A State of Art Survey of Nano Technology: Implementation, Challenges, and Future Trends

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Review Article

ABSTRACT

Nanotechnology is a field of study that aims to make our lives easier, safer, and more environmentally friendly. With current upgrades and alterations to available networking and communication paradigms, incorporating Wireless Nano Sensor Networks (WNSN) with various products, sensors, and devices would introduce new network paradigms. The Internet of Nano Things is a term for this concept (IoNT), To achieve seamless interconnection between Nano networks and existing communication networks and the Internet, many topologies and communication paradigms must be developed while technological hurdles are addressed. The amount of data accessible limits how much research and decision-making can be done. This research visualizes a wide range of nanotechnology applications. The goal of this project was to show in more than way this research method may be used to information recommendation services. The routing protocol is critical in WNSN and IoNT because of the many nanoscale constraints. While ensuring the flow of data and information, this routing protocol must take into account the specific features of nanoscale communication.This research aims to provide insight into the WNSN (Wireless Nano Sensor Networks) and IoNT (The Internet of Nano Things)

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paradigms, as well as a detailed assessment of a large number of current routing protocols that are tailored to the characteristics and features of nano communication. Big data applications with their features and characteristics in general also use cloud computing. This paper explains different hands based on neural networks and implemented on FPGAs (which is Field-Programmable Gate Array) and other genetic algorithms and neural networks. Many more approaches and models compare.

Keywords: Nanotechnology; information technology; computing; cloud systems; big data and nanotechnology; neural networks; IoNT.

1. INTRODUCTION

Between 1997 and 2001, government organizations reported a 3.5-fold rise in global nanotechnology research and development (R&D) funding, with the highest rate of 90% in 2001. At least 30 nations have started or are about to start national initiatives in this area. In the physical, biological, and engineering sciences, scientists have cast a wide net of discoveries that have left no major study field unexplored [1,2]. Nanotechnology encompasses applied physics, materials science, chemistry, biology, biomedical engineering, surface science, electrical engineering, and robotics, all of which are concerned with controlling and manipulating matter and devices on a size of fewer than 100 nanometers [3,4]. The characteristics of matter are governed at the nanoscale, and scientific fields have fewer limits. In nanotechnology, there are two major techniques [5,6]. The "bottom-up" and "top-down" techniques are referred to as such. To assemble nanostructures, materials, and gadgets, the former entails building up from atoms to molecules [7,8]. The second method entails constructing structures and gadgets from bigger entities without atomic precision. Both techniques have accelerated in recent years with the invention and implementation of susceptible instruments [9,10]. Nanotechnology was not well-known when it was first coined, even though it referred to manipulating atoms and molecules to make them into anything we wished [11,12]. Though Nanotechnology is progressively becoming a household word in the realm of science and technology [13,14]. Nanotechnology touches nearly every aspect of our lives and has the potential to significantly impact society in areas as diverse as medicine, agriculture, water, textiles, infrastructure, transportation, and consumer electronics [15,16]. It influences a wide range of sectors, including medical and healthcare, computer and information technology, electricity and energy management, etc. Generations vary [17]. Nanotechnology has various benefits over traditional computer and information technologies, including data storage and the design and development of faster processors with better durability and lower energy usage [18]. Nanotechnology's gift to IT includes better and more efficient display systems, as well as quantum technologies [19]. Nanotechnology is capable of creating new materials that are far more durable than traditional systems. So, by using this technology will be able to develop quicker, cheaper, and more powerful computers [20]. Undoubtedly, one of the most significant advantages of Nanotechnology is the ability to solve space problems. In its most basic definition, the term "big" refers to something extremely enormous in nature [21]. In contrast, basic information is referred to as data. Technology has changed dramatically in recent years [22]. Today, every foundation works with data sets that are so huge (or complicated) that typical data processing and applications are insufficient [23,24]. Big Data Management refers to data sets that are extremely large and go beyond the capabilities of standard data systems [25,26]. Managing information from a remote location with a high volume of data necessitates intelligent systems plays a critical role in this [27,28]. In nature, the term "big" denotes something enormous [29,30]. In its most basic form, data is nothing more than unprocessed data. Technology evolves and changes regularly [31,32]. It is undeniable that social media has gained widespread acceptance in recent years, transcending geographical borders. Big data is a term used to describe data volumes that are so massive (or complicated) that typical data processing and applications are insufficient [33,34]. Analysis, capture, sharing, storage, visualization, querying, and information are all difficulties in conventional contexts [35, 36]. Gradients of statistical knowledge play a significant role in this system. The key area for social scientists and economists is to combine substantive knowledge with data analysis capabilities, focusing on the use of quantitative approaches [37,38]. The training of (and understanding quantitative approaches) coding

with substantive competence is what Data Science components are all about. Big Data Analytics techniques are essential in the Data Science field [39-41]. A nanotechnology is a breakthrough approach for technological advancement that deals with material management at the nanoscale scale (one billion times smaller than a meter) [42,43]. Nanotechnology is a broad term that encompasses any nanoscale technology with a wide range of real-world applications [44,45]. Nanotechnology is defined as the manufacturing and use of chemical, physical, and biological systems at sizes ranging from single molecules or atoms to submicron dimensions, as well as the integration of these nanomaterials into larger systems. It has the power to shift our perceptions and expectations, as well as provide us with the tools we need to address global concerns [9]. Also, it can be seen as a game-changing technology with the ability to spur scientific progress while also helping society [46,47]. However, worries about potential drawbacks, including as hazards to human health, are tempering the excitement with which the scientific and technological communities are embracing the technology [48,49]. "Are these fears justified?" is a question that many people pose, but from different viewpoints. Because the interface between this technology and society is becoming increasingly complicated, appropriate responses will be based on sound research and presented within a sociological context [50,51]. Nanotechnology has the potential to solve some of the world's most pressing development issues [52]. However, to our knowledge, there has been no systematic prioritizing of nanotechnology applications aimed at addressing the issues that the developing world's 5 billion people confront [53]. Nanotechnology is a term that refers to any nanoscale technology that has a variety of real-world applications. However, it is the manufacturing and use of chemical, physical, and biological systems at sizes ranging from single molecules or atoms to submicron dimensions and the integration of these nanomaterials into larger systems [54]. It has the power to alter our perceptions and expectations and provide us the capacity to tackle global problems [55].

2. BACKGROUND THEORY

2.1 Definition of Nanotechnology

Nanotechnology will be a crucial component and technology in the future of Information Technology and Telecommunications. Nanotechnology helps deal with nanoparticles that have unique optical, electrical, and magnetic features [56]. Nanotechnology is a cutting-edge technology that enables the development and design of nanoscale devices [57]. It provides potential and practical solutions in medical, military, agriculture, environmental protection, and computer systems. There is a lot of money and initiatives from many governments throughout the world, such as the United States and China, for projects based on Nanotechnology in many fields. Oman has recently begun to incorporate nanotechnology into its many industries. An entirely new component of the Internet of Things (IoT) [58]. Molecular manufacturing reduces the need for water and other natural resources, resulting in water, land, and food conservation [59]. Nanotechnology primarily makes use of nanofabrication techniques to aid in atomic-level manipulation [60]. Nanotechnology is divided into two categories: top-down and bottom-up approaches. The first method entails developing more minor things via the utilization of bigger ones and directed assembly. A mask is typically utilized in this method. On the other hand, the second technique is concerned with molecular recognition and is hence most commonly used by chemical engineers and material scientists [61].

The display system is the primary area in which nanotechnology is widely employed [62]. Electrical carbon nanotubes may be changed to cathode-ray tubes (CRTs) for smaller and brighter displays; this is a pride of place on nanotechnologies. To create better and healthier nanotubes, the integrated display system of the scan microscope assists [63]. The development of computer equipment, especially chips. In particular, fast and efficient data management is a crucial task, and it is an essential abbreviation for MRAM or Magnetic Random Access Memory [64]. Magnetic tunnel junctions on the nanoscale scale essentially aid in its final reach.

In most cases, one computer is connected to several switches that handle data. However, the advancement of Integrated Circuits (ICs) has made this possible [65]. As a result, with the assistance of silicon chip integrated objects, easy and efficient IC communication may be achieved. Making complicated circuits out of silicon is more straightforward and, as a result, less expensive than making them out of any other material. For a simple example, see Fig. 1. [66].
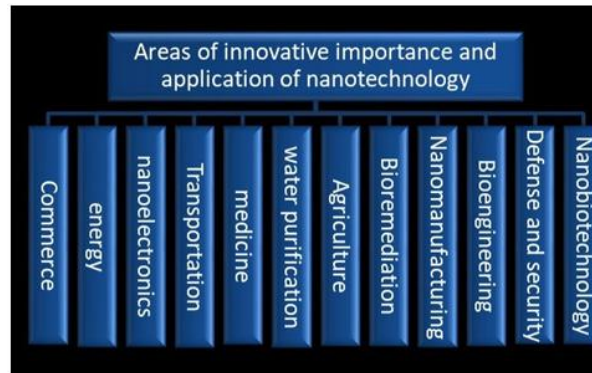
Fig. 1. Nanotechnology and its applications in informatics

2.2 Objectives of Nanotechnology

Most national nanotechnology programs' ultimate aims are to generate money and improve quality of life as goal. These goals necessitate new techniques and standards [67]. which need to devise a method for assessing the outcomes of all links in the nanoscale innovation chain, from technology transfer to diffusion, market-oriented activities, and scientific developments [68]. It must also evaluate: how nanotechnology projects are being put into action and if it's able to achieve their goals at a reasonable cost. Not only must the plan's effectiveness be taken into account in the evaluation method and not just the final product, but also how it was deployed and handled. Because of the wide range of national-level programs, a wide range of criteria should be considered in any evaluation method. Methodologies and criteria only in this manner will an individual achieve full potential [69].

2.3 Nanotechnology Implementation Fields

Nanotechnology's use in various disciplines such as Nano electronics, nanomaterials, and Nano biotechnology is a broad aspect because it is an interdisciplinary branch [70]. Healthcare, information technology, agriculture, and food processing all use it. Nature possesses nanotechnology and the capacity to create atoms and molecules, as evidenced by several studies [71]. The nanoscale ranges from 1 to 100 nanometers for biological and physiological processes [72]. A hydrogen atom has a diameter of 0.1 nanometers, while a water molecule has a diameter of one nanometer. Some biological systems have Nano systems that collaborate in specific physiological processes such as locomotion, in which action fibers travel along myosin fibers to cause muscle contraction [73]. Table 1 show the area of using nanotechnology:

Table 1. Applications of nanotechnology [73]

Area	Application
Nanoelectronics sensors	Nanomaterials used to assess the quality of the soil & water
Information & computing	Also used in cameras, Personal computers
Nanomaterials	Thin films & layers are used in water proof fabrics (One-dimensional)& electronics
Two-dimensional	Preparation of nanowires such as silican nanowires for data storage, electronic & optoelectronic device.
Three-dimensional	Nanoparticles used in cosmetics, textiles, paints and catalysis
Nanobiotechnology	By implanting silicon chips in humans or animals to monitor health and administration of drugs Also in disease diognasis and in molecular imaging technique.
Agriculture	In preparing pesticides, fertilizers, and other agrichemicals for more efficiency. Also detecting animal and plant pathogens.
Food processing	Nanocapsules to improve bioavailability of nutrients in ingredients like cooking oil etc., Preparation of plant based steroids to replace meats cholesterol.
Food packing	Applying antimicrobial & antifungal surface coatings with silver & magnesium for safety. Preparation of biodegradable nanosensors controlling temperature, moisture, and time monitoring.

2.4 Nanotechnology Challenges

Tools dominate nanotechnology's current uses for scientists on the one hand and novel nanoscale-structured materials on the other. These novel materials are now used in cosmetics, health, medicine, and a wide range of manufactured items [74]. These new technologies are also being driven by the electronics and computer technology sectors.

Nanotechnology definitions aren't usually clear or consistent. Nanotechnology is characterized by the emergence of various physical characteristics at length scales ranging from 1 nanometer to 100 nanometers [75].

These are based on scientific phenomena like quantum physics, strong surface forces, and Brownian motion at short length scales, which are less evident for more significant objects [76]. Nanotechnology will have three main timeframes of economic and societal effects [77]. Nanotechnology's current uses are primarily the product of incremental advancements in well-established fields of applied research like material science and colloid technology [78]. Nanotechnology will be used in the medium term to overcome common hurdles to continuing technological improvement, using concepts that have just recently been established in the laboratory [79]. Long-term, totally new uses may arise from research that is presently just being considered in the lab.

It's unclear whether they contain functioning Nano devices capable of assembling materials from molecular components [80]. The debate over the societal consequences of nanotechnology has primarily centered on the longer-term potential of radical nanotechnology rather than the relatively common applications that have come thus far. This envisions a level of nanoscale matter control that allows the production of almost any material or structure from a molecular level. While there is considerable disagreement over whether or not this vision is genuinely realizable, those who embrace it focus on fairly extreme, utopian, or dystopian consequences. A dispute is also brewing among those who are more concerned with immediate results. This is a battle between those who believe that nanotechnology's rapid expansion will have significant economic advantages and those who want to restrict or even stop it because of environmental concerns and social justice concerns. One pressing concern is whether existing regulatory frameworks are robust enough to deal with any unique properties that nanostructured materials may possess or whether new solutions are necessary [81].

2.5 Future Trends of Nanotechnology

Nanotechnology is becoming more common these days. With it comes the need for debates about possible advancements and the effects of technology on the environment and human health. Several organizations across the world have investigated the uses of nanomaterials as well as their environmental consequences [82]:

- Sustainable nanotechnology
- Environmental applications of nanotechnology
- Agriculture applications
- Toxicity of nanomaterials
- The fate of pollutants in the environment
- Analytical methods aiming at environmental applications

3. LITERATURE REVIEW

P. K. Paul and J. L. Dey [83] illustrated this paper's IT technique, Big Data, with a new channel. The fundamentals of Nanotechnology, as well as its applications in computers and information technology. Cloud computing and Big Data Management and their contemporary applications in Nanotechnology have been characterized. Aspects of concerns and problems were also included in the preparation of the study. Bottom-up nanotechnology, in particular, is beneficial in the computer business. Today, both computer scientists and nanoscientists are developing products and technologies that will improve computing and information technology services.

B. Navarrete et al. I. [27] The 3-nm CoFe2 O4 nanoparticles layer, constructed into a spinnaker, was sandwiched between the conventional spin-transfer torque magnetic tunneling junction (STT-MTJ) as a central layer. With an additional focused ion beam (FIB), One or more nanoparticles of two layers, separating two ferromagnetic layers of CoFeB, was converted into a two-end spintronic device using a more targeted FIB trim. Similar to one electron transport, a staircase effect was seen via the room-temperature electron transit through the device, which was further impacted by the relative orientation of the magnetic states of the

ferromagnetic layers and the high-anisotropy ferrimagnetic nanoparticles. In addition to staircase steps, the V-I curve indicated that the nanoparticles' magnetization was switched via the STT effect at currents over 0.05 au. This device's magnetoresistance (MR) curve showed an anomalous dependence on oscillating fields in a comparatively low field range of < 100oe, with the magnet field, applied perpendicular to the crossover.

R. C. Boekel et al. [84] used scientific abstracts to locate, select, and assess relevant nanotechnologies for solving industrial challenges. Engineering design methodologies are utilized to structure a technological innovation challenge in the manufacturing industry in a case study. Using SAO-parsing of the title and abstract, 1.2 million abstracts from nanotechnology-related journals are obtained from Web of Science and indexed. Precision and recall, a popular strategy in information retrieval, is used to assess the success of this unique technology.

M. Long et al. [85] recommended a VCMA-MTJ self-adaptive write circuit. Unlike a fixed-pulse write circuit, this circuit can sustain 10% fluctuations in the VCMA coefficient and the external magnetic field while conserving write energy. However, Monte Carlo simulations show that in 3 CMOS process differences, the suggested self-adaptive write circuit fails. This problem is solved using two practical ways. The first option is to turn off the external in-plane magnetic field simultaneously as the write pulse, while the second is to add a reverse pulse generator to the self-adaptive write circuit. The suggested write circuit will aid in the creation of VCMA-MTJ memory chips that are low-power and high-speed.

S. Baehr et al. [86] produced high data rates that must be sent to offline processing facilities for computationally expensive physics studies that cannot be done live. However, because the bandwidth is restricted, only a portion of the detector data may be saved. This challenge is solved by employing online data reduction algorithms and a trigger that determines when the entire data set should be readout. The online cluster analysis and the neural zVertex motivation are two of the experiment's intended methodologies. Both use neural networks and are implemented using FPGAs. To accomplish low latency processing, they're located near the detector readout.

S. Fonseca et al. [87] discussed a supplement to the classroom that may encourage children to seek jobs in science, technology, engineering, and mathematics (STEM). The ambition, knowledge, and resources for vocations in science and engineering are in shortfalls for students at middle and high schools. To promote the development of these young people by using nanotechnology as a catalyst, education is a crucial factor in achieving success. As part of this project, an educational video game was produced to inspire kids to work for STEM and bring them into nanotechnology. The planned video game uses various ways to provide knowledge on nanotechnology, including realistic depictions of nanotechnology and other nanoscale ideas, an exciting plot, and an interactive gaming experience to engage players in the lesson. The Constructivism and Mindset Learning Theories underpin all concepts and instructional practices.

J. B. Ibarra et al. [88], based on system capacity, needs to allow up to 100 mobile devices to connect wirelessly simultaneously. Because these kids were of considerably comparable academic status in their separate classrooms, the school picked two high school students to participate in the field testing of the web/android app. In their statistics lesson, the research group (n=7) utilized the web/android app, whereas the control group (n=10) used the usual classroom setup. This research intends to create a web and android application that combines a classroom response system and a learning management system without using the internet. On the same day, a technology-needs assessment (TNA) was given. A technology-needs assessment (TNA) was administered to 213 high school students, TNA was created using existing policies, programs, and initiatives, as well as long-term vision papers and climate change mitigation and adaptation plans. These development priorities are used in conjunction with climate mitigation and adaptation criteria to identify the most important (sub) sectors and to prioritize mitigation and adaptation technologies within these (sub)sectors.

J. C. G. Maghirang et al. [89] The q-gram counting filter, which uses FPGA's versatility and ability to work in paralegal applications, has been built by the Zed Board developing board. The results of the filters are addressed in the article with various sizes, some readings with varying durations, and various sequences. FPGAs are highly customizable processors intended to

handle computer-intensive tasks. However, in this study, the verification is responsible for validating these candidate locations, which need mathematical and theoretical methods. Due to the enormous quantities of Next Generation Sequencing (NGS) platform data, a filter is required to reduce specific computational difficulties created by the verification process.

P. K. D. Pramanik et al. [90], offered an introduction of nanotechnology, biosensors, nano biosensors, and the Internet of Things (IoT). Also included are multilevel taxonomies for nanotechnology, nanoparticles, biosensors, Nano biosensors, and Nano Zymes. With various instances, the possible medicinal and clinical uses of these technologies are examined in depth. This research focuses on IoNT and its application in healthcare. The communication architecture of the IoNT is described in addition to the overall design of the IoNT for healthcare. The primary goal of this research is to investigate the clinical and medical implications of these various nanotechnology implementations.

R. C. Salvador et al. [91] recommended a unique method for determining whether radio emission patterns acquired from a radio telescope are from a pulsar or not using machine learning and a genetic algorithm. The data came from the second survey of the High Time Resolution Universe (HTRU), and it comprises eight numerical characteristics and one target variable that describes the pulse profile. The dataset was subjected to the Synthetic Minority Oversampling Technique (SMOTE) to correct the imbalance between classes. The optimum feature preprocessing approach, feature selection/ reduction approach, machine learning model inside the scikit-learn library, and hyper parameter values were automatically selected using a genetic algorithm library.

O. Balghusoon and S. Mahfoudh [92] Provided a comprehensive review of several current routing protocols, which have been adapted to the characters and features of nano-communication, and insight on the WNSN and IoNT paradigms. Nanotechnology is a diverse field that facilitates our lives and makes our environmental impact less secure. Incorporating the Wireless Nano Sensor Networks (WNSN) to different objects, sensors, and devices would introduce a new network paradigm with recent developments, changes in networking and communication paradigms. This idea is named after the internet of Nano Things (IoNT).

M. Kalimoldayev et al. [93], clarified an encryption technique based on a residual class polynomial system. We investigate the implementation of FPGA bitstreams on the Xilinx and 16-nm Ultra ScaleTM ASIC architecture, which enables floating-point operations, multi-processing, parallelism, pipelining, and high-performance computing, among other things. The saved encryption key and encrypted bit stream, created by a Vivado tool, are used for software-based bit stream encryption and on-chip decoding. The use of the asymmetric key in self-authenticating algorithms is examined. The residual number polynomial system is used to build the encryption methods. ASICs are effective in implementing data encryption in a residual number scheme. It is suggested and explored how to design irreducible polynomials. The low-power FinFET FPGA design is crucial in our research and discoveries.

Y. Maglinets et al. [94] studied components of interaction such as task definition, task interpretation in the system's internal representation, task resolution, and presenting resolution findings to the Task Manager. The challenge of task solving, which is defined as the ability of the system to dynamically create schemes for accomplishing the task in dialogue with the Task Manager using a formal language of interaction, is given particular emphasis. A generic task-setting methodology is offered. When tackling monitoring difficulties in the framework of an object-oriented approach, the challenge of end-user contact with the system of remote aeronautical monitoring of the Earth's surface.

T. F. Revano and M. B. Garcia [95] confirmed the use of the Design Thinking Curriculum in school to encourage computer innovation. The influence of the Design Thinking Curriculum on the skills and capacities of future computer professionals was investigated at Higher Education Institutions, notably in Information Technology and Computer Science degrees. Computing students were given a self-assessment scale with 31 measuring items separated into seven aspects to do this. Businesses frequently employ Design Thinking as a mindset and approach to problem-solving, learning, and collaboration.

R. Gabbasov and R. Paringer [96] studied how the size of the receptive field affects CNN's training time, accuracy, and performance. On the CALTECH256 dataset, we undertake experiments using the MakiFlow framework. We

discovered that shrinking the network's receptive field to match the size of the input picture (i.e., removing the "redundant" receptive field) does not affect the network's accuracy. Simultaneously, the number of training parameters is reduced, resulting in a reduction in network training time.

4. COMPARISON AND DISCUSSION

Table 1 lists the number of papers that were utilized to describe the research and identify developing trends. It goes into the methods employed, the approaches chosen, and the flaws found. [83] provided several chances and avenues for the development of a more practical and advanced cloud computing practice. Virtualization, whether hardware, software, or applications, may all benefit from the application of Nanotechnology. Big data is another technology that may be used in a variety of areas and industries. Education, Medical, Healthcare, and Business are some of the fields in which you can work. As a result, incorporating Nanotechnology into computing may help with enormous data and massive data solutions. For increasingly advanced display systems, the nanotube might be a fantastic and significant instrument.

Nanotechnology items for the computing sector are expected to appear in smaller gadgets such as iPod Nanos, hyper-sensitive hearing aids, smart cards, flexible displays, and so on. Nanotechnology has always played a key role in developing new display systems, processors, and other electronic devices [27]. Compared to the antiparallel instance, it pushed the seated electron away from the nanoparticle and towards the other magnetic layer (receiving the electron). In other words, the CB would be more effective, making it simpler to notice the parallel spin orientation's unique staircase dependency. This might explain why only one sweep direction of the staircase is visible. The spin-polarized current eventually gains enough energy to reverse the nanoparticles' magnetization via the STT effect when the electric current is raised to above roughly 0.05 au. [84] proven that the SAO technique is a useful tool for the firm's innovation and design. Knowledge loss due to SAO-parsing and the phenomenon of information stickiness are two significant difficulties discussed in this article. Precision and recall, a popular strategy in information retrieval, is used to assess the success of this unique technology. Structured interviews with two engineering managers are

used to analyze the process further. [85] suggested a VCMA-MTJ model that was both small and SPICE compatible. Then, a self-adaptive write circuit is described, with the writing process being resistant to changes in the VCMA coefficient and the external in-plane magnetic field. Finally, two practical ways for making the proposed self-adaptive write circuit more resilient to 3 CMOS process differences are presented. [86] achieve low latency processing. The processor should be situated close to the detector readout. This paper outlines these techniques. Demonstrating the experiment's specific needs, current implementation methods, and the unique potential of employing neural networks for the intended applications. The online cluster analysis and the neural zVertex trigger are two of the intended methodologies in the investigation. Both are neural network-based and run on FPGAs. [87] provides information on nanotechnology using a variety of methods, including realistic depictions of nanotechnology and other nanoscale ideas, an interesting plot, and an interactive game experience to engage players in the lesson. The Constructivism and Mindset Learning Theories underpin all concepts and instructional practices. From the interactive menu to the platformer stages, the video game allows kids to have fun while studying. This instructional video game is intended to raise the number of pupils interested in STEM-related occupations dramatically [88]. The system setup was based on the system capacity requirements to enable simultaneous wireless connectivity of up to 100 mobile devices. Because these kids were of considerably comparable academic status in their separate classrooms, the school picked two high school students to participate in the field testing of the web/android app. In their statistics lesson, the research group (n=7) utilized the web/android app, whereas the control group (n=10) used the usual classroom setup. The field testing lasted two weeks and included a variety of teaching and learning activities, as well as assessments [89]. When compared to a C implementation, there are 34.02 percent less clock cycles with a q-gram length of 4 and 53.58 percent less clock cycles with a q-gram length of 8. Read mapping is the act of screening and verifying DNA readings against a reference genome using a predetermined measure. When a DNA read is compared to the reference genome, filtering is done by swiftly deleting erroneous areas. On the other side, verification is in charge of confirming these candidate regions, which necessitates mathematical and theoretical methodologies. A filter is required to decrease

different computational problems caused by the verification process due to the vast volumes of data produced by Next Generation Sequencing (NGS) platforms. [90] highlighted the obstacles to the effective implementation of IoNT, with a focus on the internet of bio-Nano things (IoBNT) and its potential to make IoNT more compatible with the human body. The healthcare industry is likely to profit the most from nanotechnology applications. Nanotechnology, in the forms of nanomedicine, Nano implants, Nano biosensors, and the internet of Nano things (IoNT), has the potential to revolutionize medicine and healthcare services [91]. The optimum feature preprocessing approach, feature selection/ reduction approach, machine learning model inside the scikit-learn library, and hyper parameter values were automatically selected using a genetic algorithm library. For different sets of features, the genetic algorithm recommended using a single stack and multiple stack classifiers. The same algorithm was used to determine the optimum level of hyper parameters. In all of the evaluation metrics used, the chosen pipelines consistently reported a score of more than 99 percent. [92] accommodate the features of nanoscale communication while ensuring data and information transfer This research intends to provide insight into the WNSN and IoNT paradigms, as well as a detailed assessment of a large variety of current routing protocols that have been tailored to the characteristics and features of Nano communication. Knowing about the primary hardware components that make up a Nano device is necessary for designing an effective routing protocol when working on the Nano device specification. It also involves study into network design, TB wireless communication,

and the energy supply system under consideration to meet the application's goal. [93] devised and implemented a block encryption technique based on residual class Nono positional polynomial systems. In a Nono positional polynomial number system, algorithmic, software, and FPGA hardware solutions may be used to compute polynomial parameters, execute GF(2) arithmetic operations, and evaluate encryption and decryption techniques. The 16-nm Ultra ScaleTM ASIC design is used to verify the created functionality. The symmetric data encryption technique is efficient, and it ensures data security and integrity [94]. Creating strategies for the system's capacity to dynamically accomplish the task in dialogue with the Task Manager based on the formal language of interaction was given special attention. A generic task setting methodology is described. It is also regarded as the job setting of measuring the surface temperature of the pointed out item - an agricultural field - using satellite data in the thermal range [95]. Computing students were given a set of 31 measuring objects separated into seven dimensions. The findings show that computer students who participate in a Design Thinking Curriculum do much better on all scales than those who do not. As a result, this research supports the use of Design Thinking Curriculum in education as a strategy for fostering creativity in the computer area. [96] indicate that lowering the size of the receptive field in neural networks (NNs) can cut training time by 5-7 percent while preserving network accuracy. As a result, we may regard the receptive-field-reducing approach described as an optimizing technique. Future study will focus on formalizing and developing this optimization approach.

Table 2. Critical analysis of existing studies

#	Ref.	The Algorithm	Model and Tools	Significant Results
1.	[83]	Cloud Computing, Big Data Applications in a general sense with their features and characteristics.	For smaller and smarter display units, electronic-producing carbon nanotubes can be replaced with cathode ray tubes (CRTs); this is a prime example of Nanotechnology applications. The integrated display system of the scanning probe microscope aids in the development of better and healthier nanotubes. Computing equipment, particularly chips, is a	Find out how Nanotechnology interacts with Cloud Computing and Big Data Management.

#	Ref.	The Algorithm	Model and Tools	Significant Results
			developing field. Quick and effective data handling, in particular, is a critical duty.	
			MRAM or Magnetic Random-Access Memory is a valuable name.	
2.	[27]	build spin-transfer torque (STT) dual magnetic tunneling junction (MTJ)	A two-terminal spintronic device was created using a dual-layer corner with one or more nanoparticles separating two CoFeB ferromagnetic layers.	A TEM view of a device cross-section exhibiting the nanoparticle-sandwiched multilayer structure.
			devices with essential constituents on the order of 2 nm and then evaluate their magneto trans port properties at ambient temperature	
3.	[84]	a methodology is designed which integrates engineering design and subject-action-object (SAO) text mining	In the manufacturing industry, engineering design methodologies are utilized to organize a technological innovation challenge.	Demonstrate that the SAO technique is a valuable tool for the firm's innovation and design. Knowledge loss due to SAO-parsing and the phenomenon of information stickiness are two significant difficulties discussed in this article.
4.	. [85]	VCMA-MTJ model	voltage-controlled magnetic anisotropy (VCMA), magnetic tunneling junction (MTJ)	This paper proposes a VCMA-MTJ model that is both small and SPICE compatible. Then, a self-adaptive write circuit is described, with the writing process being resistant to changes in the VCMA coefficient and the external in-plane magnetic field. Finally, Monte Carlo simulations show that two realistic strategies for making our proposed self-adaptive write circuit resilient to 3 CMOS process changes are suggested.
			A self-adaptive write circuit is suggested, which is resistant to changes in the VCMA coefficient and the external in-plane magnetic field. Finally, Monte Carlo simulations show that our proposed self-adaptive write circuit is similarly resilient to 3 CMOS process changes using two practical ways. The suggested self-adaptive write rotation can help designers create next-generation high-speed, low-power MeRAM devices.	
5.	[86]	based on neural networks and are executed on FPGAs	the online cluster analysis and the neural zVertex trigger.	The studies described are the first implementations in the field of high-energy physics. Other groups are looking at using neural networks in experiments like the LHC right now.
			Opted to employ both to make use of the benefits of both and to distribute resource usage over all of the FPGA's available resources. DSPs are used in the computationally intensive hidden layer, which has 81 neurons, whereas	

#	Ref.	The Algorithm	Model and Tools	Significant Results
			LUTs are used in the output layer. To take advantage of the DSPs' speed advantage, we picked a higher clock frequency for them, 254 MHz, double the frequency of the remaining portions of the design, which is 127 MHz. We employed asynchronous buffers to adjust for the differing clock domains.	
6.	[87]	the Constructivism and Mindset Learning Theories	This Research-to-Practice Category Work in Progress Paper discusses a supplemental learning tool to encourage students to pursue science, Technology, Engineering, and mathematics jobs. Students in middle and high schools lack the desire, knowledge, and resources to pursue professions in science and engineering. Given the importance of education in achieving success, a program was created to encourage these youngsters to pursue STEM jobs.	This instructional video game is projected to improve the number of kids interested in STEM-related vocations significantly.
7.	[88]	technology-needs assessment (TNA)	Principal component analysis was used to examine the TNA data (PCA). The PCA findings were used to set up a wireless local area network of devices connected to a central server through a wireless router devoted to deploying web and android applications intended to meet the study's demands. A test-driven development (TDD) technique was used to create the web and android applications.	The exam results were submitted to a two-sample F-test and t-test Analysis of Variance. The results demonstrate that a p-value of 0.0026 was achieved at the 5% significance level, indicating that the means of the summative test outcomes data sets are substantially different. The study group's performance differs significantly.
8.	[89]	DNA sequence alignment; Qgram counting filter, FPGA	The ZedBoard platform is used to construct a q-gram counting filter in FPGA. The Zed was utilized to execute the FPGA-based implementation. Zynq Evaluation and Development Kit using a Zynq-7000 Family of FPGA part number xc7z020clg484 running at 100MHz and Cortex-A9 Processing System at 667MHz and 500MB DDR3 was running at 533MHz.	Able to confirm that the FPGA system is appropriately programmed with the correct logic and capable of parallel execution. According to the findings, most of the filtering time is spent on the PS side, especially accessing the System's DDR memory.

#	Ref.	The Algorithm	Model and Tools	Significant Results
9.	[90]	IoNT Scheme	The IoNT goal might be fulfilled by putting nano-communication capabilities into nanodevices and enabling them to smoothly interface with current micro-and macro-devices and solve several other technological challenges.	The use of IoNT will be expanded through information exchange and cooperation between nanodevices and internet devices. Nanotechnology-based systems will substantially positively influence several elements of our everyday lives and society as they improve and become more widely used.
10.	[91]	Genetic algorithm	The optimum feature preprocessing approach, feature selection/reduction approach, machine learning model inside the scikit-learn library, and hyper parameter values were automatically selected using the genetic algorithm library.	The approach was used to determine the optimal level of hyperparameters. In all of the assessment parameters employed, the selected pipelines consistently returned a higher than 99 percent score.
11.	[92]	the Internet of Nano Things (IoNT) – wireless nanosensor network	Because of the distinct nanoscale restrictions, a routing protocol is essential in WNSN and IoNT. This routing strategy must fit the features of nanoscale communication while ensuring data and information delivery.	provides an overview of the WNSN and IoNT paradigms, as well as a complete examination of a large number of current routing protocols that have been modified to the characteristics and features of nano communication
12.	[93]	block encryption algorithm based on nonpositional polynomial systems of residual classes	In HDL Verilog, the created polynomial multiplier is explained. The 16-nm UltraScaleTM ASIC design is used to verify the developed functionality.	Using a multiplier to accomplish encryption in an NPSRC cryptosystem The pre-calculated parameters are sent to the multiplier using the Microblaze microprocessor core, which XILINX FPGA implements. Obtaining NPSRC parameters
13.	[94]	build schemes for solving the task in dialogue with the Task Manager based on the formal language of interaction	to solve monitoring issues using an object-oriented approach. Setting the job, interpreting the study in the system's internal representation, completing the task, and presenting the resolution findings to the Task Manager are all parts of interaction that are taken into consideration.	Using satellite data in the thermal range to measure the surface temperature of the pointed out item - an agricultural field - is also taken into account.
14.	[95]	Design Thinking Curriculum was explored in Higher	Computing students were given a set of 31 measuring objects separated into seven dimensions.	Validates the use of the Design Thinking Curriculum in school as a method of encouraging computer innovation.

#	Ref.	The Algorithm	Model and Tools	Significant Results
		Education Institutions		
15.	[96]	neural networks	The use of convolutional neural networks (CNNs) to digit and object recognition has proved effective. VGG16 and ResNet18 models of CNN	The findings of the studies reveal that lowering the size of the receptive field in neural networks (NNs) allows for a 5-7 percent reduction in training time while retaining the network's accuracy.

5. CONCLUSION

The amount of data accessible limits how much research and decision-making can be done. This study investigates and visualizes a variety of nanotechnology applications in great depth. The purpose of this work was to demonstrate how this practical research approach may be used for information suggestion services [64]. They used nanotechnology as a catalyst, which is a fast growing and developing field. From the literature review, it can be concluded that ref [64] created an instructional video game as part of this study to encourage students to pursue STEM jobs and to introduce them to the realm of nanotechnology, an educational video game was produced to inspire kids to work for STEM and bring them into nanotechnology and had fun while studying [88]. As more educational institutions strive to improve the quality of education, technology's effect on the growth of modern education develops considerably. This research aims to create a web and Android application that combines a classroom response system and a learning management system without the usage of the internet. Two hundred thirteen high school pupils were given a technology needs assessment (TNA). The TNA survey had 16 closed-ended questions, 15 of which needed Likert scale replies and one needed a yes/no response. Principal component analysis was used to evaluate the TNA data [90]. Create an appropriate data and information reservoir and pathways to transport that data around the network. It is necessary to create efficient information and routing strategies. Another difficulty is integrating IoNT with existing healthcare systems and other associated IoT applications in a diverse networking environment and data domains. If these obstacles can be solved, healthcare will achieve a new level of prevention, protection, and accessibility. Many illnesses might be detected in their early stages and identified in advance. Medicines will be given to the body in correct doses as and when is needed. Because the pharmaceuticals now target the appropriate body area, side effects from medications may be avoided. If health monitoring and illness curing could be summarized in a single line, it would be a straightforward process, and pricey healthcare could be delivered to anybody, everywhere, without regard to doctor and medicine availability. It is now more important than ever to create a genuinely permanent computer environment that can better serve humankind. Even so, [95] The influence of the Design Thinking Curriculum on the skills and capacities of future computer professionals was investigated at Higher Education Institutions, with a focus on Information Technology and Computer Science degrees. To accomplish so, computing students were given a self-assessment scale with 31 measuring items separated into seven aspects.

The IoNT has quickly become a huge part of how people live, communicate and do business. All around the world, web-enabled devices are turning our world into a more switched-on place to live. Still, there are many challenges faced IoNT such as: Security, Regulation, Compatibility, Bandwidth, and Customer expectations.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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