MULTISPECTRAL IMAGING AGRICULTURE

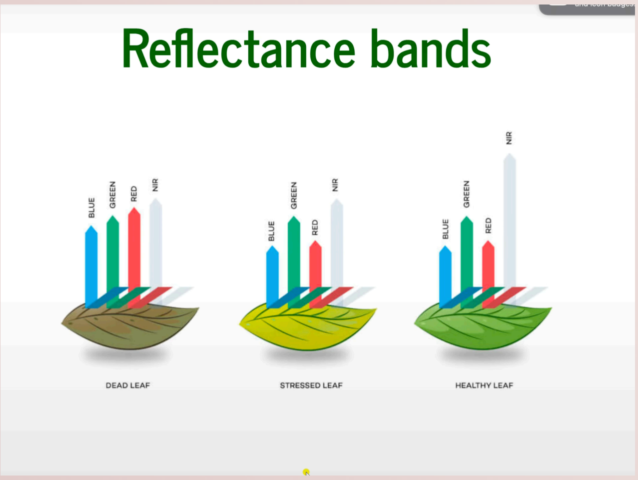
Abstract

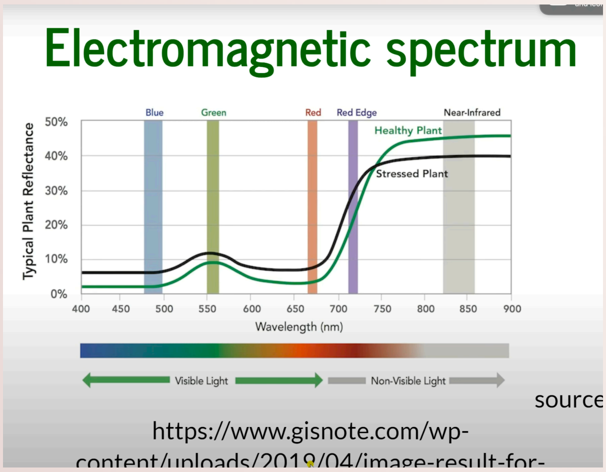
The project aims to analyse the multispectral images captured by the drone to know about vegetations, growth, disease etc, in two different months.

Problem Statement

Our main goal is to optimise the crop yield with minimising resource and environmental impact. Traditional methods of monitoring crop health are time consuming and inaccurate, not practical for large farms. To address these issues, we aim to implement smart farming techniques utilising multispectral imaging for cotton crops. Specifically, our motive is to develop an analysis system capable of assessing vegetation cover, crop growth, disease prevalence, and weed infestation. Furthermore, we seek to compare and analyse data captured at different stages of the cotton growth cycle to better understand the growth and effectiveness of the management practices.

Introduction





hop Drones Training Survey Rental Repairs

electromagnetic spectrum.

Some of the most commonly-used bands for multispectral imaging in agriculture, forestry, and land management include:

Spectral Band	Wave Length	Application
Red	600-700nm	Used to detect vegetative growth and vigor, crop type, humidity, and generates leaf area index.
Near-infrared	700-900nm	Used to measure plant health and productivity.
Red-edge	700-780nm	Used to detect crop stress, can indicate changes in chlorophyll content.
Green	500-600nm	Used to measure canopy cover and detect weed growth.
Blue	450-500nm	Used to detect water stress, disease, and large differences in plant health.

Multispectral cameras are able to present us with a separate photograph of each band.

The Mavic 3 Multispectral drone, for instance, is able to capture the Red, Near-infrared, Red Edge and Green bands. It can separate image for each of these bands and this data can be processed to build a separate orthomosiac for each

ting available

By analysing the images captured by drones, our objective is to provide farmers and agronomists with actionable insights into various aspects of cotton crop cultivation. These insights include assessing vegetation cover to gauge crop density and health, monitoring crop growth dynamics to optimise cultivation practices, detecting signs of diseases or pests for timely intervention, and identifying weed infestations to facilitate targeted weed management strategies

Dataset:

- Multi-Spectral Images captured from Drone at the altitude of 30 meters.
- Bands of each image are stored as individual files, totalling four bands: Green,
- Red,NIR and Red-Edge.
    - GRE- Green - 560nm - 600-700nm
    - RED - Red - 668nm - 500-600nm
    - REG- Red Edge - 717nm - 700-780nm
    - NIR - Near Infrared - 842nm - 700-900nm

Multispectral Cameras	Four multispectral cameras, 1/2.8 CMOS, 5MP • Near-infrared (NIR): 860 nm ± 26 nm; • Red (R): 650 nm ± 16 nm; • Red Edge (RE): 730 nm ± 16 nm; • Green (G): 560 nm ± 16 nm

Dataset sample images:

Metrics Computed

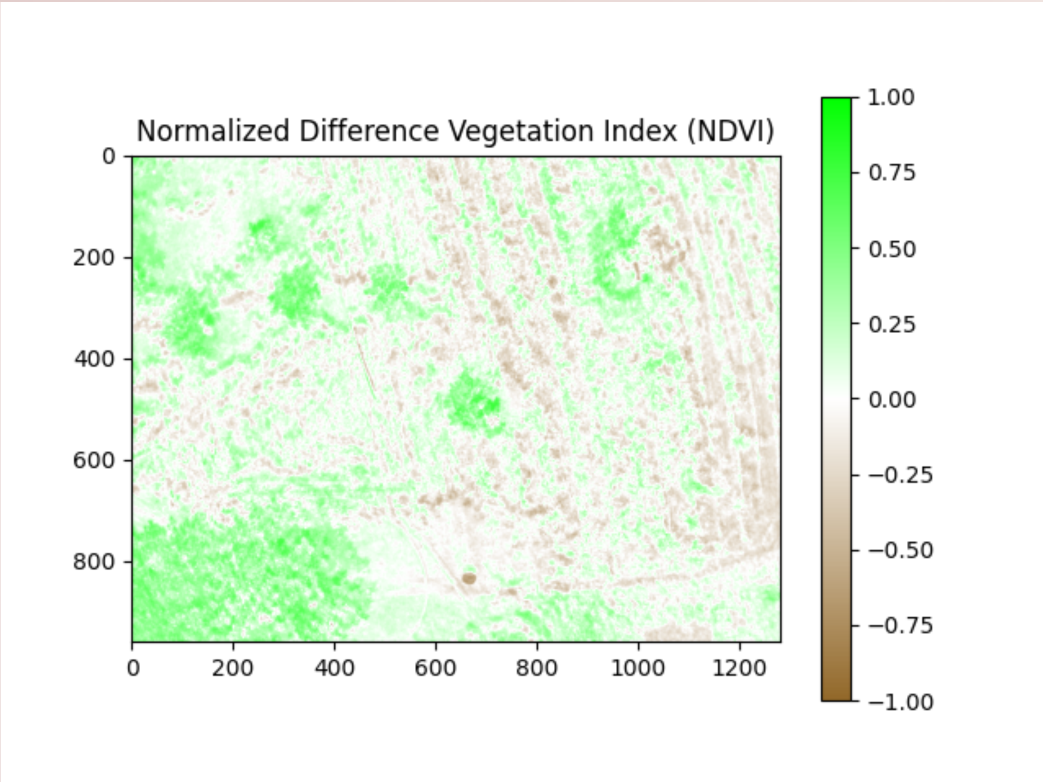
1. NDVI Map
2. NDRE

<u>NDVI (Normalised Difference Vegetation Index) :</u>

NDVI compares the reflectance of the Red band with that of the near-infrared band with values between 0 (no biomass = sick plant) and 1 (healthy plant). Simplifying, when looking at a NDVI map, the greener the map produced the more healthy and productive the vegetation is.

The formula for NDVI is

:$NDVI = (NIR - Red) \div (NIR + Red)$



[Reference]

NDRE(Normalised Difference Red Edge Index):

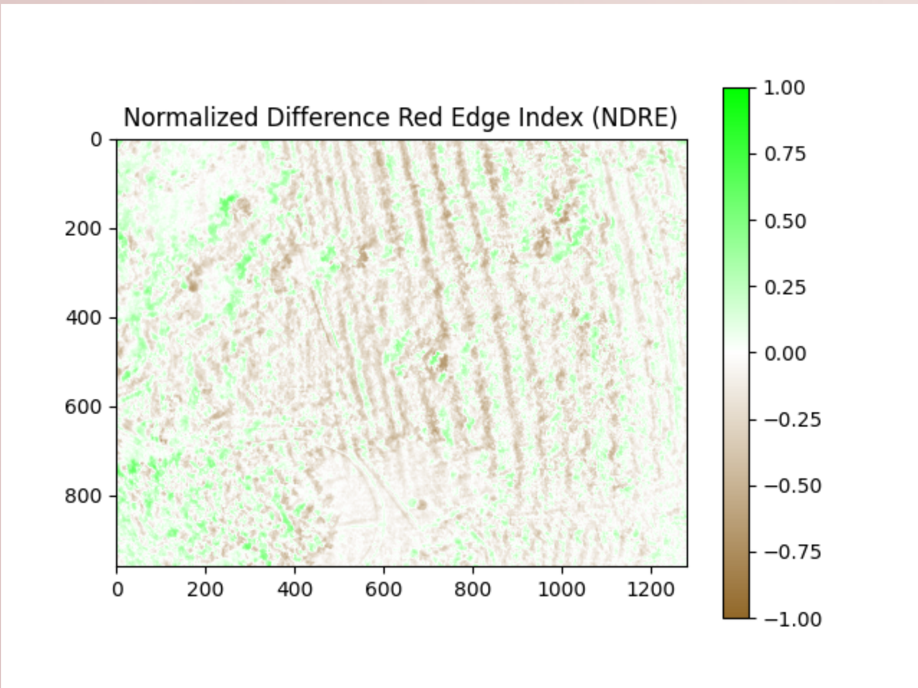
NDRE is a vegetation index used in remote sensing for measuring the chlorophyll content in plants. It is represented by a certain value calculated using a combination of a Near-InfraRed (NIR) band and the RedEdge range between visible Red and NIR. The NDRE formula is

$$NDRE = (NIR - RedEdge) \div (NIR + RedEdge)$$

Such a band combination makes NDRE extremely sensitive to those wavelengths of light that are reflected by the chlorophyll contained within the plants.
The normalised difference red edge index can, therefore, be applied to confirm whether a growing plant is healthy or not. Low amounts of chlorophyll may indicate the problem crops:

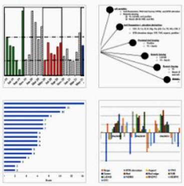
- sick plants,
- plants infested with pests,
- plants with nutrient deficiencies,
- damaged plants.

Reference



Additional Metrics

n
ı
ıd methods
of Competing Interest
ıments
upplementary materials
bility
ıtline
)



Vegetation Index	Abbreviation	Spectral Bands	Equation using Sentinel-2 bands	Source
Simple Ratio	SR	NIR and Red	$\frac{B8}{B4}$	[19]
Normalized Difference Vegetation Index	NDVI	NIR and Red	$\frac{(B8 - B4)}{(B8 + B4)}$	[20]
Normalized Difference Red Edge Index	NDRE	NIR and Rededge	$\frac{(B8 - B6)}{(B8 + B6)}$	[21]
Nonlinear Vegetation Index	NLI	NIR and Red	$\frac{(B8^2 - B4)}{(B8^2 + B4)}$	[22]
Normalized Difference 860/1240 Normalized Difference Water Index	NDWI	Green and NIR	$\frac{(B3 - B8)}{(B3 + B8)}$	[23]
Difference Vegetation Index	DVI	Red and NIR	B8 – B4	[24]
Blue-Normalized Difference Vegetation Index	BNDVI	NIR and Blue	$\frac{(B8 - B2)}{(B8 + B2)}$	[25]
Inverse of the Simple Ratio	ISR	Red and NIR	$\frac{B4}{B8}$	[26]
Green Normalized Difference Vegetation Index	GNDVI	NIR and Green	$\frac{(B8 - B3)}{(B8 + B3)}$	[21]
Red Green Blue Vegetation Index	RGBVI	Green, Blue, and Red	$\frac{B3^2 - (B2 \times B4)}{B3^2 + (B2 \times B4)}$	[27]
Soil Adjusted Vegetation Index	SAVI	NIR and Red	$\frac{(B8 - B4)}{(B8 + B4 + 1)} \times (1+1)$	[28]
Chlorophyll Index-RedEdge	CIRE	NIR and Rededge	$\frac{B8}{B6} - 1$	[29]
Infrared Percentage Vegetation Index	IPVI	NIR and Red	$\frac{B8}{(B8 + B4)}$	[30]
Ehanced Vegetation Index	EVI	NIR, Red, and Blue	$2.5 \times \frac{(B8 - B4)}{(B8 + 6 \times B4 - 7.5 \times B2) + 1}$	[31]
Ehanced Vegetation Index 2	EVI2	NIR and Red	$2.5 \times \frac{(B8 - B4)}{B8 + (2.4 \times B4) + 1}$	[32]

B2: Blue, B3: Green, B4: Red, B6: Rededge, and B8: NIR.

References

1. https://www.globhe.com/resources-collection/multispectral-data-specifications
2. https://www.heliguy.com/blogs/posts/multispectral-drones-benefits-and-applications#:~:text=Multispectral%20imaging%20captures%20and%20records,as%20infrared%20and%20ultra%2Dviolet.
3. https://www.researchgate.net/publication/327249888_Detection_of_Stress_in_Cotton_Gossypium_hirsutum_L_Caused_by_Aphids_Using_Leaf_Level_Hyperspectral_Measurements?_tp=eyJjb250ZXh0Ijp7ImZpcnN0UGFnZSI6Il9kaXJlY3QiLCJwYWdlIjoiX2RpcmVjdCJ9fQ#pf6
4. https://dl.acm.org/doi/10.1016/j.compag.2005.03.003
5. https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0205083
6. https://www.sciencedirect.com/science/article/abs/pii/S0168169923005410