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A Survey Of X-Ray Multiview Object Detection

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Abstract: ***In this paper, the x-ray imaging system for security system is discussed. The multi review x-ray is investigated to object detection. In this paper three objects that are gun, razor blades and pins in baggage are analyzed. We obtained the idea that it would be possible to design an automated aid in a target detection task using the proposed algorithm.***

Keywords: X-ray imaging; Object detection; Classification; Multiview imaging.

I. INTRODUCTION

After the September 11 attacks, automated (or semi-automatic) recognition using 3D X-ray images has become a very important element in scanning. Inspection process, however, is complex, mainly because of the threat situation is very difficult to detect when placed in closely packed bags, mounted by other objects, and / or rotate showing an undetected vision [1]. In scanning, which play an important role in human security and inspection complexity is very high, human inspectors are still used. However, during peak hours at the airport, inspections of only a few seconds to decide whether or not a bag containing a prohibited item, and the diagnosis is only about 80-90% [2] is. Before 9/11, the analysis of X-ray of luggage mainly focused on taking pictures of their content: the reader can find 30 fascinating analysis of the 1989 plane attacks around the world, and technologies available to identify terrorist threats on the basis of thermal neutron activation (TNA), fast neutron activation (FNA) and dual-energy X-rays (from the early 70s used in medicine).

In security checking system there are security man for controlling of the bags. For automatic control system we need for automatic algorithm for testing and detection the objects. For this reason we should to introduce the method for automatic detection of the objects. The very important and very robust method is pseudo coloring method. In this method the X-ray images divide to low and high energy and then this two matrix will be add and then with lookup table techniques the image convert to the colored image. After convert to colored image that time the security man can to understand the all objects inside of the bags.

In security place sometimes the bags put vertical form and this time the intensity of object that are near to X-ray lens is high than the other objects that far from X-ray lens. For this reason the all bags or other objects must to be put as horizontal form.

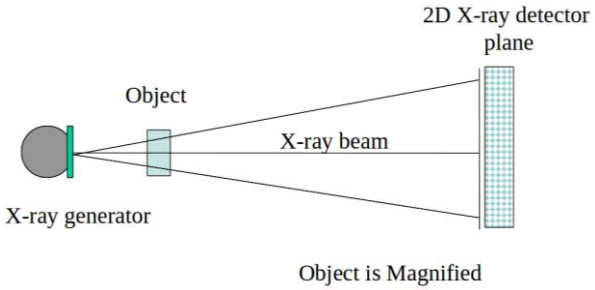

Figure 1: Schematic of X-ray Imaging system

II. LITERATURE REVIEW

A. ANALYSIS OF HUMAN INSPECTION

Visual inspection x-ray images of items of baggage at the airport is a challenging task, where detection rates suffer from

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the complexity of threats increases [3] is. The relationship between the types of threat items, aspects of image problem, and the decision to use a combination of the two components and signal detection theory is discussed briefly. In [3] 67 professional inspection a 2048 battery image is based on several factors image manipulation has been completed. Strong linear relationship between the impact and timing of decisions ($R^2 = 0.64$), was found to be the most difficult time images show a marked increase in decision-making and reduce the rate of hit. The time search across categories relatively stable threat was found, but the decision to reduce the rate of diagnosis has increased. Time decision-making has been shown to be closely related to changes in threat detection sensitivity and image reflect different problems.

They focused on speed measures to predict performance in X-Ray luggage screening tasks. Detection performance is measured using the probability of a hit as well as the sensitivity measured, which is the standardized hit rate minus the standardized false alarm rate.

B. PSEUDO-COLORING OF X-RAY IMAGES

In [4] of a series of linear and nonlinear maps pseudocoloring designed and applied to the energy of the X-ray baggage scanning at airports to help identify risk factors, especially hard on low-density weapon described in suitcase There. The psychological and physiological processes in the human perception of color as well as the effects of using different color models, such as RGB and the HIS, were studied. Black original data, images increased, and the section as input to plan mapping the different colors used in this study was designed. User-friendly interface is very interactive GUI development and testing of portable and used in a study to evaluate the performance of federal airports population was real. This study demonstrated the benefits of using color on gray level data and also allows the ranking of the best performing color map and color schemes. Improve weapons detection up to 97% through the use of color was achieved.

Dual energy X-ray imaging with a well-established technique to color code X-ray images of luggage passengers with information material discrimination [5]. Dual energy X-ray technologies available to be able to calculate the effective atomic number of objects with high precision. However, analysis of energy alone can separate two harmless organic objects of objects classified as a threat to their correct density has been set. The lack of depth information, which is necessary to calculate the density, the X-rays produced by standard 2D scanner tools provided by technology called 3D. [5] The operation of the information reported additional volume provided by dual energy X-ray method to supplement the information KDEX damping and thus improve the feature. Suggest formulate able to distinguish between a wide range of materials as a function of the Z and ρ. With data laminographic, accuracy encouragement from Z and ρ to 97% and 95% respectively for the objects obtained homogeneous well defined. A new color scheme for color coding to highlight the presence of potential threats derived ρZ information obtained 3D images have been developed.

In these papers they focused on color of X-ray image. The effects of using different color models, such as RGB and the HIS is the psychological and physiological processes in the human perception. With color human can to be understand the object in X-ray images.

C. ENHANCEMENT AND SEGMENTATION OF X-RAY IMAGES

Image enhancement for baggage screening at the airport increased sensitivity function [6] is very important. In [6] of a new approach for optimizing image enhancement tool is provided. They predict neural network that can be used to predict, in a test image data, the best algorithm for image enhancement is presented. The network has been trained using a number of sample image. Inputs to the neural network is a set of measures show the ability to increase its output selection algorithm for the picture. In a number of test images show them that it is very capable of forecasting system to predict the correct choice of enhancement algorithms (as judged by human experts). They forecasting system against a basic approach that uses an algorithm constant improvement for all categories of test images, and to find the model significantly superior compared.

In [6] they focused on optimizing image enhancement for screening luggage at airports. They used neural network for enhancement of X-ray images. The input to the neural network is a set of view ability measures and its output is the choice of enhancement algorithm for that image.

D. TEXTURE FEATURES BASED

The purpose of [7] that automatically identify and locate devices of interest (DOI) in X-ray images, even if part of it is hidden by the devices of interest, using a new ALISA (Adaptive Learning Image and Signal Analysis) and module components. This pilot study using a DOI only, a Beretta pistol of 9mm was done, but the solution can easily replace other sources, DOIs. Results obtained in real time (a few seconds) indicated that strong and accurate classification that can easily help security personnel in the defined carry-on luggage X-ray machines at the airport. The research project by the Defense Threat Reduction Agency (DTRA) was provided.

In [7] they focused on identification of objects-of-interest in X-Ray images.

E. NEURAL NETWORKS AND FUZZY RULES

[8] Presents a united classification system for detecting explosives based on fuzzy rule and neural networks. Due to imaging and influence of outer environment, preprocessing is firstly needed to improve the quality of X-ray images. Then, a test pattern may be considered as several possible objects with different degrees through the multi-level fuzzy classifier. Finally, the result of multi-level fuzzy classifier will be reconsidered through the parallel neural networks classifier. From the experience results, the united classification system performs well. yielding about 98% of performance [8].

They focused on a united classification system of X-ray image based on fuzzy rule and neural networks.

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F. SUPPORT VECTOR MACHINE

In [9], a system for automatic detection of potential threat objects in baggage scanning x-ray images is presented. Segmentation and edge-based feature vectors form the basis of automatic recognition system is used in [9]. The system in question is the use of weapons as a threat objects. Experimental results show that the system can effectively detect a gun in baggage scanning x-ray images with a minimum of false positives. Also, apart from the initial installation of the classified database, algorithms is implemented for real-time applications.

They focused on segmentation and edge-based feature vectors form the basis of the automatic detection system.

G. X-RAY TESTING BY COMPUTER VISION

In [10], they have a quick overview of computer vision methods that have been used in X-ray test now. In addition, they have some specific techniques that have been used in a program of study; and the introduction of a public database of X-ray images that can be used for testing and evaluation of image analysis and computer vision algorithms are used. Finally, they concluded the following: that there are some areas - such as casting inspection- where automated systems are very effective, and other application areas such as baggage screening where human inspection still used, specific areas such as software and cargo inspections- welding process in which there is a semi-automatic. In this paper the focused on computer vision. General schema for X-ray testing using computer vision is shown in Figure 2.

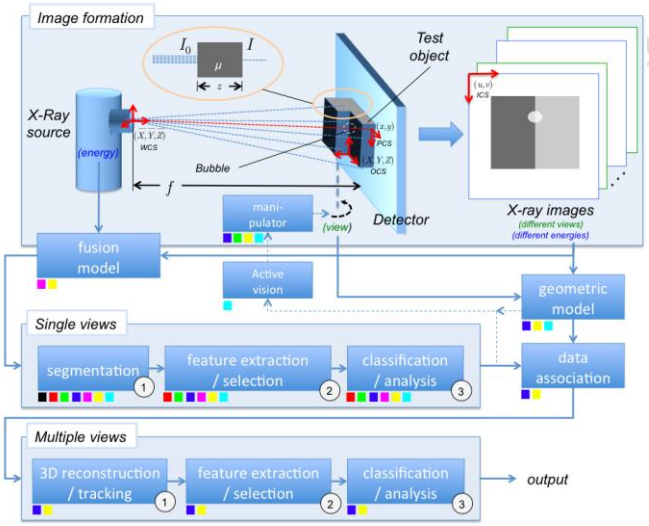

Figure 2. General schema for X-ray testing using computer vision [10]

H. DUAL ENERGY

Photo baggage inspection systems play an important role in the security of air travelers [11]. However, the false alarm rate trading systems could be due to less than perfect image processing algorithms as high as 20%. In an effort to reduce the false alarm rate, [11] a combination plan to fuse, de-noise and an increase in dual energy X-ray images of the object and threat detection for better classification suggests. The wavelet transform is a fusion step. Pictures melts generally show more detail information; however, the background sound is often amplified during the fusion process. In [11] they are based on a background noise reduction to eliminate background noise subtraction- actions of X-ray images processed very efficiently. The de-noised image and then using a new technique for reconstructing the final image is processed. The final image is not only a source of additional information from both images, but also free background noise and contrast, so easier to automate part or interpretation by inspection, thus reducing the false alarm rate is the X-ray luggage inspection.

In this study, they focused on combined approach to fusion, noise and increased energy x-ray images of luggage. In this paper, a method based on subtraction of the background noise reduction to eliminate background noise in X-ray images processed very efficiently apply.

In [12] three stage are used for object detection in X-ray image. First an extensive evaluation of standard local features for object detection on a large X-ray image dataset in a structured learning frame work is presented. Second, two dense sampling methods as key point detector for texture less objects and extend the SPIN color descriptor to utilize the material information is proposed. Finally, a multi-view branch-and-bound search algorithm for multi-view object detection is introduced. Through extensive experiments on three object categories, shown that object detection performance on X-ray images improves substantially with the help of extended features and multiple views.

This paper focused on multi-view object detection in dual energy X-Ray images.

I. STRUCTURAL SEGMENTATION METHOD BASED ON ATTRIBUTE RELATIONAL GRAPH (ARG) MATCHING

In [13] automatic threat detection for carry-on multi-energy X-ray images are presented. They have a structural segmentation method is presented based on the implementation of the ARG. Segmentation algorithm based on a series of graph algorithms implemented under a measure of similarity, are fuzzy similarity. The results show that, on average, good integration of distributed objects of experimental images.

This paper focused on X-ray image segmentation by attribute relational graph matching.

J. CLASSIFICATION APPROACH BASED ON SHAPE CONTEXT DESCRIPTOR AND ZERNIKE MOMENTS

To provide adequate security, a reliable and rapid screening techniques for inspection is required. The purpose of [14] to provide an automated method for detecting concealed weapons, usually a gun in the suitcase with image segmentation method to extract objects of interest of the image, and then the shape feature extraction method describes the background and Zernike moments. Finally, the use of fuzzy objects and object KNN as illegal or illegitimate.

This paper focused on Zernike moment for feature extraction and they used fuzzy methods for Detection of concealed weapons in x-ray images.

K. ANALYSIS OF DUAL ENERGY IMAGES

In [15] they developed an image processing system to determine the true gray levels of an object in all measures used in this paper is focused. R-L technology developed at Virginia Tech is the first true multi-sensing technologies to detect explosives. The use of X-ray technology and dual energy transmission X-ray scattering to obtain the characteristic values of an object. For example, R and L type of the object can then be determined using aircraft R-L. R is linked Standards Board and the signal obtained by dual energy transmission. L related to density, and using signals obtained from transmission and distribution. Compared to the single measurement technology and sensing technologies like multi-technology to a much higher level of recognition accuracy R-L provides. However, R and L real value can only be gray surface of an object, as the gray level measurement of an object at different measurement methods defined it with any other objects not to be calculated. Because an object in a bag that always overlap with many other things, being able to identify the object of interest and remove the key issue in determining the actual level of gray overlay effects that object [15].

In [15] they focused on image processing methods to improve the explosive detection accuracy.

III. DATABASE

There are available a few database. The GDXray database [16] contains more than 3000 X-ray images for the development, testing and evaluation of image analysis and computer vision algorithms. The database includes three groups of X-ray images: metal objects (castings, welds, razor blades, ninja stars (shuriken), guns, knives and sink strainers), baggage (bags and pen cases); and natural objects (fruits, fish bones and wood).

Some X-ray images of GDXray database is illustrated in figure 3.

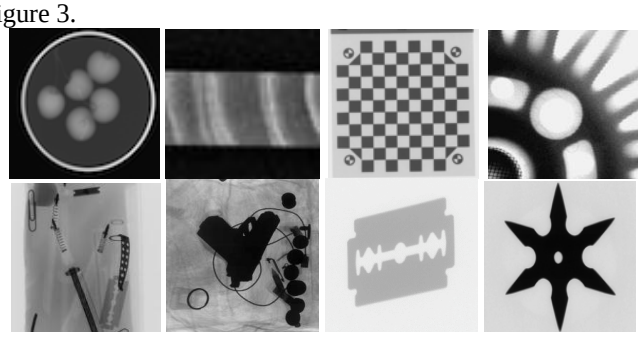

Figure 3: Apples, wood, calibration pattern, aluminum wheel, pen case, bag with a gun, razor blade and shruriken

IV. CONCLUSION

In this paper, a contribution to object recognition in baggage screening is investigated. Some methods is shown such as Pseudo-coloring of X-ray images, dual energy. Also for object classification the robust methods such as neural networks, fuzzy rules, Support Vector Machine is investigated We have shown that previous results are promising. Windows method has high accuracy and performance than the other methods. However, since the performance of the methods has been verified on a few radioscopic image, an evaluation on a broader data base is necessary. Despite these achievements, it is clear that much remains to be done. Future efforts will be focused on obtaining larger and more diverse datasets as well as on refining the algorithms described in this contribution.

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REFERENCES

[1] G. Zentai, "X-ray imaging for homeland security," International Journal of Signal and Imaging Systems Engineering, vol. 3, pp. 13-20, 2010.

[2] S. Michel, S. M. Koller, J. C. De Ruiter, R. Moerland, M. Hogervorst, and A. Schwaninger, "Computer-based training increases efficiency in X-ray image interpretation by aviation security screeners," in Security Technology, 2007 41st Annual IEEE International Carnahan Conference on, 2007, pp. 201-206.

[3] A. Wales, T. Halbherr, and A. Schwaninger, "Using speed measures to predict performance in X-ray luggage screening tasks," in Security Technology, 2009. 43rd Annual 2009 International Carnahan Conference on, 2009, pp. 212-215.

[4] B. R. Abidi, Y. Zheng, A. V. Gribok, and M. A. Abidi, "Improving weapon detection in single energy X-ray images through pseudocoloring," Systems, Man, and Cybernetics, Part C: Applications and Reviews, IEEE Transactions on, vol. 36, pp. 784-796, 2006.

[5] J. Chan, P. Evans, and X. Wang, "Enhanced color coding scheme for kinetic depth effect X-ray (KDEX) imaging," in Security Technology (ICCST), 2010 IEEE International Carnahan Conference on, 2010, pp. 155-160.

[6] M. Singh and S. Singh, "Optimizing image enhancement for screening luggage at airports," in Computational Intelligence for Homeland Security and Personal Safety, 2005. CIHSPS 2005. Proceedings of the 2005 IEEE International Conference on, 2005, pp. 131-136.

[7] C. Oertel and P. Bock, "Identification of objects-of-interest in X-Ray images," in Applied Imagery and Pattern Recognition Workshop, 2006. AIPR 2006. 35th IEEE, 2006, pp. 17-17.

[8] D. Liu and Z. Wang, "A united classification system of X-ray image based on fuzzy rule and neural networks," in Intelligent System and Knowledge Engineering, 2008. ISKE 2008. 3rd International Conference on, 2008, pp. 717-722.

[9] S. Nercessian, K. Panetta, and S. Agaian, "Automatic detection of potential threat objects in X-ray luggage scan images," in Technologies for Homeland Security, 2008 IEEE Conference on, 2008, pp. 504-509.

[10] D. Mery, "X-ray testing by computer vision," in Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition Workshops, 2013, pp. 360-367.
[11] Z. Chen, Y. Zheng, B. R. Abidi, D. L. Page, and M. A. Abidi, "A combinational approach to the fusion, de-noising and enhancement of dual-energy x-ray luggage images," in Computer Vision and Pattern Recognition-Workshops, 2005. CVPR Workshops. IEEE Computer Society Conference On, 2005, pp. 2-2.
[12] M. Bastan, W. Byeon, and T. M. Breuel, "Object Recognition in Multi-View Dual Energy X-ray Images," in BMVC, 2013.
[13] J. Ding, Y. Li, X. Xu, and L. Wang, "X-ray image segmentation by attribute relational graph matching," in 2006 8th international Conference on Signal Processing, 2006.
[14] M. Mansoor and R. Rajashankari, "Detection of concealed weapons in X-ray images using fuzzy K-NN," International Journal of Computer Science, Engineering and Information Technology, vol. 2, 2012.
[15] Q. Lu and R. W. Conners, "Using image processing methods to improve the explosive detection accuracy," Systems, Man, and Cybernetics, Part C: Applications and Reviews, IEEE Transactions on, vol. 36, pp. 750-760, 2006.
[16] D. Mery. X-Ray Testing by Computer Vision. In IEEE Conference on Computer Vision and Pattern Recognition Workshops (CVPRW), pages 360–367, 2013.