoddle Street, Clifton Hill, Melbourne; the 2019 Christchurch mosque shootings in Christchurch [12], which resulted in deaths; the 2017 Quebec City mosque shooting [13] in Quebec City; The deadliest mass shooting by a lone individual in modern history occurred in Europe with the 2011 Norway attacks [14] in Norway, in which 92 people were killed. Tragic mass shootings also happen in Israel. One hundred and ten people were injured or murdered in the Lod Airport Massacre of 1972 [15], Gun violence in India has been on the rise recently. The assaults on the Chhatrapati Shivaji Maharaj Terminus and the Taj Hotel in Mumbai, India, on November 26, 2016, were one of the most notorious events, killing 58 people and injuring 104 more.

2. LITERATURE SURVEY

The rapid spread of SARS-CoV-2 has reached pandemic proportions, impacting

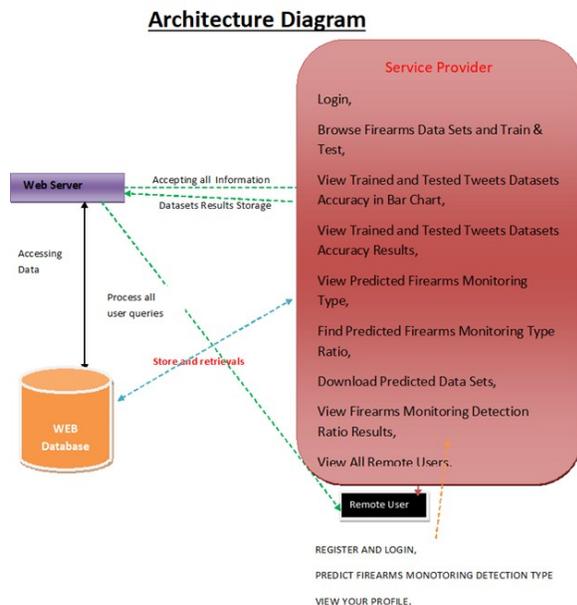
more than 100 nations in only a few short weeks. In order to get health systems throughout the globe ready, there must be an international reaction. While new cases have decreased by over 90% in China due to containment efforts, this has not been the case in other countries, with Italy bearing the brunt of the problem. There is currently great worry over the Italian national health system's ability to adequately react to the demands of patients who are sick and need acute treatment for SARS-CoV-2 pneumonia. Between March 1, 2020, and March 11, 2020, the daily reported proportion of actively infected patients in Italy's critical care units ranged from 9 to 11 percent. Italy has seen an exponential spike in the number of infected people since February 21. This tendency will result in 30,000 infected people if it persists for another week. When that happens, ICUs will be at full capacity, and hospitals may need as many as 4,000 beds by the middle of April 2020. To handle the crisis in the next days and weeks, our study could assist political leaders and health authorities in allocating sufficient resources, such as workers, beds, and critical care facilities. The exponential tendency may begin to decelerate within three to four days if the Italian epidemic follows a pattern similar to that in Hubei province, China. Dissimilarities between social distancing measures and China's ability to rapidly construct specialised facilities make this impossible to forecast at this time.

In December 2019, a mysterious pneumonia epidemic of extraordinary proportions broke

<https://doi.org/10.62647/ijitce.2025.v13.i2.pp746-753>

out in Wuhan City, Hubei province, China. As a result of its discovery, the World Health Organisation (WHO) designated a new coronavirus as COVID-19. The SARS-CoV-2 betacoronavirus, which causes COVID-19 and is related to SARS and MERS, is a respiratory illness that strikes humans and causes pneumonia in the lower respiratory tract. There have been more than 3,000 fatalities and 90,870 confirmed cases of COVID-19 despite extensive quarantine and control efforts on a global scale. In light of this worldwide epidemic, we review what is known about COVID-19 at this time.

3. SYSTEM ARCHITECTURE



4. EXISTING SYSTEM

According to the writers of [27], their model disassembles the weapon and reveals its inner workings. The weapon may now be easily located by a simple deep neural network. By integrating all of its outcomes, the finished product has been created. Just one kind of weapon, the AR-15, is being

studied. Once again, they haven't provided a semantic neural network model compared to their peers. To identify firearms in X-ray images of checked bags, the authors of [28] used a transfer learning strategy using a pre-trained Convolutional Neural Network model. One great thing about transfer learning is that it works well even when there isn't enough data for training. In order to fine-tune the present problem, the pre-trained model must first be generated with enough data samples and then reused with the same weights. Restricted movement is necessary because of the baggage's status as a static backdrop. Put simply, the categorisation model is developed in a controlled environment as opposed to being produced in the wild. A Faster RCNN for gun (pistol) recognition based on VGG16 was developed by the authors of [29]. If the model sees firearms five times in a row in the movie, the primary objective is to trigger an alarm. Despite making use of many datasets, they refrained from comparing the different detection algorithms.

This study makes use of two famous detection architectures that can differentiate between many weapon types, rather than simply one. To construct better detection models, post-processing techniques such as NMS, NMW, and WBF are used. The results demonstrate that the ensemble methods outperform the individual designs, despite the fact that the model parameters have not been trained or altered in any way. Better detection performance with time savings is the outcome of the proposed ensemble approach.

DISADVANTAGES

<https://doi.org/10.62647/ijitce.2025.v13.i2.pp746-753>

Detecting Firearms Monitoring requires most current machine learning models to correctly understand huge and complicated datasets, which adds another layer of complexity to the data.

Access to data: In order for machine learning algorithms to provide reliable predictions, they often need massive datasets. Model accuracy might be compromised in the absence of enough data.
Mislabeled: The preexisting ML models can only learn as much as the input dataset allows them to. The model's predictive abilities are severely limited if the data is mislabeled.

5. PROPOSED SYSTEM

In this study, we provide an ensemble detection method that can identify human faces with various types of firearms in a single picture or video clip. Our design is built on Faster Region-based Convolutional Neural Networks (FRCNN) [20], with ResNet50 [21], [22], [23] and VGG16 [24] serving as backbones. Additionally, for the sake of comparison, the EfficientDet [25] architecture has been put into place, using EfficientNet-B0 [26] as its backbone. We have investigated several detector configurations in stacked ensembles as a post-processing step for detection, after the construction of the models. Three different methods of merging have been used. To get the final bounding box for an item from all the overlapping boxes, methods like Weighted Box Fusion (WBF), Non-Maximum Suppression (NMS), and Non-Maximum Weighted (NMW) are used. Because the same picture is processed by

more than one detector, a plethora of boxes is produced.

What makes our study unique is that we really show, using the same trained models as the individual models, that a combination of Faster RCNN with the most recent EfficientDet architectures improves object identification performance. The word "efficient" in the title of the paper suggests that the suggested scheme can enhance detection results using pre-trained models without requiring any additional training.

Advantages

- Implementing a framework based on deep learning to enhance object detection performance through ensemble
- Automatically detecting human faces and various types of firearms in the wild Smart city security with intelligent surveillance.

6. IMPLEMENTATION

Modules Description

Service Provider

The Service Provider must provide their username and password in order to access this module. Once he successfully logs on, he will be able to do tasks like Examine the Weapons Data Sets and the Train and Test tools, Examine the Accuracy Results for Trained and Tested Tweets Datasets, See the Accuracy Graph for Trained and Tested Tweets Datasets, Get a glimpse of the predicted types of firearms monitoring, discover the ratio of predicted types of firearms monitoring, Get your hands on predictions datasets, Check Out The Results Of The Firearms Detection Ratio Monitoring, See Who Is Accessible From Afar.

<https://doi.org/10.62647/ijitce.2025.v13.i2.pp746-753>

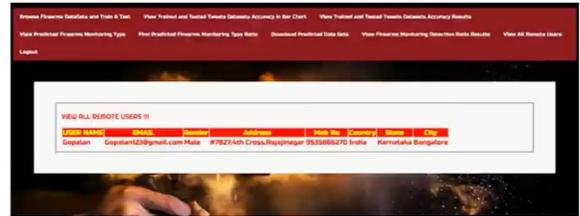
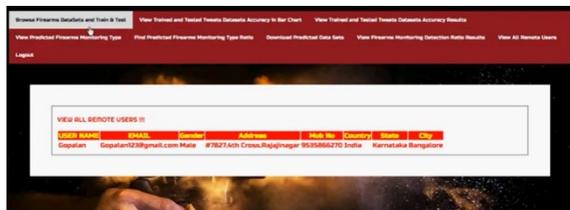
View and Authorize Users

The administrator has access to a comprehensive list of registered users in this section. Here, the administrator may see the user's information (name, email, and address) and grant them access.

Remote User

There are n users in this module at the moment. Do not proceed with any activities until the user has registered. The user's information will be entered into the database after they register. He will need to log in using the authorised username and password when registration is completed. Following a successful login, users will be able to do actions such as viewing their profile, predicting the kind of weapons monitoring detection, and registering, among others.

7. SCREEN SHOTS



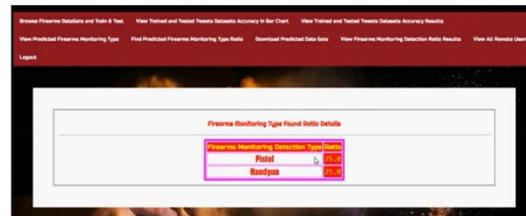
Prediction of Firearms Monitoring Detection Type II

FireId	username	date_of_detection	number_of_killed	age	gender	race	name	street	city	time	detection_by	prediction
102.22.24.124	Publik	08-01-22	shot and	75	M	White	JOHN JAMES BERGARD	HWY 16	LAURENS	Not	CCTV based	PC of
10.42.8.216-428-5219-4	Walter	08-01-22	shot	49	M	White	CHARLES WEDD M	7750 9TH ST SW	VEED BUCKE	Not	Mobile Phone	Pistol
172.27.10.110-10.42.8.155-428-5219-4	Thomas	08-01-22	shot	49	M	White	CHARLES WEDD M	7750 9TH ST SW	VEED BUCKE	Not	Mobile Phone	Pistol
10.42.8.216-50.38.117.48-33009-463-6	Marcos	14-01-22	shot	24	M	Black	WESPONEY SERVICE INC RD	25129W	NEWBERRY	Not	CCTV based	Handgun



Prediction of Firearms Monitoring Detection Type II

Phone#	account_name	date_of_incident	number_of_arrest	age	gender	race	first_name	street	city	flag	detected_by	status
802.22.24.104	Patrick Weller	06-01-22	shot and	25	M	White	BOUL JAMES BERNARD	RDV 16	LAURENS	Hot	CCTV-based	Pistol
80.42.8.211-443-5018-6	Thomas Masley	06-01-22	shot	40	M	White	WAGNET BRED JB	7750 9TH ST SW	VERO BEACH	Hot	Mobile	Pistol
172.161.18.100	Marous Gofken	14-01-22	shot	24	M	Black	PICKETT SERVICE INC	25229 W UNIVERSITY	WINTERBURY	Hot	CCTV-based	Handgun
80.42.8.211-50.26.102.46-33606-443-6	Tarrence Kellom	27-04-22	shot	20	M	Black	CLEWLEY DRIV	67000	GREENWOOD	Hot	CCTV-based	Pistol



PREDICTION OF FIREARMS MONITORING TYPE II

ENTER DATA'S DETAILS HERE II

Enter Phone#

Enter account_name

Enter date_of_incident

Enter number_of_arrest

Enter age

Enter gender

Enter race

Enter first_name

Enter street

Enter city

Enter flag

8. CONCLUSION

Using a system based on deep learning, this research presents robust empirical findings that demonstrate the ability to locate faces and firearms. Using a WBF-based ensemble object detection approach improves the accuracy of face and weapon identification. Model files generated by the FRCNN architecture are 108 MB in size, but those generated by EffDet-B0 are just 16 MB. Therefore, the lightweight ensemble might benefit from employing Efficient Det with Efficient Nets of varying sizes. Ensemble FPS values are impacted by FRCNN once again. A quicker frame rate primary detecting architecture may solve this problem. Because of the inherent diversity, the ensemble outperforms the individual models, even if they are weak. This innovation has the potential to enhance existing CCTV monitoring systems and turn them into smart surveillance networks.

<https://doi.org/10.62647/ijitce.2025.v13.i2.pp746-753>

Making our community a safer place for our loved ones is our top priority.

Deploying the work for usage in real-time testing is possible in the future. Investigation into its practical scalability and dependability is required. Combine this with the detection of other weapons (knives, swords, etc.), other violent and nonviolent actions, and you have a more powerful intelligent surveillance system. Through this, we may contribute to a safer society.

REFERENCES

- [1] A. Remuzzi and G. Remuzzi, “COVID-19 and Italy: What next?” *Lancet*, vol. 395, no. 10231, pp. 1225–1228, Apr. 2020.
- [2] C. Sohrabi, Z. Alsafi, N. O’Neill, M. Khan, A. Kerwan, A. Al-Jabir, C. Iosifidis, and R. Agha, “World Health Organization declares global emergency: A review of the 2019 novel coronavirus (COVID-19),” *Int. J. Surg.*, vol. 76, pp. 71–76, Apr. 2020.
- [3] C. Cabrera-Arnau, R. Prieto Curiel, and S. R. Bishop, “Uncovering the behaviour of road accidents in urban areas,” *Roy. Soc. Open Sci.*, vol. 7, no. 4, Apr. 2020, Art. no. 191739.
- [4] D. A. Brent, M. J. Miller, R. Loeber, E. P. Mulvey, and B. Birmaher, “Ending the silence on gun violence,” *J. Amer. Acad. Child Adolescent Psychiatry*, vol. 52, no. 4, pp. 333–338, Apr. 2013.
- [5] J. A. Fox and M. J. DeLateur, “Mass shootings in America: Moving beyond newtown,” *Homicide Stud.*, vol. 18, no. 1, pp. 125–145, Feb. 2014.

- [6] S. Jaffe, “Decisions to be made on U.S. gun violence research funds,” *Lancet*, vol. 395, no. 10222, pp. 403–404, Feb. 2020.
- [7] M. E. Smith, T. L. Sharpe, J. Richardson, R. Pahwa, D. Smith, and J. DeVylder, “The impact of exposure to gun violence fatality on mental health outcomes in four urban U.S. settings,” *Social Sci. Med.*, vol. 246, Feb. 2020, Art. no. 112587.
- [8] T. M. Stein, *Mass Shootings*, D. E. Hogan and J. L. Burstein, Eds., 2nd ed., ch. 37, pp. 444–451.
- [9] (Aug. 2019). *America’s Gun Culture in Charts*. Accessed: Feb. 6, 2023. [Online]. Available: <https://www.bbc.com/news/world-us-canada-41488081>
- [10] (Sep. 2018). *Gun Violence*. Accessed: Feb. 6, 2023. [Online]. Available: <https://www.amnesty.org/en/what-we-do/arms-control/gun-violence/>
- [11] (Sep. 2017). *Hoddle Street Massacre*. Accessed: Feb. 6, 2023. [Online]. Available: <https://www.abc.net.au/news/2017-08-09/hoddle-streetmassacre-30-years-on/8786766/>
- [12] (Mar. 2019). *Christchurch Massacre*. Accessed: Feb. 6, 2023. [Online]. Available: <https://www.bbc.com/news/world-asia-47578798>
- [13] (Jan. 2017). *Quebec City Shoot-Out*. Accessed: Feb. 6, 2023. [Online]. Available: <https://www.bbc.com/news/world-us-canada-38793071>
- [14] (Jul. 2011). *Oslo and Utøya Island Massacre*. Accessed: Feb. 6, 2023. [Online]. Available: <https://www.theguardian.com/world/2011/jul/23/norway-attacks>

<https://doi.org/10.62647/ijitce.2025.v13.i2.pp746-753>

[15] (May 2014). *Lod Airport Massacre Shoot-Out*. Accessed: Feb. 6, 2023. [Online]. Available: <https://www.bbc.com/news/av/magazine-27468978/isurvived-the-israeli-airport-massacre>