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A DEEP LEARNING-BASED EFFICIENT FIREARMS MONITORING TECHNIQUE FOR BUILDING SECURE SMART CITIES

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ABSTRACT

Any kind of violence is a shame to the world we live in. However, violence still plays a significant role in our society today and claims many innocent lives. Using a gun is one of the traditional methods of violence. Nowadays, firearm-related fatalities are a widespread occurrence. It poses a risk to public safety and presents difficulties for law enforcement. Most of these incidents take place in cities or semi-urban regions. Today, CCTV-based surveillance is widely used by both public and commercial institutions for monitoring and prevention. However, human-based monitoring is error-prone and needs a large number of person-hours as a resource. However, automated smart surveillance is better suited for large-scale and dependable monitoring of violent actions. The primary goal of the study is to demonstrate how deep learning-based methods may be used to identify weaponry, especially rifles. This research employs many detection methods for human face and gun identification, including the newest EfficientDet-based architectures and Faster Region-Based Convolutional Neural Networks (Faster RCNN). The post-processing detection performance of weapons and human faces has been enhanced using an ensemble (stacked) strategy that employs Non-Maximum Suppression, Non-Maximum Weighted, and Weighted Box Fusion techniques. In this study, the comparative outcomes of several detection methods and their ensembles have been addressed experimentally. It facilitates the police's rapid information gathering about the situation and enables them to take prompt preventative action. Additionally, social media videos may be found using the same method for gun-based content recognition. Here, the mean average precisions for the mAP0.5, mAP0.75, and mAP[0.500.95] are 77.02%, 16.40%, and 29.73%, respectively, according to the Weighted Box Fusion-based Ensemble Detection Scheme. Out of all the options tested, the outcomes provide the best performance. The model has undergone extensive testing using movie clips and unidentified test photos. The resulting ensemble schemes are consistently better than the basic models and are adequate.

1. INTRODUCTION

The global spread of the COVID-19 virus is claiming the lives of thousands of individuals across international borders [1, 2]. Very little is spoken about other prevalent causes of death in our society. Every year, homicide and road accidents claim the lives of many innocent individuals [3, 4, 5]. Many countries' conventional armies and police enforcement divisions eventually

embraced weapons after their widespread usage in the American Civil War in the 19th century. But rioters and criminals sometimes use weapons to frighten bystanders or achieve their own goals[6, 7]. Many people believe that gun violence was a contributing factor to mass shootings that occurred after WWII [8]. In 2015, 36,252 Americans were killed by firearms [9]. As long as it continues to endanger American citizens' well-being, it will remain a major issue in public health. Between 2012 and 2016, an incredible 1.4 million people lost their lives due to gun violence worldwide [10]. Hoddle Street Massacre[11] in Hoddle Street, Clifton Hill, Melbourne, Australia; the 2019 Christchurch mosque shootings[12] that killed many; the 2017 Quebec City mosque shooting [13] in Quebec City; and the 2011 Norway attacks[14] in Norway, which killed ninety-two people—the worst mass shooting in modern history—committed by a single gunman. Some of the most notorious mass shootings in history are the ones listed above. Tragically, mass shootings also happen in Israel. Gun violence in India has been on the rise in recent years, culminating in the 1972 Lod Airport Massacre [15], which killed 26 people and injured 80. Some of the most infamous incidents in history occurred on 26/11 in Mumbai, India, at the Chhatrapati Shivaji Maharaj Terminus and the Taj Hotel. A total of 58 people were killed and 104 were injured in the assaults.

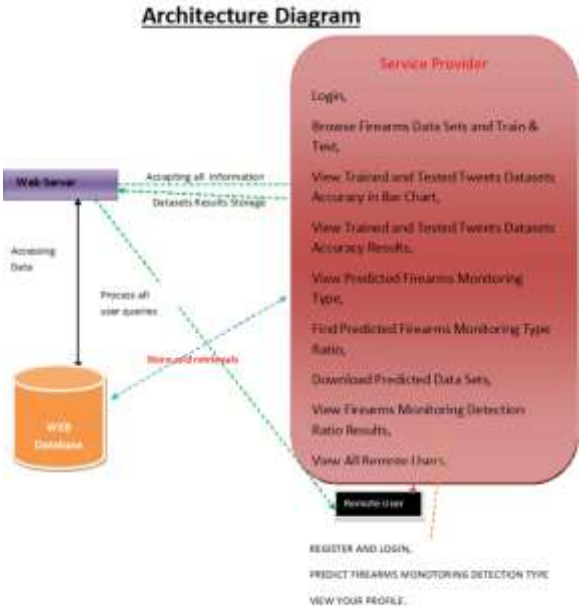
2. LITERATURE SURVEY

In only a few short weeks, SARS-CoV-2—the severe acute respiratory syndrome coronavirus—has reached pandemic proportions, spreading to more than 100 countries. To ensure that health systems are prepared worldwide, immediate action on a global scale is required. Italy is bearing the brunt of the pandemic's effects, while containment measures in China have reduced new cases by more than 90%. It is now very concerning that the Italian national health system is ill-equipped to handle the demands of critically ill patients infected with SARS-CoV-2 pneumonia. The reported daily percentage of actively infected patients in critical care in Italy from March 1, 2020, to March 11, 2020, ranged from 9 to 11 percent. There has been an almost exponential rise in the number of sick people in Italy since February 21. If the current trend continues, 30,000 individuals will be sick in only one more week. Midway through April 2020, critical care units will be at full capacity, leading to a need for as many as 4,000 hospital beds. In the next days and weeks, our findings might be helpful for political leaders and medical authorities in assigning enough critical care units, beds, and personnel to tackle the crisis. If the epidemic in Italy follows a different pattern from the one in Hubei province, China, which deviates from the exponential trend, the number of newly infected patients may begin to fall within three to four days. But at the moment, it is not possible to foresee this due to differences in social distancing policies and China's pace of building such facilities.

Wuhan City, Hubei province, China, was hit hard by a stunning pneumonia epidemic in December 2019, the source of which remains unknown. The primary infectious agent was identified as a novel coronavirus, which the WHO subsequently designated as COVID-19.

Betacoronavirus SARS-CoV-2 infects the lower respiratory tract and produces pneumonia in humans; it is believed to be connected to both MERS and SARS. This virus creates COVID-19, which in turn causes pneumonia. Worldwide, 90,870 COVID-19 cases have been verified by laboratories, and over 3,000 have died as a result. Strict containment and quarantine protocols have not proven effective. In light of this global epidemic, we provide a synopsis of the current state of COVID-19 research.

3. SYSTEM ARCHITECTURE



4. EXISTING SYSTEM

The authors of [27] state that their method breaks down a gun (or any weapon) into its component parts and shows how they work together. A basic deep neural network can now locate the weapon with ease. The final product is the result of combining all of its outputs. The AR-15 is the only rifle model that has been studied. Once again, their semantic neural net model has not been compared to any others. In order to apply the transfer learning technique to the detection of firearms, the authors of [28] used X-ray luggage imaging in combination with a pre-trained Convolutional Neural Network model. The strength of transfer learning lies in its ability to perform admirably even when sufficient training data is not available. Building the pre-trained model with enough data samples and then reusing it with the same weights will allow you to fine-tune the issue at hand. Due of the luggage's role as a static background, the amount of effort is restricted. To rephrase, the classification model does not arise organically but rather is created in a controlled setting. A faster RCNN for gun (pistol) recognition was developed by the authors of [29] using VGG16 as its basis. The main goal of the movie is to set off an alert when the

model detects five consecutive gunshots. They did not compare the various detection methods, even though they used many datasets.

This research made use of two well-known detection designs that are able to distinguish between a wide variety of weapon kinds. Utilizing post-processing methods such as NMS, NMW, and WBF allows for the creation of more accurate detection models. Despite without undergoing any more training or having their model parameters adjusted, the ensemble methods nevertheless managed to achieve better results than the individual designs. Time is saved and detection performance is increased using the suggested ensemble technique.

DISADVANTAGES

The data is complicated, and in order to identify Firearms Monitoring, most current machine learning models need to be able to correctly understand big and complicated information. Data accessibility: In order to provide reliable predictions, the majority of machine learning models need massive datasets. The reliability of the model could be compromised if there is a lack of data in enough amounts.

Mislabeling: The accuracy of current machine learning models is directly correlated to the quality of the input dataset used for training. The accuracy of the model's predictions is dependent on the accuracy of the data labels.

5. PROPOSED SYSTEM

This work proposes an ensemble detection method for human faces and weapons (handguns, pistols, etc.) in a certain image or video frame. With ResNet50 [21], [22], [23], and VGG16 [24] as its backbones, we have used the architecture of Faster Region-based Convolutional Neural Networks (henceforth, FRCNN) [20]. A comparison architecture called EfficientDet [25] has also been built using EfficientNet-B0 [26] as its foundation. Several combinations of detectors have been examined in stacked ensemble style as a post-processing step for detection after the creation of the models. Three distinct types of merging techniques have been used. By applying Non-Maximum Suppression (NMS), Non-Maximum Weighted (NMW), and Weighted Box Fusion (WBF) to all the overlapping boxes, we may finally get the last bounding box for an object. A large number of boxes are generated when many detectors are used to get a single image.

Our research stands out because it shows how an ensemble of Faster RCNN and the latest EfficientDet architectures may enhance object identification strategies by reusing trained models. Using the already-trained models to improve detection results without further training is the implication of the term "efficient" in the title of the research.

Advantages

- A framework based on deep learning is introduced to enhance object detection performance using ensemble. - In the wild, human faces and various kinds of firearms may be automatically detected. As a result, protecting smart cities with IP surveillance.

6. IMPLEMENTATION

Modules Description

Service Provider

A valid username and password are required for the Service Provider to access this module. The user will be able to do tasks like after a successful login, Explore Train & Test and Firearms Data Sets, Examine the Accuracy Results for Trained and Tested Tweets Datasets, See the Accuracy Results in a Bar Chart, Get a glimpse of the predicted types of firearms monitoring, discover the ratio of predicted types of firearms monitoring, Store Anticipated Data Sets, See the Results of the Firearms Monitoring Detection Ratio, See Who Is Accessible From Afar.

View and Authorize Users

The admin can get a complete rundown of all registered users in this section. Here, the administrator may see the user's information (name, email, and address) and grant them access.

Remote User

All all, there are n users in this module. Registration is required prior to performing any operations. Details will be entered into the database after a user registers. He will need to log in using the permitted username and password when registration is completed. After logging in, users will be able to do things like see their profile, predict the kind of weapons monitoring detection, and register and login.

7. CONCLUSION

A deep learning-based system's face and gun identification skills are shown by strong empirical data in this study. Results demonstrate that WBF-based ensemble object detection is superior at locating faces and weapons. While the FRCNN architecture generates a model file that is 108 MB in size, EffDet-B0 only generates a file that is 16 MB in size. Hence, it could be useful to build the lightweight outfit on top of Efficient Det and experiment with different sized Efficient Nets. The values of the ensemble FPS are affected by FRCNN again. To fix that, you might utilize a primary detection architecture that has a greater frame rate. Even if the individual models aren't very good, the ensemble will still do better due to the inherent variation. This concept might transform traditional CCTV monitoring into an advanced intelligent security system. Ensuring the safety of our loved ones is our first priority at work.

Potentially, the work will be accessible for use in future real-time testing. Investigation on its reliability and scalability in real-world contexts is necessary. This might be combined with other forms of violence and nonviolence, as well as the detection of other weapons, to build a more robust intelligent monitoring system. Making communities safer is something we can do.

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