# ARTIFICIAL INTELLIGENCE AND KNOWLEDGE PROCESSING: METHODS AND APPLICATIONS

Editors:
**Hemachandran K.**
**Raul V. Rodriguez**
**Umashankar Subramaniam**
**Valentina Emilia Balas**

**Bentham Books**

# Artificial Intelligence and Knowledge Processing: Methods and Applications

Edited by

**Hemachandran K.**
*Department of Artificial Intelligence*
*School of Business*
*Woxsen University*
*Hyderabad*
*India*

**Raul V. Rodriguez**
*School of Business*
*Woxsen University*
*Hyderabad*
*India*

**Umashankar Subramaniam**
*College of Engineering*
*Prince Sultan University*
*Riyadh*
*Saudi Arabia*

&

**Valentina Emilia Balas**
*Aurel Vlaicu University of Arad,*
*Arad,*
*Romania*

**Artificial Intelligence and Knowledge Processing: Methods and Applications**

Editors: Hemachandran K., Raul V. Rodriguez, Umashankar Subramaniam & Valentina Emilia Balas

ISBN (Online): 978-981-5165-73-9

ISBN (Print): 978-981-5165-74-6

ISBN (Paperback): 978-981-5165-75-3



First published in 2023.

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

# FOREWORD

Artificial Intelligence & Knowledge Processing is playing a vital role in changing most of the sectors' processes and landscapes. AI has an enormous impact on various automation industries and their functioning converting traditional industries to AI-based factories. New algorithms are changing the way business processes and results are analyzed. You will encounter a few of the topics such as AI in Robotics, AI in IoT, AI in Marketing and Operations, AI in Healthcare, how insights are extracted from bigdata, Museums including Lighting and Cooling Systems, forecast visitor behavior, management of security systems and economic use of energy and other resources, automated path planning in a garden environment using reinforcement learning and analysis of human gait by utilizing regression in this collection of articles and papers. You will undoubtedly like them as much as I did when taking part, I'm sure. With its numerous research articles and chapters on Artificial Intelligence and Knowledge Processing: Methods and Applications, which is applicable to and helpful in our current world, I hope this book makes a significant contribution to various sectors.

**Somdip Dey**
Nosh Technologies
Colchester, United Kingdom

# PREFACE

Artificial Intelligence has been gradually invading our lives, and we are using it to accomplish many fundamental tasks. Talking to Siri or Alexa, and avoiding traffic using Google Maps are the most common examples of Artificial Intelligence in our daily lives.

Intelligence, as a quality possessed by humans, is the ability to acquire and apply knowledge. This knowledge is gained through observation, perception, application of reasoning and logic to the observed facts. Artificial intelligence transforms how knowledge is captured, developed, shared, and efficiently used within organisations.

Many tools are used in AI, including mathematical optimization, logic, and probability and dwell in the fields of computer science, psychology, linguistics and many other subjects.

The major application of AI in Robotics, IoT, Marketing and Operations, how insights are extracted from bigdata, Museums including Lighting and Cooling Systems, forecast visitor behavior, management of security systems and economic use of energy and other resources, automated path planning in a garden environment using reinforcement learning and analysis of human gait by utilizing regression are discussed in this book. This book also gives insights into violence detection using computer vision for smart cities.

AI is also increasingly used in the health sector. For example, Artificial Neural Network is used to predict the presence or absence of heart disease. Scientists have used AI to predict crop suitability and rainfall prediction, referred to as a Crop Management system. Crop Management System uses parameters like the ratio of nitrogen, phosphorous, potassium, pH value of soil, and environmental factors such as humidity, rainfall, temperature, *etc.* These issues are also discussed in this book.

This book written in simple language throws light on the AI applications in several fields, including machine learning, medicine, and agriculture and briefs how AI impacts daily life. We hope that this book will be beneficial for students, researchers and all people who are

interested in Artificial Intelligence and Knowledge Processing. We express our sincere thanks to the editorial and production teams who worked relentlessly to publish this book on time.

**Hemachandran K.**
Department of Artificial Intelligence
School of Business
Woxsen University
Hyderabad
India

**Raul V. Rodriguez**
School of Business
Woxsen University
Hyderabad
India

**Umashankar Subramaniam**
College of Engineering
Prince Sultan University
Riyadh
Saudi Arabia

&

**Valentina Emilia Balas**
Aurel Vlaicu University of Arad,
Arad
Romania

# List of Contributors


| | |
|---|---|
| **Abhishek Rajput** | Vishwakarma Institute of Technology, Pune, Maharashtra, India |
| **Aditya Rasal** | Vishwakarma Institute of Technology, Pune, Maharashtra, India |
| **Amrapali Nimsarkar** | Department of Electrical Engineering, GHRCE, Nagpur, India |
| **B. R. S. S. Sowjanya** | Woxsen School of Business, Woxsen University, Kamkole, Sadasivpet, Telangana, India |
| **C. Roshan Abraham** | Madras Institute of Technology, Anna University, Chennai, India |
| **Chithik Raja** | University of Technology and Applied Sciences Salalah, Salalah, Sultanate of Oman |
| **Chinna Swamy Dudekula** | Engineering and Environment (Advanced Computer Science with Advanced Practice), Northumbria University, Newcastle, United Kingdom |
| **Choppala Swathi Priya** | Woxsen School of Business, Woxsen University, Kamkole, Sadasivpet, Telangana-500078, India |
| **Dibya Nandan Mishra** | Woxsen School of Business, Woxsen University, Kamkole, Sadasivpet, Telangana, India |
| **Devendra Dheeraj Gupta Sanagapalli** | Department of Physics, BITS Pilani Hyderabad Campus, Telangana-500078, India |
| **Ezendu Ariwa** | University of Wales Trinity Saint David, London Campus, United Kingdom |
| **Gabriel Kabanda** | School of Business, Woxsen University, Hyderabad, India |
| **Guda Vineeth Reddy** | School of Business, Woxsen University, Hyderabad, India |
| **Gaddam Venkat Shobika** | Woxsen School of Business, Woxsen University, Kamkole, Sadasivpet, Telangana, India |
| **Hemachandran K.** | Department of Artificial Intelligence, School of Business, Woxsen University, Hyderabad, India |
| **Harikumar Naidu** | Department of Electrical Engineering, GHRCE, Nagpur, India |
| **Ishank Jha** | Woxsen School of Business, Woxsen University, Kamkole, Sadasivpet, Telangana-500078, India |
| **Jyoti Madake** | Vishwakarma Institute of Technology, Pune, Maharashtra, India |
| **K. Jarina Begum** | Jazan University, Jazan, Kingdom of Saudi Arabia |
| **Keerti Adapa** | Faculty of Science and Technology, ICFAI Foundation for Higher Education, Hyderabad, India |
| **K. Vishal** | Woxsen School of Business, Woxsen University, Kamkole, Sadasivpet, Telangana, India |
| **K. Ravi Kumar Reddy** | Lifencrypt, Hyderabad, India |
| **K. Kailash** | Independent Journalist, Hyderabad, India |
| **Mamta Tembhare** | Waste Processing Division, CSIR-NEERI, Nagpur, India |

| | |
|---|---|
| **Mukul Kumar Gupta** | School of Engineering, University of Petroleum and Energy Studies (UPES), Dehradun, India |
| **Nitesh Singh Malan** | School of Engineering, University of Petroleum and Energy Studies (UPES), Dehradun, India |
| **Pingili Sravya** | School of Business, Woxsen University, Hyderabad, India |
| **P.K. Thiruvikraman** | Department of Physics, BITS Pilani Hyderabad Campus, Telangana-500078, India |
| **Piyush Kokate** | Energy & Resource management Division, CSIR-NEERI, Nagpur, India |
| **Pranay Kumar** | University of Maryland, Baltimore County, United States |
| **Pranav Balakrishnan** | Madras Institute of Technology, Anna University, Chennai, India |
| **Prathyusha Pujari** | Woxsen School of Business, Woxsen University, Kamkole, Sadasivpet, Telangana, India |
| **Rajesh Kumar K. V.** | School of Business, Woxsen University, Hyderabad, India |
| **Simran Sahni** | Department of Physics, BITS Pilani Hyderabad Campus, Telangana-500078, India |
| **Shripad Bhatlawande** | Vishwakarma Institute of Technology, Pune, Maharashtra, India |
| **Sambodhi Umare** | Vishwakarma Institute of Technology, Pune, Maharashtra, India |
| **Sri Rama Sai Pavan Kumar** | School of Business, Woxsen University, Hyderabad, India |
| **Sai Santosh Potnuru** | Woxsen School of Business, Woxsen University, Kamkole, Sadasivpet, Telangana-500078, India |
| **Sailaja Maggidi** | School of Business, Woxsen University, Hyderabad, India |
| **Sourav Chakraborty** | Woxsen School of Business, Woxsen University, Kamkole, Sadasivpet, Telangana, India |
| **Swati Shilaskar** | Vishwakarma Institute of Technology, Pune, Maharashtra, India |
| **Sandip K. Chourasiya** | University of Petroleum and Energy Studies, Dehradun, India |
| **Sudheer Hanumanthakari** | Faculty of Science and Technology, ICFAI Foundation for Higher Education, Hyderabad, India |
| **S. Sathiya Murthi** | Madras Institute of Technology, Anna University, Chennai, India |
| **Thakur Santosh** | Mahindra University, Hyderabad, India |
| **V. Sathiesh Kumar** | Madras Institute of Technology, Anna University, Chennai, India |
| **Varun Shelke** | Vishwakarma Institute of Technology, Pune, Maharashtra, India |
| **V. Devarajan** | University of Technology and Applied Sciences Salalah, Salalah, Sultanate of Oman |
| **Varadharaja Krishna** | Woxsen School of Business, Woxsen University, Kamkole, Sadasivpet, Telangana, India |
| **Y. Vani** | NLP at Google, California, USA |

# CHAPTER 1

# Artificial General Intelligence; Pragmatism or an Antithesis?

**K. Ravi Kumar Reddy**[1,*], **K. Kailash**[2] and **Y. Vani**[3]

[1] *Lifencrypt, Hyderabad, India*

[2] *Independent Journalist, Hyderabad, India*

[3] *NLP at Google, California, USA*

**Abstract:** Artificial intelligence is promoted by means of incomprehensible advocacy through business majors that cannot easily be equated with human consciousness and abilities. Behavioral natural systems are quite different from language models and numeric inferences. This paper reviews through centuries of evolved human knowledge, and the resolutions as referred through the critics of mythology, literature, imagination of celluloid, and technical work products, which are against the intellect of both educative and fear mongering. Human metamorphic abilities are compared against the possible machine takeover and scope of envisaged arguments across both the worlds of 'Artificial Intelligence' and 'Artificial General Intelligence' with perpetual integrations through 'Deep Learning' and 'Machine Learning', which are early adaptive to 'Artificial Narrow Intelligence' — a cross examination of hypothetical paranoid that is gripping humanity in modern history. The potentiality of a highly sensitive humanoid and sanctification to complete consciousness at par may not be a near probability, but social engineering through the early stages in life may indoctrinate biological senses to a much lower level of ascendancy to Artificial Narrow Intelligence — with furtherance in swindling advancement in processes may reach to a pseudo-Artificial Intelligence {i}. There are no convincing answers to the discoveries from ancient scriptures about the consciousness of archetypal humans against an anticipated replication of a fulfilling Artificial Intelligence {ii}. Human use of lexicon has been the focal of automata for the past few years and the genesis for knowledge, and with the divergence of languages and dialects, scores of dictionaries and tools that perform bidirectional voice and text — contextual services are already influencing the lives, and appeasement to selective humanly incidentals is widely sustainable today {iii}. Synthesizing and harmonizing a pretentious labyrinthine gizmo is the center of human anxiety, but only evaluative research could corroborate that tantamount to genetic consciousness.

**Keywords:** Brain, Dabus, Darpa, Enzymatic distress, Singularity, Technophobia, Upanishads.

[*] **Corresponding author K. Ravi Kumar Reddy:** Lifencrypt, Hyderabad, India; E-mail: cs@lifencrypt.com

**Hemachandran K., Raul V. Rodriguez, Umashankar Subramaniam & Valentina Emilia Balas (Eds.)**

## INTRODUCTION

Human, the conditioned being to near living of earthly matters, is expected to become a mere biological slave in front of the mammoth data insiders where machines to become brainy, and with very sturdy self-corrective aptitudes to work against the Darwinian doctrine of species. The hypothetical apocalypse of a kind that is expected to dominate all biological inhibitions and races to reduce to nothing but menials. So far, superior being on the surface of the earth system, homo-sapiens, appraised to get into deep descent in their metamorphic intelligence being transmuted to the ownership of machines. The egoistic behavior of creative gizmo with intelligence and superlative augmentation of digital proficiency is meant for reduction of civilization to an imminent atrophy. Forced authority with an invisible antagonist in the form of a burgeoning digital consciousness is foreseen to be a certainty against future genealogy. These are pragmatic proclamations, though — the reality could well be very much a disregard for the prospects of dream merchants.

Dutch artist Maurits C. Escher (1898-1972) is famous for his lithographic depiction of 'drawing hands' and is the greatest testimony to contemplation of exertion towards a lifeless scheme to be judicious. He was not of any great repute by the art world but was idolized by mathematicians [1]. The synopsis constitutes a perfect example of a genuinely strange loop, but this conviction arises from our suspended skepticism and psychic sneak into Escher's intriguing domain [2] (p.103). The venerated mastery in Escher's artistry is envisioned for perplexity across unattainability and pragmatism. Logico-semantic paradoxes may stretch a supposition to approval in the coincidence of a parallelly persistent unacceptability as contrary [3] (pp.299-308). This innate fortitude through ardent stimulus by frontal lobes for temporal paradox and reflexes is preserved to be a unique ability by humans as a biological competency that may be compared to none of artificiality and in generations to survive. Among the greatest of abilities, an unusual trait of a Liar Paradox[1] is very significant in reciprocal transactions among human intelligence — and for sure as polymorphism in egotistical motivations. The Liar had to be regarded of every circumstance as a statement that is both true and false [4], a true anomalous contradiction.

Every endeavor of the human is not definitely effortless since it warps through the multitude of fluidity and complexity of logical amplitude. The antiquity and chronicled experiences among races in each case of every being tend to be unique and unparallel. Indeed, the bizarre dilemma of annoyance, John Locke's[2] empirical epistemology symbolizes a logical and political conclusion, with advanced theories from Wollstonecraft[3] and Godwin[4] in which humans figured already as artificially altered creatures who deserve liberation from the tyranny of

political systems that had perverted and contorted their biological intelligence [5] (p.183).

Artificial Life (A-Life) is a theoretical intelligence in observations of natural occurrences to biological life — explicit to the most apparent composition of living thing, and aptitude to self-regulate as an instantaneous buildup of form and structure [6] (p.507). Langton[5] articulates that A-Life is the study relating to the replication of natural living systems through man-made appliances and would complement the synthesized biological demeanor by artificial means. Contrary, Darwinian biological evolution has many pathways in determining species across millions of years, and at each juncture of transfiguration in relinquishing those unwanted and acquisition of required abilities for continuing genetic lineage — and to have been an exhaustive fulfilment of skill in ecological conditioning, which is seized to temporal stature with categorical constraints of survival.

But enthusiastic at the arrival of the computation machine, in February 1951, Turing[6] wrote to one of his colleagues at the National Physical Laboratory, *"Our new machine [the Ferranti Mark I] is to start arriving on Monday. I am hoping as one of the first jobs to do something about 'chemical embryology'. In particular I think one can account for the appearance of Fibonacci numbers in connection with fir-cones"*. These were free interpretations from the first-generation computing probabilities, and seven decades of information history must explain these ambitions. He certainly had a question of *"Can machines think?"*, but believed it to be meaningless to deserve discussion at his time. Turing was very cautious in his argument and believed that *"at the end of the century using these words and general educated opinion will have altered so much that one will be able to speak of machines thinking without expecting to be contradicted"* [7]. By the late twentieth century, humans started defining the scope and variants in the hierarchy of artificial to deliver intelligence, so ancient sages had their own definitions of intelligence and super intelligence in the holy scriptures.

## ELUCIDATION OF ECHELONS, THE HIERARCHY

AnI is a very feeble AI and delivered in many forms, *i.e.,* Amazon, Netflix, Siri and Alexa are examples of task affirmative request comprehension. Smartphones, IoT, and pet robots are also some other forms of machines that may also be called AnI, since equipped with human supportive applications within their systems.

AI is implemented in machines to perform tasks that would require human intelligence to substantiate the functioning due to dynamics in presence, reasoning, likes and dislikes, learning, problem solving and quick decision making. AI is nothing but algorithms with certain sets of rules that try to learn the

CHAPTER 2

# Applications of Artificial Intelligence in Robotics

**Pingili Sravya**[1,*], **Hemachandran K.**[2] and **Ezendu Ariwa**[3]

[1] *School of Business, Woxsen University, Hyderabad, India*

[2] *Department of Artificial Intelligence, School of Business, Woxsen University, Hyderabad, India*

[3] *University of Wales Trinity Saint David, London Campus, United Kingdom*

**Abstract:** Artificial Intelligence is a theory of the cognitive perspective in the province with robotics to human communication with the perception of action. The ability to develop computer systems would require human intelligence to perform tasks [1]. Artificial Intelligence plays a prominent role in robotics in providing effective analytical business solutions like human behavior in the real world. The common root of artificial intelligence and robotics has a scientific interaction that transforms technological improvement in robotics application and utilization and has a potential for future robotics in various applications and AI technologies. The study of the creation of intelligent robots in Artificial Intelligence is an entity for different objectives and applications. It is known to many people that artificial intelligence is a subset of robotics. Robots have human-like behavior by which they can perform tasks like a human if enabled with Artificial Intelligence.

**Keywords:** Artificial Intelligence, Human Intelligence and Machine Learning, Robotics.

## INTRODUCTION

Artificial Intelligence deals with machines like humans and performs human-like activities creating devices that enable machines to sense and act like humans. In the branch of technology, artificial intelligence plays a prominent role that deals with the study of robots and helps in designing intelligent machines to make life easier for everyone in everyday life. The association between the two is the coherence of computers and science, which synthesize the fact of finding brain waves to perform different operations. There is no distinction between artificial intelligence and robotics, which naturally leads the way to “intelligent machine”. We might agree with the fact that not every machine is a robot; that is invented to design robots that do not deal with virtual agents.

[*] **Corresponding author Pingili Sravya:** School of Business, Woxsen University, Hyderabad, India;
E-mail: Sravya.pingili_2023@woxsen.edu.in

**Hemachandran K., Raul V. Rodriguez, Umashankar Subramaniam & Valentina Emilia Balas (Eds.)**

The vision of artificial intelligence for most of us today is that machines are not in danger of being destroyed. But AI is a real risk to the survival of human civilization. Whether artificial intelligence poses a threat is a matter of debate. Artificial Intelligence is the science and engineering of creating intelligent machines. In some ways, AI is the technology that makes devices function and behave like humans. More recently, AI has made this possible by developing apparatus and robots in many areas, such as healthcare robotics, marketing business analytics, and more. However, many applications are not recognized as AI. This is because when we think of artificial Intelligence, we often think of robots that run our daily lives. We always use truth in our daily lives because facts permeate our everyday life [2]. For example, how Google provides accurate search results and Facebook feeds consistently provide content based on our interests are artificial responses. Intelligence.

A standard misunderstanding is that numerous individuals think that artificial intelligence, machine learning, and deep learning are the same because they have typical applications. For example, Siri is his AI machine learning application, but how are these technologies erased? On the other hand, deep learning is a subset of machine learning that uses neural networks to solve complex problems. Machine learning and deep learning require artificial intelligence, which provides a set of algorithms and neural networks to solve data-driven problems. But AI isn't just banned in machine learning and deep learning. It covers many areas, such as natural language processing, object recognition, computational imagination, and robotic expert systems.

## DIFFERENCE BETWEEN AI AND ROBOTICS

Futurist of robotics and artificial intelligence helps companies understand the latest technology trends in synthetic intelligence and robotics; they both are significant trends for companies to watch, but sometimes there is an overlap between them. The area of computer science helps us to materialize computer agendas that can comprehend themselves either by foraging information or operating detectors and infusions to help algorithms understand themselves. Manufacturing or building cars would take a long time and means to enroll, but today advanced robots can do almost anything. This is where the overlap between these two areas comes into play. You can combine artificial intelligence and robotics. A robot is a body, and artificial brilliance is a brainiac.

In the past, if we had robots for long-time building things like cars, they would have picked up something programmed to screw something, but they couldn't intelligently make decisions. Nowadays, we can give those robots things like cameras that act as their eyes and add our intelligence to this equation as the

brain. Suddenly, artificially intelligent robots were born, and all advances in robotics were taken out of them. Think of drones as robots these days. For example, an artificial intelligence brain allows this drone to fly autonomously. Now, self-driving cars that combine robotics and brains are back on the scene. By combining artificial Intelligence and robotics, we can now have a machine vision camera to detect where the objects are and then uses its sensors to pick them up and ideally place them.

It shows how far autonomous robots have come in the meantime. It also has a feature called reinforcement learning. In other words, instead of feeding machines tons of data to perceive things. Recently we can see robots that can monitor the environment and learn to start to walk, and each step was a success for a robot. Combining AI and robotics is about data science that learns by themselves robots about machines that can do autonomous things. Still, by combining them, AI becomes the brain, the robot becomes the body, and you can achieve amazing things.

## PERCEPTION AND INTELLIGENT ROBOTS

A particular task related to robot perception is the thought of the human to interact with the environment with different parts like the body, ears, nose, and eyes, *i.e.,* something about the external environment similar to that of robots for real-world understanding. Manipulating and executing operations in the real world is known as robot perception. Robot perception is the same as humans use different parts of our body; robots use various sensors [3]. From Fig. (**1**), action perception is common in robotic platforms, which is confident that interacting with the world to get sensor inputs from the real world is known as sensing and perception.

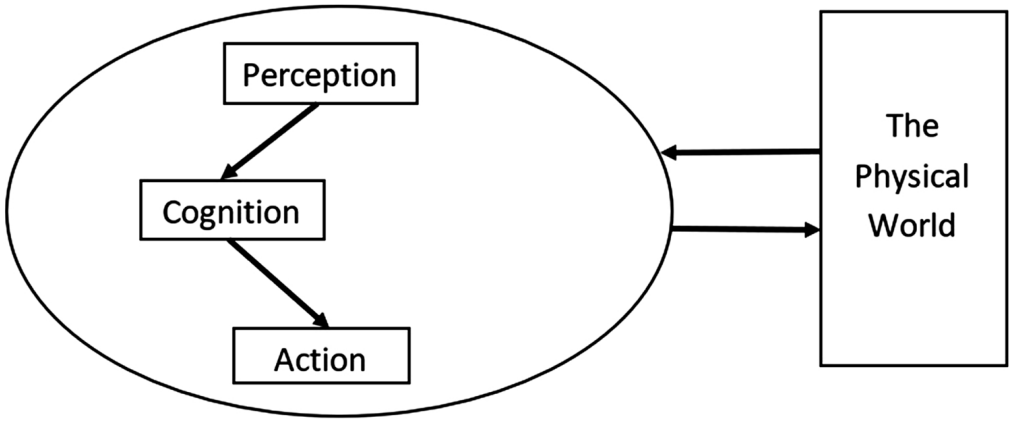


**Fig. (1).** Perception of robots to the physical world.

CHAPTER 3

# Smart Regime with IoT application using AI

**Sri Rama Sai Pavan Kumar[1,*], Guda Vineeth Reddy[1], Sailaja Maggidi[1]** and **Rajesh Kumar K. V.[1]**

[1] *School of Business, Woxsen University, Hyderabad, India*

**Abstract:** The Internet of Things (IoT) has made it possible for previously unconnected items, such as vehicle engines, to be connected to the network, leading to the emergence of numerous active data streams. The IoT and big data analytics have made considerable strides, opening up intriguing new possibilities for medical and healthcare solutions. Many organisations still struggle with the usage of AI and ML technology when attempting to expand their digital transformation programmes and utilise IoT data.

The most current trends involve modifying IoT data for smart applications using artificial intelligence techniques. Numerous apps use data science and analytics to extract conclusions from gigabytes of data. However, these applications do not deal with the issue of constantly identifying patterns in IoT data. The introduction of the IoT and the cloud has further enhanced things by offering smart business recommendations as well as insights into how people operate and how lives are changing. We discuss a variety of AI capabilities and how to apply them to IoT devices in Hands-On AI for IoT.

The logic-based substrate provides low energy footprints and higher cognitive accuracy during training and inference, which is a crucial requirement for effective AI with long operating life. The use of AI in the industrial sector has enormous potential. However, it frequently necessitates expensive and resource-intensive machine learning professionals as well as in-depth knowledge of complex statistics and how they are implemented in practical use cases.

**Keywords:** IoT and AI combined, Tools and innovations, AI for IoT.

## INTRODUCTION

In 1999, the phrase “IOT” first surfaced. This was introduced by Kevin Ashton. But at the start of 1990, a toaster was introduced as the first Internet of Things (IoT) gadget [1]. Kevin Ashton’s study was crucial to the development of the Internet of Things. He put out the most effective technique for letting computers

[*] **Corresponding author Sri Rama Sai Pavan Kumar:**School of Business, Woxsen University, Hyderabad, India; E-mail: pava.kumar_2023@woxsen.edu.in

**Hemachandran K., Raul V. Rodriguez, Umashankar Subramaniam & Valentina Emilia Balas (Eds.)**

transmit raw data without human interference [2]. He then introduced sensors and Radio Frequency Identification Devices (RFID) that gather data, are connected to the internet, and instantly feed it to the computer. Since that time, IoT has made it possible for previously disconnected items to be connected to the internet, such as actuators, automobiles, sensors, and smart mobile devices. This has resulted in the development of numerous continuous data streams. IoT applications are currently deployed in industries including agriculture and home appliances [1].

A large amount of information is being generated due to the IoT devices' unprecedently rapid proliferation. Now that sensing technologies have advanced, breakthroughs for the fourth industrial revolution are possible [3]. The majority of the sensitive data collected by IoT devices have been stored using the cloud paradigm, but the system has been rendered ineffective because it takes too long for data to be transferred from cloud data centres to end users. In order to provide services like the movement of money, supply chains, people, and interactive art production, among others [4, 5], IoT devices send a lot of useful data to the network for calculation. Artificial intelligence techniques have lately been used to manipulate IoT data for smart applications. These devices spawn a new generation of AI-powered IoT applications because of the massive amount of data they produce. These applications are designed to make vital decisions in the real world instantly rather than transmitting data to cloud servers. IoT now refers to a wide range of items that are linked to the internet, such as smartphones, actuators, and sensors. The fog network is another common name for it [6]. The great majority of AI systems today are based on the neural network concept. In the end, this makes things simpler and offers people control over the potential of IoT data. Fig. (**1**) shows two different types of IoT sensors [7, 8].

The analysis of complicated data using algorithms, data mining, and diverse technologies is covered in this chapter along with IoT implementations and approaches for integrating AI into daily life. There has been a strong movement recently to replace arithmetic with binary logic as the basic building blocks. It is laborious, though, to create IoT applications employing AI approaches. The authors offer creative strategies that enable programmers to swiftly incorporate an AI mechanism into existing IoT applications *via* a graphical user interface. IoT apps can easily incorporate AI *via* AI speak. This chapter offers knowledge that doesn't require code to use. Our goal is to assess the learning automata methods applied in the IoT for energy efficiency. We will verify the effectiveness of the AI with the aid of IoT-scale datasets to evaluate either single- or multi-class applications in the ecosystems as well as investigate the impact of noisy inputs on the overall learning efficiency. Three-dimensionality was added to scale it. Fig. (**2**) in the text below illustrates it in an odd way. These things might include somebody sporting a wristband or even a smartphone, RFID-tagged animals, as

well as commonplace appliances like refrigerators, washing machines, and coffee makers [8, 9].

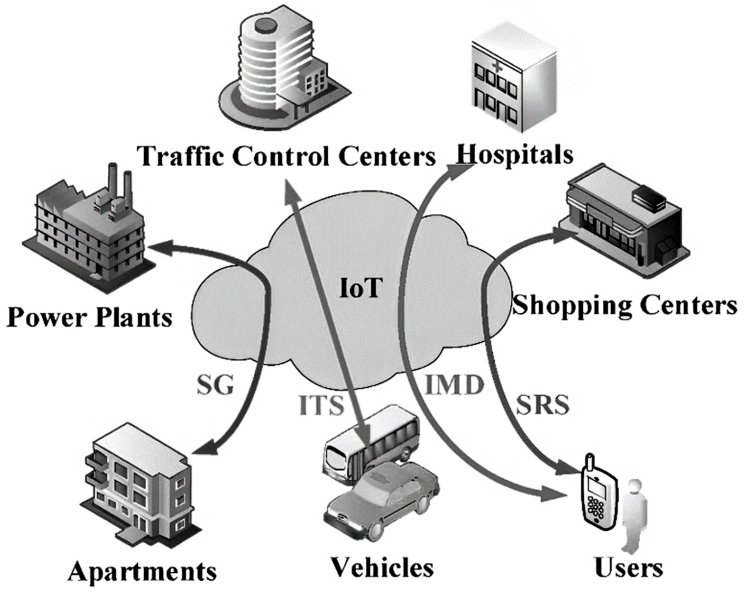


**Fig. (1).** Types of sensors used in IoT [10].

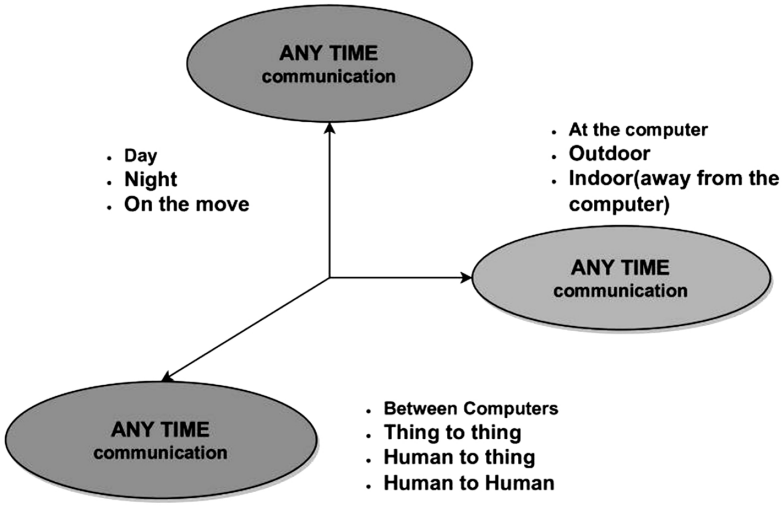


**Fig. (2).** Dimensions in IoT [11].

These real-world tangible objects can be sensed, automatically triggered, and connected to things that are not immediately apparent but exist as data and may be preserved, examined, and made available. To connect to the internet, these

CHAPTER 4

# Artificial Intelligence in Marketing and Operations

**Gaddam Venkat Shobika[1,*], Sourav Chakraborty[1], Varadharaja Krishna[1], Dibya Nandan Mishra[1]** and **Pranay Kumar[2]**

[1] *Woxsen School of Business, Woxsen University, Kamkole, Sadasivpet, Telangana, India*

[2] *University of Maryland, Baltimore County, United States*

**Abstract:** In the last 20 years, artificial intelligence (AI) and machine learning (ML) applications have advanced at an unmatched rate. The development of robotics and automation has been driven by AI technology, and this has substantial effects on practically every facet of the business, particularly supply chain operations. Smart technologies allowing real-time automatic data collection, analysis, and prediction have been widely incorporated into supply chains. We examine the current uses of AI in marketing and operations management (OM) and supply chain management in this study (SCM). Since these three industries combined account for the majority of business-related AI advancements as well as expanding problem domains, we focus specifically on innovations in healthcare, manufacturing, and retail operations. We go over the main obstacles and potential uses of AI in those sectors. We also talk about current research.

**Keywords:** Artificial Intelligence, Marketing, Market Basket Analysis, Operations.

## INTRODUCTION

The idea of Artificial Intelligence is primarily based on information technology. It is commonly used with concepts such as robotics and automation. Artificial Intelligence may also be referred to as an algorithm solicitation. The technology of AI is capable of making analytical or cognitive functions. Such may include the capacity for problem-solving as well as learning simultaneously. Mainly there are two divisions of Artificial Intelligence. One being Artificial Narrow Intelligence and the other Artificial General Intelligence. Artificial Intelligence is nothing but a clone of human intelligence that is processed by computer systems. Its applications consist of machine learning, natural language processing and deep learning.

[*] **Corresponding author Gaddam Venkat Shobika:** Woxsen School of Business, Woxsen University, Kamkole, Sadasivpet, Telangana, India; E-mail: shobika.gaddam_2023@woxsen.edu.in

**Hemachandran K., Raul V. Rodriguez, Umashankar Subramaniam & Valentina Emilia Balas (Eds.)**

Machine learning has contributed to a huge extent in the area of Artificial Intelligence. It is a science that enables a computer to perform based on available datasets even without the requirement of programming. Machine learning has several uses that include data analysis, pattern recognition, predictive analysis and statistical modelling. Deep learning is mainly a subgroup of machine learning, but it works on learning algorithms which do not even require to be managed manually. This comprises the benefit of cloud computing as well as big data. Deep learning has surely helped in the advancement of Artificial Intelligence. Natural language processing aims at speech recognition. It is one of the most essential applications of machine learning and deep learning.

There have been numerous advancements in these areas of technology which have helped in the evolution of Artificial Intelligence in the sections of autonomous robots and vehicles, decision making and image as well as voice recognition. For example, nowadays, we find Siri and Google Assistant on smartphones. This is an application of voice recognition. Decision-making system is found in the areas of education like the IBM Elements. Image detection has made it easier for payment approvals.

In the last 20 years, artificial intelligence (AI) and machine learning (ML) applications have advanced at an unmatched rate. The development of robotics and automation has been driven by AI technology, and this has substantial effects on practically every facet of the business, mainly supply chain operations. Smart technologies which permit real-time automatic data collecting and analysis have been widely incorporated into supply chains. We examine the current uses of Artificial Intelligence in operations management as well as supply chain management in this study. Since these three industries account for most business-related AI advancements as well as emerging problem areas, we focus specifically on innovations in healthcare, manufacturing, and retail operations. We go over the main obstacles and potential uses of AI in those sectors. We also talk about fads.

## Application of Artificial Intelligence in Marketing

Artificial Intelligence has made a huge impact in the field of marketing, and there has been research done by various authors in this area over some time. Some of such findings and areas of work are listed below:

The application challenges of self-governing customer experience management are popularly known as CEM, Customer Experience Management [1]. This paper also demonstrated how intelligence networks, as well as critical business value operators, are built with the help of machine learning and artificial intelligence. Artificial Intelligence transformed traditional stores into mart retail outlets.

They demonstrated the Artificial Intelligence supported machine that could track the five senses of humans [2]. It has shown significant results in better consumer-brand alliance in e-commerce. Studies based on enhancing the cement of customer experience by using Artificial Intelligence had relevant findings regarding customer experience augmented through AI-driven bots [3]. Apart from segmentation, targeting and positioning, Artificial Intelligence also helps the merchants or dealers in visiting only the state orientation of the company [4].

Artificial Intelligence has a significant impact on the Marketing Mix, specifically in creating as well as developing innovations in merchandise optimization, sales management and delivering customer service. Some practical applications of AI in the field of marketing are listed below:

1. Text processing technology - The use of a virtual assistant in shopping complexes [Alpine Artificial Intelligence]. A navigation system (GPS) not only shows the correct route to a particular place but also suggests the attractions found on that route [Naver]. The alterations in the customer service methods and analysis of the statements made by the insurance companies as well as telecoms to identify the unhealthy situations [Touchpoint]. The handling of client requests through the virtual assistant implanted in a cell phone bank application. A virtual assistant helps not only in the purchase of bank products but also provides essential information such as the location of cash machines and bank branches [ING Bank Slaski].
2. Voice Processing Technology - Virtual assistants in today's world help in task execution like Google Assistant and Siri. Amazon Alexa is another example of voice processing technology that has helped in the area of marketing.
3. Decision Making - The system of brand-new product suggestions in the case of Netflix and Amazon. The appearance of sun subjection time and location is based on the user's cell phone data. The production of a custom savings plan that matches an individual's financial capabilities through an application [Plum]. Based on data analysis, Artificial Intelligence helps to come up with specific suggestions regarding the campaign plan [Harley Davidson and Albert AI]. This is the process of contemporizing the user data from all the points of contact with a particular brand, such as email, websites as well as social media. This application of Artificial Intelligence can be found in Adidas and Salesforce, which have significantly shown better customer service over time.
4. Autonomous robots and vehicles - Autonomous shop which provides fresh goods and magazines. The shop was verified in Shanghai [Moby Mart]. Another example will include the service-free shops in the case of Amazon Go and Alibaba. The system to understand and forecast the next movements of

CHAPTER 5

# Data Insights by Using Data Visualization and Exploration

**Choppala Swathi Priya[1,*], Sai Santosh Potnuru[1], Ishank Jha[1], Hemachandran K.[2]** and **Chinna Swamy Dudekula[3]**

[1] *Woxsen School of Business, Woxsen University, Kamkole, Sadasivpet, Telangana-500078, India*

[2] *Department of Artificial Intelligence, School of Business, Woxsen University, Hyderabad, India*

[3] *Engineering and Environment (Advanced Computer Science with Advanced Practice), Northumbria University, Newcastle, United Kingdom*

**Abstract:** Any effort to make data more understandable by presenting it visually falls under the wide definition of data visualization. The graphic depiction of quantitative information is called data visualization. In other words, data visualizations turn big and small data sets into images that the brain can process more quickly. Users using data visualization can gain insight into vast volumes of data. They can use it to find new patterns and data mistakes. Users can concentrate on areas that show progress or warning signs by making sense of these patterns. This procedure then advances the business. Surprisingly frequently, data representations assume the well-known shape of charts and graphs in our daily lives. It can be used to uncover unknown facts and trends. Good data visualizations result when communication, data science, and design work together. When done properly, data visualizations provide important insights into huge, complex data sets in simple, understandable ways. Data visualization is the graphic depiction of information and data. Trends, outliers, and patterns in data are easy to spot and comprehend with the use of data visualization tools, which employ visual components like charts, graphs, and maps. Furthermore, it enables employees or business owners to convey information to non-technical audiences without misunderstanding them. In the world of big data, it is essential to have access to tools and technology for data visualization to analyze vast volumes of data and make data-driven decisions. We will discuss data visualization, its significance, data visualization technologies, and other topics in this article.

**Keywords:** Big Data, Data Visualization, Data Exploration, Outliers.

[*] **Corresponding author Choppala Swathi Priya:** Woxsen School of Business, Woxsen University, Kamkole, Sadasivpet, Telangana-500078, India; E-mail: swathipriya.choppala_2023@woxsen.edu.in

**Hemachandran K., Raul V. Rodriguez, Umashankar Subramaniam & Valentina Emilia Balas (Eds.)**

## INTRODUCTION

The most crucial tool for data analysis is visualization. It offers the first line of defense by exposing complex data structures that cannot be comprehended in any other way. We can find unexpected consequences and work to contradict anticipated ones. Bits and bytes make up data, which is kept inaccessible in a file on a computer hard drive. We must first see the facts to comprehend them. I'll define "visualizing," which only refers to textual data representations, in this chapter. For instance, data visualization can be defined as the simple act of importing a dataset into spreadsheet software [1]. The unseen data suddenly appears on our screen as a visual "image," therefore, the inquiries should not be the question of whether analysts must visualize data or not, but rather whether the type of visualization could be most helpful in a particular circumstance. Or, to put it another way: when does going beyond table visualization make sense? The response is nearly always. Tables alone cannot provide us with a thorough picture of the dataset or help us to spot patterns in the data right away. Geographical patterns are the most prevalent example here, which are only visible after displaying data on a map other patterns, however, will be revealed in this chapter.

## VISUALIZATION AS A TOOL FOR INSIGHT DISCOVERY

Expecting data visualization tools and methodologies to lower the threshold for pre-made tales from datasets is wildly unrealistic. There are no predetermined norms or guidelines that will ensure a tale. Instead, I think it makes more sense to search for "insights," which, in the hands of a talented author, may be deftly incorporated into the story. We'll learn something new about our data almost every time we create a new graphic. While some of the discoveries may be well-known (though possibly not yet confirmed), others may be brand-new or even startling to us. While some novel insights might signal the start of a narrative, others might simply be the consequence of data inaccuracies, which are most likely to be discovered by displaying the data.

I found the following procedure to be quite beneficial for improving the effectiveness of uncovering insights in data shown in Fig. (**1**):

### How to Visualize Data?

The dataset is seen from a fresh viewpoint thanks to visualization. Data can be seen in a variety of ways [2].

When dealing with a limited amount of data points, tables are especially helpful. Together, they show their full potential by displaying labels, having the capacity to rank and sort data and amounts, and filtering data and amounts. Edward Tufte

also recommended inserting minor chart elements, such as a single line chart or a bar chart per row, into table columns. Tables undoubtedly have their limitations, as was indicated in the opening. They are excellent for demonstrating outliers in one dimension.

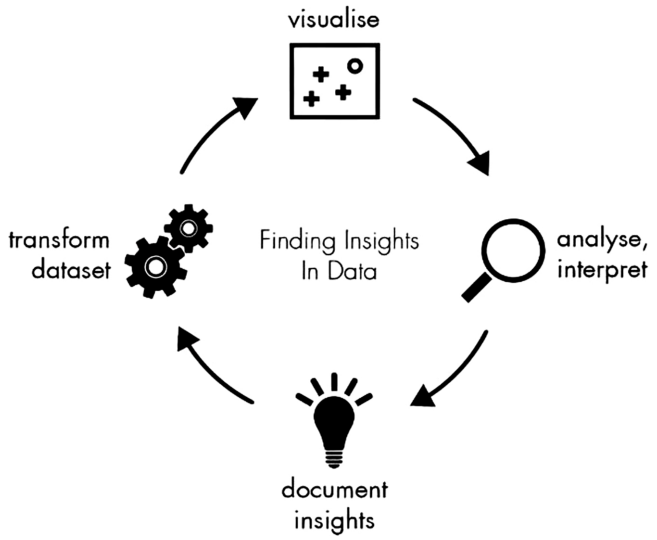


**Fig. (1).** Data Insights.

In Fig. (**2**), comparable to the top ten, they, however, perform poorly when evaluating numerous dimensions at once (For example, considering the population of each country over time).

In general, charts let you associate visual characteristics of geometric forms with dimensions in your data. The usefulness of specific visual characteristics has been extensively discussed; the gist is that color is challenging and position is crucial. For example, the x- and y-positions are mapped to two dimensions in a scatterplot. Even the size or hue of the displayed symbols can have a third dimension. Bar graphs are excellent for comparing categorical data, whereas Line charts are ideal for displaying temporal changes. Chart components can be stacked on top of one another. Using numerous iterations of the same chart to compare only a few groups in your data can be a very effective strategy (also known as small multiples). You can investigate different features of your data in any chart by using various scales (For example, linear or log scale).

In reality, the vast majority of the information we are working with has some connection to real persons. The ability of maps to connect data to the physical environment is what gives them power. Imagine a dataset of crimes that are

# CHAPTER 6

# Application of Computer Vision to Laboratory Experiments

**P.K. Thiruvikraman**[1,*], **Devendra Dheeraj Gupta Sanagapalli**[1] and **Simran Sahni**[1]

[1] *Department of Physics, BITS Pilani Hyderabad Campus, Telangana-500078, India*

**Abstract:** Computer vision has been applied in many fields. We demonstrate some simple applications of computer vision to improve the accuracy of laboratory experiments. The techniques used require only a camera in a mobile phone. Individual frames can be extracted from the video using PYTHON/MATLAB. Further processing of the images can be used to accurately measure the time period of oscillation or rotational time periods. The techniques described can be easily extended to a variety of fields.

**Keywords:** Computer vision, Colour, Digital Image Processing, MATLAB, Object Recognition, OpenCV.

## INTRODUCTION: BACKGROUND

Undergraduate Engineering and Science students typically do a lot of experiments in the laboratory to hone their experimental skills. In most of these experiments, the measurements of quantities like length and time are done manually by the students. The measurement of time using a stopwatch is especially prone to errors as the experimenter has to react quickly to start or stop the clock. While manual measurements do help in building the experimental skills of the student, they are prone to errors. If the errors are significant, then the student's understanding of the subject will be affected negatively. It is of course possible to interface instruments to a computer using a GPIB interface for accurate measurement, but these are available only in research laboratories and not in undergraduate labs. The omnipresent mobile phone can be used to record videos of experiments, and it is possible to extract information from these videos. We describe two experiments, one involving a coupled pendulum, and the other involving a flywheel. While the measurement of a time period is crucial to both experiments,

[*] **Corresponding author P.K. Thiruvikraman:** Department of Physics, BITS Pilani Hyderabad Campus, Telangana-500078, India; E-mail: thiru@hyderabad.bits-pilani.ac.in

**Hemachandran K., Raul V. Rodriguez, Umashankar Subramaniam & Valentina Emilia Balas (Eds.)**

the nature of the motion is different in the two is different. The coupled pendulum executes oscillatory motion, while the flywheel executes rotational motion. Image processing/computer vision techniques can then be used to deduce the period of oscillation or rotation, as the case may be. The accuracy of these computerised measurements is significantly better than manual measurements. The methods used here can be extended easily to analyse more complicated motions in real life situations.

Computer vision has been applied in many areas. We mention a few areas where it has been used extensively: biomedical image processing, remote sensing, character recognition, self-driving cars and unmanned vehicles.

Within biomedical imaging, it has been used for detection of various diseases like cancer [1], monkey pox [2], and COVID-19 [3]. Most of the current research in this area involves the use of artificial neural networks and deep learning. In work being reported here, we use very simple detection techniques, which mostly use colour for recognition.

## THE COUPLED PENDULUM EXPERIMENT

The coupled pendulum consists of two pendulums which are usually thin rods coupled by a spring, as shown in Fig. (**1**).

To measure the time period of oscillations, we have to track the motion of the thin rods which are hanging vertically in Fig. (**1**). One way to track the motion of the rods is to use the fact that they are straight lines in the image. We can use line detection algorithms like the Hough transform [4] to locate the pendulums in the figure. However, the pendulums are supported by some rods, and the algorithm has to distinguish between the two rods. To avoid this complication, we pasted small coloured stickers on the pendulums (the stickers are coloured yellow in Fig. (**1**)).

The pendulums are set into oscillations, and a video of the experiment (oscillations) was recorded using the camera in a mobile phone. The individual frames in the video were extracted using the VideoCapture function, which is part of the OpenCV (PYTHON) library. Matlab function “VideoReader” [5] can also be used to extract the frames. Further processing of images was done using PYTHON. A white background was placed behind the pendulum (as shown in Fig. (**1**)) to avoid the presence of other objects in the background with a colour similar to the sticker. The video was also cropped to avoid other objects present in the background. The location of the coloured sticker was detected by convolving each frame with a mask of the required colour and size. The RGB values of the

pixels were converted to HSV [6] as HSV is more sensitive to changes in light. Making use of the moments module of OpenCV, we marked the centroid of the sticker.

**Fig. (1).** The coupled pendulum.

The *x* coordinate of the centroid of the sticker is shown in Fig. (**2**) as a function of time.

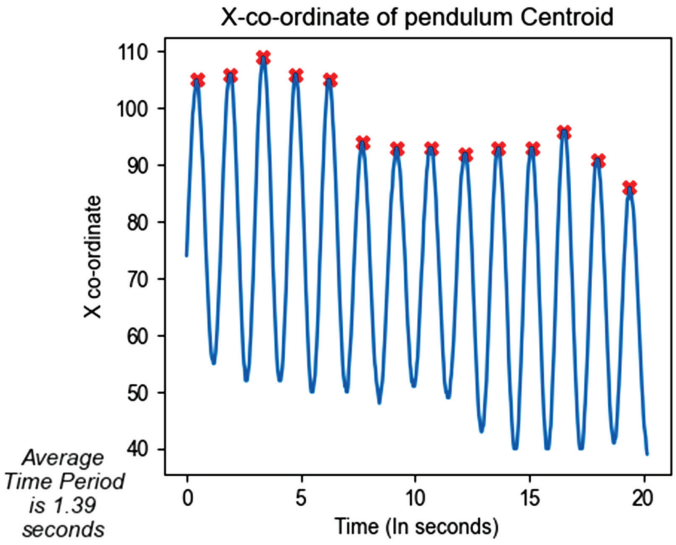


**Fig. (2).** The x coordinate of the centroid of the pendulum as a function of time.

CHAPTER 7

# Violence Detection for Smart Cities using Computer Vision

**Jyoti Madake[1,*], Shripad Bhatlawande[1], Abhishek Rajput[1], Aditya Rasal[1], Sambodhi Umare[1], Varun Shelke[1]** and **Swati Shilaskar[1]**

[1] *Vishwakarma Institute of Technology, Pune, Maharashtra, India*

**Abstract:** There is a need for developing deep learning solutions to analyze videos to identify any violence being present. This paper proposes a method for the detection of the presence of violent activities in videos using Deep Neural Networks. Recently there has been a rapid development happening in the field of Deep Neural networks, but the number of solutions that have been developed for violence detection is very few. The proposed solution will play a major role in transforming the way law enforcement works and support the government's initiative to make cities smarter. The model is built using CNN for video frame feature extraction and LSTM to capture localized features present in the video frames. The LSTM extracts the localized features using the spatiotemporal relationship between the video frames. The local motion present in the video is analyzed. This work focuses on accuracy and fast response time. The performance was evaluated on the hockey fight dataset to detect violent activities.

**Keywords:** CNN, LSTM, Violence detection.

## INTRODUCTION

Public violence is a major threat to a country's economic and social well-being. There has been a significant rise in cases of public violence, theft, *etc.,* in India. Sometimes peaceful protests can turn into a more aggressive and hostile nature leading to fights between groups, protestors causing vandalism, or even attacking the police authorities. This can lead to the destruction of public and private property and, in worst cases, loss of human life too. India is experiencing massive economic growth and is becoming an emerging economic giant; Events like these are a major threat to the sustainability of this economic growth. Public violence also hampers India's image in the world. India experiences many instances of public violence and theft which can only be solved with innovation in policing methods. Large-scale and small-scale losses of public and private property can be

[*] **Corresponding author Jyoti Madake:** Vishwakarma Institute of Technology, Pune, Maharashtra, India; E-mail: Jyoti.madake@vit.edu

**Hemachandran K., Raul V. Rodriguez, Umashankar Subramaniam & Valentina Emilia Balas (Eds.)**

avoided if these events are detected early on and stopped when instances of minor violence are detected. India is turning towards making its cities smarter, leading to efficiency in all areas of governance. In the smart cities initiative, a mere installation of surveillance systems does not solve our issue. Because the manpower in the police force is limited and therefore a lot of incidents may go unnoticed in real-time, leading to delayed justice and giving time to conspirators to flee. This issue of limited manpower leads to significant errors in detecting violence in real-time and can be solved by automating the process. Computer vision-based solutions have become popular for building images and videos to solve such image and video data-based problems. Some of the computer applications in various fields, including:

Healthcare: Computer vision is used in medical imaging to help doctors diagnose diseases and detect anomalies [16]. It can also be used to track the progression of diseases and to monitor patients remotely.

Automotive industry: Computer vision is used in driver assistance systems, such as collision warning and lane departure warning systems. It is also used in self-driving cars to help them navigate roads and avoid obstacles.

Retail industry: Computer vision is used in retail to analyze customer behavior and to personalize shopping experiences. It is also used in inventory management to track products and prevent theft.

Agriculture: Computer vision is used in agriculture to monitor crop growth, detect diseases and pests, and optimize irrigation.

Security and surveillance: Computer vision is used in security and surveillance to detect suspicious behavior, recognize faces, and track objects.

Entertainment: Computer vision is used in the entertainment industry to create special effects, enhance visual effects in movies and games, and to track the movement of actors in motion capture.

Robotics: Computer vision is used in robotics to help robots navigate and interact with their environment, recognize objects, and perform tasks autonomously. Overall, computer vision has a wide range of applications in various areas, and its use is growing rapidly as technology advances.

In this article, we have projected a computer vision-based solution to detect the presence of violence. The violence detection method is backed by deep learning. Violence detection requires features that have space and time domain correlation between them. The solution to detect violence is intended to help local police

stations. Therefore, the proposed system needs to have a low computing power, and the solution needs to be fast, accurate, robust, and require low computing power. The proposed system is built using a combination of (CNN) as our feature extractor and the LSTM for spatiotemporal feature extraction from video frames. This model was tested on the hockey fight dataset as of now, having 1000 videos, out of which 500 had instances of violence and 500 were non-violent.

## LITERATURE SURVEY

Most earlier efforts [1 - 4] used a technique to extract features that had time and space domain correlation. These researchers have used feature Motion Scale-Invariant Feature Transform (MoSIFT) [1] and Space-Time Interest Points (STIP) [2]. The STIP is the most prevalent action descriptor. MoSIFT discovers distinctive local features using local appearance and movement. MoSIFT detects the local feature points and then encodes these interest points to include the motion present, The reference [1] mentions the comparison between STIP and MoSIFT feature description techniques. It was observed that MoSIFT has better accuracy of 91% on the hockey dataset. Another reference [3] compares STIP and SIFT. It mentions that STIP has superior performance compared to SIFT.

In most cases, a deep learning approach is employed to extract Spatio-temporal information on its own. T. Hassner *et al.* proposed a deep learning architecture to extract the spatiotemporal information from the videos. The Deep neural network structure is structured in a sequence of convolutional layers, followed by multilateral integration activities to identify discriminatory key points. The convLSTM - Convolutional Long-Short Memory Encoder is used to find the frame changes to identify the violent scene in the videos, encoding frame level changes that define violent scenes in videos. This model trained and tested on the hockey dataset achieved 97.1% accuracy, which is the greatest accuracy. This model is the fastest model [4].

The reference paper [4] proposes a technique using irregular motion information. The proposed method calculates the object's velocity vector in the image. The 8-dimensional quantization of the estimated motion vector. The Co-occurrence in the direction of the quantized motion vector is then calculated. The proposed technique efficiently detects violent events, according to their experimental data. The reference paper [5] proposes a violence detector that consists of four types. The first module divides a video into several scenes. The second is tasked with extracting the skin and blood-colored regions from the scene frames, which are then further processed and filtered to find the regions of interest (which may be anything) that equate to violent stuff . After that, the motion intensities of these

# CHAPTER 8

# A Big Data Analytics Architecture Framework for Oilseeds and Textile Industry Production and International Trade for Sub-Saharan Africa (SSA)

**Gabriel Kabanda**[1,*]

[1] *School of Business, Woxsen University, Hyderabad, India*

**Abstract:** Among the most revolutionary technologies are Big Data Analytics, Artificial Intelligence (AI) and robotics, Machine Learning (ML), cybersecurity, blockchain technology, and cloud computing. The research was focused on how to create a Big Data Analytics Architecture Framework to increase production capability and global trade for Sub-Saharan Africa's oilseeds and textile industries (SSA). Legumes, shea butter, groundnuts, and soybeans are significant crops in Sub-Saharan Africa (SSA) because they offer a range of advantages in terms of the economy, society, and the environment. The infrastructure, e-commerce, and disruptive technologies in the oilseeds and textile industries, as well as global e-commerce, all demand large investments. The pragmatic worldview served as the foundation for the Mixed Methods Research technique. This study employed a review of the literature, document analysis, and focus groups. For the oilseeds and textile sectors in SSA, a Big Data analytics architectural framework was created. It supports E-commerce and is based on the Hadoop platform, which offers the analytical tools and computing power needed to handle such massive data volumes. The low rate of return on investments made in breeding, seed production, processing, and marketing limits the competitiveness of the oil crop or legume seed markets.

**Keywords:** AI, Big Data Analytics, Cybersecurity, E-Commerce, Hadoop, Machine Learning, Oilseeds, Textile industry.

## INTRODUCTION

Massive amounts of data are produced in the Internet of Things (IoT) age from a number of heterogeneous sources, such as mobile devices, sensors, and social media. Among the most revolutionary technologies are Big Data Analytics, Artificial Intelligence (AI) and robotics, Machine Learning (ML), cybersecurity, blockchain technology, and cloud computing. The automatic analysis of massive

[*] **Corresponding author Gabriel Kabanda:** School of Business, Woxsen University, Hyderabad, India;
E-mails: Gabriel.Kabanda@woxsen.edu.in / gabrielkabanda@gmail.com

**Hemachandran K., Raul V. Rodriguez, Umashankar Subramaniam & Valentina Emilia Balas (Eds.)**

data sets and the development of models for the broad relationships between data are the two key components of machine learning (ML). Data analytics [1] is "the act of analyzing huge amounts of data from many sources and in numerous variants to gain insight that can enable real-time or near-real-time decision making". The study [2] defines Big Data Analytics as the methods and technologies that can be used to examine vast quantities of complex data in order to enhance a company's performance. Technology-based analysis of large data is used to show social growth trends because big data enables precise analysis, which facilitates informed decision-making and productive work. (Fig. **1**) illustrates the five qualities of big data: volume, value, diversity, velocity, and truthfulness.

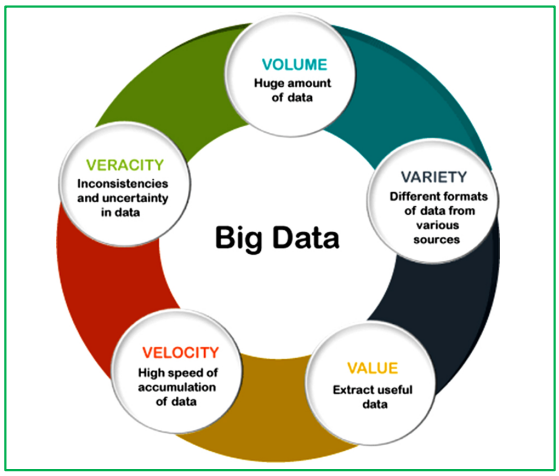


**Fig. (1).** Big Data Characteristics.

Legumes, shea butter, groundnuts, and soybeans are significant crops in Sub-Saharan Africa (SSA) because they offer a range of advantages in terms of the economy, society, and the environment. Sub-Saharan Africa produces a relatively little part of the world's agricultural output while having over 13% of the world's population and about 20% of its land area being used for agriculture [4].

## Background

Sub-Saharan Africa (SSA) is home to more than 950 million people, or about 13% of the world's population. By 2025, oilseed production in SSA is projected to rise by 2.3 percent annually to 11 Mt, or just 2% of global production.

Southern Africa accounts for the biggest share of increased protein meal use in absolute volumes, even if the predicted growth is less dramatic at 16 percent due

to a larger base. The fastest rates of growth are anticipated in Southern (1.4 percent annually) and Eastern Africa (1.2 percent annually) through 2025. As cattle industries grow in the coming years, protein meal consumption is rising throughout the majority of SSA, with Western Africa (43 percent) and Eastern Africa (43 percent) witnessing the highest increases (32 percent). By 2025, oilseed production in SSA is projected to rise by 2.3 percent annually to 11 Mt, or just 2% of global production. However, it is anticipated that overall imports into SSA will increase at a pace of 3.7 percent annually, with the majority coming from Nigeria (4 percent), Sudan (5 percent), Ethiopia (6 percent), and Kenya (3 percent). One of the commodities in the area with the quickest growth over the past ten years has been per capita consumption, which has increased at a pace of 2.1 percent annually. Sub-Saharan Africa's net food imports are predicted to increase over the next ten years, but investments that raise productivity may be able to buck this trend. Even though agricultural productivity has greatly grown over the past ten years, SSA continues to be the region with the greatest food insecurity and the slowest progress toward ending hunger. Table **1** below shows the global oilseed supply and distribution in million metric tons from 2017 to 2022.

**Table 1. Major Oilseeds World Supply and Distribution (2017-2022) [million metric tons].**

| - | 2017/18 | 2018/19 | 2019/20 | 2020/21 | 2021/22 |
|---|---|---|---|---|---|
| **Production** | - | - | - | - | - |
| Copra | 5.78 | 5.82 | 5.7 | 5.59 | 5.86 |
| Cottonseed | 45.25 | 42.97 | 43.55 | 40.81 | 42.75 |
| Palm Kernel | 18.69 | 19.46 | 19.32 | 19.03 | 20.05 |
| Peanut | 47.15 | 46.71 | 48.14 | 50.25 | 50.29 |
| Rapeseed | 75.28 | 72.85 | 69.6 | 73.59 | 71.18 |
| Soybean | 343.74 | 362.44 | 340.15 | 368.12 | 349.37 |
| Sunflowerseed | 48.01 | 50.66 | 54.2 | 49.25 | 57.38 |
| TOTAL | 583.9 | 600.91 | 580.65 | 606.64 | 596.87 |
| **Imports** | - | - | - | - | - |
| Copra | 0.13 | 0.2 | 0.15 | 0.08 | 0.08 |
| Cottonseed | 0.87 | 0.73 | 0.81 | 0.83 | 0.97 |
| Palm Kernel | 0.18 | 0.16 | 0.14 | 0.15 | 0.17 |
| Peanut | 3.08 | 3.53 | 4.34 | 4.31 | 4 |
| Rapeseed | 15.72 | 14.64 | 15.71 | 16.66 | 13.97 |
| Soybean | 154.11 | 146.02 | 165.12 | 165.47 | 154.46 |
| Sunflowerseed | 2.38 | 2.89 | 3.34 | 2.73 | 2.2 |

CHAPTER 9

# A Design of Lighting and Cooling System for Museum and Heritage Sites

**Amrapali Nimsarkar[1], Piyush Kokate[2,*], Mamta Tembhare[3]** and **Harikumar Naidu[1]**

[1] *Department of Electrical Engineering, GHRCE, Nagpur, India*

[2] *Energy & Resource management Division, CSIR-NEERI, Nagpur, India*

[3] *Waste Processing Division, CSIR-NEERI, Nagpur, India*

**Abstract:** Museums, buildings and heritage sites need artificial light at night time in darker places. At many museums, old lighting is used to illuminate the central gallery section or paintings as well. There are old lighting, including Metal Halide, Incandescent Lamp, Sodium Vapor, CFL, *etc.,* that consume more electricity and produce heat in the indoor environment, causing damage to the artwork, walls, and paintings. No standard guidelines or methodologies have been adopted by our country for lighting at the museums and archeological sites to maintain an elegant look during the day-night time. It is intended to expand in this arena due to a lack of knowledge in the field of lighting at museums as well as at heritage sites.

This paper discusses the correlation of lumen and temperature on different materials by using an LED lighting module with fiber optic cable. ANOVA method was used to correlate the dependent parameters like lumen and temperature concerning a change in distance and time on a material. We have used a lighting module that helps to prevent damage to the objects and emits negligible heat in the environment so that visitors can easily visualize the objects with proper lux level.

**Keywords:** LED, Museum lighting, Material, Optical fiber.

## INTRODUCTION

The museum and heritage sites are the main sources of attraction for foreign visitors in Asian countries [1]. UNESCO has already identified fourteen primary factors as a threat to heritage sites which includes temperature, relative humidity, light, dust, wind, paste, water, microorganisms, *etc.,* under the local conditions

* **Corresponding author Piyush Kokate:** Energy & Resource management Division, CSIR-NEERI, Nagpur, India; E-mail: pa_kokate@neeri.res.in

**Hemachandran K., Raul V. Rodriguez, Umashankar Subramaniam & Valentina Emilia Balas (Eds.)**

and physical fabrics category [2]. Most of the monuments and heritage sites are illuminated using traditional lighting technologies like CFL, LED, *etc.,* which generate heat [3].

Recent scientific studies reveal that the deterioration of sculptures, wall paintings, building materials and murals can be possible due to an increase in the indoor environmental temperature, insects and lux levels [4]. Museum sites are made up of different types of materials such as stones, wood, rock, sand, *etc* [5, 6]. Physical agents such as temperature, humidity, water, and the paste can deteriorate the structural health of buildings at a slow speed [7]. The indoor and outdoor temperature environment varies from 5°C - 10°C during temperature in summer and winter seasons. The insects, infestation of bats, get attracted towards temperature zone locations. The nonsystematic visits of tourists and the $CO_2$ emissions from visitors also contribute to the change of indoor temperate; additionally, traditional lighting devices contribute significantly to the change in the indoor temperature. Therefore, the cooling system enhanced by the replacement of traditional lighting with LED is beneficial and energy-efficient compared to High-Intensity Discharge (HID) incandescent lights and fluorescent lamps [8]. The shorter wavelength of light damages the artifacts because it has higher photon energies that are more damaging to the exhibits. Therefore, blue lights are restricted for human exposure [9]. LED has 6500k, which is cooler than other lamps, such as an incandescent lamp, which has 2800k and a fluorescent light with 2700- 6000k, *etc* [10]. According to Author Kohtaro, the LED does not provide UV radiation and IR radiation, compared with the other lighting devices. Also, LED has a high potential to replace the traditional lighting devices with a wide color range and dimming option. It produces cool light, mostly appropriate for caves, because it generates a soothing environment for visitors. In fiber-optic LED, the light rays are passed through one end of a fiber optic cable. The light gets dissipates through the core edge of the tube. At another end of the fiber optic cable, the desired output illumination can be obtained using a filter arrangement. End emitting fiber and edge-emitting fibers are divided as per the emission capacity through the core and cladding area. This glass fiber transfers light radiations uniquely, so it can be used for caves, museums, underground fortification, *etc.* The first part of this article discussed the national protocols and literature available on the lighting & illumination related studies. Then design of fiber optic LED with its circuits and experimental results on material are discussed in a systematic manner. Then the final part discussed how the fiber optic LED can be a prominent option for focused illumination [11-13].

## METHODOLOGY

A preliminary experimentation work was conducted at lab level at CSIR-NEERI to study the types of stones and materials used at such sites. It was found that most of the building structures are made up of stone, granite, bricks, tiles and concrete [14]. It was difficult to carry out the study directly at the museum or heritage sites due to restrictions and permission issues. Therefore, a fiber optic-based LED lighting device was designed and tested in an artificial chamber to study the impact on materials. Lux meter and temperature sensors were used to study the lumen and temperature with varying time and distance from the source [15]. The light was reflected on the material through LMS at a variable constant distance of 0.5m, 1m, 1.5m, and 2m with variable time duration of 10 min, 20 min, 30 min, and 40 min. Lux meter 101 A comprised of 1 X 0.9V of the power source with 0-200000 LUX range was used. Temperature sensor (EXTECH) [16] and temperature indicator (TM25) models were used to measure the change in temperature of material inside the acrylic chamber. Further, this illuminated light from the power LED is passed through the optical fiber cable. A hollow square chamber of dimension 30 cm x 30 cm was created for laboratory study, which is shown in Fig. (**1**).

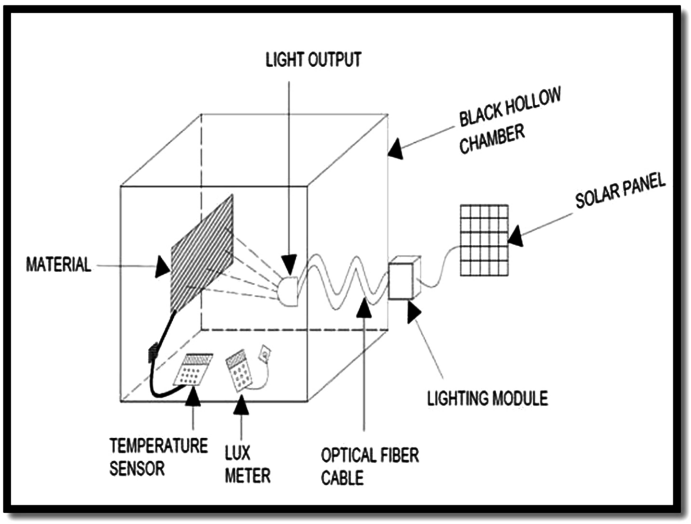


**Fig. (1).** Testing Method of Lighting Module.

### Pre-Scanning of LMS

Ocean Optics USB 2000 spectrometer was used to capture the wavelength of different lighting devices. Acrylic material was used to construct the hollow chamber, and the hardware module designed is shown in Fig. (**2**).

CHAPTER 10

# Predict Network Intruder Using Machine Learning Model and Classification

**Chithik Raja[1,*], Hemachandran K.[2], V. Devarajan[1]** and **K. Jarina Begum[3]**

[1] *University of Technology and Applied Sciences Salalah, Salalah, Sultanate of Oman*

[2] *Department of Artificial Intelligence, School of Business, Woxsen University, Hyderabad, India*

[3] *Jazan University, Jazan, Kingdom of Saudi Arabia*

**Abstract:** The massive number of sensors deployed in IoT generates humongous volumes of data for a broad range of applications such as smart home, smart healthcare, smart manufacturing, smart transportation, smart grid, smart agriculture *etc.* Analyzing such data in order to facilitate enhanced decision making and increase productivity and accuracy is a critical process for businesses and life improving paradigm. Machine Learning would play a vital role in creating smarter techniques to predict the intruder from the dataset. It has shown remarkable results in different fields, including Network security, image recognition, information retrieval, speech recognition, natural language processing, indoor localization, physiological and psychological state detection, *etc.* In this regard, intrusion detection is becoming a research focus in the field of information security. In our experiment, we used the CICIDS2017 data set to predict the Network Intruder. The Canadian Institute of Cyber Security released the data set CICIDS-2017, which consists of eight separate files and includes five days' worth of normal cum abnormal network packet data. The goal of this research is to examine relevant and significant elements of large network packets in order to increase network packet attack detection accuracy and reduce execution time. We choose important and meaningful features by applying Information Gain, ranking and grouping features based on little weight values on the CICIDS-2017 dataset; and then use Random Forest (RF), Random Tree (RT), Naive Bayes (NB), Bayes Net (BN), and J48 classifier algorithms. The findings of the experiment reveal that the amount of relevant and significant features produced by Information Gain has a substantial impact on improving detection accuracy and execution time. The Random Forest method, for example, has the best accuracy with 0.14% of negative results when using 22 relevant selected features, whereas the Random Tree classifier algorithm has a higher accuracy with 0.13% of negative results when using 52 relevant selected features but takes a longer execution time.

**Keywords:** Accuracy, CICIDS2017, Classification, Execution time, Information Gain, Model Prediction, Recent Data Set.

[*] **Corresponding author Chithik Raja:** University of Technology and Applied Sciences Salalah, Salalah, Sultanate of Oman; Tel: 94758648; E-mail: chithik43@gmail.com

## INTRODUCTION

The rapid advancements in information and communication technologies around the world present a significant challenge for network engineers.

The detection of evil behaviors in a host that later spread to other hosts over a network is a major concern for today's network engineers and researchers. Intrusion is a term used to describe an untrustworthy program that is forced to participate in this calamity. Intrusion is defined as unauthorized access to the system or network resources. Intrusion Detection Systems (IDS) serve a crucial role in reducing such activities. The majority of IDSs use anomaly detection or misuse detection mechanisms. In companies, misuse detection mechanisms are common for creating successful commercial IDS, whereas heuristic analysis mechanisms are confined to create successful commercial IDS, whereas anomaly detection is reserved for academic research and development [1]. However, in order to identify future assaults, an IDS requires existing data. That is why IDSs were previously trained on a useful dataset.

Numerous studies have been published which use techniques for selecting features to boost anomaly detection effectively. The Network Security Laboratory-Knowledge Discovery and Data Mining (NSL-KDD) is an updated and enhanced version of the KDD Cup 99 dataset used in the majority of the studies. To increase classification rate, various techniques and metrics have been suggested, including Chi-Square, Information Gain, Correlation Based with Naive Bayes and Decision Tree Classifier, Support Vector Machine (SVM), and Random Forest [2]. Those strategies, however, were not put to the test on a large dataset with a significant number of features. As indicated in [3], data with large datasets can alter the learning model, which tends to overt, lowering efficiencies, increasing memory footprint, and increasing analytic processing cost. In reality, the computational time is rarely considered by researchers, particularly in anomaly detection have regularly used Information Gain to examine significant and relevant aspects.

The Information Gain is utilized to minimize the dimension of the data by picking the most relevant characteristics with feature weight calculation [4, 5].The detecting system's performance may be improved by removing irrelevant features. Many research studies use Information Gain to examine a dataset with few attributes. In this analysis, the CICIDS-2017 dataset with its more intricate properties is used. A large variety of attributes and a large volume of packets are available in the CICIDS-2017 dataset, which can be utilized to identify anomalies.

The Information Gain feature selection technique has been employed in earlier studies that used the CICIDS-2017 dataset, but those studies were unable to

explain how or why the scoring value used alone during feature selection is derived [3]. The distinct score value is given by every researcher. The capacity of Information Gain to choose significant characteristics for network packet classification, particularly for data with a huge dataset, is investigated and analyzed [6 - 8]. The features are divided into groups by their minimal score values. Our experiment selects pertinent and significant features by using ranking, grouping and Information Gain features based on a few weighting factors, and implementing the Random Forest (RF), Naive Bayes (NB), Bayes Net, and Random Tree classifier algorithms in experiments on the CICIDS-2017 dataset. The experiment's results show that enhancing detection accuracy and execution time is significantly impacted by the quantity of meaningful and relevant characteristics created by Information Gain.

## RELEVANT RESEARCH

The problem of feature selection in relation to network attack detection has been studied by choosing the most important features [9], which uses a combination of filtered-based and wrapper-based algorithms to evaluate the features of big network packets. The method creates ten significant features, has a 0.2% of the unidentifiable rate, and a 0.34 percent false alarm rate. A supervised filtered-based features selection method called Flexible Mutual Information Feature Selection (FMIFS) [10] has been presented. Compared to earlier techniques, the strategy improves the Least-Squares Support-Vector Machines (LS-SVM) IDS's computational efficiency and dependability.

In order to give weight to every feature [11], a study proposes a feature identification approach that blends filtered- and wrapper-based methods with a clustering algorithm. The proposed approach can find features that could really improve attack detection accuracy. Literature [12] describe a tree-seed algorithm (TSA) for extracting useful features. The proposed method reduces the dimension of data by removing redundant characteristics and increasing the precision of the K-Nearest Neighbor (KNN) classifier. The proposed strategy provides 16 significant characteristics with a classification accuracy of 99.92 percent using the C4.5 Machine Learning method and a Discrete Differential Evolution (DDE) mechanism. The FACO algorithm, which combines the Ant-Colony Optimization technique and feature selection, is used by Peng *et al.* The described method can result in features that improve the classification algorithm's precision. Finally, researchers [2] suggest an IDS called FWP-SVM-GA based on the genetic algorithm and SVM. This method reduces the number of false positives while

CHAPTER 11

# Machine Learning Based Crop Recommendation System

**Keerti Adapa**[1] and **Sudheer Hanumanthakari**[1,*]

[1] *Faculty of Science and Technology, ICFAI Foundation for Higher Education, Hyderabad, India*

**Abstract:** Agriculture is very important in the Indian economy. Nowadays, due to the change in climate and the increase in global warming, the weather is an unpredictable variable. So, the most common issue that Indian farmers encounter is that they fail to identify the best-suited and appropriate crop for their soil using conventional methods. As a result, they experience a significant drop in production. This is a big problem in a country where farming employs over 58 percent of the population and results in low crop production. To overcome this issue, a model is built using machine learning which has a better system to guide the farmers, and it is a modern agricultural strategy for selecting the best crop by considering all the factors like nitrogen, phosphorus, potassium percentages, temperature, humidity, rainfall, and ph value. This paper proposes the use of machine learning techniques such as logistic regression, decision tree, KNN (k-Nearest Neighbours) and Naive Bayes to determine the best-suited crop based on attributes of soil and environmental factors. In the end, an accuracy of 96.36 percent from the logistic regression, 99.54 percent from the decision tree, 98.03 percent from the k-nearest neighbours and 99.09 percent from the naive Bayes is obtained, resulting in the decision tree having the highest accuracy with 99.54 percent. This paper gives an extensive Exploratory Data Analysis (EDA) on the Crop recommendation Dataset and builds an appropriate Machine Learning Model that will help farmers predict their suitable crops based on their parameters.

**Keywords:** Accuracy, Crop recommendation, Dataset, Data pre-processing, Decision tree, Humidity, k-nearest neighbours (KNN) algorithm, Logistic Regression, Machine learning (ML), ML algorithms, Naive Bayes algorithm, Ph value, Python, Rainfall, SciKit-learn, Soil NPK percentages, Streamlit, Temperature.

## INTRODUCTION

Agriculture is a standout amongst the most vital divisions in numerous countries. Maintaining sustainable agriculture in a country like India, where agriculture and

* **Corresponding author Sudheer Hanumanthakari:** Faculty of Science and Technology, ICFAI Foundation for Higher Education, Hyderabad, India; E-mail: hsudheer@ifheindia,org

**Hemachandran K., Raul V. Rodriguez, Umashankar Subramaniam & Valentina Emilia Balas (Eds.)**

allied sectors account for roughly 20% of the country's Gross Value Added (GVA), is important to meet rising demand [1]. In general, a farmer's selection on which crop to produce is impacted by his intuition as well as other non-essential variables such as making quick money, being oblivious of market demand, overestimating a soil's potential to support a specific crop, and so on [1]. A farmer's erroneous decision could put a substantial burden on his family's financial situation, and such an error would have bad consequences not only for the farmer's family but for the entire economy of an area. Despite the fact that many initiatives have been taken to reduce crop loss, traditional methods have their own set of disadvantages. As a result, rather than practising traditional farming methods, it is critical to adopt modern agricultural methods that make use of technology. Hence there is a need to develop a user-friendly scientific procedure for farmers which helps them to select the crop based on scientific attributes line, type of soil, temperature and rainfall forecast, nitrogen in soil, pH values, *etc* [2].

## Effect of Soil Types on Crop Production

Soil is made up of inorganic particles and organic stuff, and it offers structural support to agricultural plants. Soil is classified based on its chemical and physical properties. Leaching, weathering, and microbiological activity all work together to create a diverse spectrum of soil types. For agricultural productivity, each variety has distinct strengths and limitations. The texture of the soil is determined by the combination of mineral fractions (gravel, sand, silt, and clay particles) and organic matter fractions. Few crops, such as rice cultivation, require water wetness; hence clay soil is preferred over sandy soil.

Soil colour can illustrate the organic nutrient, parent material, the degree of weathering, and the features of the soil drainage. The key indicator of how soils drain is the colour of the soil. White sands, for example, have a lighter colour that indicates low fertility. Darker soils (such as black clays) are, on the other hand, highly fertile. The percentage of nitrogen, phosphorous and potassium present in the soil is the major factor that affects crop production. Nitrogen helps in the growth of leafs, phosphorus helps in the development of new roots and seed growth, and potassium aids in the formation of strong stems and the rapid growth of plants.

## Effect of Rainfall on Crop Production

Rainfall has a significant impact on soil. It may also predict how quickly a crop will grow from seed to maturity, as well as when it will be ready to harvest. A healthy rain-water balance combined with efficient irrigation can result in faster-growing plants and the time between seeding and harvest. Excessive rainfall can

have a variety of effects on crop yield. It leads to physical damage to the crop, and root growth is restrained. It causes nutrient loss and oxygen insufficiency, resulting in poor growth and overall health. Overwatering or too much rain can also encourage the growth of bacteria, fungi, and mould in the soil [3].

## Role of Temperature in Crop Production

Plant growth and development are also influenced by temperature. The plant is affected by temperature both in the short and long term. The ideal temperature for a plant is determined by a number of factors. Plant growth is also influenced by its stage of development and how it reacts to temperature changes over time till harvesting [4].

## Crop Recommendation System

To eliminate the aforementioned drawbacks, an intelligent crop recommendation system is proposed; it takes into account all relevant parameters, such as type and condition of the soil, rainfall, temperature, and geographical location, to anticipate crop suitability. This framework is generally worried with filling the essential role of Agro-Consultant, giving yield suggestions to farmer's algorithms. In general, recommendation systems can be characterized as a class of programming which assists clients with getting the most reasonable product as indicated by their inclinations, needs, or tastes. It applies information disclosure methods to the issue of customized suggestions for data, products or services generally known as e-commerce, social media and content-based sites [5, 6].

The use of recommendation system machine learning models will help in the farming sector. By picking the right factors, the most valuable information can be developed using the Machine Learning (ML) models, and this produced information helps the farmers by recommending the right harvest to be planted. The fundamental point of the Crop Recommendation model is to propose the exact crop for a specific field region. By picking reasonable harvests for the field region, we can limit the deficiency of yields. Appropriate algorithms with specific highlights must be picked since the level of accuracy in crop recommendation varies depending on the algorithm used. Machine Learning is tracked down to be the best innovation for anticipating appropriate crops and their yield. The ML models are developed using Python programming language because it is widely acknowledged in the Machine Learning field [7].

CHAPTER 12

# Artificial Neural Networks based Distributed Approach for Heart Disease Prediction

**Thakur Santosh[1,*], Hemachandran K.[4], Sandip K. Chourasiya[3], Prathyusha Pujari[2], K. Vishal[2]** and **B. R. S. S. Sowjanya[2]**

[1] *Mahindra University, Hyderabad, India*

[2] *Woxsen School of Business, Woxsen University, Kamkole, Sadasivpet, Telangana, India*

[3] *University of Petroleum and Energy Studies, Dehradun, India*

[4] *Department of Artificial Intelligence, School of Business, Woxsen University, Hyderabad, India*

**Abstract:** A recent study shows that almost 30% of total global deaths are caused by heart disease. These days precise diagnosis related to heart disease is very difficult. The doctor advises patients to take various tests for diagnosis, which is a very costly and time-consuming process as medical databases are large and cannot be processed quickly. A new approach has been proposed to predict heart disease from historical data sets. In this chapter, heart disease possibilities in patients are predicted with the help of neural networks on distributed computing. Feature selection was applied to the dataset to get better results and to increase the performance. Feature selection reduces the number of attributes from the dataset and only provides the necessary attributes, which directly reduces the number of tests required for the diagnosis.

**Keywords:** Artificial Neural Networks (ANN), Distributed Computing, Hadoop, Hadoop Distributed File System (HDFS).

## INTRODUCTION

Today, heart disease is one of the leading causes of death in many countries due to changes in lifestyle, food habits and smoking and alcohol consumption. Different health activities is also one of the reasons for heart diseases like hypertension, obesity, *etc*. Therefore, more efficient methods are required to predict heart diseases [1]. Today, cardiovascular diseases, primarily heart disease, are diagnosed by an expert doctor. Even though some cases are wrongly diagnosed, patients are advised to undergo many tests for precise diagnosis, which

[*] **Corresponding author Thakur Santosh:** Mahindra University, Hyderabad, India;
E-mail: Santosh.thakur@mahindrauniversity.edu.in

**Hemachandran K., Raul V. Rodriguez, Umashankar Subramaniam & Valentina Emilia Balas (Eds.)**

is very costly, and large medical databases cannot be processed quickly. It also makes the diagnosis process very time-consuming. Therefore, data analytics has become a basic need of the medical healthcare world.

Data analytics is the process of extracting valuable information from a large amount of databases. It is a very important method in the medical field where it extracts biomedical and healthcare knowledge and provides a great help in complicated medical decisions [2]. Pre-processing the data is a vital role in data analysis. In this process, the unwanted data is removed refined. It also enhances the quality of diagnosis results.

Unprocessed data can increase the computation time and can affect the accuracy of the results. This type of useless data can be eliminated before learning with the help of feature selection. Feature selection is the process to find a minimum set of attributes that are necessary for the current operation and eliminate irrelevant, redundant, or noisy data [3]. This reduction gives a great impact on the data mining process and also increases the accuracy level of diagnosis. ANN is an information processing paradigm which directly stimulates the human brain and can be applied to various real world problems. Neural networks are well trained for pattern recognition, and also for storing and retrieving patterns to solve combinatorial optimization problems. These abilities also make neural networks very good for classification problems. When there is the use of high-dimensional datasets, we arise a problem called data dimensionality, which cannot be handled with traditional machine learning algorithms. When we perform iterations with machine learning algorithms, it consumes a large amount of time and leads to low accuracy. Hence to improve the accuracy of the model and to implement machine learning algorithms. A novel distributed approach is implemented.

In this chapter, Linear Discernment Analysis (LDA) feature selection and Distributed Artificial Neural Networks (D-ANN) are applied to classify the instances. The main aim of this chapter is to predict heart disease in a patient with reduced number of attributes, which directly reduces various numbers of tests required to diagnose the presence of heart disease.

This chapter is organized as follows: Section 1 provides an introduction to the work. Section 2 proposes related work. Section 3 explains the overview of methods that are used in our research. Section 4 describes the experimental setup and data set. Section 5 provides the experiments and results. Section 6 gives the conclusion.

## RELATED WORK

Few researchers have done some interesting work for the diagnosis of different types of heart diseases. Our approach is to apply the ANN to distributed computing for the prediction of heart disease. Patil *et al.* [4] presented a heart disease prediction model. Here they applied a multilayer neural network. In this model, 13 clinical features are used as input for ANN and a back-propagation algorithm is used for training purposes.

Deekshatulu *et al.* [2] applied feature selection with ANN and performed the classification of various cardiovascular diseases. For the data pre-processing, PCA is applied to reduce the number of attributes. Suganya *et al.* [4] presented a neural model which can predict heart disease in an early stage with a minimum number of attributes. In this model, multilayer neural networks are applied. Subanya *et al*. [5] applied a metaheuristic algorithm to detect heart disease. They used a Binary Artificial Bee Colony (BABC) algorithm to regulate the set of optimal numbers of features with better accuracy. Finally, the KNN method is applied for classification. Priti Chandra *et al.* [6] presented a new approach to heart disease prediction. They used hybrid feature selection with associative classification. In this method, they pruned irrelevant, redundant attributes from the given data and produced a solid rule set. These rules are written by the physicians to build the classifier for the detection of heart disease in a patient. M. Anbarsai *et al.* [1] applied Genetic Algorithm (GA) to detect heart disease with a minimum number of attributes. To classify the instances, Naive Bayes and Decision Tree are applied. Yasin Kaya *et al.* [7] focused on the classification of heartbeats from ECG signals. Selected features were used for performance evaluation. The main objective is to use GA for feature selection to select the best features and integrate them for analysis. To obtain the experimental results, various classification algorithms like neural network, support vector machine and K-nearest neighbor were applied. Training a dataset with noise and irrelevant data may lead to less accuracy for classification. Therefore feature subset selection is used as the data pre-processing step, which plays a significant role in the field of data analysis. Abeer S. Desuky *et al.* [3] proposed a wrapper approach with Particle Swarm Optimization (PSO) for feature selection on large medical databases. The selected features are used as input to five classifiers, and the output is compared with other researcher's work. An intelligent Heart Disease Prediction System (IHDPS) was developed [8]. In this method, they used three data mining techniques to build the model. This model can be used to find and extract hidden knowledge associated with heart disease from a large historical heart-related database. It can also answer heart disease-related complex queries and can help doctors in better decision-making. If proper features of a system are selected, the efficiency and per-

CHAPTER 13

# Reinforcement Learning Based Automated Path Planning in Garden Environment using Depth - RAPiG-D

**S. Sathiya Murthi[1,*], Pranav Balakrishnan[1], C. Roshan Abraham[1]** and **V. Sathiesh Kumar[1]**

[1] *Madras Institute of Technology, Anna University, Chennai, India*

**Abstract:** Path planning by employing Reinforcement Learning is a versatile implementation that can account for the ability of a robot to autonomously map any unknown environment. In this paper, such a hardware implementation is proposed and tested by making use of the SARSA algorithm for path planning and by utilizing stereovision for depth estimation based obstacle detection. The robot is tested in a cell-based environment – 3x3 with 2 obstacles. The goal is to map the environment by detecting and mapping the obstacles and finding the ideal route to the destination. The robot starts at one end of the environment and runs through it for a specified number of episodes, and it is observed that the robot can accurately identify and map obstacles and find the shortest path to the destination in under 10 episodes. Currently, the destination is a fixed point and is taken as the other diagonal end of the environment.

**Keywords:** Adaptive, Autonomous, Cell-based, Closed environment, Depth Estimation, Depth map, Dynamic, Episodes, Map, Micro-controller, Obstacle Detection, On Policy, Path planning, Q-Table, Reinforcement learning, Robot, Route, SARSA, Stereo Vision, Thresholding.

## INTRODUCTION

Reinforcement Learning is an adaptable and learning-based method that can allow an agent to learn and determine the optimal solution to a problem on its own based on the rewards and penalties offered by the environment [1]. This allows the agent to handle any state that it might encounter while learning to achieve the required results. SARSA or State-Action-Reward-State-Action is a basic Reinforcement Learning Algorithm, an On Policy technique. With increasing innovations and implementations of Reinforcement Learning in Self-driving vehicles [2], Autonomous Robots [3], and UAVs [4, 5], there rises a requirement

[*] **Corresponding author S. Sathiya Murthi:** Madras Institute of Technology, Anna University, Chennai, India; E-mail: sathiyamurthi239@gmail.com

**Hemachandran K., Raul V. Rodriguez, Umashankar Subramaniam & Valentina Emilia Balas (Eds.)**

for adaptive mapping of unknown environments and the ability to determine the shortest path to any given destination to handle unpredictable and dynamic environments. Reinforcement Learning is an effective method that can be used to satisfy the requirements of such an environment by learning from repeated iterations of trials to estimate the optimal path from source to destination while negotiating obstacles [6]. In this paper, this implementation has been employed to plan routes and identify obstacles in a garden environment which can be used to automate the management and caretaking of gardens and plants. This technique can further be extended to exploring and searching tasks such as space exploration and mapping, Air crash and accident investigations.

## RELATED WORKS

To discover the path between source and destination, Konor *et al.* reported on an enhanced Q-learning approach [7]. The step distance (from one state to the next) and the eventual destination are assumed here. It is used to update the entries in the Q-table. Unlike the traditional Q-learning approach, where the values are continually updated, the values are only entered once. At each state, the Q-value derived for the best action is saved. In terms of traversal time and the number of states traversed, performance tends to increase [8]. describes end-to-end path planning using Deep Reinforcement Learning. To estimate the Q-value for each state-action, a deep Q-network (DQN) is first created and trained. The RGB picture frame is fed into the DQN. The best course of action is chosen using an action selection approach. The authors claimed that using the DQN approach for path planning resulted in a successful outcome. Path planning is done using a Q-learning algorithm based on the Markov Decision Process [9], according to Sichkar *et al.* [10].

It is challenging to find an optimal path in complicated situations using the traditional Q-learning approach. The robot determined/identified an optimal path from the source to the destination by avoiding collisions with impediments in its propagation path, according to the authors. The shortest path between the source and destination is determined using Q-learning and SARSA algorithms [11]. The method has been tested in a simulated environment with preset barriers. Different learning periods are included in the two algorithms used. It also fluctuates in the number of steps it takes to get to its objective by avoiding collisions with objects along the route.

The shortest path between the source and destination cannot be found using traditional Breadth First Search (BFS) or Rapidly Exploring Random Trees (RRT) techniques. As a result, the authors designed and showed a path-planning algorithm based on reinforcement learning [12]. To begin, a random route graph

is chosen. If the chosen path has barriers, it is not taken into account. A collision-free route is found using the Q-learning approach. When compared to RRT and BFS algorithms, the suggested approach provided a smooth and quickest path, according to the authors.

In an unknown environment, the iterative SARSA algorithm [13] is used to discover the best path from the source to the destination. Traditional Reinforcement learning techniques are contrasted on criteria like route length and processing complexity (Q-learning and SARSA). The authors claim that as compared to typical Reinforcement learning approaches, the Iterative SARSA algorithm used during robot path planning produces better results.

Based on a thorough review of the literature, it has been determined that path-planning Reinforcement learning is still in its infancy. The algorithm may be fine-tuned or improved further so that it can be used in real-time situations. The use of the Reinforcement learning algorithm in connection to path planning in an unknown environment is investigated in this work. In the process of picking a suitable action for the robot, the SARSA algorithm is applied.

## METHODOLOGY

Reinforcement learning is a machine learning technique based on rewarding desired behaviors and/or penalizing undesired actions. A reinforcement learning agent can observe and interpret its environment, take actions and learn through experience.

Fig. (**1**) depicts the basic flow of the SARSA algorithm: State – Action – Reward – State – Action. A software implementation of the SARSA algorithm was initially tested to check the validity of the path-planning algorithm and its ability to map an unknown environment. The algorithm is then modified to make it suitable for hardware implementation.

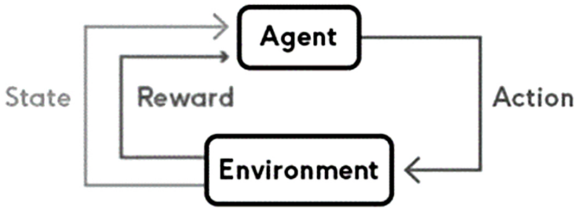


**Fig. (1).** SARSA Illustration.

The SARSA algorithm involves learning the environment by choosing actions at each state using a policy function. The policy function used in this

CHAPTER 14

# Analysis of Human Gait by Selecting Anthropometric Data Based on Machine Learning Regression Approach

**Nitesh Singh Malan**[1,*] and **Mukul Kumar Gupta**[1,*]

[1] *School of Engineering, University of Petroleum and Energy Studies (UPES), Dehradun, India*

**Abstract:** This paper aims to elucidate a method to simulate human gait, which can help design a fully functional exoskeleton to rehabilitate the human lower limb. We present a method to calculate the forces and moments of each lower limb joint using human anthropometric parameters and free body diagrams. Various forces and moment of forces of lower limb joints have been calculated. The anthropometric data is evaluated using the linear regression approach. Also, in this work, we have simulated the normal human walking pattern. The forces and moments acting on lower limb joints are calculated in horizontal and vertical directions, and the human gait was simulated for a speed of 1.8m/s. The estimated results can be used as input parameters for the development of an exoskeleton for the rehabilitation of the human lower limb.

**Keywords:** Anthropometric data, Human Gait, Regression, Rehabilitation.

## INTRODUCTION

When the movements of the lower limbs are affected by some injuries or stroke, rehabilitation treatment is required to restore gait function and regain the capacity to walk independently. A number of individual rehabilitation treatment approaches have been proposed to improve overall walking ability [1]. The most important task considered is to be re-learned, that is, the possibility to walk again [2]. In traditional techniques, manual regular treadmill training was used to improve the walking capabilities of the patients. Repetitive training requires leg movements of the patient assisted by physiotherapists, which usually limits this training [3]. A driven gait orthosis (DGO) [4] was designed to improve treadmill training for patients. DGO is a robot that provides automated locomotor training to non-ambulatory patients, which gives advantages over manual training. DGO is

[*] **Corresponding authors Nitesh Singh Malan and Mukul Kumar Gupta:** School of Engineering, University of Petroleum and Energy Studies (UPES), Dehradun, India; E-mails: niteshs.malan@ddn.upes.ac.in and mkgupta@ddn.upes.ac.in

**Hemachandran K., Raul V. Rodriguez, Umashankar Subramaniam & Valentina Emilia Balas (Eds.)**

stronger than the therapists' physical abilities and requires fewer therapists to carry out the therapy. Also, work on robotic rehabilitation has proven effective compared with manual therapy in patients suffering from a stroke. A mechanized gait trainer for gait rehabilitation was designed and constructed by Stefan Hesse and Dietmar Uhlenbrock for the repetitive practice of a gait pattern to improve the walking capabilities of stroke patients [5]. In recent developments, many wearable robotic devices have been developed to assist patients with a lack of mobility. Also, work on robotic rehabilitation has proven to be effective compared with manual therapy in patients suffering from a stroke. A mechanized gait trainer for gait rehabilitation was designed and constructed by Stefan Hesse and Dietmar Uhlenbrock for the repetitive practice of a gait pattern to improve the walking capabilities of stroke patients [5]. In recent developments, many wearable robotic devices have been developed to assist patients with a lack of mobility.

For designing any robotic device for the rehabilitation of human gait, a detailed study of human gait is required, including range of motion, forces, and moment of forces at different joints of the lower limb. A study [6] proposed a mathematical model for human movement dynamics. It argues that previous moment records can demonstrate a typical walking pattern. The combined moment of force values of the ankle, knee, and hip joints can maintain the balance of the body during the stance phase of gait. The final moment was defined as the summation of the moment of the knee joint and the difference in the moment of the hip and ankle joints [7]. A computer model was developed to calculate the force and moment of hip, knee, and ankle joint muscles [8]. The 3-d plain was used to obtain kinematics data. To maintain the stability of whole body during human gait, a model was used. It evaluated the effects of forces, acceleration and joint moments which are acting on the foot and hip, but active hip abduction moment was used to control the stability of the upper body & swing leg [9, 10]. Dynamic equations were proposed to evaluate the proximal end forces and moments with respect to the distal end forces and moments for each lower limb segment. In this method, forces acting on foot are evaluated first and continued up the limb [11]. Differential equations are used for direct dynamic modeling, making this process very complicated [12]. To interpret variations and their source and effect relationships, kinematic and kinetic patterns were studied. The hip and knee joints showed high changes in kinetic force patterns [13].

The study of human gait is broadly classified into kinematics and kinetics. Kinematics is the study of the motion of bodies with respect to time, displacement, and velocity, either in longitudinal or rotational directions. The study of the forces associated with the motion and forces resulting from the motion is known as kinetics. The study of the kinetics of human movement plays a vital role in understanding the basic mechanics of the human lower limb's

movement while walking and finding the cause of deviation of any movement. The cause of deviation of any movement can be determined by estimating different patterns of the forces. The kinetics study also helps explain the method to calculate force and moment of forces using kinematic and inertial properties. The use of a free body diagram is suggested [14], in which segments are broken, and a free body diagram is used for presenting the various forces acting on the various segments of the body *(i.e.,* thigh, shank and foot). The range of motions at the hip, knee and ankle joints while people walk at normal speed should be evaluated [15]. This paper aims to simulate human gait, to estimate various parameters of lower limbs involved during walking. These estimated parameters can serve as design inputs for developing a fully functional exoskeleton for the rehabilitation of human lower limbs.

## METHODS AND MATERIALS

This problem was analyzed, formulated and divided into different parts. In this work, a simple and novel way of simulating human gait is proposed. Rehabilitation of human lower limbs is possible with the help of findings gained in this work. We have proposed a method to simulate a human walking pattern in this work. First, we used the machine learning regression approach for anthropometric parameters and found the lower limb segmental length, weight, moment of inertia, *etc.,* of an average adult male. Then we utilize segmental values to estimate all the forces and moments of force acting on the lower limb joint using the differential equations. Programming has been used to calculate joint forces and moments of forces acting on the joints in horizontal and vertical directions. Using these estimated values as input parameters, we designed a 3-link model on Simulink to mimic the human walking pattern. 3 links correspond to the foot, shank and thigh, and the joints correspond to the ankle and knee joints. The estimated results can be used as input parameters for the development of an exoskeleton for the rehabilitation of the human lower limb. Newtonian mechanics method is used to study the cause of deviation during different phases of human gait. The Newton-Eular method is a mathematical approach to solve a system of equations; it starts with initial conditions and then applies input values (here, the input values are normalized segmental mass, length and acceleration) to estimate force and moment values. In this work, normalized values of mass, length, and center of mass for each lower limb segment of a normal human subject assuming weight 70Kg and height 170cm have been calculated with the help of the approximate proportion values of Dempster's table. Using the parallel axis theorem, we have also calculated the moments of inertia on the basis of the axis of rotation of different segments of lower limbs. Estimated values are tabulated in Table **1**.

# SUBJECT INDEX

## E



## F



## G



## H



## I

## K



## L



## M



## N



## O

## P



## R



## S

## T



## U



## V



## W

## Hemachandran K.

Prof. Hemachandran K. is currently working as a professor in the Department of Analytics and Artificial Intelligence at the School of Business, Woxsen University, Hyderabad, Telangana, India. He is a passionate teacher with 14 years of teaching experience and 5 years of research experience. His research interests are machine learning, deep learning, computer vision, NLP, knowledge engineering and decision support systems. He has three patents, more than 20 journals and international conference publications to his credit and has served as a resource person at various national and international scientific conferences.

## Raul V. Rodriguez

Prof. Raul V. Rodriguez is the Professor in the School of Business, Woxsen University, Hyderabad, Telangana, India. He holds a Ph.D. in artificial intelligence and robotics process automation applications in human resources. Fmr. Co-CEO at Irians Research Institute. His areas of expertise and interest are machine learning, deep learning, natural language processing, computer vision, robotic process automation, multi-agent systems, knowledge engineering, and quantum artificial intelligence. He has co-authored two reference books and has more than 70 publications to his credit.

## Umashankar Subramaniam

Prof. Umashankar Subramaniam is an associate professor in electrical engineering at the College of Engineering, Prince Sultan University, Riyadh Saudi Arabia. Previously, he has worked as an associate professor and head of the Department of Energy, VIT, Vellore. He has more than 15 years of teaching, research, and industrial R&D experience. He has published more than 250 research papers in national and international journals and prestigious conferences. He is an editor of IEEE Access, Heliyon, and other high-impact journals.

## Valentina Emilia Balas

Prof. Valentina Emilia Balas is a professor in the Department of Automatics and Applied Software at the Faculty of Engineering, "Aurel Vlaicu" University of Arad, Romania. She holds a Ph.D. Cum Laude, in applied electronics and telecommunications from the Polytechnic University of Timisoara. Prof. Balas is the author of more than 350 research papers in refereed journals and international conferences. Her research interests are in intelligent systems, fuzzy control, soft computing, smart sensors, information fusion, modeling, and simulation. She is the editor-in-chief to the International Journal of Advanced Intelligence Paradigms (IJAIP) and to the International Journal of Computational Systems Engineering (IJCSysE).