**1.ABSTRACT:-**

In the present scenario, bomb blasts are rampant all around the world. Bombs went of in buses and underground stations, killed many and left many injured. Bomb blasts can not be predicted before hand. This paper is all about the technology which predicts the suicide bombers and explosion of weapons through IMAGING FOR CONCLEAD WEAPON DETECTION, the sensor improvements, how the imaging takes place and the challenge And we also describe techniques for simultaneous noise suppression, object enhancement of video data and show some mathematical results.

The detection of weapons concealed underneath a persons 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.

Imaging techniques based on a combination of sensor technologies and processing will potentially play a key role in addressing the concealed weapon detection problem. Recent advances in MMW sensor technology have led to video-rate (30 frames/s) MMW cameras. However, MMW cameras alone cannot provide useful information about the detail and location of the individual being monitored. 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. .

.

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

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.

**3. 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.

**4. PMW IMAGING SENSORS:**

**4.1FIRST 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.

Following figure1 (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 figure1 (b) was obtained by scanning a single detector across the object plane using a mechanical scanner. The radiometric image clearly shows both firearms.

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.

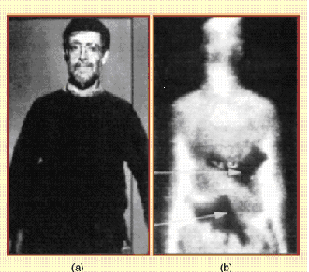


Figure: 1(a) visible and 1(b) MMW image of a person concealing 2 guns beneath a heavy sweater

**4.2SECOND GENERATION:**

Recent advances in MMW sensor technology have led to video-rate (30 frames/s) MMW cameras.This system collects up to 30 frames/s of MMW data. Following figure shows the visible and second-generation MMW images of an individual hiding a gun underneath his jacket. It is clear from the figures 1(b), 2(b) that the image quality of the camera is degraded.

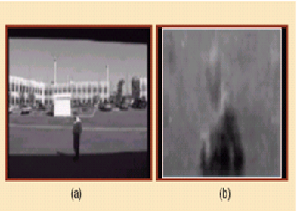


FIGURE 2(a) visual image 2(b) second-generation image of a person concealing a handgun beneath a jacket.

**5.CWD THROUGH IMAGE FUSION:**

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 benefits of image fusion for the CWD application, which integrates complementary information from multiple types of sensors.

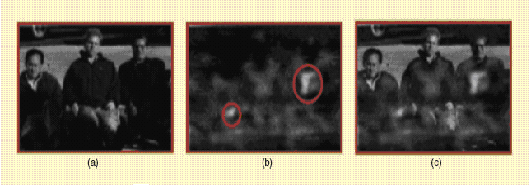


FIGURE 3: An example of image fusion for CWD. (a) Image1: visual (b) Image2: MMW (c) Fused Image.

**6.IMAGING PROCESSING ARCHITECTURE**:

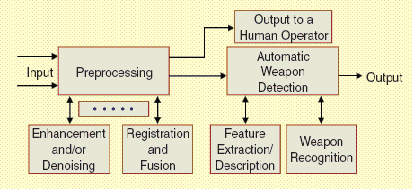


FIGURE 4: An imaging processing architecture overview for CWD

An image processing architecture for CWD is shown in Figure 4.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 4. 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 de-noising to automatic pattern recognition

**7.WAVELET APPROACHS FOR PRE PROCESSING:**

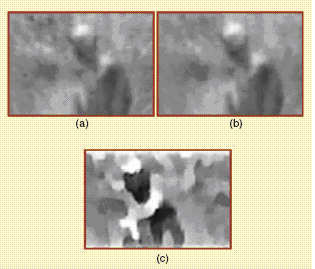
Before an image or video sequence is presented to a human observer for operator-assisted weapon detection or fed into an automatic weapon detection algorithm, it is desirable to preprocess the images or video data to maximize their exploitation. The preprocessing steps considered in this section include 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.

**7.1) IMAGE DENOISING & ENHANCEMENT THROUGH WAVELETS:**

Many techniques have been developed to improve the quality of MMW images in this section, we describe a technique for simultaneous noise suppression and object enhancement of passive MMW video data and show some mathematical results.De-noising of the video sequences can be achieved temporally or spatially. First, temporal de-noising is achieved by motion compensated filtering, which estimates the motion trajectory of each pixel and then conducts a 1-D filtering along the trajectory.

This reduces the blurring effect that occurs when temporal filtering is performed without regard to object motion between frames. The motion trajectory of a pixel can be estimated by various algorithms such as optical flow methods, block-based methods and Bayesian-methods. If the motion in an image sequence is not abrupt, we can restrict the search to a small region in the subsequent frames for the motion trajectory. For additional de-noising and object enhancement, the technique employs a wavelet transform method that is based on multi scale edge representation.

The detection of weapons concealed underneath a persons 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.



**FIGURE: 5a)** original frame 5b) de-noised frame 5c) de-noised and enhanced frame by wavelet approach

In above figure 5(a), which shows a frame taken from the sample video sequence, the concealed gun does not show clearly the de-noised frame by motion-compensated filtering. The frame was then spatially de-noised and enhanced by the wavelet transform methods. Four decomposition levels were used and edges in the figure.

The fine scales were detected using the magnitude and angles of the gradient of the multi-scale edge representation. The threshold for de-noising was 15% of the maximum gradient at each scale. Figure 5(c) shows the final results of the contrast enhanced and demised frames. Note that the image of the handgun on the chest of the subject is more apparent in the enhanced frame than it is in the original frame. However, spurious features such as glint are also enhanced; higher-level procedures such as pattern.Recognition has to be used to discard these undesirable features.

**7.2) CLUTTER FILTERING:**

Clutter filtering is used to remove unwanted details (shadows, wrinkles, imaging artifacts, etc.) that are not needed in the final image for human observation, and can adversely affect the performance of the automatic recognition stage. This helps improve the recognition performance, either operator-assisted or automatic. For this purpose, morphological filters have been employed. Examples of the use of morphological filtering for noise removal are provided through the complete CWD example given in Figure. A complete description of the example is given in a later section.because of noise and low contrast.

**7.3) REGISTRATION OF MULTI- SENSOR IMAGES:**

As indicated earlier, making use of multiple sensors may increase the efficacy of a CWD system. The first step toward image fusion is a precise alignment of images (i.e., image registration).

Very little has been reported on the registration problem for the CWD application. Here, we describe a registration approach for images taken at the same time from different but Nearly collocated (adjacent and parallel) sensors based on the maximization of mutual information (MMI) criterion. MMI states that two images are registered when their mutual information (MI) reaches its maximum value. This can be expressed mathematically as the following:



where *F* and *R* are the images to be registered. *F* is referred to as the *floating image*, whose pixel coordinates *(˜x)* are to be mapped to new coordinates on the *reference image R*. The reference image *R* is to be re-sampled according to the positions defined by the new coordinates *Ta(* ˜*x)*, where *T* denotes the transformation model, and the dependence of *T* on its associated parameters *a* is indicated by the use of notation *Ta*.

*I* is the MI similarity measure calculated over the region of overlap of the two images and can be calculated through the joint histogram of the two images the above criterion says that the two images *F* and *R* are registered through *Ta*\* when *a*\* globally optimizes the MI measure, a two-stage registration algorithm was developed for the registration of IR images and the corresponding MMW images of the first generation. At the first stage, two human silhouette extraction algorithms were developed, followed by a binary correlation to coarsely register the two images.

The fine scales were detected using the magnitude and angles of the gradient of the multi-scale edge representation. The threshold for de-noising was 15% of the maximum gradient at each scale. Figure 5(c) shows the final results of the contrast enhanced and demised frames. Note that the image of the handgun on the chest of the subject is more apparent in the enhanced frame than it is in the original frame. However, spurious features such as glint are also enhanced; higher-level procedures such as pattern.Recognition has to be used to discard these undesirable features.

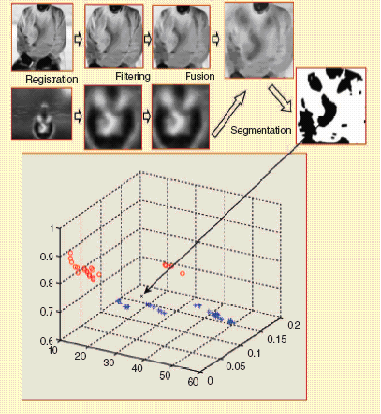


FIGURE 6: A CWD EXAMPLE

The purpose was to provide an initial search point close to the final solution for the second stage of the registration algorithm based on the MMI criterion. In this manner, any local optimizer can be employed to maximize the MI measure.One registration result obtained by this approach is illustrated through the example given in Figure 6.

**7.4) IMAGE DECOMPOSITION:**

The most straightforward approach to image fusion is to take the average of the source images, but produce undesirable results such as a decrease in contrast. Many of the advanced image fusion methods involve multi resolution image decomposition based on the wavelet transform. First, an image pyramid constructed for each source image by applying the wavelet transform to the source images. This domain representation emphasizes important details of the source images at different scales, which is useful for choosing the best fusion rules. can produce undesirable results such as a decrease in contrast. Many of the advanced image fusion methods involve multi resolution image decomposition based on the wavelet transform.

First, an image pyramid is constructed for each source image by applying the wavelet transform to the source images. This transform domain representation emphasizes important details of the source images at different scales, which is useful for choosing the best fusion rules. Then, using a feature selection rule, a fused pyramid is formed for the composite image from the pyramid coefficients of the source images. The simplest feature selection rule is choosing the maximum of the two corresponding transform values. This allows the integration of details into one image from two or more images. Finally, the composite image is obtained by taking an inverse pyramid transform of the composite wavelet representation. The process can be applied to fusion of multiple source imagery.

This type of method has been used to fuse IR and MMW images for CWD application [7]. The first fusion example for CWD application is given in Figure 7. Two IR images taken from separate IR cameras from different viewing angles are considered in this case. The advantage of image fusion for this case is clear since we can observe a complete gun shape only in the fused image. The second fusion example, fusion of IR and MMW images, is provided in Figure 6.

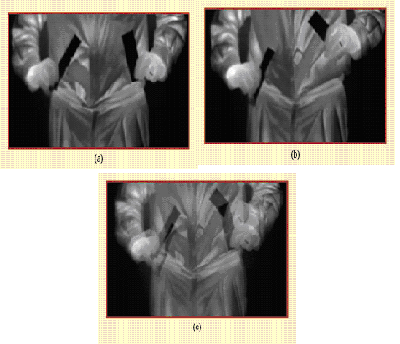


FIGURE 7: (a) and (b) are original IR images (c) is fused image

## 8.AUTOMATIC WEAPON DETECTION:

After preprocessing, the images /video sequences can be displayed for operator-assisted weapon detection or fed into a weapon detection module for automated weapon detection. Toward this aim, several steps are required, including object extraction, shape description, and weapon recognition.

# 9.SEGMENTATION FOR OBJECT EXTRACTION:

Object extraction is an important step towards automatic recognition of a weapon, regardless of whether or not the image fusion step is involved. It has been successfully used to extract the gun shape from the fused IR and MMW images. This could not be achieved using the original images alone. Segmented result from the fused IR and MMW image is shown in Figure 6.

**10.CHALLENGES:**

There are several challenges ahead. One critical issue is the challenge of performing detection at a distance with high probability of detection and low probability of false alarm. Yet another difficulty to be surmounted is forging portable multi-sensor instruments. Also, detection systems go hand in hand with subsequent response by the operator, and system development should take into account the overall context of deployment.

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.

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.

Concealed weapon detection (CWD) is an increasingly important topic in the general area of law and enforcement and it appears to be a critical technology for dealing with terrorism, which appears to be the cwd.Since no single sensor technology can provide acceptable performance in CWD applications, image fusion has been identified as a key technology to achieve improved CWD procedures.  
Existing image sensing mechanisms include thermal/infrared (IR), millimeter wave, and visual.   
In current work we focus on fusingvisual and IR image for cwd**.**To develop a new algorithm to fuse a color visual image and a corresponding IR image for 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 cwd.

This reduces the blurring effect that occurs when temporal filtering is performed without regard to object motion between frames. The motion trajectory of a pixel can be estimated by various algorithms such as optical flow methods, block-based methods andBayesian-methods. If the motion in an image sequence is not abrupt, we can restrict the search to a small region in the subsequent frames for the motion trajectory.he IR sensor.

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.

Then, using a feature selection rule, a fused pyramid is formed for the composite image from the pyramid coefficients of the source images. The simplest feature selection rule is choosing the maximum of the two corresponding transform values. This allows the integration of details into one image from two or more images. Finally, the composite image is obtained by taking an inverse pyramid transform of the composite wavelet representation. The process can be applied to fusion of multiple source imagery.

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.

**11.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. Recent advances in MMW sensor technology have led to video-rate (30 frames/s) MMW cameras. However, MMW cameras alone cannot provide useful information about the detail and location of the individual being monitored. 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.

**12.REFERENCES:**

1. An Article from “IEEE SIGNAL PROCESSING MAGAZINE**”** March 2005 pp. 52-61

2. www.wikipedia.org

3. N.G.Paulter, “Guide to the technologies of concealed weapon imaging and detection,” *NIJ Guide 602-00*, 2001

4. www.imageprocessing.com