Nanotechnology in the Life Sciences

Khalid Rehman Hakeem
Tanveer Bilal Pirzadah *Editors*

Nanobiotechnology in Agriculture

An Approach Towards Sustainability

Springer

Nanotechnology: A Boost for the Urgently Needed Second Green Revolution in Indian Agriculture

Kaizar Hossain, Syed Zaghum Abbas, Akil Ahmad, Mohd Rafatullah, Norli Ismail, Gaurav Pant, and Maruthi Avasn

1 Introduction

Agriculture is one of the major sectors that provide food for human, indirectly or directly in addition to feed, fibre, fire, and fuels. World agricultural industry is facing challenges such as climate change, urbanization, sustainable use of natural resources, and other environmental issues including urban runoff and accumulation of pesticides and fertilizers (Mukhopadhyay 2014). These problems are further intensified by an alarming population and food demand increment as an estimated population of 6–9 billion by 2050 is to be fed (Scott and Chen 2013; Chen and Yada 2011). India has targeted an average growth of 4% per annum for the agricultural sector by 2020 (Subramanian and Tarafdar 2011). However, India's agricultural growth has been experiencing decline during the last decade from about 3.6% (1985–1995) to less than 2% (1995–2005). Food grains production level is the major concern. The per capita annual production of cereals has shown declination from 200–205 kg in 1991/1995 to only 180–185 kg during 2004–2007, and it is still in decreasing trends which leads to great concerns towards food security. In order to achieve the 4% annual growth target, productivity and income per unit of these

K. Hossain (✉)
Department of Environmental Science, Asutosh College (Estd.- 1916), Kolkata, West Bengal, India

S. Z. Abbas · A. Ahmad · M. Rafatullah · N. Ismail
Environmental Technology Division, School of Industrial Technology, Universiti Sains Malaysia, Gelugor, Pulau Pinang, Malaysia

G. Pant
Institute of Applied Sciences and Humanities, GLA University, Mathura, Uttar Pradesh, India

M. Avasn
Department of Biosciences and Biotechnology, Krishna University, Machilipatnam, Andhra Pradesh, India

K. R. Hakeem, T. B. Pirzadah (eds.), *Nanobiotechnology in Agriculture*, Nanotechnology in the Life Sciences, https://doi.org/10.1007/978-3-030-39978-8_2

Algal Research 50 (2020) 102018

Contents lists available at ScienceDirect

Algal Research

journal homepage: www.elsevier.com/locate/algal

Short communication

Deep learning-based ResNeXt model in phycological studies for future

D.P. Yadav[a], A.S. Jalal[a], Deviram Garlapati[b], Kaizar Hossain[c], Ayush Goyal[d], Gaurav Pant[e,*]

[a] Department of Computer Engineering & Applications, G.L.A. University, Mathura, U.P., India
[b] National Centre for Coastal Research, Ministry of Earth Science (MoES), Govt. of India, Chennai, India
[c] Department of Environmental Science, Asutosh College (Estd. - 1916), Kolkata, West Bengal, India
[d] Department of Biotechnology, G.L.A. University, Mathura, U.P., India
[e] Department of Electrical Engineering and Computer Science, Texas A & M University Kingsville, Kingsville, TX, USA

ARTICLE INFO

Keywords:
Data augmentation
Algal genera
Convolution neural network
ResNeXt topology

ABSTRACT

Algae are photosynthetic eukaryotes that may range from unicellular to multicellular forms. Algae have been reported from almost all the ecological systems, including terrestrial, marine, and aquatic ecosystems. The manual classification of algae is a time-consuming method and requires great efforts with expertise due to the numerous families and genera. In the present study, an automated system is developed for the identification and classification of the 16 algal families with a data set of 80,000 images by a modified ResNeXt CNN (Convolution Neural Network) model. Cell differentiation by modified ResNeXt CNN topology is based on cell arrangement and morphological features including area, width, shape, and length of the cell. An experimental result of 99.97% classification accuracy demonstrates the effectiveness of the proposed method. The present investigation may open a new path in the future for the development of a time and a cost-effective, highly sensitive computer-based system for the identification and classification of different algae.

1. Introduction

Water is a fundamental component of life [1]. But due to various natural and anthropogenic activities, quality and quantity of water bodies are reducing globally [2,3]. Harmful algal blooms (HABs) are one of the major agents, affecting water quality due to their ability for producing various toxins [4,5]. Algae are photosynthetic eukaryotes that may range from unicellular to multicellular forms and produce a wide range of bioactive substances in which some are classes of toxins [6,7]. Various environmental conditions such as high concentrations of nutrients, particularly phosphorus, high water temperature, long hydraulic retention time, stable water body stratification, etc., favor algal bloom formation [8,9]. Regulatory and specialized agencies concerned with public health have introduced specific water quality protocols concerning algae for potable water. These risk management approaches are based on hazard assessment by algal identification, determination, and limitation of critical control points [10,11]. Therefore types and threshold levels of algal species have become critical for ensuring successful water management. As the manual identification of algae requires expertise and great efforts, a computer-based automated system with high accuracy may open a new path for the development of time and a cost-effective approach [12]. The advanced machine learning technique like deep learning is an emerging and effective tool for the identification and differentiation of different algal genera. Similar to manual identification, automated technique classifies algal cells based on the morphological characters and parameters including area, width, shape, and length of the cell [13].

For the last few decades some studies reported, different automated models such as a convolutional neural network (CNN), neural architecture search (NAS), artificial neural networks (ANN), etc. for algal identification. Promdaen et al. [14] demonstrate an automated recognition system with computing texture descriptors, feature combination approach, and Sequential Minimal Optimization (SMO) for the identification of 12 microalgae found in water resources of Thailand. They confirmed the effectiveness of the method in terms of 97.22% classification accuracy. Li et al. [15] demonstrate a promising and efficient solution via the Mueller matrix imaging system based on convolutional neural networks (CNNs) for the automatic classification of morphologically similar algae. They worked on a data set contains 10,463 Mueller matrices and achieve 97% classification accuracy. Deglint et al. [16] developed an innovative system with 96% accuracy for classifying six algal genera using a pre-trained deep residual convolution neural network. Park et al. [13] developed an effective CNN model for the classification of eight algal genera from watersheds with an F1-score of 0.95. They conclude the automated system as an emerging tool with high efficiency and rapid responses for monitoring algal events in

* Corresponding author at: Department of Biotechnology, Institute of Applied Sciences & Humanities, G.L.A. University, Mathura, U.P., India.
E-mail address: gaurav.pant@gla.ac.in (G. Pant).

https://doi.org/10.1016/j.algal.2020.102018
Received 28 May 2020; Received in revised form 14 July 2020; Accepted 18 July 2020
Available online 27 July 2020

Environmental Science and Pollution Research
https://doi.org/10.1007/s11356-020-11061-y

SHORT RESEARCH AND DISCUSSION ARTICLE

Air quality assessment among populous sites of major metropolitan cities in India during COVID-19 pandemic confinement

Gaurav Pant[1] · Alka[2] · Deviram Garlapati[3] · Ashish Gaur[1] · Kaizar Hossain[4] · Shoor Vir Singh[1] · Ashish Kumar Gupta[5]

Received: 12 June 2020 / Accepted: 29 September 2020

Abstract

The present study aims to determine the impact of COVID-19 pandemic confinement on air quality among populous sites of four major metropolitan cities in India (Delhi, Mumbai, Kolkata, and Chennai) from January 1, 2020 to May 31, 2020 by analyzing particulate matter (PM2.5 and PM10), nitrogen dioxide (NO_2), ammonia (NH_3), sulfur dioxide (SO_2), carbon monoxide (CO), and ozone levels. The most prominent pollutant concerning air quality index (AQI) was determined by Pearson's correlation analysis and unpaired Welch's two-sample *t* test was carried out to measure the statistically significant reduction in average AQI for all the four sites. AQI significantly plummeted by 44%, 59%, 59%, and 6% in ITO-Delhi, Worli-Mumbai, Jadavpur-Kolkata, and Manali Village-Chennai respectively. The findings conclude a significant improvement in air quality with respect to reduction of 49–73%, 17–63%, 30–74%, and 15–58% in the mean concentration of PM2.5, PM10, NH_3, and SO_2 respectively during the confinement for the studied locations. The *p* values for all of the four studied locations were found significantly less than the 5% level of significance for Welch's *t* test analysis. In addition, reduced AQI values were highly correlated with prominent pollutants (PM2.5 and PM10) during Pearson's correlation analysis. These positive results due to pandemic imprisonment might aid to alter the current policies and strategies of pollution control for a safe and sustainable environment.

Keywords Air quality index · COVID-19 pandemic confinement · Pearson correlation analysis · Welch's *t* test analysis

Introduction

COVID-19 crisis is caused by coronavirus 2 (SARS-CoV-2), a severe acute respiratory syndrome (Jandrić 2020). Currently, India is undergoing a 4.0 phase of confinement and has 190,649 confirmed COVID-19 cases and 5406 deaths until May 31, 2020 (covid19india.org). Confinement in India or any part of the world ensures that all transportation, factories, construction work, restaurants, and other social places should be closed to follow the social distancing on a serious note. These confinement phases not only help to control the spreading of infection, but also offer improvement in planetary health.

Air pollution is a major subgroup of environmental pollution which poses a serious threat to the ecosystem. The risk of global sustainability can be reduced by controlling anthropogenic activities responsible for the emission of air pollutants in the environment. India accounts for having one of the most polluted capitals and cities within the globe (Guttikunda et al. 2019). During a study conducted by the Central Pollution Control Board (CPCB), the Ministry of Environment, India confirmed significant impact of 1-day confinement in the country (March 22, 2020), named as "Janata Curfew" of 14 h from 7 a.m. to 9 p.m., on air quality in terms of reducing pollutant level when compared with previous day data (Barkur and Vibha 2020) (source CPCB, India).

Keeping in view the above, in the present study, impact of COVID-19 confinement on air qualities among the populous site of four major metropolitan cities in India (i.e., site 1—

Responsible Editor: Marcus Schulz

✉ Gaurav Pant
rgauravpant@gmail.com; gaurav.pant@gla.ac.in

[1] Department of Biotechnology, Institute of Applied Sciences & Humanities, G.L.A. University, Mathura, Uttar Pradesh, India

[2] Department of Mathematics and Statistics, Banasthali Vidyapith, Banasthali, Rajasthan, India

[3] National Centre for Coastal Research, Ministry of Earth Sciences (MoES), Govt. of India, Chennai, India

[4] Department of Environmental Science, Asutosh College (Estd. - 1916), Kolkata, West Bengal, India

[5] Amity University, Noida, Uttar Pradesh, India

Published online: 11 October 2020