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Weapons Detection of Criminal Activities Based on Computer Vision

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Abstract: In contemporary the term 'computer vision' is applicable vastly for significant research arena. Many researchers have a keen interest in this field. In this computer vision-based system, there have managed to detect weapons of two types (different guns and knives) to inform the concerned authority of property about crimes ongoing inside the place. While a property is under such criminal activity that the criminals carry guns or/and knives with them, the system detects those weapons through a camera integrated module and runs the necessary functions accordingly. Due to witnessing weapons, the system immediately informs the concerned authority to alert them about the upcoming risk to the property via mobile message and call. Consequently, the proprietor is alerted about the forthcoming risk and takes possible measures to handle the situation. Apart from that, the system can make sound alarms around the place of crime so that the people near to the property can come forward to help. This research is applicable in various properties such as banks, offices, homes or anywhere to protect the valuable properties from being theft or robbed. In this research computer vision and machine learning approaches are applied for the optimal result prediction.

Keywords: Computer Vision, Image Processing, Machine Learning, Artificial Intelligence, Weapon Detection

1. Introduction

It is a matter of great joy for computer engineers throughout the world that, nowadays, machine learning and computer vision have gone a long way. These technologies are being used to analysis many things from our daily surroundings to lessen our efforts. It is often noticed that many criminal activities happen around the world. Due to the poor security measures, the cops cannot catch the criminals but rather escape [9]. Although there are CCTV cameras, criminals commit crimes such as robbery, snatching and so on. The authority knows about the crime by checking the camera footage later which does not provide better security for their property. However, if there were an intelligent machine to detect criminal activities and take necessary actions immediately, the property would be saved. This paper proposes a solution for that type of problem by help of computer vision approaches. The proposed system immediately informs the corresponding authorities about the danger going on with the property by detecting crime weapons. Humans are bestowed with a God-gifted brain which they use to perform operations with their organs. The human being can understand a situation and able to act accordingly. It is natural for a human however, a machine needs to understand a sophisticated matter the same as a human being for a specific purpose. In that case, the machine needs to be trained about the world which is none other than machine learning [10]. In this research, there have used python programming language to integrate computer vision with machine to learn about weapons and recognize similar afterward. This study uses five thousand images of several guns and knives. There have been trained the machine with

more than ten thousand Null backgrounds to ensure the detection confidence is high for better accuracy.

2. Literature Review

Computer vision is an excellent term to hear and an excellent field of innovation in this technological era. It was not supposed to be one of the most engaging fields of communication at the previous time. Nonetheless, with the advanced algorithms there are many projects and related researches of this field. However, there have implemented such a project with the help of computer vision that can efficiently identify different weapons and, assist the cops and authorities be safe from letting properties be robbed. Some of the existing systems to review and compare with the proposed system are as follows:

The article presented a visual gun detection framework by Rohit Kumar Tiwari and Gyanendra K. Verma [1]. The authors have proposed a system to detect visual guns from images. This research have used color-based segmentation and SURF interest point detector. The system raises the alarm if the similarity score of detection is greater than 50%. There is found that the system has lack the detection of weapons other than guns. In contrast, our proposed system can detect several weapons including guns, rifles, knives and shotguns. Moreover, our system can raise alarm, send messages and calls to concerned authorities of the property.

Harsh Jain and et al. published an article regarding on a gun detection strategy. Their system focuses on gun detection accurately and classifying it correctly. The authors have proposed the implementation with SSD and RCNN algorithms [2]. However, our proposed system can detect numerous weapons, not only the specific name of the gun detection.

The authors Andrzej Glowacz and et al. proposed a model on a robust knife detecting system. Their study is mainly on the automatic knives detection in images [3]. This study exists lack in contrast our objectives.

Suraj Satpute and et al have demonstrated a real-time object detection method. In the process, they have used OpenCV packages, convolution neural network (CNN), SVM classifier and evaluation protocol map to detect an object from picture and video to relate to the real world [4].

Mahadevi Parande and Shridevi Soma developed an automatic detection system of concealed weapons. They applied sensor technologies integrated with image processing. The authors tried to detect concealed weapons inside the clothes of humans by using the infrared imaging (IR) method [5].

The authors A. Agurto and et al. have published a paper reviewing the recent developments in detecting concealed weapons including metal detection, magnetic field distortion, electromagnetic resonance, acoustic and ultrasonic inspection, millimeter waves, terahertz imaging, Infrared, X-ray and, some other tactics with their advantages and disadvantages [6].

Joseph Redmon and et al has introduced a new approach to object detection that performs fast detection. The model name is YOLO (You Only Look Once). Some of the advantages of their strategy are such as Image Processing happens in real-time, 45 fps is the rate for image processing and FAST YOLO version is also available that processes 155 fps [7].

There is a system proposed by Kiran Kamble and et al. have claimed that they combined weapon detection with facial expression with the context. SSD and Faster RCNN have been used for the detection algorithm [8].

From the above discussion, there is noticed that our proposed system is highly efficient, lightweight and easily installed in any required place. This study is possible to take three measures (sms, calling and alarm raise) while detecting criminal activity with weapons. Our approach is reliable and can be easily installed. However, the authority of property is not able to run the system at a particular time, they can change its working activity according to their needs. Both AC and DC power can be supplied to the system to operate.

3. Proposed System

This research proposed a system aims to inform the authority of a property when it is under criminal activities such as robbery, snatching with guns, knives, and other weapons. The design focuses on detecting the gun through the camera setup attached to system. After capturing an image of weapons, it processes the image through the OpenCV and detects it. All the needed hardware is set, and the software codes are installed in Raspberry Pi 3 Model B [11].

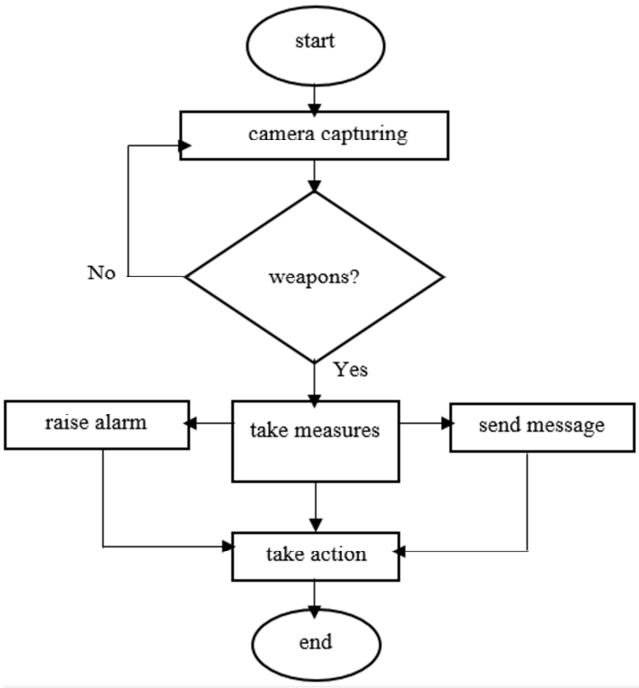

Figure 1. *Flow diagram of the system.*

It has already been mentioned that we have trained our system with more than 5000 images of weapons. However, the reliability of the system concerns, we have introduced the system with more than 10000 images where weapons are not present. In this study, the system needs a higher GPU speed. The similarity percentage of the weapons is 70% assumed as the threshold value. The flow diagram of this study is shown in Figure 1. While the weapons detection is completed, the system immediately performs the following three operations:

1. The system continuously raises alarms via a buzzer.
2. The system sends a message about the ongoing danger ("Warning! Your Property is in danger!! Please take immediate action!!!") to the authorities.
3. The system calls the phone number of the authorities for better communication so that the authorities can take action accordingly.

4. Methodology

In building up the proposed system, there is used both hardware and software to detect several weapons and taken action accordingly. In this study mainly used hardware are the Raspberry Pi 3 Model B, Pi Camera module v1, corresponding SIM800L GSM module, and a buzzer. We have used python codes, TensorFlow library, OpenCV and Raspberry Pi OS [12].

A. Training images and System setup

The images have been trained through the TensorFlow library of python generated code. The Raspberry Pi Operating System has been installed in an SD card and inserted in the built-in SD card slot. The required python codes have been installed to the Raspberry Pi 3 Model B through a USB pen drive. There is a Raspberry Pi camera module 1 which has been set to the Raspberry Pi. However a weapon is taken in front of the camera, it is detected by the system through OpenCV. The structure of the system is shown in Figure 2.

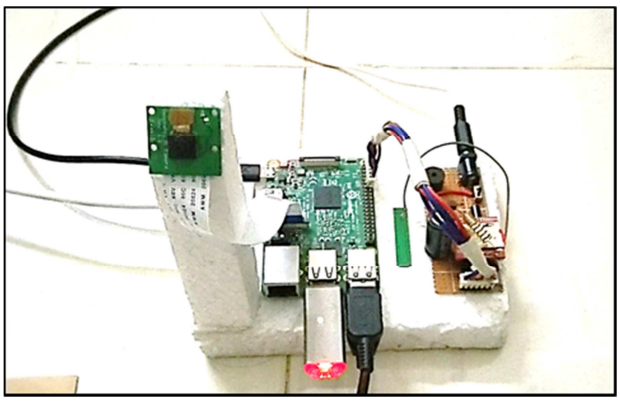

Figure 2. *Structure of the system.*

B. Functionalities of the System

While the system detects a weapon with similarity to the threshold value 70% confidence to be a weapon, it immediately starts to raise the alarm, send a text message to the previously selected phone number and call the property owner for a greater safety efficiency. The Figure 3 shows the image representation. A gun has been detected with a confidence of 97.86% by the camera (the toy gun was used for testing purposes). The buzzer alarm immediately starts to raise the alarm continuously for a specified amount of time. It is seen in Figure 3 the shell informs that the text mode is enabled, and it is sending a text message and calling the specific number.

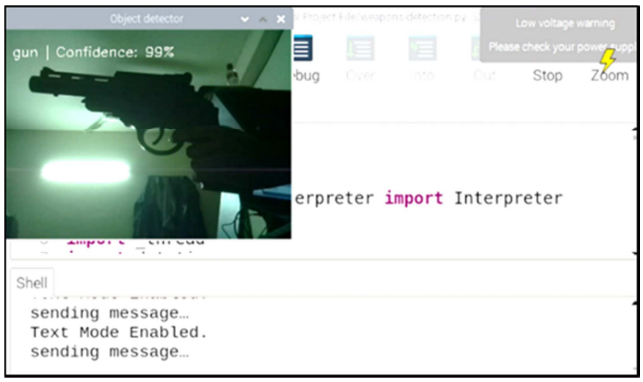

Figure 3. *Weapon detection and taking action.*

C. Calling and Sending SMS Interfaces

The system calls to the prior stored number while the weapon is detected as well as send an SMS by mentioning the message “Warning! Your property is in danger! Please take an immediate action!!!”.

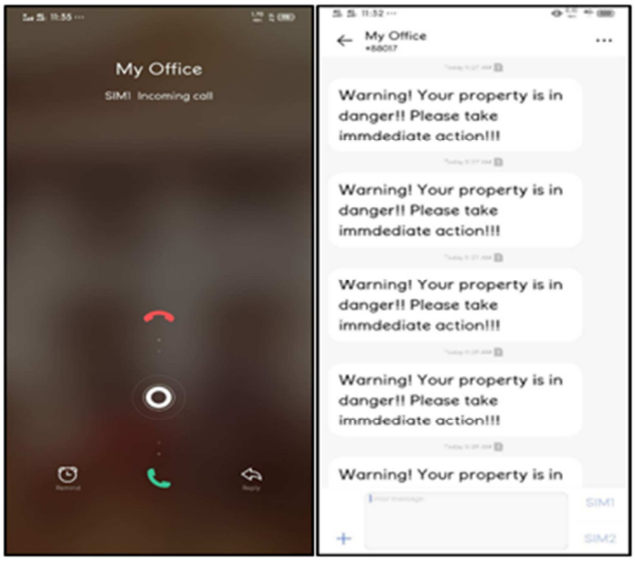

Figure 4. *Calling and sending SMS interfaces.*

5. Result and Discussion

The proposed system is tested in several times and there have obtained test results. In the testing of this research, all the operations are working flawlessly. The table 1 shows the result of the testing inputs and outputs.

The table 1 shows the experimental report for gun and knife detection are 97.86% and 98% respectively and all

other operations are going on in precisely. This concludes the system is working fine with reasonable accuracy and hopefully that the system will handle every armed detection and take action accordingly.

Table 1. *Testing of all aspects of the system.*

Serial No.	Test Input	Expected Output	Actual Output	Result
1	Running the program	Run	Successfully Run	Alright
2	GSM test	Should start GSM	GSM Started Normally	Pass
3	Showing gun to camera	Detect with above 70% accuracy	Detected with 97.86% accuracy	Pass
4	Showing Knife to camera	Detected with above 70% accuracy	Detected with 98% accuracy	Pass
5	Raising alarm test	Buzzer on	Buzzer on normally	Pass
6	Sending SMS test	Should send SMS	SMS sent within a very short time	Pass
7	Phone call test	The system should call to authority	Called the authority immediately	Pass

6. Conclusion

This study tests the proposed model several times with different dummy weapons, and it worked every interval with satisfactory output. The system detects the weapons with high accuracy such as for guns and knives 97.86% and 98% respectively. The projected model is capable of doing the same job for all the environments where it is installed. However, the features of the system are much more convenient and innovative in present and the future. This research impacts the society for projecting the valuable property of being robbed and theft. The developed system is highly efficient, lightweight and easily installed in anywhere. However, the authority of property is not able to run the system at a particular time, they can change its working activities according to their needs. Both AC and DC power can be supplied to the system to operate. The research generated the security model is cost efficient and time saving.

In the future, this study will add a GPS-based location tracking system to make the system useful for the cops. However, this research will incorporate the unusual facial activities to the system to detect what is going inside the mind of a human being.

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