A New Paradigm for Healthcare System Using Emerging Technologies

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Abstract. There are many diseases threatening humans around the globe. Many of them are from the past centuries, and a few are newly discovered. This study has mainly focused on trending technologies such as Artificial Intelligence, Machine Learning, Big Data, Internet of Things that are used to predict diseases in the health sector. This study has collected data from the previously published articles from the reputed publishers using a systematic review approach, and these data were analyzed separately for each technology mentioned above. Studies confirmed that most of the research focused on IoT in the health sector. Furthermore, all the above technologies provide higher accuracy in predicting diseases. But, IoT provides higher accuracy than other emerging technologies for predicting most diseases. A few constraints of the study were the size of the dataset and missing quality qualities. In the end, it is recommended to study the security issues in IoT in the healthcare sector to predict and diagnose diseases.

Keywords: Big Data · Internet of Things · Artificial Intelligence · Machine Learning

1 Introduction

Diversified issues have evolved as the population of today's societies continues to grow. Education, jobs, healthcare, economics, and management are just a few topics brought up. Healthcare is one of the most critical areas in development [1]. Healthcare services have improved in the last decade compared to the previous decade. Healthcare has changed dramatically in recent years due to new and evolving technology. Physicians and health offices of all types have used new technologies to reply to ever-changing regulative surroundings and enhance the general quality of service for patients. Nowadays, Medical centers are high-tech operations with modern-day era inside the palms of quite skilled personnel. On the other hand, hospitals and healthcare facilities nevertheless have a variety of areas to enhance their deployment and utilization of the latest technologies.

Technology has changed the world's landscape and moved us closer to a technologically advanced world. The rapid advancement of knowledge and communication reigns supreme in every corner of the globe. ICT innovations have created an incredible platform for handling healthcare problems [2]. The Internet of Things (IoT) [3], cloud

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computing [4], mobile services, and Machine Learning (ML) [5], and Big Data [6], Artificial Intelligence (AI) [7], and wireless communications, have all had a substantial impact on the healthcare industry. Healthcare attempts to provide healthcare services regardless of locations and times. It is designed to provide offerings to sufferers at any time and from any place, allowing them to move around quickly. Sufferers with diabetes, arthritis, lupus and heart disease may receive care remotely through networked healthcare.

The current scenario resembles a data flood in some ways. Efficiency advancements have benefited us in generating a rising volume of data, which is presently unmanageable with existing technologies. As a result, the phrase "big data" was invented to describe massive and unmanageable data. ML, AI, and other technologies contribute to the refining of data processing capabilities in the healthcare industry. The employed technology assists in support of healthcare applications and the analysis of activities. This study presents to identify the maximum related aspects that have lately been involved in the healthcare area. This research also focuses on how technology-related services benefit the health industry in many ways. Finally, this study adds to scientific knowledge by showing the potential for innovation in this field of study.

2 Emerging Technologies Used in the Healthcare Sector

Information Communication Technologies (ICT) has resulted in the improvement of recent re assets of information in healthcare [8]. Key center regions incorporate the utilization of AI, Enormous Information and IoT [9], ML, Big Data in the significance of numerical displaying for expectations, use of innovation for local area concealing, and nanotechnology for treatment and immunization advancement.

2.1 Big Data

Big data can have collected from different sources. Unfortunately, data can't be controlled through a guide or conventional methods. Mainly, big data is used to gather massive datasets. Also, used to store and manage data analysis. Medical aid, live patient monitoring anticipating the evolution of diseases, and improving the remedy methods are analyzed by Big Data. Data masking help to the confidentiality of data encrypting. The Healthcare model includes four layers. Heterogonous Layer offers facts source layer, data storage layer deals with storage optimization, security privacy features are included in records protection, and privacy layer and ML base security coating layer take care of different tasks. The early prediction of disease helps patients get treatment at the beginning stage. Big data is the cause of examining a tremendous volume of data structures such as data mining and AI [10]. With significant data development in biomedical and medical services networks, a detailed examination of clinical data helps early illness recognition, patient consideration, and local area administrations [11].

IoT has gradually developed diverse advancements. It is essential in global communication between many devices with wired/remote sensors, electronic apparatuses such as TVs, refrigerators, and other equipment connected to the Internet [12]. Hadoop utilizes two principal parts, MapReduce and Hadoop Circulated Record Framework [13].

Compared to big data in other sectors, medical data has its own set of characteristics [14].

2.2 Internet of Things

IoT sensor data are created by various factors such as data layouts, communication protocols, and devices in particular, which are all diverse. These measure of information isn't coordinated and investigated manually [15]. IoT is rapidly growing attention, including personalized healthcare. In the IoT framework, Body Area Sensor Network (BASN) is used for health monitoring, such as a wearable IoT-based health monitoring system that is cloud-based. The body temperature, blood pressure, and heartbeat sensors are all used in these wearable sensors [16]. Mainly, Blockchain Technology gives a smart of protection of user's personal information [17]. IoT devices are used for chronic care; implantable medical devices are Insulin pumps, pacemakers, and Temperature measures. Moreover, data created by these devices are saved on the cloud [18]. Cloud computing has been widely supporting IoT-enabled healthcare solutions. A Cloud-Fog reference architecture administration was joined and coordinating viewpoint of inoperable IoT arrangements [19]. On the other hand, methods and systems for steganography coding algorithms are accustomed conceal digital info in an exceeding picture [20].

IoMT (Internet of Medical Things) targets circulating the Deep Learning responsibility in between nodes of cloud and fog, frequently consigning the layout model preparing to the cloud computing and pushing decision-making to the edge [21]. IoT is the organization of actual articles or things inserted devices, programming, sensors, and organization availability; this allows these things to gather and altercation data. This method uses a collection of physical devices and other products with electronics, software, sensors, and network connectivity that collect and share data [22]. IoT ascends as a fantastic space where implanted devices and sensors, and computers may communicate and exchange data over the Internet. Because the importance of IoT devices and information might be fundamental, security restrictions are required to safeguard IoT data from intruders; confirmation is one of the most important and influential ways to ensure data protection and security [23]. IoT is defined by collecting and exchanging critical information from organization-related devices over a secure help layer [24].

Nowadays, IoT and cloud stages have become broadly utilized in different medical care applications. Moreover, an online clinical choice emotionally supportive network (OMDSS) is presented for constant kidney sickness (CKD) forecast [25]. However, traditional healthcare support systems cannot forecast specific patient health information and needs, reducing the precision of patient assistance. An IoT sensor with AI is used to forecast specific patient characteristics to address these challenges, allowing the proper support method to be selected. A mobile healthcare application was developed to achieve this purpose and collect patient information [26]. Energy Productive Molecule Multitude Enhancement (PSO) centered Grouping (EEPSOC) procedure for the viable choice of bunch heads (CHs) among different IoT gadgets. IoT gadgets used for detecting medical services information are gathered into bunches, and a CH will be chosen by the utilization of EEPSOC [27].

The utilization of AI has reformed at almost every level; there are H-IoT frameworks. Moreover, Product Characterized Organizations carry adaptability toward framework,

whereas the blockchains [28] observe the maximum original use cases in H-IoT. The Internet of Nano Things (IoNT) and Tackle Internet are pouring the advancement in H-IoT applications. At long last, in light of the assessed contemplates, power the executives, trust and security, mist figuring, and asset the board as driving open issues; material Web, informal communities, extensive information investigation, SDN/NFV, IoNT, and Blockchain as significant future patterns; and interoperability, actually tested execution, versatility, and portability as difficulties are worth considering and exploring in HIoT frameworks [28]. The sensors are utilized to analyze the colorectal malignant growth in apt sensors. Using the precise development of ligands (SELEX) technique, aptamers will be disconnected after arbitrarily combined Ribonucleic Acid or Deoxyribonucleic Acid pools and made [29]. IoT imagines a future wherein anything/anybody/any assistance can be connected through accurate data and correspondence advances, acquiring innovative revolution in domestics, intelligent homes, healthcare frameworks, great observing, and coordination [30]. For the IoT associated medical services applications, the remote body region organization (WBAN) is acquiring prevalence as wearable gadgets spring into the market [31]. Specifically, few imaginative types of medical care frameworks with BSN have been presented, based on the contactless nature and effectiveness of the information recovery of smart mobile items [32].

2.3 Machine Learning

Smart unavoidable sensor networks are becoming a significant piece of our regular routines [33]. ML is used to appraise the danger of non-infectious illness wellbeing results. One more typical way to deal with illness forecast and reconnaissance is the utilization of ML and data mining, along with information from online web-based social media organizations and web search tools [34]. In ML Hybrid Random Forest with Linear Model uses various clinical records for prediction to find out the specific status of the patient in connection to heart disease [35]. The following types of ML are Reinforcement, Supervised, Unsupervised, and Semi-supervised, which are the four types of learning [36].

Various ML calculations are reasonable for diverse size and information and have limited [37]. Cloud computing Climate acquired a significant job in Health Care Service (HCS) because of its capacity to work on the HCS Execution. HCS was dependent on cloud climate utilizing Parallel Particle Swarm Optimization to advance the VMs determination. Moreover, another model for CKD determination and expectation [38]. Both ANN and SVM strategies can be utilized as a separate classifiers. Yet, SVM maps the component dispersion of preparing information to the highlight space of higher aspects, making the preparation information in the high-dimensional element space present a straight appropriation, while the yield of the SVM is one or zero [39].

2.4 Artificial Intelligence

AI devices help diabetes patients to manage and personalize their current situations [40]. Furthermore, the Information Investigation Coordinating with Cycle is utilized to allow this information to exact regions, for example, assessing the standard and speed

information for neuronal volume organization demonstrating just such as arrangement also, order [41].

IoT is filling in as an impetus to upgrade the force of simulated intelligence applications in medical services. The fundamental point of the work is to propose an AI-based medical services model to anticipate various illnesses ahead of schedule. In this work, seven AI arrangement calculations, for example, choice tree, support vector machine, Guileless Bayes, versatile helping, Random Forest, counterfeit neural organization, and K-closest neighbor, are utilized to anticipate the nine lethal sicknesses like coronary illness, people with diabetes bosom disease, hepatitis, liver problem, dermatology, medical procedure information [42].

3 Methodology

This article has been done using a qualitative approach called systematic review from the previous published research and articles within the last 5 five years. The collected data were analyzed using a qualitative method to explore applications, positive and negative sides of selected technologies in medicine. The required information was gathered mainly from the following technologies: IoT, AI, Big data, and ML.

3.1 Criteria for Article Selection

The following significant factors have been considered for shortlisting the downloaded articles selected from reputed publishers such as IEEE, Springer, Emerald, Inderscience, and Sage. Similarly, terminologies such as IoT, ML, Big data, AI, healthcare, prediction, and diagnosis with Boolean operators AND and OR were used to search the research articles. In addition, Fig. 1 depicts the systematic process literature review categorization diagram.

- Only full-length papers are accepted.
- Articles in citation databases with a high index. Open access articles
- Published after 2015
- Emerging technologies (IoT, Big data, ML, AI) in Health sectors
- Published in the English language

3.2 Research Questions

The below table shows the study questions development for the article.

Finalizing to summarize the required data for analyzing purpose for this study. Therefore, these articles have been shortlisted according to above Fig. 1 and Sect. 3.1 (Table 1).

According to the above procedures, major discussed topics of Big data, AI, ML, and IoT were concluded based on the research questions above.

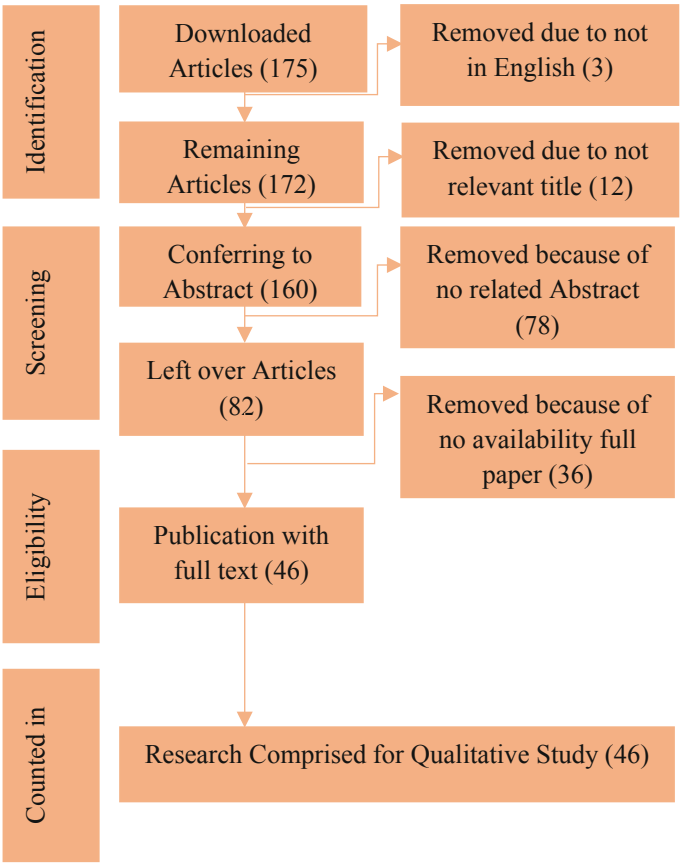

Fig. 1. Classifications of research papers

Table 1. Develop research questions

S. no.	RQ	Motivation
1	How are emerging technologies Influencing the healthcare sector?	Identifying the positive and negative consequences of Big data, AI, ML, and IoT in the medical sector
2	Which emerging technology assist in Predicting and Diagnosing diseases?	Identifying suitable emerging technology for predicting and diagnosing particular diseases
3	What are the significant challenges in using emerging technologies for health sector application?	Find the research gap and develop a strong recommendation for future research to reduce those challenges

4 Results and Discussion

Big Data, ML, AI, and IoT emerging technologies are used in the healthcare sector from various perspectives. According to the following table, the deep analysis shows the technologies, the proposed or recommended technologies, diseases, and their accuracy rate. However, some of the research doesn't contain accuracy. Firstly, about [43], Big Data is the primary technology used for healthcare. Also, ML is used in the fourth Layer to enhance the results (Table 2).

Table 2. Reviewed paper table

Suggested technology	Used special features (proposed/recommended techniques)	Disease	Accuracy
IoT	Bluetooth Low Energy (BLE) module [8]. Healthcare IoT, SDN, IoNT [13]. BASN, WISE (Wearable IoT-cloud-based health monitoring system). WISE adopts the BASN framework [16]. Cloud-Fog [19]. WBAN, SDN, and Network Function Virtualization (NFV) [17]. 2D Discrete Wavelet Transform 1 Level (2D-DWT-1L), 2D Discrete Wavelet Transform 2 Level (2D-DWT-2L), steganography and hybrid blending Advanced Encryption Standard (AES) and Rivest, Shamir, and Adleman (RSA) cryptographic techniques [20]. ECC algorithm over the CoAP protocol [23]. INTEL GALILEO 2ND generation development board [24]. OMDSS, CKD, logistic regression (LR) [23]. PSO-based Clustering EEPSOC, cluster heads (CHs), and ANN [27]. BSN, Fuzzy Random Forest (FRF) [42] Reasoning base Intelligence Control (GARIC) and Genome-wide association study (GWAS) [29]. Cloud-IoT (e-prescribing system, Electronic Health Records, Personal Health Records, Clinical Disease Systems and Pharmacy healthcare Framework) [30]. WBAN, Solar energy harvesting wearable sensor node and BLE and maximum power point tracking (MPPT) [31]. BSN [32]	Cardiovascular, neurological, and glucose disorders [8]. Generally all diseases [13]. Diabetes, cardiovascular disease, obesity, and so on [16]. All Diseases[17, 19, 20, 27, 29, 30, 32, 42]. To Support Intensive Care Unit [24]. Kidney Diseases [23]. Temperature, heartbeat & accelerometer [31]	97.7% [23]. sensitivity 96.094%, specificity 93.492%, accuracy 94.066% and F-score value of 94.066% [27]. 93.57% [42] 96.33% [29]

(*continued*)

Table 2. (*continued*)

Suggested technology	Used special features (proposed/recommended techniques)	Disease	Accuracy
Big Data and ML	Four layers healthcare model [43]	Disease diagnosis [43]	–
ML	Convolutional neural network based multimodal disease risk prediction [11]. Regression, KNN, Decision Tree, Random Forest and Bagging [35]	Chronic diseases [11]. Mental Stress [35]	94.8% [11]. 75.13% [35]
IoT and AI	H-IoT [40]. IoMT [21] Iterative Golden Section Optimized Deep Belief Neural Network (IGDBN) and MATLAB tool [26]	All diseases [21, 26, 40]	Precision 99.87% simple matching coefficient 99.71% Matthews correlation coefficient 99.10% and accuracy 99.86% [26]

As for the ML reference [11] and [35] are used in their papers. But proposed techniques differ from one to another. The reference [11] includes the CNN-MDRP algorithm for chronic diseases, and the accuracy is 94.8%. And the reference [35] pointed to Regression, KNN, Decision Tree, Random Forest, and Bagging for mental stress. Finally, the accuracy is 75.13%. When comparing these two methods, the reference gives high accuracy [11]. AI reference [40] is used AI combined with IoT. They used H-IoT as a technique for all diseases. At the same time, reference [21] used AI and IoT. But their technique is a little different. They used IoMT for all diseases. When it comes to reference [26], they also indicate AI and IoT as main Technologies for all diseases, especially for patient assistance. They mentioned almost 99% of accuracy.

In reference [8, 13, 16, 17, 19, 20, 23, 24, 27, 29–31, 42] and [32] are used IoT as the main technology for their studies. They used different technologies as well. Reference [8] mentioned a wireless implanted sensor prototype for chronic illnesses that includes a power management circuit, a temperature sensor, and a BLE component for subcutaneous solar energy harvesting. Reference [13] includes Healthcare IoT, Software SDN, IoNT for all diseases. Reference [16] includes BASN WISE. To offer real-time health monitoring for diabetes, cardiovascular disease, obesity, and other conditions, WISE uses the BASN architecture. Reference [17] proposed WBAN, SDN, and NFV, reference [19] includes Cloud-Fog, [20] indicates 2D-DWT-1L, 2D-DWT-2L, steganography, and hybrid blending AES and Rivest, RSA cryptographic techniques, includes ECC algorithm over the CoAP protocol with the accuracy of 97.7%, [23] recommended

ECC algorithm over the CoAP protocol, [24] refer INTEL GALILEO 2ND generation development board, [27] authenticate PSO, EEPSOC, CHs, and ANN. It includes approximately 94% of accuracy, [42] indicates BSN, FRF with the accuracy of 93.57%, [29] includes HER [44], GARIC and GWAS with 96.33% accuracy, [30] refer Cloud-IoT, [31] proposed WBAN, wearable sensor node with solar energy harvesting and BLE and MPPT and [32] includes BSN. Every papers includes all diseases excludes reference [20, 24] and [31].

Moreover, according to the table, we can recommend IoT Technology as the best among other technologies. Also, PSO-based Clustering EEPSOC, CHs, and ANN techniques are the best options for the Healthcare system according to the high accuracy.

5 Conclusions

There are various types of diseases and many new diseases scaring the human species around the globe. Also, emerging technologies assist in predicting and diagnosing these diseases. Therefore, this study has examined how emerging technologies help in the health sector, challenges in those technologies, and future direction using qualitative data analyzing techniques called the systematic review approach.

Our study found that AI, ML, Big Data, and IoT are used to predict diseases. According to the review papers, Big Data is used with emerging technologies such as ML and IoT. ML was used in two papers among twenty-one papers. The ML technology used a convolutional neural network based on the CNN-MDRP algorithm and Regression, KNN, Decision Tree, Random Forest, and Bagging techniques. As per AI, the H-IoT, Internet, IGDBN, and MATLAB tool predict disease. Finally, the IoT includes a large number of techniques. They used a wireless implantable sensor, BLE module, HIoT, SDN, IoNT, BASN, WISE, WBAN, SDN and NFV, Cloud-Fog, 2D-DWT-1L, 2D-DWT-2L, steganography, and hybrid blending AES and Rivest, RSA cryptographic techniques, ECC algorithm over the CoAP protocol, INTEL GALILEO 2ND generation development board, OMDSS, CKD, LR, PSO based Clustering EEPSOC, CHs and ANN, BSN, FRF, GARIC and GWAS, Cloud-IoT, WBAN, wearable sensor node with solar energy harvesting and BLE and MPPT. Moreover, IoT technology with PSO-based Clustering EEPSOC, CHs, and ANN techniques are most efficient and accurate, among other techniques. They provide approximately 94.4295% accuracy to predict all diseases. However, the heterogeneous and complex nature of Industrial (includes healthcare sector) IoT systems have overcome many technical challenges, such as security and reliability, resource management, interoperability, heterogeneity, scalability, and data protection [45].

A few constraints of this review are the size of the dataset and missing quality qualities. Significantly, most of the review papers don't contain the accuracy percentage. Nevertheless, in the end, we are recommending the IoT technology with 99% highest accuracy techniques.

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