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## Abstract

Internet of Things and Machine Learning Implementation in the Healthcare SectorModern health monitoring is crucial. Today's busy lifestyles lead to early health issues. Many issues occur from daily routines. Despite their ignorance of the risks, people enjoy many hobbies. Thus, identifying daily activities that affect health and predicting future diseases is crucial. However, electronic health data can forecast diseases like diabetes, TB, and others.Machine learning is used to predict a person's overall health. A complete health examination includes sleep quality, food, physical activity, and other elements. Also, the internet of things (IoT) is crucial in monitoring health and giving information when abnormalities occur. This paper focuses on the importance of monitoring health, and the role of the internet of things and machine learning in accomplishing this. And, providing the usage percentages of IoT applications in the healthcare sector from different countries.

***Index terms—***

## 1 I. INTRODUCTION

Digital Technology helps society in achieving global health prospects. Sustainable Development 2030 highlights ICT growth and its worldwide influence, since interconnectedness can accelerate human progress. Strategies and actions are needed to close the digital divide and create knowledge societies. Technology has improved government services, and made them more accessible to more people, especially in healthcare, because services and data that were unavailable previously, are now affordable.

Ministers and delegation heads are involved in exploiting healthcare information to obtain sustainable growth, accelerate progress in the healthcare field, and help in reaching the health related sustainable development goals (SDGs).

The commercial sector and civic society play a crucial role, because the information and communication includes academic and technolo -gical communities. Developing countries urge the World Health Organization (WHO) to act in its field. The World Summit on the Information Society (WSIS) emphasizes ICTs at a global level.

Then, it is important to allocate enough resources and recognize information and communications roles in this case since technology opens new possibilities, at the same time, achieving the 17 sustainable development goals. Global health experts increasingly agree on the importance of strategic use of digital technologies and cutting-edge information systems. Concerted efforts are needed to include an extra billion people in universal access to critical services facilitated by ICT. WHO [1] asserted on digital interventions and using technology to solve problems and improve outcomes. The "health system" is the comprehensive network of organizations, and resources that deliver medical services and promote health. Digital health's 2020-2025 global plan emphasizes technology use.

Health emergencies are a priority to help one billion people, and health coverage protects an additional billion people. The Thirteenth General Program of Work, from 2019 to 2023, sets an organization's goals and priorities. IoT, virtual care, and remote technologies are being used in more fields, and AI, big data analytics, and blockchain technologies are being used in academic and professional fields. Data-sharing Internet of Things and Machine Learning Implementation in the Healthcare Sector platforms, wearables, and tools, and remote data capture and

interchange using storage systems and technology are used to enable Healthcare information sharing. Medical diagnosis and data-driven treatment can enhance outcomes, and decision-making, digital therapies, clinical trials, and healthcare self-management are essential.

Professional support requires knowledge, skills, and competence to enhance evidence-based practices and person-centered care. Despite great achievements by some nations, many nations remain confronting development issues and still need institutional help to develop, then, national eHealth/digital health plans and initiatives are needed, and their action plan requires extra work. This analysis examines resources and capabilities, and digital health strategy worldwide is needed for the goal of improving and supplementing existing and new efforts. These principles protect sensitive data. This paper focuses on the importance of individual health and the role of digital technologies like AI and IoT in enhancing healthcare. The rest of the paper is organized as follows section 2 includes importance of individual health, section 3 focuses on using machine learning in healthcare, then, section 4 focuses on IoT role and usage in the healthcare sector, then finally, conclusions and future scope are discussed. Predicting these events without computations may be inaccurate. Professional counsel may cost low-middle and middle-class families. Thus, a model that predicts their health based on multiple parameters is needed. Knowing one's health helps prevent future ailments. As mentioned, sleep patterns affect health beside smoking, sickness, and other factors. Healthcare data management emphasizes data handling efficiency. Patients create a lot of organized and unstructured data, besides diagnostics, doctor prescriptions, and wearable devices, that are now unstructured data that need to be collected and analyzed to be used in the benefit of a person's health. Data analysis can be accomplished through the use of machine learning and collected from smart devices connected to the internet (IoT).

# 2 II. INDIVIDUAL HEALTH

# 3 III. AI IN HEALTHCARE

Healthcare focuses on data analysis and forecasting in healthcare domains. Disease prediction has a big impact on healthcare analytics. Predictive models help prevent preventable illness epidemics, improving quality of life. Several recent studies have proposed health prediction models. With many considerations. Sahoo, Mohapatra, and Wu proposed in a study [2]. The study established a cloud-based probabilistic data collecting system and a framework for forecasting an individual's future health state using their current health status. Hirshkowitz et al. [3] developed a sleep duration assessment and suggestion system using age based classification. Researchers [4] proposed a new approach for 21st-Century Health Status Estimation Using Machine Learning. The study introduced the Convolutional Neural Network for disease risk prediction. A study using unimodal illness risk prediction and CNN-based multimodal disease analysis found that risk prediction intrigues. Weng, and his colleagues [5] examined disease prediction methods using ANNs. The researchers evaluated and contrasted each method using statistics. Researchers [6] devised a technique to collect health data using a specific method, in which, deep learning architectures assessed questionnaire results. Tayeb et al. [7] employed K-Nearest Neighbors (KNN) to predict cardiac disease and chronic renal failure. The author [8] proposed using EMRs to predict strokes. The researchers compared Deep Neural Networks (DNNs) to gradients in Error Correction Mechanisms (EMCs). Researchers [9] suggested a cloud-based smart clothing system for sustainability and human well-being monitoring, also, technology implementation was also discussed. Regarding studied methods, Schmidt, Tittlbach, Bös, and Woll [10] examined numerous types. Over 18 years, the researchers found substantial links between fitness, health, and physical activity. In a recent university fitness center data analysis [11], user fitness activity data predicts fitness center occupancy, but the fitness activity data can be predictive. Health parameter quantification study is extensive. Additionally, The computation of health parameters using alternate parameters is well-documented. Harris-Benedict [12] uses physical measurements to calculate a person's BMR. This method estimates the calorie needs for optimal health. Daily living activities affect health. Personalization can tailor health projections and recommendations, and this inspired the design of a daily life-based health prediction model. In the new Healthcare Era, the society healthcare is influenced by many factors, and affects in the finance, transportation , and entertainment. Big data and machine learning algorithms have transformed data analysis and insight extraction.

Integration has improved predictive analytics, pattern detection, and decision-making. In summary, modern society includes entertainment, business, and healthcare. Netflix knows which films people like and shows them. The timing, location, and item preferences of consumers are of interest for companies, like Amazon and Google. This enquiry concerns symptoms and conditions people are actively researching. Data can be used for intricate individual profiling, which can be valuable. Behavioral knowledge and targeting can help us predict and understand healthcare trends. AI could improve several fields. Healthcare includes diagnostics and therapy. Already important AI algorithms are performing comparisons in medical image interpretation and other activities, humans outperform machines. Using AI, examining symptoms and EMR biomarkers, as well as, characterizing and prognosticating diseases with EMRs can be performed. Many countries have a shortage of doctors due to increased healthcare demand. Healthcare facilities are likewise coping with many issues.

# 4 New Technology and Patient Expectations

The user bases service and outcome expectations on Amazon and Apple items [13]. The advances in wireless technology and cellphones have opened many doors. Health tracking apps and search portals have enabled on-demand healthcare services, enabling remote healthcare delivery 24/7| | © 2023 Great ] Britain Journals Press Volume 23 Issue 3 ?"? Compilation 1.0

Internet of Things and Machine Learning Implementation in the Healthcare Sector interactions. Cost-effective techniques are needed to meet the needs of underserved and under specialized regions. Minimizing unneeded clinic exposure reduces the danger of communicable diseases. Recently, healthcare AI has garnered interest. AI, a discipline of computer science, creates intelligent machines that can do human tasks. Traditional healthcare infrastructure may be inadequate.

Healthcare infrastructure needs to be identified as the system expands. It was designed to meet current needs [14]. Though understandable, these solutions' success in treating patients requires thorough independent assessment, besides safety and efficacy are crucial. Today, AI-enabled healthcare technologies are gaining importance. Next-generation healthcare technology tools can be implemented. It's widely believed that AI improves healthcare operations and processes, also, AI application implementation which rely on the system, could save costs in the healthcare sector. Cost reductions come from reduction of hospitalizations, doctor visits, and medical care treatments from reactive to proactive healthcare, Health management is prioritized over disease treatment. AI-based technologies will help with many chores, since monitoring and guidance keep people healthy. To improve patient care, diagnose faster, personalize treatment programs, and improve monitoring and evaluations, AI-based healthcare technologies are expected to increase rapidly. Technology has advanced in the past decade, also, AI and data science has advanced. Currently, different applications have been explored for decades. The current AI enthusiasm is unique. Optimized computational processing speed, data collection capacity and AI talented people are required to accelerate AI development. The use of tools and technology [15,16] in the AI field, will revolutionize artificial intelligence (AI) technology and its widespread use and effect on society. Specifically, deep learning (DL) has significantly impacted healthcare.

The aforementioned reason has had a major impact on current AI tool viewpoints and has driven several AI tool innovations. Given the present enthusiasm for using artificial intelligence (AI) in numerous disciplines, it is clear that these

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Internet of Things and Machine Learning Implementation in the Healthcare Sector well-studied in research [21]. Numerous applications exist throughout the healthcare value chain. Also, drug development and ambient assisted living (AAL) research have grown in popularity.

# 6 Precision Medicine

Precision medicine is known as personalized medicine, is a new medical strategy that tailors treatments and interventions to individual patients. Precision medicine can tailor healthcare to patients' disease features. Genomic variants and other medical considerations will be considered in a customized therapeutic approach. Precision medicine examines age, gender, geography, race, family history, immunological profile, and metabolism. Precision medicine uses individual biological traits rather than population-based trends. Throughout a patient's treatment, data collection is involved. Individuals provide genetic and physiological data. Precision medicine benefits healthcare. Healthcare costs may be reduced. Precision medicine can save healthcare expenses by avoiding needless operations, testing, and drugs. Precision medicine reduces harmful medication reactions. Precision medicine is expected to benefit from its novel approaches. This study examines patient outcomes and health service delivery and evaluation changes after healthcare interventions. Modern healthcare emphasizes digital health apps and "omics"-based diagnostics.

Machine learning methods are used with large datasets. Many precision medicine initiatives benefit the discipline as a whole. Academic research often uses genetic, demographic, and electronic data. Health records can be diagnosis and therapy selection. Digital health apps record and process data.

Patients also reported diet, mental well-being, and physical activity using wearable, smartphone, and other health monitoring data. In precision medicine, machine learning algorithms find patterns in data sets to improve prediction and outcomes. Healthcare AI research is growing. Omics-based testing uses population genetic data.

Machine learning algorithms find relationships and predict patient treatment responses. Metabolite profiles can also reveal health and disease. These biomarkers provide a complete picture of an individual's physiological condition and can be used to determine disease risks, progression, and treatment efficacy. Protein expression patterns can help researchers understand disease mechanisms. The gut microbiome's makeup and diversity can illuminate microbial communities' function in health and disease. Metabolite profiles also reveal a person's metabolic processes. Metabolic profiling and machine learning can provide personalized treatment [22,23].

# 7 Healthcare AI Implementation Barriers

In order to assess the potential fluctuations in the healthcare industry's integration of artificial intelligence (AI), specifically with regards to variables associated with technological adoption. What insights can be gleaned from previous healthcare information technology (IT) implementations?

The scholarly literature underscores the significance of integrating advancements in the implementation of artificial intelligence (AI) and other information technology within enterprises. The successful implementation of electronic medical records necessitated the utilization of inventive strategies for integrating software systems and introduced novel procedures for healthcare professionals, chemists, and other occupations within the healthcare industry. Consequently, the greater affordability of complementary innovation in larger corporations and metropolitan regions is anticipated to result in a higher prevalence of AI implementation within larger healthcare institutions and urban locales.

The application of artificial intelligence (AI) in the healthcare sector can be exemplified by the analysis of a substantial dataset consisting of 1,840,784 job advertisements originating from 4,556 hospitals. A total of 1,479 job listings from 126 hospitals were assessed by Burning Glass Technologies, with a specific focus on the requirement of artificial intelligence (AI) skills.

Internet of Things and Machine Learning Implementation in the Healthcare Sector

The job listings encompassed positions such as "Analytics Architect," "Bioinformatics Analyst," "Cardiac Sonographer," "Physician -Internal Medicine," and "Respiratory Therapist." The findings of the analysis revealed that a majority of AI-related job opportunities, specifically 60%, were categorized as clinical positions. Administrative roles accounted for 34% of the job opportunities, while research-focused positions constituted a smaller proportion of 6%.

The research identified a total of 1,479 job advertisements related to artificial intelligence. A significant discovery indicates a deficiency in healthcare skills related to artificial intelligence. Based on the findings of a previous study in the field of information technology, it has been observed that the 126 hospitals that are actively recruiting for artificial intelligence (AI) positions tend to exhibit a higher number of personnel and are predominantly situated in densely populated urban areas. It is anticipated that artificial intelligence (AI) has the potential to ameliorate the existing state of affairs in the healthcare sector. It is anticipated that the implementation of artificial intelligence will primarily commence within large-scale institutions and major urban centers, encompassing domains such as electronic medical records, computer systems, and the commercial internet.

Gaining insight into the factors that contribute to hospitals' reluctance to adopt artificial intelligence (AI) is imperative for comprehending the potential complementary advancements that could facilitate its implementation within healthcare settings. There are several factors that impede the widespread adoption of a proposal, including algorithmic limitations, restrictions on data access, legislative barriers, and misaligned incentives.

# 8 Legal and Administrative Hurdles

Legal and administrative hurdles hinder industry and sector operations. Foundational regulatory constraints cause algorithmic and data issues. Three types of regulations matter. Privacy regulations initially complicate healthcare data collection and consolidation. Due to privacy concerns in the healthcare field, using actual health data to train AI models may be difficult, slowing progress compared to other industries. Novel medical technology requires lengthy and demanding regulatory approval. Innovation clearance takes years. Health care providers' fear of responsibility can also prevent them from adopting innovative technologies. Health care regulation is more conservative than in other businesses. This means that innovative regulatory frameworks are needed to integrate AI into healthcare. This approach will maximize AI's benefits while protecting patient rights and maintaining high-quality healthcare. Three regulatory hurdles could be modified to complement each other. These issues involve health care data ownership and use, AI medical device and software approval, and medical provider-AI developer liability.

# 9 Data Constraints

Data quality affects AI algorithm performance. Thus, data scarcity is another barrier to adoption. Medical data gathering and access are difficult. Medical practitioners sometimes dislike data collecting because it disturbs their workflow and produces incomplete data. Data aggregation between hospitals or healthcare providers is difficult. Electronic Healthcare Record (EHR) systems used by government-certified providers serving hospitals and healthcare facilities are incompatible, resulting in localized data collection rather than an integrated approach to documenting a patient's medical history across multiple providers. Lack of large, high-quality datasets hinders AI system development.

# 10 Algorithm Limitations

Neural network advancements have increased artificial intelligence's potential but decreased interpretability. Neural networks make AI algorithms "black boxes" that require a lot of work to understand. Thus, without proactive efforts to identify issues with neural network-generated algorithms, there is a risk that the AI will produce flawed solutions that are only discovered after deployment. This lack of transparency can undermine

trust in AI and impede its adoption by| | Volume 23 Issue 3 ?"? Compilation 1.0 © 2023 Great ] Britain Journals Press

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Internet of Things and Machine Learning Implementation in the Healthcare Sector healthcare providers, especially since doctors and hospitals may be held responsible for decisions involving AI. Complementary innovation in trustworthy AI, such as using technology or methods to understand AI algorithms, is widely recognized. Many large-scale projects aim to develop and improve AI. Interpretable AI could reduce the black box problem and increase confidence. Healthcare practitioners may trust AI systems by understanding how AI makes suggestions. Individuals are working to standardize AI clinical trial techniques. These efforts should improve healthcare AI integration. Implementing such criteria will help healthcare practitioners identify how biases or knowledge gaps affected an AI system's suggestions.

# 12 IV. IOT SITUATION IN HEALTHCARE

This section provides an overview of the global healthcare Internet of Things (IoT) industry. Medical devices can be categorized into fixed, wearable, implanted, and other classifications. The software and system components encompass various segments, such as application security, network security, data analytics, remote device management, and network bandwidth control. The market is divided into segments based on services, products, connectivity, and end users. This section investigates industry trends, growth prospects, and regional forecasts spanning the period from 2022 to 2030. The global healthcare Internet of Things (IoT) market attained a valuation of USD 180.5 billion in the year 2021 [24]. According to projections, the estimated value of USD 960.2 billion is anticipated to be achieved by the year 2030, with a compound annual growth rate (CAGR) of 20.41%. Services accounted for 59% of the total revenue generated in the year 2021 [24].

In the year 2021, hospitals experienced a 35% increase in end-user income. In the year 2021, North America exhibited the highest proportion of revenue, accounting for 40.3%. The Asia Pacific region is projected to experience a growth rate of 18.50% during the period from 2022 to 2030. Table 1 [24] presents the projected forecast for the Internet of Things (IoT) in the healthcare sector until the year 2030.

Data gathering, analysis, monitoring, and research occur online. Sensors, software, and information processing systems dominate the healthcare IoT market. Due to expanding demand for medical devices in healthcare facilities and more patients seeking medical attention, the Internet of Things (IoT) in healthcare has grown significantly. Medical gadgets with improved efficiency and faster results have also been prioritized.

New technology and developments have increased digitalization in many locations, especially developing countries. The healthcare market has grown significantly since the governments integrated and promoted medical device development and provision. The Internet of Things (IoT) transmits data between machines, Healthcare IoT applications are categorized by medical equipment type. This category includes fixed, implanted, wearable, and other modern medical devices in healthcare institutions. Wi-Fi, Bluetooth, and signee-enabled embedded systems enable uninterrupted work operations. Analytics, database, and network layers comprise the system and software. Microsoft Application Insights lets developers monitor and diagnose their apps' performance and usage. Telemedicine, store and forward telemedicine facilitated by software using wireless connections, medication management, interactive medication, patient monitoring, clinical operations, workflow management, clinical imaging, and fitness measurement can be used to segment healthcare applications in the IoT. Drug development and research have boosted the IoT healthcare market. In 2021, the percentage of healthcare IoT market share by region [ 24] is shown in table 2. From a geographical standpoint, it is anticipated that the Asia Pacific region will take the forefront in the advancement of healthcare Internet of Things (IoT) technology. The proliferation of advanced technologies and the increasing demand for goods and services have resulted in an upward trend in market rates. The government has facilitated the implementation of Internet of Things (IoT) in hospitals through the utilization of advanced infrastructure. The utilization of healthcare Internet of Things (IoT) has witnessed an increase in North America, Europe, Latin America, the Middle East, and Africa as well. The implementation of this initiative has significantly enhanced healthcare services in the aforementioned regions. In recent times, numerous disciplines have witnessed noteworthy advancements. In 2020, Abbott and Insulet unveiled a novel system for glucose monitoring and automated insulin delivery. In the year 2021, Hill Rom unveiled integrated solutions aimed at enhancing patient outcomes. In 2021, the SyncaR AR technology and StealthStation S8 surgical navigation system were introduced by Surgical Theatre and Medtronic. Medical devices are utilized for the purposes of diagnosing, treating, and preventing various diseases.

Implantable medical devices are specifically engineered to be surgically inserted into the human body for the purpose of diagnosing, monitoring, or treating specific medical conditions. The term "Software and System" encompasses computer programs and hardware components that collaborate to accomplish predetermined objectives. This connection facilitates operational efficiency and enhances overall performance. Application security is a discipline that aims to safeguard software from potential threats and vulnerabilities. Data analytics involves the examination and interpretation of extensive datasets in order to derive meaningful insights and inform decision-making processes. The practice of remote device management encompasses the ability to exert

control over devices from a distance. The tasks encompassed in this domain include monitoring, configuring, updating, and troubleshooting. The practice of architecture involves the design and implementation of system integration within a broader framework. The issue at hand pertains to application development, with a specific focus on support and maintenance.

# 13 Glucometers

test blood glucose levels. Electrocardiograms (ECGs) and heart rate monitors are used in clinical settings to examine and monitor heart electrical activity and measure heart rate. Medical devices assess blood pressure against artery walls. Clinical settings use these gadgets. Multiparameter monitors measure and show numerous patient physiological parameters. Oximeters are breathing support devices that help people with breathing issues. Imaging systems capture, record, and reproduce images.

Implantable cardioverter-defibrillators (ICDs) monitor heart rhythms and are surgically installed. Implantable cardiac monitors, also known as implantable loop recorders, are medical devices surgically inserted to monitor and record heart electrical activity. Infusion pumps supply fluids like drugs or nutrition to patients. Fetal monitoring devices evaluate a developing fetus's health and physiological parameters during pregnancy. Neurological gadgets diagnose, monitor, and treat nervous system disorders. Embedded systems are computer systems that execute specific duties within a larger system or device. Finally, laboratory research is regulated, methodical investigation in a lab.

# 14 V. CONCLUSIONS AND FUTURE SCOPE

This paper discusses the importance of monitoring the health of individuals, as this helps in maintaining a balanced lifestyle. Also, the importance of using AI in the healthcare sector, to help analyze patients' data, for detecting any health issues, and help in taking precautions before health deteriorates, and decreases costs at the same time in the healthcare sector. Also, precision medicine is a type of medicine that depends on AI in detecting health problems based on each individual's metrics.

Besides, implementation of AI challenges in healthcare were discussed in this paper. The role of internet of things (IoT) in facilitating transmission of patients' data from specialized devices to analyze these data, and provides results of analysis to doctors. It is expected in the future for healthcare using IoT to increase annually due to the benefits and costs reduction it provides in healthcare. [1]

Health system strengthening is essential and health plans should include digital health. The major goal is to let people benefit ethically while maintaining safety, security, and reliability. Academic fields prioritize equity and sustainability. Development should follow principles. Academics value transparency, accessibility, scalability, replicability, and interoperability. Technology, law, and ethics all require privacy, security, and confidentiality.

Figure 1:

**1**

IoT in Healthcare Market Size,
Year
2021 to 2030 (USD Billion)



Figure 2: Table 1 :

**2**

| Regions | Revenue share in 2021 (%) |
|---|---|
| North America | 40.30% |
| Asia Pacific | 20.60% |
| Europe | 25.70% |
| Latin America | 9% |
| MEA | 4.40% |

Figure 3: Table 2 :

[1] | | © 2023 Great ] Britain Journals Press Volume 23 Issue 3 ?"? Compilation 1.0 Internet of Things and Machine Learning Implementation in the Healthcare Sector

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