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IDENTIFICATION OF CONCEALED WEAPON IN HUMAN BODY USING IMAGE PROCESSING

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Abstract

We have recently witnessed a suicide bombing in Pulwama (INDIA) which killed many of our soldiers and left many injured, left the world in shell shock and the Indians in terror. The situation is not limited to India but it can happen anywhere and anytime in the world. Here it is shown the technology which predicts the suicide bombers and explosion of weapons through, IMAGING FOR CONCEALED WEAPON DETECTION. Manual screening procedures for detecting concealed weapons such as knives, handguns and explosives are common in controlled access settings like entrances to sensitive buildings, airports and public events. The identification of weapons concealed underneath a person's clothing is very important obstacle to the improvement of the security of the general public as well as the safety of public assets like airports and malls. It is very desirable to be able to detect concealed weapons from some far distance, especially when it is impossible to arrange the flow of people through some controlled procedure. The goal is the eventual deployment of automatic detection and recognition of concealed weapons. It is also a technological challenge that requires innovative solutions in sensor technologies and image processing. Number of sensors based on different phenomenology as well as image processing support are being developed to observe objects underneath people's clothing. In 'CONCEALEAD WEAPON DETECTION' the sensor improvements, how the imaging place techniques for simultaneous noise suppression, object enhancement of video data and finally hidden object/weapon is detected.

Index Terms*: CWD, IR, DT-CWD, RGB, ATC.*

1. INTRODUCTION

A weapon is any object that can harm to another individual or group of individuals. This definition not only includes objects typically thought of as weapons, such as guns, knives and firearms, but also explosives, chemicals, etc. so these harmful things need to be detected for securing general public as well as public assets like malls, airports and buildings etc. Some of the already used manual screening procedure sometimes gives wrong alarm indication, and fails when the object is not in the range of security personnel as well as when it is impossible to manage the flow of people through some controlled procedure. It also disappoints us when we further try to identify a person who is the victim of an accident in future. Most of us think that bomb blasts can't be predicted before handled. In all the cases the CWD by scanning the images gives satisfactory results. But only single sensor technology cannot provide acceptable performance. So here attempt is made to bring out the eventual deployment of automatic detection and recognition of concealed weapons.

A number of sensors based on different phenomenology as well as image processing support are being developed to observe objects underneath people's clothing. Nowadays, image fusion has been identified as a key technology to achieve improved CWD procedures. In this technology focus is on fusing visual and a low cost IR images for CWD. IR images depend on the temperature distribution information of the target to form an image. Usually the principle of working follows here is that the infrared radiation emitted by the human body is absorbed by clothing and then re-emitted by it. In the IR image the background is almost black with little detail because of the high thermal emissivity of body. The weapon is much darker than the surrounding body due to a temperature difference between it and the body (it is colder than human body). The visual image is nothing but the RGB image that supports human visual perception. The resolution in the visual image is much higher than the IR image. But there is no any useful information on the concealed weapon in the visual image as such. The human visual system is much sensitive to the colours. To utilize this ability if we apply this image with other image in fusion technique we will a better fused image which will helps for detection.

2. CWD ARCHITECTURE

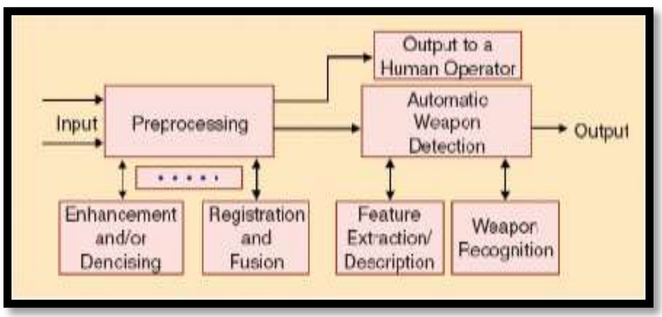


Fig. 1 CWD Architecture.

2.1. Multiple Inputs

In this technique for CWD we consider two types of image – a visual image and an IR image.

Visual_image: Visible image is nothing but an RGB image which has three main colour components i.e. Red, Green and Blue. This image is obtained from normal camera. Since the human visual system is very sensitive to colours this image creates a natural perception of an object to human vision but not helps so much in the detection of concealed weapon. That means advantage of this is we can detect the person and disadvantage is we cannot detect the weapon. For this we consider IR image as second input.

IR_Image: IR Image is obtained from IR Camera. IR Image basically depends on high thermal emissivity of the body. Basically, the infrared radiation emitted by the body is absorbed by clothing and then re-emitted by it, is sensed by the infrared sensors. Due to difference in thermal emissivity we can realize the hidden object but since the background is almost black this image cannot help in CWD alone. That means advantage is we can detect the hidden weapon but cannot recognize the person who is having the weapon.

MMW Image: We can also use passive MMW sensor as third input because of special features like it can give clear image even in the poor visibility conditions like clouds, fog, rain, smoke, etc. Also, it has the ability to detect the movements that are as small as fraction of a millimeter(mm).

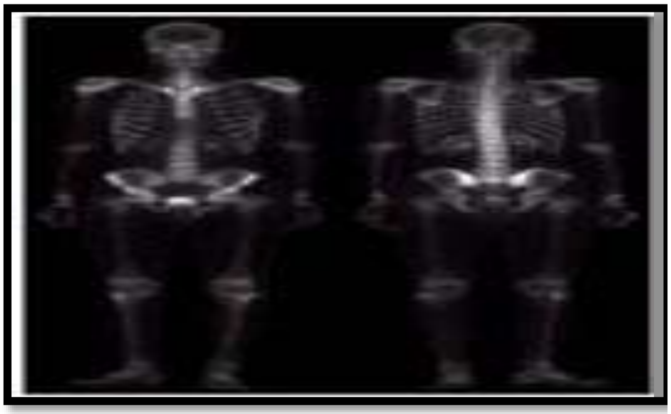
2.2. Enhancement and Denoising

a) *Image Enhancement*: is basically improvement done in the interpretability or perception of information in images for human viewers and providing `better' input for other automated image processing techniques. The basic objective of image enhancement is to modify attributes of an image to make it more suitable for a given task and a specific observer. At the time of this process, one or more attributes of the image are modified. The choice of attributes and the way they are modified are specific to a given task. Moreover, observer-specific factors, such as the human visual system and the observer's experience, will introduce a great deal of subjectivity into the choice of image enhancement methods. Image enhancement includes removing blurring and noise, which increases contrast and thus giving more details about the image.

The technique used is: Contrast Adjustment: It is done by scaling all the pixels of image by a constant k, is given by: $g[m,n]=f[m,n] * k$

Principle of working: Specifying a value above 1 will increase the contrast by making bright sample brighter and dark samples darker. And a value below 1 will do the opposite.

b) *Denoising*: An image is more often corrupted by noise in its acquisition or transmission. The main objective of denoising is to remove the noise while retaining as much as possible the important signal features. Denoising is done by filtering which can be either linear filtering or non-linear filtering.



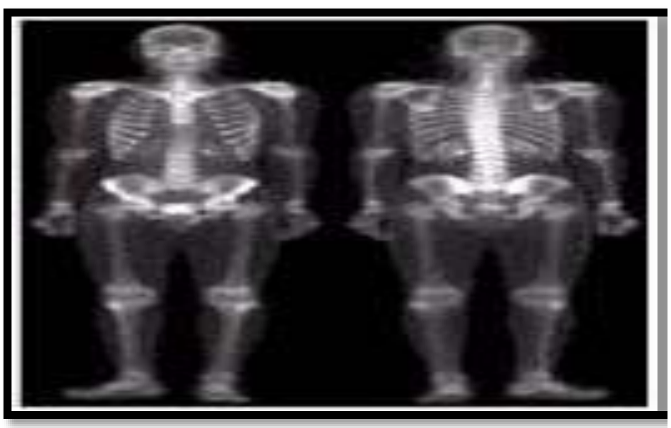


Fig. 2 Image after Enhancement and Denoising

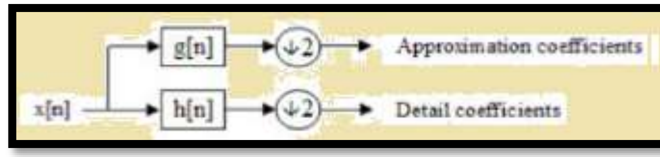


Fig. 3 Decomposition of discreate wavelet transform

The above figure shows that when the signal is passed through low pass filter it will only give some approximation coefficients/features. But when signal is passed through high pass filter it will give details about the signal. Here signal is nothing but the image. DT-CWT based fusion: DT - CWT structure is nothing but the decomposition of an image into two filter banks. The methodology of DT-CWT based fusion is as follows.

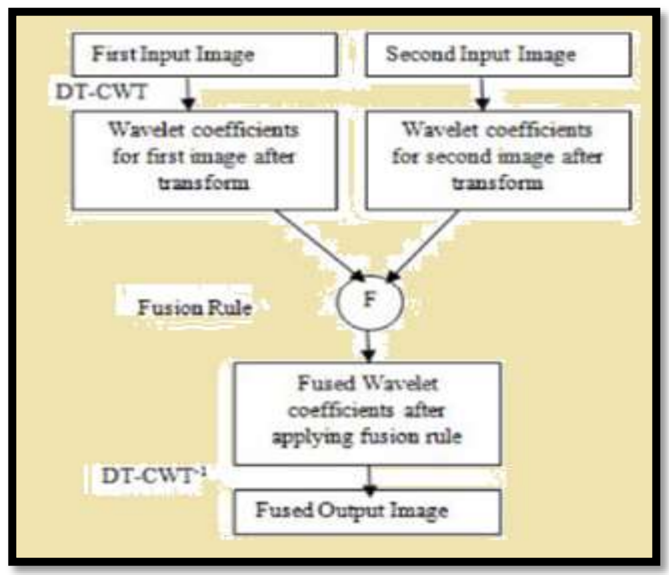


Fig. 4 DT-CWT Based Fusion

2.3. Registration and Fusion

Multiple sensors used in order to increase the efficiency of CWD, must be fused together in order to have processing over the images. First step towards image fusion is image registration. Image Registration states that: “two images are register only when the mutual information reaches its maximum value.” Even though MMW imager penetrates clothing but they do not provide well resolution due to limited resolution.IR sensors on other hand provide well resolved pictures. So, combination/fusion of these two will give well resolved and better view of weapon. Fusion Image is decomposed by two filters here: i). Low pass filter g(n) and ii). High pass filter h(n)

2.4. Segmentation for Object Extraction

Weapon is extracted using segmentation process. Segmentation is a process of partitioning an image into groups of pixels which are homogeneous with respect to some criteria. Broadly classified procedures are: i) Region approach ii) Boundary approach iii) Edge extraction

Procedure used here is: Slamani Mapping Procedure.

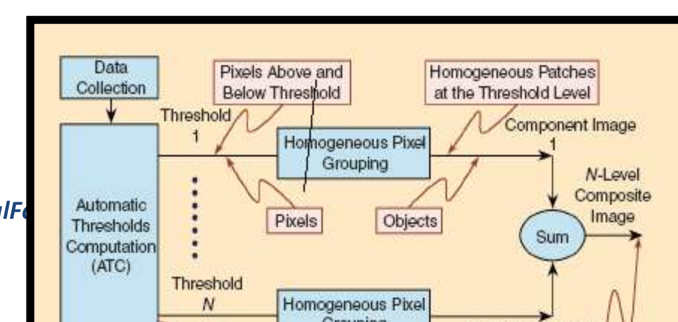


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Fig. 5 Slamani Mapping Procedure

In the above block diagram, automatic threshold computation (ATC) calculate different threshold values of the image based on: Region with different intensity levels and Region with same intensity levels. Region with different intensity levels will have multimodal histogram because of the difference in intensity levels. And regions with same intensity levels will have overlapping histograms. Threshold from both cases are fused together and quantized to get pixels above and below threshold. Adaptive filters are used to perform homogeneous pixel grouping which will give pixels of same kind to give component image. After doing summation of all these component images we get a composite image, where weapon appears as a single object. Intensity histogram is "graph showing number of pixel values of an image on different intensity values"

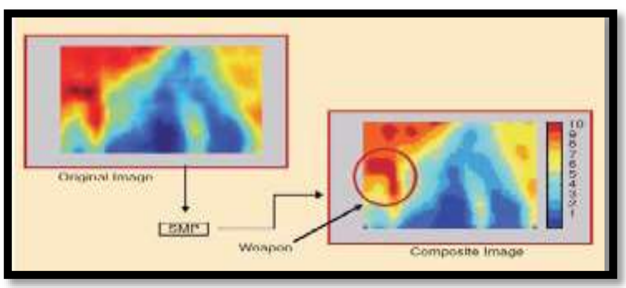

Fig. 6 Original and composite Image

2.5. Automatic Weapon Recognition

In this section, a standard pattern recognition approach is used to differentiate between the shapes representing weapons and the shapes representing non-weapons according to the shape descriptors adopted. Automatic weapon detection system uses computer that executes the program to implement mathematical algorithm. First, two shape libraries are constructed from known weapon and non-weapon images. The recognition of this new shape is achieved by applying the nearest-neighbor method in this N dimensional space. The normalized Euclidean distances between the new sample and each sample of the reference libraries are computed.

The shortest distance determines the class of the new image, given by:

$d(p,q) = \sqrt{[(p1-q1)2 + (p2-q2)2 + \ldots\ldots(pn-qn)2]}$

3.ALGORITHM

Step 1: Take a visual image (basically, RGB image) and an infrared (IR) image as input.
Step 2: Resize these two images so that they have same size.
Step 3: Combine i.e. add resized Visual and IR image.
Step 4: Complement the IR image.
Step 5: Combine i.e. add resized Visual image and complemented IR image.
Step 6: Convert the visual RGB image to its HSV format.
Step 7: Perform DWT fusion on Step 5's combined image and Step 6's converted HSV image.
Step 8: Convert the fused image into its gray scale format.
Step 9: Binarize the Fused image.
Step 10: Detect the weapon from that image.
Step 11: Combine this detected weapon with visual image.
Step 12: For detecting the weapon clearly we find out the contour of the weapon.
Step 13:Then combine the contour of the weapon with visual image.
Step 14: End

Fig 7 RGB Image

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Fig 8 IR Image

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Fig 9 Combined Image

Fig 10 Complemented IR

Figure 11 Combined image

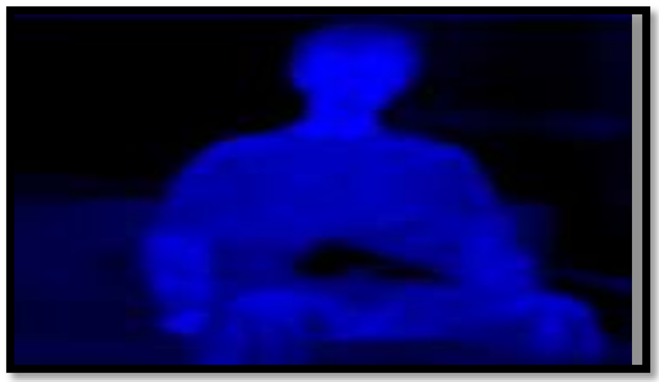

Fig 12 HSV Image

Fig 13 Fused Image

Fig 14 Fused Grey Image

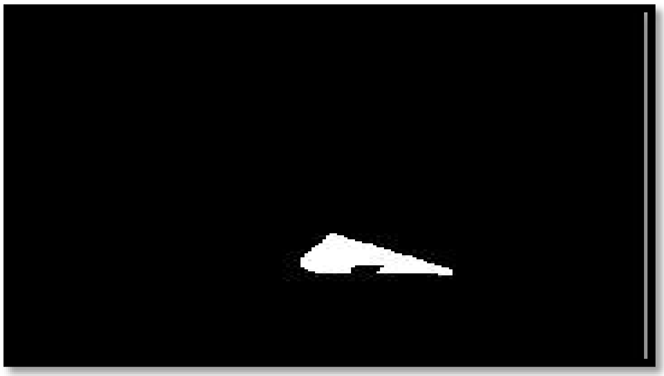

Fig 15 Weapon in binary image

Fig 16 Weapon in visual image

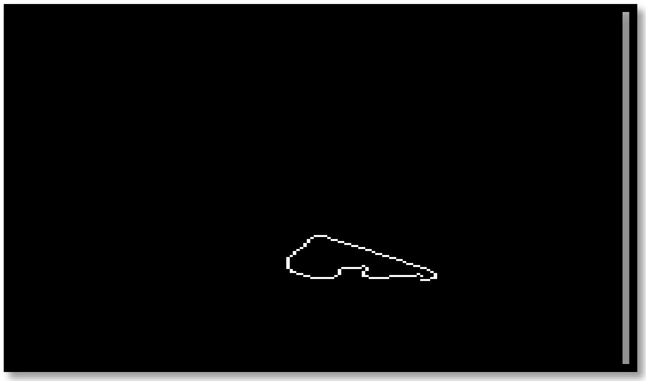

Fig 17 Contour of the weapon image

Fig 18 Contour of visual image

4. ADVANTAGES AND DISADVANTAGES

4.1. Advantages

1.Detection of weapon is possible even for heavy clothing including leather.

2.Ability to generate consistent images indoors and outdoors independent of weather.

3.Three dimensional data for better identification of data.

4.Generates data that is machine understandable, so it does not raise any kind of privacy concern.

4.2. Disadvantages

1.If the clothing is loose, proper detection of weapon will not be possible.

5. CONCLUSION

So, this technology suits best for concealed weapon detection. It accepts two different inputs, where each one of the inputs has its own spatiality. Then by enhancement and denoising process, image quality is improved and noise is removed. By registration and fusion process, the features of these images are combined together which is useful for further processing. Before giving this input to automatic weapon detection, process of segmentation is done which will help to extract the weapon from composed image.

And, finally this input will be given to automatic weapon detection which will compare the extracted shape of object with the present libraries of weapon and non-weapon. And the final result will be displayed on screen.

6. 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 multisensor 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.

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