AUTOMATED CROP NITROGEN ANALYSIS USING IMAGE PROCESSING AND IOT

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Introduction

The process of Nitrogen analysis [4] is used to determine the Nitrogen content in organic substances, including plants. **Nitrogen (N) is one of the ample mineral which plays an important role in yield of crops, major element for plant growth, and essential part of chlorophyll (Ch)**. More importantly, Nitrogen analysis also help us to find the amount of fertilizer need to grow the plants healthy.

Motivation

Traditional Nitrogen analysis methods [3] such as **Kjeldahl method, SPAD meter & LCC** use manual approaches, which are very slow, and not suitable for large scale crop lands. Comparison result of traditional methods indicated that LCC was faster than others.

Manual Process with LCC

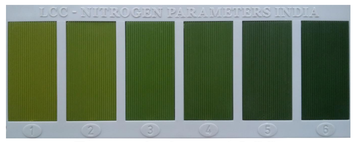


Figure 1: 6-panel LCC.

- The Leaf Color Chart (LCC) [2] is usually a plastic, ruler-shaped strip containing six panels that range in color from yellowish green to dark green based on chlorophyll values.
- An expert in agriculture needs to analyze at least 20 leaves selected randomly from one acre to find the nitrogen content of the analyzed area.
- Human view is different from each other and this is a time consuming method.

“ Therefore, Can modern technologies, specially IoT Devices with image processing techniques, help to analyze Nitrogen in crop, specially in large paddy fields, precisely within few seconds ? ”

Dataset

Nitrogen Category	1	2	3	4	5	6
$(R+G^2+B)/4$ Value	252	234	187	226	198	154

Table 1: Dataset

A data set representing the LCC [2] has been created **capturing images of each category** and then analyzed using Image Mechanic tool [1] to get appropriate values for each Nitrogen categories according to the **Formula 1** based on Red, Green and Blue. The **Formula 1** is an empirical one, which is used to find the unique values for each nitrogen category. **Formula1 => $(R+G^2+B)/4$**

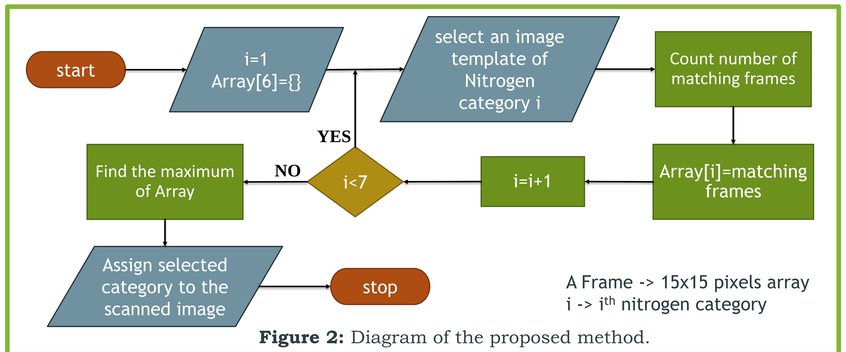


Figure 2: Diagram of the proposed method.

Experimental Setup

Devices used for Prototyping

- Raspberry pi 3B with camera, Ardupilot Mega V.2.6
- 6 × Ultrasonic range sensors, GPIO Cables
- 3DR U-BLOX NEO-6M GPS Module
- 4 × 30A ESC, 4 × 820kv brushless Motors
- A Smart phone (with android os)

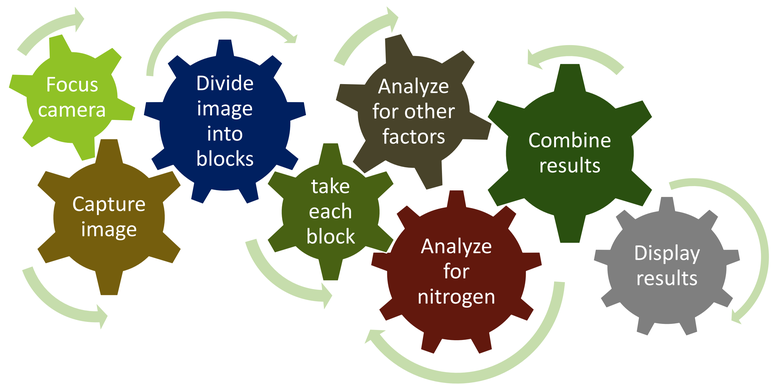


Figure 3: Diagram of working system.

Experiments

My experiments were mainly focused on RGB histograms of each nitrogen category to obtain a RGB value that uniquely identify each nitrogen category. Figures given below show the RGB histograms plotted using Image mechanic tool [1].

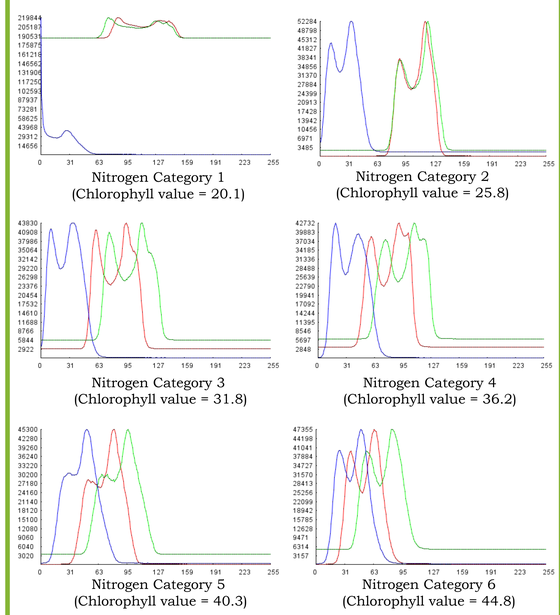
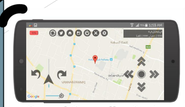


Figure 4: RGB histograms of Nitrogen categories

Solution

1. Receive control data from mobile app.
2. Capture image.
3. Get location information to calculate the flying area
4. Get battery status to analyze the remaining flying time
5. Package all data.
6. Add packet identity
7. Transmit packet to the mobile app.

1. Receive transmitted data from drone.
2. Analyze the received data.
3. Generate the control data based on location.
4. Package all data and add packet identity.
5. Transmit packet back to the drone.



Ground Controller Station (Android)

Results

Nitrogen Category	Detection Level (%)
1	80
2	75
3	70
4	85
5	70
6	85

Table 2: Results

The system is yet to be tested thoroughly in paddy fields. However, the initial testing which was done in a field showed the following results in **Table 2**. The results were obtained under recommended weather condition. [2] [3].

Conclusion

- ✓ Proposed system is an **automated technique** to estimate nitrogen content in paddy leaves, this also can be used for maize leaves.
- ✓ Proposed system also **gives the amount of fertilizer** in kilograms needed to apply to the area analyzed.

Reference

[1]. Mohammad Naseer, Aslal Sujath, Sankalpani sewwandika, & Muhammadh Jafran. (2016, February 26). *Image Mechanic* . Retrieved from uojimechanic: https://uojimechanic.blogspot.com/

[2]. *About Leaf Color Chart (LCC)*. (n.d.). Retrieved from nitrogen_parameters: http://www.nitrogenparameters.com/about.html

[3]. M.M. Ali, Ahmed Al-Ani, Derek Eamus and Daniel K.Y. Tan, " Leaf Nitrogen Determination using Handheld Meters". http://www.regional.org.au/au/asa/2012/precision-agriculture/7979_alim.html

[4]. Research, A. C. (1995). *Analysis of nitrogen.* Australia: Australian Centre for International Agricultural Research.