**Information Search and Analysis Skills**

**“Thermal Imaging”**

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PREFACE

Praise be to the Lord of the universe for all the blessings, grace, Taufik, and His guidance so that we can finish the ISAS with the title “Thermal Imaging".

In the preparation of this ISAS, the authors derive a lot of help from various parties. The author wishes to thank Mr. Riza Muhammad Nurman college teacher preceptor who has provided guidance and direction so that we can finish this ISAS, as well as both parents, large family’s authors, and fellow college student CCIT-FTUI always pray and give motivation to the authors.

The authors recognize that there is still a lot of ISAS shortcomings. Therefore, the authors expect criticism and suggestions so this ISAS can be better. Final terms of reference the authors hope this paper can provide insight and knowledge to the readers in general and the author in particular.

Depok, Maret 2017

Writer

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CHAPTER I

INTRODUCTION

I.1. Background

Along with the growth of modern science, the thermal imaging system is quickly emerging as an ever-powerful solution with diverse capabilities to detect temperature. Such measurements were often performed using thermometers, thermocouples, and resistance temperature detectors (RTD). Such instruments, however, can only obtain temperatures at specific points and need contact with the target. An alternative, the thermal imager, converts the infrared radiation emitted from the target into digital data and thus visualizes the whole temperature map through the infrared focal plane array (IRFPA) device. The thermal imager allows for an outstanding nondestructive temperature measurement in many complex situations. This feature makes the utilization of such devices rather competitive with quite a few other methods, which promises its profound impact in many coming practices.

Despite the above-mentioned advantages in temperature measurement, a series of technical barriers still impede the wide adoption of thermal imager. Owing to the difficult fabrication of sensors, the thermal imager is usually high-priced, even for commercial purposes. Besides, most of the thermal imagers are lacking wireless communication ability and require cable or Secure Digital (SD) memory card to transfer data to the client. Although some thermal imagers provide wireless capability to the tablets and mobile phone, it seems that the client is not involved in the image processing and data calibration.

Therefore, such machine serves as almost just like a graphical user interface or display unit. Apparently, the powerful computing capacity of the mobile phone is not fully used.

I.2.Writing Objective

Goals writing ISAS are as follows:

1. To share knowledge on “Thermal Imaging”.
2. To find out more about technology security, especially on the “Thermal Imaging”.
3. Seeking knowledge of the latest technology.

I.3. Problem Domain

Problem domain based on the above it can be argued formulation of the problem as follows : “function and advantages of Thermal Imaging, and how system Thermal Imaging work”.

I.4. Writing Methodology

The method used is the method of research with data collection techniques using literatur from reliable media. Including browsing and knowledge from friend.

I.5. Writing Framework

To facilitate the preparation of the ISAS, the use a writing framework as follows:

**Chapter I Introduction**

This section describes the background of the title with the writing objective, problem domain, writing methodology, writing framework.

**Chapter II Basic Theory**

This section describes about history of security system, definition of thermal imaging.

**Chapter III Problem Analysis**

This section describes about the development of implementation of thermal imaging.

**Chapter IV Conclusion and Suggestion**

This section describes about conclusion and suggestion.

CHAPTER II

BASIC THEORY

II.1 Thermal Imaging

Thermography or thermal imaging was originally made for military purposes. In 1929, Hungarian physicist Kalman Tihanyi invented the first infrared-sensitive electronic television camera for an anti-aircraft defense in England. In the late 1950s and 1960s, Texas Instruments, Hughes Aircraft and Honeywell developed a single element detector that scanned the scene and produced a line drawing. In the 1970s, Philips and EEV developed a pyroelectric vidicon tube in which the tube was used to detect electromagnetic radiation in the wavelength range from 2μm to 14μm.

Thermography or thermal imaging is a technique when the invisible infrared energy emitted by an object is converted into a visual image of heat. Thermal imaging can be regarded as a touchless heat mapping and heat pattern analysis on the surface. Any object over a temperature of 0 will radiate heat energy around the earth in the form of infrared energy. Infrared energy cannot be visible to the human eye because the infrared wavelength is not covered by the ability of the human eye.

Thermal Imaging can be used as a way to inspect electrical or mechanical equipment to determine the functional abnormality by obtaining heat. This method is based on reality as a large component in a system that will show an increase or decrease in temperature in case of malfunction. With thermal imaging able to observe the heat pattern when the system components operate, the damage or interference can be directly evaluated and corrected, as it can be directly used without having to shut down the machine to be detected.

II.2 Type Thermal Imaging

1. Un-Cooled

This is the most common type of thermal-imaging device. The infrared-detector elements are contained in a unit that operates at room temperature. This type of system is completely quiet, activates immediately and has the battery built right in.

1. Cryogenically cooled

More expensive and more susceptible to damage from rugged use, these systems have the elements sealed inside a container that cools them to below 32 F (zero C). The advantage of such a system is the incredible resolution and sensitivity that result from cooling the elements. Cryogenically-cooled systems can "see" a difference as small as 0.2 F (0.1 C) from more than 1,000 ft (300 m) away.

II.3 Temperature

Temperature is a physical quantity expressing hot and cold. Temperature is measured with a thermometer, historically calibrated in various temperature scales and units of measurement. The most commonly used scales are the Celsius scale, denoted in °C (informally, degrees centigrade), the Fahrenheit scale (°F), and the Kelvin scale. The kelvin (K) is the unit of temperature in the International System of Units (SI), in which temperature is one of the seven fundamental base quantities.

The coldest theoretical temperature is absolute zero, at which the thermal motion of all fundamental particles in matter reaches a minimum. Although classically described as motionless, particles still possess a finite zero-point energy in the quantum mechanical description. Absolute zero is denoted as 0 K on the Kelvin scale, −273.15 °C on the Celsius scale, and −459.67 °F on the Fahrenheit scale.

Temperature is a proportional measure of the average translational kinetic energy of the random motions of the constituent microscopic particles in a system (such as electrons, atoms, and molecules); based on the historical development of the kinetic theory of gases, but more rigorous definitions include all quantum states of matter.

CHAPTER III

PROBLEM ANALYSIS

III.1 Thermal Imaging Work

Thermal cameras detect temperature by recognizing and capturing different levels of infrared light. This light is invisible to the naked eye, but can be felt as heat if the intensity is high enough. All objects emit some kind of infrared radiation, and it’s one of the ways that heat is transferred.

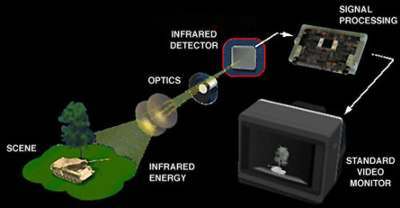
All objects emit some kind of infrared radiation, and it’s one of the ways that heat is transferred.Thermal cameras can see this radiation and convert it to an image that human can see. Inside of a thermal camera, there are a bunch of tiny measuring devices that capture infrared radiation, called microbolometers, and each pixel has one. From there, the microbolometer records the temperature and then assigns that pixel to an appropriate color.

Figure III. 1 Thermal Imaging Work

Here's how thermal imaging works:

1. A special lens focuses the infrared light emitted by all of the objects in view.
2. The focused light is scanned by a [phased array](http://glossary.its.bldrdoc.gov/fs-1037/dir-027/_3979.htm) of infrared-detector elements. The detector elements create a very detailed temperature pattern called a thermogram. It only takes about one-thirtieth of a second for the detector array to obtain the temperature information to make the thermogram. This information is obtained from several thousand points in the field of view of the detector array.
3. The thermogram created by the detector elements is translated into electric impulses.
4. The impulses are sent to a signal-processing unit, a circuit board with a dedicated chip that translates the information from the elements into data for the display.
5. The signal-processing unit sends the information to the display, where it appears as various colors depending on the intensity of the infrared emission. The combination of all the impulses from all of the elements creates the image.

III.2 Critical Specifications of Thermal Imaging

1. Temperature Range

Temperature range is very important, the outside temperature range will facilitate accommodate facilities that have high temperature equipment such as boilers and steam.

1. Thermal Sensitivity (NETD)

Thermal sensitivity, or Noise-Equivalent Temperature Difference (NETD), measures the smallest temperature difference that a thermal imaging camera can detect in the presence of electronic circuit noise. Cameras with a low NETD will detect smaller temperature differences and provide higher resolution images with increased accuracy. Thermal sensitivity is measured in milliKelvins (mK).

1. Resolution

Detector resolution plays a pivotal role in image quality of thermal imaging cameras. Higher resolutions provide precise and reliable measurements of smaller targets from further distances, creating sharper thermal images. The higher the detector resolution, the more accurate the camera.

III.3 Thermal Imaging Camera Features

Thermal imaging cameras can be purchased with the bare minimum of features that only read the temperature of the fixed center crosshairs on the display or with multiple features that allow the user to select multiple moveable crosshairs and draw comparisons between them to show the high, low and average temperatures on the display. Thermal imaging cameras have user-selectable multiple color palettes, such as black/white, iron or rainbow. The iron palette is most commonly used by home inspectors. The black/white palette helps identify details on an image, and the rainbow palette has the best thermal sensitivity for displaying the differences in temperature. See sample images below of some color palettes.



Figure III. 2 Iron palette of fuse bus bar



Figure III. 3 Black or white or gray palette

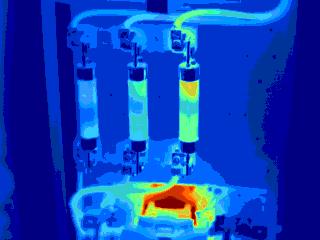


Figure III. 4 Rainbow palette

III.4 Analysis SWOT

1. Strengths

* Can see an object in the dark.
* Can reduce the risk of accidents in the industry.
* Can be used to detect living creatures in ports.

1. Weaknesses

* The price of devices that support thermal imaging is expensive.
* Resolution of small camera results, most have a resolution of 640 × 480.
* A little guidebook on thermal imaging.
* It is difficult to determine the accurate results of thermal imaging because it requires experience and knowledge to judge it.

1. Opportunities

* Can be further developed in modern life.

1. Threats

* Because it is easy to develop it should be more see the problems in the environment so as not to lose in competing.

CHAPTER IV

CONCLUSION AND SUGGESTION

IV.1 Conclusion

Thermography or thermal imaging is a technique when the invisible infrared energy emitted by an object is converted into a visual image of heat. Where first used thermal imaging for military needs, but now thermal imaging is widely used for security systems that one of them is to check the goods at the port to avoid illegal goods such as rare animals and others.

IV.2 Suggestion

The author hopes to have more guidebooks on thermal imaging as it is difficult to get accurate results from thermal imaging, which requires experience and knowledge of thermal imaging.

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