International Journal of Research in Advent Technology (IJRAT) Special Issue
E-ISSN: 2321-9637
Available online at www.ijrat.org
*International Conference "*INTELINC 18*", 12th & 13th October 2018*

Thermal Image Processing-An Eagle Eye Analysis

P.Kanimozhi#1,S.Sathiya*2,M.Balasubramanian#3, P.Sivaraj*4
#1.PhD Research scholar, Department of Computer Science, AnnamalaiUniversity
Khani.pappi@gmail.com
** 2&3. Assistant Professor, Department of Computer Science and Engineering, FEAT, Annamalai University*
Sathiya.sep05@gmail.com, balu_ june1@yahoo.co.in
** 4. Assistant Professor in MFG, Annamalai University*
cemajorsiva@gmail.com

Abstract:- Thermal Image processing has been developing into one of the most valuable technique in various grounds like industries, medical areas, engineering, biometrics and in plants synthesis.A new technique called thermography is used which is based on temperature variations.Thermal imaging absorbsthe property present in the infrared spectrum of light which cannot be viewed by normal eyes and providesessential details in acute situation. Novel use of thermal imaging technology can therefore play an important role in many presentations. Nowadays many fields including medical diagnosis also employs thermal images for early inspection of fatal diseases. This paper provides future vision in thermal imaging technology and its uses in different areas. Many field examples using thermal images in various sectionswhich can be accessible are presented in this paper.

Keywords – Biometrics, thermography, fatal diseases

1. INTRODUCTION

Thermal imaging is a new technique which seldom uses the natural light, but intakes the light produced by the substances by making use of the infrared radiations of the objects, which are invisible for usual vision. Thermal imaging is one of the most commonly used night vision technologies. Unlike the other methods, thermal imaging works in environments without any ambient light. The technique essentially uses naturally emitted infrared radiation from the surface of the objects. Newly developing technology is encouraging even economically poor countries to use thermal images for their accuracy and early corrective results.The most common tool used for thermal imaging today is the thermal infrared cameras. Thermal infrared cameras are used to find the infrared radiations emitted by the objects which are targeted and which produce heat above complete zero. They produce the images of the objects which are scanned using the infrared energy emitted by all objectsThermal Imaging are having wide applications in many situations to shorten the detection, location and assessment of temperature related problems andfor a variety of heat detection errands.Thermography is anability capable of providing very detailed images of scenes invisible to thenaked eyes.

2.SIGNIFICANCE OF THERMAL IMAGING

The basic property of the element is the heat production in the form of infrared energy as a purpose of the original temperature activated on the body surface. The infrared energy emitted by thebody is known as its **heat signature**. In general the radiation produced by the objects depends on the degree of temperature. More the temperature, greater is the radiation .Heat sensor, a device used to monitor the variations in temperature is the thermal imager also identified as a thermal camera. The device used in thermography. Thiscamera records even little differences in the temperature of the surface and produces images based on statistics of the infrared radiation. Sinceentitiesdiffer among themselves and from others in releasing the temperature, a thermal camera can detect various objects exactly by the variationscaused so they will appear as distinct in a thermal image [1].

Fig.1 is thermal image of a person

Over decades significantadvancement in the presentation of thermal image processing have been developed by improving the tools of infrared images and evolving different protocols for enlightening the clarity of thermal images.The physiological mechanisms of temperature distribution on the body surface are now better understood.[2].The mechanism used in thermal imaging is the transformation of radiated or replicated heat into originalportraits or images. A thermal image is created on the analoguevariations of temperature emitted by the objects which can be viewed clearly only in the monitor. This is based on the fact that all elements emit radiation in the form of infrared waves which are above zero degrees. So liableto temperature variations and heat emission, thermal images can be produced,which is used for various applications in different fields.

Fig 2 is a thermal image of a cat

3.ASSESSMENT ON THERMAL METAPHORS

Thermal images are normally **grayscale** in nature: The values (0, 1) indicate the changes in the colour. The objects scanned in dark areas are light in colour whereas objectsin light shade areas show thick colours. The values between 0 and 1 show various gray shades depicting the variations of the objects scanned.Different colour shades are emitted by the infrared radiation based on the variations shown in the temperature which is completely above zero degree. According to the *black body radiation law*, thermal images are produced in the absence of light sources receivingthe light produced by the inner natural heat of the substances. There are differences in the temperature produced by the objects which is unknown therefore, thermography is based on this variation in temperature to produce images based on this minute variations. When viewed through a thermal imaging camera, warm objects stand out well against cooler backgrounds.[3]

Even though there is variation in the temperaturenaturally produced by the objects, the balance of heat is produced by a simple transfer of power from hot to cold objects. According to the principlestated in the second law of thermodynamics the transfer is possible. So the distribution of variety of objects with varying temperature is balanced by the attraction of radiation emitted by the scorchingitems in the thermal image.

The basic idea behind the thermal images is the difference in the infra-red radiations.These variations are measured using a device called thermal camera or infrared camera .These cameras are based on the visible infrared bands usually 3 to 5 µm for small bands and 7 to 14 for long bands.There is a focal plane array in the camera which captures the radiation in the provided band to produce thermal images. Everyarticleemitsradiation above the measurable degree. Hence this is an excellent way to ration thermal variations. Abnormal temperature profiles at the surface of an object are an indication of a potential problem. [3]

4.DEPICTION OF THERMAL CAMERA

Thermography, also called thermal imaging, uses a distinctive camera to measure the temperature of the skin on the body's exterior. It is harmless and non-destructive as there is no leakage that causes danger to the surroundings.Thermographic cameras usually work by the principle that identifies radiation in the long-infrared series of the electromagnetic spectrum (roughly 9,000–14,000 nanometres or 9–14 µm) and produce images based on this range ofemission called thermograms

Fig 3 is the picture of thermal image camera

Infrared dimension of the radiation consists of seizing an image to make visible to the naked eyes, the image of an object andrecords the variation to produce a scheme of temperature capacities of a zone. Infrared images are based on the illustrationof the heat discharged by objects, equipment, structures and depict minor variations also. One of the presentationsof thermal camera is to confirm quality by tracing problems without causing destruction to the building. Thus thermal imaging cameras may be of curiosity to builders, architects, experts, marketers, administration etc.

4.1.*Procedures of camera*

- Loss of heat in firms caused by air infiltrations through joints between tops and partitions can be detected.
- Thermal properties of water facilitate to noticedampness and harms caused by water such air humidity on a roof caused by a leak.
- Monitor roofing and coating eminence, control of thermal transmission in planes, assessment of dry processes in materials, heating and cooling systems task and local electrical risk assessment can be done.
- Alterations in materials temperature can be exposed, since infrared radiation is anissue related to temperature.

4.2.*Installation*

While purchasing a thermal imaging camera, the customer should take into account the following points: number of pixels in the camera, spectral sensitivity, sensor life of the lens, field of view, dynamic range of the pixel, input power, mass and volume.Camera can be installed in two ways-one way is used forstillor immobile installation in which the camera can be used as a fixed device connected to a system. Other way is using thermal camera for mobile service as handheld device. But the later method is complicated because there is no live transmission possible.Example for still applications is one such like PCE-PI series which has small dimensions, sothey can be used in complex areas where access is impossible. This facility is unavailable in mobile type since continuous monitoring is needed for some applications .Here static installation helps the situation and software of the thermal device helps in accurate readings of the environment.

Fig 4 show thermal camera attached with machine

Recent models of thermal cameras can be attached to our smart phones which use high range of temperature based delicatepatternsthat can identify objects even when there is no light source available. This advantage is beneficial when there are applications like dense forest area to identify insects or birds passing by while travelling. With the difference in heat produced by the objects they can be easily predictable.

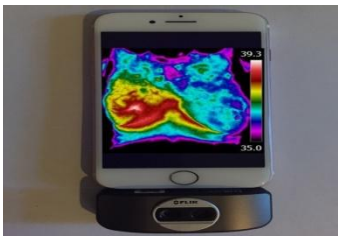

Fig 5 shows thermal camera attached with phone

The variation in temperature can be checked by both the software of the thermal image camera and a small device called calibrator installed in the camera which can assess even small modifications and produces image based on the emission correctly. The software helps in finding the level of temperature when high by passing alarm to the device. So the images of any objects can be created with very high accuracy with the help of thermal image cameras.

5. **USES OF THERMAL IMAGES**

5.1.*Boundarysafety*

One of the essential applications of thermal images is particularlyused for border investigation due to the ability of two different types of thermal cameras available. One iscool camera used to detect enlargedvictims from very high dimensions inample darkness and in dangerous weather disorders. Un-cooled cameras are used in topographies likemountainous regions and hillswhere long distance viewing is impossible. The advantage of cool camera is their better presentation when compared to uncooled cameras. Thermal imaging cameras can be combined with radar arrangements to forecast weather situations and other calamity changes.

5.2.*Facial expression*

For face recognition system one of the methods used is thermal face recognition which takes thermal face as an input[4]. For unique identification nowadays, face images are used because face is having exclusive vein and blood vessels. Based on the temperature and different features emitted by diverseobjects, thermal images are produced. Due to the variation in heatpattern of the individuals, corresponding thermal images are created. Normally the temperature varies between 35.5°C to 37.5°Cfor all individuals which cause obvious changes in the face construction. All human faces are having different tissue and bonecompositionproducing various shapesfor their faces. Hence the unique face can be identified using thermal images.

5.3.*Insulator in engineering*

Thermal imageshave considerable applications in engineering field by acting as an insulator in construction work, checking leakages in power circuits and pipelines .Thermal images are used to monitor the variations in temperature and provides alertness about the loss of temperature. Thereby any fire accidents and any collisions can be avoided in prior.Thermal images are considered more advantageous because their usage is passive and no one is needed to check the working of the camera. So the thermal camera can record dangerous occasionscausing no disturbance to the images.

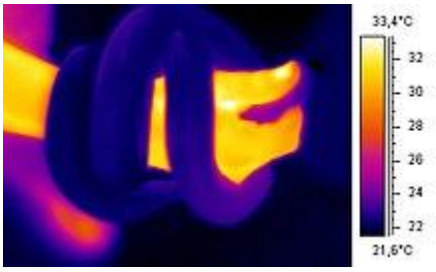

Fig6 shows thermal image of a snake rounded in a person hand

5.4. *Observing thermal variations*

Any hazards and dangerous situations can be surveyed by the thermal imaging cameras so any hurdles caused by over heat problems or leakage problems can be avoided before any fatal results occur .One of thesignificant applications of thermal images is the monitoring of temperature variations in industries and factories and alarming the dangers produced by any explosives. Both types, fixed and mobile thermal camerascan be used for different applications to avoid dangers. Awareness of the problem can be provided as future prediction. Precaution is better than cure so the use of the thermal imaging cameras in the preservation of temperature avoids many dangers in various fields and reduces the injuries.

5.5. *Organizingvariousarticles*

The research started with exploring the development of software that could identify objects of interest (birds and bats) sensed with thermal imaging video equipment. [5] Thermal images play a major role in identification of diverse objects like small worms, birds, insects, bats and snakes in forest exploration. In wild life video footage, most coverage needs nil observers as danger stops the inspection of the movements of hazardous species. Here thermal cameras can be installed and clear images are retrieved.Sensors in the camera capture hot spots of different classes like bats, birds and other warm targets producinghot images when they change their locationusing the view point of the camera. Theapplication ofthermal images based on infrared video cameras are the nominal method for the analysisof birds and animals.

5.6. *Medical diagnosis*

One of the useful applications of thermalimages is the contributions in medical field. Images are used in various applications like scanning, screening and in diagnosing diseases earlier to other traditional methods like sputum testing, mammography, tomography, x-ray etc. Many fatal diseases can be diagnosed in advance so treatment can be provided and curing is guaranteed.

6.METHODS USED IN ANALYSING

- In the case of breast cancer, heat is monitored in the breast and surrounding areas using heat sensing camera and the technique used is segmentation, feature extraction and classification using thermography images. [ref table 1]
- In another application rotational thermo gram technique is used for extracting texture features for detecting malignant breasts. Classification and feature reduction are the techniques used.
- A therapeutic technique for calculating heat in treatment of cancer cells is the magnetic fluid hyperthermia where nanoparticles temperature was checked by thermal images using thermo graphic calibration processed in MATLAB.[ref table 3]

7. CONCLUSION

Thermal image technique has become a popular field because of its various advantages like capturing mobile targets in real time applications, capable to find deterioration and defects in hazardous locations. It is a non-destructive method and can be used insites where there are no light sources. But there are some limitations like expense of the larger pixel array,so usage of fewer pixels may reduce the quality.Based on the differing emissivity and reflections from body surfaces, exact images cannot be produced. These problems are condensed in active thermal imaging, so standard of thermal imaging is improving day by day. Areas of application are also included more and variety of routines are increasing for future usage

REFERENCES

[1] AngelikiKylili, Paris A. Fokaides, PetrosChristou, Soteris A. Kalogirou. Applied Energy. 134: 531–549. . *Retrieved 30 October 2014*

[2] Medical Imaging Research Unit, Faculty of Advanced Technology, University of Glamorgan, Pontypridd, CF37 1DL, UK 2 Institute for Physical Medicine and Rehabilitation, Hanuschkrankenhaus, Vienna, Austria

[3] FLIR T1K HD Thermal imaging camera specifications. Retrieved on 2015-12-10. "Infrared Technology". *thermalscope.com. Retrieved 31 October 201*

[4] VS. Elanthendral1 , R.K.Rekha2 , M. Rameshkumar3 CSE Department, VeltechMultitechDr.RangarajanDr.Sakunthala Engineering College Chennai, Tamil Nadu

[5] CA Duberstein DJ Virden S Matzner J Meyer VI Cullinan AR Maxwel-l

[6] . Maldague X. P. V., Jones T. S., Kaplan H., Marinetti S. and Prystay M. (2001) "Chapter 2: Part 1. Principles of Infrared and Thermal Testing," in *Nondestructive Handbook, Infrared and Thermal Testing*, Volume 3, X. Maldague technical ed., P. O. Moore ed., 3rd edition, Columbus, Ohio, ASNT Press

[7] Infrared Building Inspections — Resources for Electrical, Mechanical, Residential and Commercial Infrared/Thermal Inspections. Infrared-buildinginspections.com (2008-09-04). Retrieved on 2013-06-18.

[8] R, Altschuler C, Giraud D and Spitalier J M-1984 Recent Advances in Medical Thermologyed E F J Ring and B Phillips (New York: Plenum) pp 623–

[9] Arora N, Martins D, RuggerioD.. Am J Surg.Oct 2008;196(4):523-526

[10] Ng EY, Sudharsan NM.. BMC Cancer. Apr 28 2004;4:17.

REFERENCE TABLE FOR PAPER PUBLISHING

S.NO	PAPER TITLE	AUTHOR NAME	PUBLICATION/YEAR	TECHNIQUES USED
1	Breast Cancer Detection and Classification Using Thermography: A Review	Abdel hameedebrahim	Research gate. January 2018	image acquisition, pre-processing, segmentation, feature extraction , classification
2	Breast cancer detection using thermography	P.Hankare	IRJET-V314211 2016	Classification with segmentation
3	Thermal Infrared Image Processing to Assess Heat Generated by Magnetic Nanoparticles for Hyperthermia Applications	Raquel O. Rodrigues	Pringer 2015	MATLAB with the thermo graphic calibration
4	Thermography based breast cancer detection using texture features	M.Milosevic	NCBI-2014	Pattern matching, neural classifiers, texture analysis
5	Segmentation Algorithms for Thermal Images	A.Duarte	Research gate 2018	medical thermography using geometric shapes and segmentation