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SURVEY & PROPOSED MODEL OF NUTRIENT ANALYSIS IN PLANTS

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ABSTRACT

Plants require adequate nutrient content for a total as well as natural life cycle. Six macronutrients such as nitrogen, calcium, phosphorus, potassium, sulfur and magnesium are important for the natural and healthy rise of plants. Regular activities with a lack of nutrients in plants lead to transportation difficulties and ultimately affect crop. Plants show the definite lack of nutrient on their leaves, fruits with notable differences in pattern. Our research suggested is to provide an automated and economically viable method for detecting defects nutritional conditions. Our system uses helpful information to forecast performance of crops. The dataset for faulty leaves and healthy leaves is developed with the help of the RGB Color Extraction Analysis Technique, Disclosure of texture in real time, Identification of bottom edge etc. This dataset will allow supervised machine learning to predict and identify accurate shortages of vitamins and healthy plants to prohibit growth rates.

Keywords: RGB Color Extraction Analysis Technique, Supervised machine learning, Deep Learning, Image Processing

1. Introduction

In order to develop a highly efficient plant nutrient deficiency classification system, various image processing and signal processing operations must be designed to work in tandem. A visual description of these operations can be observed from figure 1, where operations like image capture, filtering, feature extraction, classification and post processing can be seen. These operations vary depending upon the type of dataset, and the nature of their application, they include, but are not limited to,

- Effective image capture via near field imagery, wherein plant leaf images are captures with the help of high-resolution sensors. These sensors allow the system to digitize the nutrient deficiencies in plants, thereby allowing for further analysis.
- The captured images are given to a pre-processing block, where operations like noise removal, image enhancement, picture correction, image registration, etc. are performed. The main responsibility of this

block is to prepare the images for further processing, in such a manner that the regions of interest are visually distinct from rest of the image.

Image acquisition
Image pre-processing
Image Segmentation
Feature extraction
Statistical analysis
Classification
Diagnosis Results

Figure 1. Example plant leaf nutrient detection system

- After pre-processing, a segmentation layer is attached to the process. This layer performs extraction of regions of interest from the pre-processed images. This is one of the most efficiently designed layers in the entire process, because the output of this layer controls effectiveness of the entire nutrient classification system. Algorithms like Saliency maps, kMeans, etc. are used for this purpose, and allow the system to extract regions which consist of useful information with respect to nutrient detection.
- The segmented regions are given to a feature extraction and selection unit. This unit extracts shape-based, colour-based, texture-based and domain-based features. Algorithms like local binary patterns (LBP), grey level co-occurrence matrix (GLCM), etc. are used for this purpose. The main aim of this block is to extract features, such that features of one type of nutrient deficiency regions are sufficiently different from extracted features of other nutrient deficiency regions. This block must also make sure that features of one type of nutrient deficiency regions must be similar to features of similar nutrient deficiency regions.
- Extracted features are given to a classification block, wherein they are categorized on the basis of either nutrient type or on the level of deficiency. Algorithms like support vector machines (SVM), neural network (NN), long-short-term-memory (LSTM), etc. are used for this purpose.
- After classification, a post processing block is designed to aggregate all this classification information and generate a final report on the number and extent of deficiencies in the leaf images. Algorithms like gated recurrent units (GRUs), auto encoders (AE), etc. are used for this purpose.

A large number of research works are published in the domain of nutrient deficiency detection, and each of them throw light on a different aspect of the system. A review of such algorithms and their application specific performance is mentioned in the next section. This is followed by objectives, motivation, and other supported contents which will assist in carrying out future research work.

2. Literature Survey

In this work we have considered the recent related papers & recent work is also reviewed as follows:

Susanto B. et al [1] this paper found out nutrient content in wheat leaves by defining color types of leaves pictures taken on field with several lighting circumstances. They proposed the advancement of DSELM fusion and genetic algorithm (GA) to regularize plant images and to decrease color disparity produced due to sunlight intensity. In the picture segmentation, they applied the DSELM to distinguish wheat leaves from a dynamic background. Mean, variance, skewness and kurtosis the 4 moments are takeout and used as forecasters in the nutrient approximation. The results have shown superior quality and processing speed.

Shichao Jin, et.al [2] Precise and high-performance extraction of phenotypic crop characteristics, as a key phase in molecular breeding, is of great significance in that production. Automatic stem-leaf segmentation, though, remains a major challenge as a requirement for certain correct extractions of phenotypic traits. Current research focuses on the analysis of 2-D image-based separation that is adaptive to illumination. With lively laser scanning and strong penetrating capabilities that pass through 2-D to 3-D phenotyping, precise 3-D information can be obtained through Light Detection and Ranging (LiDAR).

Pavit Noinongyao et. al. [3] this paper suggested an image analysis approach to identify unusual regions that are induced by nutritional shortages on plant leaves. The suggested solution analyzes a histogram of normal leaf colors for the detection of irregularities on trees. This is divisible into three main acts. Firstly, the color characteristics of the leaf area are computed in an input image.

Mahadi S. Hosseini, et al [4] presented design of picture deblurring in the appearance of one-shot convolution filtering. Used a Gaussian LPF to distinguish the image noise removal difficulty for image edge deblurring. Proposed an unsighted method to find the PSF statistics for 2 Gaussian and Laplacian model, planned for testing and authenticate the competency in given technique using 2054 originally blurred pictures across 6 imaging applications & 7 state-of-the-art de-convolution technique.

Mustafa merchant et. al [5] Discussed as Indian national fruit, its leaves are enormous affected by a number of nutrient deficiencies such as nitrogen, phosphorus, potassium and copper. Mango leaves nutrients alter color. These leaves are considered defective. This research has found the numerous nutrient deficiencies in mango leaves. At the beginning a data set is created by obtain the various mango leave features.

Fumiaki Mitsugi,[6] Suggested the consumption of plasma to eliminate soil-borne pathogens & worms

as a method in least chemicals in farming. Ozone dispersion handling method used & real farming place for soil disinfection. By calculating the soil acidity and nitrogen nutrients, the ozone presence in soil measured. After that a part of the field infected with the Streptomyces, taken along the ozone dispersion method. And then, radish seeds planted in the ozone area & control area. The result was radishes showed improved growth compared to the control & were not contaminated from outside.

P. Krithika et al.[7] The aim was to find diseases of the salad cucumber leaf at the first stage. The natural diseases existing in salad cucumber are Alternaria leaf blight, Bacterial wilt, Cucumber green mottle montage, Leaf Miner, Leaf spot, Cucumber Mosaic Virus (CMV) disease etc. In this work, the use of K-means clustering, an unsupervised algorithm with Support Vector Machine (SVM) used to provide this problem

Itamar F Salazar et.al [8], this article provided an automatic system for understanding the root condition of avocado. This method uses k-means to divide leaves from identical backgrounds from pictures taken in ground under semi-controlled circumstances in s-v space at the super pixel level & a light neural network for classifying collected histograms from segmented plants into following parts: Healthy, Fe insufficiency, Mg insufficiency and red spider plague. The presented strategy divides the leaf from literature with an typical F-score of 0.98 and categorized the leaf state with a total correctness of 96.8 percent.

Siddharth Singh et. al [9] The plant is essential for any living organism. Plants suffer from different kinds of diseases alike a human or other living thing. Such diseases are detrimental to crops, as they can influence the development of trees, seeds, fruits and leaves, etc. which can even cause the plant to die. BRBFNN method was designed to find and grouping of plant leaf diseases. The findings shown higher performance in diagnosing leaf.

Aaditi shaha et al.[10] Intended that plants require sufficient nutritional content for a full and balanced lifecycle. Adequate amounts of six macronutrients such as Nitrogen, Calcium, Phosphorous, Potassium, Sulphur, and Magnesium are more essential for natural and balanced plant development. The lack of nutrients causes problems in plants everyday operations and reduces the yield.

Choi Jae-Won et.al [11] Mineral nutrients are the significant basics in plant development procedure during the production of tomato. So it was of great interest to describe the mechanism. This paper suggested tool and quantify nutrient deficiencies and predicting the nutrient shortage that happens on tomato plant fruiting phrase depend on the deep neural network. It used two vital organic nutrients (i.e. Calcium and Potassium) for assessing the nutrient position in the growth of tomato plant. To differentiate the overhead mineral nutrients from taken images of tomato plant development under the greenhouse environment Inseption-ResNet based CNN is used the given research aimed was to increase the predictability of the nutrient deficiency to increase the crop. The purpose of given study was to enhance the accurate estimate of nutrient lagging in order to rise crop making and avoid the growth of

tomato pathology due to absence of nutrients. Efficiency in Inception-ResNet v2 is validated by true images of fruit taken from the manufacturing of the tomato plant.

Ukrit Watchareeruet et al.[12] A novel method of surface-based image processing is suggested for the identification of plant nutrient shortages. Next, the proposed solution divides the representation of an input leaf into tiny bits. Second, a population of convolutionary neural networks (CNNs) is fed per set of leaf-pixels. CNN is explicitly designed for a nutritional deficiency which is used to assess whether there are any symptoms occurring in a row.

M. V. Latte et al.[13] It proposed an pattern recognition and color property analysis algorithm and was tested for multiple defective images. The outcome suggests a 90 percent overall precision that could be further improved by increasing the sample to fine-tune the law. It was possible to extend the algorithm to evaluate all three drawbacks (NPK) present in a single node.

Tanya Makkar et.al. [14] As environmental changes and water logging causes the deficiency disorder in different plants. The proportional examination of Boron and Calcium shortage system for fruit using computer based vision tool. It used MATLAB software for GUI. It provided the deficiency detection and helped the user to use different techniques of image processing and also choose the selective methods.

Kadipa Aung Myo Han et al. [15] The usage of several profoundly convolutionary neural networks (CNNs) to understand how the leaf picture identifies nutrient deficiencies has been studied. Experiments were performed using a sample of 4,088 black grams (Vignamungo) of the leaves developed seven various treatments, i.e. whole nutrient therapy and six treatments with nutrient defects.

Carlos Arrasco et.al, [16] proposed a technique to improve the venation pattern of the leaf part, so that the quality feature withdrawal in windows portions in the plant kinds findings get increased. For this two kinds of texture structures are compared and it was done with an own dataset in good resolution appearance of 10 plants types. The output proven the veins improving procedure increase the species organization job.

Laís Escorcio Correiaet.al [17] proposed to find the phyllochron, leaf growth period and lifetime period in adult Arabica coffee plants based on growing strength periods, axis order and place of emitted leaves. Four-year-old plants were organized following the V Plants procedure in lively multiscale-tree-graphs. Leaf development constraints assessed on 5 axis orders. To mix the influence of heat on leaf growth factors, they remained taken as purposes of gathered thermal time.

Shezhou Luo et.al [18], equated the LAI estimation with LiDAR height & concentration data & discovered the prospective valuing forest LAI with the help of collective LiDAR height and intensity information. LAI assessment models recognized with the help of LiDAR height, intensity and a mixture of LiDAR height and intensity metrics depends on unplanned forest regression algorithm.

Sundara Met Subramanian et.al [19] Image segmentation represents a critical step. Hematologists may assess sensitivity to a number of diseases through microscopic photographs of white blood cells (WBC). Automatic segmentation of different types of WBCs is the most challenging task in predicting the outbreak of disease. The goal was to use segmentation to divide the blood cells into microscopic pictures. Color is a important effect on the discernment from microscopic photographs of segmented WBCs. This paper measured the efficacy of various color-based segmentation approaches and compared the results in ground reality against the picture. Analysis of experiments utilizing dice similarities shown that the most effective strategy for segmenting WBC cells is segmentation based on saliency.

Jingwei Xu. et al [20] implemented a 2-deep encoder design to address problem of fully automated segmentation of the video object. These two channels, ImSeg (for static picture segmentation), and MoSeg, are generated in the similar way as Encoder. When computer, the Encoder part produces a low-mask by varying positions and smooth angles. In addition, to address the question of insufficient tools for the segmentation of video items, we propose a search technique to produce a broad variety of handcrafted training tests. Study of two conventional datasets reveals that the new technique is more state solutions in the reliability and runtime of segmentation.

Jung won Cha. et al [21] Precise and high-performance extraction of phenotypic seed characteristics is of great significance for this production as a main phase in molecular breeding. Automatic stem-leaf segmentation, though, remains a major obstacle as a requirement for certain unusual extractions of phenotypic traits. The most current research focuses on the segmentation of 2-D pictures, which is sensitive to illumination.

Xinjia Fang, et al.[22] Identifying surface defects in LED brackets is an essential step in ensuring that the product is suitable. In this article a method of image segmentation algorithm was suggested for LED bracket detection. Firstly, the basic principle and structure of the solution suggested, which includes the use of threshold segmentation. It is designed and adopted technique and boundary-based segmentation protocol. Second, the segmentation outcomes and efficiencies of three strategies are evaluated on the basis of the LED frame image, namely the threshold-dependent segmentation technique, the region-widening methodology and the proposed procedure.

Abdelkarim Ben Ayed, et al.[23] Data clustering is an essential phase that emerges in several problems like pattern detection and applications for decision taking. This move had acquired significant attention, and many methods were suggested to increase the efficiency of clustering. They suggested a novel ensemble grouping method focused on the usage of a complex fuzzy exponent inside the clustering of fuzzy C-Means, an unattended function selected.

Jia LI et al. [24] Data clustering is typically time-consuming because it involves iterative sorting and analysis of vast amounts of data by design. Approximate sample-based aggregation produces outcomes that are guaranteed easily and with accuracy. Within this article, we suggest using data clustering

approximation techniques to achieve the trade-off between clustering efficiency and results consistency, along with online accuracy estimates

Haiguang Wang et al.[25] Automatic detection of plant disease and increased photographic precision of plant disease, two types of grape disease (grape downy mildew and grape powdery mildew) and two types of wheat disease (wheat stripe rust and wheat leaf rust) were chosen as test items and disease recognition based on picture analysis and pattern recognition.

Mia Rizkinia, et al [26] presented local spectral element decay technique on the basis of the local distribution line's function. Noise on multi-channel images by using linear similarities within the spectral area of a local region minimized. Computed a linear function about the spectral parameters of an M-channel signal, which we call the spectral line.

Changwei Tan,et al.[27] This developed future comprehensive quality forecast for wintry weather wheat granule providing remote sensing to create a predictive network and meet winter wheat demand. The experimentation done in Jiangsu area in the winter wheat growing period 2007-2009 to forecast the protein content of grain (GPC)

Xu Junzeng, et al.[28] Ambient nitrogen deposition was main forms of nitrogen for both water and the eco-system. The important part from nitrogen releases from rice paddy & from source of ambient nitrogen was ammonia volatilization. Land studies for determining nitrogen wet concentration & connection with losses the large concentration of gross nitrogen, ammonia nitrogen and nitrate fluid in the rice-growing season is 16.04kg•hm-2, 7.40kg•hm-2, and 3.39kg•hm-2, respectively.

Shih-Cheng Hu et al. [29] NF3's electrical thermal oxidation is analyzed in the perspective of kinetic and activation strength, with focus on reaction rate interaction. The impact of NF3 flow rate, N2 flow rate, and operating temperature on NF3 decay studied to improve the economic viability of the wet deposition cycle. The reactions at issue are pursuing kinetics in first order

Xinyue Han, et al.[30] Direct immersion cooling explained for HCPV systems with rigidly packed III-V cells. The device's performance is dependent on the optical property of immersion liquids. In applications with great concentration III-V photovoltaic immersion cooling, eight liquids may be installed. Their transmittance was measured with the help of spectrophotometer transmittance calculation of two path-length cuvettes. This was a beneficial property with respect to the bottom subcell which generates an excess current. These liquids were appropriate for the immersion of 3-junction cells. Immersion of therminol VP-1, followed by dimethyl silicon oil, would cause the smallest cell power loss.

Sandra Jimenez et al. [31], proposed analysis which allowed evaluating the progress in the individuality of the solution based on the curvature of a surface. Pixel dependant approach were unpredictable, it showed consideration of spatial information create the difficulty. Proposed method make it simple for

understanding as curvature is reliable with complication of the sources calculated in form of significant Eigen values.

Huawei Jiang, et al.[32] Reported on in-situ, real-time nitrate and phosphorus absorption tracking utilizing optimized plant nutrient sensors developed in a micro fluidic plant processor. The plant chip comprised the development medium, with proven additives and early concentrations for rising plants. Declining nutrient in the medium indicates nutritional consumption by the plant.

Helmy et al.[33] Hydroponic is one of the strategies of soilless development which needs nutritionally rich water. Nutrient solution is very critical in deciding development of hydroponic crops. One hydroponic approach was the Nutrient Film Methodology (NFT). System NFT uses the root area with nutrient solution for drainage. The pH norm for lettuce is 6.0-6.5 while the norm for electrical conductivity (EC).In city settings the hydroponic green house could not get a wide area just in one place. It was used to resolve the problem by real-time control of hydroponic NFT lettuce cultivation. In this context, the solution includes planning, training, design, development and socialization.

Marianah Masrie et al.[34] Soil is the most important source for rising crops. This thesis developed an optical sensor detection system for the main soil nutrients; nitrogen, phosphorus, and potassium (NPK). The optical sensor was equipped with 2 modules - transfer and detection methods. The transmission mechanism makes use of Arduino UNO powered LEDs as a part of direct light transmission. The detector system used two photodiodes equipped with a signal conditioner and an enhancement circuit to calculate concentration of soil nutrients from residual light and to improve the light signal with respect to possible variations.

Susanto B.Sulistyo et.al [35] presented a color constancy technique with the help of neural networks combination & a genetic algorithm which regularize a variety of plant pictures due to diverse sunlight. A Macbeth color organizer used for indicating regularities in color pictures. Moreover designed a mixture of neural networks with the help of a committee machine for finding the nitrogen content in wheat leaves.

Heidi Van Deventer et al [36] proposed an assessment of 1) Tree type's categorization optimized with the option of band related to well-known plant property 2) Partial least square conversion improved species categorization above principal component analysis.

Kawaljit kaur et al [37] Agriculture plays a vital position in planting every product. Human society in reality relies greatly on agriculture. Normal Filed soil prevalence and water conservation is essential to attaining successful development targets. The nature and quantities of plant and fruit diseases correlated with processing was adversely influenced. Diseases are normal days today. In this region, the pesticides and other dangerous manure are the biggest obstacle. This paper analyzes illnesses caused by harvesting fruit. Chemical imaging methods are used to analyze fruit crop degradation. Comprehensive review of the filtering strategies correlated with identification of distortions is provided.

V. C. Bagal, et al.[38] Plants are very essential on earth both for humans and other living creatures. The food that people consume every day comes from plants explicitly or indirectly. Doctors use X- image in the medical field to correctly identify disease. We used the same definition here. Geometric characteristics and digital morphological characteristics are derived from the leaf's two- picture.

Juanxiu Hu et.al.[39] The wavelength spectral transmittance ranged from 300 to 1100 nm and the amounts of chlorophyll and nitrogen were measured in five different volumes of rice and cucumber leaves added in solution. A comparative study showed that 560, 650 and 720 nm was measured as wavelengths for feature, and 940 nm as reference wavelengths for nitrogen detection. Used job parameters and log as plant nitrogen markers may be used to measure chlorophyll and nitrogen content and to facilitate the detection of non- plant nutrients and soil fertilizers.

Ahmad Nizar Harun et.al [40] This research deals with the impact of different LED light treatments on the concentration of nutrients and the use of Internet technologies to share leaf gasses in Brassica Chines is They'd done light therapy work. Developed a smart network using an embedded device which tracks online plant factory environmental guideline. In the plant factory sector the findings indicated the unit.

Ekdeep Singh Lubana et al [41] This paper suggested an optical sensor system which would use raw images of leaves to assess the quality of chlorophyll. Pixel values produced by raw image used to measure spectral parameters that are recognized for their association with concentration of chlorophyll. The linear regression model between GNDVI was created using 50 sample cotton leaves as calculated by Snap and SPAD 502 + chlorophyll meters.

Vaishnavi Mande et al [42]. This paper proposed a description of the damaged, balanced leafy vegetables. It is to find the chlorophyll content in the leaves and warn the correct amount of nourishment. The robotic arm for plucking the leaves was designed to the both time and resources. Therefore they regain the essential minerals in leafy vegetables which are suitable for expenditure.

Takumi Okamoto et al [43] constructed an very-small nutrient analyzer, a compact 3D monitor and ambient ultra-light sensor that can be mounted near plants. In this production of the lettuce leaves and roots was studied picture analysis focused on noticeable and thermo graphic thermal imagers taken by cameras in real time and non-damaging growth of the leaf root in lettuce hydroponic community.

Shraddha Bet. al.[44] suggested a non-destructive tool for detecting leaf nutrient content and supplying fertilizers to prevent excessive wastage. They used sensors to measure nutrient rates in the plant. The findings were detected as small, medium, and wide in three levels, based on sensor results. Measured nutrients were Nitrogen and Phosphorus.

S. Jeyalakshmi et.al. [45] Constructed a continuous monitoring system to track plant nutrient status to improve production and yield proficiency. A diagnostic system that Utilizes optical picture processing can identify symptoms of disease even more easily than human eyes can identify. That will require

farmers to take timely and effective corrective action. This article looks at the usage of photographs to conduct work.

Kai Zhang et.al [46] presented a rapid & supple noise removing CNN, namely FFDNet, with a tunable noise intensity taken as the input. The given FFDNet worked on down sampled sub-images, providing a good exchange between inference speed & noise removing operation. FFDNet gave some attractive properties: 1) the capability to hold a extensive variety of noise levels with a only network; 2) the capability to take out variation in noise by a non-uniform noise level map 3) faster speed than benchmark BM3D.

Srdjan Sladojevic et.al [47] developed a method for plant disease detection with the help of leaf image classification, with the help of deep convolutional networks. Used new technique for training and the method taken to make possible a rapid and simple structure performance. The developed model is capable to identify 13 diverse types of plant diseases from healthy leaves.

Bharat Mishra et.al [48] presented a survey on diverse technologies of leaf disease recognition using image processing. Also differentiated this on the basis of analysis tool and application. Approximately all technologies related to leaf disease detection system were reviewed. Differentiation of accessible approaches were examined and explained.

2.1 Comparative study of research articles

Indexing/ Year	Performance Evaluation Parameters	Dataset Size	Algorithm/ Technique/ Approach	Findings	Limitations
[1] IEEE Year: 2018	Accuracy, precision, and delay	Nutrient Use and Outcome Network dataset with over 1200 images	DSELM fusion and genetic algorithm (GA)	In this work, Nutrient content in wheat leaves by defining color types of leaves pictures taken on field with several lighting circumstances. They proposed the advancement of DSELM fusion and genetic algorithm (GA) to regularize plant images and to decrease color disparity produced due to sunlight intensity. Mean, variance, skewness, and kurtosis the 4 moments are takeout and used as forecasters in the nutrient approximation. The results have shown superior quality and processing speed.	Moderate accuracy due to use of linear features
[2] IEEE Year-2019	Accuracy, precision, and delay	Eden Library dataset with over 1000 images	Molecular breeding, LiDAR	With lively laser scanning and strong penetrating capabilities that pass through 2-D to 3-D phenotyping, precise 3-D information can be obtained through Light	High cost due to LiDAR processing

Indexing/ Year	Performance Evaluation Parameters	Dataset Size	Algorithm/ Technique/ Approach	Findings	Limitations
				Detection and Ranging (LiDAR)..	
[3] JCSSE Year:2017	Accuracy, recall, and delay	Mendeley dataset with over 1500 images	Image analysis approach nutritional shortages on plant leaves.	Good accuracy, with low complexity	Scalability is a main issue here
[4]IEEE transaction Year:2019	Accuracy, Precision, and delay	Quantitative dataset with over 800 images	Gaussian LPF to distinguish the image noise removal difficulty for image edge deblurring. the PSF statistics for 2 Gaussian and Laplacian model,	Large scale denoising can be performed using this method	Not applicable for classification
[5] ICCT Year:2018	Accuracy, precision, and delay	Nutrient Use and Outcome Network dataset with over 1300 images	Image processing for detecting multiple nutrient types	With high accuracy and low delay	Cannot be scaled to other image types
[6] IEEE	Accuracy,	Eden Library	Ozone dispersion handling	The result was radishes showed improved	Costly for real-time

Indexing/ Year	Performance Evaluation Parameters	Dataset Size	Algorithm/ Technique/ Approach	Findings	Limitations
Transactions Year:2019	precision, and delay	dataset with over 1200 images	method used & real farming place for soil disinfection..	growth compared to the control & were not contaminated from outside	use, and cannot evaluate multiple types of nutrients
[7] IEEE Conference Year:2017	Accuracy, recall, and delay	Mendeley dataset with over 1000 images	K-means clustering, an unsupervised algorithm with Support Vector Machine(SVM)	High scalability and low delay due to use of linear classification models	Moderate accuracy and low precision due to linear model use
[8] STSIVA Year:2019	Accuracy, Precision, and delay	Quantitative dataset with over 900 images	k-means,light neural network	The presented strategy divides the leaf from literature with an typical F-score of 0.98 and categorized the leaf state with a total correctness of 96.8 percent	Cannot be scaled to other image types, moderate accuracy with moderate precision performance
[9] IEEE Access Year:2017	Accuracy, precision, and delay	Nutrient Use and Outcome Network dataset with	BRBFNN method.	The findings shown higher performance in diagnosing leaf yield in terms of accuracy	Moderate accuracy and low precision due to linear model use

Indexing/ Year	Performance Evaluation Parameters	Dataset Size	Algorithm/ Technique/ Approach	Findings	Limitations
		over 1200 images			
[10] ICCT Year:2018	Accuracy, precision, and delay	Eden Library dataset with over 1000 images	IP,ML algorithms	Good accuracy, with moderate delay which makes it useful for moderate sized application deployments	Moderate size application deployment.
[11] ICFTA Year:2018	Accuracy, recall, and delay	Mendeley dataset with over 1500 images	Inception-ResNet based CNN	Increase the predictability of the nutrient deficiency to increase the crop. Enhance the accurate estimation.	High cost of deployment with limited scalability
[12] IEECON Year: 2018	Accuracy, Precision, and delay	Quantitative dataset with over 800 images	CNN	CNN is explicitly designed for a nutritional deficiency which is used to assess whether there are any symptoms occurring in a row, which makes it highly useful for real-time applications that require moderate accuracy	High complexity, and limited scalability for a wide variety of leaf disease types
[13] ICCS Year:2016	Accuracy, precision, and delay	Nutrient Use and Outcome Network	Pattern recognition and color property analysis algorithm.	It was possible to extend the algorithm to evaluate all three nutrients (NPK) present in a single node with low cost	Accuracy is low due to use of simple sensor interfaces

Indexing/ Year	Performance Evaluation Parameters	Dataset Size	Algorithm/ Technique/ Approach	Findings	Limitations
		dataset with over 1300 images			
[14] ICCCA Year:2018	Accuracy, precision, and delay	Eden Library dataset with over 1200 images	Computer-based vision tool & IP Techniques	It provided the deficiency detection and helped the user to use different techniques of image processing and also choose the selective methods	Moderate accuracy, and high complexity for large number of diseases
[15] IEEE Conference Year: 2019	Accuracy, recall, and delay	Mendeley dataset with over 1000 images	Convolutionary neural networks (CNNs)	Moderate accuracy with moderate precision performance	Cannot be extended to plants, and other element types
[16] IEEE Conference Year:2018	Accuracy, Precision, and delay	Quantitative dataset with over 900 images	Venation pattern of the leaf part, so that the quality feature withdrawal in windows portions in the plant kinds findings get increased. For these two	The output proven that the veins improving procedure increase the species organization job, thereby producing high accuracy	High complexity, and limited scalability for a wide variety of leaf disease types

Indexing/ Year	Performance Evaluation Parameters	Dataset Size	Algorithm/ Technique/ Approach	Findings	Limitations
			kinds of texture structures are compared and it was done with an own dataset in good resolution appearance of 10 plants types.		
[17] IEEE Conference Year:2016	Accuracy, precision, and delay	Nutrient Use and Outcome Network dataset with over 1200 images	To find the phyllochron, leaf growth period and lifetime period in adult Arabica coffee plants based on growing strength periods, axis order and place of emitted leaves. Four-year-old plants were organized following the V Plants procedure in lively multiscale-tree-graphs. Leaf development constraints assessed on 5 axis orders. To	High accuracy, with moderate level of complexity which makes it useful for moderately scaled applications	High complexity, and limited scalability for a wide variety of leaf disease types

Indexing/ Year	Performance Evaluation Parameters	Dataset Size	Algorithm/ Technique/ Approach	Findings	Limitations
			mix the influence of heat on leaf growth factors, they remained taken as purposes of gathered thermal time		
[18] IEEE Conference Year:2017	Accuracy, precision, and delay	Eden Library dataset with over 1000 images	They have equated the LAI estimation with LiDAR height & concentration data & discovered the prospective valuing forest LAI with the help of collective LiDAR height and intensity information. LAI assessment models recognized with the help of LiDAR height, intensity and a mixture of LiDAR height and intensity metrics depends on unplanned forest regression	High accuracy, and moderate scalability for a wide variety of plant types	Very costly, and this cannot be used for real-time processing

Indexing/ Year	Performance Evaluation Parameters	Dataset Size	Algorithm/ Technique/ Approach	Findings	Limitations
			algorithm		
[19] IEEE Explore Year:2019	Accuracy, recall, and delay	Mendeley dataset with over 1500 images	Image segmentation represents a critical step. Hematologists may assess sensitivity to a number of diseases through microscopic photographs of white blood cells (WBC). Automatic segmentation of different types of WBCs is the most challenging task in predicting the outbreak of disease. The goal was to use segmentation to divide the blood cells into microscopic pictures. Color is a important effect on the discernment from microscopic	Analysis of experiments utilizing dice similarities shown that the most effective strategy for segmenting WBC cells is segmentation based on saliency	Saliency map produces good results, and can be mapped with deep learning for better performance.

Indexing/ Year	Performance Evaluation Parameters	Dataset Size	Algorithm/ Technique/ Approach	Findings	Limitations
			photographs of segmented WBCs. This work measured the efficacy of various color-based segmentation approaches and compared the results in ground reality against the picture.		
[20] IEEE Conference Year:2017	Accuracy, Precision, and delay	Quantitative dataset with over 800 images	Implemented a 2-deep encoder design to address problem of fully automated segmentation of the video object. These two channels, ImSeg (for static picture segmentation), and MoSeg, are generated in the similar way as Encoder. When computer, the Encoder part produces a low-mask by	Study of two conventional datasets reveals that the new technique is more state solutions in the reliability and runtime of segmentation	Low scalability and moderate level of accuracy for large scale applications

Indexing/ Year	Performance Evaluation Parameters	Dataset Size	Algorithm/ Technique/ Approach	Findings	Limitations
			varying positions and smooth angles. In addition, to address the question of insufficient tools for the segmentation of video items, researchers propose a search technique to produce a broad variety of handcrafted training tests.		
[21] IEEE Conference Year:2017	Accuracy, precision, and delay	Nutrient Use and Outcome Network dataset with over 1300 images	Precise and high-performance extraction of phenotypic seed characteristics is of great significance for this production as a main phase in molecular breeding. Automatic stem-leaf segmentation, though,	Moderate accuracy, and moderate delay needed for large-scale applications.	Highly complex for real-time deployment

Indexing/ Year	Performance Evaluation Parameters	Dataset Size	Algorithm/ Technique/ Approach	Findings	Limitations
			remains a major obstacle as a requirement for certain unusual extractions of phenotypic traits. The most current research focuses on the segmentation of 2-D pictures, which is sensitive to illumination.		
[22] IEEE Conference Year:2016	Accuracy, precision, and delay	Eden Library dataset with over 1200 images	Identifying surface defects in LED brackets is an essential step in ensuring that the product is suitable. In this article a method of image segmentation algorithm was suggested for LED bracket detection. Firstly, the basic principle and structure of the solution suggested, which	The segmentation outcomes and efficiencies of three strategies are improved on the basis of the LED frame image, namely the threshold-dependent segmentation technique, the region-widening methodology and the proposed procedure.	Low accuracy for classification and detection of nutrients

Indexing/ Year	Performance Evaluation Parameters	Dataset Size	Algorithm/ Technique/ Approach	Findings	Limitations
			includes the use of threshold segmentation. It is designed and adopted technique and boundary-based segmentation protocol.		
[23] IEEE Conference Year:2017	Accuracy, recall, and delay	Mendeley dataset with over 1000 images	Data clustering is an essential phase that emerges in several problems like pattern detection and applications for decision taking. This move had acquired significant attention, and many methods were suggested to increase the efficiency of clustering.	Fuzzy logic reduces delay needed for computations, with moderate accuracy	Low precision, and low AUC performance when compared with deep learning models
[24] IEEE Conference Year:2015	Accuracy, Precision, and delay	Quantitative dataset with over 900	Data clustering is typically time-consuming because it involves iterative sorting and	Approximate sample-based aggregation produces outcomes that are guaranteed easily and with accuracy. Within this	Cannot be scaled for a large number of plants & disease

Indexing/ Year	Performance Evaluation Parameters	Dataset Size	Algorithm/ Technique/ Approach	Findings	Limitations
		images	analysis of vast amounts of data by design.	article, researchers suggest using data clustering approximation techniques to achieve the trade-off between clustering efficiency and results consistency, along with online accuracy estimates	types
[25] CISP Year: 2012	Accuracy, precision, and delay	Nutrient Use and Outcome Network dataset with over 1200 images	Automatic detection of plant disease and increased photographic precision of plant disease, two types of grape disease (grape downy mildew and grape powdery mildew) and two types of wheat disease (wheat stripe rust and wheat leaf rust) were chosen as test items and disease recognition based on picture analysis and	Low delay, and moderate accuracy	Limited scalability, with moderate precision & low recall performance

Indexing/ Year	Performance Evaluation Parameters	Dataset Size	Algorithm/ Technique/ Approach	Findings	Limitations
			pattern recognition		
[26] IEEE Transactions Year:2016	Accuracy, precision, and delay	Eden Library dataset with over 1000 images	local spectral element decay technique on the basis of the local distribution line's function. Noise on multi-channel images by using linear similarities within the spectral area of a local region minimized. Computed a linear function about the spectral parameters of an M-channel signal, which researchers call the spectral line	Moderate accuracy, and moderate delay needed for large-scale applications.	Highly complex for real-time deployment
[27] IEEE Conference Year:2011	Accuracy, recall, and delay	Mendeley dataset with over 1500 images	This developed future comprehensive quality forecast for wintry weather wheat granule providing	Moderate accuracy and medium delay needed for large-scale applications.	Highly complex for real-time deployment due to use of satellite

Indexing/ Year	Performance Evaluation Parameters	Dataset Size	Algorithm/ Technique/ Approach	Findings	Limitations
			remote sensing to create a predictive network and meet winter wheat demand. The experimentation done in Jiangsu area in the winter wheat growing period 2007-2009 to forecast the protein content of grain (GPC)		image sensors
[28] ICEET Year:2009	Accuracy, Precision, and delay	Quantitative dataset with over 800 images	Xu Junzeng, et al.[28] Ambient nitrogen deposition was main forms of nitrogen for both water and the eco-system. The important part from nitrogen releases from rice paddy & from source of ambient nitrogen was ammonia volatilization. Land studies for determining	Can be used to detect large number of disease types, and nutrient types, with low delay	Moderate accuracy, with moderate precision performance, with limited AUC & ROC values

Indexing/ Year	Performance Evaluation Parameters	Dataset Size	Algorithm/ Technique/ Approach	Findings	Limitations
			nitrogen wet concentration & connection with losses		
[29] IEEE Year:2018	Accuracy, precision, and delay	Nutrient Use and Outcome Network dataset with over 1300 images	NF3's electrical thermal oxidation is analyzed in the perspective of kinetic and activation strength, with focus on reaction rate interaction. The impact of NF3 flow rate, N2 flow rate, and operating temperature on NF3 decay studied to improve the economic viability of the wet deposition cycle.	Good Noise removal capabilities when applied to large-scale applications	Highly complex for real-time deployment
[30] IEEE Conference Year:2017	Accuracy, precision, and delay	Eden Library dataset with over 1200 images	Direct immersion cooling explained for HCPV systems with rigidly packed III-V cells. The device's	This was a beneficial property with respect to the bottom sub cell which generates an excess current. These liquids were appropriate for the immersion of 3- junction	Moderate accuracy due to use of linear features

Indexing/ Year	Performance Evaluation Parameters	Dataset Size	Algorithm/ Technique/ Approach	Findings	Limitations
			performance is dependent on the optical property of immersion liquids. In applications with great concentration III-V photovoltaic immersion cooling, eight liquids may be installed. Their transmittance was measured with the help of spectrophotometer transmittance calculation of two path-length cuvettes.	cells. Immersion of terminal VP-1, followed by dimethyl silicon oil, would cause the smallest cell power loss.	
[31] IEEE Transactions Year:2014	Accuracy, recall, and delay	Mendeley dataset with over 1000 images	Proposed analysis which allowed evaluated the progress in the individuality of the solution based on the curvature of a surface. Pixel dependent approaches were	Proposed method make it simple for understanding as curvature is reliable with complication of the sources calculated in form of significant eigenvalues	High cost due to LiDAR processing

Indexing/ Year	Performance Evaluation Parameters	Dataset Size	Algorithm/ Technique/ Approach	Findings	Limitations
			unpredictable, it showed consideration of spatial information create the difficulty.		
[32] ICSAM Year:2017	Accuracy, Precision, and delay	Quantitative dataset with over 900 images	This approach reported on in-situ, real-time nitrate and phosphorus absorption tracking utilizing optimized plant nutrient sensors developed in a micro fluidic plant processor. The plant chip comprised the development medium, with proven additives and early concentrations for rising plants..	Declining nutrient in the medium indicates nutritional consumption by the plant.	Scalability is a main issue here
[33] IEEE Conference	Accuracy, precision, and	Nutrient Use and Outcome	Hydroponic is one of the strategies of soilless	It was used to resolve the problem by real-time control of hydroponic NFT lettuce	Not applicable for classification

Indexing/ Year	Performance Evaluation Parameters	Dataset Size	Algorithm/ Technique/ Approach	Findings	Limitations
Year:2017	delay	Network dataset with over 1200 images	development which needs nutritionally rich water. Nutrient solution is very critical in deciding development of hydroponic crops. One hydroponic approach was the Nutrient Film Methodology (NFT). System NFT uses the root area with nutrient solution for drainage. The pH norm for lettuce is 6.0-6.5 while the norm for electrical conductivity (EC).In city settings the hydroponic green house could not get a wide area just in one place.	cultivation. In this context, the solution includes planning, training, design, development and socialization	
[34] IEEE	Accuracy,	Eden Library	Developed an optical sensor	The detector system used two photodiodes	Cannot be scaled to

Indexing/ Year	Performance Evaluation Parameters	Dataset Size	Algorithm/ Technique/ Approach	Findings	Limitations
Conference Year:2018	precision, and delay	dataset with over 1000 images	detection system for the main soil nutrients; nitrogen, phosphorus, and potassium (NPK). The optical sensor was equipped with 2 modules - transfer and detection methods. The transmission mechanism makes use of Arduino UNO powered LEDs as a part of direct light transmission.	equipped with a signal conditioner and an enhancement circuit to calculate concentration of soil nutrients from residual light and to improve the light signal with respect to possible variations	other image types
[35] IEEE Transactions Year:2017	Accuracy, recall, and delay	Mendeley dataset with over 1500 images	Presented color constancy technique with the help of neural networks combination & a genetic algorithm which regularize a variety of plant pictures due to diverse sunlight. A Macbeth color	Moreover, designed a mixture of neural networks with the help of a committee machine for finding the nitrogen content in wheat leaves for better accuracy	Costly for real-time use, and cannot evaluate multiple types of nutrients

Indexing/ Year	Performance Evaluation Parameters	Dataset Size	Algorithm/ Technique/ Approach	Findings	Limitations
			organizer used for indicating regularities in color pictures.		
[36] IEEE Journal Year:2015	Accuracy, precision, and delay	Eden Library dataset with over 1200 images	assessment of Tree types categorization optimized with the option of band related to well-known plant property	Partial least square conversion improved species categorization above principal component analysis for reduced features and better accuracy	Moderate accuracy and low precision due to linear model use
[37] ICTEI Year:2017	Accuracy, recall, and delay	Mendeley dataset with over 1000 images	Chemical imaging methods are used to analyze fruit crop	In this wok, Normal Filed soil prevalence and water conservation is essential to attaining successful development targets. The nature and quantities of plant and fruit diseases correlated with processing was adversely influenced. Diseases are normal days today. In this region, the pesticides and other dangerous manure are the biggest obstacles. This work analyzes illnesses caused by harvesting fruit. Chemical imaging methods	

Indexing/ Year	Performance Evaluation Parameters	Dataset Size	Algorithm/ Technique/ Approach	Findings	Limitations
				are used to analyze fruit crop degradation. Comprehensive review of the filtering strategies correlated with identification of distortions is provided.	
[38] ICEEOT Year:2016	Accuracy, Precision, and delay	Quantitative dataset with over 900 images	X- image in the medical field to correctly identify disease. researchers used the same definition here.	Geometric characteristics and digital morphological characteristics are derived from the leaf's two- picture for better efficiency and low delay.	High cost of deployment with limited scalability
[39] IFIP Year:2011	Accuracy, precision, and delay	Nutrient Use and Outcome Network dataset with over 1200 images	The wavelength spectral transmittance ranged from 300 to 1100 nm and the amounts of chlorophyll and nitrogen were measured in five different volumes of rice and cucumber leaves added in solution.	A comparative study showed that 560, 650 and 720 nm were measured as wavelengths for feature, and 940 nm as reference wavelengths for nitrogen detection. Used job parameters and log as plant nitrogen markers may be used to measure chlorophyll and nitrogen content and to facilitate the detection of non- plant nutrients and soil fertilizers	
[40] IEEE	Accuracy,	Eden Library	Impact of different LED	Developed a smart network using an	Accuracy is low

Indexing/ Year	Performance Evaluation Parameters	Dataset Size	Algorithm/ Technique/ Approach	Findings	Limitations
Conference Year:2018	precision, and delay	dataset with over 1000 images	light treatments on the concentration of nutrients and the use of Internet technologies to share leaf gasses in Brassica Chines is They'd done light therapy work.	embedded device which tracks online plant factory environmental guideline. In the plant factory sector, the findings indicated the unit had good accuracy, with low complexity.	due to use of simple sensor interfaces
[41] IEEE Conference Year:2018	Accuracy, recall, and delay	Mendeley dataset with over 1500 images	Optical sensor system	In this work, suggested an optical sensor system which would use raw images of leaves to assess the quality of chlorophyll. Pixel values produced by raw image used to measure spectral parameters that are recognized for their association with concentration of chlorophyll. The linear regression model between GNDVI was created using 50 sample cotton leaves as calculated by snap and SPAD 502 + chlorophyll meters for high accuracy, and	Moderate accuracy, and high complexity for large number of diseases

Indexing/ Year	Performance Evaluation Parameters	Dataset Size	Algorithm/ Technique/ Approach	Findings	Limitations
				moderate scalability.	
[42] ICCT Year:2018	Accuracy, Precision, and delay	Quantitative dataset with over 800 images	Robotic arm for plucking the leaves was designed to the both time and resources	In this work, a description of the damaged, balanced leafy vegetables. It is to find the chlorophyll content in the leaves and warn the correct amount of nourishment. The robotic arm for plucking the leaves was designed to the both time and resources. They regain the essential minerals in leafy vegetables which are suitable for expenditure and high efficiency and low complexity.	Cannot be extended to plants, and other element types
[43] IEEE Conference Year:2018	Accuracy, precision, and delay	Nutrient Use and Outcome Network dataset with over 1300 images	Very-small nutrient analyzer, a compact 3D monitor and ambient ultra-light sensor	In this work, constructed a very-small nutrient analyzer, a compact 3D monitor and ambient ultra-light sensor that can be mounted near plants. Production of the lettuce leaves and roots was studied picture analysis focused on noticeable and thermographic thermal images taken by	High complexity, and limited scalability for a wide variety of leaf disease types

Indexing/ Year	Performance Evaluation Parameters	Dataset Size	Algorithm/ Technique/ Approach	Findings	Limitations
				cameras in real time and non-damaging growth of the leaf root in lettuce hydroponic community with good accuracy.	
[44] ICACCT Year:2018	Accuracy, precision, and delay	Eden Library dataset with over 1200 images	Non-destructive tool for detecting leaf nutrient content and supplying	This work suggested a non-destructive tool for detecting leaf nutrient content and supplying fertilizers to prevent excessive wastage. They used sensors to measure nutrient rates in the plant.The findings were detected as small, medium, and wide in three levels, based on sensor results. Measured nutrients were Nitrogen and Phosphorus with good scalability & low delay	Moderate accuracy due to use of linear features
[45] ICTACT Year:2017	Accuracy, recall, and delay	Mendeley dataset with over 1000 images	Optical picture processing	In this work, Constructed a continuous monitoring system to track plant nutrient status to improve production and yield proficiency. A diagnostic system that utilizes optical picture processing can	High cost due to LiDAR processing

Indexing/ Year	Performance Evaluation Parameters	Dataset Size	Algorithm/ Technique/ Approach	Findings	Limitations
				identify symptoms of disease even more easily than human eyes can identify. That will require farmers to take timely and effective corrective action. This article looks at the usage of photographs to conduct work.	
[46] IEEE transaction Year:2018	Accuracy, Precision, and delay	Quantitative dataset with over 900 images	CNN, FFDNet,	This paper represented a rapid & supple noise removing CNN, namely FFDNet, with a tunable noise intensity taken as the input. The given FFDNet worked on down sampled sub-images, providing a good exchange between inference speed & noise removing operation. FFDNet gave some attractive properties Capability to hold a extensive variety of noise levels with a only network; capability to take out variation in noise by a non-uniform noise level map and faster speed	Scalability is a main issue here

Indexing/ Year	Performance Evaluation Parameters	Dataset Size	Algorithm/ Technique/ Approach	Findings	Limitations
				than benchmark BM3D	
[47] JCIN Year:2016	Accuracy, precision, and delay	Nutrient Use and Outcome Network dataset with over 1200 images	Leaf image classification, with the help of deep convolutional networks.	In this work, developed an method for plant disease detection with the help of leaf image classification, with the help of deep convolutional networks. Used new technique for training and the method taken to make possible a rapid and simple structure performance The developed model is capable to identify 13 diverse type of plant diseases from healthy leaves with good accuracy & moderate delay	Not applicable for classification
[48] IEEE Conference Year:2017	Accuracy, precision, and delay	Eden Library dataset with over 1000 images	Leaf disease recognition using image processing. Also differentiated this on the basis of analysis tool and application.	In this work, they represented a survey on diverse technologies of leaf disease recognition using image processing. Also differentiated this on the basis of analysis tool and application. Approximately all technologies related to leaf disease	Cannot be scaled to other image types

Indexing/ Year	Performance Evaluation Parameters	Dataset Size	Algorithm/ Technique/ Approach	Findings	Limitations
				detection system were reviewed. Differentiation of accessible approaches were examined and explained	

2.2 Recent Advances

Quality agriculture production is very crucial factor in the development of nation. If an effective system is developed for prediction of nutrient detection then it can be very helpful for fertilizer, pesticides recommendation & improvise yield and quality of production. As suggested by some researchers that to carry out such nutrient detection system plays a crucial role. It can be clearly seen from research work like [1],[7],[8],[9],[13],[14],[20],[28],[30],[34] that there is moderate or less accuracy in nutrient detection system, we require more accurate result. Hence a system consisting of good dataset can be designed and developed to provide more promising and accurate results. Due to some reason more parameters can be utilized to compare the obtained results

2.3 Research Gaps

Several research papers from plant nutrient analysis background were reviewed and analyzed thoroughly. After exploring these papers below mentioned research gap was observed.

- Limited research has been done in the field of Nutrient identification with their intensity estimation
- Recommendation on how much fertilizer required to the crops must be improved
- Limited accuracy of prediction about the quality of future crops, and suggestions on how to improve quality of crops.
- Efficiency of making appropriate suggestions for the quantity of pesticide, based on nutrient intensity is limited, and hasn't been explored in details
- Highly scalable system design which can be used for multiple types of crops, along with recommendations for each type is still under research
- Forecasting the market response of crops based on current yield prediction can be incorporated
- Cross plant analysis for learning about one type of plant nutrients using other data of other plants can be researched for better prediction efficiency

3. Motivation

From the review it is observed that limited research has been done in the field of Nutrient identification with their intensity estimation, and recommendation on how much fertilizer required to the crops must be improved. While limited accuracy of prediction about the quality of future crops, and suggestions on how to improve quality of crops, due to which the main motivation of this work is to design a prediction system to evaluate quality of future crops, and recommend how to improve quality of crops, which will be followed by design of a model for yield prediction of crops using temporal data & crop quality, and recommend quantity of pesticide, based on nutrient intensity levels, and extension of the system model to be applicable for multiple types of plant and leaf datasets

4. Problem Statement

To perform empirical evaluation of various nutrient detection models applied to different plants, and identify nutrient levels in plants & leaf imagery using deep learning models, along with prediction system to evaluate quality of future crops, and recommend how to improve quality of crops via pesticide prediction.

5. Research Objectives and Scope

5.1 Research Objectives

- Empirical evaluation of various nutrient identification with their intensity estimation
- Based on identified Nutrient levels evaluate Intensity and suggest how much amount of fertilizer required for crops.
- Design a prediction system to evaluate quality of future crops, and recommend how to improve quality of crops.
- Design a model for yield prediction of crops using temporal data & crop quality, and recommend quantity of pesticide, based on nutrient intensity levels
- Extend the system model to be applicable for multiple types of plant and leaf datasets

5.2 Scope

- The scope of this work is to design a prediction system to evaluate quality of future crops, and recommend how to improve quality of crops. Once that is completed, then design a model for yield prediction of crops using temporal data & crop quality, and recommend quantity of pesticide, based on nutrient intensity levels, and finally extend the system model to be applicable for multiple types of plant and leaf datasets.

6. Proposed Approach of Methodology

Detailed description of steps that are followed during development

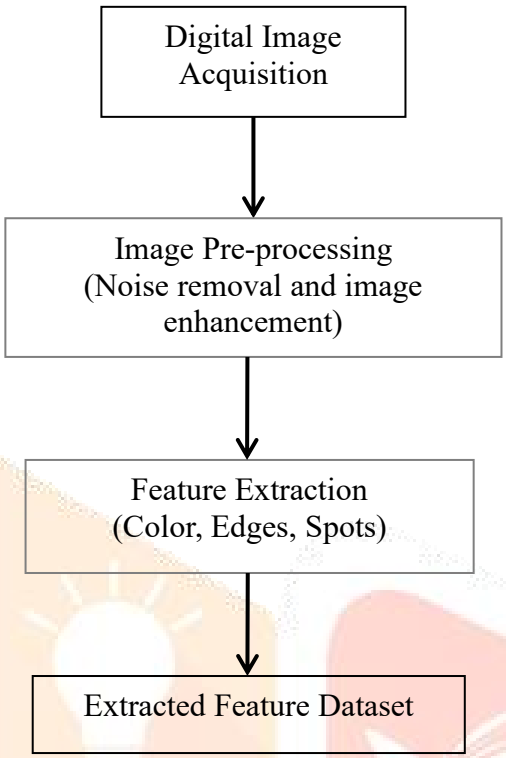

Fig 2. Dataset formation for machine learning

Initially we will start with digital image acquisition followed by image preprocessing with noise removal and enhancement etc. After that feature extraction consist color, edges, spots, then we will have extracted feature dataset .

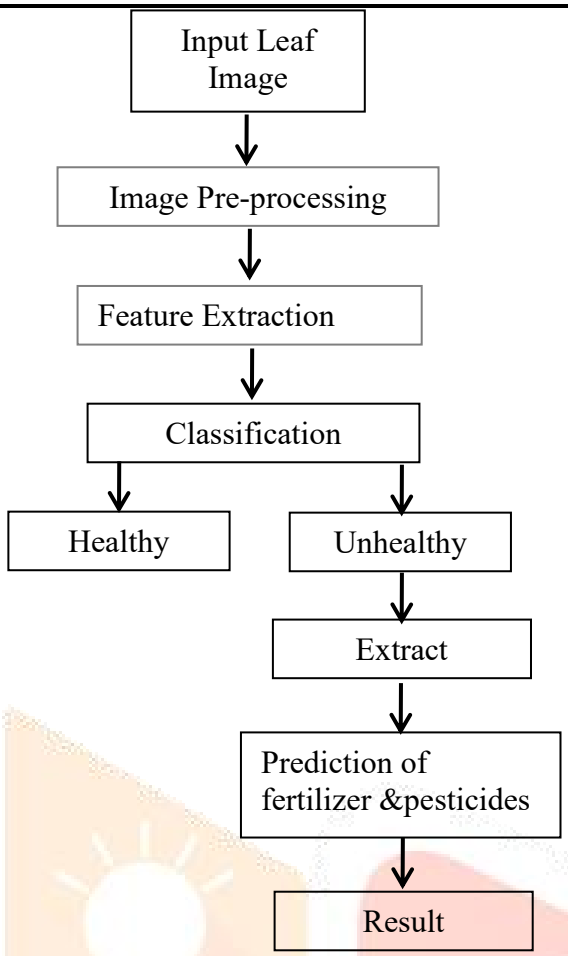

Fig 3. Deficiency identification using Machine learning

Image Acquisition

• First, researchers have to shape the Supervised Machine Learning dataset. Violently 700 photos are needed for the healthy plant and six nutrient absences, around 100 for each.

• For every defective and stable leaf to take an image of the white background in usual brilliance, digital camera is used.

Image Pre-processing

The image taken can contain some unnecessary noise or detail. Subtracting the context brings on the role of meaning. Noise is also taken out, if present, & the value portion, i.e. leaf, is improved for additional isolation & examination of deficiencies. By using Mean filtration to reduce noise and to provide a smooth picture. Mean filter eliminates abrupt pixel value shifts by substituting each pixel value with the nearest usual pixel value. This is centered on the kernel that specifies the size and shape of the region to be verified. Amplitude is measured for Image Improvement using histogram equalization.

Feature Extraction

Then the already processed image is taken to retrieve the fir feat = extraction. The characteristics are red (12), green (G), blue (B), G / R and GB band ratios. As contrast is firstly dominant on good leaf green is color. It also tests the average color spectrum of R,G, B from 0 to 255.

Edge Detection

If the value of the green color in the given input image is not dominant, a nutrient deficiency is likely in such cases, the area for error detection and the area for error detection shall be the edge detection. Different edge detectors as Laplacian of Gaussian, Roberts, Prewitt, Sobel, Zero Crossing, Canny etc. Roberts, Prewitt & Sobel used to discover 1st order derivative and Zero crossing, canny & LoG used to discover 2nd order derivatives. The gradient is the derivative of the 1st scale used to calculate changes in the amplitude of the signal gradient.

Classification

In ML, classification is supervised learning procedure where the input is already known and the output depends on the output data. Classification is supervised learning procedure in ML in that data is already known and success is based on feedback from study, i.e. output is analyzed. Researchers are using decision tree here for deficiency grouping. Picture will be piped and the extraction method will be used. Such parameters will now be compared to the input dataset by judgment , where the real parameters will fit the data set.

Result Prediction:

In this step, we will predict the result based upon the model which we have used for training purpose. Also, we will perform cross validation and parameter tuning for improvising the predicted results.

6.1 Hardware & Software Requirements

Hardware Requirements	Software Requirements
RAM: Minimum 1 GB or above	Operating System:Windows7 or above
Hard Disk:500 MB or above	Tool Used: Arduino interface, Raspberry Pi, MATLAB
Processor:13 or above	Tool Used: Python, OpenCV, Tensor Flow

7. Research Plan

Outline of the main activities and their timetable

Sr. No.	Phases	Duration in Months
1	Literature Survey	6
2	Problem Identification	6
3	Analysis and Design	11
4	Implementation	8
5	Testing	2
6	Thesis Writing	3

8. Implication

Several nutrition identification techniques has been reviewed and analyzed in this work. It has been observed that the limited work has been done in nutrient identification with their intensity estimation, Hence the system which we will be implementing, will address this issue. In this research, we will be identifying nutrient levels evaluate Intensity and suggest how much amount of fertilizer required for crops. And based on the obtained result will evaluate quality of future crops, and recommend how to improve quality of crops & yield prediction of crops using temporal data & crop quality, and recommend quantity of pesticide, based on nutrient intensity levels and extend the system model to be applicable for multiple types of plant and leaf datasets.

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