A New Methodology in Weapon Detection Using Advanced Sensor Technology and DIP

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Abstract:* We have recently witnessed the series of bomb blasts in Mumbai. Bombs went of in buses and underground stations. And killed many and left many injured. People think bomb blasts can't be predicted before handled. Here we show you the technology which predicts the suicide bombers and explosion of weapons through IMAGE PROCESSING FOR CONCLEAD WEAPON DETECTION. The detection of weapons concealed underneath a person's clothing is very much important to the improvement of the security of the general public as well as the safety of public assets like airports, buildings, and railway stations etc. Manual screening procedures for detecting concealed weapons such as handguns, knives, and explosives are common in controlled access settings like airports, entrances to sensitive buildings and public events. It is desirable sometimes to be able to detect concealed weapons from a standoff distance, especially when it is impossible to arrange the flow of people through a controlled procedure. In the present paper we describe the concepts of the technology 'CONCEALEAD WEAPON DETECTION' the sensor improvements, how the imaging takes place and the challenges. And we also describe techniques for simultaneous noise suppression, object enhancement of video data.

Keywords—weapon detection, sensor technology, object enhancement.

I. INTRODUCTION

. Till now the detection of concealed weapons is done by manual screening procedures. To control the explosives in some places like airports, sensitive buildings, famous constructions etc. But these manual screening procedures are not giving satisfactory results, because this type of manual screenings procedures screens the person when the person is near the screening machine and also some times it gives wrong alarm indications so we are need of a technology that almost detects the weapon by scanning. This can be achieved by imaging for concealed weapons.

The goal is the eventual deployment of automatic detection and recognition of concealed weapons. It is a technological challenge that requires innovative solutions in sensor technologies and image processing.

The problem also presents challenges in the legal arena; a number of sensors based on different phenomenology as well as image processing support are being developed to observe objects underneath people's clothing.

II. IMAGING SENSORS

These imaging sensors developed for CWD applications depending on their portability, proximity and whether they use active or passive illuminations.

2.1 INFRARED IMAGER:

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.

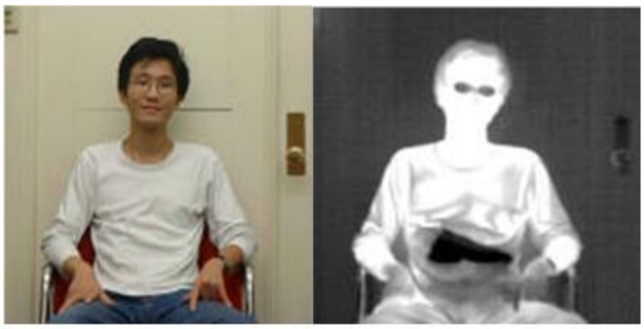

Fig 1: Example of infrared imager

2.2 P M W IMAGING SENSORS:

The first data processed in early 1995 consisted of Infrared (IR) and millimeter wave (MMW) types. The MMW data were scanned using a single detector that took up to 30 minutes to collect one set of data. The latest MMW data available since 2001 are collected in real-time at 30 frames-per-second. This type of sensors is released in two generations.

- **FIRST GENERATION:**

Passive millimeter wave (MMW) 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 emissive 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 emissive and high reflectivity of objects like metallic guns. In early 1995, the MMW data were obtained by means of scans using a single detector that took up to 90 minutes to generate one image. Amongst the first MMW sensors is the Focal-Plane Array MMW Sensor by Millitech Corporation of South Deerfield, MA.

Following figure2 (a) shows a visual image of a person wearing a heavy sweater that conceals two guns made with metal and ceramics. The corresponding 94-GHz radiometric image figure2 (b) was obtained by scanning a single detector across the object plane using a mechanical scanner. The radiometric image clearly shows both firearms.

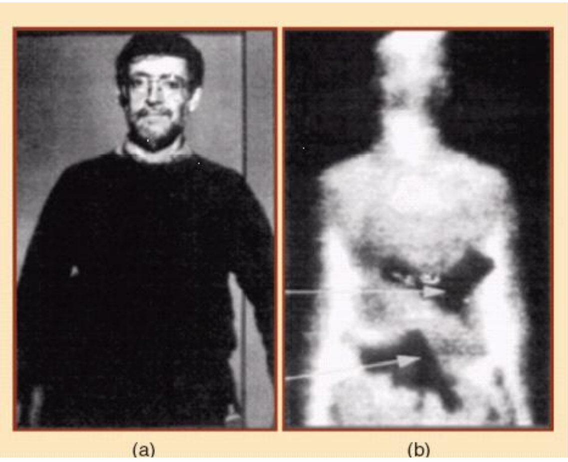

Fig: 2(a) visible and 2(b) MMW image of a person concealing 2 guns beneath a heavy sweater

- **SECOND GENERATION:**

Recent advances in MMW sensor technology have led to video-rate (30 frames/s) MMW cameras .One such camera is the pupil-plane array from Terex Enterprises. It is a 94-GHz radiometric pupil-plane imaging system that employs frequency scanning to achieve vertical resolution and uses an array of 32 individual wave-guide antennas for horizontal resolution. This system collects up to 30 frames/s of MMW data.

In summary, the MMW sensors provide an effective way to detect a variety of metallic and non-metallic weapons. For practical use of MMW sensors, it is necessary to provide an enhanced picture in which a user can effectively and easily detect weapons if present in the scene. In addition, it is desired to have an automatic way of detection to assist the user in finding suspicious objects. This can only be done through image processing.

III. CWD THROUGH FUSION AND REGISTRATION

By fusing passive MMW image data and its corresponding infrared (IR) or electro-optical (EO) image, more complete information can be obtained; the information can then be utilized to facilitate concealed weapon detection. Fusion of an IR image revealing a concealed weapon and its corresponding MMW image has been shown to facilitate extraction of the concealed weapon. This is illustrated in the example given in following figure 3a) Shows an image taken from a regular CCD camera, and

Figure3b) shows a corresponding MMW image. If either one of these two images alone is presented to a human operator, it is difficult to recognize the weapon concealed underneath the rightmost person's clothing.

If a fused image as shown in Figure 3c) is presented, a human operator is able to respond with higher accuracy. This demonstrates the benefit of image fusion for the CWD application, which integrates complementary information from multiple types of sensors.

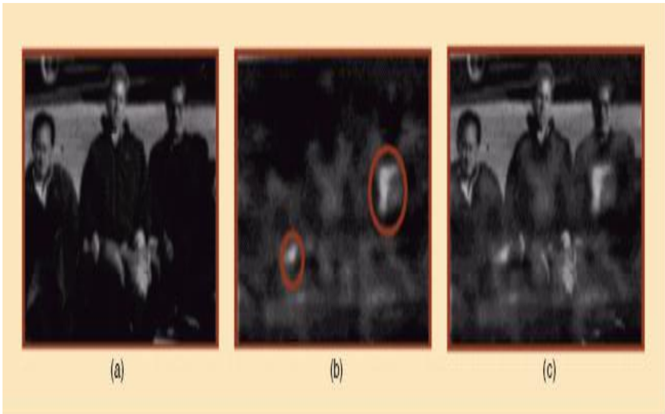

Fig3: example of MMW image

3.1 REGISTRATION PROCEDURE

Even though MMW imagers penetrate clothing they do not provide the best picture due to their limited resolution. Infrared (IR) sensors, on the other hand, provide well-resolved pictures with less capability for clothing penetration. Combining both technologies should provide a better way to display a well-resolved image with a better view of a concealed weapon. Combination of IR and MMW image sensors require registration and fusion procedures. The registration algorithm is explained in this section.

First, in order to develop the registration algorithm, the following assumptions were made [3]:

1. The distances between the object and the sensors are large enough so that the object can be considered planar and its depth neglected.

2. The scale factor between the two images can be calculated based on distance information and sensor parameters like the field of view (FOV).

3. The sensors are positioned so that no rotation is needed.

The above assumptions ensure that the only pose parameters needed are x and y displacements. The registration procedure is based on the observation that the body shapes are well preserved in IR and MMW images. We first scale the IR image according to some prior knowledge about the sensors. Then, the body shapes are extracted from the backgrounds of the IR and MMW images. Finally, we apply correlation to the resulting binary images to determine the x and y displacements.

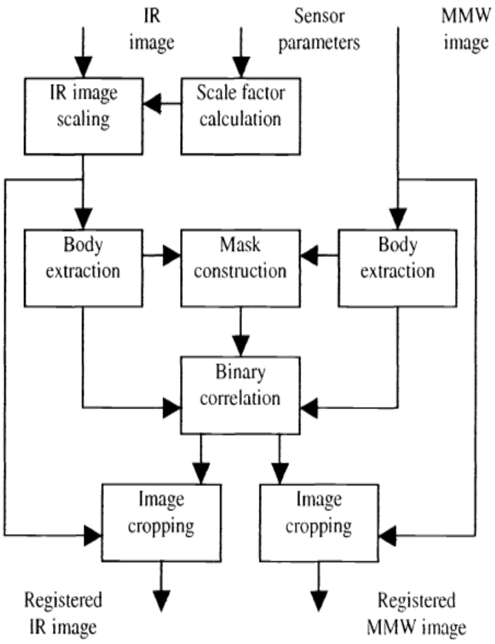

Fig4: Block Diagram for RIGISTRATION PROCEDURE

An example of the application of the registration procedure is shown in Figure 5. Note how the MMW image (bottom right) is well registered with respect to the JR image (top right) in terms of scale and displacement.

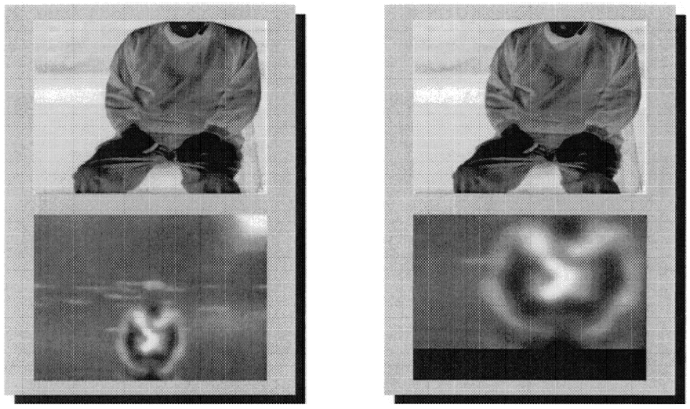

Fig6: example for registration procedure

3.2 FUSION PROCEDURE

The fusion procedure involves multiresolution image decomposition based on the wavelet transform. Burt first proposed the approach as a model for binocular fusion in human stereo-vision. His implementation used a Laplacian pyramid and a "maximum" selection rule. Others have used similar pyramid methods, including the wavelet transform, and different selection rules to fuse images [5-7]. First, an image pyramid is constructed for each source image by applying the wavelet transform to the source images. Then, using a feature selection rule, a fused pyramid is formed for the composite image from the pyramid coefficients of the source images. Finally, the composite image is obtained by taking an inverse pyramid transform of the composite wavelet representation. .

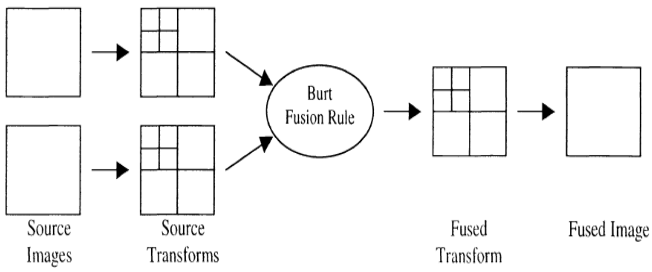

Fig6: Block diagram for FUSION PROCEDURE

IV. CWD USING COLOR IMAGE FUSION

Image fusion is studied for detecting weapons or other objects hidden underneath a person's clothing. Here we are focusing on a new algorithm to fuse a color visual image and a corresponding IR image for such a concealed weapon detection application. The fused image obtained by the proposed algorithm will maintain the high resolution of the visual image, incorporate any concealed weapons detected by the IR sensor, and keep the natural color of the visual image. The feasibility of the proposed fusion technique is demonstrated by some experimental results.

In our current work, we are interested in using image fusion to help a human or computer in detecting a concealed weapon using IR and visual sensors. One example is given in Figure 8. Figure 8 shows the color visual image and (b) shows the corresponding IR image. The visual and IR images have been aligned by image registration. We observe that the body is brighter than the background in the IR image. Further the background is almost black and shows little detail because of the high thermal emissivity of body. The weapon is darker than the surrounding body due to a temperature difference between it and the body (it is colder than human body). The resolution in the visual image is much higher than that of the IR image, but there is no information on the concealed weapon in the visual image.

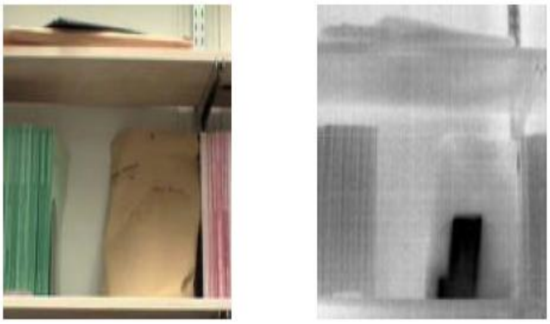

Fig8: example for color image fusion

4. 1Imaging Processing Architecture:

An image processing architecture for CWD is shown in Figure 12.The input can be multi sensor (i.e., MMW + IR, MMW + EO, or MMW + IR + EO) data or only the MMW data. In the latter case, the blocks showing registration and fusion can be removed from Figure 9. The output can take several forms. It can be as simple as a processed image/video sequence displayed on a screen; a cued display where potential concealed weapon types and locations are highlighted with associated confidence measures; a “yes,” “no,” or “maybe” indicator; or a combination of the above. The image processing procedures that have been investigated for CWD applications range from simple denoising to automatic pattern recognition.

Before an image or video sequence is presented to a human observer for operator-assisted weapon detection or fed into an automatic weapon detection algorithm, it is desirable to preprocess the images or video data to maximize their exploitation. The preprocessing steps considered in this section include enhancement and filtering for the removal of shadows, wrinkles, and other artifacts. When more than one sensor is used, preprocessing must also include registration and fusion procedures.

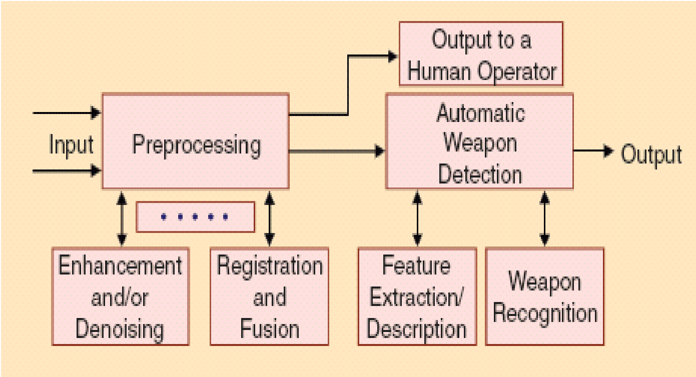

FIG 9: An imaging processing architecture overview for CWD

V. CONCLUSION

Imaging techniques based on a combination of sensor technologies and processing will potentially play a key role in addressing the concealed weapon detection problem. In this paper, we first briefly reviewed the sensor technologies being investigated for the CWD application of the various methods being investigated, passive MMW imaging sensors offer the best near-term potential for providing a noninvasive method of observing metallic and plastic objects concealed underneath common clothing. Recent advances in MMW sensor technology have led to video-rate (30 frames/s) MMW cameras.

To enhance the practical values of passive MMW cameras, sensor fusion approaches using MMW and IR, or MMW and EO cameras are being described. By integrating the complementary information from different sensors, a more effective CWD system is expected. In the second part of this paper, we provided a survey of the image processing techniques being developed to achieve this goal. Specifically, topics such as MMW image/video enhancement, filtering, registration, fusion, extraction, description, and recognition were discussed. A preliminary study on the performance of several shape descriptors that show promising results has also been reported in this paper.

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