Nitrogen Fertilizer Recommendation for Paddies through Automating the Leaf Color Chart (LCC)

Torikul Islam[1], Rafsan Uddin Beg Rizan[2], Yeasir Arefin Tusher[3], Md Shafiuzzaman[4],
Md. Alam Hossain[5] and Syed Galib[6*]
Department of Computer Science and Engineering, Jashore University of Science and Technology, Jashore, Bangladesh

***Abstract*—Nitrogen fertilizer is inevitable for rice production to ensure that the crop's nitrogen need is adequately supplied, during the growing season. International Rice Research Institute (IRRI) has proposed Leaf Color Chart (LCC) to detect the exact nitrogen need of paddy. Farmers generally monitor the plant's growth (which is also an indicator of the nitrogen concentration of leaves) by comparing the leaf color with the corresponding color of the LCC. Currently, in most cases, LCC is used manually to determine the fertilizer need and thus, there is a chance of either overestimating or underestimating the amount of fertilizer. To avoid this problem, a smart fertilizer recommendation system is proposed in this paper. The proposed method is able to automate the manual acquisition and interpretation of leaf color for classification through LCC. The experimentation considers a sample of 6000 Aman paddy leaf images. The data acquisition process was performed according to IRRI's guidance of taking the paddy leaf images within the body shade by our developed application. The data/images have already been made public in Kaggle - a well-known dataset website. The semantic segmentation of the dataset was performed by a powerful Convolutional Neural Network (CNN) backbone architecture - DeepLabV3+. Color classification into 4 categories of the LCC was performed by CNN architecture which consists of seven layers. Information gain based evaluation was performed in the Decision Tree (DT) approach to select features and with the selected features DT classified images into 4 categories. Color classification by our two proposed methods achieved 94.22% accuracy in CNN Model and 91.22% accuracy in the DT classifier.**

***Keywords*—Leaf Color Chart (LCC); Convolutional Neural Network (CNN); fertilizer recommendation system; color classification; Decision Tree (DT)**

I. Introduction

Paddy (*Oryza sativa L.*) is one of the principal food crops and also is consumed by one third of the world population residing in developing countries [1]. Nitrogen is a principle nutrient for paddy. The crop yields in the world are improved significantly due to the use of Nitrogen fertilizer [2]. However, farmers around the world are facing a problem to detect the nitrogen need of paddies for proper cultivation. Farmers attempt to estimate the required amount of nitrogen fertilizers through simply looking at the color of the crop's leaves. They generally apply nitrogen fertilizer too much (little Phosphorus (P) and Potassium (K) and other nutrients) that results in high pest and disease incidence [3]. Therefore, overestimation can be resolved by carefully matching leaf color with the LCC [4]. The optimum use of nitrogen fertilizer can be achieved by matching nitrogen supply with crop demand.

International Rice Research Institute (IRRI) has proposed Leaf Color Chart (LCC) to detect the exact nitrogen level of paddy [5]. LCC is used in the agricultural areas for recommending accurate amount of nitrogen fertilizer. In practice, leaf color is compared with its corresponding color in LCC inside body shade with proper lighting conditions. An exact color calibration process is necessary in the digital dimension for interpreting leaf colors. The calibration process evaluates the performance with the operational lighting conditions and determines whether the crops need fertilizers.

The LCC is being made of the plastic body having four green color levels with the standard suggestion of the amount of nitrogen fertilizers for different species such as Aman and Boro. It is arranged with such a shape where the panels are shown horizontally from yellowish green to dark green. IRRI's standard version ensures that the colors of the paddy leaves can be matched with corresponding LCC colors. The standard version having four green color variations as represented from two for yellowish green to five for the dark green is shown in Fig. 1.

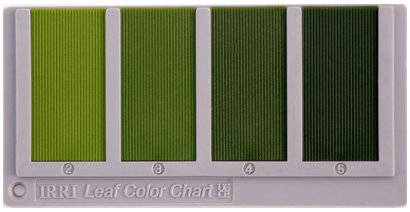

Fig. 1. Standard Leaf Color Chart [5]

Currently, the leaf color comparison process with LCC is manual i.e. farmers have to place paddy leaves on the shades of LCC and match it by simply visualizing. Thus, accurate measurement process is difficult for them. The farmers are also required to compare 6 to 10 leaves with the LCC level and find the average values. If the average value of Aman paddy leaf color level is less than or equal to 3.5 LCC level, nitrogen fertilizer is required of 7.5 kg per 0.133 hectares of land [6]. Usually, this process lacks the ease of detecting the accurate amount of fertilizers due to assumption. With the use of LCC for paddy, there is a possibility of saving fertilizers which may cause a positive environmental effect. The estimated annual saving of urea is 261.6 tons for Bangladesh if 50 per cent of the farmers use LCC in the irrigated rice area of 3488 million hectares of land [4].

Similar research has been proposed for nitrogen fertilizers of Soybean crops [7] by using the Fuzzy Logic method. The nitrogen fertilizer demand for Broccoli Plants was estimated

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E-mail: bjsir07@gmail.com

Time controlled automatic fish feeder for indoor aquarium

M. A. Ali[1], M. M. Rahman[2], M. N. Hasan[3] and S. M. Galib*[4]

[1]*Department of Biomedical Engineering, Jashore University of Science and Technology, Jashore 7408, Bangladesh*

[2]*Department of Computer Science and Engineering, Jashore University of Science and Technology, Jashore 7408, Bangladesh*

[3]*Department of Genetic Engineering and Biotechnology, Jashore University of Science and Technology, Jashore 7408, Bangladesh*

[4]*Department of Computer Science and Engineering, Jashore University of Science and Technology,Jashore 7408, Bangladesh*

Abstract

The purpose of this research is about the design and implementation of an automatic feeder to feed fishes in the aquarium when their owners leave home for a prolonged time or forget to feed timely due to their busyness. The mechanical drawing of the feeder is prepared in Auto Desk Fusion 360 software which is followed by the fabrication in a 3-D printer. For automatic feeding, an Arduino microcontroller board has been integrated with the designed mechanical system to control the opening and closing of the food chamber door with the help of a servo motor. An easy digital LCD programming system allows the user to set the time interval between two successive food deliveries and the number of servo rotation at each delivery to supply their desired amount of food. The performance of this portable and the low-cost feeder has been tested which has shown the reliability to dispense the accurate amount of food.

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Introduction

At present, especially urban people lead a very busy life. Being exhausted through the discharge of various duties is a daily occurrence there. Thus, to enjoy a little tranquility or just by mere hobbies, amid of hundredth busyness, one may fish in an aquarium or may fowl on the porch, while someone may feed cats or other pet animals. However, there is a problem when one forgets to feed his pets in time for busyness or goes on a long vacation during the occasions of Eid, Durga Puja, or Christmas festivals (especially in Bangladesh people go to their native villages to celebrate these occasions with their relatives). It is difficult to take these pet animals, especially the fish aquarium with them. Again, it is impossible to leave them behind, because without food the animals or fishes may become sick or even may die. There are many options available for feeding dogs and cats while away from home. But, the choices of fish owners are

*Corresponding author e-mail: galib.cse@just.edu.bd

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Protein secondary structure prediction by a neural network architecture with simple positioning algorithm techniques

Romana Rahman Ema[1], Sharmin Sultana[2], Shakil Ahmed Shaj[2], Syed Md. Galib[1]
[1]Department of Computer Science and Engineering, Faculty of Engineering and Technology, Jashore University of Science and Technology, Jashore, Bangladesh
[2]Department of Computer Science and Engineering, Faculty of Science and Technology, North Western University, Khulna, Bangladesh

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ABSTRACT

Protein secondary structure is an immense achievement of bioinformatics. It's an amino acid residue in a polypeptide backbone. In this paper, an innovative method has been proposed for predicting protein secondary structures based on 3-state protein secondary structure by neural network architecture with simple positioning algorithm (SIMPA) technique. Q3 (3-state prediction of protein secondary structure) is a fundamental methodology for our approach. Initially, the prediction of the secondary structure of the protein using the Q3 prediction method has been done. For this, a model has been built from its primary structure. Then it will retrieve the percentage of amino acid sequences from the original sequence to the accuracy of the predicted sequence. Utilizing the SIMPA technique from the 3-state secondary structure predicted sequence, the percentage of dissimilar residues of the three types (α-helix, β-sheet and coil) of Q3 has been extracted. Then the verification of the Q3 predicted accuracy through the SIMPA technique was done. Finally using a new method of neural network, it is verified that the Q3 prediction method gives good results from the neural network approach.

Corresponding Author:

Syed Md. Galib
Department of Computer Science and Engineering, Faculty of Engineering and Technology, Jashore University of Science and Technology
Jashore-7408, Bangladesh
Email: galib.cse@just.edu.bd

1. INTRODUCTION

Protein secondary structure prediction is the 3-D form of amino acid sequence that based on hydrogen bonding patterns and some geometric constraints. Secondary prediction has focused on the kind of amino acid that a residue's backbone adopts for an individual sequence. In support of this work prospect, three types: α-helix (H), β-sheet (E), and coil (C) have been analyzed [1], [2]. Simple positioning algorithm (SIMPA) is a concept of nearest neighborhood strategy that its traits towards a transition. It is often used to indicate data points based on how its neighbors are classified [3]. Neural networks are complex structures made up of artificial neurons that can capture 1 input and 1 output layer [4]. Here one hidden layer is observed. The number of 10-100 neurons are present here. The input level will be 20 window size order. This will reduce the window size of order window size to the hidden level. Activation function in a neural network which explains how the loaded amount of the input is converted from a node to output at a layer of the network. Nearest neighbor rule is a test case in point of protein structure [5]. Protein secondary structure prediction is usually performed at the input level in the form of sequence profiles and in addition to sequential structure matches [6]. Secondary structure states are divided into three categories: α-helix, β sheet,

Artificial Intelligence for Parkinson's Disease Diagnosis: A Review

Moradul Siddique Yeasir, Arefin Tusher, Humaun Kabir, and Syed Galib

Department of Computer Science and Engineering, Jashore University of Science and Technology, Jashore, Bangladesh

Mohammad Farhad Bulbul

Department of Mathematics Jashore University of Science and Technology, Jashore, Bangladesh and
Department of Computer Science and Engineering, Pohang University of Science and Technology, Pohang, South Korea

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Parkinson's disease (PD) is an illness of the neurological system that involves tremors, muscle stiffening, impairment of posture and movement, state of imbalance, changes in speech and writing, and reduction of concentration. Considering proper care, early and quick PD detection is essential for every probable patient. For detecting PD, however, there are no specific medical tests except the assessment of clinical symptoms. For a conclusive outcome, several physical issues must be noticeable in order to diagnose PD. Artificial Intelligence (AI)-driven approaches such as machine learning (ML), deep learning (DL), computer vision, and natural language processing (NLP) have been used for the classification and assessment of the severity of PD patients. However, a comprehensive and technical overview of AI methods through various data like non-motor signs and symptoms of PD are missing. Therefore, in this chapter, we present a systematic review of the literature based on the application of AI that serves to identify PD that have been recently published to diagnose PD from the medical and technical database. Hence, the review covers numerous

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A Deep Learning Approach for Covid-19 Detection in Chest X-Rays

SK. Shalauddin Kabir
Department of Computer Science and Engineering, Jashore University of Science and Technology, Jashore-7408, Bangladesh

Mohammad Farhad Bulbul
Department of Computer Science and Engineering, Pohang University of Science and Technology (POSTECH), 77 Cheongam, Pohang 37673, Republic of Korea;
Department of Mathematics, Jashore University of Science and Technology, Jashore-7408, Bangladesh

Fee Faysal Ahmed
Department of Mathematics, Jashore University of Science and Technology, Jashore-7408, Bangladesh

Syed Galib
Department of Computer Science and Engineering, Jashore University of Science and Technology, Jashore-7408, Bangladesh

Hazrat Ali
College of Science and Engineering, Hamad Bin Khalifa University, Qatar Foundation, Doha, Qatar

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Data Article

Paddynet: An organized dataset of paddy leaves for a smart fertilizer recommendation system

Md. Moradul Siddique[a], Torikul Islam[b], Yeasir Arefin Tusher[a], Romana Rahman Ema[a], Md. Nasim Adnan[a], Syed Md. Galib[a,*]

[a] Department of Computer Science and Engineering, Jashore University of Science and Technology, Jashore 7408, Bangladesh
[b] Institute of Information Technology, University of Dhaka, Dhaka 1217, Bangladesh

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ABSTRACT

The dataset of Leaf Color Chart (PaddyNet) is publicly unavailable. As far as the author's knowledge, this is the first dataset about paddy leaves based on LCC. This dataset has been generated by collecting images from a particular location such as Sajiali, Dogachia and Shyamnagar at Jashore, Bangladesh. This dataset contains 4 categories of Aman paddy leaves. The leaf images were captured by smart phones. There are 560 images of Aman paddy leaves. The data collection procedure was carried out according to the guidelines of Bangladesh Agricultural Research Institute (BARI). We meticulously categorized the entire dataset with regard to the LCC level and validated the data with the assistance of domain specialists. Hence, the images are analyzed and categorized with standards. The dataset is utilized for recognizing Leaf Color Chart level which will help of farmers recommending nitrogen fertilizer in their paddy fields.

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* Corresponding author.
E-mail address: galib.cse@just.edu.bd (S.Md. Galib).

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