

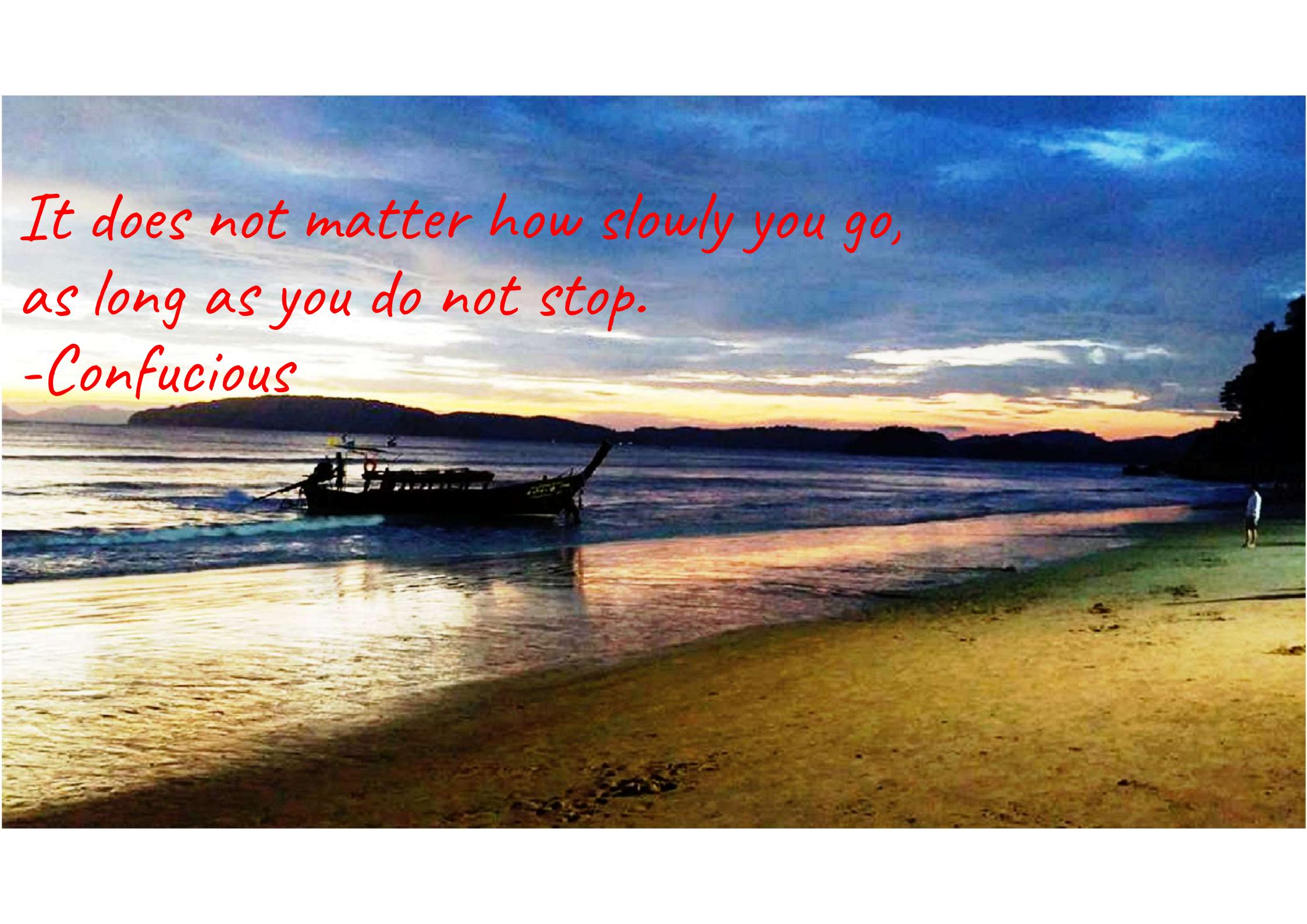
My Life's Journey as a Researcher and Beyond

Ronnie O. Serfa Juan, PECE, PhD, AE

LU Laboratory, Myanmar

November 6, 2021



A photograph of a tropical beach at sunset. The sky is filled with warm orange and yellow hues, transitioning into cooler blues and purples. A longtail boat is silhouetted against the water on the left. The sandy beach curves along the right side of the frame. In the distance, a range of hills or mountains is visible under the setting sun.

*It does not matter how slowly you go,
as long as you do not stop.*

-Confucious



2006

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2007

Ronnie O. Serfa Juan



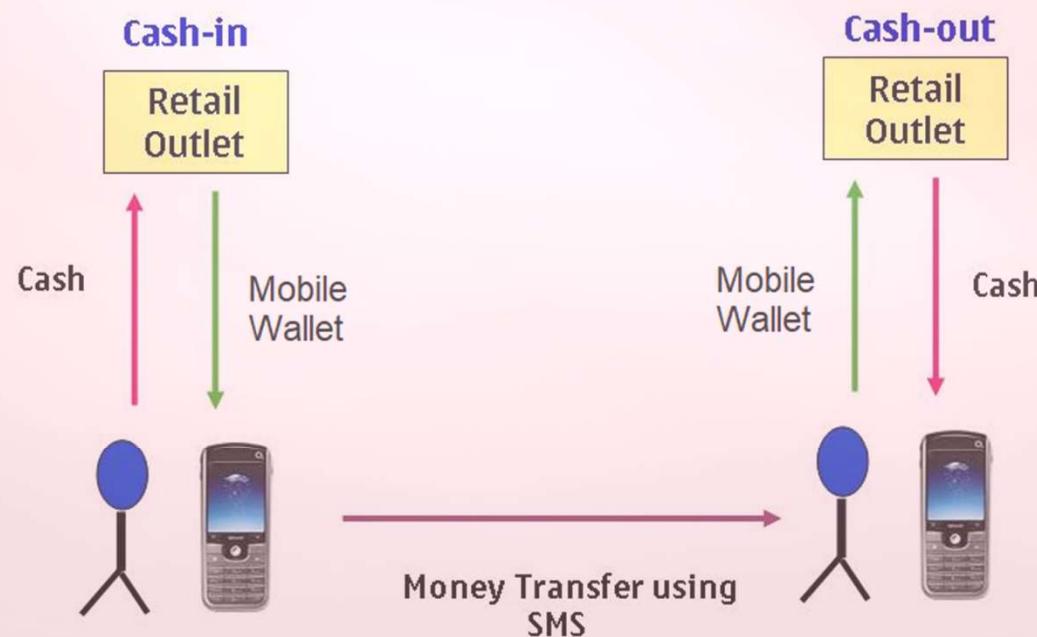
2016



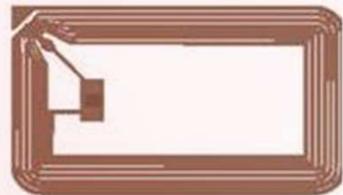
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UNTACT and CONTACT

“Untact” – contact free



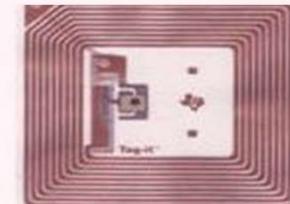
RFID tags



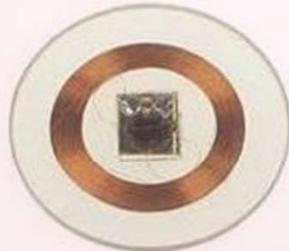
Paper Tag



Disc Tag



Inlay Tag



Glue Tag



Key Tag



Glass Tube Tag

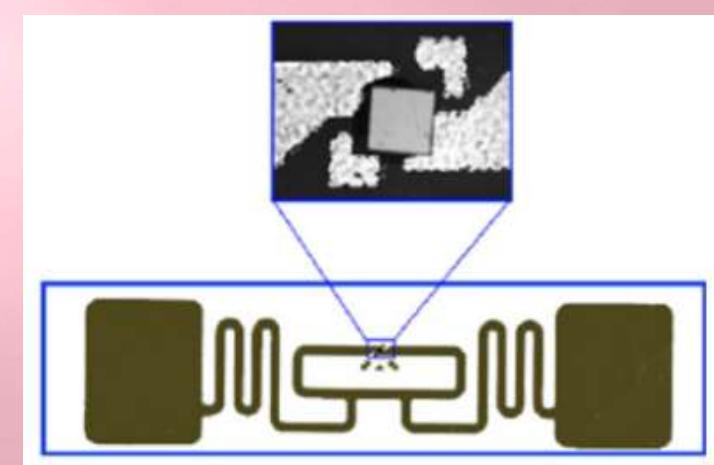
IoT



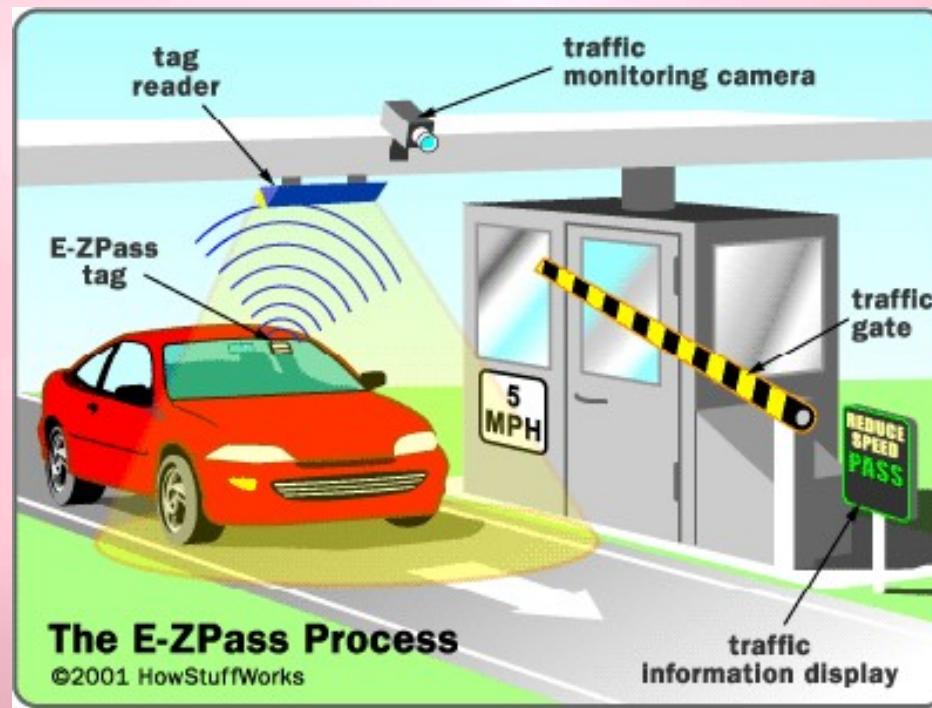
In 1999, Kevin Ashton coins the term
“Internet of Things”
He established the
MIT’s Auto-ID Center
which focused on both
RFID and IoT
- Increase efficiency

Before IoT

- Ubiquitous
- Radio Frequency Identification (RFID)
- Ubiquitous Sensor Network

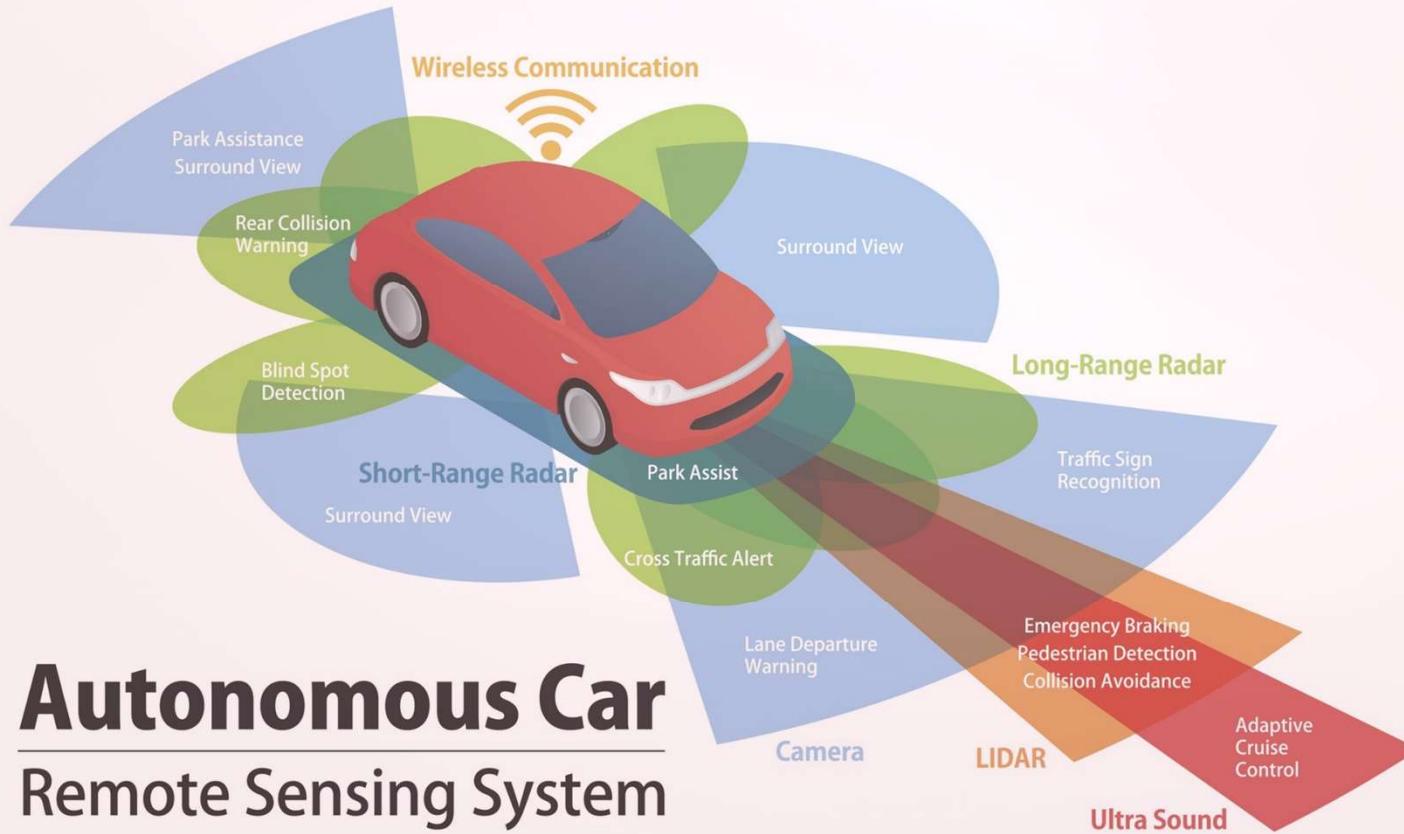


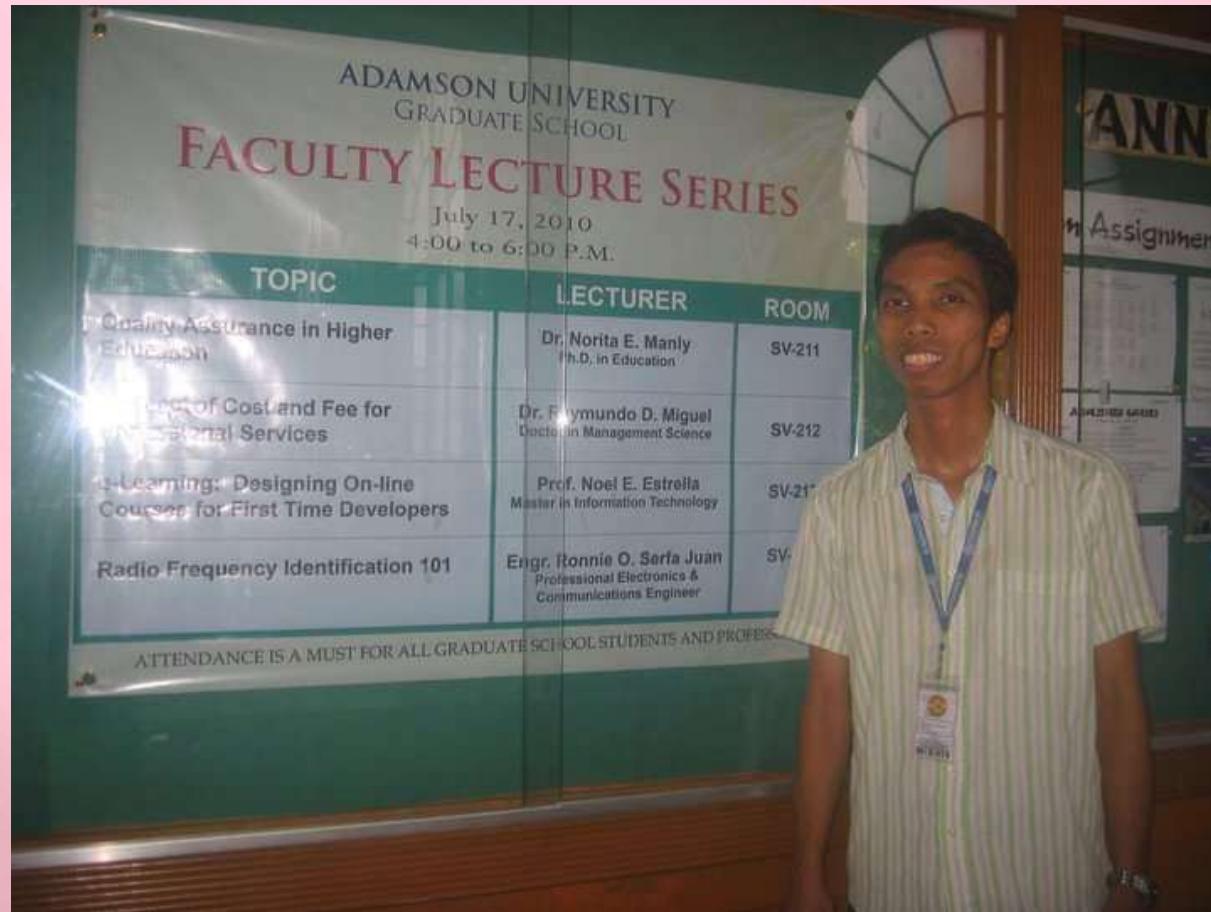
Automated Toll Collection



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Automobiles with built-in sensors





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Healthcare



- the prevention and treatment of diseases through medical professional services
- treatment of illness or injury, especially on a comprehensive, ongoing basis

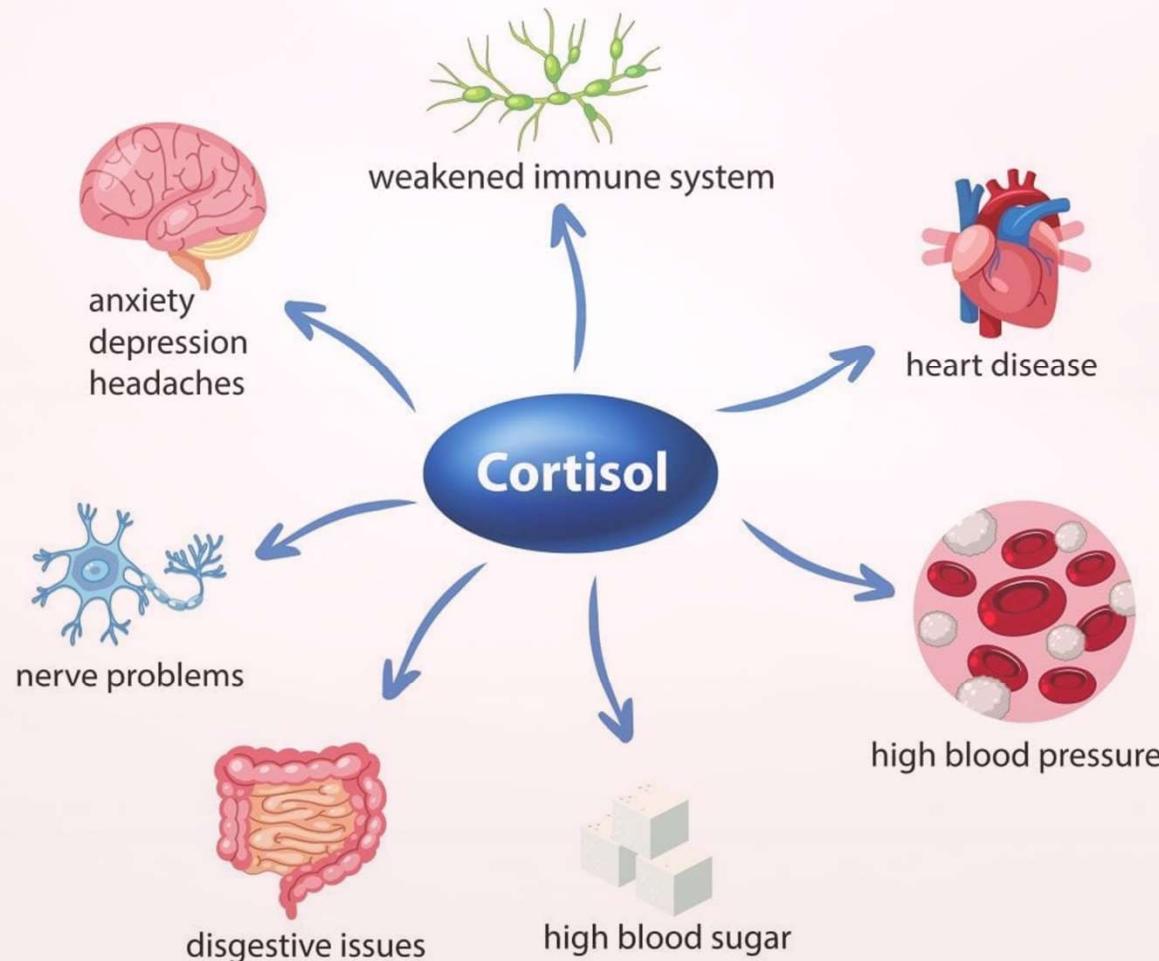




Healthcare System

- technology that involves sensors (body temperature, patient's heartbeat, etc.) and can be embedded to human or in a **stand-alone** machine which can monitor the patient condition

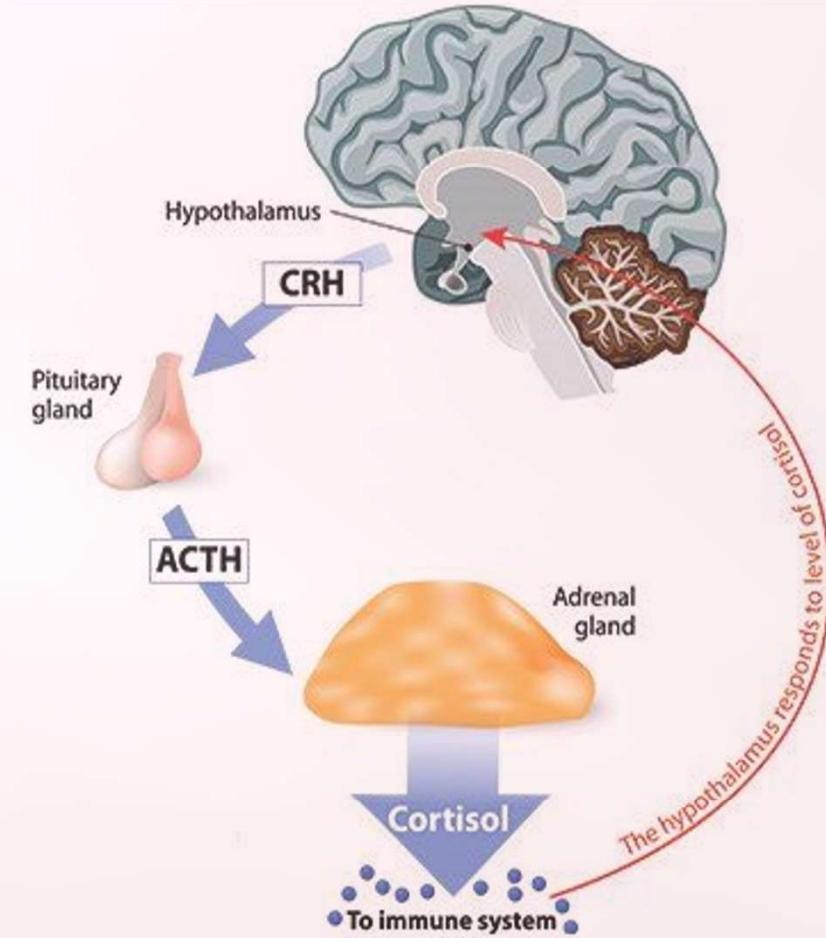
Human ↔ Machine Intervention



Cortisol

- Stress hormones!
 - Cortisol is essential for life!
- Without it, we will die!!!

But too much Cortisol can have a **catastrophic effect** to our body!





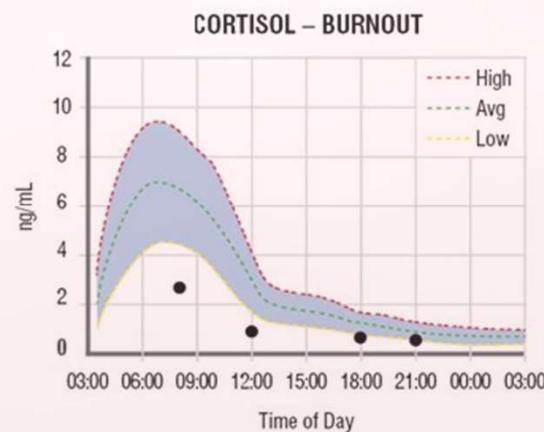
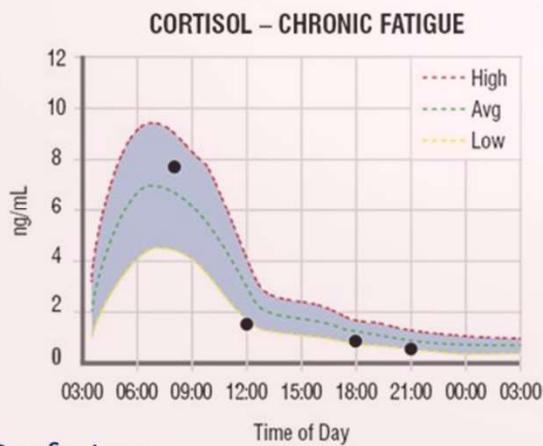
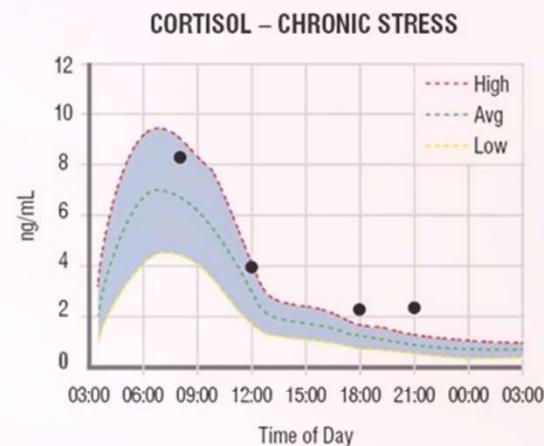
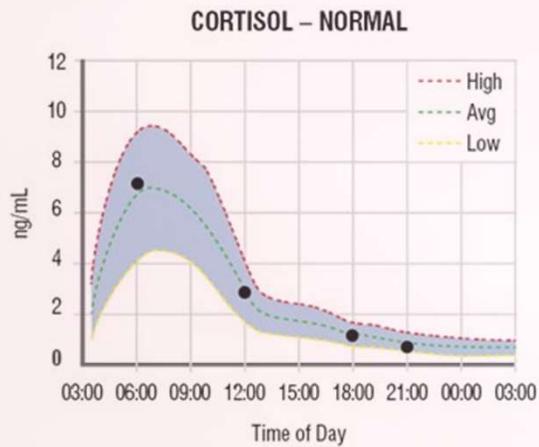
CAVEMENWORLD.COM

Cortisol and Metabolism

Purpose of cortisol

- It stimulates the liver to increase production of **blood sugar**
- It also helps the body convert fats, proteins, and carbohydrates into **usable energy**
- As part of the body's **fight-or-flight response**, cortisol is released during stressful times to give your body a natural **energy boost (adrenalin)**

Cortisol Level

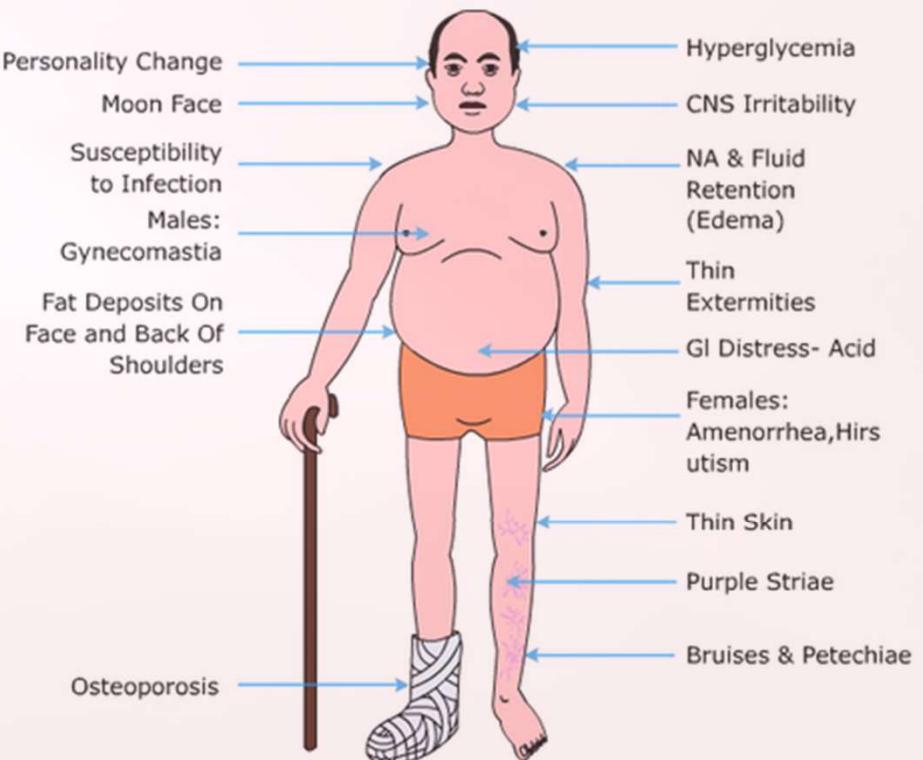


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Cushing's Syndrome

Cushing's syndrome happens when there is too much cortisol in the blood for a prolonged period. This can cause physical and mental changes.

- Weight gain or loss
- High blood pressure
- High blood sugar
- Muscle loss and weakness
- Swelling of the face
- Depression
- Skin that bruises easily
- Diabetes



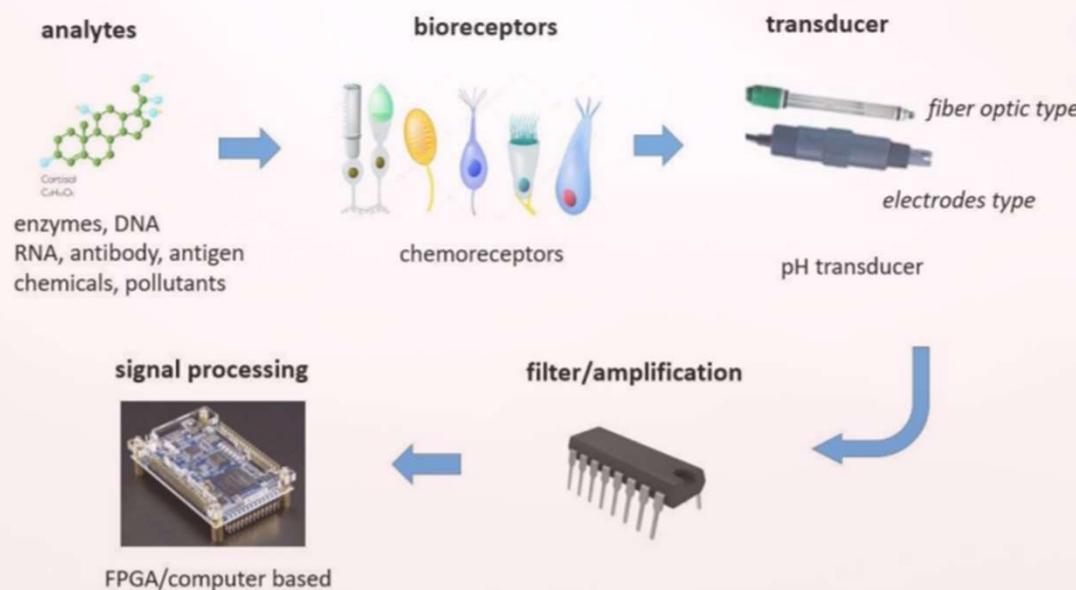
Testing Cortisol Levels

Cortisol levels can be measured in **blood**, urine, **saliva**, or even in **body sweat**

- **Blood test** is done by measuring levels in the blood both before and an hour after the injection of a drug called **adrenocorticotropic hormone (ACTH)**
- **Saliva** may be collected, swab into your mouth and wait a few minutes until it is saturated with saliva
- **Urine test**, urine is collected within a 24-hour period in a container provided by the laboratory, but sometimes be tested with a single sample of the first urine in the morning
- **Sweat test** is done by collecting the sweat sample of the patient in actual manner (*because cortisol composition varies immediately*)

IoT-based Monitoring Model for Pre-Cognitive Impairment using pH Level as Analyte

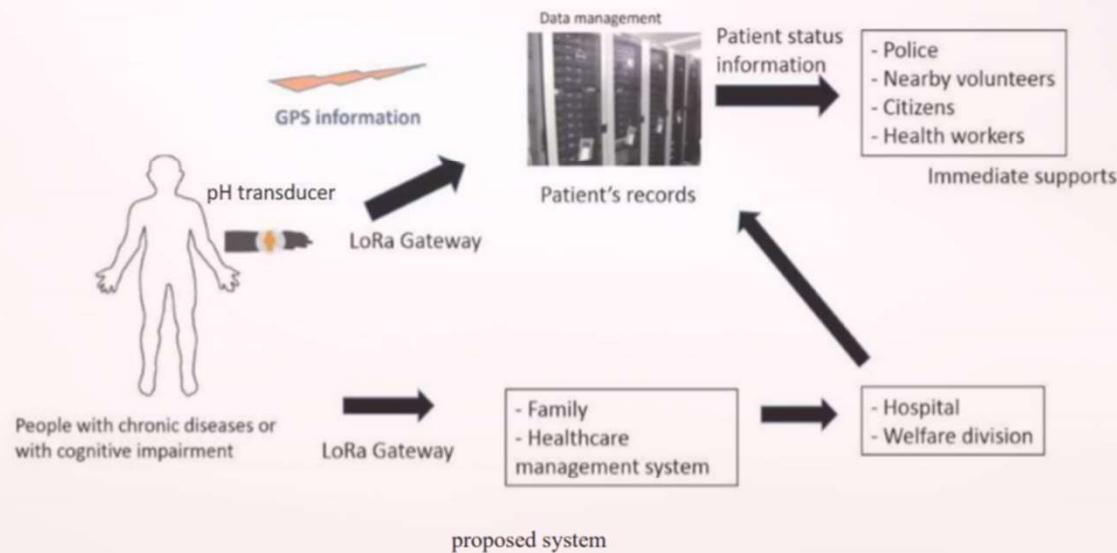
Rosemarie Theresa M. Cruz, Lean Karlo S. Tolentino,
Ronnie O. Serfa Juan, and Hi Seok Kim



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The general architecture of a Biosensor.

IoT-based Monitoring Model for Pre-Cognitive Impairment using pH Level as Analyte





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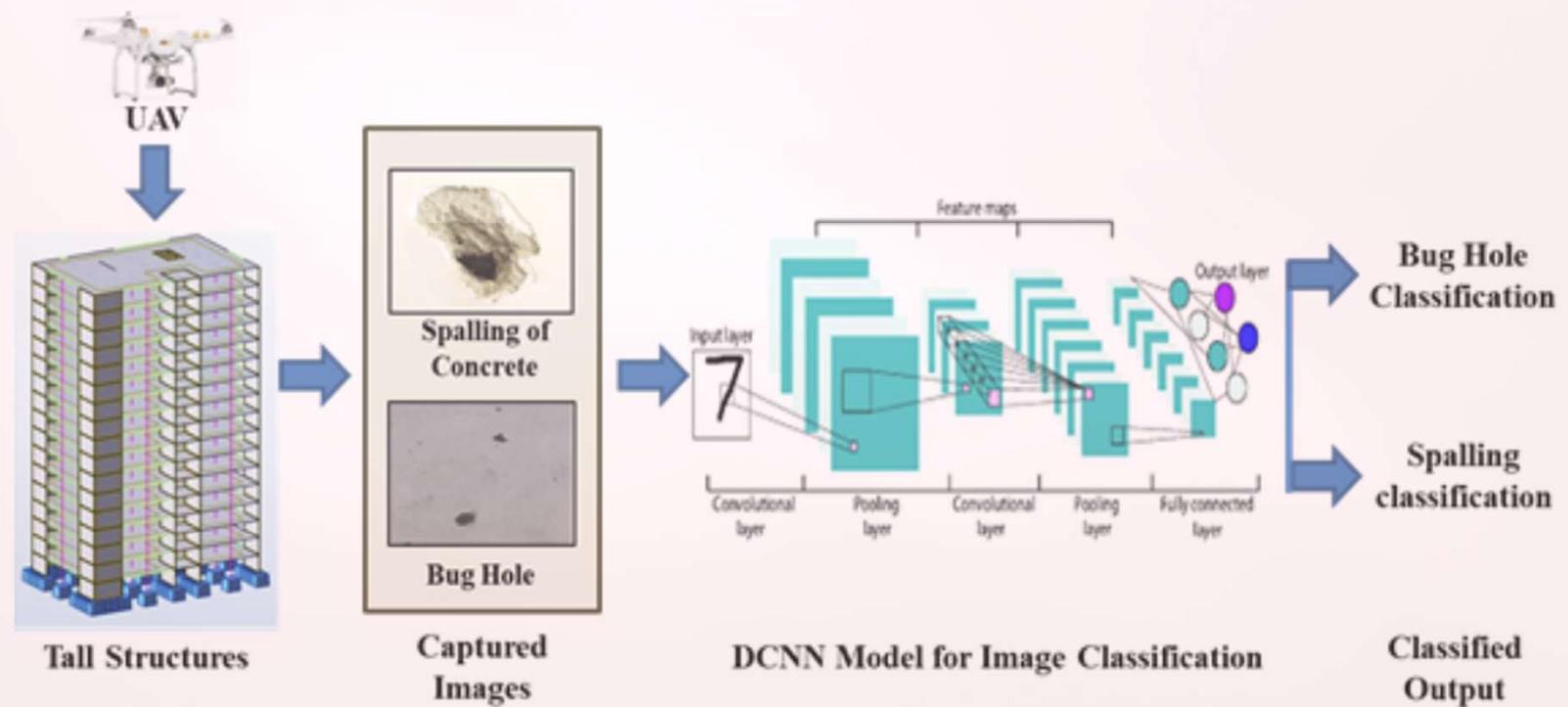
Ronnie O. Serfa Juan



Ronnie O. Serfa Juan

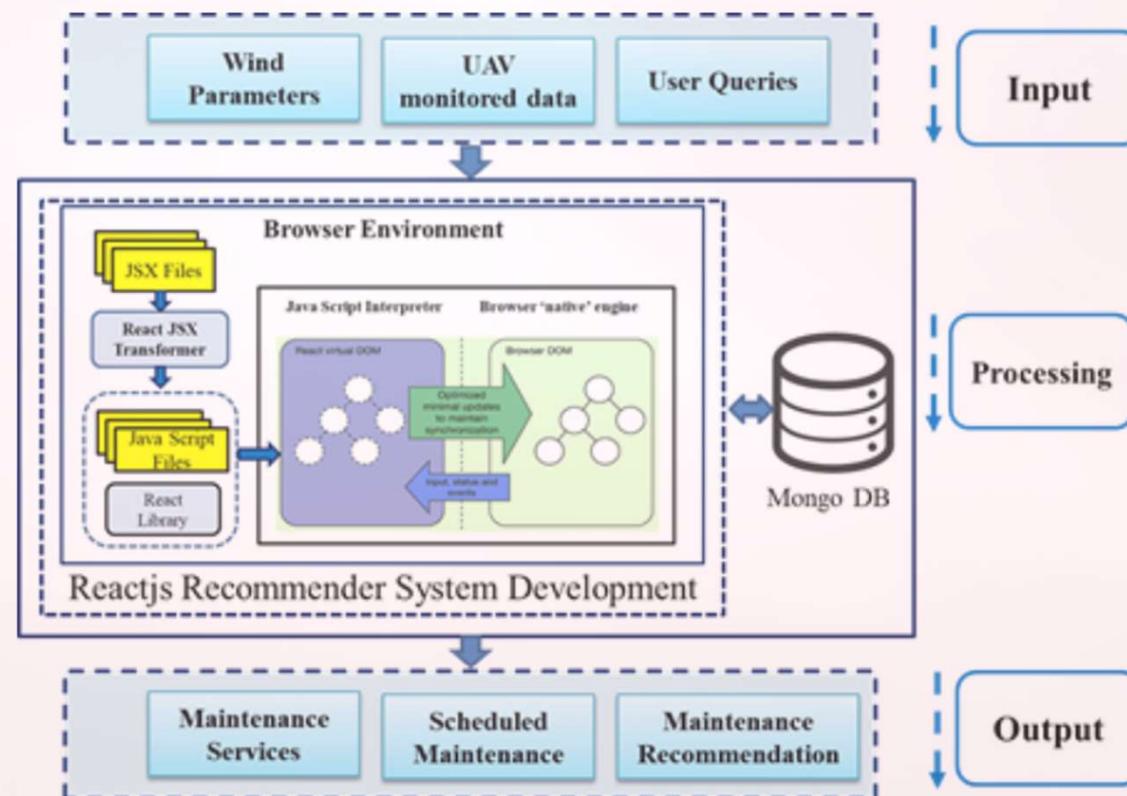
CONSTRUCTION AND SAFETY MONITORING OF BUILDING STRUCTURES USING ARTIFICIAL INTELLIGENCE

(인공지능을 이용한 건축구조물의 시공성 및 안전성 모니터링)



WIND-INDUCED RESPONSES AND EVALUATION OF LOCAL PRESSURES IN TALL BUILDINGS WITH DIVERSE SHAPES

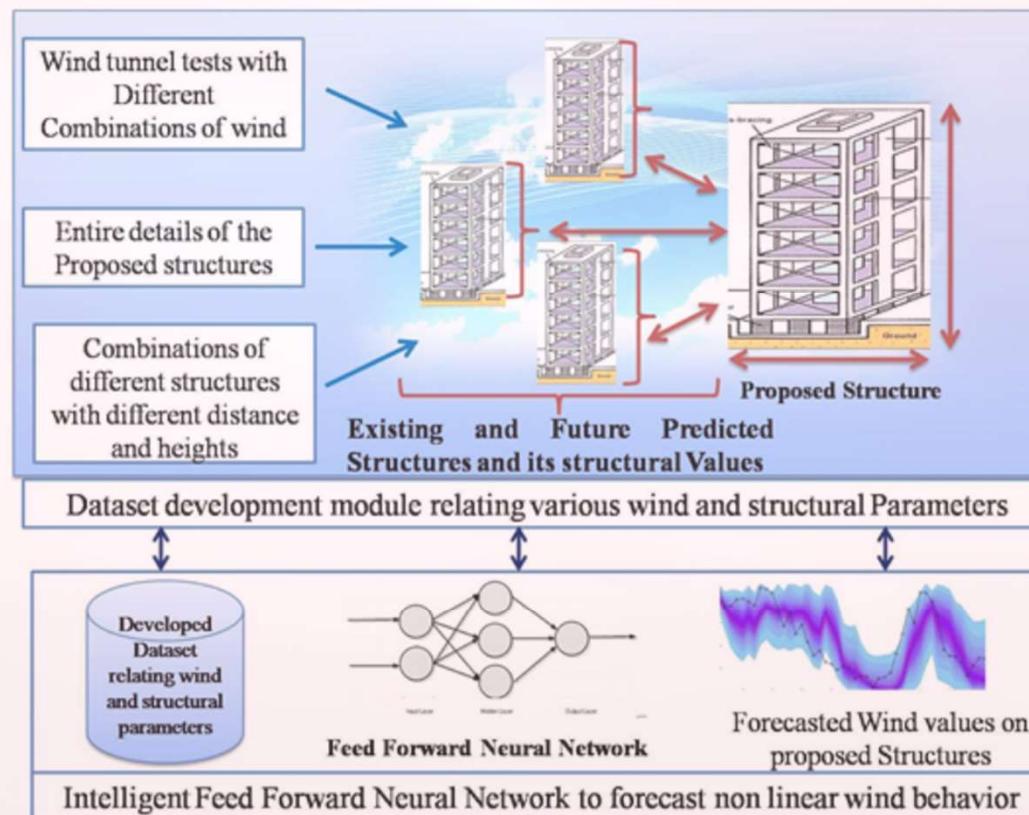
(다양한 형태의 고층건물에 대한 풍응답과 국부풍압에 대한 평가)



Ronnie O. Serfa Juan

ARTIFICIAL INTELLIGENT SYSTEM FOR ENSURING STRUCTURAL SAFETY AND SMART BUILDING MAINTENANCE UNDER DYNAMIC WIND LOAD

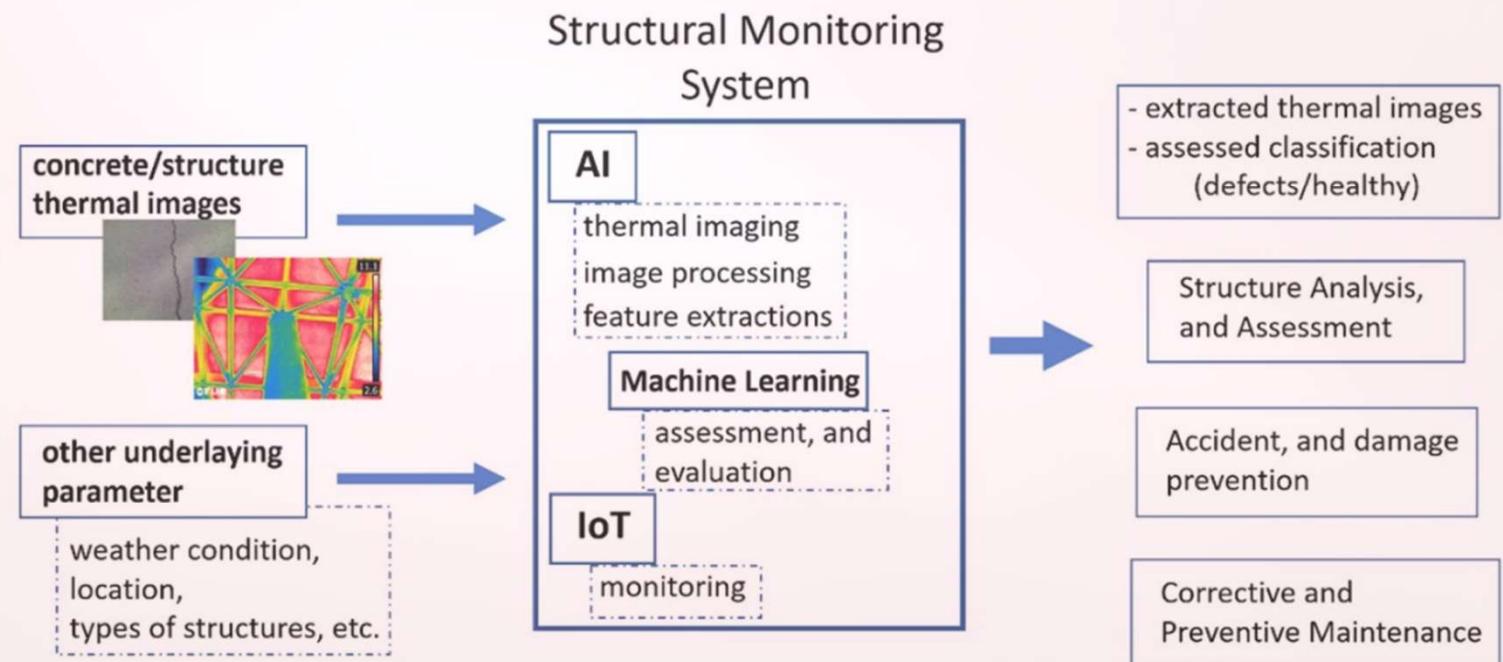
(동적풍하중에 대한 건축구조물의 안전성 및 효과적인 유지관리 보장을 위한 인공지능 시스템)



Ronnie O. Serfa Juan

DEVELOPMENT OF STRUCTURAL MONITORING SYSTEM FOR THERMAL IMAGING OF USING MULTIVARIANT CLASSIFICATION BASED ON CONVOLUTIONAL NEURAL NETWORK

(합성곱 신경망 기반 다변량 분류 및 열화상 이미지를 이용한 모니터링 시스템 개발)



Importance of Extracted Features using Thermal Imaging Technique of Photovoltaic Module

Ronnie O. Serfa Juan

Project brief

- Renewable energy aims to be a reliable power supply, maintain energy security, reduction of fuel spills, and its demand.
- Solar Energy as a Renewable Power Source



Solar Energy Applications [1]

- **Architecture and Urban Planning**
- **Agriculture**
- **Heating, Cooling and Ventilation**
- **Cooking**
- **Fuel Production**
- **Electricity Generation**

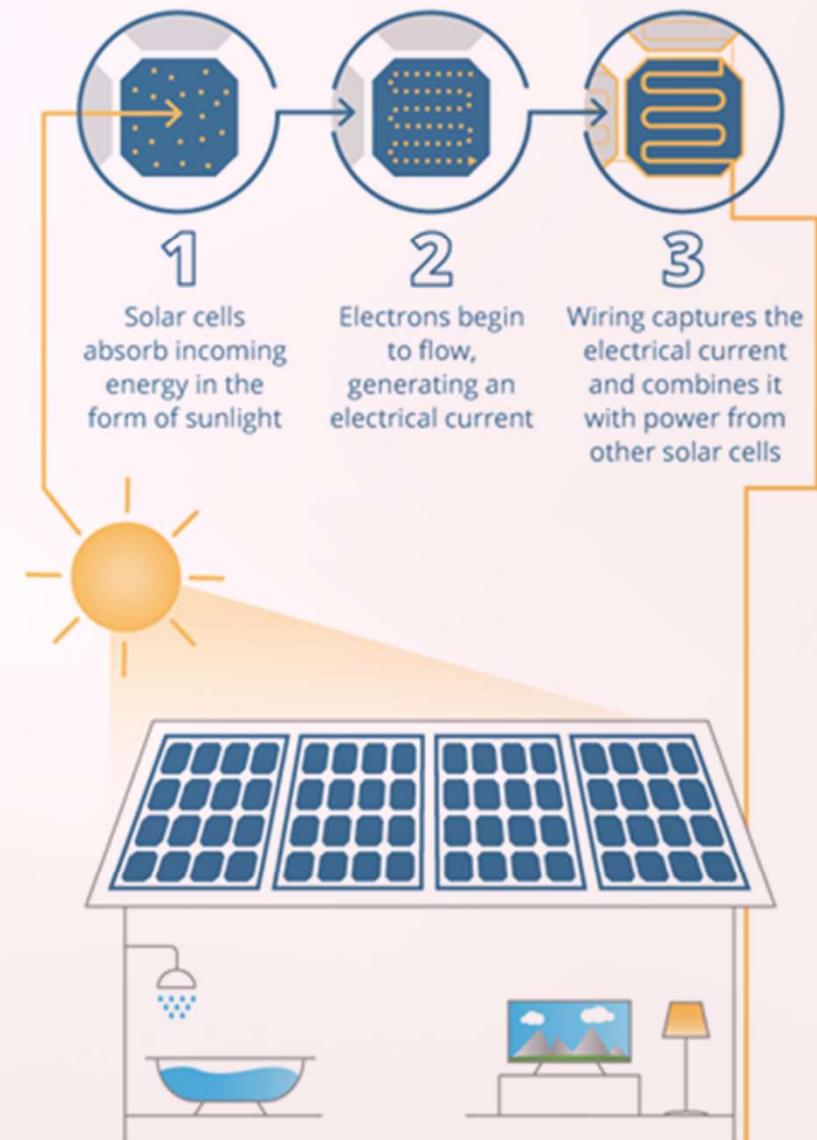
[1] M. Hammami, S. Torretti, F. Grimaccia, and G. Gradi, “Thermal and Performance Analysis of a Photovoltaic Module with an Integrated Energy Storage System,” Applied Sciences, vol. 7, no. 11, pp. 1-15, 2017.

Solar Energy

Solar Energy can be used to generate electricity in two ways:

- **Thermal Solar Energy:** Using solar energy for heating fluids which can be used as a heat source or to run turbines to generate electricity.
- **Photovoltaic Solar Energy:** Using solar energy for the direct generation of electricity using photovoltaic phenomenon [2].

[2] Available online: <https://guide.sportmansguide.com/how-thermal-imaging-works/>



Solar Panel

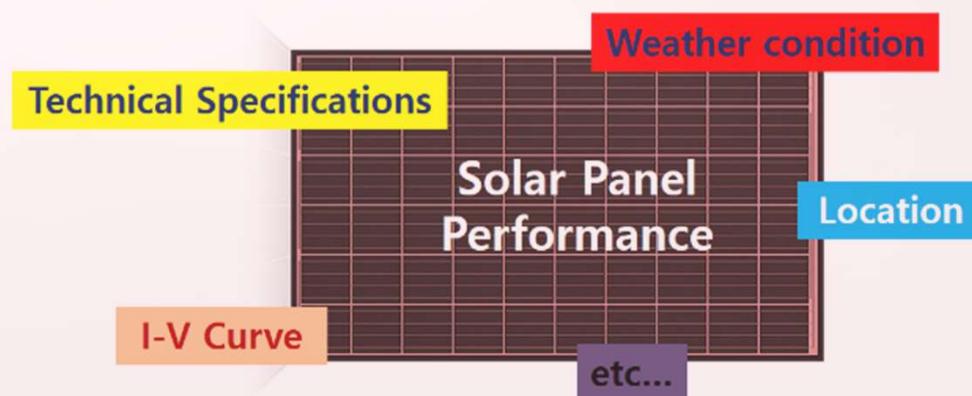
Solar Panel is responsible to collect solar radiations and transform it into electrical energy.



Problems in the Solar panel modules

Factors affecting the performance of the Solar Panel Modules

- type of materials and components used
- resistance of the load
- intensity of sunlight
- environmental conditions and shadowing
- temperature of the solar panels



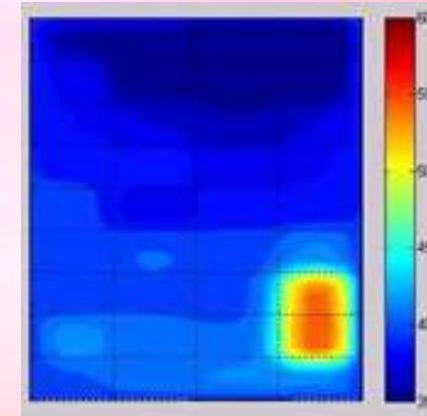
Common Solar Panel Defects



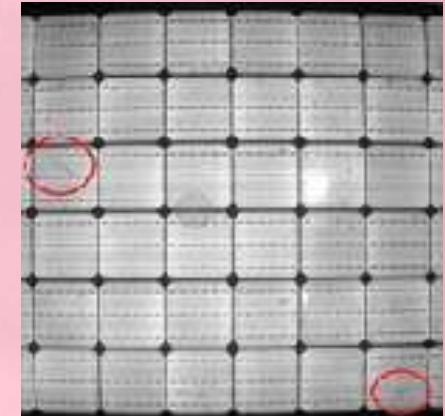
a)



b)



c)



d)

Common solar panel defects: a) broken or chipped; b) scratches; c) hot spot; and d) microcracks

Solar cell image extraction

- Extracting the features of the sampled thermal images of a solar panel provides more detailed information in contrast to an image in the red, green, and blue (RGB) color model.
- Essential for fault diagnosis of solar panels

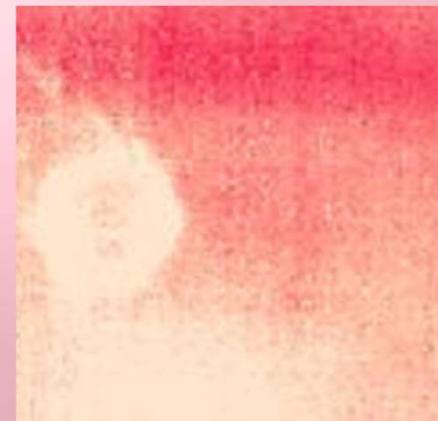
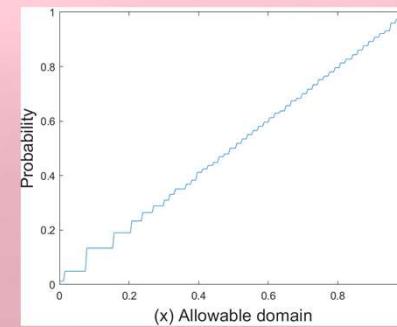
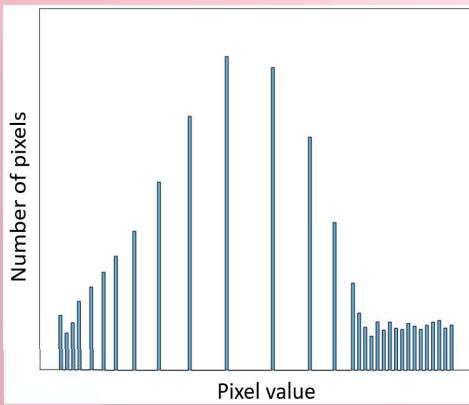


Image feature extraction

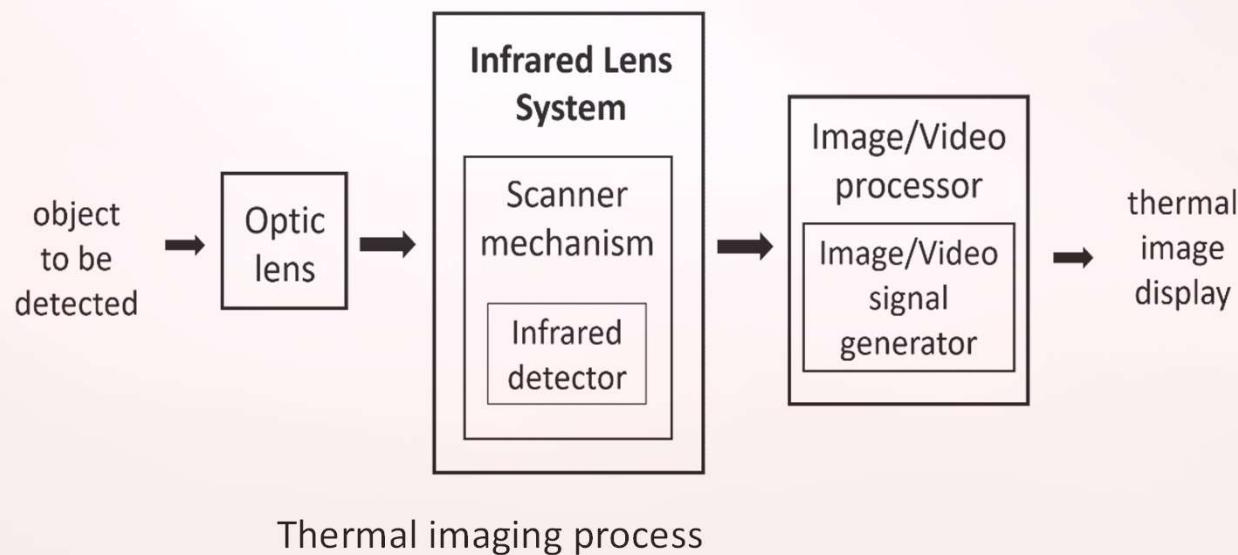
- Histogram is an important tool for inspecting images. It provides to view the spot background and grey value range at a glance of an image
- Cumulative Distribution Function (CDF) – provides the associated information of an image based on symmetric distribution of image grayscale value.

A linear **cdf** is associated to the uniform histogram



Thermal Imaging

A thermal image is a special type of visual information that converts thermal radiation into the visual range perceived by the human eye [3].



[3] Dulski, R.; Powalisz, P.; Kastek, M.; Trzaskawka, P. Enhancing image quality produced by IR cameras. Proceedings of SPIE – The International Society for Optical Engineering, 2010; pp. 1–9.

Thermography

- Thermography is a technique for producing a visible image of invisible to human eyes using infra red radiation emitted by objects due to their thermal conditions [4].



a)



b)

a) raw RGB image, b) thermal image of a)

Importance of Thermography

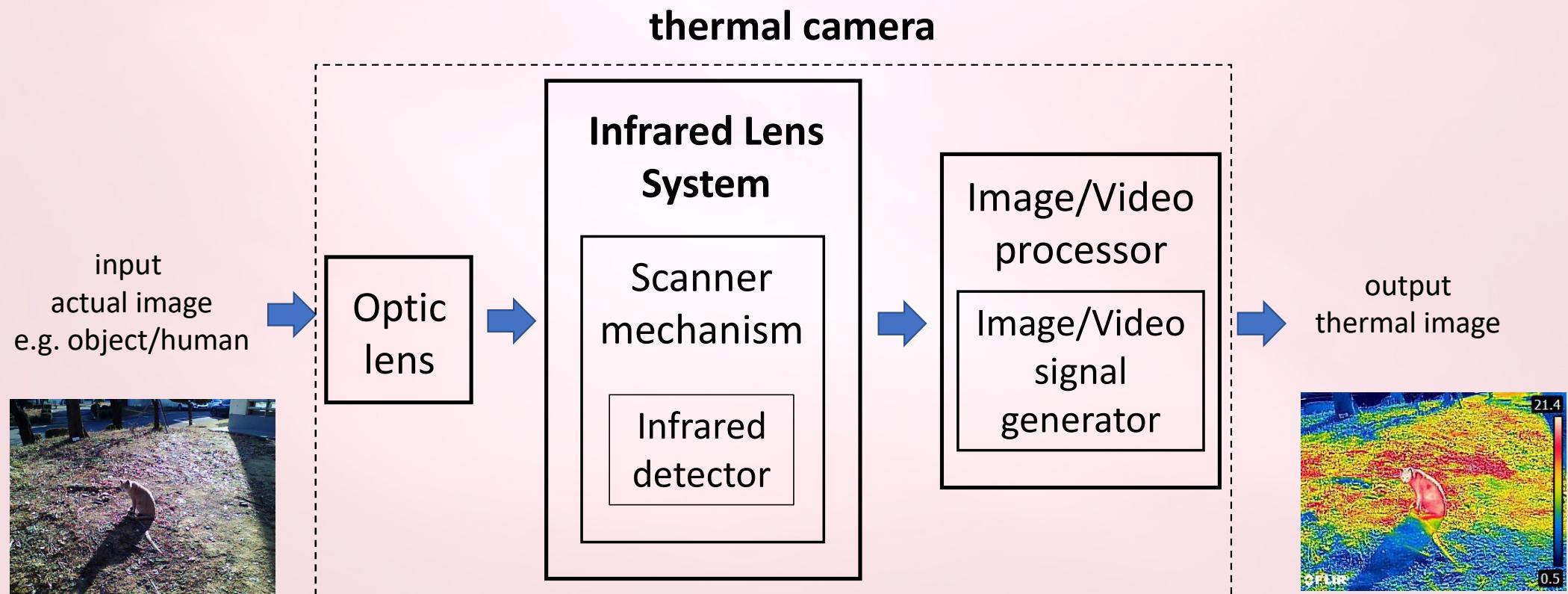
- Available for non-contact data acquisition
- Rapid Scanning
- Data can be recorded in differing formats (e.g. thermal image)
- Images produced are comprehensive & reliable



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RGB image to thermal image

Thermal Imaging Technique



Advantages

- Non-contact - safe
- Non-Intrusive – non-destructive testing
- Can work at a distance
- Fast and Reliable
- Can be Portable
- Provide Accurate Results

Limitations

- There must be a temperature difference for certain survey/inspection
- Operator experience is essential
- Filters may be needed for certain applications
- Only able to detect directly surface temperatures

Some Applications of Thermal Imaging

- **Electrical Inspections**

- *Hot Connections*
- *Failing Components*
- *Overloaded Circuits*

- **Fire**

- *Hot Spots*
- *People Rescue*

- **Building**

- *Structural hidden cracks*
- *Roof Leaks*

- **Medical**

- *Early fever detection*
- *Severe Acute Respiratory Syndrome (SARS)*

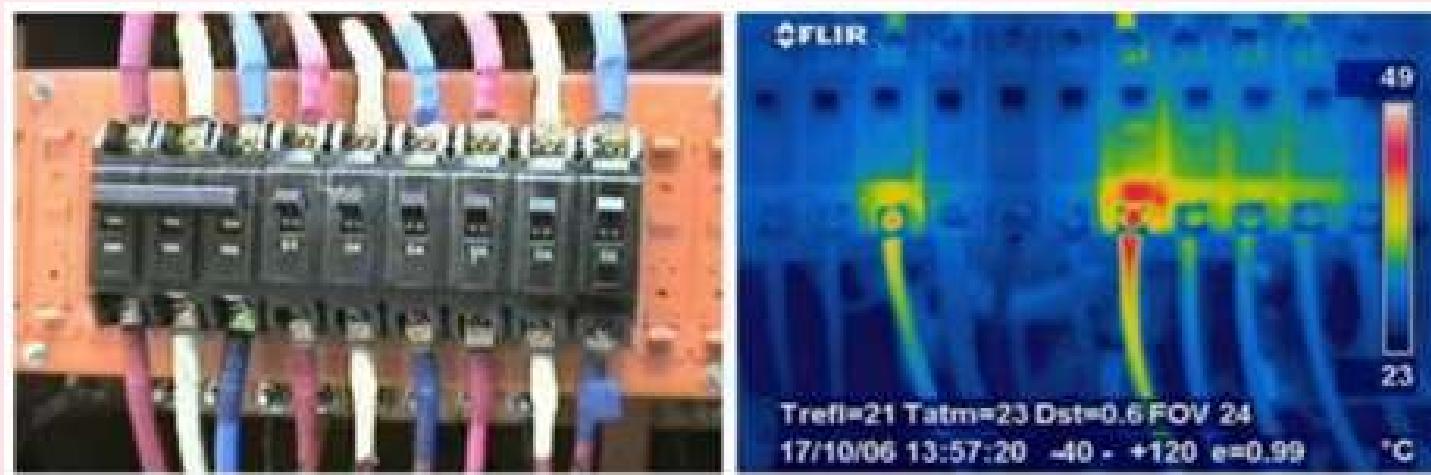
- **Mill Operations**

- Slag Detection

- **Animal**

- Equine hot joints ligaments

Thermal Imaging in Electrical Inspection



Normal camera

Thermal camera

[5] Kim, H. S., FPGA-based of Thermogram Enhancement Algorithm for Non-destructive Thermal Characterization. *International Journal of Engineering*, Volume 31, Number 10, 208; pp. 1675–1681

Thermal Imaging in Fire



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Thermal Imaging in Building



moisture



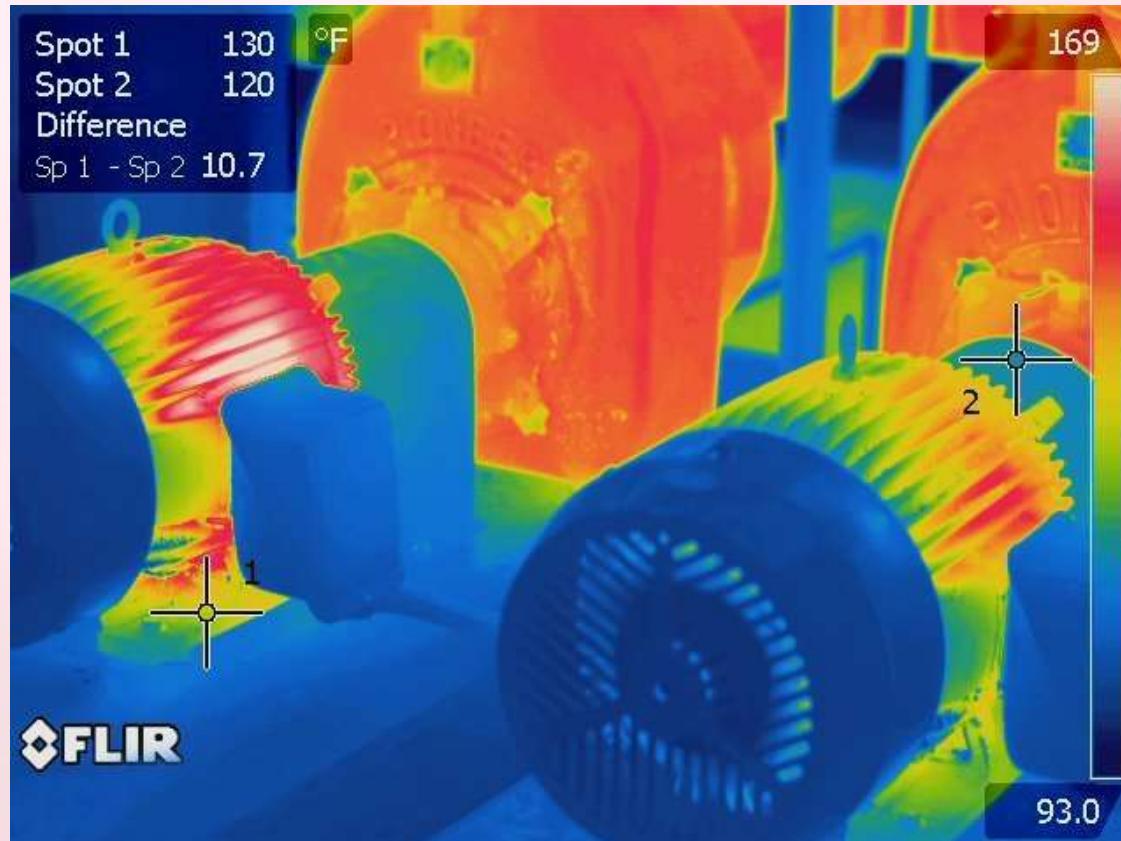
pipelines

Thermal Imaging in Medical



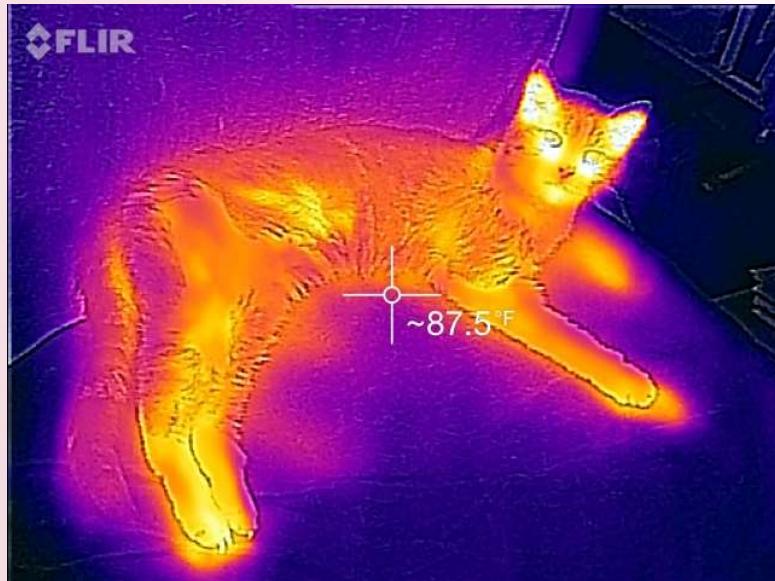
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Thermal Imaging in Mill operation



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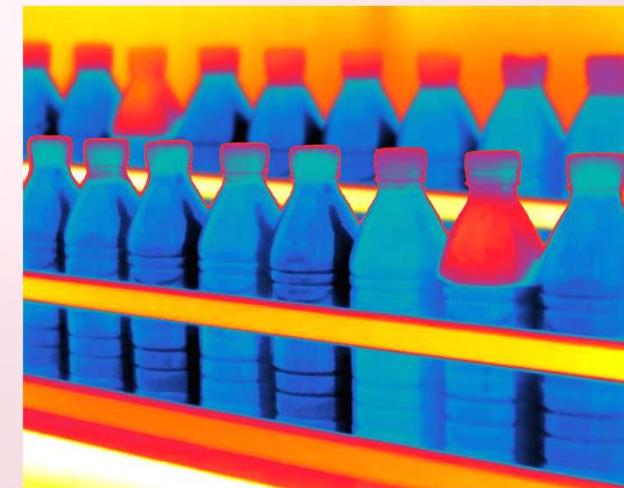
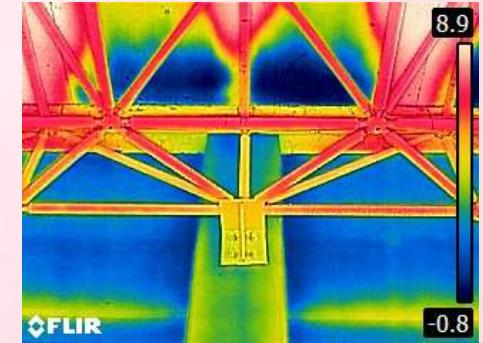
Thermal Imaging in Animal



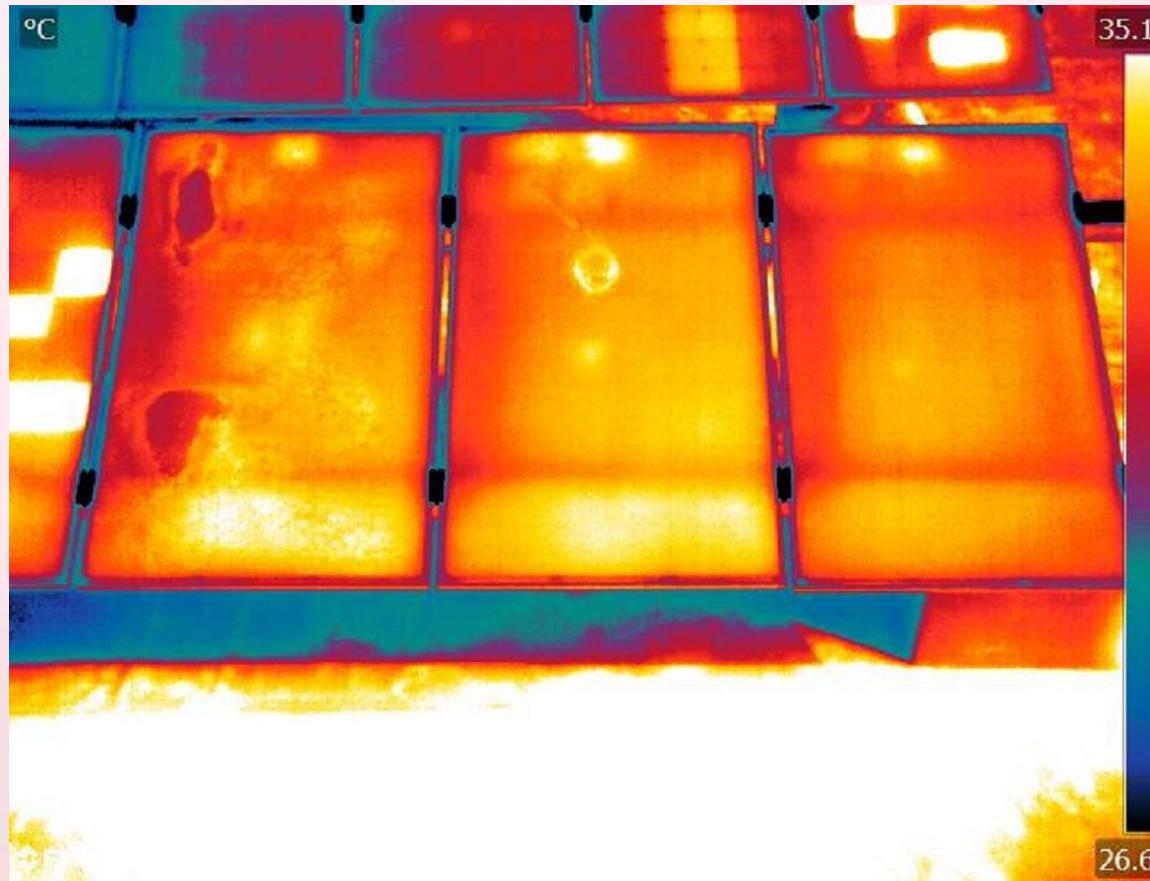
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Other Applications

- Evaluation of Solar Panels
- Thermal mapping
- Food and Agriculture



Thermal Imaging in Solar Panel Evaluation



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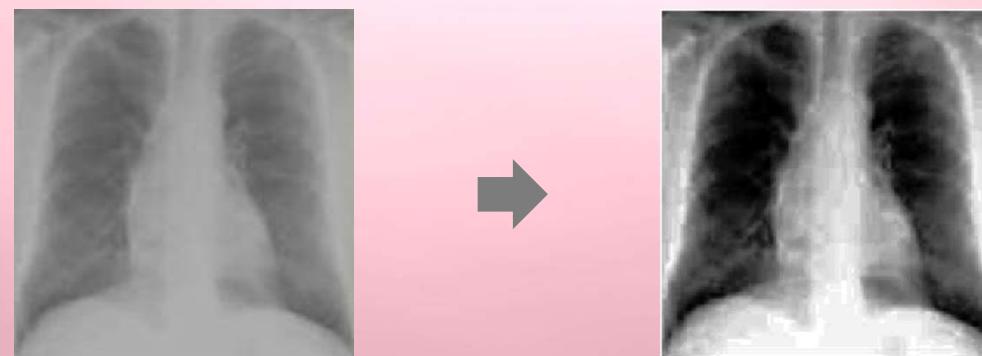
Digital Image Processing

The purpose of Digital image processing are

- a) improve the appearance of an image to a human eye,
- b) to extract from an image quantitative information,
- c) to calibrate an image in photometric or geometric terms [7].

[6] J. Druzik, D. Glackin, D. Lynn, and R. Quiros, “The use of digital image Processing to clarify the radiography of understanding”

Image Processing for image improvements



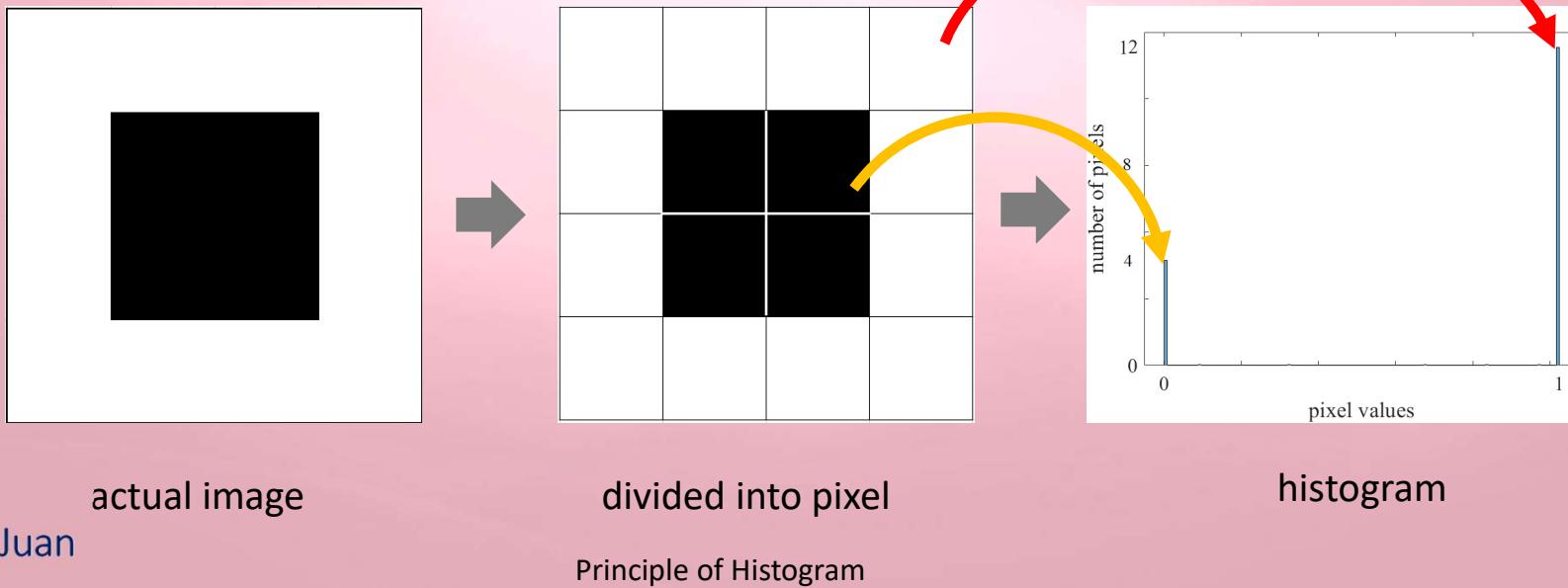
Feature extraction of image

- In image processing, feature extraction converts the image into a different domain. In this domain, important characteristics of images are detected, such as shapes, edges, or motion in a digital image or video to process them.

Quantitative Information

Histogram (intensity histogram)

- graphical representation of pixel intensity (on the x-axis) versus number of pixels (on the y-axis)



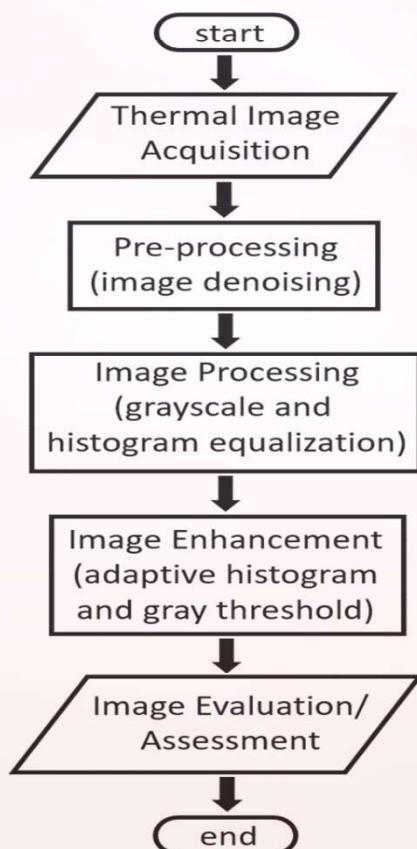
Thermal Imaging as a Solution

If thermal imaging techniques are to be utilized in the field of PVs, the early detection of defects would be manageable.

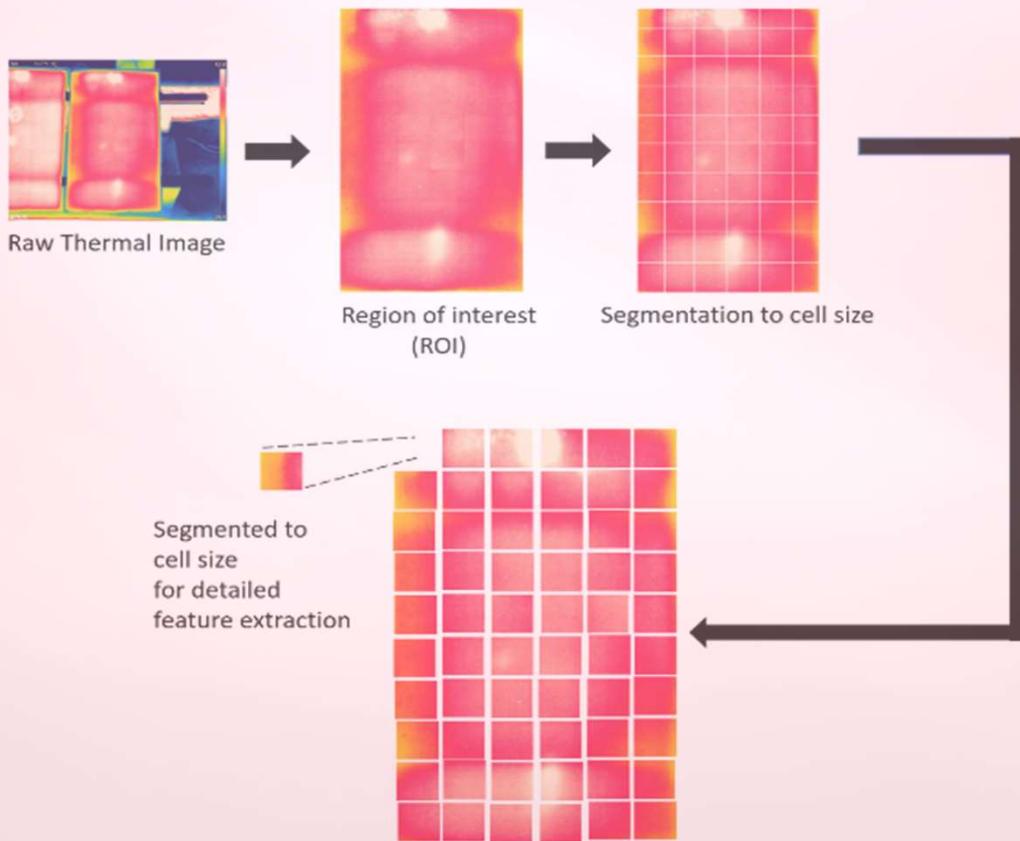
This could also help to provide important solar cell/panel information, such as

- a. characteristics
- b. health status,
- c. assessment for power output estimations.

Proposed Methodology



Data Acquisition

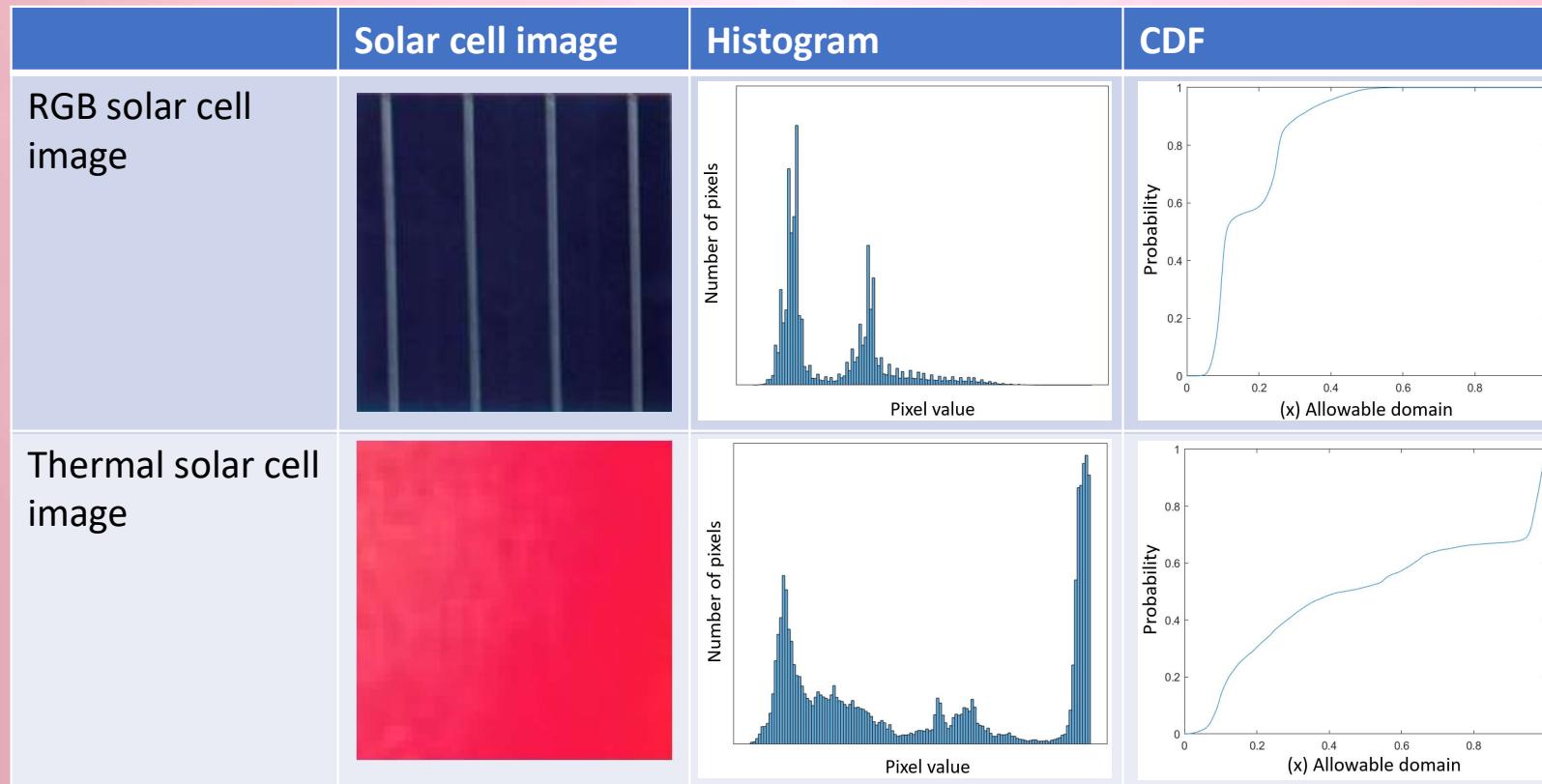


Ronnie O. Serfa Juan Segmented solar cell sizes to provide a more detailed feature extraction.

Preprocessing

- All segmented thermal solar cell images were preprocessed (e.g. resizing and filtering or denoising) – to improve the raw image data that were suppressed by unwanted distortions of some image features
- Size adjustments were implemented to maintain uniformity and execution of statistical measurements.

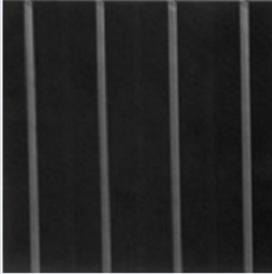
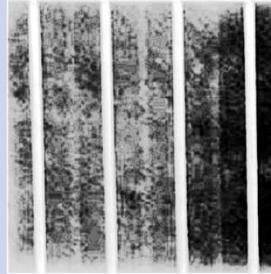
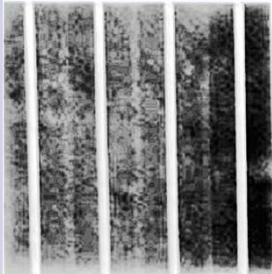
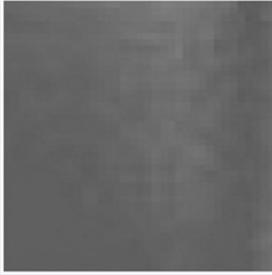
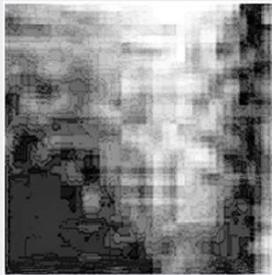
Results and Discussion



The corresponding histogram and *CDF* of the raw RGB and thermal solar cell images.

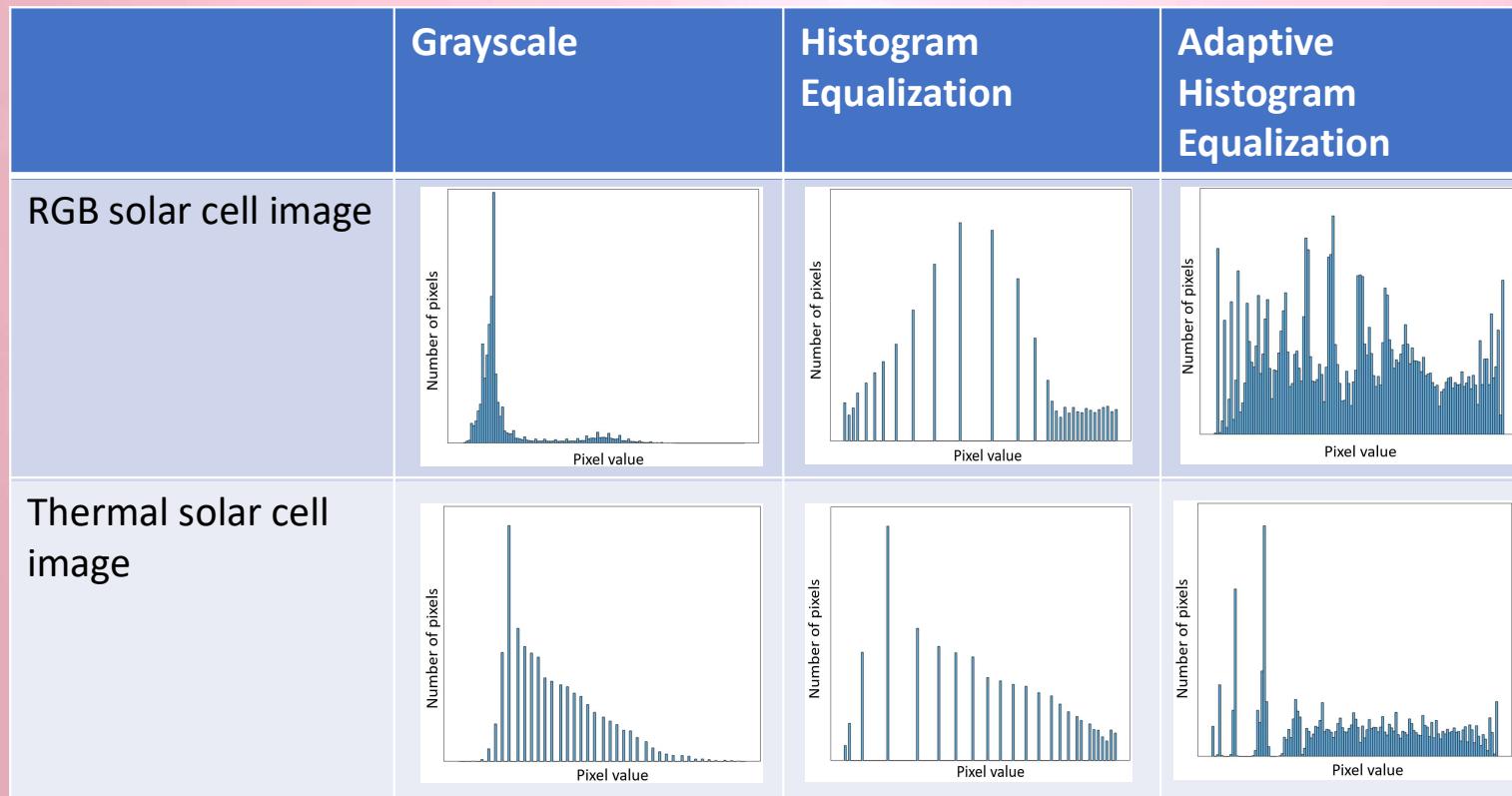
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Results and Discussion

	Solar cell image	Grayscale	Histogram Equalization	Adaptive Histogram Equalization
RGB solar cell image				
Thermal solar cell image				

Processed images of both the RGB and the thermal solar cell images.

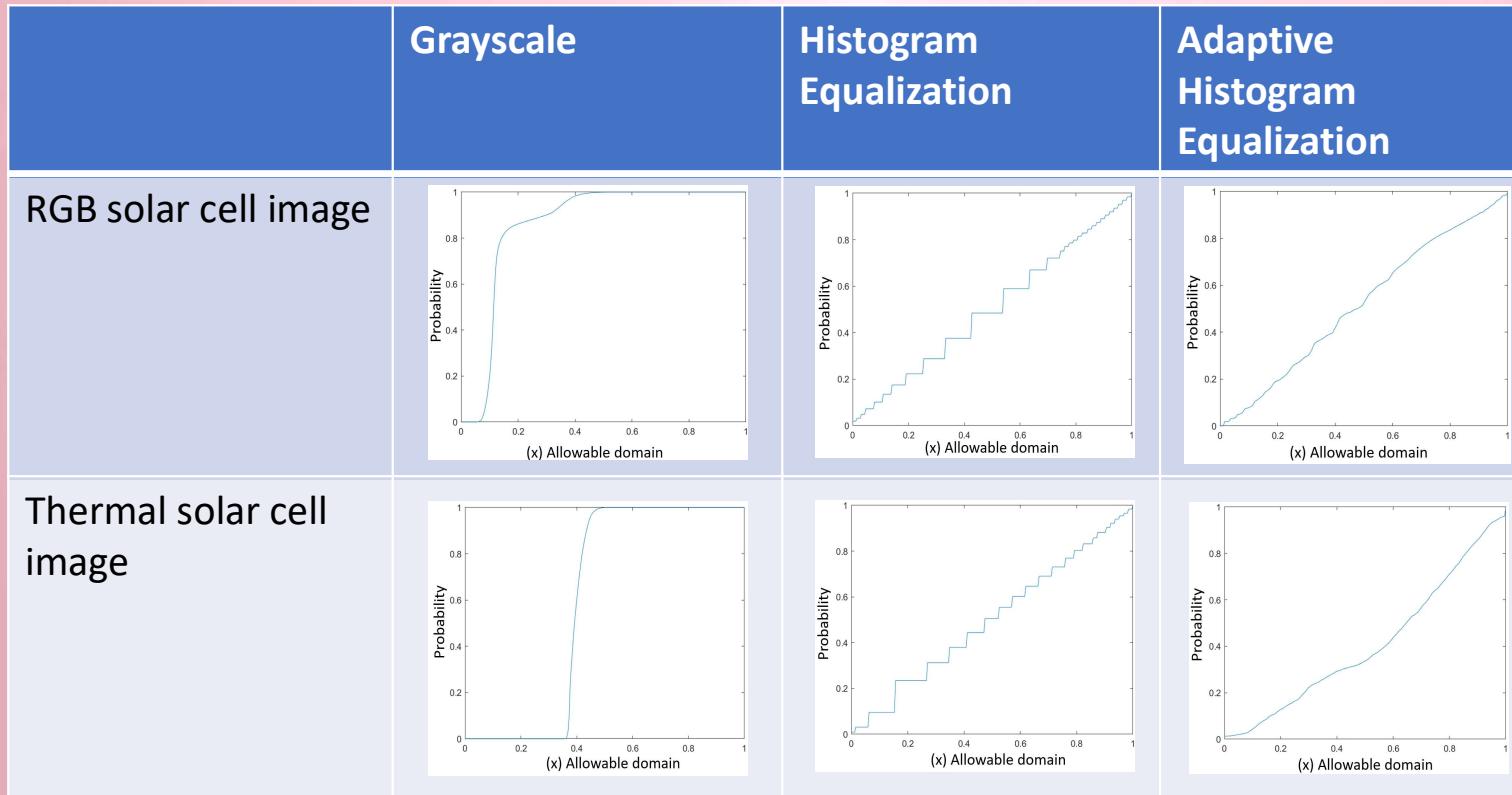
Results and Discussion



Histogram representation of the processed RGB and thermal images.

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Results and Discussion



CDF representation of the processed RGB and thermal images.

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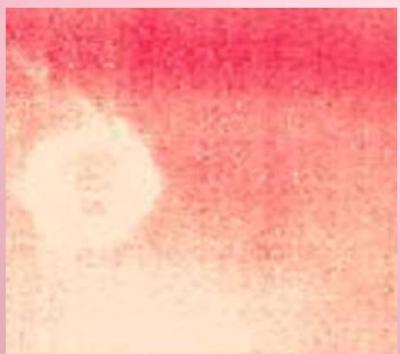
Results and Discussion



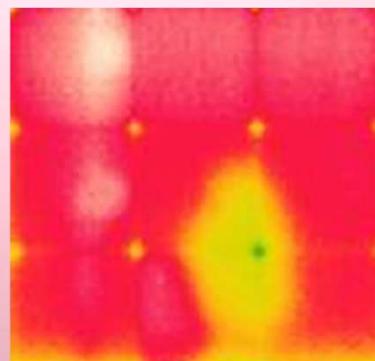
a) Solar panel in RGB mode



b) Non-defective solar panel



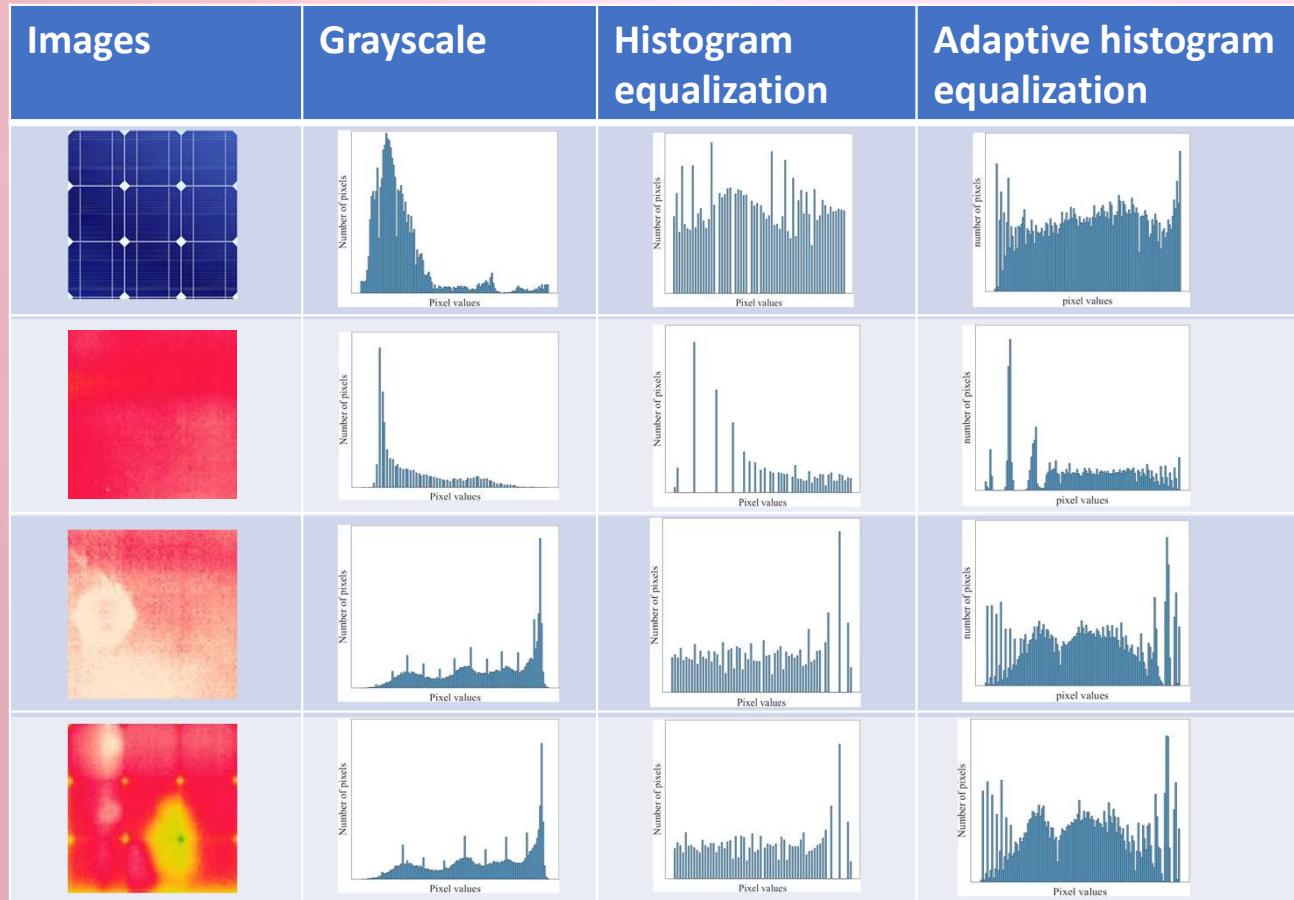
c) Solar panel with hot spot



d) Solar panel with series crack (internal)

Portion of four different solar panel images under different conditions

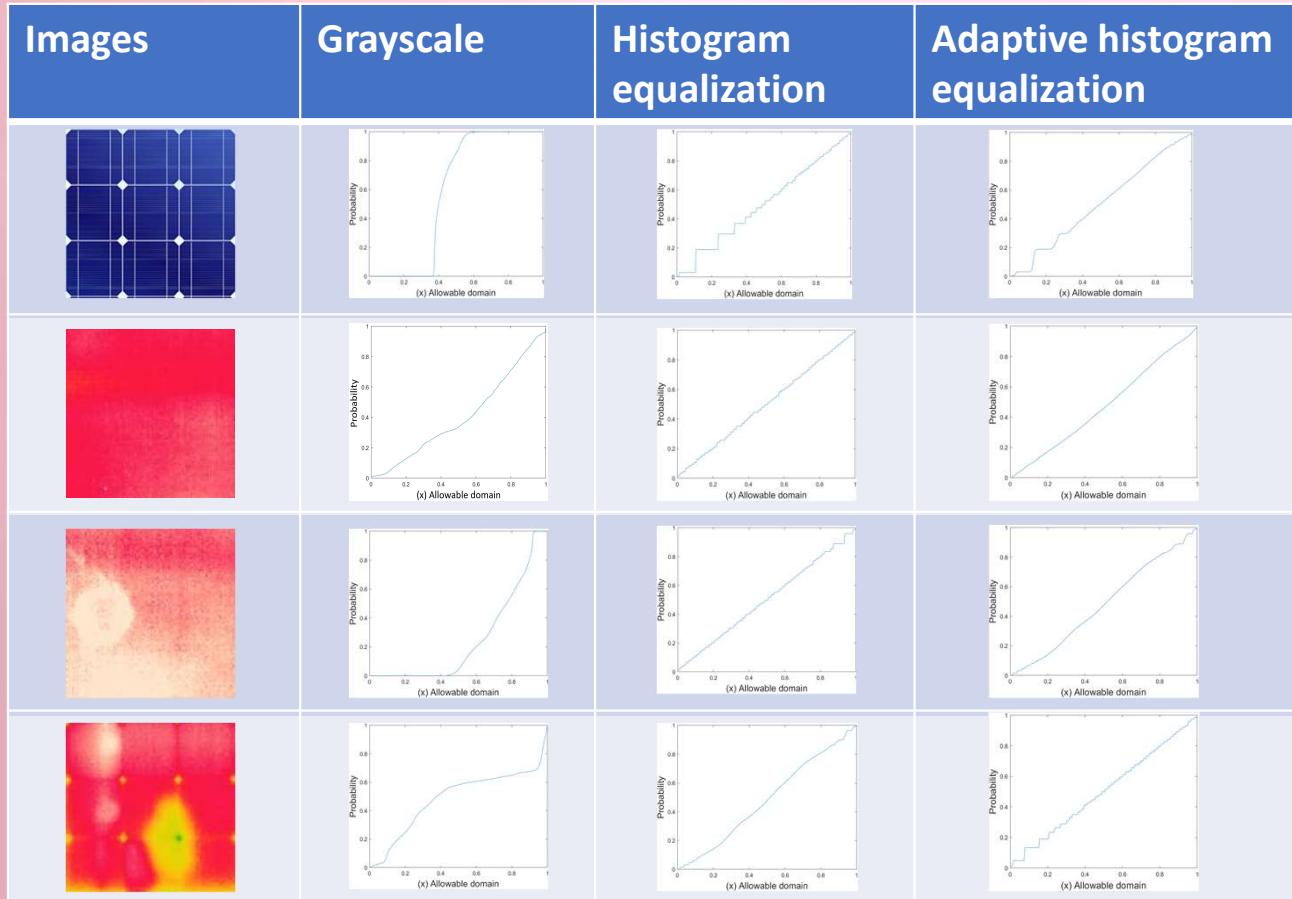
Results and Discussion



The histogram comparison on the four images under three conditions.

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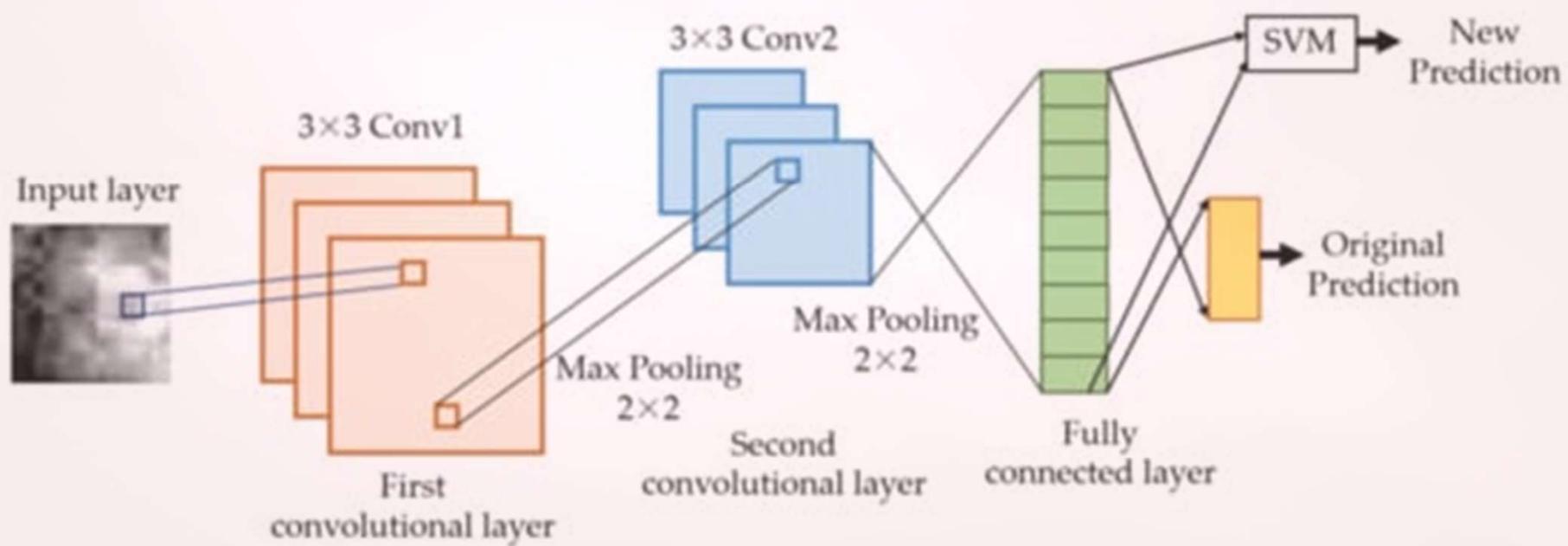
Results and Discussion



The *CDF* comparison on the four images under three conditions.

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Image Classifier



Conclusion

- This paper presents an algorithm for thermal imaging technology that extracts the features of thermal images—in particular, for solar panel applications—with the aim of simplifying the representation into an easier domain for analysis.
- Aside from the image histograms, the *CDF* provides significant insight as one of the parameters when dealing with image processing.
- The experimental results revealed that the extracted results of thermal images provided better histogram and *CDF* features, even if the RGB images were processed to grayscale, and had histogram equalization, and AHE techniques applied.

Current studies



Example - AR



Ronnie O. Serfa Juan

Medical Applications

- VR can be used for the treatment of patients with mental disorders of phobia.
- The users are allowed to confront their fears in a controlled environment which is otherwise impractical to achieve in a real scenario.
- It is also used as a meditation technique for overcoming stress and anxiety.
- Intuitive, alternative therapies based on VR are nowadays used for mental and physical rehabilitation.



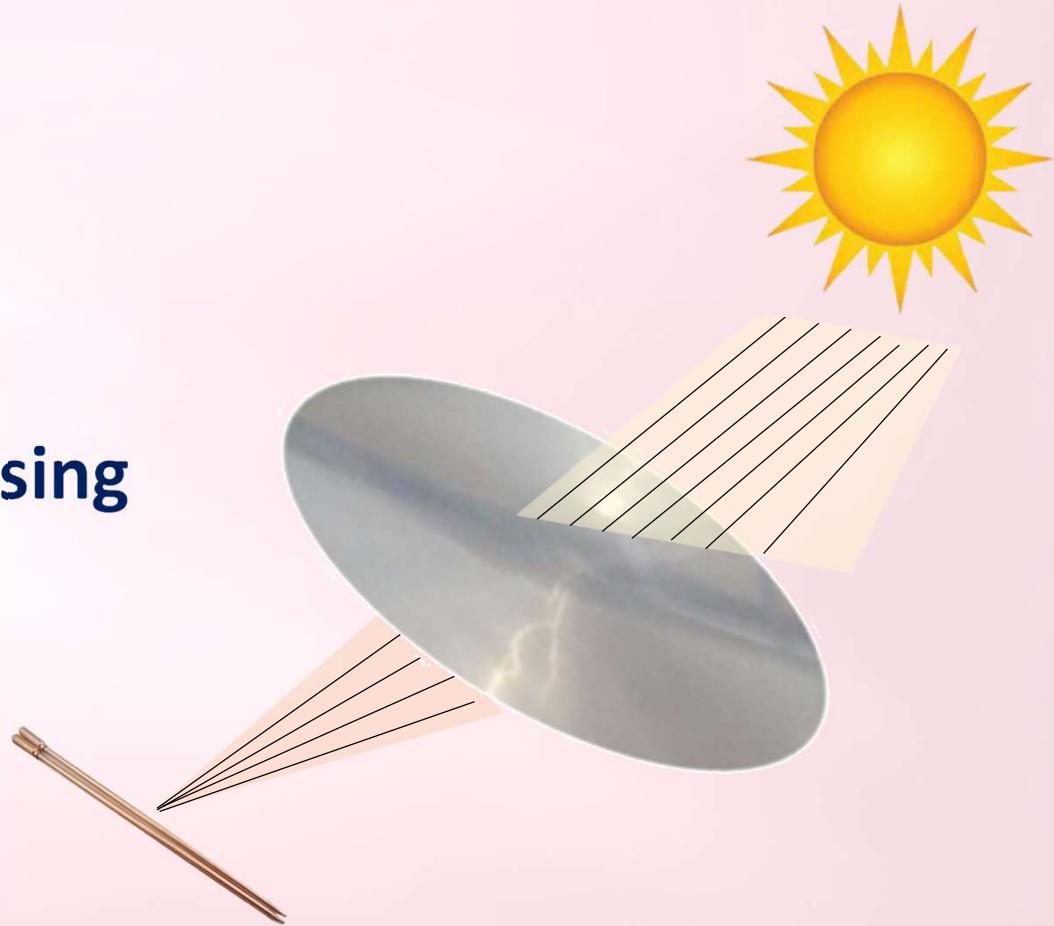
Ronnie O. Serfa Juan

Example – Cognitive Therapy

- Behavior disorders
 - e.g eating, gambling
- Phobias
 - e.g. social phobia, agoraphobia

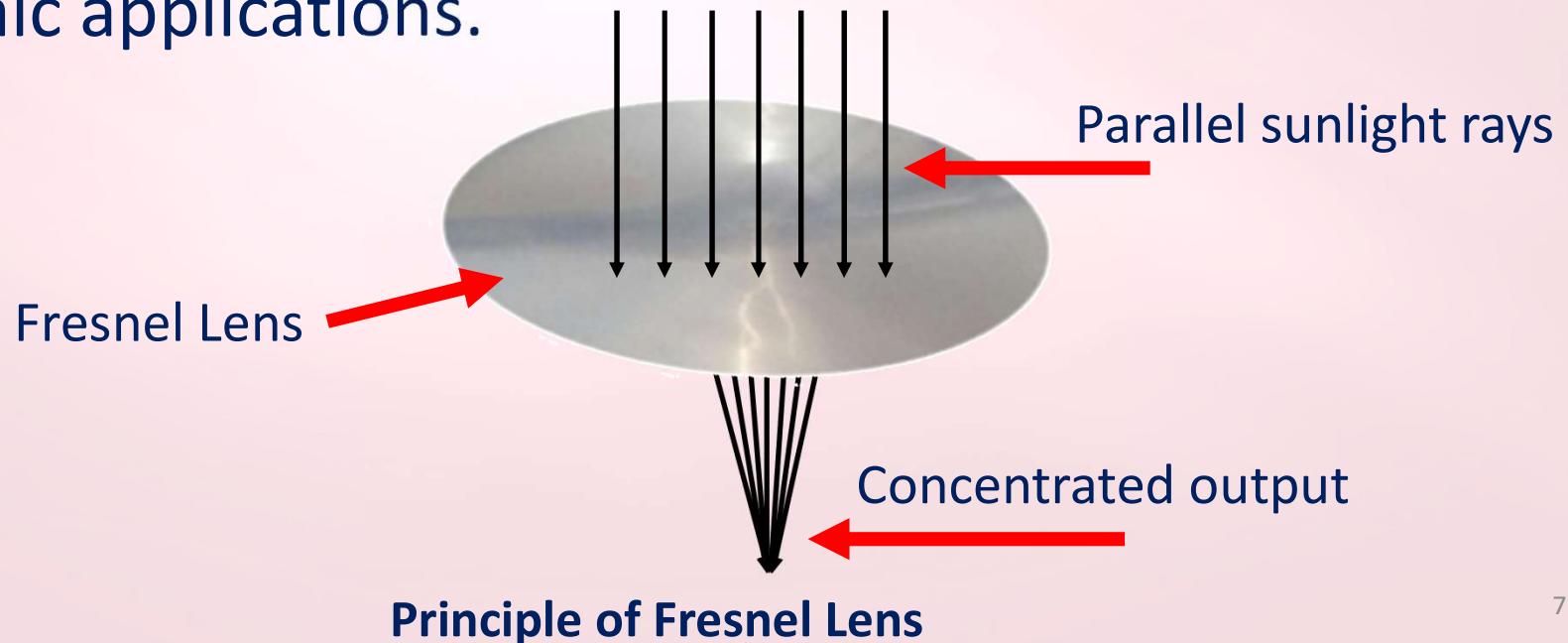


Solar Light Energy Concentrator using Fresnel Lens



Project Brief

The Fresnel lens function as a solar light energy concentrator that converts the sunlight into a concentrated heat which may be used to power either thermal or photovoltaic applications.



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There are
opportunities
even in the
most difficult
moments.

-Wangari Maathai

Thank you very much!

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