Ser.mac® GREENTECHNOLOGY BIOMETiC

ENTER THE SMART FARMING ERA

FIFTH INTERNATIONAL FESTIVAL OF JORDANIAN DATES
IN AMMAN 13-15 NOVEMBER 2023

Innovative Date Processing & Sorting Solutions

My name is Leo Dalle Vacche, Engineer.

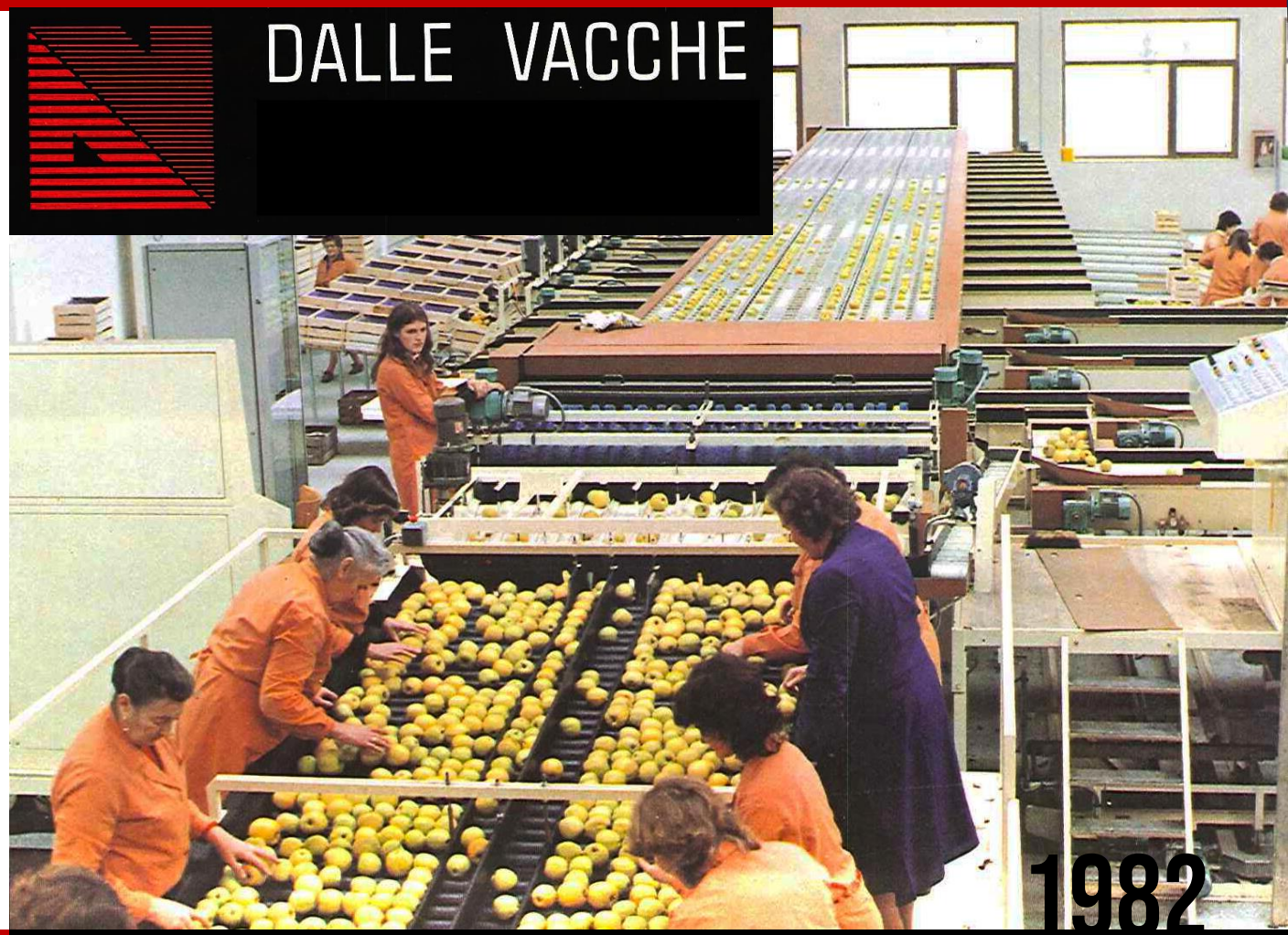
My grandfather, then my father and me, we dedicated our lives to mechanization of fruit sorting sector, for almost 90 years.

Way back in 1981 two friends Leo Dalle Vacche and Federico Giudiceandrea (MICROTEC- BIOMETIC) created the first Italan opto-electronic sorter for fruit.

Since then our **GREEN-SERMAC-BIOMETIC** companies have continued in the evolution, research and development of mechanical innovations and "scanning solutions" for the fruit sector.

About dates: in the year 2008 I had the chance to meet a very extraordinary person who introduced me the palm dates “world” and its peculiarity.

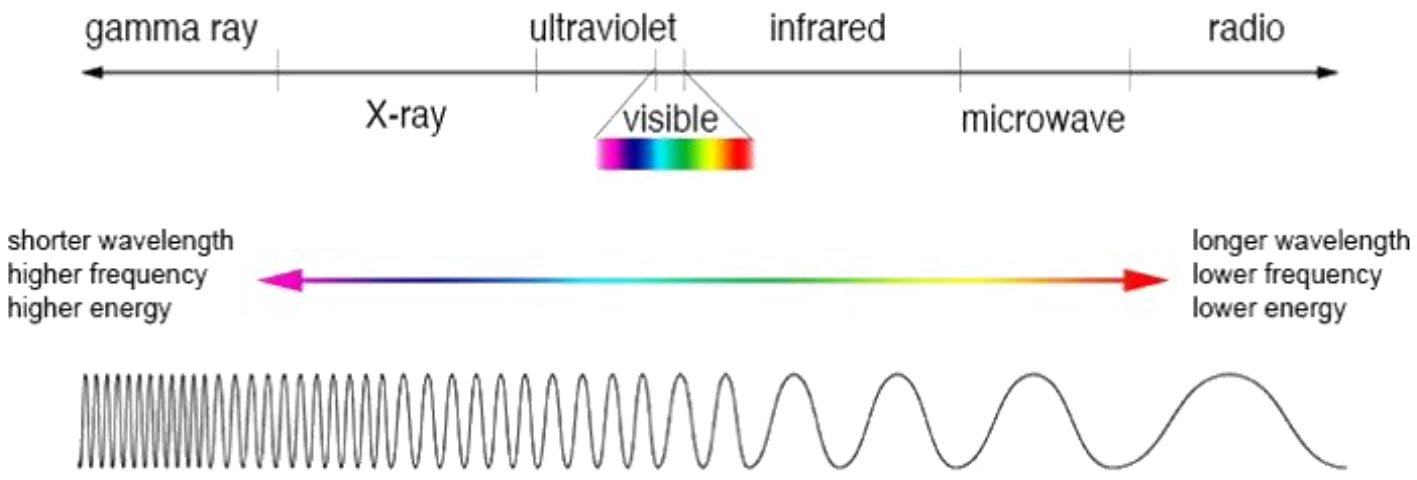
This unforgettable person was Doctor Abdullah Arar who managed, with patience, to make me understand what the needs of the sector were and what the possible developments were.



. CALIBRATRICE ELETTRONICA A PESO

. CERNITRICE ELETTRONICA DI COLORE

MULTI-SENSOR SCANNING



- ✓ External quality
- ✓ Internal quality

Mainly we acquire in the visible and infrared band, for some fruits and defects also in the ultraviolet (but this is not the case for dates)

Colour is detected in the visible band.

The **hyperspectral camera** acquires not only the visible band but also the near-infrared band – SWIR.

Hyperspectral camera imaging can provide detailed information about an object based on its infrared spectrum.

The sensor are sensitive to wavelength from 0,9 to 1,7 nm. . detecting both **NIR and SWIR**

HIGH-SPEED INTELLIGENT CAMERA

CROMETIC CAMERA

In-house developed camera with high-performance digital sensors that deliver full HD images at very high speed (600fps)

MAIN ADVANTAGES OF IN-HOUSE DEVELOPED CAMERA

- Pre-process images directly on the camera via proprietary firmware to add accuracy levels to the **AI system**
- **Guaranteed** to keep spare parts for longer than a commercial product.
- **Possibility of refurbishing the product over time.**

Q EYE SMART

By integrating it directly into the production lines, **Q Eye Smart** analyzes your fruit with extremely high precision.

The inspection is carried out with the help of multi-sensor in-line scanning.

This non-destructive technology acquires and recreates in detail the shape and characteristics of your fruit.

The scanner can be installed on existing (retrofit) or new sorting lanes.

Image elaboration algorithms and the Artificial Intelligence platform (BIOMETiC Ai) enable a 360° fruit surface analysis.

DETERMINATION OF THE INTERNAL AND EXTERNAL QUALITY OF DATES

Listed below, are just some of the **specific characteristics of dates** that **Q Eye Smart** can detect:

Characteristics and detectable defects:

- Color
- Loose skin
- Bird picks
- Yellow ring
- Internal defects
- Moisture

Shape and dimensions:

- Length
- Width
- Diameter
- Volume
- Weight

LOOSE SKIN

MOISTURE
BLACK MOLD

COMPUTER VISION

Computer vision is a field of **artificial intelligence (AI)** that allows computers to derive meaningful information from digital images, videos and other visual input - and take actions or formulate warnings based on that information.

If AI enables computers to think, computer vision enables them to see, observe and understand.

Computer vision works much the same as human vision, except that humans have an advantage. Human vision has the advantage of years and years of experience in which it has been trained to distinguish objects, how far away they are, if they are moving and if there is something wrong with an image.

Computer vision allows machines to perform these functions, in much less time with cameras, data and algorithms other than with retinas, optic nerves and a visual cortex.

A system based on computer vision can analyse thousands of products or processes per minute, noticing imperceptible defects or problems quickly exceeding the capabilities of the human eye.

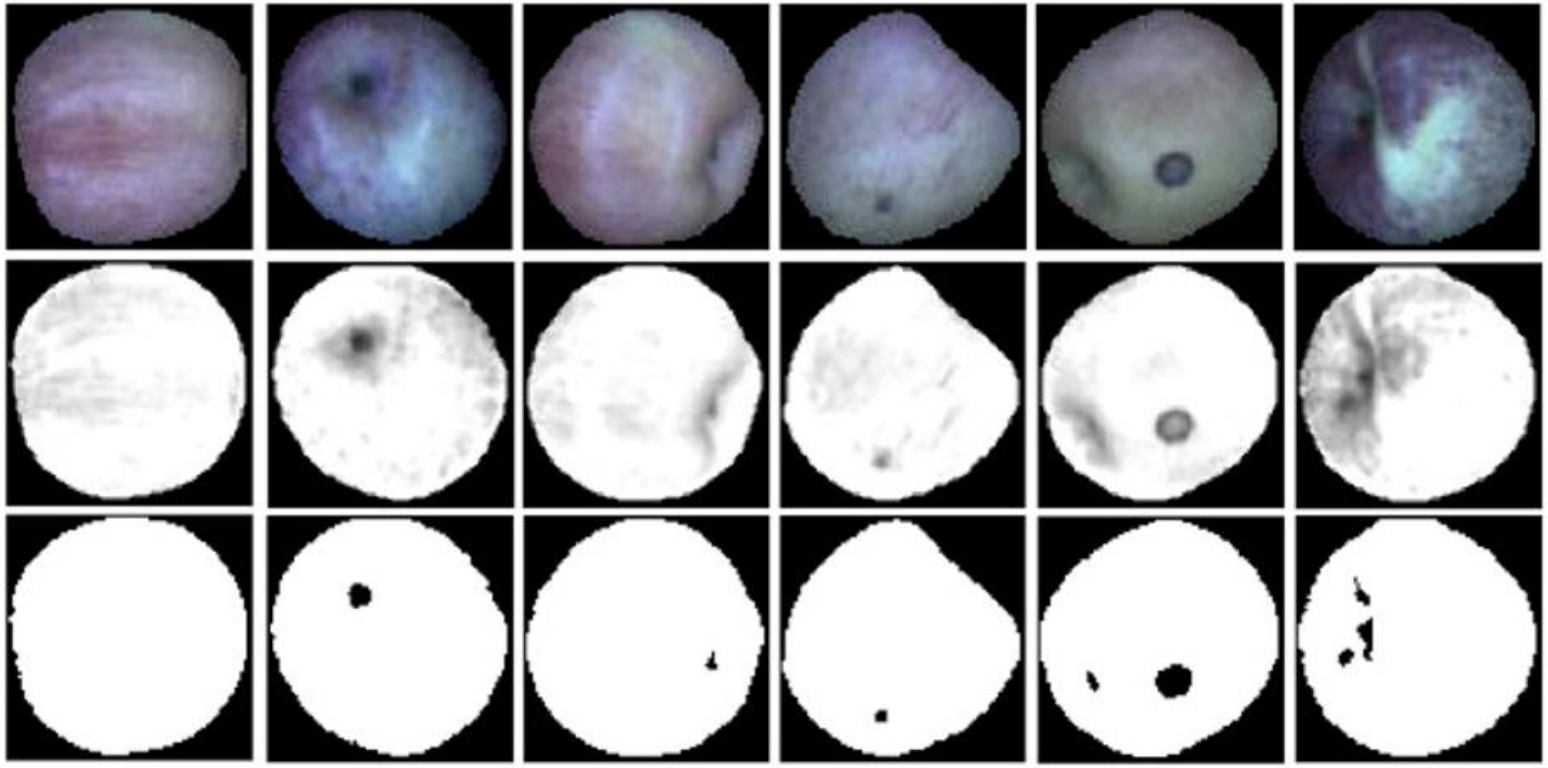
But this is limited to the objects and processes for which it has **been trained** and without any awareness

WHAT IS COMPUTER VISION?

RGB

Corrected R components

Defect candidates



A B C D E F

COMPUTER VISION, DEEP LEARNING

Computer vision needs a lot of data. It analyses data over and over again until it distinguishes and recognises images. For example, to train a computer to recognise dates and defects, it needs to be fed with a large amount of dates images and related defects in order to learn the differences and recognise a date, and related defects.

To achieve this, essentially two technologies are used: a type of machine learning called **deep learning** and a **convolutional neural network (CNN).**

DEEP LEARNING uses algorithm models that allow a computer to learn the context of visual data by itself.

If enough data is fed into this model, the computer will 'look' at the data and learn by itself to distinguish one image from another. Algorithms allow the machine to learn on its own, without someone programming it to recognise an image.

1/ COMPUTER VISION, CNN

A CNN is a more advanced system that wants to mimic the first layers of neuronal layers of the optic nerve and the human cerebral cortex. A CNN helps a machine learning or deep learning model to 'look' by breaking down images into areas of pixels (labels).

In each area, the neural network identifies any 'simple patterns' present in the analysed area (such as edges, dots, straight or curved lines, spots, etc.) just as it does at the earliest levels of human visual cortex.

A CNN uses these labels to perform convolutions - a mathematical operation that is performed on extremely fast electronic cards called GPUs (Graphical Process Units) and develops predictions based on what it 'sees'.

Successive reiterations of convolutions increase the level of structure (the area of the image) and with each interaction, the CNN checks the accuracy of its predictions until the predictions begin to come true.

2/ COMPUTER VISION, HOW DOES IT WORK?

Like a human being, a CNN first distinguishes sharp contours and simple shapes, then adds information as it performs iterations of its predictions.

Technological progress in electronics applied to the world of computers now makes it possible to use high-performance PCs and GPUs of a capacity that was unthinkable even a decade ago, where computer vision was only available against huge investments and for highly specialised laboratories.

The advantage of this approach is the possibility of training on problems that are 'easily intuited' and that the human eye, even the untrained one, can recognise in fractions of a second without awareness.

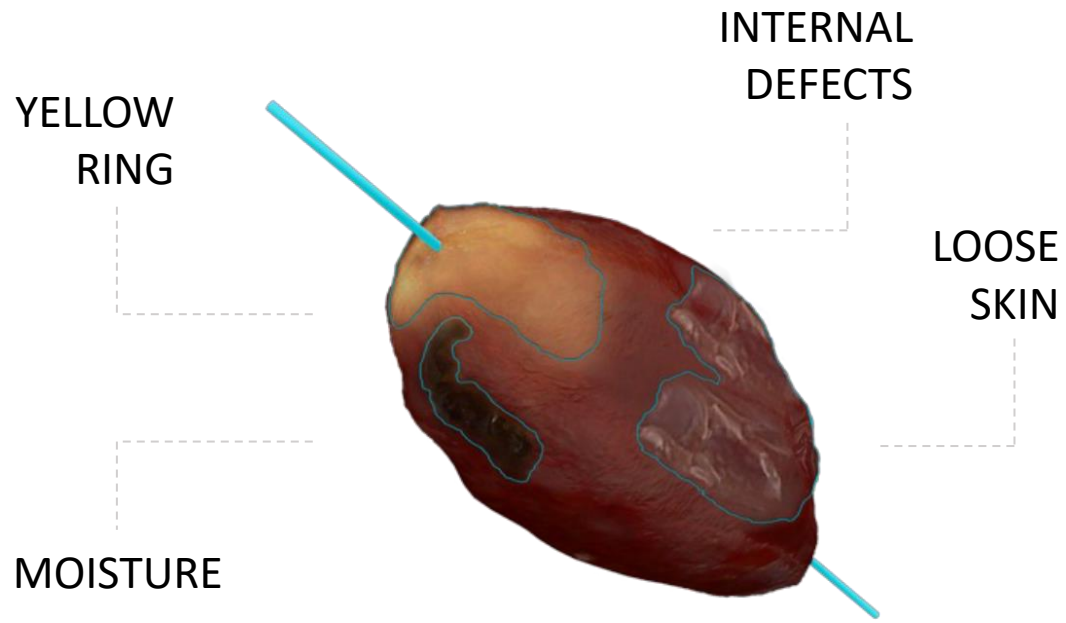
PRACTICAL I APPLICATION I ON I DATES

Our experience with **Neural Networks** dates back to 1999, when, in cooperation with the National Institute of Bioelectronics, we classified dates based on their quality.

Today, **this technology is applied to Q Eye Smart,** the scanner for external quality.

Having this advanced sorting technology allows your products to be **completely homogenous in quality and size,** giving the customer exactly what they want.

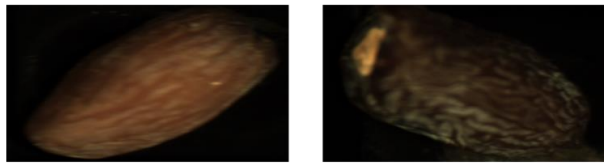
Moreover, having a homogenous product prolongs the shelf life of the dates as **it prevents moisture level mixing.**



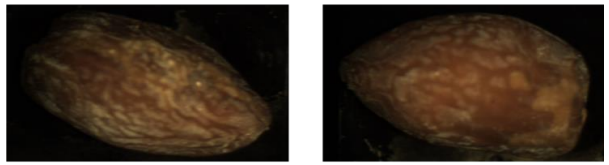
Q Eye Smart Labeling/Lose skin and other defects

Detection through single or multiple views **and classification** up to 5 quality classes (A-E).

A



B



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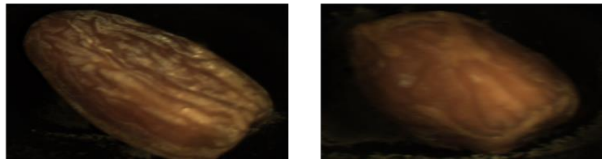
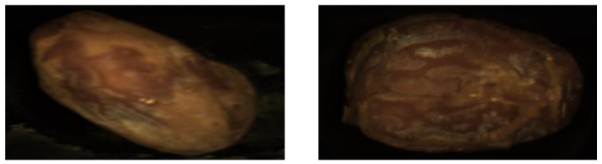
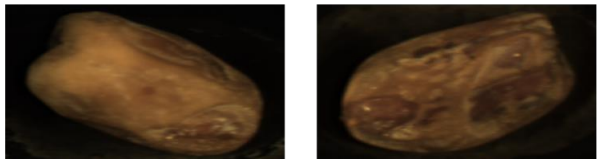


D



E



The **Q Eye Smart Labeling** is a software extension for automatic image storage of the scanner.

After installing the scanner, it will be possible to activate images to be saved during production for improvement of the CNN for defect classification.

The process requires that the customer scans and labels at least 1.000 images of the target defect/classes with the installed scanner.

Then via an offline procedure the deep learning infrastructure is trained to distinguish the specific defect.

The result is a dedicated and personalized AI model that will be installed on the scanner.

HINTS AT INTERNAL QUALITY

Thanks to innovative technologies and sensors, it has also been possible to analyse the inside of the fruit. Wanting to measure characteristics and properties that are precisely 'internal' and therefore by definition not visible to the human eye, we had to change our approach. As is well known, the human eye is able to visualise a very narrow band, the visible band, of the light spectrum; by using sensors capable of acquiring a wider spectrum than the visible one, one is able to acquire additional information. A known example of a camera capable of acquiring a spectrum wider than the visible is the thermal imaging camera. Generally, this type of sensor acquires infrared frequencies that are invisible to the naked eye.

Using sensors capable of acquiring signals outside the visible, we are able to determine the moisture content of dates by dividing the fruit into up to five moisture categories and to determine whether a fruit is affected by aspergillus.

Visualizing water

Smartphone camera image

Detecting moisture in the dents on the apple skin

Under visible light

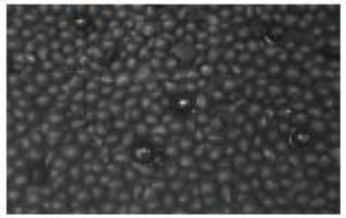
Under SWIR (1,450 nm)

Water becomes black in an image taken with a camera set at the wavelength of 1,450 nm because water absorbs the light at this wavelength. This attribute can be leveraged for detecting moisture in objects.

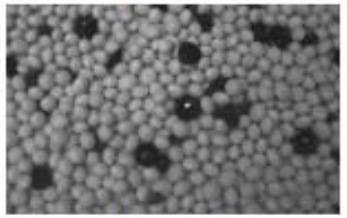
Sorting materials

Smartphone camera image

Detecting plastic and metal pieces in a pile of black beans



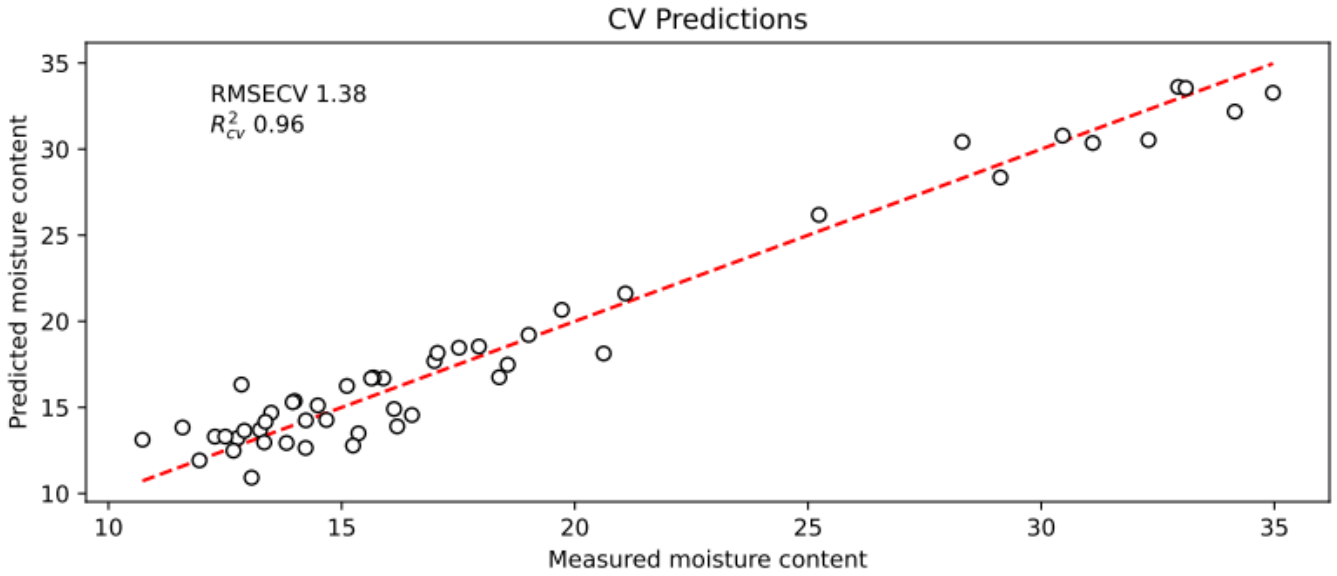
Under visible light

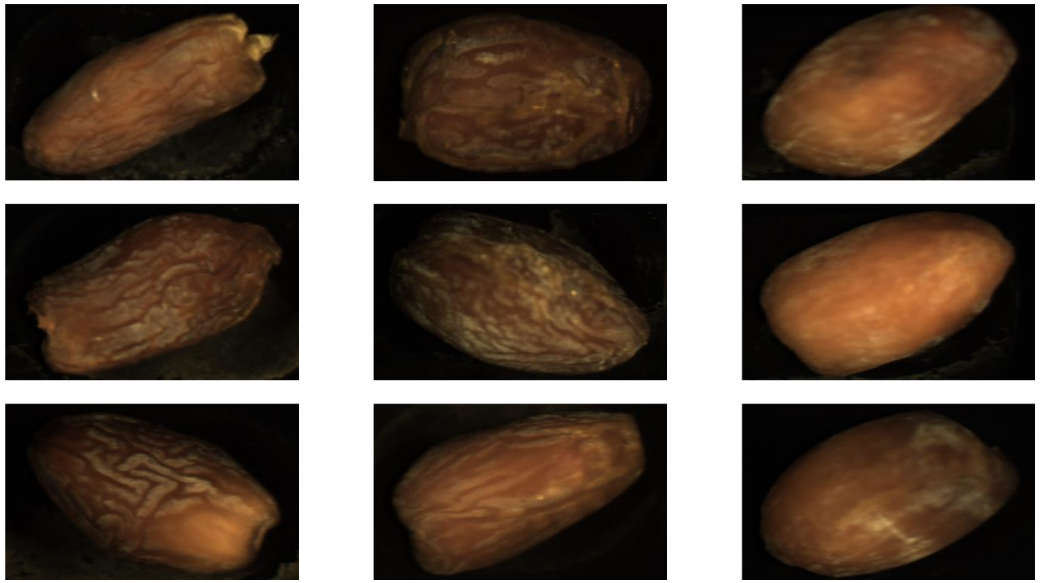


Under SWIR (1,300 nm)

Infrared reflectance and absorptance vary at different wavelengths from one material to another. Utilizing this attribute, a specific material can be singled out among other materials, such as plastics, that may look very similar to one another under visible light.

NEW TESTS IN JORDAN WITH OUR NEW HYPERSPECTRAL CAMERA 2023





Dry Ripe Wet

Detection through single or multiple views and classification into 3 status classes based on the appearance of the date

GREENTECHNOLOGY

ENGINEERING FOOD PROCESSING