Publications, Patents

International Journal of Data Science and Analytics
https://doi.org/10.1007/s41060-023-00477-7

REGULAR PAPER

Optimizing energy and latency trade-offs in mobile ultra-dense IoT networks within futuristic smart vertical networks

Venkata Chunduri[1] · Atul Kumar[2] · Anjali Joshi[3] · Soumya Ranjan Jena[4] · Akbar Jumaev[5] · Sujeet More[6]

Received: 23 September 2023 / Accepted: 8 November 2023

Abstract
As the Internet of Things (IoT) evolves and is integrated into cutting-edge Smart Vertical Networks-based IoT, a plethora of IoT mobile devices (IMD) must contend with the increasing processing demands of time-critical tasks. The dynamic nature of the environment raises novel challenges for networks that use mobile edge computing. As a proactive response to these issues, the concept of ultra-dense IoT with Mobile Edge Computing has emerged. Within this architecture, Integrated Mobile Devices (IMDs) can save power and preserve their internal processing resources by offloading compute-intensive tasks to servers located at the network's periphery (the "edge"). Nevertheless, the increased efficiency comes at the cost of greater transmission overhead, leading to an elevated delay. To achieve an ideal equilibrium between energy preservation and latency reduction, we propose a new optimization problem that focuses on minimizing both energy utilization and latency in ultra-dense IoT networks with multiple users and tasks. This issue entails the complex optimization of concurrent user (IMD) associations, computation offloading decisions, and resource allocations. To achieve a fair distribution of network load and maximize the utilization of computational resources, we integrate multi-step computation offloading methodologies into the issue formulation. Finally, the Adaptive Particle Swarm Optimization (PSO) technique is utilized as an intelligent way of solving the problem. Significantly, our methodology exhibits a noteworthy improvement over traditional Particle Swarm Optimization (PSO) techniques, resulting in a substantial decrease in overall expenses, encompassing reductions that span from 20 to 65%.

Keywords IoT · Futuristic smart vertical networks · Ultra-dense IoT networks · Mobile edge computing · IoT mobile devices · Latency-sensitive tasks · Energy utilization

1 Introduction

The "Internet of Everything" [1] age has arrived with the rapid development of fifth-generation (5G) mobile communication technology. Wireless network access and transmission have been challenged by the growing number of connected devices, including smartphones, cars, tablets, augmented reality (AR) glasses, etc. The creation of various augmented reality services aimed at the smart city idea, based on Internet of Things infrastructure, is made possible by the rising use

✉ Venkata Chunduri
vchunduri@sycamores.indstate.edu; chunduriv1@gmail.com

Atul Kumar
atulk.singh@yahoo.co.in

Anjali Joshi
anjali.joshi@mmit.edu.in

Soumya Ranjan Jena
soumyajena1989@gmail.com

Akbar Jumaev
jumaev@tfi.uz

Sujeet More
sujeetmore7@gmail.com

[1] Department of Mathematics and Computer Science, Indiana State University, Terre Haute, USA

[2] Dr. D. Y. Patil B-School, Pune, India

[3] Mechanical Engineering, Marathwada Mitra Mandal's Institute of Technology, Lohagaon, Pune, India

[4] Department of Computer Science and Engineering, Mahindra University, Hyderabad, Telangana 500043, India

[5] The Department of Statistics and Econometrics, Tashkent Institute of Finance, Tashkent, Uzbekistan

[6] Department of Computer Engineering, Trinity College of Engineering and Research, Pune, India

Published online: 07 December 2023

International Journal of
INTELLIGENT SYSTEMS AND APPLICATIONS IN ENGINEERING
ISSN:2147-6799 www.ijisae.org Original Research Paper

Enhancing Routing Performance in Software-Defined Wireless Sensor Networks through Reinforcement Learning

Nilesh P. Sable[1], Vijay U. Rathod[2], Mangesh D. Salunke[3], Hemantkumar B Jadhav[4], Ravindra S. Tambe[5], Suhas R. Kothavle[6]

Submitted: 21/05/2023 **Revised**: 07/07/2023 **Accepted**: 26/07/2023

Abstract: Software-Defined Networking (SDN) has swiftly taken over networks in data centers, telecommunications companies, and organizations because to its programmable and adaptable control plane. Due to its adaptability, SDN is a new architecture that is employed in numerous applications. The necessity for routing optimization has increased as a consequence of the exponential growth in network traffic demands needing quality of services. In order to enable the Internet of Things (IoTs), it is considered to be vital. Modern developments in SDN technology has allowed for central control and management, and programmatic interfaces enable flexible customization of network service like switches. SDN for routing has been introduced in WSNs. The SDN controller uses a variety of different methods to establish the routing path, but none of them are sufficiently efficient to provide the ideal routing path. As a result, reinforcement learning (RL) is a practical method for figuring out the best routing path. In this study, we improve the SDWSN's RL-based routing path. It is recommended to use a reward system that contains the relevant network QoS and energy efficiency metrics. While the agent receives the award and chooses what to do next base on the reward received, the SDWSN controller improves the routing path based on prior information. However, the Web also allows for remote management of the entire network.

***Keywords*:** *WSNs, SDWSN, routing, RL-based WSN, RL, IoTs, Energy optimization.*

1. Introduction

SDN has developed as one of the most intriguing networking recently developed technologies. The paradigm emphasized in emphasizes the separation of the control plane from the data plane and runs on high-performance commodity hardware with a logically centralized control plane. It has been widely embraced in actual wireless networking contexts, including datacentres, organizations that provide network infrastructure, and business networks. Additionally, since SDN has gained popularity, its security has drawn greater scrutiny. As a result, it is simple to locate numerous SDN security-related works that aim to protect SDN elements namely the switching, controllers, and SDN applications as shown in Figure 1.

[1]*Department of Information Technology, Bansilal Ramnath Agarwal Charitable Trusts, Vishwakarma Institute of Information Technology, SPPU, Pune, India, drsablenilesh@gmail.com*
[2]*Department of Artificial Intelligence & Data Science, GH Raisoni College of Engineering & Management Wagholi, Pune, SPPU, Pune, India, vijay.rathod25bel@gmail.com*
[3]*Department of Computer Engineering, Marathwada Mitramandal's Institute of Technology, SPPU, Pune, India, salunkemangesh019@gmail.com*
[4]*Department Department of Computer Engineering, Adsul's technical campus, Ahmednagar, India, hem3577@gmail.com*
[5]*Department Department of Computer Engineering, Dr. Vithalrao Vikhe Patil College of Engineering, Ahmednagar, India, ravindra.tambe01@gmail.com*
[6]*Department of Computer Engineering, Marathwada Mitramandal's Institute of Technology, SPPU, Pune, India, suhas.kothavle15@gmail.com*

International Journal of
INTELLIGENT SYSTEMS AND APPLICATIONS IN ENGINEERING
ISSN:2147-6799 www.ijisae.org Original Research Paper

Transformative Trends in Generative AI: Harnessing Large Language Models for Natural Language Understanding and Generation

Dr. Dinesh D. Patil[1], Dr.Dhanraj R. Dhotre[2], Dr. Gopal S. Gawande[3], Ms. Dipali S. Mate[4], Dr. Mayura V. Shelke[5], Prof. Tejaswini S. Bhoye[6]

Submitted: 06/09/2023 **Revised:** 20/10/2023 **Accepted:** 07/11/2023

Abstract: The advent of Large Language Models (LLMs) has ushered in transformative trends in the field of Generative Artificial Intelligence (AI). These models, with billions of parameters, have demonstrated unparalleled capabilities in Natural Language Understanding (NLU) and Generation (NLG) tasks. This paper delves into the evolution of generative AI, emphasizing the pivotal role played by LLMs. We explore the mechanisms by which these models have revolutionized NLU and NLG through their capacity to process vast amounts of textual data and generate coherent and contextually relevant text. Additionally, we investigate the techniques and methodologies employed in harnessing the power of LLMs for various applications, ranging from chatbots and content generation to machine translation and sentiment analysis. Furthermore, we examine the challenges associated with LLM-based generative AI, such as ethical concerns, model bias, and the computational resources required for training and fine-tuning. Finally, we offer insights into the future directions of research in this domain, with a focus on optimizing LLMs for broader applications, mitigating their limitations, and ensuring their responsible deployment in real-world scenarios. This paper serves as a comprehensive overview of the current state of generative AI, shedding light on its potential to reshape the way we interact with and generate natural language content.

Keywords: *Generative AI,Large Language Models (LLMs), Natural Language Understanding (NLU),Natural Language Generation (NLG),Content Generation Ethics, Multimodal AI, Human-AI, Ethical Content Generation, Data Privacy.*

1. Introduction

In recent years, the field of artificial intelligence (AI) has been witness to a remarkable transformation, largely attributed to the emergence of Large Language Models (LLMs) [1]. These models, equipped with billions of parameters, have redefined the landscape of generative AI by enabling unprecedented capabilities in Natural Language Understanding (NLU) and Generation (NLG) [2][3]. As we stand at the intersection of technology and linguistics, it becomes increasingly evident that LLMs are not just a trend but a transformative force shaping the future of AI-driven language applications.

The deployment of LLMs, such as GPT-3 and its successors, has given rise to new possibilities in human-computer interaction, content generation, and information retrieval. These models have demonstrated an exceptional ability to process vast amounts of textual data, discern context, and generate coherent and contextually relevant text in a human-like manner. From chatbots that engage users in natural conversations to automated content creation for a multitude of domains, the applications of LLM-based generative AI are manifold and continue to expand.

This paper embarks on a comprehensive exploration of the transformative trends driven by LLMs in the domain of generative AI, with a primary focus on their role in enhancing Natural Language Understanding and Generation. We aim to provide a holistic view of the evolution, methodologies, challenges, and future prospects associated with harnessing LLMs for NLU and NLG tasks.

[1]*Associate Professor, Department of Computer Science and Engineering, Shri Sant Gadge Baba College of Engineering andTechnology,Bhusawal. dineshonly@gmail.com*
[2] *Associate Professor Department of Computer Science and Engineering, School of Computing ,MIT Art Design and Technology University, Loni, Pune, India. dhanraj.dhotre@mituniversity.edu.in*
[3] *Associate professor : Deptt of E & TC Engg. Marathwada Mitra Mandal's College of Engineering Karve Nagar, Pune gopalgawande@mmcoe.edu.in*
[4] *BE ME Computer Sci.&Engg. Pune, dipumate@gmail.com*
[5] *Faculty,AI&DS Department, AISSMS Institute of Information Technology,Pune. mayura.shelke@gmail.com*
[6] *Assistant Professor,Computer engineering Department , Marathwada Mitra Mandal's College of Engineering Karve Nagar, Pune. tejaswini.chaure@gmail.com*

पेटेंट कार्यालय
शासकीय जर्नल

OFFICIAL JOURNAL
OF
THE PATENT OFFICE

निर्गमन सं. 33/2023	शुक्रवार	दिनांक: 18/08/2023
ISSUE NO. 33/2023	FRIDAY	DATE: 18/08/2023

पेटेंट कार्यालय का एक प्रकाशन
PUBLICATION OF THE PATENT OFFICE

(12) PATENT APPLICATION PUBLICATION
(19) INDIA
(22) Date of filing of Application :16/07/2023

(21) Application No.202321047867 A
(43) Publication Date : 18/08/2023

(54) Title of the invention : MACHINE LEARNING BASED GRADIENT BOOSTING REGRESSION APPROACH FOR WIND POWER PRODUCTION FORECASTING

(51) International classification :F03D 070200, F03D 092500, G06N 050000, G06N 200000, G06N 202000
(86) International Application No :PCT//
Filing Date :01/01/1900
(87) International Publication No : NA
(61) Patent of Addition to Application Number :NA
Filing Date :NA
(62) Divisional to Application Number :NA
Filing Date :NA

(71)**Name of Applicant :**
1)Dr. Satish S Banait
Address of Applicant :Assistant Professor, Department of Computer Engineering, K. K. Wagh Institute of Engineering Education & Research, Nashik, Amrutdhan Panchwati -422003, Maharashtra, India Nashik ---------- ----------
2)Dr. Prajakta Sachin Vispute
3)Prof. Sanjay Anil Agrawal
4)Prof. Rucha Abhishek Agrawal
5)Prof. Archana S. Banait
Name of Applicant : NA
Address of Applicant : NA
(72)**Name of Inventor :**
1)Dr. Satish S Banait
Address of Applicant :Assistant Professor, Department of Computer Engineering, K. K. Wagh Institute of Engineering Education & Research, Nashik, Amrutdhan Panchwati -422003, Maharashtra, India Nashik ---------- ----------
2)Dr. Prajakta Sachin Vispute
Address of Applicant :Shrirang Near K. J. Mehta, Dwarkawadi, Nashik Road, Nashik - 422011, Maharashtra, India Nashik ---------- ----------
3)Prof. Sanjay Anil Agrawal
Address of Applicant :Assistant Professor, Department of Computer Engineering, Marathwada Mitra Mandal's Institute of Technology, Vadgaon Shinde Road, Lohgaon, Pune - 411047, Maharashtra, India Lohgaon ---------- ----------
4)Prof. Rucha Abhishek Agrawal
Address of Applicant :Assistant Professor, Department of AI & DS, Marathwada Mitra Mandal's Institute of Technology, Vadgaon Shinde Road, Lohgaon, Pune - 411047, Maharashtra, India Pune ---------- ----------
5)Prof. Archana S. Banait
Address of Applicant :Department of Computer Engineering, MET's Institute of Engineering, Bhujbal Knowledge city, Nashik - 422207, Maharashtra, India Nashik ---------- ----------

(57) Abstract :
In the last few years, several countries have accomplished their determined renewable energy targets to achieve their future energy requirements with the foremost aim to encourage sustainable growth with reduced emissions, mainly through the implementation of wind and solar energy. In the present study, we propose and compare five optimized robust regression machine learning methods, namely, random forest, gradient boosting machine (GBM), k-nearest neighbor (kNN), decision-tree, and extra tree regression, which are applied to improve the forecasting accuracy of short-term wind energy generation in the wind farms, on the basis of a historic data of the wind speed and direction. Polar diagrams are plotted and the impacts of input variables such as the wind speed and direction on the wind energy generation are examined. Scatter curves depicting relationships between the wind speed and the produced turbine power are plotted for all of the methods and the predicted average wind power is compared with the real average power from the turbine with the help of the plotted error curves. The results demonstrate the superior forecasting performance of the algorithm incorporating gradient boosting machine regression.

No. of Pages : 23 No. of Claims : 8

INTELLECTUAL PROPERTY INDIA
PATENTS | DESIGNS | TRADE MARKS
GEOGRAPHICAL INDICATIONS

सत्यमेव जयते

क्रम सं/SL No :022138359

पेटेंट कार्यालय,भारत सरकार | The Patent Office, Government Of India

पेटेंट प्रमाण पत्र | Patent Certificate

(पेटेंट नियमावली का नियम 74) | (Rule 74 of The Patents Rules)

पेटेंट सं. / Patent No.	:	509408
आवेदन सं. / Application No.	:	201921016572
फाइल करने की तारीख / Date of Filing	:	26/04/2019
पेटेंटी / Patentee	:	1.PROF. DR. S.B. CHORDIYA 2.DR.DUSHYANT KUMAR SINGH 3.DR. CHUKKA SANTHAIAH (ASSOCIATE PROFESSOR, CSE DEPT.) 4.MRS. BHARATI K VYAS / PUROHIT

प्रमाणित किया जाता है कि पेटेंटी को, उपरोक्त आवेदन में यथाप्रकटित *I-LIFT: INTELLIGENT LIFT* नामक आविष्कार के लिए, पेटेंट अधिनियम, 1970 के उपबंधों के अनुसार आज तारीख अप्रैल 2019 के छब्बीसवें दिन से बीस वर्ष की अवधि के लिए पेटेंट अनुदत्त किया गया है।

It is hereby certified that a patent has been granted to the patentee for an invention entitled *I-LIFT: INTELLIGENT LIFT* as disclosed in the above mentioned application for the term of 20 years from the 26th day of April 2019 in accordance with the provisions of the Patents Act,1970.

अनुदान की तारीख : 10/02/2024
Date of Grant :

पेटेंट नियंत्रक
Controller of Patents

टिप्पणी - इस पेटेंट के नवीकरण के लिए फीस, यदि इसे बनाए रखा जाना है, अप्रैल 2021 के छब्बीसवें दिन को और उसके पश्चात प्रत्येक वर्ष मे उसी दिन देय होगी।

Note. - The fees for renewal of this patent, if it is to be maintained, will fall / has fallen due on 26th day of April 2021 and on the same day in every year thereafter.

*चूंकि पेटेंटी व आविष्कारकों की संख्या अधिक है, पेटेंटी व आविष्कारकों के नाम पृष्ठ संख्या 2 पर जारी हैं।
*Since the Number of Patentees / Inventors is more, the name of Patentees / Inventors are continued on Page No. 2

INTELLECTUAL PROPERTY INDIA
PATENTS | DESIGNS | TRADE MARKS
GEOGRAPHICAL INDICATIONS

पेटेंट प्रमाणपत्र के लिए अनुलग्नक/Annexure to Patent Certificate

पेटेंट सं. / Patent No.	:	509408
आवेदन सं. / Application No.	:	201921016572
फाइल करने की तारीख / Date of Filing	:	26/04/2019
पेटेंटी / Patentee (जारी/Continued)	:	5.MRS GAURI BHUSHAN GARUD 6.DR.RUPESH VASUDEO BHORTAKE 7.DR. KISHOR BHASKAR WAGHULDE 8.PROF. TEJASWINI SUNIL BHOYE 9.PROF .GIRISH L. ALLAMPALLEWAR 10.PROF. APARNA VIJAY PATIL 11.PROF.(DR.) BEG RAJ

Office of the Controller General of Patents, Designs & Trade Marks
Department for Promotion of Industry and Internal Trade
Ministry of Commerce & Industry,
Government of India

(http://ipindia.nic.in/index.htm)

INTELLECTUAL PROPERTY INDIA
PATENTS | DESIGNS | TRADE MARKS
GEOGRAPHICAL INDICATIONS

(http://ipindia.nic.in/index.htm)

Application Details	
APPLICATION NUMBER	202421007233
APPLICATION TYPE	ORDINARY APPLICATION
DATE OF FILING	02/02/2024
APPLICANT NAME	1 . Dr. Atul Prakashchandra Khatri 2 . Leena Abhijit Deshmukh 3 . Punam Bhimrao Kokate 4 . Vaibhav Dinkar Sawant 5 . Prajkta Dhananjay Shinde 6 . Reshma Shantaram Fegade 7 . Narendra Ramesh Kalbhor 8 . Mayur Ramkrishna Gandhile
TITLE OF INVENTION	DEVELOPMENT OF RCC SHORT COLUMNS WITH METAL PLATE AS A CONFINING REINFORCEMENT
FIELD OF INVENTION	CIVIL
E-MAIL (As Per Record)	avbreddy9@gmail.com
ADDITIONAL-EMAIL (As Per Record)	
E-MAIL (UPDATED Online)	
PRIORITY DATE	
REQUEST FOR EXAMINATION DATE	--
PUBLICATION DATE (U/S 11A)	01/03/2024