The Significance of Digitalisation and Artificial Intelligence in the Healthcare Sector: A Review

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ABSTRACT— ***Nowadays, artificial intelligence, machine learning, and deep learning are among the most popular and applied topics in many scientific and life fields that serve humanity. This science seeks to impose itself strongly on the various activities and academic circles and information science. Artificial intelligence techniques have proven their worth to be important in many fields, especially in the medical fields, business administration, military applications, communications, and many others. In short, artificial intelligence is from another world that will be of great importance in the future. In this article, the importance of digitisation and artificial intelligence in the healthcare sector will be addressed, what services they provide to this sector, and how they contribute to the service of healthcare workers and patient satisfaction. This article concluded that artificial intelligence and digital technologies are of great importance in the healthcare sector and can never be dispensed with.***

Keywords— Artificial Intelligence, Digitalisation, Healthcare sector, Machine learning, Internet of things.

1. INTRODUCTION

Health services are one of the most important needs of every individual in this universe [1][2]. Health is an important step for achieving physical existence, developing societies, and building nations where they can be socially, economically, and culturally diversified [3][4]. Health services can be described as a global market that meets human needs to continue living [5][6]. The world's governments seek to develop this market through the use of technological means to limit the spread of serious infectious diseases, such as what happened in 2019 and other epidemiological events that occurred on the planet [7][8]. Technology and the improvements it always brings positively impact the quality of life. From a health perspective, advanced technologies and methods improve the quality of medical operations, communicate well with patients, and keep track of their health status [9-12]. In other words, modern phone and internet connectivity solutions are characterised by the growth of virtual processes between the physician and the patient, such as preparing visit appointments, preparing reports, and tracking the patient's health status [13-15]. Besides, all data is kept physically with backups to the cloud. There are many areas in which the digitisation process exists, such as transportation, purchasing clothes, communication between machines in factories, cloud computing, the Internet of things and artificial intelligence [16-20]. Figure 1 illustrates the growth of AI techniques in the US healthcare market from 2020-2030. Healthcare workers seek to apply the digitisation process to a large extent and benefit from its services in order to achieve better health services that satisfy patients [21-25]. The digitisation of the infrastructure and systems utilised has paved the way for workers to acquire new and advanced skills and for health institutions to work with suitable personnel. This has created new positions and career opportunities in healthcare operations [26-30].

Today, the use of artificial intelligence is gaining wide popularity in the healthcare sector. Thanks to machine learning and deep learning techniques, which are one of the branches of artificial intelligence, healthcare professionals are moving to new manners of operations such as diagnosis, prediction, disease identification, treatment, and rehabilitation [32-35]. These technologies provide advanced methods that contribute to the development of health institutions in terms of cost and efficiency. For example, many health operations have been carried out using artificial intelligence techniques, and this is done through cooperation between companies, university hospitals and research and

development laboratories. This article is a review in which the applications of digital transformation and artificial intelligence in health services are explained and explained [36-40].

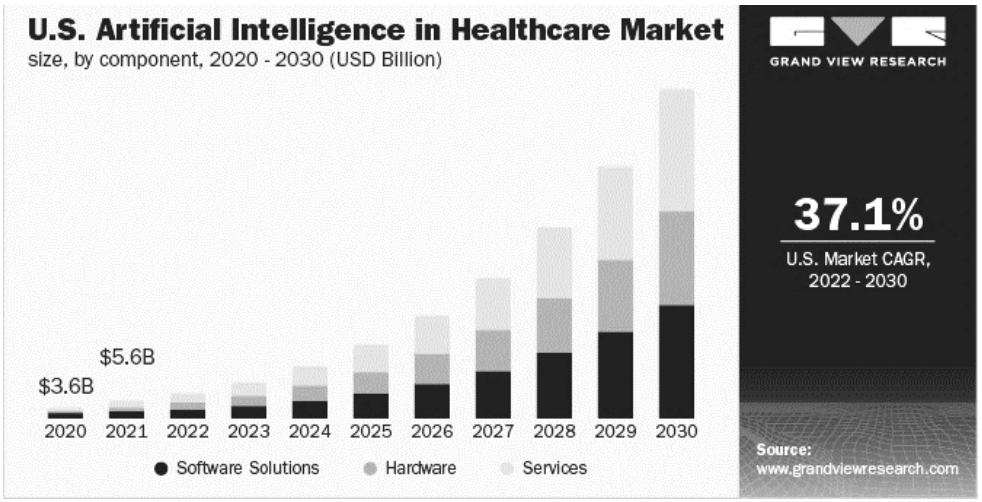

Figure 1: The growth of AI techniques in the US healthcare market from 2020-2030 [31].

2. DIGITALISATION AND AI IN HEALTHCARE

The idea of digital transformation is not a recent idea, but rather an old idea that occurred in the eighteenth century. With the growth of the industrial revolution and the arrival of 3.0, computers and automation entered all sectors and became a vital part of doing business. Virtualisation started with the fourth industrial revolution and became the basis of industry and workflow. The main reasons, such as the increase in the population, the increase in health needs and the increase in health literacy, led to a focus on growing the health sector and introducing digitisation and artificial intelligence in it [41-46]. Although the health sector was lingering behind the rest of the sectors in applying artificial intelligence, it quickly adapted to artificial intelligence and electronic digitisation [47-50]. As a result, it was able to reach somewhat sufficient stages. For example, what occurred at the end of 20219 with the spread of the COVID-19 pandemic and the death of many people, artificial intelligence was able to control the spread of the virus, track cases of infection and analyse patient data with high speed and accuracy [51-55]. So, without artificial intelligence, the health sector is not working properly. Looking at digital technologies in the healthcare sector, and the emergence of concepts such as the ability to monitor an individual's health with applications running smartphones that help healthcare workers survey and monitor patients' conditions—the use of intelligent autonomous systems in diagnosis and treatment and the establishment of a virtual hospital [56-60]. Moreover, the patient makes use of virtual health services online in processes such as screening, treatment, reporting, home care and use of wearable technologies; patient data is transmitted to health centres where the information is organised in a digital cloud over the internet, and healthcare professionals can access this data remotely and do what is needed of them.

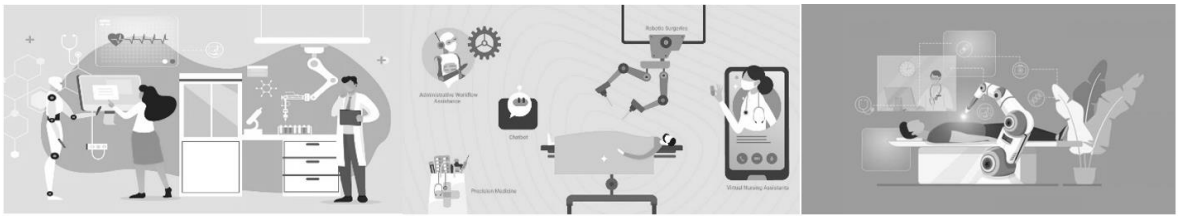

Figure 2: Application of modern technologies in the healthcare sector [downloaded from Google].

Artificial intelligence techniques are utilised in modern health services such as medical and digital health services and mobile health, where artificial intelligence solutions appear with voice response systems in mobile health and diagnostic applications [61-65]. Artificial intelligence applications constitute all health services in the digital fields. Artificial intelligence enters clinical terms such as diagnosis, treatment, early diagnosis, prediction, home care, ... etc (see Figure 2). People are assisted using artificial intelligence techniques and the Internet of Medical Things (IoMT) (see Figure 3), utilising smart sensors through which heart rate, blood pressure, calories, and walking steps are tracked and suggesting a set of exercises and appropriate sports programs according to the human health condition [66-68]. In addition, artificial intelligence techniques based on natural language processing are involved in protecting the mental and physical health and providing medical and psychological counselling to a patient, and this is done through a simple application that can be referred to a mobile phone. Moreover, providing a set of instructions and advice to patients about

various psychological disorders such as depression, stress, anxiety and lack of sleep. Mobile phone applications have become significant to many people, and the number of downloaders of these applications reaches more than one million actual users annually. Diagnosis is one of the most important things for physicians, especially for complex cases, so healthcare workers resort to machine learning techniques, deep learning, and expert systems in diagnosing patients and giving results that help them make decisions. For instance, using strategies to create digital patient records, make predictions about the patient's condition, and store this data in an electronic cloud. Moreover, computer-aided imaging techniques are of great importance in diagnosing and analysing the patient's condition. The most influential country that continually strives to develop the health sector is South Korea [69][70], where all patient data and results of image-based monitoring are kept in the cloud infrastructure. The data saved in this project is passed through the decision support systems used in AI-based disease diagnosis and then presented to clinicians, accelerating the diagnosis process for the patient with comfort and safety.

Experts and physicians employ artificial intelligence to understand and diagnose diseases such as heart disease and cancer in the early stages. Early diagnosis of these diseases is challenging with the known traditional methods. In addition, deep learning techniques are utilised to detect breast cancer by locating the disease from images or videos, classifying images, and analysing visual information within images or videos [71-75]. In fact, early diagnosis and careful follow-up are significant in chronic diseases. The development of remote monitoring systems based on the Internet of things is supported by artificial intelligence and the data is processed using machine learning algorithms that enable early identification of the disease in the case and quality and give full details of the disease and location of infection.

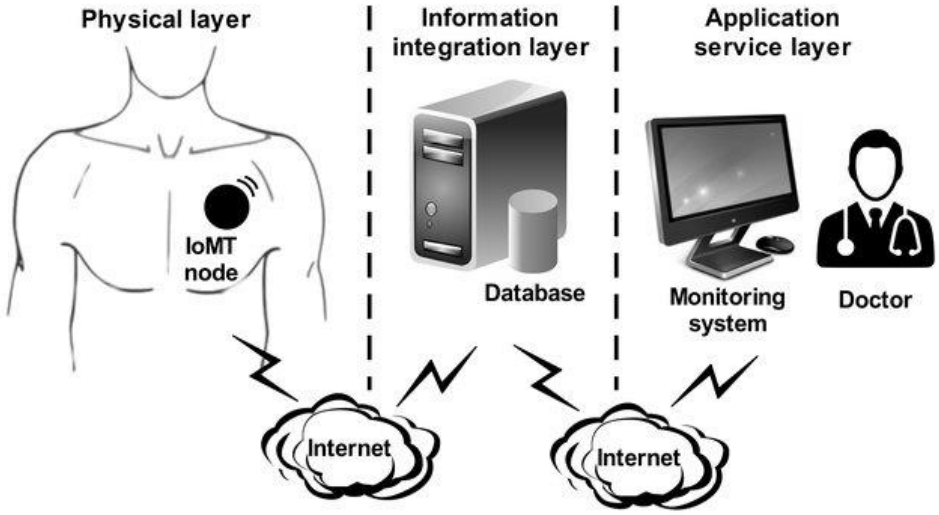

Figure 3: Architecture for Internet-of-Medical-Things (IoMT) [76].

With the current growth of electronic devices and digital transformation, the operations of electronic patient records and the recording of monitoring results began in the electronic environment. The process of digital transformation is considered one of the most important issues in hospitals, medical clinics, and laboratories because it aims to save patient records in a physical electronic environment or in the cloud and send this data quickly to any physician or specialist, regardless of his position, to view it and diagnose the patient’s condition. There are a large number of investigations in which artificial intelligence techniques have been used in analysing medical data, whether images or texts, due to the significance of these technologies in healthcare. From 2019 until August 2022, many investigations appeared in the application of machine learning and deep learning techniques in diagnosing COVID-19 diseases through chest X-rays and comparing the performance and practices of these techniques in analysing the most significant number of images [77-81]. Analyses based on machine learning in the field of diagnosis focus on many diseases, including heart disease, cancer, kidney disease, and Alzheimer's. Internet of things solutions are gaining great popularity in diseases, especially chronic diseases. It aims to store data collected from patients using wearable devices or sensors in a cloud computing environment and use by healthcare workers or doctors for analysis and decision-making. The most common disease for which wearable devices are employed is heart disease. AI has the ability to deliver correct results directly with healthy and accurate data quality. The data collected with the Internet of Things can be used to determine people's health risks in advance, as well as create health risk maps in regions and cities to reduce the spread of disease and reduce mortality. Therefore, artificial intelligence and Internet of Things technologies should be employed in the healthcare sector and with data storage in the cloud, as approximately 35 trillion gigabytes of data are currently stored in the cloud [82].

3. CONCLUSIONS

Health services are one of the essential items for economic growth in nations. Advances in science and technology have led to modifications in the healthcare sector and it has global markets. Advances in information technologies and digital transformation have come a long way in a short time in the field of health. The digital transformation of clinical management and operations has begun in the health field. Every day, new steps are being taken regarding automation, artificial intelligence and the Internet of Things. The AI applications that come with digital transformation have quickly adapted to the healthcare sector. There are various applications in both administrative and clinical processes that are carried out on a daily basis. AI reduces administrative and clinical costs by restructuring health service operations. It speeds up processes such as diagnosis, monitoring and treatment in clinical processes, and aims to increase service quality by reducing human interaction. Wearable Technologies With the widespread use of The Internet of Medical Things (IoMT) devices, this type of wearable device can also monitor the health of individuals, where they can send data to a physician. In the future, as the data obtained by tracking these devices gains, the use of supported AI systems will become more and more popular.

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