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Detection Improvised Explosive Device (IED) Emplacement Using Infrared Image

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***Abstract* — This paper presents a method to detect an improvised explosive device (IED) by using infrared thermography (IRT) technology. The detection of IED will be done automatically and accurately even the IED detection expert is not present. Combining the advantage of IRT and image processing technique, the proposed method is very efficient and responsive to detect the existence of hidden IED. The captured images are filtered and segmented to extract the heat pattern before the decision is made. Based on the experimental result, the proposed system produced about 92 % of detection accuracy.**

Keywords- infrared imaging, improvised explosive device, image segmentation

I. INTRODUCTION

In recent years, IED has become the most threat of terrorism, criminals and suicide bombers [1]. IED can come in many forms because of the term improvised, which is like a small pipe bomb and capable of causing massive destruction and also loss of life. Therefore, early detection of IED is of paramount importance. To increase the fast and accurate detection, an automated system is required in order to prevent misinterpretation of human inspection. By far, there are many methods of IED detection have been developed. Since, IED commonly buried underground and occluded, it requires the expert to be close to the target area for an inspection. This will be definitely dangerous to them.

Many researchers have been undergoing to detect the hidden objects under the ground that always used by terrorist to do harm and danger to civilian people. The first method was introduced by Shimoni et al. to detect an occluded object [2]. The occluded object is detected by applying a multivariate statistical based (cross-covariance) and class conditional change detector algorithms [3]. Another method was proposed by Kemp by analyzing electromagnetic radiation wave for identifying hidden objects [4]. The electromagnetic radiations are sensed between in the range of 30 GHz to 300 GHz (wavelength 1 cm – 1 mm) in the millimeter-wave and 300 GHz to 3 THz (wavelengths 1 mm – 100 μm) in the terahertz region [5][6]. Therefore, this detection is more about the transmission of radiation, which is through the barrier materials. The method has been used to create two and three dimensional (3D) imaging system. This detection technique is mainly based on frequencies, which are in millimeter-waves and terahertz-waves. Consequently, it is harder to detect when it reached beyond terahertz frequencies due to the lack of detectors and partial's sources. Nevertheless, there are many factors need to consider such as including common explosive, materials, exhibit characteristic of terahertz spectral features for detecting IED [4].

Miles et al. proposed laser-based hidden object detection for IED identification [7]. Two complementary techniques were used to probe that objects involving a backward-propagating laser generated in the air sample, and a radar echo off ions and electrons from the trace gas molecules that have been selectively ionized by a laser. In another research, Bell et al. proposed an X-ray backscatter as the source of radiation for detecting IED [8]. However, since the current X-ray detection system is limited to a certain distance, the proposed system is able to attend the X-ray detection into a few meters.

To overcome the limitation of the previous methods, this research proposes a new method of IED detection based on infrared image analysis. Employing IRT technology, the existence of IED can be revealed even in a quite far distance. The IED can be detected by examining the thermal pattern shown by the image. Fig. 1 shows an example of the actual visual image of IED and its corresponding infrared image which is buried underground. Since, this technology has the advantage of wide-area coverage where multi IED locations can be detected. Using an advanced image processing technique, an accurate and a faster IED detection response can be produced.

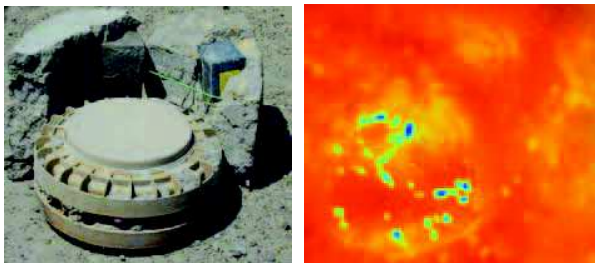

Figure 1. Visual image of IED and its corresponding underground infrared image.

This paper proposes a new method of detecting IED by using infrared image analysis. The remainder of this paper is organized as follows: Section 2 discusses the proposed method of IED detection system. Experimental results and discussions are given in Section 3 and finally concluding remark appears in Section 4.

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