International Review of Applied Engineering Research.
ISSN 2248-9967 Volume 4, Number 1 (2014), pp. 71-76

http://www.ripublication.com/iraer.htm

Detection Techniques for Human Safety from Concealed weapon and Harmful EDS

Pooja Pratihar[1] Arun Kumar Yadav[2]

[1]Robotics Engineering, University of Petroleum and Energy studies, Bidholi, Dehradun, Uttra Khand, India.
[2]Robotics Engineering, University of Petroleum and Energy Studies, Bidholi, Dehradun, Uttra Khand, India.

Abstract

In the world, common man has faced many kinds of terror and terrorist attack which has been destroys mankind and friendly environment. For the protection and safety of an individual in the world who is travelling through airlines, buses, trains etc. there are some categorized techniques or we can say methods for the detection of weapons like guns, knives and chemical explosives which are concealed beneath the layer of clothes or inside in the case. These methods should apply to the entrance of airports, bus stations, railway stations where the probability of risk are more to the mankind. It is very desirable to sometimes to detect concealed weapons from a standoff distance especially when it is impossible to arrange the flow of people through a controlled procedure .Here our goal is development of an effective Detection Technique of concealed weapon using image processing by the use of infrared rays and sensor technology .The main process of this system is followed by an algorithm using a color visual image and a corresponding IR image for concealed weapons.

Keywords: Concealed Weapon Detection; Image sensing; Image processing; Sensor technology; EDS technology; mm-wave.

1. Introduction

Concealed weapons can be detected through various techniques which are Image Processing, Active and Passive millimeter-wave sensors, Phased Antenna array, and explosives can be detected through Signal Processing and Pattern Recognition. For the

perfect effectiveness and visualization, image processing methods are generally opting. There are many layers in processing of image which scan out the real picture of concealed material. Sensors are also very effective for the security. It helps to complete the aim of detection of weapons, explosive, chemical threats.

A pulse synthesized, time domain approach relaying on Stepped Frequency Continuous Wave (SFCW) radar implemented in a phased array of antenna is proposed. Both the location of items (that support appreciable induced surface currents) concealed on the human body and the nature of these concealed item [3].

In order to detect contraband, it is important to understand their characteristics. Gozani lists the properties that are of greatest interest in identifying both drugs and explosives. For examples, drugs have following constitutes: carbon (high), oxygen (low), chlorine (moderate), and density (moderate). On the other hand for the explosives we get: carbon (moderate), nitrogen (high/moderate), oxygen (very high/ high) and density (very high). Nitrogen based explosives, rich in nitrogen (bonding agent) and oxygen (oxidizing agent) are commonly used due to their high power. The explosives also contain carbon and sometimes hydrogen as fuel. Usually, explosive device consist of two main components: an explosive agent and a detonating system. The blasting material consists primarily of inorganic nitrates and carbonaceous fuels and detonators are made of metallic tubes or shells with an initiating explosive. In case of plastic explosives, they can self-detonate due to their unstable nature. There are more than one hundred types of military and civilian explosives and around twenty commonly used drugs. A number of explosives characteristics can be used for their detection [4].

2. Types of Detection

2.1 Detection using image processing (By using infrared radiation)

Infrared image utilize the temperature distribution information of the target to form an image. Normally they are used for a variety of night-vision application, such as viewing vehicles and people [1]. The underlying theory is that the infrared radiation emitted by the human body is absorbed by the 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 layer clothing area, thus decreasing the ability to image a weapon [5].

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 [6]. So there is series of steps which enhance the quality of image. On the bases of these steps the algorithm is set.

2.1.1 Algorithm

Step1: Take the visual image which is basically RGB and an infrared (IR) image as an input.

Step2: Resize both the image with same ratio.
Step3: combine both the resized image i.e; RGB and IR image.
Step4: complementing IR image.
Step5: Now combination of complement IR image and resized RGB image.
Step6: Convert visual RGB image into its HSV format.
Step7: Apply DWT fusion on resultant image of Step 5 and Step 6.
Step8: Obtained image i.e; fused image get converted into its gray scale format.
Step9: Binary image obtained from fused image.
Step10: Detect weapon from the image.
Step11: Combine detected weapon with visual RGB image.
Step12: Clear image of weapon get contour.
Step13: combine the contour weapon image with visual image and in next stage terminate the process.

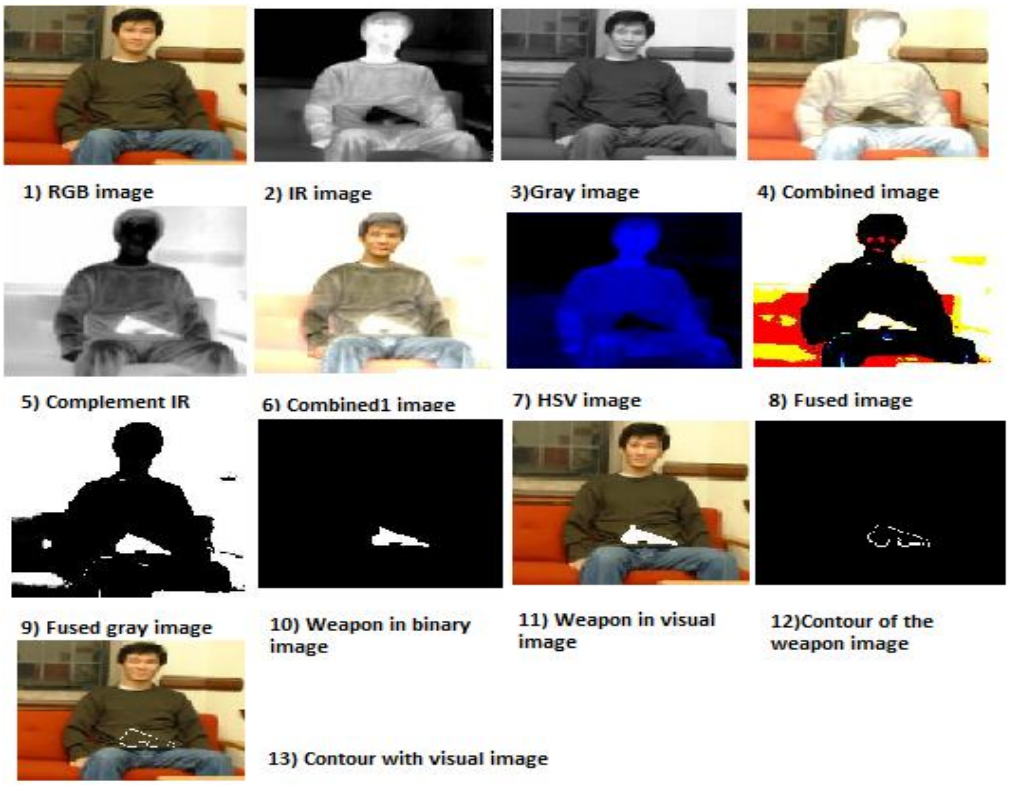

Fig. 1: Sequence of images showing the process step by step which is mentioned in the algorithm.

2.2 Passive sensor used to detect concealed weapon at 94 Hz

Passive mm-wave imaging with or without artificial illumination by an incoherent noise source is optimal for detecting concealed weapons, which are worn under any kind of clothes. Because of the incoherent illumination, no polarizing effects on the surface or in the clothing material itself occur [2].

Fig. 2a: Visible image.

Fig. 2b: Image taken by MMW sensor.

In Fig. 2a) visible image of person is shown who is carrying two guns which are made up of metal (top gun) and ceramic (bottom gun). The weapon is hidden beneath the heavy woolen sweater but passive mm-wave sensor is able to detect it. Fig. 2b) shows the scanned radiometric image which shows the hidden weapons.

Passive millimeter wave (MMW) sensor measure the apparent temperature through the energy that is emitted and reflected by sources. The output of the sensor is the function of emissivity of the object in 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 reflectivity of object like metallic gun [5].

2.3 Detection of concealed weapon using Active sensor

Through scanning beam antenna which is 2D, scan of person can be performed much faster than two axis positioner. The duration of a complete measurement is typically in order of few minutes. Because the antenna's field of view is limited to $\pm 10^{o}$ the optimum distance to the target is about 3 to 4 meters [2]. The image resolution we is obtain through it is not as good as it was in passive mm-wave. The bandwidth of an antenna is 400 MHz, in radar system with the help of the antenna we can scan out the 3-dimensional image of target with resolution of approx. 37 cm.

Both passive sensor and active sensor demonstrate and scan out different properties. If we combine both the sensor then there will be more effective outcomes. And both of the sensor will reduce the flaws of each other by giving combine effective result. There are few weapons like knives and guns having flat surface, their surface scatter the beam. So, these objects can be detected if illuminated surface is perpendicular to the radar line of sight.

Millimeter wave imaging, in the frequency range of 30 – 300 GHz has yielded several systems which are currently used to screen people in sensitive areas like airports. The current trend is towards higher frequencies, with terahertz (>1THz) imaging offering enhanced imager quality and detection and discrimination of concealed objects at greater stand-off ranges than is achievable with millimeter wave imaging [3].

2.4 Concealed weapon detection using Phased Antenna Array

The complex natural resonances and especially the fundamental resonance are excited by ultra wide band, Stepped frequency continuous wave (SFCW) illumination of the target, using a phased array of antenna to focus the radiation. Broadband illumination

of target with microwave radiation of suitable frequency range (typically 0.3 – 3 GHz for handgun sized objects) excites low order complex natural resonance (CNR) frequency and late time response(LTR) of the concealed item can be spatially located using phased array imaging techniques. Further processing of the late time response enables classification of the concealed object, based on the complex natural resonant (CNR) frequencies of the object, so that the threat item such as handguns and knives can be differentiated from benign items such as mobile phone and camera [3].

A phased array antenna works on the both location of item and the nature of concealed item. It determines the characteristics of the item, if it is get matched with their resonant frequencies then it indicates the presence of item beneath the layer of cloths. Stepped frequency continuous wave (SFCW) is used for the detection of metallic suspicious item. Illumination of SFCW get scattered by an object and then it will get examine by comparing it with corresponding frequencies. In digital system the signal can be sampled with respect to time and process accordingly.

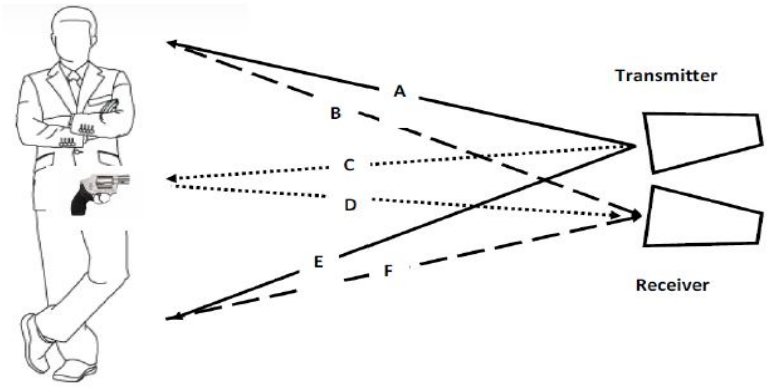

Fig. 3: Scattering of microwave radiation from the human body.

The ray A which has been transmitted from the transmitter will get reflected and received at the receiver side as ray B. In similar way ray E get transmitted and reflected back as ray F which will get received at the receiver end. But the reflection of ray from C to D is very fast as compare to AB and EF, which shows the presence of suspicious item. The obtain signal will further process to get assurance of threat.

2.5 Concealed material detection by using Explosive detection system (EDS)

This method is used to get prevent from terrorism and smuggling. Past few years' material related to chemical and drugs are migrated for destruction motive. Such kind of activities should be stop to save our nation from the silent terror of chemical and drugs. Also used for the detection of metal.

When there is requirement of bulk screening then X-ray screening method is opt which is used to scan the material and fetch the Object density d and effective Atomic numberZ_{eff}. With help of d and Z_{eff} we can estimate the element present inside the luggage. As this method is quite economical so this method can apply easily. There are number of sub-categorized techniques which reduce flaws.

Conventional transmission X-ray how many X-ray photons were removed from an illuminating beam. The atomic cross-section determines the attenuation at any location in the transmission image and is the total X-ray interactive cross-section which is the sum of photoelectric and scattering cross section. High energy X-ray is used to detect the weapons, this system is known as Dual energy X-ray. At higher level, over 100 KV, the absorbed energy primarily depends upon the density of material. Higher the density, the more energy is absorbed by the object and therefore darker the image. Object such as metal or weapons would appear very dark in the transmission image. Areas of heavy metals are dark in both views whereas areas of light elements are dark in lower energy view [4].

3. Conclusion

In this paper we tried to list out the main techniques which can apply to the important areas like airports, railway stations, bus stations, entrance of any premises where chances of risk can rise suddenly. Through above explained techniques, detection of concealed dangerous weapons and explosives chemical materials can search more effectively. If such system is fabricated to each and every area then we can save the mankind against the terror and then only we can reduce its influence across the world.

References

[1] Bhavna Khajone, Prof. V.K,Shandilya,"Concealed weapon detection using image processing", International journal of Scientific & Engineering, Volume3, Issue6, June2012.

[2] Helmut Essen1, Hans-Hellmuth Fuchs1, Manfred H¨agelen1, Stephan Stanko1, Denis N¨otel1, Sreenivas Erukulla1, Johann Huck1, Michael Schlechtweg2, Axel Tessmann2, "Concealed weapon detection with Active and Passive Millimeterwave Sensor, Two Approches,

[3] S.W.Harmer, S.E.Cole, N.J. Bowring, N.D Rezgui, and D. Andrews, "On body concealed weapon detection using A Phased Antenna Array", Progress In Electromynetics Research, Vol.124, 187-210, 2012.

[4] Sameer Singh and Maneesha Singh,"Explosives detection system(EDS) for Aviation Security: A Review",

[5] Hua-Mei Chen, Seungsin Lee, Raghuveer M. Rao,Mohamed-Adel Slamani, and Pramod K. Varshney,"Imaging for concealed weapon detection", IEEE SIGNAL PROCESSING MAGAZINE [**52**] MARCH 2005.

[6] Prof. Samir K. Bandyopadhyay1, Biswajita Datta2, Sudipta Roy3," Identification of concealed weapon on the human body",

[7] M. Schlechtweg, A. Tessmann, A. Leuther, C. Schw¨orer, H. Massler, M. Mikulla, M. Walther, R. L¨osch, *Advanced Millimeter- Wave ICs Using Metamorphic HEMT Technology*, 32nd International Symposium on Compound Semiconductors (ISCS05), September 2005.

[8] L.G. Brown,A survey of image registration tech-niques, ACM Computing Surveys 24 (1992) 326–376.

[9] S. Erukulla, Design and Optimisation of Millimetrewave Sensors for Security Imaging, Master's Thesis, Chalmers University of Technology, G¨oteborg, February 2006.

[10] A. Toet, "Color image fusion for concealed weapon detection,'' Proc. SPIE, Sept. 2003, vol. 5071, no.1, pp. 372–379.

[11] Mohamed-Adel Slamani , Pramod K. Varshney , David D. Ferris. : Survey of Image Processing Techniques Applied to the Enhancement and Detection of Weapons in MMW Data. SPIE Vol. 4719 (2002).