EFFICIENT RECOGNIZING NUTRIENT DEFICIENCY OF AGRICULTURAL CROP USING C4.5 DECISION TREE

Vivek Ugale[1], Deepak Gupta[2]

[1] PG Student, Department of Computer Engineering, Siddhant College of Engineering, Pune, Maharashtra State, India
[2] Professor, Department of Computer Engineering, Siddhant College of Engineering, Pune, Maharashtra State, India

ABSTRACT

Agriculture is most important occupation in India because population of india increasing exponentially. To fulfill food requirement of 12.5 billion population of India, researchers are doing study on how to increase efficiency of agricultural crop yield by early detection of any disease, minimizing impact of disease by taking preventive measures on arising problem. Nutrients are very important for crop and any insufficiency causes to disease which affect crop yield very drastically. There are 15 nutrients out of which 12 nutrient deficiencies occur in plant. Existing systems are very time consuming, not possible over large field area and less efficient. As we are computer researchers, our main objective of this work is to recognize nutrient deficiency of agricultural crop using computer technology. For this research work, we use smart phone camera to take image of infected agricultural crop leaf for processing. For extracting features more accurately, we applied color based segmentation on captured crop leaf image. Extracted color features are converted into discrete attributes. We converted captured leaf information in discrete attributes like age of leaf, primary color etc. For classification, we use decision tree C4.5 algorithm. Decision tree is trained by database created by experienced farmer and agricultural expert. For finding nutrient deficiency, we traverse tree with extracted attributes. We implemented system which recognizes nutrient deficiency successfully. In this paper, we described our system, its results and efficiency as well as advantages. Our system successfully recognize nutrient deficiency real time since it recognize nutrient deficiency on the spot, time efficient, easy to use by farmers, provide remedial solution and can applied over any agricultural crop and removes drawbacks of existing systems.

Keyword: - *Nutrient deficiency, Visual symptoms, feature extraction, decision tree*

1. INTRODUCTION

India is known as agricultural county as agriculture is primary and main occupation of 50% people of India. In India, directly 70% people are depends on revenue of agricultural business as well as food requirements. India is the second number most populated county on the earth after China. Population of India is about 1.252 billion and growing. It is predicted that India can become number one County in population in 2050. As the food is primary source of energy, this exponential growth of population required huge food from agricultural sector of India.

But, today's condition of agricultural sector of India is very bad because unpredictable environment like flood, draught, extreme weather conditions like very hot summer or very cool winter. The worst condition is that about 90% farmers are doing agriculture based on their own experience of agricultural work. They don't know any scientific knowledge about how to do farming, specific crop requirements, diseases, pests. 9% educated farmers just doing office job related agriculture and their direct agricultural farm contact very poor. Only 1% educated farmer doing agriculture scientifically and using advanced engineering equipment s. Because of this reasons, the efficiency of agricultural sector is very less. To fulfill food requirements, agricultural efficiency about crop yield must be increase.

Nutrients like N, P, K etc. are very important for crop for better yield and resistance towards any disease. There are 15 nutrients out of which 12 nutrients deficiency occurs in agricultural crop. If crop got required nutrient less than desirable amount, crop shows that particular nutrient deficiency using visual color symptoms on leaves.

Fig -1: Zink nutrient deficiency

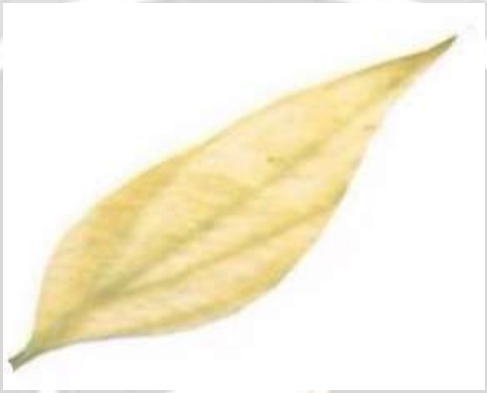

Fig -2: Nitrogen nutrient deficiency

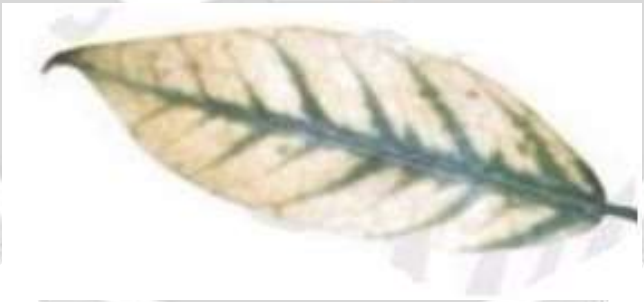

Fig -3: Magnesium nutrient deficiency

In existing system, agricultural expert visit agricultural farm, inspect leaves and recognize nutrient deficiency. This existing systems have many drawbacks such as time consuming, efficiency is directly based on Agricultural experts experience and physical condition and working of eyes, human limitations are imposed, less efficient, agricultural expert cannot inspect each and every leaves of crop, agricultural expert s are in less number and very expensive to farmers. Laboratory methods are also expensive and required near farm.

Computer researchers are finding solutions for agricultural problems using computer technology such as image processing, data mining. As agricultural problem leave mark on crop, various image processing techniques are used to find that specific mark or visual symptoms on crop.

We took nutrient deficiency recognition problem to solve with computer technology. As nutrient deficiency leave visual symptoms on crop leaves, we used leaf image as our main interest area in system to for analysis. As today's smart phone got popularity, we build our system using Android language. We captured infected leaf using Android smart phone camera. Then visual symptoms are extracted from leaf color using image processing techniques. We took one discreet attribute from farmer that leaf age type. The database is created by standard leaf which represents

nutrient deficiency, agricultural expert and experienced farmers. Decision tree generates by c4.5 algorithm trained by this database. Then for recognizing nutrient deficiency, we use rule generated by decision tree.
In literature survey section, we gave the literature review of existing methods of computer research s about solving agricultural problem using computer technology. System architecture and module description is given in next system overview section. In result section, we gave system results, efficiency chart of outputs. And finally, we concluded in conclusion section.

2. LITERATURE SURVEY

Some methods are common in most researchers presented in this section, that are the images are captured using consumer-level cameras in a controlled laboratory environment, and the format used for the images is RGB. Since their experiments are done in controlled environment it is not suitable for their method to work properly outside conditions. Also all authors applied some kind of preprocessing method on image for better result.
First developed algorithm strategy in this leaf image processing is detection type strategy. In this type, only leaf is infected or not, is detected. And it is like real time monitoring that system continuously monitor crop and issued alarm as soon as disease of interest is detected. The papers by Sena et al. [1] and Story et al. [2] are similar to this strategy.
Second strategy is quantification strategy. The objective of methods included in this strategy to quantify the severity of a given disease. Such a severity calculated by the area of the leaves that are affected by the disease, which can be estimated by means of color and texture features. Most quantification algorithms include a segmentation step to isolate the symptoms, from which features can be extracted and properly processed in order to provide an estimate for the severity of the disease. This strategy is very useful than manually calculation of severity. Patil and Bodhe used this quantification strategy to find severity of fungi-related disease on sugarcane leaves [3].
Third strategy is classification strategy. It is also considered as next enhancement in detection strategy. Detection strategy only specific to single disease, so classification provides benefit that multiple disease can identify using same method just changing the extracting features. Sanyal et al. used this strategy for detecting and classifying six types of mineral deficiencies in rice crops [4]. They also used same method for identification of two diseases which affect rice crop [5].
We summarized this literature survey as authors' methods are too specific for only for specific crop and only for specific disease problem. Many authors used very complex method to find solution. Finally all experiments are done in controlled environment which very deferent from actual agricultural farm conditions.

3. SYSTEM OVERVIEW

3.1 Problem definition

To develop a system that efficiently recognizes nutrient deficiency from captured agricultural crop leaf and gives remedial solutions.

3.2 System Architecture

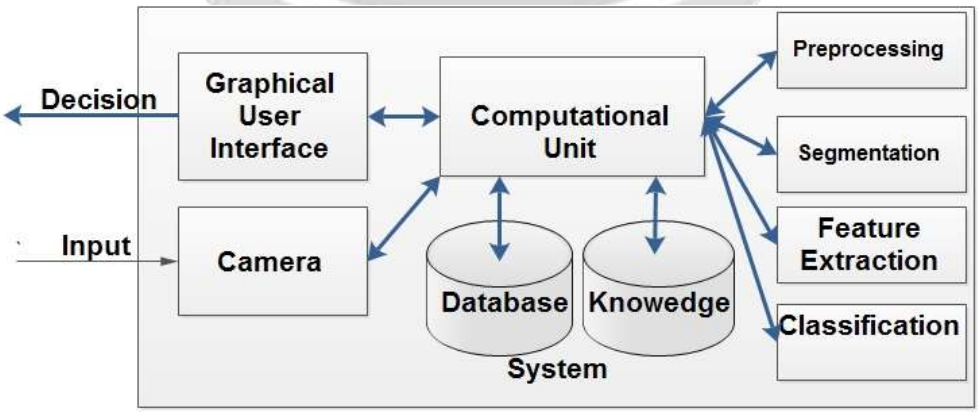

Fig -4: System Architecture

System consist of following main components description given in Table 1

Table -1: System main components and its working

Component	Working
Camera	Capture image of leaf
Database	Store visual information
Knowledge	Store decision tree
Computational Unit	Do require processing and calculations.

3.3 Module description and algorithms

i. **Acquisition module**: User click on button available on touch screen and capture infected leaf.

ii. **Preprocessing module:** In this module, canny edge detection is applied to detect edges of leaf. Then interested region of leaf is extracted.
Canny edge detection algorithm
Step 1: apply Gaussian blur
Step 2: find edge gradient strength and directions
Step 3: trace along the edges
Step 4: suppress non maximum edges

iii. **Color based segmentation:** Apply Euclidean distance formula to find nearest predefined color centroid.

iv. **Features extraction module**: From assignment of predefined color centroid, primary color as centroid having maximum count pixel, secondary color and third color as second maximum count and third maximum count respectively converted.

v. **Classification module**: In this module, firstly decision tree is generated by C4.5 algorithm on database created by experienced farmer and nutrient expert. When, to find nutrient deficiency infected leaf image is passed to system, according to extracted features of that leaf, tree traversal is done. And reached leaf node represents nutrients insufficiency.

vi.

C4.5 algorithm
Decision Tree (Training Database)
Create a new tree T with single root node
If Stoping Criteria (Training Database) then
    Mark T as a leaf the most common value of target feature in Training Database
Else
{
    Find the best attribute by Split Criteria

    Label node with best attribute

    For each outcome of best attribute
        Set Subtree= Decision Tree(Training Database having outcome) // recursive call
    End for
}

4. RESULTS AND ANALYSIS

Results are shown in the following figures and analysis is shown by charts.

Fig -5: Initial Screen

Fig -6: Captured Leaf Image

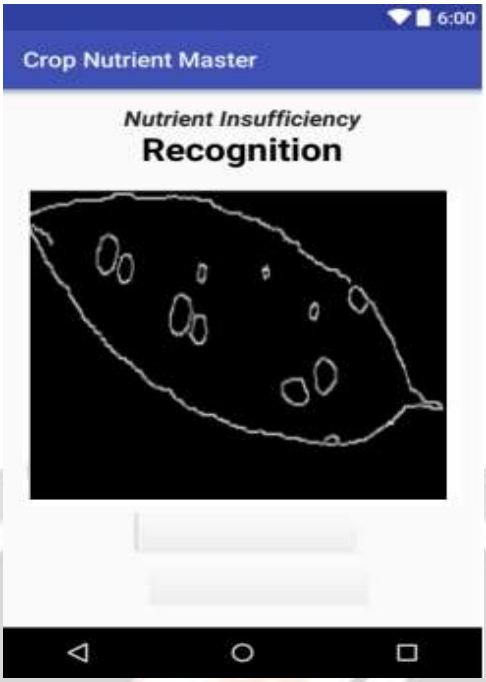

Fig -7: Edge detected

Fig -8: Nutrient deficiency recognized and solution

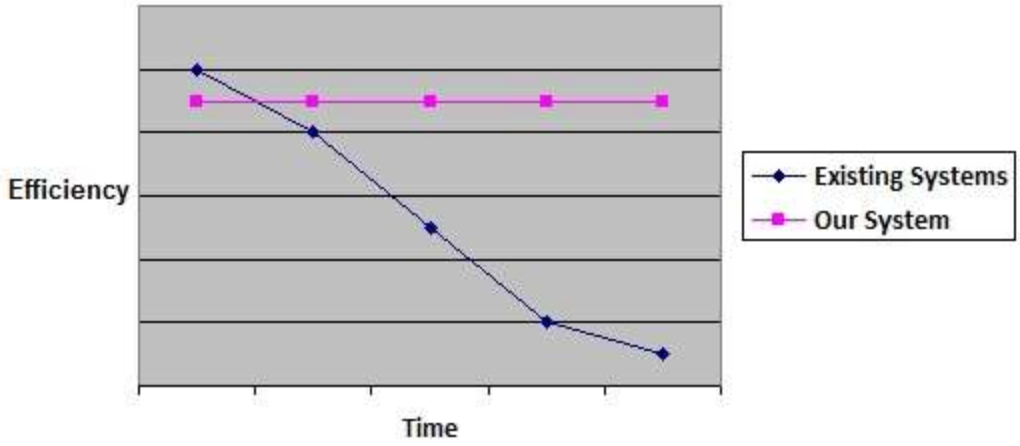

Chart -1: Efficiency vs Time

Above chart-1 shows that efficiency of our system is constant as time increases but existing systems efficiency decreases because of human limitations.

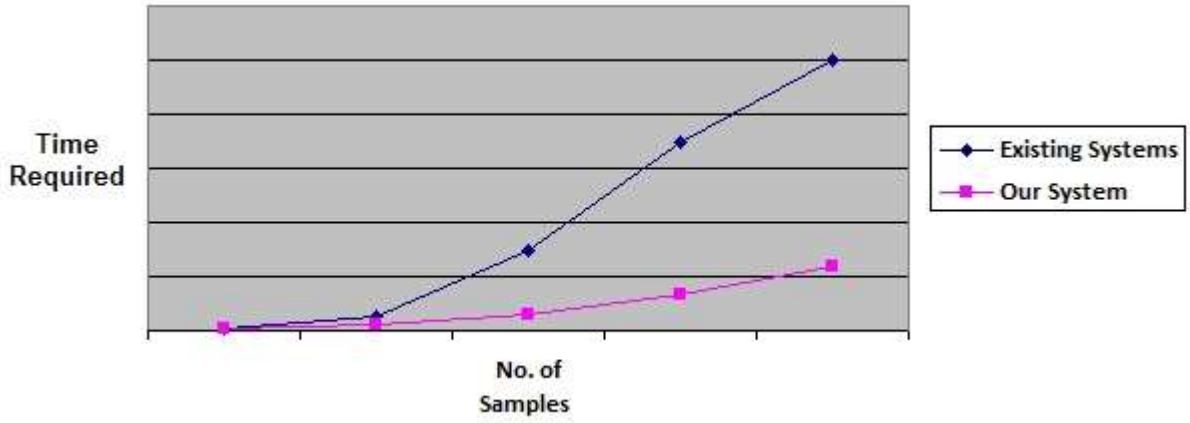

Chart -2: Execution time required vs Number of samples.

From chart-2, we got that our system required time is less than existing system. Our system is suitable for large number of samples.

5. CONCLUSIONS

After analyzing results, we concluded that our nutrient recognition system is very useful for Indian farmer. Farmers got solution at real time at the front of crop instantly. So, a crop yield will increase as well as Indian farmer situation also be better. Our system removes important drawbacks of existing system such as efficiency, time complexity, human errors and limitations. Decision tree C4.5 algorithm is very useful and simple algorithm than complex methods. Our system is very versatile and useful to recognize 12 nutrient deficiencies.

Our system is just use single image at a time. So, future enhancement in our system is that system can be work on video mode. And system can also use other functionality of android smart phone like global positioning system. Our system can be implemented in robotics.

.

6. ACKNOWLEDGEMENT

I would like to express my sincere thanks to my guide Prof. Deepak Gupta, Siddhant college of Engineering for his motivation and useful suggestions which truly helped me in improving the quality and effectiveness of this paper. I take this opportunity to express my thanks to my teacher, family and friends for their encouragement and support and valuable suggestions.

7. REFERENCES

[1]. Sena DG Jr, Pinto FAC, Queiroz DM, Viana PA, Fall armyworm damaged maize plant identification using digital images. Biosyst Eng 85(4):449–454, 2003
[2]. Story D, Kacira M, Kubota C, Akoglu A, An L, Lettuce calcium deficiency detection with machine vision computed plant features in controlled environments. Computer Electron Agric 74(2):238–243, 2010
[3]. Patil SB, Bodhe SK, Leaf disease severity measurement using image processing. Int J Eng Technol 3(5) : 297–301, 2011
[4]. Sanyal P, Bhattacharya U, Parui SK, Bandyopadhyay SK, Patel S, Color texture analysis of rice leaves diagnosing deficiency in the balance of mineral levels towards improvement of crop productivity. In: 10th International Conference on Information Technology (ICIT 2007). IEEE, Orissa, pp 85–90, 2007.
[5]. Sanyal P, Patel SC, Pattern recognition method to detect two diseases in rice plants. Imaging Sci J 56(6):7, 2008
[6]. Rafael C. Gonzalez, Woods, Digital image processing, Pearson, 2011
[7]. Lior Rokack, Data mining with decision trees, Word scienceific, 2008
[8]. Wilhelm Burger, Digital image processing : An algorithmic Introduction using java, 2007