Chapter 8
Analysts and Detection of Concealed Weapons Using IR Fusion With MMW Support Imaging Technology

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ABSTRACT

The detection of weapons concealed underneath a person's clothing is an important obstacle to the improvement of the security of the general public as well as the safety of public assets like airports and buildings. The lack of proper mechanisms to detect and identify concealed weapons in advance results in the increase of crime rate. This chapter presents a study for concealed weapon detection using passive millimeter wave imaging sensors combined with image processing and convolutional neural networks. This eliminates the ambiguity of using millimeter wave imaging alone. The proposed system will perform the fusion of Passive MMW images with corresponding IR images followed by YOLO and VGG Net detection models.

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INTRODUCTION

Concealed weapons are a great threat to the public. The absence of proper detection mechanisms for concealed weapons plays a major role when it comes to terrorist attacks and other crime incidents. Even though there are smart surveillance systems like CCTVs around each and every corner of the world, due to the manual nature of data gathering methods and failure to provide an immediate response to danger, they are mostly used to identify and track down perpetrators once the harm is done. Various studies had tried to address this issue by considering image processing and object detection separately due to the unavailability of a proper dataset and it is also mentioned that in order to increase the performance of the presented system it is preferable to use a large dataset. The purpose of this paper is to present a solution for concealed weapon detection using Image processing techniques and Convolutional Neural Networks with the goal of rapid detection and identification of concealed weapons.

Image fusion, recently identified as a key technology for concealed weapon detection along with two Convolutional Neural Networks will be used to construct the proposed system. Image fusion is being employed in various fields like concealed weapon detection, artificial intelligence, surveillance system, multi-focus imagery, medical diagnosis and such. While other fusion techniques such as Multi-Resolution Analysis (MRA) can be utilized, the resulting fused images are of poor quality making it difficult for the machine or human to recognize concealed objects. This paper's objective is to improvise the existing MMW imaging technique by combining it with image processing and Convolutional Neural Networks. Passive millimeter wave sensors measure the apparent temperature through the energy that is emitted or reflected by sources. The output of the sensors is a function of the emissivity of the objects in the MMW spectrum as measured by the receiver. Clothing penetration for concealed weapon detection is made possible by MMW sensors due to the low emissivity and high reflectivity of objects like metallic guns. Among the first generation of MMW sensors is the focal-plane array MMW sensor by Millitech Corporation. MMW imaging is preferred as a primary imaging technique over IR imaging because Infrared imagers utilize the temperature distribution information of the target to form an image. Normally they are used for a variety of night-vision applications, such as viewing vehicles and people. The underlying theory is that the infrared radiation emitted by the human body is absorbed by clothing and then re-emitted by it. As a result, infrared radiation can be used to show the image of a concealed weapon only when the clothing is tight, thin, and stationary. For normally loose clothing, the emitted infrared radiation will be spread over a larger clothing area, thus decreasing the ability to image a weapon. The infrared radiation emitted by the human body is absorbed by clothing and then re-emitted by it. As a result, infrared radiation can be used to show the image of a concealed weapon only when the clothing is tight, thin, and stationary. For normally loose clothing, the emitted infrared radiation will be spread over a larger clothing area, thus decreasing the ability to image a weapon. This paper utilizes Passive MMW imaging as the primary imaging technique combined with IR imaging.

Moreover, object identification is the crucial part of this process. Classifying the objects present inside a baggage is not sufficient. YOLO (You Only Look Once) is applied to identify the concealed objects in real time. It divides the obtained image into segments and predicts bounding boxes and their probability. YOLO is popular for its high accuracy and processing speed. With VGG Net and YOLO, large scale image classification with high accuracy is ensured. Many improvised methods related to Convolutional Neural Networks have been developed. Though these networks yield remarkable performance in classification and detection, their configuration architecture is complex. VGG Net is exploited for