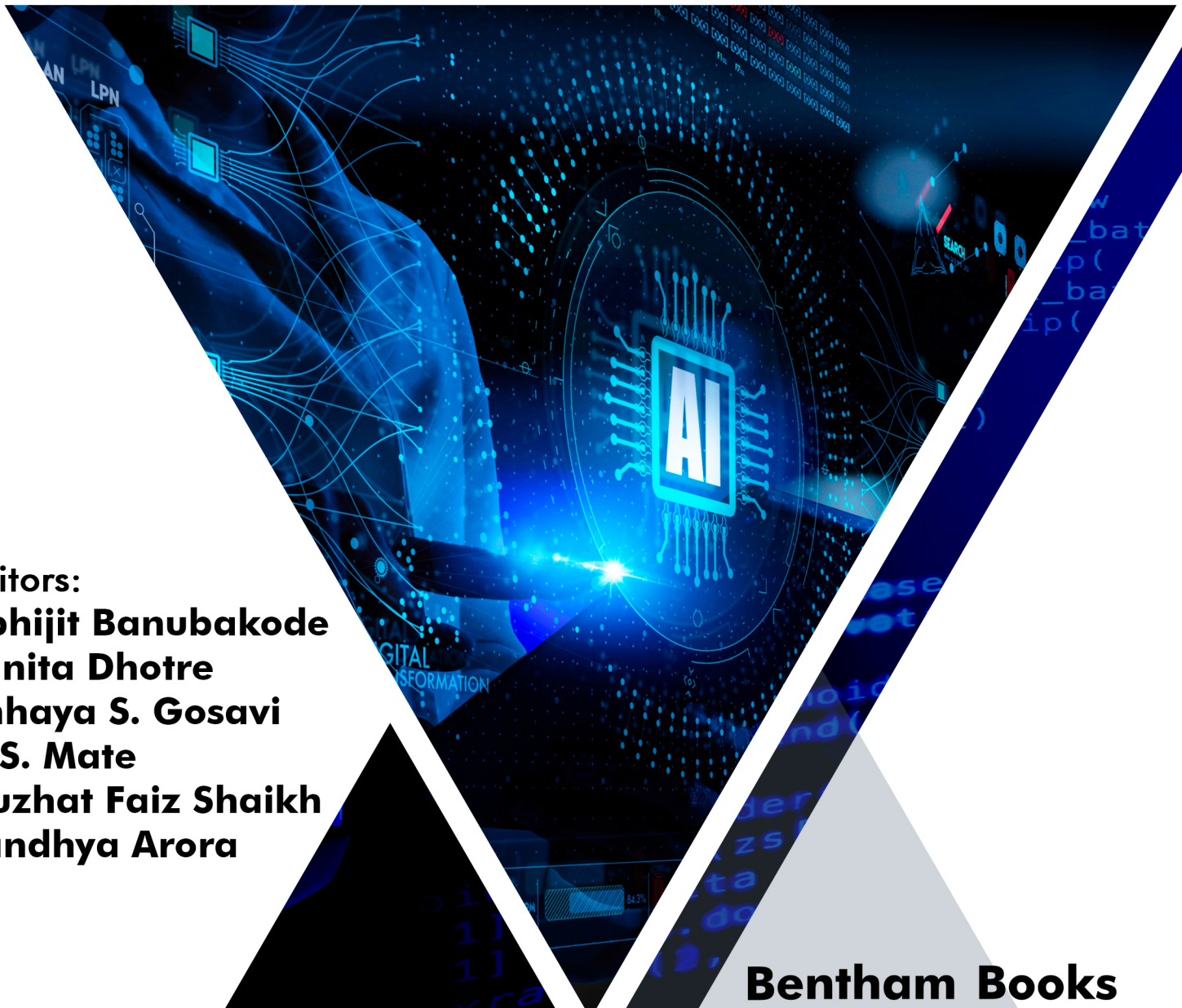
ARTIFICIAL INTELLIGENCE, MACHINE LEARNING AND USER INTERFACE DESIGN



Editors:
Abhijit Banubakode
Sunita Dhotre
Chhaya S. Gosavi
G.S. Mate
Nuzhat Faiz Shaikh
Sandhya Arora

Bentham Books

Artificial Intelligence, Machine Learning and User Interface Design

Edited By

Abhijit Banubakode
MET Institute of Computer Science, Bhujbal Knowledge City
Bandra Reclamation, Bandra (West)
Mumbai, Maharashtra, India

Sunita Dhotre
Department of Computer Engineering
Bharati Vidyapeeth (Deemed to be University)
College of Engineering
Pune, Maharashtra, India

Chhaya S. Gosavi
Department of Computer Engineering
MKSSS's Cummins College of Engineering for Women
Pune, Maharashtra, India

G. S. Mate
Department of Information Technology
JSPMs Rajarshi Shahu College of Engineering
Pune, Maharashtra, India

Nuzhat Faiz Shaikh
Department of Computer Engineering
M. E. S's Wadia College of Engineering
Pune, Maharashtra, India

&

Sandhya Arora
Department of Computer Engineering
MKSSS's Cummins College of Engineering for Women
Pune, Maharashtra, India

Artificial Intelligence, Machine Learning and User Interface Design

Editors: Abhijit Banubakode, Sunita Dhotre, Chhaya S. Gosavi, G. S. Mate,

Nuzhat Faiz Shaikh and Sandhya Arora

ISBN (Online): 978-981-5179-60-6

ISBN (Print): 978-981-5179-61-3

ISBN (Paperback): 978-981-5179-62-0

First published in 2024.

need for a court order if at any point you breach any terms of this License Agreement. In no event will any delay or failure by Bentham Science Publishers in enforcing your compliance with this License Agreement constitute a waiver of any of its rights.

3. You acknowledge that you have read this License Agreement, and agree to be bound by its terms and conditions. To the extent that any other terms and conditions presented on any website of Bentham Science Publishers conflict with, or are inconsistent with, the terms and conditions set out in this License Agreement, you acknowledge that the terms and conditions set out in this License Agreement shall prevail.

Bentham Science Publishers Pte. Ltd.
80 Robinson Road #02-00
Singapore 068898
Singapore
Email: subscriptions@benthamscience.net

CONTENTS

PREFACE

This edited book is aimed to be used by undergraduate or postgraduate students, researchers and industry professionals from a wide range of backgrounds like finance, e-learning, agriculture, social media, healthcare and many more.

Artificial Intelligence is a multidisciplinary field with an intrinsic relationship as a subfield to computer science. AI algorithms are preferred for faster and more accurate results, which enables AI to do many complicated and extensive tasks.

Machine learning has been playing a vital role in almost all major fields, such as finance, marketing, security, healthcare, social sciences, automobile, e-learning and many more. Machine learning, one of the most significant advances of this century, refers to an emerging area related to the collection, preparation, analysis, visualization, management, and preservation of both - structured and unstructured data. This book covers a vast range of topics critical to the field of Artificial Intelligence and Machine Learning in an easy-to-understand language.

This edited book will be ideal for both - beginners and experts related to Artificial Intelligence and Machine Learning.

Abhijit Banubakode
MET Institute of Computer Science, Bhujbal Knowledge City
Bandra Reclamation, Bandra (West)
Mumbai, Maharashtra, India

Sunita Dhotre
Department of Computer Engineering
Bharati Vidyapeeth (Deemed to be University)
College of Engineering
Pune, Maharashtra, India

Chhaya S. Gosavi
Department of Computer Engineering
MKSSS's Cummins College of Engineering for Women
Pune, Maharashtra, India

G. S. Mate
Department of Information Technology
JSPMs Rajarshi Shahu College of Engineering
Pune, Maharashtra, India

Nuzhat Faiz Shaikh
Department of Computer Engineering
M. E. S's Wadia College of Engineering
Pune, Maharashtra, India

&

Sandhya Arora
Department of Computer Engineering
MKSSS's Cummins College of Engineering for Women
Pune, Maharashtra, India

List of Contributors

Abhijit Banubakode	MET Institute of Computer Science, Bhujbal Knowledge City, Bandra Reclamation, Bandra (West), Mumbai, Maharashtra, India Shri Sant Gajanan Maharaj College of Engineering, Shegaon, Maharashtra-444203, India
Archana L. Rane	K. K. Wagh Institute of Engineering Education and Research, Nashik, Maharashtra, India
Ashok B. More	Department of Civil Engineering, D.Y. Patil College of Engineering, Akurdi, Maharashtra, India
Ajinkya Kunjir	Orium, Sault Ste. Marie, Ontario, Canada
Arjun Singh	Department of Computer Science and Engineering, Greater Noida Institute of Technology, Greater Noida, India
Arun Kumar Singh	Department of Computer Science and Engineering, Greater Noida Institute of Technology, Greater Noida, India
Amruta Bajirao Patil	Department of Electronics and Telecommunication Engineering, Symbiosis Institute of Technology SIT, Symbiosis International Deemed University SIU, Lavale, Pune-412115, India
Ashish Tripathi	School of Computing Science and Engineering, Galgotias University, Greater Noida, India
Chhaya S. Gosavi	Department of Computer Engineering, MKSSS's Cummins College of Engineering for Women Pune, Maharashtra, India
Debam Bhattacharya	K. K. Wagh Institute of Engineering Education and Research, Nashik, Maharashtra, India
Hrushikesh Pathade	Modern Education Society's College of Engineering, Pune, India
Krantee M. Jamdaade	Department of Data Science and Technology, K. J. Somaiya Institute of Management, Mumbai, India
Mahendra Deore	Department of Computer Engineering, Cummins College of Engineering for Women, Pune, Maharashtra, India
Mahesh Kumar Singh	Dronacharya Group of Institutions, Greater Noida-201306, Uttar Pradesh, India
Mrinal Rahul Bachute	Department of Electronics and Telecommunication Engineering, Symbiosis Institute of Technology SIT, Symbiosis International Deemed University SIU, Lavale, Pune-412115, India
Mrutunjay Biswal	Department of Data Science and Technology, K. J. Somaiya Institute of Management, Mumbai, India
Manoj Singhal	Department of Information Technology, G. L. Bajaj Institute of Technology and Management, Greater Noida, India
Nikhita Mangaonkar	Bharatiya Vidya Bhavan's Sardar Patel Institute of Technology, Andheri-West, Mumbai, India
Nirmala Joshi	MET Institute of Management, Mumbai, India
Narendra M. Kandoi	Shri Sant Gajanan Maharaj College of Engineering, Shegaon, Maharashtra-444203, India

CHAPTER 1

Artificial Taste Perception of Tea Beverage Using Machine Learning

Amruta Bajirao Patil[1] and **Mrinal Rahul Bachute**[1,*]

[1] *Department of Electronics and Telecommunication Engineering, Symbiosis Institute of Technology SIT, Symbiosis International Deemed University SIU, Lavale, Pune-412115, India*

Abstract: Nowadays, an artificial perception of beverages is in high demand as working hours increase, and people depend on readymade food and beverages. An assurance of quality, safety, and edibility of food and drink products is essential both for food producers and consumers. Assurance of unique beverage taste and consistent taste uniformity creates a distinct identity in the market. India is the second largest tea producer country in the world. Based on geographic location, the tea has a specific flavor and aroma. Artificial Intelligence (AI) can contribute to the feature identification and grading of tea species. The taste, aroma, and color are the three main attributes that can be sensed with the help of E-tongue, E-nose and E-vision, and can be processed further for automatic tea grading. The various potentiometric, voltammetric, Metal Oxide Semiconductor (MOS) and acoustic sensors are available with Principal Component Analysis (PCA). For tea analysis, various reviews are mentioned, like User Experience (UX evaluation, literature review, bibliometric review, and patent review. An in-depth analysis of artificial taste perception using machine learning has been described in the chapter. The topic covered almost all possible approaches to the artificial perception of tea with various interesting facts.

Keywords: Artificial taste perception, Acoustic wave sensors, Color, Flavor and odor detection, MOS sensors, Machine learning algorithms, Tea.

INTRODUCTION

Nowadays, several new diseases are caused due to changing lifestyles. Everyone is just running behind the money by keeping daily basic needs aside or making compromises. There is no use of such blindfolded thinking, as gaining money cannot assure a healthy life. A person can buy required readymade things and products with money, but the quality of the product needs to be verified from time

* **Corresponding author Mrinal Rahul Bachute:** Department of Electronics and Telecommunication Engineering, Symbiosis Institute of Technology SIT, Symbiosis International Deemed University SIU, Lavale, Pune-412115, India; E-mail:Mrinal.bachute@sitpune.edu.in

Abhijit Banubakode, Sunita Dhotre, Chhaya S. Gosavi, G. S. Mate, Nuzhat Faiz Shaikh & Sandhya Arora (Eds.)

to time. Today is the world of ready-to-eat or ready-to-drink products. Quality is a big concern for both food producers and consumers.

So, assurance of the quality and taste uniformity of food and beverages is very much necessary. Technology must be incorporated for artificial perception and quality grading as it is directly related to human health awareness and care. Artificial taste perception will set the benchmark for flavors in the food industry. It also assures the safety and edibility of food and beverages. The food and beverage industries depend upon brand popularity and standards to sustain a good rapport with the end user. Businesses can be clogged by goods recall or contamination. The adulteration may harm consumers' lives badly. Ultimately, "Artificial taste perception and verification" means food brand protection. It also helps reduce wastage and recall due to taste variation [1].

The sensor assembly can be used to monitor results in beverage development, beverage purity authentication, flavor aging analysis, alcoholic, or non-alcoholic drinks, measure the effect of process control variables, establish devotion to government standards, measure levels of spice, flavors, dissolved compounds, and compute taste-masking success. Taste sensors have artificial polyvinyl chloride (PVC)/lipid membranes that react with a test liquor such as beverages, blood, caffeine, *etc*. The voltage of the lipid membrane varies the sensor output or measurement monitoring potential variation results in measuring the "taste" provided by the production of the chemical substances. With the sensor assembly, multiple sensors provide a change in conductivity and form a complete response [2 - 5]. Artificial taste perception is about various taste patterns that can be assessed for uniformity.

India is the second largest tea-producing country on the globe. Tea is the national drink of India and its agro-asset as well. According to IMARC (a leading market research company), the global tea market extended a value of US$ 21 Billion in 2020 and expected a Compound Annual Growth Rate (CAGR) of 5.1% during 2021-2026. In India, "the tea board of India" decides the policies for tea farming, manufacturing to marketing. Three important varieties of tea have been produced in India- Black Tea, Green Tea, and Oolong Tea. Each species has its own advantages.

Due to several advantages, tea is treated as a herbal medicine and is used in many health care products. In the last two decades, the second variety of tea has gained more popularity, named green tea. Nowadays the world is growing with the information technology sector, and due to this, desk jobs or motionless jobs are increasing daily. We face many issues, such as increased blood pressure, high blood sugar, excess body fat around the waist, and abnormal cholesterol levels.

So, sometimes prescribed tea consumption is helpful for the human body. Daily, it should be monitored for each consumption.

Three primary attributes of tea taste, color, and fragrance are essential. In artificial taste perception, the tea taste is analyzed for its pH parameter [2 - 5].

Fig. (**1**) shows the hardware and software requirements of the tea testing. This research aims to automate tea tasting and classification with the help of electronic gadgets and Machine learning algorithms.

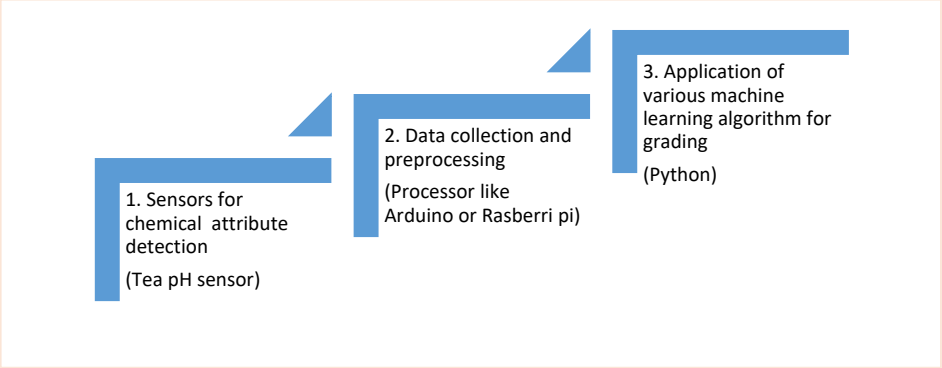


Fig. (1). Hardware and software requirement of artificial taste perception.

Fig. (**2**) shows the classification of tea according to its size. The broken and tiny tea leaves form a mixture of tea dust, making the tea sample dark and have a strong flavor. The other type has been formed by whole tea leaves, which causes a lighter and softer taste of tea liquor. For the tea Industry, it is difficult to predict the actual age of the tea sample. No such electronic technology has been implemented yet. In India, an electronic technique is implemented for artificial odor perception of black tea grading as “E-nose” using a microcontroller by CDAC and Jadavpur University, which is under verification. Alpha Mos is the manufacturing industry of France, which provides a global solution for beverage analysis. In India, tea analysis is not implemented with the machine learning concept [2 - 5].

The tea grading depends on three essential attributes of tea- its flavor, fragrance, and color. The fusion of all three features still needs to be developed [1 - 3, 6].

Four essential reviews are considered for this research on the Indian Tea Industry, as listed in Fig. (**3**).

CHAPTER 2

Significance of Evolutionary Artificial Intelligence: A Detailed Overview of the Concepts, Techniques, and Applications

Ashish Tripathi[1,*], Rajnesh Singh[1], Arun Kumar Singh[2], Pragati Gupta[1], Siddharth Vats[3] and **Manoj Singhal[4]**

[1] *School of Computing Science and Engineering, Galgotias University, Greater Noida, India*

[2] *Department of Computer Science & Engineering, Greater Noida Institute of Technology, Greater Noida, India*

[3] *Department of Biotechnology, IMS Engineering College, Ghaziabad, India*

[4] *Department of Information Technology, G. L. Bajaj Institute of Technology and Management, Greater Noida, India*

Abstract: An evolutionary algorithm (EA) is known as a subset of evolutionary computation. It is inspired by natural evolution and applies natural phenomena to search for the optimal solution. Its parallel search capability and randomized nature enable it to be effective and unique in solving different real-world problems in comparison to existing classical optimization algorithms. The evolutionary algorithm applies biological techniques such as selection, reproduction, and mutation to solve complex problems. It starts with a random population of candidate solutions and applies biological techniques to every generation until feasible solutions are obtained. The only fit solutionis intelligence (AI) simulation human intelligence in machines. Machines are programmed enough to think like humans and imitate their actions. AI based models are developed to provide new solutions to real-world problems. As real-world problems are very complex, the desired solutions for such problems are required to be explored in complex, high-dimensional, and very large search spaces. In this context, nature inspired and population based evolutionary techniques are the most suitable approach to find the optimal solution. The nature-inspired evolutionary techniques follow the natural phenomenon and these phenomenon helps to search for the desired optimal solution when the direction of the search is allowed to survive and continue to move in further generations to determine the optimal solution. Artificial not known at the beginning. So, "Evolutionary Artificial Intelligence (EAI)" is the term that presents the combination of human intelligence and natural phenomenon-based solutions to real-world complex problems. This chapter covers an overview of optimization techniques, artificial intelligence, and evolutionary computation in detail.

[*] **Corresponding author Ashish Tripathi:** School of Computing Science and Engineering, Galgotias University, Greater Noida, India; E-mail: ashish.mnnit44@gmail.com

Abhijit Banubakode, Sunita Dhotre, Chhaya S. Gosavi, G. S. Mate, Nuzhat Faiz Shaikh & Sandhya Arora (Eds.)

A detailed discussion on evolutionary artificial intelligence, followed by applications of evolutionary machine learning is also presented. After that, the significance of evolutionary artificial intelligence in decision making has been discussed. Finally, the conclusion has been given, which shows the summary of the chapter.

Keywords: Artificial intelligence, Evolutionary algorithms, Optimization techniques, Natural evolution.

INTRODUCTION

The study of problems in which one attempts to minimize or maximize an objective function by methodically selecting integer or real values within a permitted set is referred to as optimization. In other words, optimization means to discover the minimum or maximum value of an objective function by selecting the input values systematically within the permitted set of values [1]. The issues related to optimization are crucial since they are intended to either increase profits or decrease losses. Thus, optimization deals with the selection of optimal solutions from the set of all available feasible solutions [2]. Determining whether the solution is optimal or not can be found by calculating the degree of the solution. The degree can be understood as the quality of the solution that ensures whether the given solution fulfills the desired optimality with respect to the given problem. The term degree is calculated with respect to the objective function (fitness function) that is to be maximized or minimized. For example, if you want to buy a car, generally, two prime objectives are to get the car at minimum cost and maximum comfort. Thus, here the objectives (problems) are to minimize the cost and maximize the comfort. For that, we do search and analyze *via* showrooms, websites, friends and family, and finally, we get the optimal solution. Here, optimal means getting the best among all feasible solutions.

In several real-life optimization problems, such as image processing, feature extraction, augmented reality, market prediction, defense, automation, *etc*., the role of optimization techniques is significant. Based on the diverse nature of the problems, different types of optimization algorithms have been proposed by researchers from time to time. Usually, for a given problem, many alternative feasible solutions may be possible, but which is the best solution among all alternative solutions is decided by the objective of the problem. There are two types of optimal solutions, *i.e*., global optimal and local optimal. If the solution is better than all possible candidate solutions in the complete search space, then it is known as the global optimal solution. While if it is better only within its neighborhood solutions (*i.e*., all candidate solution s in the neighbor), then it is known as a local optimal solution [3].

Optimization algorithm has two categories, deterministic and randomized. The selection of either of the two depends on the complexity of the optimization problem. If the given search space has less number of candidate solutions (*i.e*., the number of search points) to find the optimal solution, the deterministic approach is the better option [4]. Because the number of solutions reduces the number of comparisons in the search space. Thus, it minimizes the computation complexity. Therefore, in this context, dynamic programming could be used to get the optimal solution. It can provide the optimal solution based on the comparative analysis of the fitness of all possible solutions. While the problems with a large number of feasible candidate solutions require several comparisons to get the optimal solution which is not feasible due to its computational complexity. These problems are considered Non-Polynomial (NP) hard problems, where finding an optimal solution is not simple as in the previous case. For such problems, randomized algorithms could be the best option for providing the optimal solution.

In literature, various optimization algorithms have been discussed and implemented to handle problems which are NP-hard in nature. These algorithms are developed with the objective of providing the solution with desired optimality and reduced computational time. The goodness of the randomized algorithms is that they conduct searching for the solution in a random direction. This search operation continues until the optimal solution is found. In this reference, evolutionary algorithms have already proved their acceptance as widely used algorithms for providing feasible solutions for different optimization problems [5]. Evolutionary Algorithms (EAs) are one of the types of Artificial Intelligence (AI). The optimization processes existing in nature are incorporated in EAs. In other words, it can be seen as the incorporation of nature-inspired techniques into human-made techniques for problem-solving. The natural techniques include gradual evolution, survival selection, bird flocking, ant colonies, reproduction, *etc*. EAs incorporate the heuristic approaches to provide the solution for real-world problems which could not be possible to solve in polynomial time easily. Such types of problems could be NP-Hard in nature or problems that take too long time to completely process.

The randomized search techniques of EAs include natural selection and genetic engineering for searching the feasible solutions, which finally gives the optimal solution. The algorithms which come under EAs follow the idea of natural selection, which is based on Darwin's principle of "Survival of the fittest" *i.e*. select the best and discard the rest [6]. According to this theory only the fit individuals can survivewhile the rest are eliminated by nature. Another concept is the Theory of Adaptive Learning. Nature trains individuals to survive under environmental pressure which is possible through adaptive learning. Adaptive

CHAPTER 3

Impact of Deep Learning on Natural Language Processing

Arun Kumar Singh[1,*], Ashish Tripathi[2], Sandeep Saxena[2], Pushpa Choudhary[2], Mahesh Kumar Singh[3] and **Arjun Singh[1]**

[1] *Department of Computer Science and Engineering, Greater Noida Institute of Technology, Greater Noida, India*

[2] *School of Computing Science and Engineering, Galgotias University, Greater Noida, India*

[3] *Dronacharya Group of Institutions, Greater Noida-201306, Uttar Pradesh, India*

Abstract: In the era of digitalization, electronic gadgets such as Google Translate, Siri, and Alexa have at least one characteristic: They are all the products of natural language processing (NLP). "Natural Language" refers to a human language used for daily communication, such as English, Hindi, Bengali, *etc*. Natural languages, as opposed to artificial languages such as computer languages and mathematical nomenclature, have evolved as they have been transmitted from generation to generation and are challenging to explain with clear limits in the first instance. In natural language processing, artificial intelligence (Singh *et al*., 2021), linguistics, information processing, and cognitive science are all related fields (NLP). NLP aims to use intelligent computer techniques to process human language. However, NLP technologies such as voice recognition, language comprehension, and machine translation exist. With such limited obvious exclusions, machine learning algorithms in NLP sometimes lacked sufficient capacity to consume massive amounts of training data. In addition, the algorithms, techniques, and infrastructural facilities lack enough strength.

Humans design features in traditional machine learning, and feature engineering is a limitation that requires significant human expertise. Simultaneously, the accompanying superficial algorithms lack depiction capability and, as a result, the ability to generate layers of duplicatable concepts that would naturally separate intricate aspects in forming visible linguistic data. Deep learning overcomes the challenges mentioned earlier by using deep, layered modelling architectures, often using neural networks and the corresponding full-stack learning methods.

Deep learning has recently enhanced natural language processing by using artificial neural networks based on biological brain systems and Backpropagation. Deep learning approaches that use several processing layers to develop hierarchy data representations

[*] **Corresponding author Arun Kumar Singh:** Department of Computer Science and Engineering, Greater Noida Institute of Technology, Greater Noida, India; E-mail: arun.k.singh.iiit@gmail.com

Abhijit Banubakode, Sunita Dhotre, Chhaya S. Gosavi, G. S. Mate, Nuzhat Faiz Shaikh & Sandhya Arora (Eds.)

have produced cutting-edge results in various areas. This chapter introduces natural-language processing (NLP) as an AI component. The history of NLP is next. Distributed language representations are the core of NLP's profound learning revolution. After the survey, the boundaries of deep learning for NLP are investigated. The paper proposes five NLP scientific fields.

Keywords: Attention, Convolutional neural networks (CNN), Deep learning (DL), LSTM, Natural language processing (NLP), POS tagging, Recurrent neural networks (RNN), Sentiment analysis, Word2Vec.

INTRODUCTION

In the digital age, a piece of new information is created and conveyed to each other *via* Facebook, WhatsApp, Twitter, and other internet platforms, in which information may be in the form of video, audio or textual. However, the preliminary data is textual, which is unstructured in behavior. Consequently, it is necessary to understand Natural Language Processing systems (NLP) [1] to develop significant knowledge from such a piece of information. Artificial Intelligence (AI) branch [2], Natural Language Processing, manages human languages [3]. Translating languages comes up whenever people talk about different human languages, which is one of the most sophisticated and complex aspects of our being. Generic algorithms [4] carry out a predetermined sequence of operations following what they have been instructed to accomplish and therefore do not have the capability of resolving issues that have not been predicted. Most challenges must be overcome in the real world, including many unknown variables, making conventional algorithms significantly less efficient. The benefit of machine learning [5] is that it empowers the system with the capacity to learn from prior instances and perceptions. With the assistance of previous events, a machine learning system [6] is significantly more capable of tackling these unanticipated difficulties. Machine Learning and Natural Language Processing [7] are crucial in transforming an artificial agent into an artificial "intelligent" agent. On the other aspect, Natural Language Processing refers to a computer's ability to recognize and work with human languages.

A computer system can only understand the binary language, *i.e*., 0s & 1s; it is not intelligent enough to understand human languages such as Bengali, Hindi, or English. NLP has enabled the computer to interpret not just Bengali & Hindi but also other regional languages like Tamil, Telugu, Odiya, *etc*. and international languages such as Russian, German, and so on. Natural language processing is a significant aspect of artificial intelligence [2]. NLP is predicated on linguistics concepts. Modern machine learning techniques and deep neural networks to NLP challenges [8] have also been substantiated. Although NLP has several unresolved issues [9], it currently has numerous practical applications. NLP enables

individuals to modify their thinking, behaviour, and communication with themselves and others to overcome obstacles and achieve greatness.

Machine Learning is a superset of Deep learning [10] that utilizes artificial neural networks (ANN) [11] with massive datasets to replicate a biological neural system and detect patterns that may be used to make decisions. NLP attempts to facilitate human-machine communication by making human languages approachable [12] to systems in realistic conditions.

FUNDAMENTAL CONCEPTS OF A DEEP NEURAL NETWORK

Deep-Learning [13] is a solution to problems that Machine Learning cannot resolve. Machine Learning is effective in many scenarios and is equal to or better than human specialists in certain circumstances. However, Deep-Learning [14] can solve those problems that ML cannot. The following issues are described here:

- Situations in which human specialists are unavailable.
- People cannot justify conclusions based on their understanding (language comprehension, medical decisions, and voice recognition).
- Sometimes, prediction depends on time and conditions, such as weather, stock market forecasting, *etc*.
- Cases when approaches must be interpreted depending on specific events like biometrics *etc*.
- Situations in which the scale of the issue overcomes our limited conceptual understanding, such as sentiment classification, matching advertising to Facebook, and calculating website rankings.

The Artificial Neural Network [15] is a subset of machine learning techniques known as Deep Learning. In recent years, it has been noticed that approaches for deep learning have been frequently accepted and have achieved positive outcomes. Deep-learning methods are at the forefront of machine learning approaches applied to natural language processing research.

A specific neural network with multiple convolution layers [16] is called “deep”. In recent literature, however, deep networks reflect those that have numerous additional layers. The network depicted in the diagram is a primary one, with the initial Layer representing input data, the top level becoming the output, and the layers in between representing the hidden layers indicated in Fig. (**1**).

CHAPTER 4

A Review on Categorization of the Waste Using Transfer Learning

Krantee M. Jamdaade[1], Mrutunjay Biswal[1,*] and **Yash Niranjan Pitre[1]**

[1] *Department of Data Science and Technology, K. J. Somaiya Institute of Management, Mumbai, India*

Abstract: In this paper, we have aimed to develop a system that will help waste collectors segregate different types of waste without needing much human intervention. We have experimented with various deep learning and transfer learning techniques to determine which model is more suited for this purpose. The dataset we used contained 8369 images that are classified into 9 classes: batteries, clothes, e-waste, glass, light bulbs, metal, organic, paper, and plastic. We used models like VGG16, Inceptionv3, ResNet50, MobileNET, NASNetMobile and Xception. We have also conducted a survey to know about the waste management habits of the respondents. Our experiments showed that models like MobileNET gave us the best accuracy of 93.17% and identified all the waste categories correctly and the Xception model predicted images correctly with the use of both Adam and Adadelta.

Keywords: Deep learning and transfer learning, Inception v3, MobileNET, NASNetMobile, ResNet50, VGG16, Xception.

INTRODUCTION

We are living in the age of rapid technological development, where innovations and engineering achievements are achieved every day. With the rise of the industrial revolution and technological development, there is always a problem that needs to be solved. One such problem is managing the Waste Disposal which is generated by every field. Managing the waste is one of the challenging things which humans face throughout our life. With the increase in human population, this problem is really challenging as it affects the lives of many people. In India, it is common for people to just throw away their untreated and unsegregated waste in the open and let the municipal authorities take care of that waste. This mindset is dangerous for human society because if we do not manage the waste properly, many diseases arise like Dengue, Typhoid, *etc*. Moreover, some people also

* **Corresponding author Mrutunjay Biswal:** Department of Data Science and Technology, K. J. Somaiya Institute of Management, Mumbai, India; E-mail: mrutunjay.b@somaiya.edu

Abhijit Banubakode, Sunita Dhotre, Chhaya S. Gosavi, G. S. Mate, Nuzhat Faiz Shaikh & Sandhya Arora (Eds.)

believe that burning the waste is a quick way to get rid of the waste. However, this causes air pollution and causes increase in diseases like Asthma and Cancer. We need a solution that can efficiently identify the waste and can fix the problem that we have been facing for a long time. The traditional way is picking up the waste manually which is done by waste collectors. Doing this involves a lot of labor work and it is prone to health problems. The waste collectors are more inclined towards diseases because of the toxic elements present in the garbage. More than 300 people have died in the last 5 years. We need a solution where we can recognize various types of waste so we can process it further. We need an effective plan that can classify the waste at source and treat different components of waste in different ways. Following are the kinds of waste that can be recycled [1, 2]:

• **Paper Waste:** It can be recycled and we can again make paper out of it

• **Organic Waste:** It can be used for composting purposes which can be utilised by farmers.

• **Glass Waste:** It can be recycled to make glass again.

• **Clothes Waste:** It can be used for making rags at home.

• **Metal Waste:** It can be melted and a new form can be made.

• **e-Waste:** Useful metals like Gold and copper can be extracted from it.

With the use of technologies like Deep Learning, Artificial Intelligence, and Machine Learning, we can finally classify waste which will help us fix this problem. According to a survey conducted by the Central Control Pollution Board, Ministry of Environment [3, 4], the volume of wastewater generated in India is 9275 million liters per day out of which 8892.7 million liters per day is produced domestically, and 382.3 million liters per day is produced industrially. The total amount of waste generated in India is 1,52,076.7 tonnes per day (TPD) of which 1,49,748.6 tonnes per day is collected, 55,759.6 tonnes per day is treated while 50,161.3 is landfilled. The state that generates the highest waste is Maharashtra where total waste generated per day is 23,844 tonnes out of which 23,675.7 is collected, 12,623.3 is treated and 11,052.4 is landfilled. According to data, in 2018-19, the city that generates the highest amount of waste per day was Delhi, which generated about 10,817 tonnes of waste per day. The total amount of hazardous waste generated per year is 87,82,691 metric tons of which 21,33,013 tonnes is landfillable, 3,97,106 is incinerable, 20,71,848 is recyclable and 41,80,725 is utilizable. The state that generates the highest amount of hazardous waste is Gujarat which generates 24,85,317 tonnes per year. The total amount of

biomedical waste generated in India per day is 6,20,472 kg per day. The state that generates the highest amount of biomedical waste is Karnataka which amounts to 77,545 tonnes per day.

RELATED WORKS

We have reviewed a total number of 18 papers and we classified the research papers into 4 sub-topics. Having some insights into previous and related workwill help us with our research paper. The sole purpose of this section is to examine how similar kinds of work were carried out by different researchers in the past and based on that we classified the research papers into the following techniques:

Machine Learning Techniques

In 2020, Yujie He *et al*. suggested to usethe TrashNet dataset where they classifiedthe waste into 6 categories and they used a Support Vector Machine model where they were able to achieve 79.94% accuracy. They used a linear activation function with an optimizer as Adam and learning rate of 0.000005 [5].

Deep Learning Techniques

In 2021, ALilly Raamesh *et al*. used the Xception model where the model accuracy was 95% and they were able to classify the waste into 10 categories. They have used an optimizer as Adam with a learning score of 0.001 [6]. In Feb 2022, Sylwia Majchrowska *et al*. classified the waste into 8 categories. The dataset consists of more than 28,000 images from sources such as TrashCan 1.0, and TrashICRA 19. EfficientDet-D2 & EfficientNet-B2 were used in this paper [7]. In 2019 Olugboja Adedeji *et al*. used the ResNet-50 model. The dataset was from ImageNet with a size of 224 x 224. The accuracy was 87% [8]. In Feb 2021, Madhura Patil, *et al*. used Simple CNN, ResNet-50 and VGG16 where ResNet-50 gave the best results to them. There were a total of 2467 images and the garbage was classified into Cardboard, Glass, Metal, Paper, Plastic,and Trash [9].

In 2021, Cuiping Shi *et al*. proposed a multilayer hybrid CNN, which is a waste classification method. The accuracy achieved was 92.6% [9]. In the same year, Raymond Erz Saragih *et al*. have used MobileNET v2 and NASNetMobile models where the highest accuracy was obtained in MobileNET v2 with 96.18% [10].

In 2021, Mohd Anjum *et al*. classified the waste into 2 classes; that is waste and no-waste, where they are working on the DCNN Algorithm. The accuracy they have achieved was 97.76% [11]. In May 2020, Piotr Nowakowski *et al*. used CNN & R-CNN models where they were able to recognize the waste equipment

CHAPTER 5

Automated Bird Species Identification using Audio Signal Processing and Neural Network

Samruddhi Bhor[1,*], **Rutuja Ganage**[1], **Hrushikesh Pathade**[1], **Omkar Domb**[1] and **Shilpa Khedkar**[1]

[1] *Modern Education Society's College of Engineering, Pune, India*

Abstract: Many bird species are rare nowadays, and when they are found, they are difficult to classify. As an example, in various scenarios, birds include different sizes, forms, colors, and a person's viewpoint from different angles. Although domain specialists can classify birds manually, with increasing volumes of data, this becomes a tiresome and time-consuming procedure. Using our approach, we can reliably and quickly identify bird species. It is now feasible to track the number of birds as well as their activity using automated bird species recognition and machine learning algorithms. Convolutional neural networks (CNN) were chosen above standard classifiers such as SVM, Random Forest, and SMACPY. For this system, we used the "BirdCLEF 2021" dataset from Kaggle. The input dataset will be preprocessed, which will involve framing, silence removal, and reconstruction, which will be supplied as input to a convolutional neural network, followed by CNN modification, testing, and classification. To avoid overfitting, we add a dropout layer. Preprocessing includes importing the Librosa library. MFCC is a program that extracts distinct characteristics from audio files (Mel-Frequency-Cepstral-Coefficients). The MFCC summarizes the frequency distribution over the window size, allowing for sound frequency and temporal analysis. The result is then compared with respect to the pre-trained data, and output is shown, and birds are classified based on their classes.

Keywords: Bird sound classification, Classification, Convolutional neural networks (CNN), Dataset, Librosa, Mel-frequency-cepstral-coefficients (MFCC), Pre-processing, Random forest, SMACPY.

INTRODUCTION

Bird species identification is becoming increasingly essential in the domains of ecological conservation and ornithology, and implementing efforts to protect the environment and endangered creatures is an urgent responsibility. Observing the behavior of birds allows us to more thoroughly evaluate our living environment.

[*] **Corresponding author Samruddhi Bhor:** Modern Education Society's College of Engineering, Pune, India; E-mail: samruddhibhor2001@gmail.com

Abhijit Banubakode, Sunita Dhotre, Chhaya S. Gosavi, G. S. Mate, Nuzhat Faiz Shaikh & Sandhya Arora (Eds.)

Birds are more abundant and sensitive to environmental changes than other species, and they are also simpler to watch.

The project's main goal is to identify different bird species by analyzing a vocal note. Some professionals, such as ornithologists, were unable to accurately identify bird species based on a photograph. Therefore, it is particularly important to spot the birds. With the advent of audio identification technology, using modern technology to spot birds has become a good research method. The fundamental objective for creating the identification model is to raise knowledge of birdwatching, birds and how to identify them, particularly in India. It also meets the need for reducing the process of bird identification, making bird-watching easier. It is now possible to swiftly identify them because of the development of automated bird classification systems, which use audios of the birds to recognize them apart based on a Convolutional neural network.

In the study [1], a CNN is designed to classify audios which no doubt successfully evaluates the fields of image processing and sound recognition. A CNN system for categorizing bird noises is given and evaluated using a variety of setups and hyperparameters. For our preprocessing and testing purposes, we used the dataset "BirdCLEF 2021" for bird songs, which is freely accessible online from the 'Kaggle' website. Because these recordings are frequently cut or contain noise, dependable automated approaches must be utilized instead of manual conventional methods. Bird noises are often categorized as songs or calls, with songs being more melodic and associated with mating and calls being used as an alarm signal or for other communications. Calls are often extremely brief and fleeting noises. Bird songs are longer and more melodic, making them perfect for identifying bird species, according to scientists [2]. When evaluating the problem in a conventional categorization situation, Machine Learning (ML) algorithms can produce decision processes.

For identification purposes, one important component is the selection of the most relevant audio segments. Many academics and experts working in the subject of ornithology have made breakthroughs in order to make bird species recognition more possible and simpler and efficient.

Automatically identifying bird cries from continuous recordings gathered from the environment would be a huge boost to ornithology and biology research techniques in general [3].

Following are the steps:

1. Outdoor bird song recording.

2. Because these recordings are frequently obtained in loud locations, audio pre-processing procedures are used to improve signal quality.
3. Extracting parts from auditory input.
4. Combining these features into machine learning algorithms to produce a judgement mechanism capable of recognizing bird species.

RELATED WORK

This section examines related work on automated species classification, with a particular emphasis on the literature on auditory classification.

Various methods have been used to identify singing birds in audio recordings [4].

BIRD CLASSIFICATION CHALLENGES

MLSP 2013

In each audio sample, the purpose was to identify all acoustically active bird species. As part of a test set, 19 distinct bird species were documented. It was thought to be a difficulty of single-instance multi-label categorization. Six hundred and forty-five ten-second audio recordings were separated into a training set (50 percent) and a test set (50 percent). The data was classified using the Random Forest (RF) algorithm and template matching was employed to extract the input data. The templates were created using a unique time-frequency segmentation approach in which each boxed segment was saved as a template and only the boxed segments were calculated. In the paper [5], a single sound class was assigned to each of the 81 audio recordings. After that, each recording's spectrogram was computed. The relation between both the template and the spectrogram was examined using a template matching approach, with the highest value of the normalized cross-correlation map providing a feature vector with the same extent as the quantity of templates retrieved from the 81 signal label files.

BirdCLEF 2016

The BirdCLEF challenge makes use of a large data collection of bird recordings. The data originates from the xeno-canto 1 bird song database, a web-based service that allows bird lovers to contribute and share bird song recordings. There are 325,268 recordings comprising over 4,750 hours of recorded sound from 9,680 different foreground bird species and 10,246 different background bird species, recorded by 3,290 different recordists. The data collection contains roughly 33,200 recordings that have been normalized to 44.1 kHz 16-bit mono format (right channel) audio files. The data set is divided into two sections: 33% test data and 67% training data, with the mean average precision (MAP) over all

CHAPTER 6

Powering User Interface Design of Tourism Recommendation System with AI and ML

P.M. Shelke[1], Suruchi Dedgaonkar[1,*] and **R.N. Bhimanpallewar[1]**

[1] *Department of Information Technology, Vishwakarma Institute of Information Technology, Pune, India*

Abstract: The term "User Experience" (UX) refers to all elements of a customer's relationship with a company, including its services, products, and overall customer experience. Meeting the specific consumer demands and knowing their behavioral patterns are the most important criteria for an efficient UX.

The backend that selects what to recommend and the frontend that gives the recommendation are the two essential components of recommendation systems (RS). An RS's user interface must deliver recommendations in a way that allows users to anticipate taking action on them. A user interface is required to provide the recommendations. When creating a recommender's user interface, the designers must make several decisions. Understandability, transparency, assessability, trust, and timeliness are five elements that the designer must address.

When it comes to organizing a trip, people are becoming increasingly accustomed to using modern technology. Users are provided with a large quantity of data, which they must evaluate in order to choose the offerings that are interesting or appropriate for them. A customized tourist attractions recommender system is thought to be the most efficient way for visitors to find tourist attractions. The recommender system compares the acquired data to comparable and dissimilar data from other sources to provide a list of recommended tourist sites.

These systems, which assist people in finding what they need on the internet, have been a huge success, and they wouldn't be conceivable without an excellent user interface. Data can now be easily segmented based on demographics, habits, trends, and a variety of other factors, thanks to the application of machine learning and AI. The main concept is to provide each user with better strategic decisions to their preferences based on their prior travel data and behavior. In this way, every facet of human behavior that these systems supply and explore is then fed into algorithms, which develop meaningful patterns. These patterns are then expressed through an interface and then transformed into useful products and services that help businesses improve their user experience.

[*] **Corresponding author Suruchi Dedgaonkar:** Department of Information Technology, Vishwakarma Institute of Information Technology, Pune, India; E-mail: suruchi.dedgaonkar@viit.ac.in

Abhijit Banubakode, Sunita Dhotre, Chhaya S. Gosavi, G. S. Mate, Nuzhat Faiz Shaikh & Sandhya Arora (Eds.)

Both AI and machine learning are extremely compatible and friendly with UX; they all follow the same concepts and aims. However, there are many challenges to their implementation. AI/ML engineers and UX designers should collaborate on a shared platform to create a blueprint for a fantastic UX experience. The mix of qualitative and quantitative data is crucial if AI and machine learning connect with UX. There is no other technology that can improve UX as much as AI.

Keywords: Artificial intelligence (AI), Machine learning (ML), - Tourism recommendation system, User interface (UI) design, User experience (UX).

INTRODUCTION

Humans always have a natural desire to travel. Regardless of obstacles like age, gender, color, or geographic barriers, people aspire to travel for a variety of reasons. Travel and adventure are currently the most popular forms of entertainment. Hence, in many regions, the tourist industry has emerged as a promising sector for economic development. UNWTO is the World Tourism Organization, which has announced that worldwide tourist arrivals increased by 4% in 2019, reaching 1.5 billion [1] in the month of Jan in 2020. Additional tourism destinations discovery belongs various places will result in increased tourism undoubtedly.

The COVID-19 epidemic has caused unparalleled worldwide health, social, and economic crises. One of the industries most impacted is travel and tourism. After the coronavirus pandemic broke out in early 2020, there was an extraordinary decline in the number of travelers abroad due to widespread restrictions on foreign travel and a dramatic reduction in demand. By 6 April 2020, travel restrictions have been implemented in 96% of all destinations. A total of 90 tourist locations had closed their borders to travelers entirely or in part, while 44 more had restricted specific visitors based on their place of origin. The UN World Tourism Organization (UNWTO) projects that global tourism would have decreased by 73 percent in 2020, which would be a record-breaking decline.

International arrivals increased by 5% in 2021 but decreased by 71% from levels in 2019. (UNWTO 2022). According to the most recent data, a significant increase in international tourist arrivals at the start of 2022 (UNWTO 2022) confirmed the positive trend that had already started in 2021 as a result of the vaccination rollout and the lifting or easing of travel restrictions, which have significantly relieved pent-up demand [2].

Despite the substantial obstacles, global tourism continues to rebound strongly. In the first five months of 2022, international tourism had a significant upswing,

with visitors exceeding almost half (46%) the levels of the same period in 2019 [3].

Looking at the current scenario, tourism industries need to take an opportunity to enhance the service by following marketing strategies. People can manually search using several search engines to get information on tourism. Of course, even using keywords, their search is still inefficient since they will receive overwhelming results. For novice travelers, making a vacation plan takes a lot of time and effort. Modern travelers frequently utilize mobile devices to manage their trip plans and make selections about where to go. Considering the current trends toward smart-recent ICT, which are location-based systems and intelligent systems, the tourist sector has scope to enhance stakeholder services.

A customized recommendation system for tourist attractions is thought to be the most efficient approach for people to seek attractions. The recommender system creates a list of suggested tourist sites for the traveler by comparing the obtained data to similar and different data collected from others. Such a system also works based on the location of the person, that is, mobile device and display features [4].

With the use of smart ICT, tourists who utilize the tourism sector require more intelligent systems and dynamic recommendations for certain tourism services to enhance their travel experiences [5].

THE EVOLUTION OF TRAVEL RECOMMENDER SYSTEMS

A recommendation system might be characterized as a technique for giving people options based on their own interests. The information must be filtered to do this. There are several filtering techniques that scientists have employed in the past [6].

The recommendation systems are classified based on their features, as below [7], diagrammatically classification is shown in Fig. (**1**):

The Collaborative Filtering (CF)

The Collaborative Filtering method recommends solutions based on the similar preferences of the target users.

The Content Based Filtering (CB)

The Content Based Filtering technique builds a profile for each user, storing their unique characteristics that may be used to propose solutions. The characteristics, which are derived from the users' prior selections, establish the user preference.

CHAPTER 7

Exploring the Applications of Complex Adaptive Systems in the Real World: A Review

Ajinkya Kunjir[1,*]

[1] *Orium, Sault Ste. Marie, Ontario, Canada*

Abstract: Complex Adaptive Systems (CAS) are gradually becoming the primary modelling framework in the industry where autonomously evolving and self-adaptive systems exist. There has been a quick escalation in the research results in the past few years as the concept of CAS is emerging in the working sectors due to its capabilities and vital properties to shape an organizational workflow. CAS exhibits self-organization, adaptability, modularity, and others beyond complex systems. Designing CAS models is a tedious task as the intra-system components are composed of sub-components that interact with running operations across the system. Researchers in engineering, healthcare, defense and military automation are extensively progressing in adapting the CAS framework and conceptualizing the systems for increasing performance efficiency. This paper primarily argues for the relevance and value of the CAS approach and then presents a detailed discussion on the core concepts of CAS and Agent-based modelling, highlighting the difference between them. Furthermore, the paper provides a detailed review of the applications of CAS, such as Manufacturing (Assembly systems), Defense and Analysis, Internet of Things (IoT), Distributed Networks, Healthcare organizations and a few social-ecological systems (SES). Many pieces of software agent-based modelling, tools for CAS development and data visualizations are surveyed and discussed in the second half of the paper.

Keywords: Adaptability, Agent-based modeling, Complex adaptive systems, Emergence, Framework, Self-organization.

INTRODUCTION

Over the past few years, the concept of complex science has become a possible alternative to the standard methods used for scientific discovery. Complexity science is supported by a subjective paradigm that considers the world as a system of interconnected entities that give rise to observable patterns when communicating with each other. According to the fundamentals of complexity theory, a system with inter-related entities possesses 'emergent' characteristics that

[*] **Corresponding author Ajinkya Kunjir:** Orium, Sault Ste. Marie, Ontario, Canada;
E-mail: ajinkyajr101@gmail.com

Abhijit Banubakode, Sunita Dhotre, Chhaya S. Gosavi, G. S. Mate, Nuzhat Faiz Shaikh & Sandhya Arora (Eds.)

improve the system's behaviour from within [1]. John Holland coined the term 'CAS' as a system consisting of autonomous, interactive, adaptive and self-organized agents [2]. Another definition was CAS as a system consisting of numerous distinct components working together as one, with the powerful abilities to adapt and evolve while indicating complex behaviours [3]. There have been several other definitions for CAS based on the interest of application areas [4, 5]. The agents in a complex system had the purpose of resolving specific problems such as stock markets, epidemic pervasions, manufacturing scheduling, animal behaviours, forest ecological systems, healthcare organizations and others of relevance. As mentioned previously, the properties and mechanisms of the complex adaptive systems were first thought of by John Holland [2], and it was also termed that the agents use 'IF (condition) THEN (action)' rules to interact with each other in a system. Brownlee [6] mentioned a fact about the rules that they can evolve inside the agent automatically to form a new set using evolutionary genetic algorithms. This property is called 'emergence' for the whole system, and it proves that the system can develop new rules according to the 'fitness' in certain situations.

Every working organization with information flow between several modules in it can be conceptualized using the CAS framework for implementing features like adaptation and emergence behavior for dynamic user interactions. In this paper, we primarily focus on explaining the application areas of CAS on which theories have been established or any partial or full empirical study is completed. This paper represents a systematic review of the applications of Complex Adaptive Systems (CAS) such as Manufacturing systems, Healthcare and EMS, Military and Defence, Internet of Things (IoT) and Distributed Systems. Following the introduction to complex systems and the latest work in the field, we have presented the properties of CAS with some basic background information in section II of this paper. Section III is dedicated to define CAS and multi-agent/agent-based modeling approach (MAM/ABM) and enlists the differences and applications of both in a short comparative study. All the potential application areas of CAS have been discussed in detail, along with their past and current work, advantages and disadvantages, and approach towards CAS framework adoption. All the currently existing tools and software to model CAS simulations have been mentioned in the section following the extensive piece on the exploration of the potential application. There is an enormous amount of data generated from the complex system simulations as a lot of interactions are exchanged and traced to keep the transaction record. The users and researchers could benefit from the visualizations of such data as it would ease the process of understanding the simulations and also for predictive analysis on the basis of current and historical data. From a point of view, there is a need to draw the reader’s attention into this common and crucial issue faced by all the CAS

applications. The final section VI describes the need for visualization in complex systems and provides decent reasoning in the same context.

BACKGROUND

The basic mechanisms offered by CAS are tagging, building blocks and internal models. A signal in a complex system indicates the agents to perform a particular action and, therefore, can be termed as a 'building block' of any signal-boundary (s/b) system. The agents respond consciously to messages as they acquire the internal model of the environment and the internal model of other agents in the surrounding. The complexity of CAS is divided into internal and external complexities. Jost. J proposed that the use of neural network architecture to study pattern recognition and has the potential to increase external complexity and decrease the internal complexity of the system [7]. To give a brief explanation of the properties and mechanisms of CAS, we have a diagrammatical representation given in Fig. (**1**).

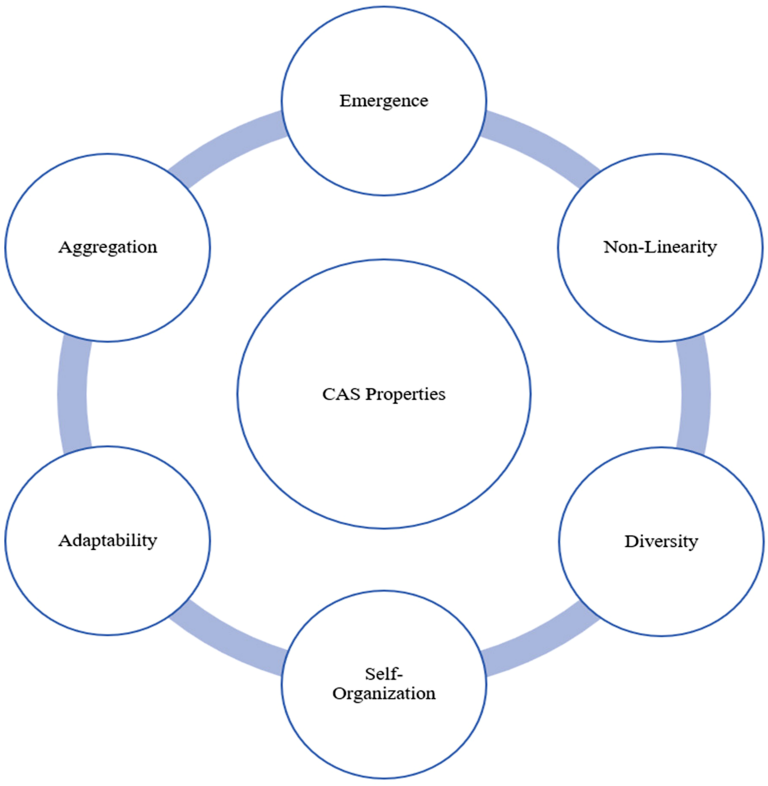


Fig. (1). Properties of CAS.

CHAPTER 8

Insights into Deep Learning and Non-Deep Learning Techniques for Code Clone Detection

Ajinkya Kunjir[1,*]

[1] *Orium, Sault Ste. Marie, Ontario, Canada*

Abstract: A source code clone is a type of bad smell caused by pieces of code that have the same functional semantics, but the syntactical representation varies. In the past few years, there have been several studies about code clone detection, steered by numerous machine learning models, software techniques and other mathematical measures. This paper aims to conduct an impartial comparative study of the existing literature on Deep Learning and Non-Deep Learning techniques. Due to the lack of work in studying the previous and the current state-of-the-art tools in code clone detection, there is no concrete evidence found to underpin the use of Deep Learning approaches in clone detection, except for a preference from the evolutionary point of view. We will address and investigate a few research questions related to the intentions of using DL techniques for code clone detection compared to those of non-DL approaches (Based on –token, text, AST, metrics, and others). Furthermore, we will discuss the challenges faced in the Deep Learning implementation for clone detection and their potential resolutions if feasible. This review would help the audience understand how different approaches aid the clone detection process along with their performance measures, limitations, issues, and challenges.

Keywords: Code analysis, Code clone, Deep learning, Machine learning, Review, Source transformation, Tokenization.

INTRODUCTION

A code clone, in some cases, has a negative impact on software maintenance and its subsidiary evolutionary process. This clone is called ‘bad smell’ in the residing source code as the semantics of the fragment are identical, but the syntax varies from the original [1]. This phenomenon can increase the failure of the system or raise multiple vulnerabilities deteriorating the quality of the system [2]. Researchers in these past few years have made efforts to detect the code smell in software systems using various approaches such as Deep Learning (DL),

* **Corresponding author Ajinkya Kunjir:** Orium, Sault Ste. Marie, Ontario, Canada;
E-mail: ajinkyajr101@gmail.com

Abhijit Banubakode, Sunita Dhotre, Chhaya S. Gosavi, G. S. Mate, Nuzhat Faiz Shaikh & Sandhya Arora (Eds.)

Machine Learning (ML) and by using the traditional code clone detection (TCCD) techniques such as token-based, AST-parser based, metric-based, PDG or graphs-based and many others that have been combined as a hybrid traditional approach, *i.e*., extracting metrics from the AST nodes, a combination of AST-parser and metric-based approaches to achieve clone detection. Over the years, Machine learning algorithms were considered for clone detection over the traditional methods with the intention and possibility of achieving automatic feature extraction from source codes and increasing the prediction accuracy in terms of identifying the code clones in a system. Deep learning, which is a level-up for Machine learning and leverages neural networks to make highly accurate decisions on the duplicity of code fragments. Neural networks are best known for classification due to their mechanism of neuron processing along with added weights through the hidden layers specified by the user, which makes the accuracy furnished and trustworthy.

Since the year 2016, there have been numerous studies on applying Deep learning techniques to code clone detection (more discussed in section II-Literature Survey), but there are not enough studies which explain the relationships, analyses and context differences between all the existing DL approaches. There could be some insights shared about these DL experiments with future researchers to make them aware of the existing challenges and limitations. To give an example of a few studies, Rattan *et al*. presented a generic comprehensive study on types of software clones and various approaches published till the year 2012 but did not share clone detection using ML or DL techniques [3]. In the year 2007, C.K Roy wrote a systematic survey on software clone detection research and elaborated on the type of clones, terminologies, advantages and disadvantages of cloning and derived a brief taxonomy of clones with the clone detection process [4]. This survey is a benchmark for providing brief analysis and insights on the existing studies and how they are related to each other with respect to their approach. Talking about ML, Azeem *et al*., in their paper, reviewed the applicability of machine learning for code smell detection (including duplicate code), but the study did not have the core focus on clone detection [5]. There are other surveys which highlight ML achievements for code clone detection and source code analysis but offer a wide spectrum of categories under the domain of software engineering. This offering and coverage of applying ML to several categories complicate binding the relationships and obtaining insights to form a proper analysis of techniques.

The existing clone detectors encapsulating Deep Learning techniques emphasize more on detecting weak/moderate type-3 and type-4 clones, completely leaving behind the other types (types-1, 2, VST3, ST3). The paper will highlight the limitations and open challenges of the DL approaches incapable of detecting the

above-mentioned types. Moreover, around 85% of the DL approaches only target one programming language for code detection and the rest expand their clone detection spectrum to a short set of programming languages (Cross-Language) [6]. The secondary objective of this paper would be to address the question of cross-language compatibility and the limitations of the same. In this paper, we will be focusing on all the existing ML, DL and TCCD approaches and perform a tri-comparative study to answer the following questions- (a) What traditional, ML, and DL clone detection techniques exist, and how much of work has been done using them? (b) How well are they when compared to each other based on their performance, complexity and scalability? (c) Which approach should the researcher consider when working on clone detection? (d) What are the current challenges and limitations faced by the researchers? There are several observations found out from the studies that 'Token-based approaches provide a convenient approach towards clone detection','Deep Neural Network (DNN) and Recurrent Neural Networks (RNN) are the two DL techniques mostly used for clone detection' and many more sounding reasonable. We will evaluate these observations by finding factual information from the current studies and suggesting the readers choose the appropriate approach based on their requirements, availability of resources, access to data, time complexity, type of application commitments and other relevant concerns. This study is simply an indicator which aids the reader or the user to make decisions about going forward with the most suitable approach for their design model.

The rest of the paper is organized as follows. Section II discusses the relevant background literature for all the major approaches, enlists the research questions which we are intend to answer, provides a concise overview of software clones and their types and lastly, the benchmarks available for CCD evaluation. Section III illustrates the taxonomies and compares all the approaches – ML, DL and TCCD. Section IV deals with the open challenges and limitations in all the approaches of interest and deduces a matrix which helps the user to make decisions for CCD based on suitability and advantages. Moreover, section V answers the research questions asked in section II and concludes the study.

BACKGROUND

Code Clones

When heterogeneous code fragments are in the same source code origin at a method level or a class level, they are called 'clone pair'. Cloning can simply be duplicating the code fragment for business purposes. Plagiarism is when an entity copies some other entities' code and disguises it to claim ownership [7]. The difference between plagiarism and cloning is a debatable topic and there's not

CHAPTER 9

Application Using Machine Learning to Predict Child's Health

Saurabh Kolapate[1,*], **Tejal Jadhav**[1] and **Nikhita Mangaonkar**[1]

[1] *Bharatiya Vidya Bhavan's Sardar Patel Institute of Technology, Andheri-West, Mumbai, India*

Abstract: Nowadays, modern technologies are applied in many different areas of medical science. One such piece of technology that helps in the diagnosis of numerous illnesses and infections is the expert system. The Medical Expert System was created to assist doctors in making diagnoses and to make it easier for the public to recognize disorders. To diagnose the user, it treats facts and symptoms as queries or inputs. This suggests that a medical expert system makes a diagnosis based on information about the patient and knowledge of the diseases. Designing an Expert System for disease diagnosis in youngsters up to the age of 16 is the main goal of this project. Python, Java, and Flask are all used as computer programming languages. The selected symptoms supplied as the question will enable the expert system to correctly diagnose these diseases. With this discovery, we think the creation of an expert system will be advantageous for disease diagnosis in pediatric instances and will also become more affordable. Multiple tests are necessary for the diagnosis of disorders in children because the symptoms might occasionally be deceiving. In these situations, an expert system can aid in identifying and treating the true issue. In addition to a prescription, it can diagnose the illness and offer information.

Keywords: Care, Child, Children, Check-ups, Diagnosis, Expert system, Health, Rule-based, Respiratory distress.

INTRODUCTION

Taking care of a young child might seem challenging at first, especially when the parents are unaware of what the child is feeling. For children at a very young age, it is difficult for their parents to identify their needs. At this stage, utmost care and attention are required. Your child's health includes all areas of their physical, mental, and social wellbeing. Most parents know the basics of keeping children healthy, like offering them healthy food, making sure they get enough sleep and exercise and ensuring their safety [1 - 2]. It's crucial that kids visit their doctor on

* **Corresponding author Saurabh Kolapate:** Bharatiya Vidya Bhavan's Sardar Patel Institute of Technology, Andheri-West, Mumbai, India; E-mail:saurabh.kolapate@spit.ac.in

Abhijit Banubakode, Sunita Dhotre, Chhaya S. Gosavi, G. S. Mate, Nuzhat Faiz Shaikh & Sandhya Arora (Eds.)

a regular basis for check-ups. Other than check-ups, school-age children should be seen for:

1. Significant weight gain or loss

2. Behavioral changes or issues with sleep

3. Fever of more than 102°F

4. Rashes or skin infections

5. Frequent throat infections

6. Breathing issues

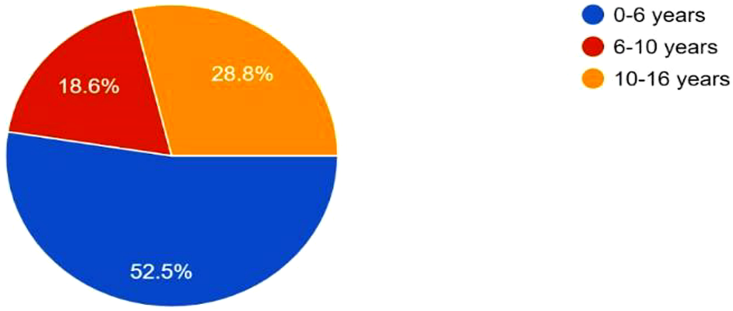
In addition to the reality of COVID-19, social isolation and self-quarantine, a parent must deal with difficulties relating to their children's health daily. This can be difficult. By taking care of themselves first, parents can best support their kids. Like in the case of Covid-19, people are probably more concerned about their children than they are about themselves, which makes them more eager to visit clinics and results in incorrect treatment. As a result, a computer-based system is created to provide children with an option for making their own health-related diagnoses based on provided symptoms. It is important to emphasize this tactic so that people may accurately use the data as a guide for taking care of children's health [3].

Technology is mostly used to reduce human error and provide precise diagnoses for diseases that can be treated. The field of applied artificial intelligence (AI), which includes expert systems (ES), was founded in the middle of the 1960s. Instead of using traditional procedural code, it was created to handle complicated issues by reasoning through bodies of knowledge that were primarily represented as if-then rules. The expert system is applicable to many different fields, including medicine [4]. The goal of the medical expert system is to provide human reasoning based on knowledge to support comprehension. To offer answers, it considers both facts and symptoms. It suggests that a medical expert system employs knowledge of diseases and information about patients to offer a diagnosis in the context of a medical application. Children are particularly susceptible to infections, and parents frequently worry that they won't be able to recognize the symptoms of illnesses that typically affect kids. This pediatric diagnosis expert application system is a knowledge-based application that helps parents join up as users and determine the type of illness that their children are experiencing based on their perception of the symptoms [5].

SURVEY REPORT

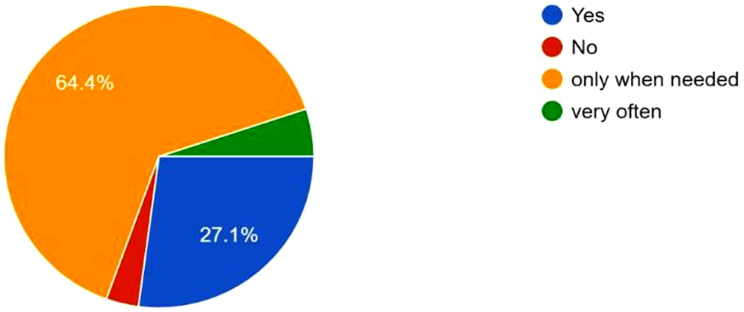
1. What is the age of your child ?

59 responses



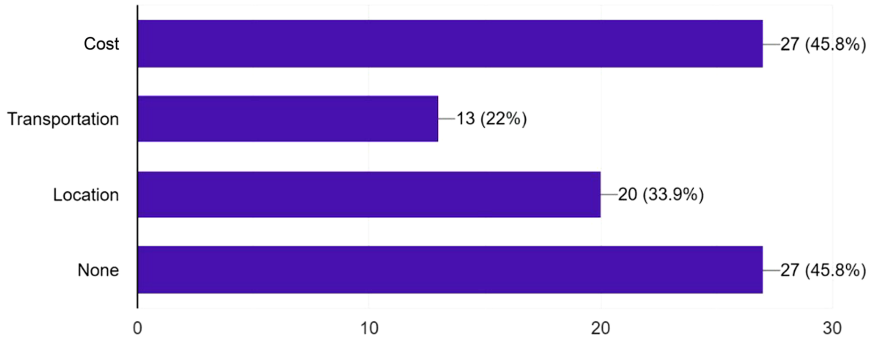
2. Do you schedule health check up plans for your child ?

59 responses



3. What are the problems you face while planning for health check ups ?

59 responses



CHAPTER 10

Shifting from Red AI To Green AI

Samruddhi Shetty[1], Nirmala Joshi[1,*] and **Abhijit Banubakode[2,3]**

[1] *MET Institute of Management, Mumbai, India*

[2] *MET Institute of Computer Science, Bhujbal Knowledge City, Bandra Reclamation, Bandra (West), Mumbai, Maharashtra, India*

[3] *Shri Sant Gajanan Maharaj College of Engineering, Shegaon, Maharashtra-444203, India*

Abstract: The 2020s may see amazing advances in AI, however, as far as the foundation and proficient utilization of energy is concerned, we have not reached the optimized level. As AI research advances, we should demand the best platform, methodologies, and tools for building AI models. Organizations heavily rely on AI for various activities today, with only 7% of businesses trying to discover the facts related to the problem that a bigger carbon footprint is left by AI, with the training process for several large AI models emitting as much as 626,000 pounds of carbon dioxide equivalent to the lifetime carbon footprint of nearly 3640 iPhones. As we know, algorithmic training is an endless process for AI-powered tools, as a result, growing reliance on AI only speeds up the death of the immediate environment. The awareness among the people about how AI can impact the sustainability of the environment in the near future is not considered while developing the solution. Apart from big players in the market, the cognizant of sustainable and responsible AI is still a big question mark. The end user or the consumers should be aware of the services they use, whether they are only accurate or efficient as well. The balance between both factors should be maintained based on the context and requirement. The same is studied in the given paper concerning the concept of Red AI and Green AI and how they should be balanced considering the environmental sustainability factor.

Keywords: Artificial intelligence, Ethics, Red and green AI, Sustainable development, Transparency.

INTRODUCTION

AI technologies are already altering sectors and becoming an indispensable part of our daily lives. Such systems, which employ machines to process and analyse massive volumes of data, have transformed how people work and play, and are now used in a variety of industries, including finance, energy, and agriculture.

[*] **Corresponding author Nirmala Joshi:** MET Institute of Management, Mumbai, India;
E-mail: nirmalaj_iom@met.edu

Abhijit Banubakode, Sunita Dhotre, Chhaya S. Gosavi, G. S. Mate, Nuzhat Faiz Shaikh & Sandhya Arora (Eds.)

However, AI systems can be energy-intensive, and those working in the field of AI must recognise the potential for significant environmental repercussions. This is especially true as the demand for data and clever devices grows. Environmental standards have also become an important performance indicator for businesses and industries. (Joshi 2021) [1].

METHODOLOGY

This is a conceptual paper, based on the secondary data available, on the internet in the form of articles, research papers, conference papers, *etc*. The data is collected from secondary sources which include articles published in journals, research papers, published interviews, and various sustainability programs and initiatives taken by the corporates to achieve sustainable AI.

The small online survey used Google Forms among the population of Mumbai to check the awareness of AI for environmental and sustainability purposes. The process is sequentially explained in Fig. **(1).**

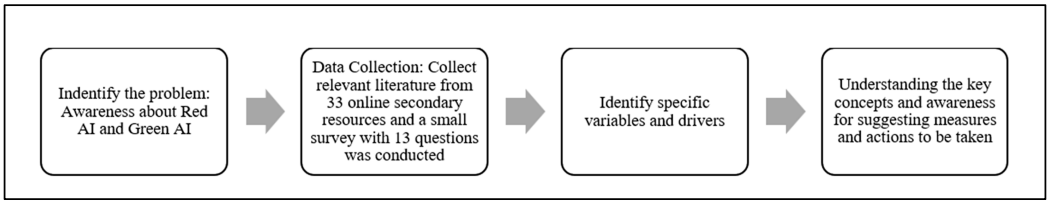


Fig. (1). Methodology Adopted.

Rationale

The effect of AI advancement on the environment and how to utilize it in a more efficient and sustainable **way with contributions from big players like Amazon, Microsoft, and Google.**

The objective of the literature review is to find the factors influencing the shift from Red AI to Green AI and to categorize them into 3 categories- technology, organization, and environment.

How government and various regulatory bodies are setting goals and providing insights into CO_2 emission from data centres of the companies hosting AI models and how to plan strategies to support sustainability?

Objective

Find out the awareness in people about the concept of Red AI and Green AI.

To compare the positive and negative impact of AI from a sustainability perspective.

Hypothesis

Hypothesis 1

H0: There is no impact of Gender, Age, Experience, and Occupation on the awareness about Red AI among the population of Mumbai.

Ha: There is an impact of Gender, Age, Experience, and Occupation on the awareness about Red AI among the population of Mumbai.

Hypothesis 2

H0: There is no impact of Gender, Age, Experience, and Occupation on the awareness about Green AI among the population of Mumbai.

Ha: There is an impact of Gender, Age, Experience, and Occupation on the awareness about Green AI among the population of Mumbai.

Hypothesis 3

H0: There is no impact of Gender, Age, Experience, and Occupation on the awareness about GHGs among the population of Mumbai.

Ha: There is an impact of Gender, Age, Experience, and Occupation on the awareness about GHGs among the population of Mumbai.

Conceptual Framework

Artificial Intelligence AI-definition

As per IBM, Artificial intelligence leverages computers and machines to mimic the problem-solving and decision-making capabilities of the human mind (Education, 2020) [2].

For designing and training machine learning algorithms, AI requires a foundation of specialised hardware and software. Although no single programming language is synonymous with AI, a few stand out, including Python, R, and Java.

AI systems, in general, work by consuming huge volumes of labelled training data, analysing the data for correlations and patterns, and then using these patterns to forecast future states.

CHAPTER 11

Knowledge Representation in Artificial Intelligence - A Practical Approach

Vandana C. Bagal[1,*], Archana L. Rane[1], Debam Bhattacharya[1], Abhijeet Banubakode[2,3] and **Vishwanath S. Mahalle[3]**

[1] *K. K. Wagh Institute of Engineering Education and Research, Nashik, Maharashtra, India*

[2] *MET Institute of Computer Science, Bhujbal Knowledge City, Bandra Reclamation, Bandra (West), Mumbai, Maharashtra, India*

[3] *Shri Sant Gajanan Maharaj College of Engineering, Shegaon, Maharashtra-444203, India*

Abstract: In the realm of artificial intelligence, knowledge representation is a vital aspect that enables effective information sharing and processing. Humans excel at sharing trusted information, which is acquired through rigorous testing and validation, resulting in what we commonly refer to as knowledge. The representation of knowledge can take various forms, such as graphs, maps, or textual formats. With the continuous evolution of the IT sector, the introduction of AI has simplified many tasks, often surpassing human capabilities and effortlessly handling even the most basic activities. However, understanding the concept of knowledge representation remains a fundamental question. In this research paper, we delve into the basics of knowledge representation to directly address this question. The understanding of knowledge representation is best achieved by examining the role knowledge plays in specific case studies or systems, which includes scientific reasoning and comprehension of the world. By exploring the intricacies of knowledge representation, we aim to provide a practical approach to its implementation in the field of artificial intelligence.

Keywords: AI capabilities, Artificial intelligence, Comprehension, Fundamental question, Graphs, IT sector, Information sharing, Knowledge representation, Maps, Practical approach, Scientific reasoning, Testing, Trusted information, Textual formats, Understanding, Validation.

INTRODUCTION

Knowledge representation is a fundamental concept in the field of artificial intelligence, playing a crucial role in various tasks. Understanding knowledge representation is essential for effectively utilizing and processing information in AI systems. In recent years, researchers worldwide have dedicated significant

[*] **Corresponding author Vandana C. Bagal:** K. K. Wagh Institute of Engineering Education and Research, Nashik, Maharashtra, India; E-mail: vcbagal@kkwagh.edu.in

Abhijit Banubakode, Sunita Dhotre, Chhaya S. Gosavi, G. S. Mate, Nuzhat Faiz Shaikh & Sandhya Arora (Eds.)

efforts to delve deeper into Knowledge Representation Learning (KRL) within the context of large-scale knowledge graphs (KG). KRL holds immense importance in the field of Artificial Intelligence, particularly in conjunction with natural language processing. It involves the calculation of semantics for attributes, entities, and relationships in a dimensional space, aiming to address the challenge of data sparsity. By employing KRL techniques, AI systems can effectively navigate and make sense of complex knowledge structures. In this paper, we present a practical approach to knowledge representation in artificial intelligence, exploring the significance of KRL and its role in overcoming data sparsity issues.

LITERATURE SURVEY

In the realm of artificial intelligence (AI), effective knowledge representation is vital. Two notable works contributing to this field are Stanojevic and Vranes' (2007) "Knowledge Representation with SOUL" and Davis, Shrobe, and Szolovits' (2002) "What is a Knowledge Representation?" [1].

Stanojevic and Vranes propose SOUL (Structured Object-oriented Language) as a method for knowledge representation, offering a structured approach tailored for AI systems. Their work likely discusses SOUL's syntax, semantics, and applications, emphasizing its advantages. Davis, Shrobe, and Szolovits provide a broader exploration of knowledge representation. They delve into various representation schemes and their roles in different AI systems, offering insights into the interdisciplinary nature of the field [2].

The Knowledge Discovery from Data (KDD) is used for extraction of patterns representing knowledge implicitly stored or catchable in large databases, data warehouses, the Web, other massive information repositories, or data streams. The author has focused on the explosive growth in stored or transient data that has generated an urgent need for new techniques and automated tools that can intelligently assist in transforming vast amounts of data into useful information and knowledge [3].

Randall Davis, Howard Shrobe, and Peter Szolovits proposed that a knowledge representation plays five distinct roles, each important to the nature of representation and its basic tasks [4].

Edward E. Ogheneovo and Promise A. Nlerum claimed that knowledge representation is an important concept used in an expert system as a part of artificial intelligence where the author proposed to use the computation environment where thinking is accomplished. They have implemented an inference rule for explaining the forward chain concept in the admission process to drive the conclusion [5 - 7].

Olegs Verhodubs and Janis Grundspenkis introduced a new concept in knowledge presentation called semantic web expert system in which the system itself plays in an automatic mode where a human expert cannot provide the appropriate answer, and the system automatically responds with necessary decisions based on the outcome and answer to the user's query [8].

Artificial intelligence plays a pivotal role in knowledge representation by assisting us in transforming vast amount of data into useful information and knowledge. The author proposed one case study of the diversities of data in society [9].

As a part of knowledge representation and artificial intelligence study, the authors studied formalization and algorithmization of the phenomenology of the intellectual process, which seems to be very promising [10].

Expert systems have gained prominence as valuable tools in various domains, including economics, facilitating decision-making processes and enhancing analytical capabilities. Claudiu-Leonardo's study, "A Study Regarding the Use of Expert Systems in Economic Field," published in Procedia Economics and Finance in 2013, contributes to understanding the application of expert systems within the economic domain. The study likely investigates the utilization of expert systems in economics, exploring their effectiveness, applications, and implications [11].

In this paper, the author considered a real-world example to demonstrate the relation between knowledge and intelligence. The author claims that in the real world, knowledge plays a vital role in intelligence as well as in creating artificial intelligence. It demonstrates intelligent behavior in AI systems. A decision maker takes the decision as an intelligence system based on definite rules. If required, it applies the predicate logic and performs the task [12 - 14].

A computer requires a well-defined problem description to process and provide a well-defined acceptable solution. For this, we need first to formulate a description in our spoken language and then represent it in formal language so that the computer can understand it, which is called a framework of knowledge representation, shown in the Fig. (**1**) below:

CHAPTER 12

File Content-based Malware Classification

Mahendra Deore[1,*] and **Chhaya S. Gosavi**[1]

[1] *Department of Computer Engineering, Cummins College of Engineering for Women, Pune, Maharashtra, India*

Abstract: Malicious Software (MALWARE) is a serious threat to system security the moment any electronic gadget or 'Thing' is connected to the World Wide Web (WWW). The malware - stealthy software that is used to collect sensitive information gains access to private systems and can disrupt device operation. Thus, malware acts against the user requirement and is a threat to all operating systems (OS), but more to Windows and Android systems, as those are the most widely used OS. Malware developers try to invade the system by means of viruses, adware, spyware, ransomware, botware, Trojans, *etc*. Developers try different anti-forensic techniques so that malware cannot be detected or investigated. Malware developers typically play 'peekaboo' with the malware investigators. The result is that investigating such attacks becomes more complex, and many times it fails because of immature forensics methodology or a lack of appropriate tools. This chapter is the first step towards analysing malware. The process started with malware dataset collection and understanding the same. ML has two basic blocks, *i.e*., feature extraction and classification. In the case of supervised learning, this feature plays a significant role. This asks for understanding features and their effect on classification, which was a major task. Two separate experimental processes were explored. The first one involved extracting n-grams from the binary files using the kfNgram tool, and the second one used a shell script to parse the assembly files for method calls to external API libraries. Several supervised machine learning classifiers like Decision Trees, SVM, and Naive Bayes were used to classify the malware family based on extracted features. We proposed a method to classify malware into nine families as per the Kaggle dataset. It analyses the n-gram of the malware file to generate the feature vector. Here, the value of 'n' in n-gram is selectable; presently, it is four. The objective was to extract highly probable n-grams from the binary files after pre-processing, *i.e*., calculating the IG parameter. The present threshold for selecting n-gram from the top-most lists is five hundred. It has been observed that SVM and Decision trees provide accuracy on the scale of 98%. Nevertheless, there are chances of improvement as there is a probability of selecting irrelevant n-grams due to the sequential selection of n-grams. This method is considered a starting point for malware classification.

Keywords: Dynamic, Malware, Machine learning, Random forest, Static, Support vector machine.

[*] **Corresponding author Mahendra Deore:** Department of Computer Engineering, Cummins College of Engineering for Women, Pune, Maharashtra, India; E-mail: Mdeore83@gmail.com

Abhijit Banubakode, Sunita Dhotre, Chhaya S. Gosavi, G. S. Mate, Nuzhat Faiz Shaikh & Sandhya Arora (Eds.)

INTRODUCTION

This chapter is the first step towards analysing malware. The process started with malware dataset collection and understanding the same. Machine Learning has two basic blocks, *i.e*., feature extraction and classification. In the case of supervised learning, this feature plays a significant role. This asks for understanding features and their effect on classification, which was a major task.

Two separate experimental processes were explored. The first one involved extracting n-grams from the binary files using the kfNgram tool, and the second one used a shell script to parse the assembly files for method calls to external API libraries. Several supervised machine learning classifiers like Decision Trees, SVM, and Naive Bayes were used to classify the malware family based on extracted features. This experimentation helped build a base for the research work.

Malware: A Threat to the Network

Today, the globe is moving to a fast-moving digital world. The use of cybertechnologies is part of our daily routine. The use of computers and mobile devices with an internet connection has become integral. At the same time, it is not only limited to information access and personnel computation, but it is also playing a vital role. All embedded devices are getting connected to the internet, opening more advanced streams like the Industrial Internet of Things (IIoT), Web of Things (WoT), Cryptocurrency, *etc*. Presently, the globe is connected *via* professional interactions, commercial transactions, and economic activities over worldwide networks. These transactions are happening due to Information and Communications Technologies (ICT). The positive side is that the digital world is growing as per expectations of technologies, but at the same time, these technologies, with the use of computers and electronic gadgets, have opened new serpentine challenges to the digital world. It will not be exaggerated to say that every moment of every day, small to large firms and businesses are facing cyber-attacks from a community called cyber criminals. E-banking to E-commerce, a cyber infrastructure, is needed [1]. The cyber infrastructure is dealing with a variety of cyberattacks like Distributed Denial of Service (DDOS), identity threats, phishing, ransomware, *etc*. Most advanced cyberattacks are conducted directly or indirectly using Malicious software, *i.e*., the MALWARE program. Malware is a computer software program that is deliberately developed for malicious activities like system hijacks, information stealing, other malware downloads, file deletion, attacking computer networks, and spamming [2]. The malicious activities log is immense, and the same is growing regularly and fast with the new entries. For instance, as a target on the malicious list, Stuxnet has

added critical infrastructure [3]. Thus, malware can be thought of in broad categories with two types, *i.e.*, newly produced malware and variants of malware [4]. In relation to the same, Fig. (**1**) displays the surge in the voluminous growth rate of the new malware and the total malware during the period of 2010 to 2020 [5].

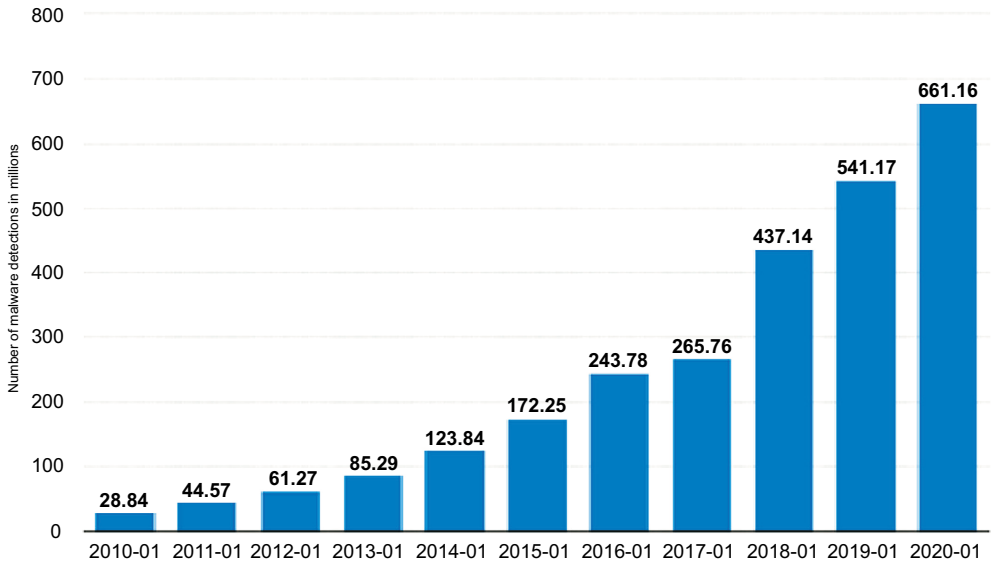


Fig. (1). Malware growth (period 2010-20) [4].

It is not only the growth of malware that is critical, but on top of it, malware detectors are always on tenterhooks about malware developers' novel approaches. Every moment, malware developers are evolving in sophistication. A few such sophistications are self-mutilation [6], crypto virology [7 - 9], various obfuscation [10], anti-analysis techniques [11 - 12], and multi-payload, *e.g.*, Nimda worm, multi-propagation, and multiplatform execution. Thus, existing anti-malware solutions are facing major challenges due to the escalating growth of this advanced malware. The purpose of the malware writers is also changing from writing malware for fun, fame, and thrill to presently writing malware to make a profit [3], cyber espionage, *e.g.*, duqu, dino, and ame [13], and terrorist activity, *e.g.*, Stuxnet. Looking at the growth and malicious intentions of the malware developer to protect huge organisations' networks and normal users' machines, an antidote to malware is necessary in the form of Anti-Virus (AV) software, which will detect the malware and quarantine it.

CHAPTER 13

Enhancing Efficiency in Content-based Image Retrieval System Using Pre-trained Convolutional Neural Network Models

Vishwanath S. Mahalle[1,*], Narendra M. Kandoi[1], Santosh B. Patil[1], Abhijit Banubakode[1,2] and **Vandana C. Bagal[3]**

[1] *Shri Sant Gajanan Maharaj College of Engineering, Shegaon, Maharashtra-444203, India*

[2] *MET Institute of Computer Science, Bhujbal Knowledge City, Bandra Reclamation, Bandra (West), Mumbai, Maharashtra, India*

[3] *K. K. Wagh Institute of Engineering Education and Research, Nashik, Maharashtra, India*

Abstract: Traditionally, image retrieval is done using a text-based approach. In the text-based approach, the user must query metadata or textual information, such as keywords, tags, or descriptions. The effectiveness and utility of this approach in the digital realm for solving image retrieval problems are limited. We introduce an innovative method that relies on visual content for image retrieval. Various visual aspects of the image, including color, texture, shape, and more, are employed to identify relevant images. The choice of the most suitable feature significantly influences the system's performance. Convolutional Neural Network (CNN) is an important machine learning model. Creating an efficient new CNN model requires considerable time and computational resources. There are many pre-trained CNN models that are already trained on large image datasets, such as ImageNet containing millions of images. We can use these pre-train CNN models by transferring the learned knowledge to solve our specific content-based image retrieval talk.

In this chapter, we propose an efficient pre-trained CNN model for content-based image retrieval (CBIR) named as ResNet model. The experiment was conducted by applying a pre-trained ResNet model on the Paris 6K and Oxford 5K datasets. The performance of similar image retrieval has been measured and compared with the state-of-the-art AlexNet model. It is found that the AlexNet architecture takes a longer time to get more accurate results. The ResNet architecture does not need to fire all neurons at every epoch. This significantly reduces training time and improves accuracy. In the ResNet architecture, once the feature is extracted, it will not extract the feature again. It will try to learn a new feature. To measure its performance, we used the average mean precision. We obtained the result for Paris6K 92.12% and Oxford5K 84.81%. The Mean Precision at different ranks, for example, at the first rank in Paris6k, we get 100% result, and for Oxford5k, we get 97.06%.

[*] **Corresponding author Vishwanath S. Mahalle:** Shri Sant Gajanan Maharaj College of Engineering, Shegaon, Maharashtra-444203, India; E-mail: vvntvsm@gmail.com

Abhijit Banubakode, Sunita Dhotre, Chhaya S. Gosavi, G. S. Mate, Nuzhat Faiz Shaikh & Sandhya Arora (Eds.)

Keywords: Content-based image retrieval, Convolution neural network architectures, Transfer learning.

INTRODUCTION

As Internet technology and affordable media have become more widely used and accessible, a vast number of image databases have been created in various fields like education, industry, medicine, remote sensing, *etc*. This has led to the challenge of developing efficient methods for retrieving similar images from these large databases based on a specified query image. It is a complex research problem that requires innovative approaches to handle the sheer volume of visual data and deliver accurate retrieval results.

In the quest to tackle the difficulties of retrieving images from large databases, researchers have explored different approaches over the years. One such approach is the "Text-based image retrieval" approach which relies heavily on precise and detailed textual annotations like tags, captions, or annotations that are linked to the images. However, manually annotating or describing each image in the database can be a time-consuming task and often impractical due to the scale of the databases. Content-based image retrieval (CBIR) represents an alternative approach to retrieving similar images based on a query image from image databases. This method effectively addresses the limitations of text-based image retrieval. The CBIR process encompasses feature extraction, classification, and similarity measurement. Fig. (**1**) illustrates the relevant retrieved images within different components of the image retrieval system, based on matching scores. In CBIR, features are extracted based on their visual content, such as colours, shapes, textures, or other visual features. Some commonly used techniques for extracting color features in CBIR include color histogram, color moments, color coherence vector, *etc*. Gray-Level Co-occurrence Matrix (GLCM), Local Binary Patterns (LBP), Wavelet Transform, *etc*., are some techniques used for extracting texture features and Boundary-based Shape Descriptors, Zernike Moments, Scale-Invariant Feature Transform (SIFT), Speeded-Up Robust Features (SURF), *etc*., are another some techniques used for extracting shape features. The choice of technique depends on the specific requirements of the application and the desired level of feature information to be captured for image retrieval purposes. For feature selection in CBIR, instead of using all available features for retrieval, the most informative and discriminative features can be selected. Principal Component Analysis (PCA), Linear Discriminant Analysis (LDA), Genetic algorithms, *etc*., are some of the feature selection techniques that depend on the specific requirements of the application and the characteristics of the feature set.

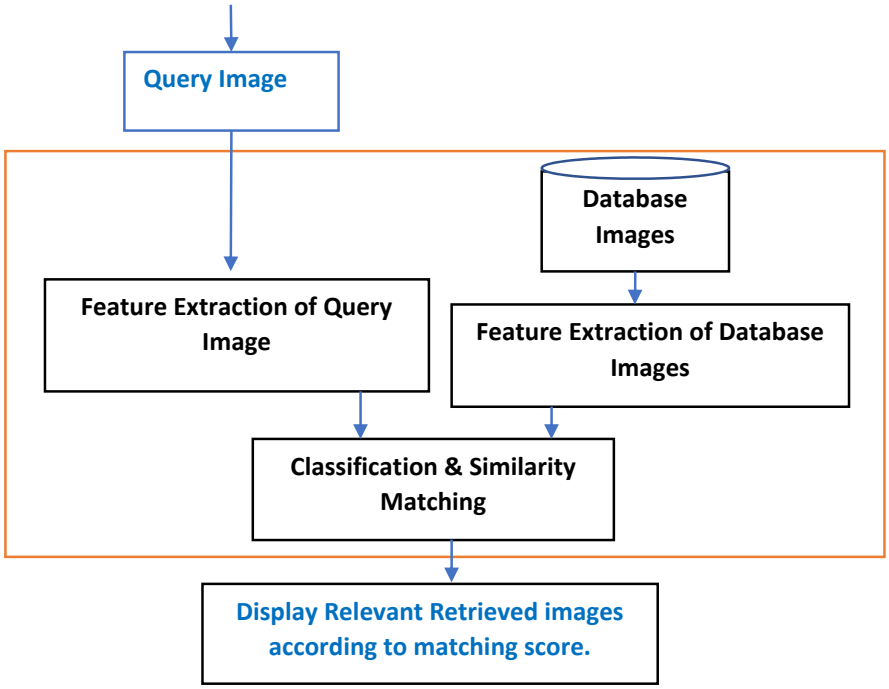


Fig. (1). Various parts of the image retrieval system.

In content-based image retrieval (CBIR), similarity measures play a crucial role in comparing and quantifying the similarity between query images and images in the database. Various similarity measures and techniques are employed in CBIR to determine the resemblance between images. Some commonly used similarity measures in CBIR are Euclidean Distance, Cosine Similarity, Manhattan Distance, Minkowski Distance, Hamming Distance, *etc*. The choice of similarity measure depends on the type of features being compared, the desired characteristics of the retrieval system, and the specific requirements of the application. The ranking for displaying images relies on feature similarity. Traditional CBIR approaches have primarily focused on low-level visual features such as color, texture, and shape descriptors. However, these methods often struggle to capture the semantic meaning and high-level features of images accurately. To overcome this limitation, recent advancements in deep learning have paved the way for leveraging Convolutional Neural Networks (CNNs) in CBIR. Convolutional Neural Network (CNN) is an important machine learning model that can be applied to the image retrieval problem by automatically learning and extracting meaningful features from images through multiple layers of convolutional and pooling operations. However, creating a new efficient CNN model requires considerable training time and it takes more computational

CHAPTER 14

Role of Artificial Intelligence (AI) in Solid Waste Management: A Synopsis

Pankaj Bhattacharjee[1,*] and **Ashok B. More**[2]

[1] *D.Y. Patil College of Engineering, Akurdi, Pune, Maharashtra, India*

[2] *Department of Civil Engineering, D.Y. Patil College of Engineering, Akurdi, Pune, Maharashtra, India*

Abstract: Rapid urbanisation and subsequent growth in population have brought about a worldwide spike in the production of municipal solid waste. Poor management skills in the collection of waste and the improper allocation of transporting vehicles due to lack of technology usage, also, insufficient funds and inappropriate management of human resources have contributed towards making Municipal Solid Waste Management (MSWM) which is a big challenge nowadays, especially in developing countries. Scientists and researchers have been working towards developing cutting-edge technology in order to address this issue. Modern Artificial Intelligence (AI) technologies are being studied for their potential usefulness in the Solid Waste Management (SWM) industry. Waste management as a whole, including collection, transportation, and sorting, may benefit substantially from the intelligent use of AI algorithms. This article provides a brief overview of the way in which Machine Learning (ML) algorithms are used in MSWM across the whole process, from the initial creation of waste through its collection, transportation, and ultimate disposal.

Keywords: Algorithms, Artificial intelligence (AI), Deep learning, Internet of things (IoT), Machine learning (ML), Municipal solid waste management (MSWM).

INTRODUCTION

In cities and Metropolitan areas nowadays, the accumulation of Municipal Solid Waste has become a point of major concern, which, if not addressed properly, may result in environmental degradation and pose danger to human health [1]. This necessitates adopting a smarter system of managing the waste generated in order to care for a range of different waste materials.

[*] **Corresponding author Pankaj Bhattacharjee:** D.Y. Patil College of Engineering, Akurdi, Pune, Maharashtra, India; E-mail: pankaj_1922@yahoo.co.in

Abhijit Banubakode, Sunita Dhotre, Chhaya S. Gosavi, G. S. Mate, Nuzhat Faiz Shaikh & Sandhya Arora (Eds.)

Solid waste is generally a composition of debris, a range of materials rejected and thrown out by households, commercial units like shops and different industries, and agricultural establishments in the form of food waste, plastic, rubber, glass, metal, textile products, ceramics, *etc* [2]. Urbanisation, growth in population and poverty are the main factors which make the disposal of municipal solid waste a matter of concern in developing countries [3]. Improper dumping of waste and poor management in the waste disposal system cause the transmission of different kinds of diseases, fire and chemical hazards, odour nuisance, along with air and water pollution.

The use of waste management systems, which have been designed based on Information and Communication Technologies (ICT), is nowadays being considered as the most effective solutions [4]. These technologies can give current on-site information on the garbage and provide an optimized route for the vehicles that collect the waste, thereby reducing both cost and overall processing time. The Artificial Intelligence (AI) systems are greatly contributing towards bringing higher efficiency and optimisation into the waste management practices nowadays [5].

Artificial Intelligence (AI) can be described as the development of computer programmes which are able to perform tasks or mitigate problems which generally require human intelligence. Functions like recognition of speech, visual perception, making decisions and translation of words which are a task of the human brain can now be completed by using the designated programmes in a computer. AI programming concentrates on creating some rules or criteria, which can be utilised to transform the data obtained in the kind of information for a computer to be able to act on it. These rules or criteria, called algorithms, provide a system with instructions to perform a specific task efficiently in a step-by-step manner.

PROBLEM STATEMENT

The prevailing waste situation in modern cities is bounded by a number of inconveniences. Generally, only a particular type of waste bin is used in order to collect almost all categories of waste, which compels direct disposal of the garbage into the dumping ground without being properly segregated. Also, the accumulation of waste around an uncovered bin becomes obvious, and this situation invites several problems. Along with bad odors, this particular place becomes a breeding ground for insects, flies and different bacteria, which in turn bring health hazards for humans. Ignorance and unawareness among people about the basic waste management system adds fuel to these situations. Most people even do not have the idea to differentiate between dry and wet waste. Unsuitable

classification and improper disposal of municipal garbage can become hazardous and unwholesome for both humans as well as animals. Poorly maintained waste area results in bad aesthetics, which can decrease the market value of the land, thus affecting the economic factor of that nation.

Contribution of Artificial Intelligence (AI) and Machine Learning Algorithm in Solid Waste Management

Artificial Intelligence (AI) is being adopted in many fields of technology with reference to modern innovations. In the domain of solid waste management (SWM), new artificial intelligence (AI) approaches are being worked out for their potential value in a broad range of waste management processes, including collection, transportation, and sorting, in a number of different contexts. In waste management facility Machine Learning (ML) approaches are being used in different phases of the MSWM process, starting with the formation of waste and up to its disposal for all types of waste, including medical and biohazard waste.

'Machine Learning' (ML) is described as a function of artificial intelligence (AI) that empowers a system to learn and make decisions on its own without being given instruction. It is a scientific analysis of a particular set of statistics and algorithms. In the same way, another necessary and compulsory part of machine learning is "Deep Learning". An important deep learning algorithm named Convolutional Neural Network (CNN) helps in image recognition as well as image classification of the wastes. ML analyses the data which is fed to them in order to "train" a system to complete a given task by the use of various algorithms designed and stored for that particular kind of job. This CNN is mostly used in the camera module system in a Waste management facility.

The "Internet of Things" (IoT) is a kind of network of substantial articles called "things" referring to any of a wide range of everyday objects that have been retrofitted with electronics like sensors, processors, and wireless network modules so that they can join a network and exchange data with other nodes in the internet. These devices range from the typical to the very specialised in their function. Currently, one of the most significant difficulties that the majority of smart cities are confronting is the effective management of solid waste. Providing a solution that is based on the Internet of Things (IoT) makes it possible to streamline the automation and monitoring of the process of managing solid waste generated in a smart city.

SUBJECT INDEX

A

B

C

D

E

F

G

H

I

J

L

M

N

O

U

V

W

An interesting edited book full of research articles focusing on important terms, concepts and algorithms in AI/ML for those of us - researchers, academicians, scholars, professionals and students, who want to get acquainted with use of intelligence in real-life ICT applications such as waste management, beverage testing, bird species identification, travel and tourism, child health, code cloning, information retrieval and much more. I really appreciate the editors' effort in dissemination of ICT knowledge.

Dr. Ganesh D. Bhutkar
Department of Computer Engineering,
Vishwakarma Institute of Technology (VIT),
Pune, Maharashtra,
India

Abhijit Banubakode

MET Institute of Computer Science
Bhujbal Knowledge City, Bandra Reclamation
Bandra (West), Mumbai, Maharashtra
India

Sunita Dhotre

Department of Computer Engineering
Bharati Vidyapeeth (Deemed to be University)
College of Engineering, Pune, Maharashtra
India

Chhaya S. Gosavi

Department of Computer Engineering
MKSSS's Cummins College of Engineering for Women
Pune, Maharashtra
India

G.S. Mate

Department of Information Technology
JSPMs Rajarshi Shahu College of Engineering
Pune, Maharashtra
India

Nuzhat Faiz Shaikh

Department of Computer Engineering,
M. E. S's Wadia College of Engineering
Pune, Maharashtra
India

Sandhya Arora

Department of Computer Engineering
MKSSS's Cummins College of Engineering for Women
Pune, Maharashtra
India