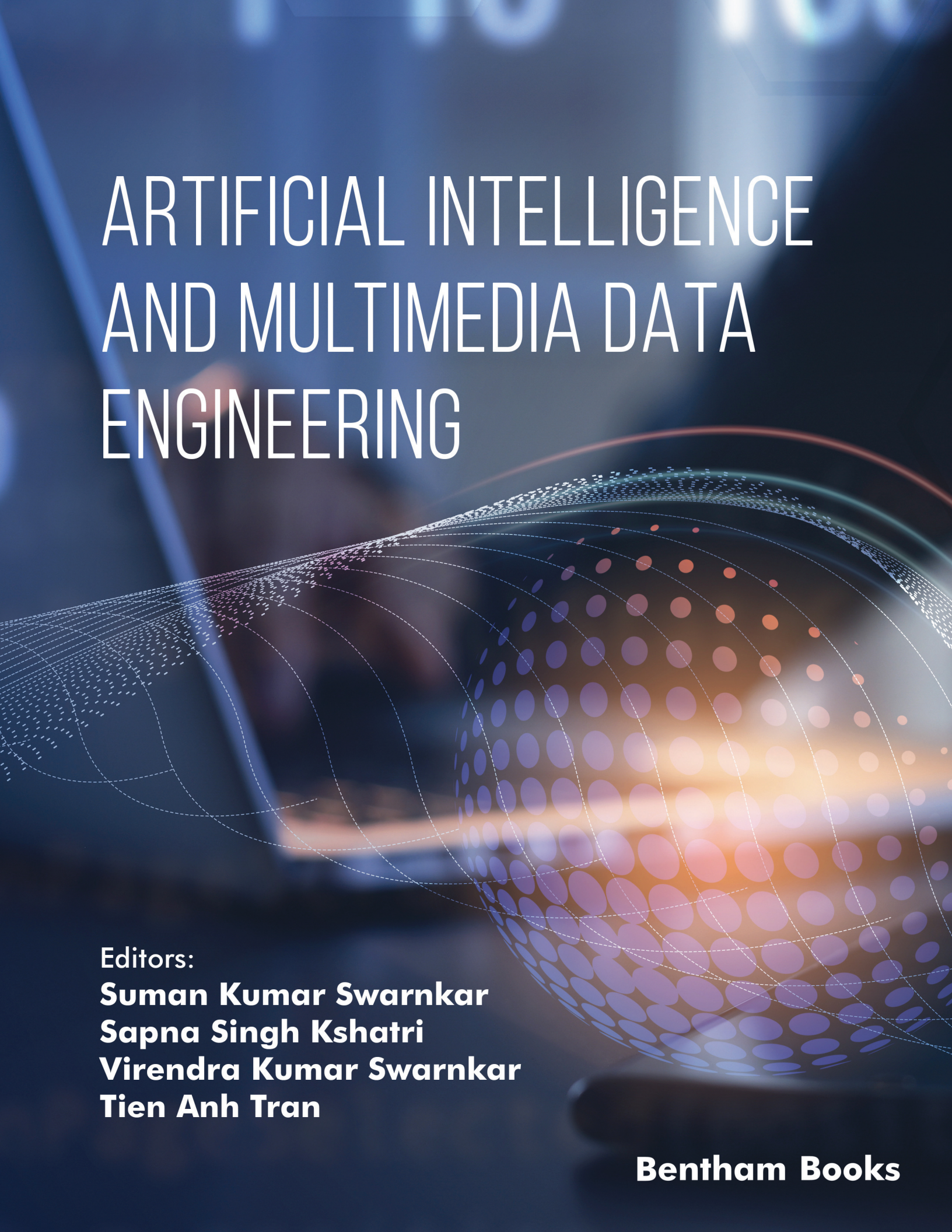
ARTIFICIAL INTELLIGENCE AND MULTIMEDIA DATA ENGINEERING



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Volume 1

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CONTENTS

PREFACE i

LIST OF CONTRIBUTORS ii

CHAPTER 1 A QUANTUM-ASSISTED DIAGNOSTICS METHOD FOR INTELLIGENT MANUFACTURING 1

Vishal Sharma

INTRODUCTION 1

METHODOLOGY 2

Feature Selection 2

Results 3

CONCLUSION 6

REFERENCES 7

CHAPTER 2 EVALUATION OF BIO-INSPIRED COMPUTATIONAL METHODS FOR MEASURING COGNITIVE WORKLOAD 9

R. K. Kapila Vani and *Jayashree Padmanabhan*

INTRODUCTION 9

COGNITIVE WORKLOAD 11

Definition and Applications 11

Task Models 11

Cognitive Task Model 11

Operational Task Model 12

MACHINE LEARNING 12

Traditional Machine Learning Techniques to Detect Cognitive Workload 13

Datasets 13

EEGLearn 13

EEGMAT 14

Hybrid EEG-NIRS 14

WM-EEG 14

STEW 14

DATA PREPROCESSING 15

FEATURE EXTRACTION 16

Time Domain 16

Frequency Domain 16

Spatial Domain 16

Linear Domain 17

Nonlinear Dynamics 17

Functional Connectivity Features 17

FEATURE SELECTION 17

Filtering Methods 18

Wrapper Techniques 18

Embedded Techniques 18

Ensemble Feature Selection Techniques 19

Optimization Techniques 19

CLASSIFICATION 19

Deep Learning Models 20

PERFORMANCE EVALUATION 20

CONCLUSION 22

REFERENCES 23

CHAPTER 3 MANAGING LIBRARIES AND INFORMATION CENTRES USING CLOUD COMPUTING 27
C. A. Harikrishnan
INTRODUCTION 27
DEFINITION OF CLOUD COMPUTING 28
CHARACTERISTICS OF CLOUD COMPUTING 28
TYPES OF CLOUD 29
Public Cloud 29
Private Cloud 29
Hybrid Cloud 29
SERVICES PROVIDED BY CLOUD COMPUTING 29
Platform as a Service 29
Infrastructure as a Service 29
Software as a Service 29
TYPES OF COMPUTING TECHNIQUES 30
Cluster Computing 30
Distributed Computing 30
Invasive Sensors 30
Grid Computing 30
Utility Computing 30
LATEST INITIATIVES OF CLOUD COMPUTING BY VARIOUS COMPANIES/ORGANIZATIONS 30
Amazon Web Services 30
Microsoft Azure 31
Google Apps 31
NEED FOR CLOUD COMPUTING IN LIBRARIES 31
CLOUD COMPUTING SERVICES AND ITS APPLICATIONS IN THE LIBRARY 32
Library Automation 32
Digital Library and Repository 32
Website Hosting 32
Searching Scholarly Content 32
Storage and Retrieval of Information 33
CLOUD COMPUTING PLATFORMS IN LIBRARY AND INFORMATION SCIENCE FIELD 33
DuraCloud by Duraspace 33
Webscale by OCLC 33
Ex-Libris Cloud 33
OSS Labs 33
ENHANCING VARIOUS SERVICES PROVIDED BY THE LIBRARIES AND INFORMATION CENTRES USING CLOUD COMPUTING 34
E-Learning 34
File/Document Sharing 34
Interaction with the Users 34
Collection Development 34
Information Search and Discovery 34
Lending of E-books 35
Shared Catalogue/Union Catalogue/OPAC 35
Document Download and Delivery Service 36
Current Awareness Service and Information Literacy/Orientation 36
ROLE OF LIBRARIAN IN THE CLOUD ENVIRONMENT 36

ADVANTAGES OF CLOUD COMPUTING IN LIBRARY SERVICES 36
Cloud OPAC 36
Less Cost Involved 37
Scalability 37
Accessibility 37
Higher Level Security 37
Portability 37
Reduced Risk Rate 37
Adjustable Storage 37
CONCLUSION 38
REFERENCES 38

CHAPTER 4 BIOMETRIC VOTING USING IOT TO TRANSFER VOTE TO CENTRALIZED SYSTEM: A BIBLIOMETRIC 40
Richard Essah, Darpan Anand, Surender Singh and *Isaac Atta Senior Ampofo*
INTRODUCTION 40
LITERATURE REVIEW 42
REVIEW METHODOLOGY 43
RESULTS AND DISCUSSION 44
Publications by Year 44
Keyword Analysis 48
Geographical Analysis of Publications 49
Publications Analysis by Organization 50
Analysis of Citations 52
Analysis by Author 53
Analysis of Research Opportunities 55
DISCUSSION 55
CONCLUSION 56
REFERENCES 58

CHAPTER 5 FACE RECOGNITION USING CONVOLUTIONAL NEURAL NETWORK ALGORITHMS 60
Eram Fatima, Ankit Kumar and *Anil Kumar Singh*
INTRODUCTION 60
PROPOSED METHODOLOGY 62
Viola Jones 62
Deep Reinforcement 63
Convolutional Neural Network (CNN) 65
EXPERIMENTAL RESULTS 66
CONCLUSION 69
REFERENCES 69

CHAPTER 6 MULTIMEDIA SECURITY IN AUDIO SIGNAL 70
Ritesh Diwaker and *Deepak Asrani*
INTRODUCTION 71
RELATED WORK 71
PROPOSED METHODOLOGY 73
FFT Decomposition of Audio Signal 75
QR-Cordic Decomposition 75
Watermark Embedding Technique 75
EXPERIMENTAL RESULTS 76
CONCLUSION 80

REFERENCES 80

CHAPTER 7 RECENT ADVANCEMENTS AND IMPACT OF MULTIMEDIA IN EDUCATION 82

Gausiya Yasmeen, Syed Adnan Afaq, Mohd Faisal and *Saman Uzma*

INTRODUCTION 83

MULTIMEDIA 84

MULTIMEDIA LEARNING ENVIRONMENT 86

E-LEARNING AND EDUCATIONAL TECHNOLOGY 88

INNOVATIVE TEACHING AND LEARNING METHODS 91

Role of ICT 91

Blockchain Technology Impact 92

Importance of Big Data 92

Advent of Artificial Intelligence(AI) 93

Informatics for Learning 93

STEAM 93

Use of Social Media 94

RECENT ADVANCEMENTS AND BENEFITS OF MULTIMEDIA LEARNING 94

CONCLUSION 96

REFERENCES 97

CHAPTER 8 EMERGING AI TRENDS IN INTELLIGENT AND INTERACTIVE MULTIMEDIA SYSTEMS 98

P. Devisivasankari and *R. Vijayakumar*

INTRODUCTION 98

ROLE OF DL, ML IN INTELLIGENT AND INTERACTIVE MULTIMEDIA SYSTEMS 100

SPECIFIC APPLICATIONS OF AI 100

ENHANCE THE NATURALNESS, SCALABILITY, AND CUSTOMIZATION OF INTELLIGENT AND INTERACTIVE MULTIMEDIA SYSTEMS 102

FUTURE SCOPES 108

VISUAL TURING TEST 109

Recent Developments made in the Turing Test for Multimedia 109

An Explanation of Justification in Multimedia Formats 110

Automated Forms of Both Machine and Meta-Learning 110

Digital Retinas 110

The First Part of the Multimedia Turing Test 111

META-LEARNING AND AUTOMATIC MACHINE LEARNING 112

CONCLUSION 115

REFERENCES 116

SUBJECT INDEX 118

PREFACE

Welcome to "Artificial Intelligence and Multimedia Data Engineering Vol. 1". In this book, we embark on a captivating journey through the cutting-edge realms of artificial intelligence (AI) and multimedia data engineering, exploring the remarkable synergies that exist between these two rapidly evolving fields. This fusion of AI and multimedia data engineering has opened up unprecedented opportunities for innovation and has profoundly impacted various industries, making it essential for researchers, practitioners, and enthusiasts alike to stay at the forefront of this dynamic landscape.

Advancements in AI, coupled with the explosive growth of multimedia data, have revolutionized the way we interact with technology and perceive the world around us. From computer vision and natural language processing to deep learning and intelligent systems, AI has become an indispensable part of our lives, shaping our experiences in ways we could have only imagined a few decades ago. Furthermore, multimedia data, including images, videos, audio, and other sensor-generated content, has become an integral part of our digital existence, leading to the creation of a vast ocean of information that needs to be efficiently processed and harnessed.

The primary aim of this book is to present a comprehensive overview of the interdisciplinary domain that intertwines AI and multimedia data engineering. Our endeavor is to provide a well-rounded understanding of the fundamental concepts, techniques, and applications that form the bedrock of this exciting field. Whether you are a seasoned professional seeking to expand your knowledge or a newcomer eager to explore the frontiers of AI and multimedia data engineering, this book caters to a wide audience with diverse interests and backgrounds.

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CHAPTER 1

A Quantum-assisted Diagnostics Method for Intelligent Manufacturing

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Abstract: Present manufacturing machines have few methods to investigate machine health. To minimize issues and enhance the correctness of machine decisions and automation, machine health conditions require to be investigated. Therefore, the evolution of a fresh investigating and diagnostics approach for additive manufacturing machines is needed for better productivity in Industry 4.0. In the current chapter, an intelligent technique for the condition monitoring of additive manufacturing (AM) is described, where an accelerometer fitted on the extruder assembly is used to receive vibration signals. The process errors with the printer were the worn-out timing belts driving the extruder assembly. Quantum-based Support Vector Machine was simulated to identify the 3D-printer status. The simulation outcomes presented here show that this approach has better correctness as compared to the previous Support Vector Machine techniques.

Keywords: 3D Printer, Additive Manufacturing, Industry 4.0, Support Vector Machine.

INTRODUCTION

3D printer is one of the important fields of research under the Industry 4.0. This technique provides many benefits. Therefore, it is essential to confirm feasible and safety equipment functioning. If mechanical equipment fail, it can create many issues [1 - 3]. Several scientists have done a lot of innovation, and proposed many impactful fault diagnosis approaches [4 - 9]. The recent research work accomplished in the domain of quantum technologies [10 - 19] showed a significant improvement in terms of speed, accuracy, security, and parallel processing with minimum resources.

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Suman Kumar Swarnkar, Sapna Singh Kshatri, Virendra Kumar Swarnkar & Tien Anh Tran (Eds.)

3D printing is a suitable term to detail the techniques of additive manufacturing. The term 3D printing covers many techniques [17]. 3D printing techniques have

the strength to make better science, technology, and engineering as well as to speed up manufacturing techniques. While the possible uses of 3D printing have been enhancing over time, a number of problems continue to stop its widespread acceptance [19]. The main difficulties in 3D printing are increased manufacturing time as compared to standard methods, dimensional correctness, non-linearity (many resolutions for X, Y and Z axes, wall thickness), material properties and system cost. All these are being highlighted by the machine manufacturers for improvement in the manufacturing steps [20].

Even though additive manufacturing has been present since the 1980s, it was not until recently that 3D printing was deployed in commercial manufacturing [19]. Hence, a diagnostics model could be framed for a 3D printer in case of unsuccessful timing belts. Acoustic emissions of 3D printers were also analysed [17, 19]. The printer was run at many nozzle temperatures. The experiments were carried out to analyse the condition monitoring of the nozzle through the deployment of a vibration sensor [21].

Here we try to construct a real-time diagnostic approach for condition monitoring of the machine, in order to find out and preclude breakdowns and process failures. The comprehensive target is to get better process reliability, dimensional correctness of the product, and automation of Additive manufacturing. Mainly, the concentration is on the health status of the belts driving the extruder. They are important parts of a 3D printer device which impact the overall feature and efficiency of the product. In the current chapter, an analysis of the reliability of PHM-based vibration signal analysis is described and based on the results from the signal, a diagnosis model for a 3D printer fault detection is constructed [22].

METHODOLOGY

With the demand of AM, its health status observation has become an important and untouched field of research [23]. The complete working procedure is shown in Fig. (**1**).

Feature Selection

It is required to know important parameters and remove repeated ones.

Fig. (**1**) likely illustrates the steps or stages involved in diagnosing issues or problems related to a 3D printer. It visually represents the diagnostic workflow,

showing the sequential or parallel steps involved in identifying and resolving printer malfunctions or errors.

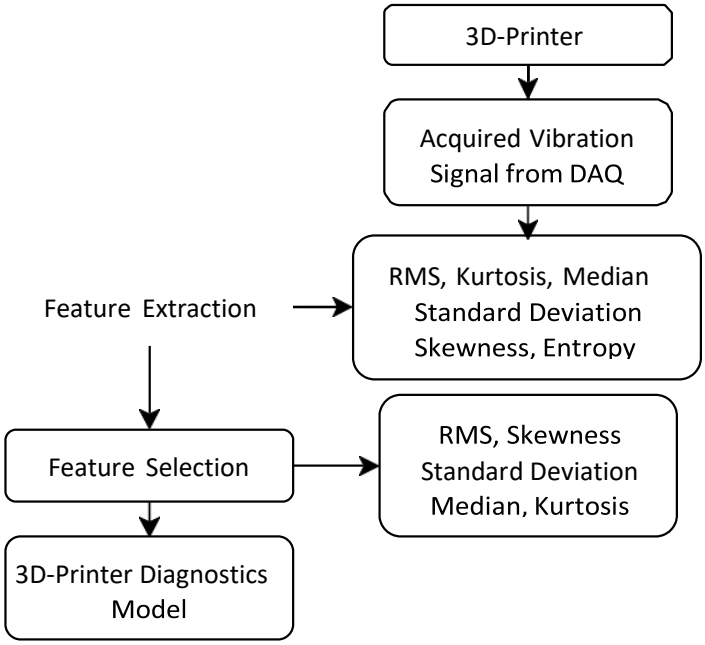

Fig. (1). 3D Printer Diagnostic Process [2].

Results

In Fig. (**2**), 3D-Printer Test Rig likely refers to a figure depicting a test setup or apparatus specifically designed for testing and evaluating 3D printers.

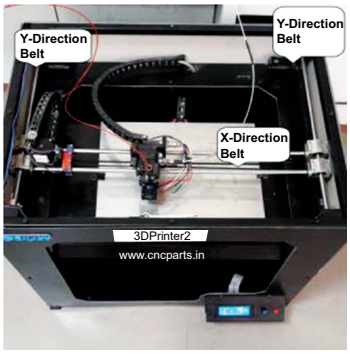

Fig. (2). 3D-Printer Test Rig [2].

CHAPTER 2

Evaluation of Bio-inspired Computational Methods for Measuring Cognitive Workload

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Abstract: Evaluating mental workload is crucial to preserve health and prevent mishaps. The reliability and mental states of individuals in any human-computer interaction scenario are assessed utilizing features of the electroencephalogram (EEG) by means of many approaches in machine learning and deep learning This study reviews and identifies the multiple Machine Learning and Deep Learning algorithms used for workload assessment, as well as the various datasets, characteristics, and features that contribute to workload assessment. When ML and DL approaches were compared, it was found that deep learning techniques and ensemble techniques work best when EEG's Power Spectral Density Features are used. We have also used optimization techniques like GWO and taken into account numerous features from various domains and assessed the workload. This study discovered that when measuring cognitive load, features like PSD were employed and deep learning algorithms were applied if algorithm performance was crucial. However, when accuracy was valued more highly, all features were taken into account and only a small subset of them was chosen using optimization techniques. The latter method was found to be more accurate and reliable than the methods currently in use.

Keywords: Cognitive workload, Deep learning, Electroencephalogram (EEG), Machine learning, Optimization techniques.

INTRODUCTION

The Brain Computer Interface (BCI), a key method of communication, enables people to control portable gadgets with their thoughts. The electroencephalogram (EEG) signal is currently the foremost used signal in BCI systems because of its high temporal resolution and utility. It is regarded as an example of non-invasive measurements. Berger was the first person to identify electroencephalography

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Suman Kumar Swarnkar, Sapna Singh Kshatri, Virendra Kumar Swarnkar & Tien Anh Tran (Eds.)

(EEG) impulses in the human brain in 1929 and since then more study has been done on brain electrical signals. Research on BCI technology has become a rising trend in recent years, thanks to faster computer hardware, machine learning, and the application of neuroscience [1]. Applications for BCI include disease detection, emotion detection, motion recognition, and e-learning. This study aims to evaluate the effectiveness of several algorithms while assessing the cognitive load or working memory of an individual.

Working memory relates to the capability of tracking numerous bits of knowledge while tackling a single challenge [2]. Cognitive load refers to the task strain placed on working memory, when participating in mental activity [3]. The level of cognitive load that BCI interface users endure is primarily related to how successfully they do their tasks [4]. Cognitive stress is related to working memory tasks requiring executive control. Maintaining the optimal level of cognitive load will increase precision and efficacy. Deteriorating performance in areas like Public transit systems, airline traffic control or combat activities could result in catastrophic accidents [5]. In these industries, the creation and assessment of a job activity necessitate an evaluation of the cognitive strain [6].

Subjective and objective indicators of cognitive workload have been identified and discussed below. Subjective assessments are based on operators' perceptions and self-rating. Cognitive workload is measured by surveys like the National Aeronautics and Space Administration-Task Load Index [7]. Although these methods are easy to use, they do not result in timely and reliable data. However, realistic assessments that focus more emphasis on task performance and physiological indications may be useful in resolving the aforementioned issues [8].

Amongst participants, EEG signals are weak, chaotic, and non-stationary. In light of this, finding significant characteristics in EEG remain a difficulty. Conventional analytical techniques rely on empirical tests to confirm differences between attributes, like power changes with specialized frequency ranges that may not provide sufficient modelling power. The literature has produced a variety of machine-learning techniques to deal with these problems [9]. From data that faithfully reflects the intrinsic rules, machine learning may extract prejudiced traits and utilize them to build prediction models.

Even though numerous papers discuss how to evaluate cognitive workload using a variety of physiological data, many are not aware of the use of machine learning techniques for accurately identifying cognitive burden based on EEG. For instance, a study [10] examines 24 cognitive workload assessment systems that incorporate a wide range of physiological factors. Recent assessments and multi-

modal integration for the cognitive load put a special emphasis on a number of physiological markers. The objective of this research was to fill the vacuum by reviewing the machine learning and deep learning-based cognitive workload assessment methods and highlighting the most important developments in their application to the identification of cognitive burden [11].

In this study, we assess the cognitive strain with EEG data using different ML and DL techniques. The ideas, applications, and key concepts of cognitive load and machine learning are covered in the subsequent sections. The first section introduces concepts related to cognitive workload [12].

COGNITIVE WORKLOAD

Definition and Applications

The cognitive load is described as "the relationship between the function linking the mental resources requested by a task and those resources accessible to be supplied by the human". Social and contextual influences, individual differences, shifts in functional state, task difficulty, and more can all have an impact on cognitive load [13]. Operators may come across underload, normal, and overload workload conditions in real-world scenarios. Maintaining a healthy and balanced workload can help operators perform safely and productively. In recent years, computer-assisted diagnoses such as cancer, depression, schizophrenia, and autistic spectrum disorder have also used cognitive workload [14].

Task Models

To perceive different cognitive workload states, people are usually needed to engage in tasks of varying complexity levels. The most common technique for simulating cognitive burden is operating a machine in a real or virtual environment or conducting a cognitive task in a controlled laboratory setting. The models are divided into two categories: cognitive and operational [15].

Cognitive Task Model

The participants were generally expected to perform a few physical operations while engaging in mental activity. Reading and mental arithmetic tasks often demand the temporary processing and storage of informative elements. These tasks include the Sternberg working memory test, the n-back working memory test, and others [16].

CHAPTER 3

Managing Libraries and Information Centres using Cloud Computing

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Abstract: Cloud computing is basically a new phenomenon for providing services over the internet. The biggest plus point of cloud computing is that it uses third-party hardware and software applications for providing services. It is very much cost-effective and easy to maintain. This type of emerging technology is being adopted by the 21st century libraries and information centres. Cloud computing can be used in libraries to provide better services. Cloud computing allows users of the library to access information from any geographic location. Cloud computing is helpful for libraries and information centres in automating and managing their services.

Keywords: Automation, Cloud computing, Digital library, OPAC, Repository.

INTRODUCTION

Information and communication technology has made revolutionary changes in the functioning of libraries and information centres [1]. Now we have libraries and information centres without walls. Information can be accessed by the users with the help of Cloud computing services without even visiting libraries or information centres. Libraries are now acting as data centre which require computers to operate in a better way. The latest trend in the field of Library and Information Science is the use of cloud computing for storage and retrieval of information. There is a paradigm shift from traditional library management to a more systematic, technical and user-oriented one. Cloud computing offers more personalized service which ultimately leads to more user satisfaction [2].

Multinational companies like Amazon, Microsoft, Google and so on are developing cloud computing systems and providing services to a wide variety of

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Suman Kumar Swarnkar, Sapna Singh Kshatri, Virendra Kumar Swarnkar & Tien Anh Tran (Eds.)

users. There are basically three segments in cloud computing; they are: i) Application, ii) Storage and iii) Connectivity. Each of these segments serves a different purpose and also offers different types of products for business purpose and for individual purposes.

DEFINITION OF CLOUD COMPUTING

The National Institute of Technology and Standards (NIST) defines Cloud computing as a model for enabling, convenient, on-demand network access to a shared pool of configurable computing resources [3].

Garner defines cloud computing as a style of computing where massively scalable IT-related capabilities are provided as a service using Internet technologies to multiple external customers.

CHARACTERISTICS OF CLOUD COMPUTING

i. It supports a wide group of platforms such as workstations and mobile devices.

ii. It works efficiently with multiple users and multiple applications.

iii. It reduces the cost of services.

iv. It works very fast in the distributed computing environment.

v. Users can access information from any corner of the world with the help of network/internet connectivity.

vi. There are very less chances of infrastructure failure. It is reliable and ensures on-demand provision of resources.

vii. Resource usage can be monitored and measured based on utilization by the users.

viii. Cloud computing applications are installed on a common platform and can be accessed from various places.

ix. Services can be accessed using Application Programming Interfaces on the cloud and it can be paid as per the usage.

TYPES OF CLOUD

Public Cloud

A public cloud environment is owned by a cloud provider and is accessible to many businesses through the Internet. Public clouds are ideal for small and medium-sized businesses whose budget is less [4].

Private Cloud

A private cloud is owned by a single business party/firm. It offers a more controlled environment. It can offer a higher level of security and autonomy [5].

Hybrid Cloud

A hybrid cloud model provides a tailored IT solution, seeking the benefit of both public and private cloud models.

SERVICES PROVIDED BY CLOUD COMPUTING

Platform as a Service

It provides customers the freedom to build their own applications which run on the provider's infrastructure. Platform as a service provider offers a predefined combination of OS and application servers such as restricted J2EE, Ruby, *etc*. [6].

Examples: Google's App Engine, Force.com *etc*.

Infrastructure as a Service

It provides basic storage and computing capabilities as standardized services over the network. The customer can typically deploy his own software on the infrastructure.

Example: Amazon, 3 Tera, Go Grid *etc*.

Software as a Service

In this model, the customer needs not to invest in servers and software licences, while for the provider, the cost is lowered because only a single application needs to be hosted and maintained [7].

Examples: Microsoft, Zoho *etc*.

CHAPTER 4

Biometric Voting using IoT to Transfer Vote to Centralized System: A Bibliometric

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Abstract: Several studies have empirically explored biometric voting using the IoT to transfer votes to the central system. There aren't many bibliometric studies that categorize the output in this area, though. By keeping an eye on the papers posted on the Scopus platform, this study's goal is to present a research bibliometric analysis of biometric voting utilizing IoT to transfer votes to a central system, classifying trends, the state of the art, and other indications. 267 different materials made up the sample. Using the VOS viewer program, the data was processed and the outcomes graphically represented. According to a study, that examined publications' simultaneous occurrence by year, trends of keyword, co-citations, coupling bibliographic, and co-authorship analysis, institutions, and countries, the body of knowledge on biometric voting that uses the Internet of Things to transfer votes to a central system is expanding quickly. More than 530 citations were found in just eight works. However, there are other industrious writers. The most significant of the 267 sources used in the review were published in 26.066 percent of the papers. China is the world's leader in this field. This study offers knowledge about the current state of the art and indicates research opportunities and gaps in IoT-based biometric voting.

Keywords: Blockchain, Bibliometric, Centralised system, IoT, Vos viewer.

INTRODUCTION

The astounding spread and quick development of technology in many spheres of life has greatly aided humankind as a whole [1]. Voting has historically been the main way for people to express their thoughts on topics and subjects that are imp-

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Suman Kumar Swarnkar, Sapna Singh Kshatri, Virendra Kumar Swarnkar & Tien Anh Tran (Eds.)

ortant to them [2]. Voting is a democratic practice. The election process is crucial in democracies because it takes place on a regular basis with the participation of people who have attained voting age and are permitted to do so. Because of this, it is urgently necessary to guarantee the integrity of the elections by providing citizens with protection and security so that they can vote in comfort [3]. Many nations have had authoritarian governments that lacked honesty and openness in the voting process. Having an election system focused on safety, integrity, protecting votes from repetition, manipulation, and tampering, as well as faster results delivery, is a solution for several governments seeking to improve and demonstrate their transparency and credibility in the public eye [4]. In democratic administrations, the practice of voting is utilized to allow the populace to select their representatives. Modern democracies are founded on voting, whether it is by electronic voting (e-voting) or traditional voting based on ballots. Apathy voters have been rising recently, particularly among the younger, more tech-savvy generation [5]. E-voting is promoted as a potential way to get more young people to vote [6, 7]. Many security and functional requirements, such as transparency, correctness, auditability, data and system integrity, privacy and secrecy, authority distribution, and availability, are listed for a reliable e-voting scheme [8 - 10]. Our suggested method depends on blockchain and Internet of Things (IoT) technology to provide security and high performance because the IoT and its applications have become nations' future looking to expand their fields [11]. IoT is viewed as numerous devices' collection linked together in a network to exchange data that, once processed, can be utilized to make the proper decisions when they are needed. The word "IoT" often defines interconnected objects' networks. It is made up of billions of interconnected "things" or gadgets that can perceive, calculate, communicate, and maybe trigger [12]. The technology of blockchain has been around since the 1980s, and today there is more interest in it than ever before thanks to the 2009 invention of the digital currency known as Bitcoin [13]. Blockchain equations were the technology used in the development of Bitcoin, which was regarded as a widely used digital currency in financial transactions. Credibility and security issues affect voters' ability to cast valid ballots in elections. Others stay away from the polls to escape the commotion and lengthy lines. The use of traditional voting procedures in elections has a number of drawbacks, including fraud in the voting process; stuffing extra ballots; faking certain ballots; difficulty with counting; and delays in reporting the results. For governments, the voting process is challenging because of all these issues. To tackle these issues, it is a good idea to create a quick, secure, and dependable system [14]. In some nations, such as India, for example, there is a difficulty with voting centers (kiosks), as they are not widely dispersed. Because these facilities are located in different locations, remote from some communities, they require employees to maintain them. Voters must travel great distances to cast their

ballots, which will decrease the number of citizens who should vote. As a result, our method is viewed as a solution to this problem because machines do not require human intervention to operate, allowing authorities to position them near all populous areas and are capable of placing multiple devices in the same space. Voting centers, punch-card voting, optical scan voting, and electronic voting are a few examples of technologies that were deployed (kiosks). It also covers a variety of network types, including mobile networks, private computer networks, and online social media usage. These outdated electronic voting systems have evolved, though, as a result of technical advancements, and the academic community is now more interested than ever in voting equipment that uses the Internet of Things [15]. This system will only be used in government elections. Likewise, in questionnaires and referendums, as well as by private and governmental organizations to learn what the public thinks about a particular service or product, or by community organizations or institutions that want to understand what the general public thinks about a particular issue. The solution depends on blockchain and the IoT working together to provide speed, efficiency, and security in biometric voting. Similar studies have been done on biometric voting using IoT to transfer vote to centralized system [16, 17]. Thus, there is the need to measure these similar studies as well as to assess the productivity of specific scholars, nations, journals, and other performance levels.

LITERATURE REVIEW

Along with the suggested works in this paper to advance the voting electronic process and improve its reliability and efficiency, we will present several solutions that were stated in previous researchers' works that combined electronic voting and blockchain in this section to permit decentralization for the voting electronic process and its services. South Korea participated in tests with electronic voting on the blockchain. Gyeonggi-do Province launched it in March 2018 and did so initially. Officials feel that despite the fact that this was only tried on a small scale, with only 9,000 participants, it demonstrates the possibility of adopting Blockchain technology for voting online [18]. A specific mechanism has been put forth by researchers in an effort to address the issues with the central electronic voting procedure. By fragmenting and encrypting the data and building a network of peer-to-peer, the blockchain technology of Ethereum, which is centered on a network decentralized, assures a secure vote. It is the method of uniquely identifying a vote using the Aadhar number provided by the government, which is connected to a distributed ledger that buries the inner difficulties of the consumer. By connecting all voters with a private and public key, it is possible to assure voter verification and prevent double voting. Because the Aadhar number verification technique is not totally secure, additional measures like a verification

CHAPTER 5

Face Recognition using Convolutional Neural Network Algorithms

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Abstract: Biometric applications have massive demand in today's era. The areas of applications are mostly linked with the security of the system. Biometric features are regarded as the primary resource for security purposes due to their own distinctiveness and non-volatile essence. System authentication using biometrics is considered to be a sophisticated technology. Noise effect inducts variation in the biometric subject that causes an adverse impact on establishing the recognition. The proposed model supported the development of an effective method for performing facial biometric feature recognition. The model's goal is to reduce the number of false approvals and refusals. The proposed algorithm has been applied over a video dataset containing surveillance video frames that capture facial subjects dynamically. The first step is the pre-processing of the video frames that have been carried out in the proposed model. Then, the Viola-Jones algorithm was applied to detect the facial subjects in the video frames. Feature extraction from the facial subject has been accomplished by applying a deep reinforcement learning algorithm. Further, the proposed model applied a convolutional neural network (CNN) algorithm to perform feature recognition of facial identity accurately. The proposed technique aims to maintain a huge recognition rate of dynamic facial subjects under various unprecedented noise variations. In the classification algorithm, the recognition accuracy is found to be 98.85%.

Keywords: Convolution neural network, Deep reinforcement, Face recognition, Pre-processing learning.

INTRODUCTION

Any individual's biometric features contain extremely important information. System authentication that uses biometric features is pretty common and reliable nowadays; even so, due to vulnerabilities in communication systems, such features can be hijacked or bypassed by an imposter to establish redundant authentication in the system. Biometric identity is a type of user's permanent and

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Suman Kumar Swarnkar, Sapna Singh Kshatri, Virendra Kumar Swarnkar & Tien Anh Tran (Eds.)

unique identity that is used to keep the user's authentication secure. Within an image's areas, segmentation divides it into elements or artifacts. It is an important instrument for the processing of facial images as described by Rafael & Richard (2017) [1]. Segmentation is an important method for radiological assessment or computer-aided diagnosis in most medical image processing and classification. Face detection and recognition seem to be useful in a wide variety of video processing application fields, including user authentication, video forensic investigations, as well as a wide range of many other video processing applications. The recognition rate may be negatively affected if facial features are read within the less-quality frames in the video [2]. It speeds up the feature learning process in models where feature statistics aren't efficient enough to guarantee exact recognition. The given paper uses deep reinforcement learning with the CNN algorithm to tackle the issues of low-quality video data. Different layers of CNN effectively analyze a video's low-quality frame. The CNN classifier accomplishes the goal of facial image classification using extracted features. The work's major contribution is that it continues to attain face recognition using dynamic video input instead of static pictures. This same video data is adopted from the chokepoint dataset [3], which is a standard database. This paper employs the concepts of Viola Jones, pre-processing, deep reinforcement learning, as well as CNN to efficiently implement face recognition. This work aims to contribute by detecting and identifying the facial subject from video input under relatively undiscovered circumstances including poor illumination, noise, blurring, different poses, angles, changing expressions, and so on. Over the past few decades, the utilization of artificial intelligence (AI) and deep learning (DL) has consistently risen. Studies centered on convolutional neural networks (CNNs) have gained significant prominence, given their effectiveness in analyzing images and other forms of structured data. CNNs are widely regarded as a powerful tool in this regard [4].

The goal of this research is to reduce error rates (FAR and FRR) under various image processing threats. The model's reliability for vibrant input, including such video data, is confirmed by this work [5]. A specific video frame can sometimes contain images of multiple individuals, making it difficult for any basic model to identify and recognize each face individually. The suggested model performs exceptionally well in a frame of multiple faces while retaining high recognition accuracy. The remaining modules are arranged as follows: Module II demonstrates the proposed methodology. Module III contains the results of the experiment. The conclusion/proposal will be summarized in last section. References are kept in the final module.

PROPOSED METHODOLOGY

The suggested method collects data of video with a video recorder on the inside of any room which records distinct individuals who enters the room. A few video frames of data input comprise various images of the same person. These video frames are then analyzed to see if each user's face can be recognized. Fig. (**1**) shows sample input video dataset [5].

Fig. (1). Frames from the input video.

As shown in the diagram above, several people have indeed managed to capture throughout video frames. The image resolution is 552X480 pixels and the frame rate is 30 frames per second. The dataset contains 48 video sequences and 64,204 face images in total.

Viola Jones

A system with the efficiency to detect objects in real time can able to fetch a portion of the facial subject of individuals from the input video. One of these kinds of systems termed as “Viola Jones” has been utilized in the proposed solution. To find facial portions throughout video frames, the model uses the Viola-Jones scheme, which detects features of haar from facial portions [6]. These characteristics are indistinguishable from one another and are unaffected by noise, poor lighting, an abnormal expression, or even the pose of an individual in the recorded video frame. The algorithm tracks the subject's face by scanning every one of the video frames' situated feature points and enclosing it in a rectangular surrounding. The area of a rectangular surrounding has been computed and compared to the sum of the values of each feature point to generate Haar feature points. A few video frame samples of the extricated facial subjects have been presented in Fig. (**2**).

CHAPTER 6

Multimedia Security in Audio Signal

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Abstract: The security of Digital media has been varying continuously due to advanced malware attacks. Multimedia security has become one of the major concerns since new technologies are introduced. The proposed paper applied the watermarking technique in digital audio signals in which unique data is inserted in one-dimensional data in such a way that it must not affect the major information of the audio signal. The hybrid decomposition scheme has been applied to the audio data in order to extract features in terms of energy bands. The data is kept hidden in a low significant energy band that contains less information. This watermarking technique ensures the ownership of the multimedia data. Only authorized authors can be able to claim ownership of the audio data. The correct authorization of audio data can be proven by the extraction method in which the hidden watermark data has been extracted back to its original form without leaving any distortion in audio data. The proposed work introduces a hybrid approach to watermarking 2D data into an audio file. A hybrid audio decomposition technique was introduced by the proposed scheme in which a dual form of audio decomposition method has been applied containing Fast Fourier transform (FFT) and Cordic QR scheme. The correct location from the energy band has been found to embed the watermark data. Before the embedding procedure, the watermarking data has been selected. The proposed method selects an image containing information as a watermark that is first encrypted before initiating the embedding process. Watermark Encryption has been done using a cyclic coding algorithm and Arnold's cat map. The disintegration of the audio file will finally result in Q and R matrices. Both such matrices are of orthogonal type. Then, the encrypted watermark data has been implanted in a random fashion in the R component of decomposed audio data during the embedding process. The inverse procedure has been applied for the watermark extraction and decryption process.

Keywords: Fast fourier transformation, Q-R cordic decomposition, Watermarking in audio signals, Watermark encryption, Watermark embedding, Water- mark extraction.

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Suman Kumar Swarnkar, Sapna Singh Kshatri, Virendra Kumar Swarnkar & Tien Anh Tran (Eds.)

INTRODUCTION

Multimedia security is one of the challenging concepts in research field. Securing multimedia using encryption is found to be the most frequently used technique. Various encryption techniques [1] have been utilized earlier but few challenges remain untouched. The basic challenge is to tackle advanced hacking algorithms [2] that generally varies according to an algorithm. A cyber attacker is used to exploit the vulnerability of the existing system and uses hacking algorithm to obtain unauthorized access. When it comes to digital rights management, the watermarking [3] method is one of the reliable techniques applied to secure multimedia content by hiding watermark data in the host multimedia data. The challenging concept in the watermarking approach is to maintain balance among imperceptibility, robustness, and payload. The watermarked audio signal must be imperceptible so that no watermark hidden clue can be generated in terms of noise. The robustness has been measured under the application of signal-processing attacks. The influence of the hidden watermark has been seen under the application of attacks in multimedia signals. Payload is the amount of the data that will be inserted into the host multimedia. Therefore, the maximum payload must be kept in order to maintain digital right management while maintaining imperceptibility and robustness. Various existing approaches [4] fail to establish a balance among these three factors and therefore may leave a loophole for the imposter.

RELATED WORK

A model based on a human interface system contains an input sensor to employ facial expressions, an ECG signal reader, a voice recorder, a body movement video recorder, etc. The interface records the body signals to extract feature variation that can be used for watermark hiding. Liscombe *et al*. [5] performed feature extraction from non-static speech one-dimensional input signal containing amplitude, pitch, frequency variation, etc. In the past years [6], various algorithms were developed to recognize human feelings. Researches include algorithms such as support vector machine, Gaussian mixture models, hidden Markov models, etc. in order to find suitable energy bands for the embedding process. A multimodal [7] system for the watermarking of image data into facial expression signals is used, in which two different body signals are employed over a single deep learning algorithm for better embedding. Pan *et al*. [8] studied a hybrid fusion of a multimodal system by using visual and textual signals from an individual for the watermarking approach. The model uses an LSTM algorithm for feature extraction from both datasets. Siriwardhana *et al*. [6] implemented a self-supervised learning model for the textural input data from people to embed the data by applying modalities in the feature vector. Priyasad *et al*. [7] introduced a

deep learning scheme for the analysis of features such as acoustic features by applying the band pass filtering technique. The features are represented in the N-gram level in a bidirectional recurrent network. Krishna *et al*. [8] utilized a raw waveform dataset over a neural network algorithm. They applied audio processing in order to refine the feature vector to obtain the enhanced energy spectrum for the insertion of the watermark so that the data must be hidden in good format. Lee *et al*. [9] applied a deep learning algorithm that uses a multimodal system containing textual details and facial images in order to find a correlation between the embedding and extraction process. Liu *et al*. [10] used an LSTM network for the recognition of emotions from audio features. The method was also tested with a machine learning algorithm for feature analysis. LSTM modal describes the interpretation of lyrics from audio signals and correlates the meaning variation of noises for the detection of any hidden entity in the host signal. Most strategies in earlier literature [11] were based on facial expression correlation watermarking hiding technique. The facial image dataset contains a 2-dimensional representation of Gabor wavelet for the extraction of characteristics. Table **1** shows the literature that presents various strategies for emotion recognition. Each study focuses on different modalities, techniques, datasets, and feature vectors for accurate emotion classification. The accuracy obtained in each study is reported as the average accuracy achieved based on their respective experiments and evaluations.

Table 1. Few recent literature containing various emotion recognition strategies.

Reference	Modal	Technique	Dataset	Feature vector	Accuracy Obtained
Jayalaxmi J *et al*. [3]	SVM, KNN	Blind water-marking	JAFFE	LBP, DTC, Viola Jones face detection	91.85% average accuracy
Li W *et al*. [4]	CNN	Hybrid feature decomposition	CIFE dataset	Filter, transforms and viola jones face detector	82.4% average accuracy
Mehendale N. et al. [5]	Deep Learning	Spatial do- main	CMU, NIST dataset	Skin tone detection	85% average accuracy
Islam B. *et al*. [6]	ANN	Frequency Domain	JAFFE	HOG, LBP, Viola Jones	93.51% average accuracy
Singh G *et al*. [8]	ROI based FER	Hybrid de-composition	JAFFE	Audio features	75% average accuracy

CHAPTER 7

Recent Advancements and Impact of Multimedia in Education

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Abstract: The term "multimedia learning" refers to education that combines words and images. Reading a physics textbook, seeing a recorded lecture, or watching a PowerPoint presentation are all examples of multimedia learning. Also with the advent of artificial intelligence, the format of the learning procedure has now become more advanced, personalized, and relevant as students can get their answers more random with full specification as compared to earlier processes. The 21st century, known colloquially as the era of information and technology (IT), is currently in effect. Nowadays, the educational sector makes extensive use of information and technology to make teaching and learning successful and enjoyable for both teachers and students. Teachers are the cornerstone of any society that is able to function. The use of technology is crucial in teacher training programmers. Students can learn and gain information through varied sources like the Internet, digital media, cable networks, and social media sites like Whatsapp, Linkedin, Igo, Line, Facebook, Twitter, and Wechat. Thus, multimedia, Information, and Communication Technologies (ICT) play a significant role in training purposes and enhancing skills of teaching abilities. In the ushering era of technology, namely multimedia, it is now utilized as a teaching tool. Multimedia applications can be designed in effective ways to produce successful educational results, according to several researchers and educators. Not only that, but we'll also talk about the definition of multimedia, how it relates to learning tools, the idea of multimedia applications, how they're made using various media, the kinds of educational components that encourage students to learn in their natural environments, and real-world problems. This article explains the concepts and traits of multimedia and educational components. In light of the many altering needs of our society, attention is now paid to various educational conceptions and practices. Changes are being made in teacher education as well, as per these beliefs and practices. The interdisciplinary approach, correspondence courses, orientation courses, and other modern trends in teacher education are included below. Other methods utilized in teacher education include team teaching, programmed instruction, micro-teaching, and simulations. Action research is now used in teacher education as well.

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Suman Kumar Swarnkar, Sapna Singh Kshatri, Virendra Kumar Swarnkar & Tien Anh Tran (Eds.)

Keywords: Educational, ICT, Information and Technology, Multimedia, Simulations, Technology, Teacher Training.

INTRODUCTION

An educational scenario where a pupil has the power to study the module at one's own place and in accordance with one's own preferences, needs, and thought abilities where interactive multimedia for instruction is most commonly used. The major purpose of collaborative multimedia study material is to completely alter the role of the instructor rather than to completely exchange the educator. As a result, multimedia ought to be exceptionally well-designed and clever enough to replicate the best educator by integrating the best design techniques with the numerous components of cognitive processes. In the sphere of education, we support classroom instruction *via* audio, video, slides, overhead transparencies, *etc*. A mixture of many media is referred to as multimedia. People began utilizing computers to accomplish numerous jobs to ease their lives as they became commonplace in society. A trustworthy technical advancement, interactive multimedia has the ability to update how we read and discover new information. Information and Communication Technology (ICT) is a key component of modern life in practically every aspect. The use of ICT technologies in the social and academic spheres has altered the social and academic environment as a whole. All schools, colleges, and institutions remain closed due to lockdown during the COVID-19 epidemic [1]. This has an impact on student academic loss. In order to counter this, ICT technologies are utilized to stop academic loss among students, keep in touch with them, keep them engaged, offer them tasks, and get their feedback. Information and communication technology (ICT) has steadily raised the bar for education, affecting instructional strategies, learning techniques, scientific inquiry, and information availability. Information and communication technology (ICT) emphasizes the role of an intelligent building management system by integrating telecom, computers, the internet, tools, middleware, storage, wireless communications, phone, text messaging, video and audio, networking sites (Face book), voice over Internet protocol (VoIP), as well as other communication mediums [2]. All aspects of digital data storage, retrieval, modification, transmission, and receipt are covered. It has slowly evolved from an educational society to a knowledge and information society, transforming the economy into a knowledge economy and assisting countries in developing their ability for knowledge-based wealth creation. It is a leading-edge high-tech method that will have a huge impact on the educational system.

The obligation to educate children falls on every country. It is a fundamental right of theirs. However, it also refers to the right to get great education from a qualified teacher, not only the right to access education. Education has a long

history of being associated with social responsibility and societal empowerment procedure. However, the era of globalization, is evolving around a socio-commercial pursuit that arose uniquely endowing society a combination of traditional and contemporary approaches. Technical know-how has become the foundation of every single thing in today's hypercompetitive realm. Also, AI (Artificial Intelligence) has empowered education and education techniques like Examination Integrity, Plagiarism Detection Chatbots for enrollment and retention, LMSs, faculty lecture transcription, improved online discussion boards, student success metrics analysis, and academic research [3]. AI is boosting personalized learning plans and educational tracks for students, encouraging tutoring by assisting students in honing their strengths and strengthening their weak areas, facilitating rapid interaction between teachers and students, and promoting universal 24/7 learning access. AI enables teachers to provide pupils with individualized responses to pertinent queries. In accordance with the problems and inquiries they encounter in course materials and online sessions, it also aids in students' education. Students can now communicate with teachers *via* a more extensive mechanism. The Learning Management System (LMS) enables educators to develop courses, deliver instruction, facilitate communication, and student participation in collaborative effort, appraise educational outcomes, and provide added resources for students' assistance, thereby assisting schools in maintaining the integrity of their educational programs [4]. You may consolidate all of your training materials, resources, personal development goals, assessment results, and progress outcomes using an LMS. This has made things effortlessly easy to check which activities are accomplished and by whom. Also, the identification of content was made effective, provided with continuous training. Nearly all universities nowadays assert to have a plan in place to make use of the potential offered by the internet or other digital media in order to enhance and develop conventional education. In the middle of the 1990s, when the World Wide Web first appeared, the phrase "e-learning" was invented, creating buzz. Some predicted sweeping changes to the educational landscape or the demise of conventional education as a whole. In the paper, we will discuss how multimedia and various technologies have changed the traditional face of imparting quality education.

MULTIMEDIA

The presentation of text, images, music, and video together with links and other tools that enable the user to explore, connect, create, and converse using a computer is known as multimedia. The concept provided above includes four elements that are crucial to multimedia. They are:

CHAPTER 8

Emerging AI Trends in Intelligent and Interactive Multimedia Systems

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Abstract: Intelligent and interactive multimedia systems are in a constant state of evolution, with new technologies and developments being introduced daily. AI is a fundamental enabler of these technologies, providing intelligence and interactivity required to make them more useful and user-friendly. This article examines the current state of AI-based intelligent and interactive multimedia systems, highlighting the most promising trends and obstacles. Then, we explore emerging AI trends that are anticipated to play a significant role in overcoming these obstacles and enabling the development of new and more complex intelligent and interactive multimedia systems.

Keywords: Educational, ICT, Information and technology, Multimedia, Simulations, Technology, Teacher training.

INTRODUCTION

With the use of artificial intelligence (AI) algorithms, we can generate new content, such as photographs, videos, and text. Explainable AI refers to the usage of AI systems that can explain their decision-making process, which aids in establishing user confidence. The use of Multi-modal systems is intended to make the integration of several modalities, such as vision, speech, and language, to provide interactions that are more realistic and human-like [1]. The following are emerging AI trends for intelligent and interactive multimedia systems:

Deep Learning entails the application of deep neural networks to image and video processing, natural language processing, and speech recognition.

Computer Vision: The application of artificial intelligence systems to analyse, comprehend, and interpret visual data from the real world, such as photographs and videos.

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Suman Kumar Swarnkar, Sapna Singh Kshatri, Virendra Kumar Swarnkar & Tien Anh Tran (Eds.)

Natural Language Processing (NLP) is the use of artificial intelligence (AI) systems to analyse, comprehend, and synthesize human language, such as speech and text.

Reinforcement Learning: The application of artificial intelligence (AI) algorithms that learn *via* trial and error, enabling systems to adapt and improve over time.

Fig. (**1**) explains Multimedia Intelligence, which focuses on the advancements and developments in AI that aim to overcome obstacles in intelligent and interactive multimedia systems.

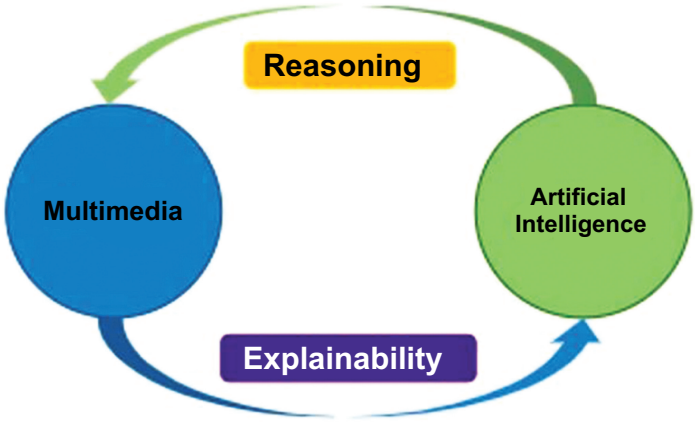

Fig. (1). Multimedia Intelligence [1].

There are a number of AI developments aimed at overcoming the obstacles in intelligent and interactive multimedia systems, including: Natural Language Processing (NLP) that is used to enhance the interaction between users and multimedia systems by permitting them to communicate in natural language. Computer vision is used to allow multimedia systems to comprehend and interpret visual data, such as photos and videos. Deep Learning is used to enhance the ability of multimedia systems to learn and adapt to new data. Reinforcement learning is used to enhance the decision-making abilities of multimedia systems by permitting them to learn from their experiences. Generative models such as GANs and VAEs are used to enhance the capacity of multimedia systems to generate and create new content. Explainable AI is used to increase the interpretability and transparency of multimedia systems, making it easier for people to comprehend how and why the system makes certain judgments. Fig. (**1**) depicts the MM intelligence in interactive systems.

ROLE OF DL, ML IN INTELLIGENT AND INTERACTIVE MULTIMEDIA SYSTEMS

These developments aim to make multimedia systems smarter and more interactive by enhancing their capacity to comprehend, process, and generate multimedia content. Developing intelligent and interactive multimedia systems has numerous obstacles, including Natural language comprehension, which is the capability of a computer system to comprehend and interpret human language in a manner similar to that of a person. Multimodal integration is the incorporation of diverse modalities, such as text, audio, and video, and the interpretation of the information they supply. Personalization is the process of tailoring user experiences depending on their choices and behaviour. Interactivity is the design of interfaces that are user-friendly and intuitive. Adaptability: the capacity of a system to adapt to changing user circumstances and requirements. Scalability is the capacity to manage big volumes of data and a large number of concurrent users. Privacy and security: safeguarding user information and protecting the system from harmful attacks. Fig. (**2**) depicts that AI is a major enabling technology for interactive multimedia systems because it enables the development of intelligent and responsive systems that can adapt to the users' demands and preferences.

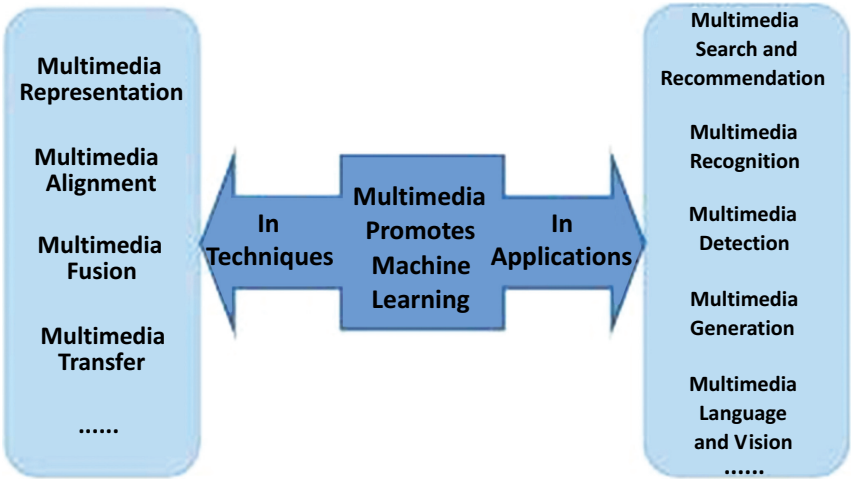

Fig. (2). How multimedia promotes machine learning [2].

SPECIFIC APPLICATIONS OF AI

Natural Language Processing uses NLP approaches powered by artificial intelligence. Multimedia systems can comprehend and respond to user input in natural language. This enables more natural and intuitive system interfaces, such as voice commands and text-based queries. Computer vision techniques driven by

SUBJECT INDEX

A

AI-based 52, 103, 104, 105, 106
  intelligent multimedia systems 103, 104, 105, 106
  systems 104
  two-stage intrusion detection for software 52
AI-powered 101, 102, 103
  computer vision 103
  multimodal systems 102, 103
  natural language processing 102
  recommender systems 101
  techniques 101
  video analytics systems 101
Amazon web services 30
ANN 4, 5, 6, 18, 20, 21, 72
  classifier 6
  techniques 21
Anomalous sensor data 44
Apple's Siri 101
Application(s) 10, 11, 28, 29, 30, 31, 32, 43, 71, 98, 99, 100, 106, 107, 113, 114
  programming interfaces 28
  visualization 43
Applied Arnold's cat map technique 75
Artefacts, transitory 16
Artificial intelligence 47, 98
  and lecture notes in bioinformatics 47
  systems 98
Artificial neurons 111
Assessments, radiological 61
Attacks, signal-processing 71
Audio signals 71, 79
  attacked watermarked 79
  watermarked 71
Audio watermark 74
Autistic spectrum disorder 11
Automated machine learning 110
Automatic machine learning 112, 113
AutoML algorithm 113
Autonomous vehicles 107, 109

B

BCI 9, 10, 20
  systems 9, 20
  technology 10
Bibliometric 43, 58
  analysis 43, 58
  technique 58
Bio-inspired algorithms 22
Blockchain technology 41, 42, 55
  for voting online 42
Blockchain trust model for malicious node 52
  detection 52
Boosting algorithms 13
Brain 9, 10, 14
  computer interface (BCI) 9, 10
  connection analyses 14
  processes 14

C

Canonical correlation analysis 16
Classrooms, traditional 88
Cloud 29, 30, 35, 36
  environment 36
  infrastructure 30
  platform 35
  provider 29
  resources 36
Cloud computing 27, 28, 30, 32, 33, 34, 36, 37, 38
  applications 28
  for libraries and information centres 33
  platforms 32, 33
  services 27, 30, 32, 34, 36, 37, 38
  systems, developing 27
  use of 27, 34, 37
CNN algorithm 61
Cognitive 10, 13, 18
  effort 13, 18
  stress 10, 13
Compound annual growth rate (CAGR) 95

Computation 19
  fitness function 19
Computer 10, 52, 61, 86, 96, 100, 111
  aided diagnosis 61
  algorithm 111
  communications 52
  hardware 10, 86
  skills 96
  vision techniques 100
Computing techniques 30
Convolution neural network (CNN) 13, 20, 22, 60, 61, 65, 72, 111
CORDIC QR decomposition 75, 80
COVID-19 83, 92
  epidemic 83
Cross-task analysis 14
Crow search algorithm 22

D

Deep 13, 20, 21, 22, 56, 98, 110, 112
  belief networks (DBN) 13, 20, 21, 22
  neural network (DNNs) 56, 98, 110, 112
Deep learning (DL) 9, 11, 13, 20, 21, 22, 61, 71, 72, 98, 99, 100, 106, 107, 114
  algorithms 9, 72
  methods 13
Design filter techniques 19
Detect cognitive workload 13
Devices 28, 31, 85, 108
  information communication 31
  mobile 28
Digital 27, 31, 32, 41
  currency 41
  library 27, 31, 32
Distributed ledger technology (DLT) 92
DL techniques 11
Driver drowsiness 20

E

EdTech 93, 95, 96
  company 96
  marketplaces 93
  sector 95
EEG 11, 13, 14, 15, 17, 20
  and near-infrared reflectance spectroscopy 14
  data 11, 13, 15, 17, 20
  electrodes 14, 17
  processing technology 15
Elections, governmental voting 56
Electroencephalography 9
Electronic voting system 55
Ensemble 17, 19
  embedding techniques 17
  feature selection techniques 19
Environments 86, 89
  accessible learning 89
  multimedia-based constructivist learning 86

F

Fast fourier transform (FFT) 21, 22, 70, 73, 74, 75, 80, 86
Fenrich's definition 86
FFT transformation 75
Filter 15, 18
  EEG signals 15
  techniques 18
Filtering methods 18
Financial transactions 41
Fingerprint 56
  verification technique 56
Fourier transform 16

G

Gaussian radial basis functions 19
Google 31
  App engine service 31
  Apps 31
  classroom 31
Government elections 42
Greencom CPSCOM smart data blockchain 47
Grid computing 30

H

HOG feature visualization 66
Host web applications 31
Human 71, 108
  computer interaction 108
  interface system 71
Hybrid 29, 71
  cloud 29
  fusion 71

I

Image 61, 71
  data 71
  processing threats 61
Information 52, 82, 83, 91, 93, 94, 98
  and communication technologies (ICT) 82, 83, 91, 93, 94, 98
  security 52
Input 13, 62, 64, 71, 101, 103, 106, 109
  comprehend auditory 106
  raw data 13
  sensor 71
  vectors 64
  video 62
  visual 101, 103, 106, 109
Integrated library management software 31
Integration 86, 88, 98, 108, 112, 114
  flawless 86
Intelligent 1, 47, 83, 101, 102, 103, 104
  building management system 83
  interactive multimodal systems 103
  multimedia systems 104
  multimodal interaction systems 102
  recommender systems 101
  systems and computing 47
  technique 1
  video analytics 101
Interactions 102, 103
  automating customer service 102
  human computer 103
Interactive 106, 115
  multimodal systems 106
  visualizations 115
Internet 28, 43, 48, 49, 57
  of things 43, 48, 49, 57
  technologies 28
Inverse Arnold's cat map algorithm 76
IoT 40, 56, 58
  based biometric voting 40
  devices 56
  variables 58

K

Knimbus cloud service 32
Kruskal-Wallis test 21

L

Labelled dataset matching 19
Languages 95, 98, 99, 100, 103, 106, 112
  logic programming 112
  natural 99, 100, 103, 106
  program 112
Learning 11, 12, 13, 30, 82, 83, 84, 86, 87, 88, 89, 90, 91, 93, 94, 95, 96, 105, 107, 112
  based cognitive workload assessment methods, deep 11
  communities 91
  experiences, interactive 88
  human-like cognitive 112
  internet-based 88
  management system (LMS) 84, 96
  techniques 83
  technology 89
  tools 82, 94, 96
  transfer 13, 105
  video-based 88
Local area network 30
LSTM 71, 72
  algorithm for feature extraction 71
  network 72

M

Machine 1
  decisions 1
  health conditions 1
Machine learning 9, 10, 11, 12, 13, 18, 19, 49, 72, 100, 102, 103, 111, 112, 113
  algorithms 72, 103
  classification algorithms 19
  meta-learning and automatic 112, 113
  process 18
  techniques 10, 12
  traditional 13
Malicious node detection 52
Management 27, 71, 88
  digital rights 71
  learning content 88
  traditional library 27
Managing air traffic 12
Manufacturing 1, 2
  machines 1
  techniques 2
MapReduce 52

approach 52
technique 52
Massive open online courses (MOOCs) 92
Mental workspace 12
Methods, chalk-and-talk 86
Microsoft windows azure 31
Multi-attribute task battery (MATB) 12
Multimedia 21, 70, 82, 83, 85, 86, 87, 88, 89, 94, 96, 99, 107, 108, 109, 110, 111, 113, 115, 116,
activities 113
data 70, 115, 116
experience 85
formats 110
inputs 108, 109, 115
intelligence 99, 109, 110, 111, 115
interactive 83, 107
learning 21, 82
learning environment 86
materials 89
modalities 111
software programmes 88
streaming systems 107
tasks 113
technology 87, 88, 94, 96
turing test 108, 109, 110, 111
Multimedia systems 99, 100, 101, 106, 109
capacity of intelligent and interactive 106
smarter 100

N

Natural language 100, 106
comprehension 100, 106
Natural language processing (NLP) 98, 99, 100, 101, 102, 106
deep learning 106
Near-infrared reflectance spectroscopy (NIRS) 14
Networks 42, 52
mobile 42
wireless sensor 52
Neural network(s) 4, 56, 60, 61, 65, 68, 72, 98, 104, 106, 109, 110, 111, 112
algorithm 72
artificial 4, 110, 111
deep 56, 98, 110, 112
Noise 13, 15, 61, 62, 71, 72, 78, 79
influence of 78, 79
removal techniques 15

P

Particle swarm optimization (PSO) 19
Plagiarism detection Chatbots 84
Polaris software 32
Power 7, 31, 83, 89, 109, 114
computer processing 109
Google applications 31
Process 19, 42, 56, 77, 83, 85, 86, 100, 101, 104, 109, 110, 113, 116
audio-visual 101
cognitive 83
electronic 42
Processing, medical image 61
Public 10, 29
clouds 29
transit systems 10

R

Reasoning, neural-symbolic 112
Reinforcement learning 13, 60, 61, 63, 64 66, 99, 105, 107
deep 61, 63, 64
algorithm, deep 60
Resources 11, 28, 88, 89
configurable computing 28
electronic 88, 89
mental 11
Risk, potential cybersecurity 58

S

Schizophrenia 11
Sensors 4, 6, 7, 30, 52, 55, 56
fingerprint 55
Sequences, random 80
Services 31, 32
cloud-based 32
communication 31
Skills, technological 36
Social 82, 91, 94, 103
media sites 82, 91, 103
networking sites 94
STEAM 93
based education 93
education 93
STEM-based curricular topics 93

Systems 41, 42, 43, 60, 62, 63, 64, 83, 92, 93, 99, 100, 101, 103, 105, 107, 113
communication 60
educational 83
electronic 43

T

Tasks 10, 11, 12, 14, 15, 18, 20, 93, 105, 106, 109, 110, 112, 113
automate routine 93
cognitive 11, 14
mental arithmetic 11, 14
visual 12
Technology 27, 32, 38, 83, 88, 89, 95
computer systems 38
educational 88, 89, 95
information and communication 27, 32, 83
Telecom, integrating 83
Traffic 12, 56
management 12
sign recognition 56
Turing test for multimedia 109
Two-layer encryption technique 80

V

Vaughan's terms 86
Vibration signals 1, 6
Video(s) 61, 62, 66, 68, 83, 84, 85, 86, 87, 91, 94, 98, 99, 100, 101, 103, 105, 106, 108, 115
animated educational 94
conferencing 91
data 61, 62, 68
educational 94
processing 98
recorder 62, 66
surveillance systems 103
Video input 61, 69
dynamic 61
Viola jones method 66
Visual 21, 109, 111, 112
inspection 21
turing test 109, 111, 112
Voice recorder 71
VOSviewer 43, 51
program 51
software 43
Voting 40, 41, 42, 43, 44, 49, 56, 57
age, attained 41
based anomaly imputation technique 44
machines 56
optical scan 42
procedure, central electronic 42
traditional 41
VQA 114
framework 114
systems 114
VR technologies 108

W

Water-mark extraction 70
Watermark 70, 71, 72, 73, 74, 75, 76, 77, 78, 80
embedding technique 75
extraction process 76
Watermarking 70, 72
facial expression correlation 72
technique 70

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