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Research paper

Internet of Things Advances in Medical Imaging: Approaches, Applications, and Feasibility for Improving Healthcare

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Extended Abstract

In recent decades, the convergence of Internet of Things (IoT) technology and medical imaging has transformed healthcare. This research explores IoT-enabled medical imaging, its potential, applications, and feasibility in enhancing healthcare services. IoT in medical imaging boosts diagnostic precision and treatment capabilities, ensuring accurate disease diagnoses while preserving patient privacy through secure image uploads with encrypted data. Incorporating artificial intelligence (AI) into IoT-based imaging enhances disease detection and treatment. AI algorithms improve image quality and accuracy, raising the standard of care. IoT enables remote medical imaging and precise patient monitoring, emphasizing the importance of data security through encryption. This research highlights IoT's vital role in healthcare, fostering collaboration between devices and data to enhance public health.

Introduction

In the past decades, tremendous technological and scientific advances in all fields of medicine, including medical imaging, which has experienced a revolution in the last three decades, have made research significantly more complex [1-3]. Medical imaging in the field of radiology is evolving, and in addition, the concept of medical imaging can also be related to the achievements of the Internet of Things [4]. Medical image processing tasks are divided into two broad categories image reconstruction and information enhancement [3]. This field also presents opportunities and challenges for researchers, from innovations in diagnostic imaging methods to real-time intraoperative support tools such as surgical support tools [1]. IoT-enabled medical imaging systems have a significant impact on diagnostic approaches to imaging [5,6]. Medical images integrating the Internet of Things in hospitals, in addition to playing a vital role in imaging diagnoses, by searching for similar images, increase the accuracy of diagnosis preserve the privacy of patients, and provide the possibility of uploading medical images with encryption of personal information [7-9]. Deep learning techniques are used in medical imaging in different ways. The most prolific but vital work in modern times is the study of medical imaging in modern medicine. Medical imaging is the main reason for the development of classification, segmentation, reconstruction, diagnosis, diagnosis, and characterization [10,11]. In recent decades, significant advances in Internet of Things technology in medical imaging have led to major changes in the healthcare industry. These advances have not only increased the accuracy in diagnosing diseases and providing better treatments but have also provided new possibilities for improving healthcare. This article examines the importance of IoT in medical imaging, artificial intelligence imaging technologies and their applications in disease diagnosis, the possibilities of remote medical imaging using IoT, the role of imaging in improving healthcare through connecting devices to each other, and medical data security and transmission. Intelligence pays. Finally, the possibility of the future of the Internet of Things in medical imaging is examined. This research promotes the development and improvement of healthcare through communication and

collaboration between medical devices and data.

The importance of the Internet of Things in medical imaging

The introduction of the Internet of Things to hospitals by searching for similar medical images leads to improving the accuracy of diagnosis and increasing treatment capabilities; Also, by guaranteeing the protection of patients' privacy, it acts as an auxiliary tool in medical diagnoses and enables hospitals to upload the medical images they want, and extract and encrypt the features of the medical images [7]. The Internet of Things is used to maintain security for medical images so that the personal information of patients such as names, identification numbers, and patient records are protected [8,9]. The Internet of Things (IoT) with the cooperation of smart devices, sensors, and applicators, provides the possibility of comprehensive communication between the practical and real world, and in the field of medical imaging and communication between patients and doctors, by using encryption and program security, it is possible to monitor and manage the physical condition. And it facilitates human systems and more communication between them [12-15]. In the modern healthcare sector, medical image analysis using the Internet of Things (IoT) and IoT devices in hospitals collect and analyze imaging data for diagnosis, treatment planning, and monitoring response to treatment, and deep learning algorithms as extractors. and classifiers have made significant progress in this field [16-21]. Users of medical imaging systems are taking advantage of the Internet of Things by increasing information sharing in companies, through new storage methods such as cloud edge, to improve security, privacy, and effective management of challenges related to the Internet of Things in medical imaging. [22,23] The existence of the Internet of Medical Things (IoMT) and 6G technologies has improved the diagnosis and prediction of diseases in the medical field; Using 6G technologies, IoMT helps in early and real-time diagnosis of diseases (such as cancer) and improves diagnosis accuracy by using deep learning algorithms and optimization in medical image analysis [24-28].

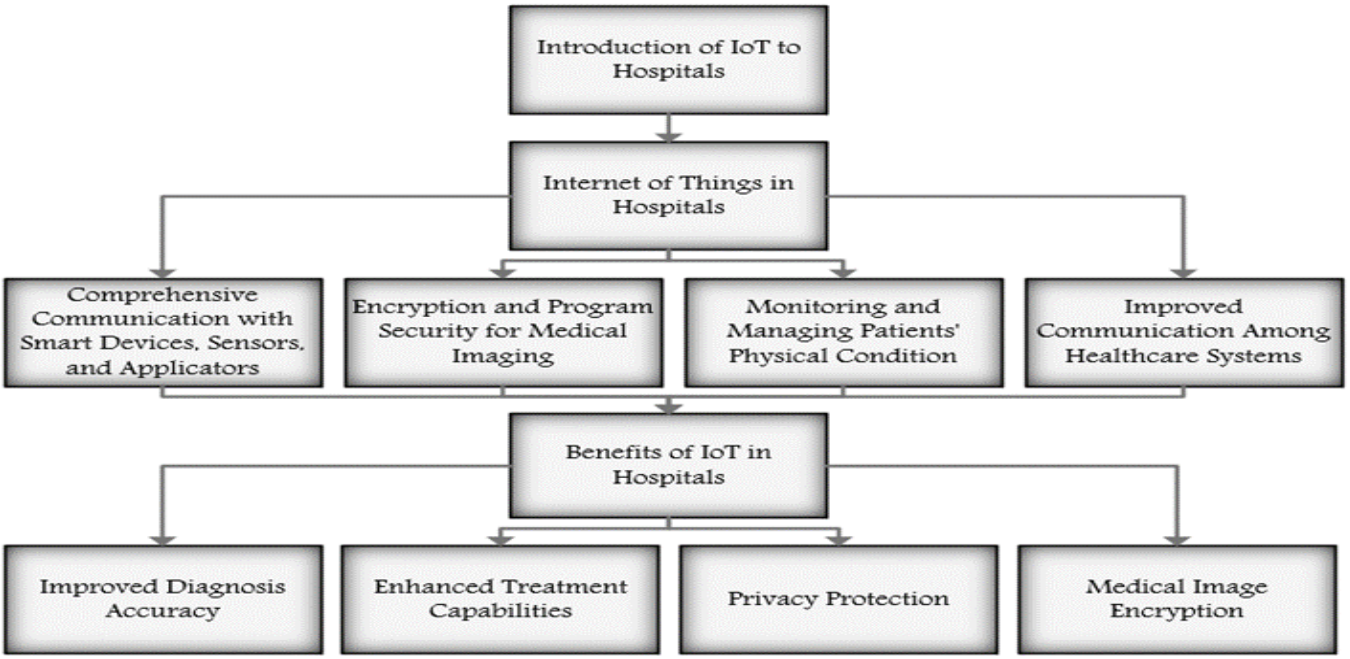

Fig. 1: The role of the Internet of Things in the hospital

Smart imaging technologies and applications in the Internet of Things for diagnosing diseases

In recent years, the rapid development of Internet of Things and artificial intelligence technology, with many upgrades, has shown a lot of potential in intelligent imaging in the field of Internet of Things and brought it to applications in the fields of medical imaging, artificial intelligence driving, and urban management [29-31]. Advanced technologies such as artificial intelligence and the Internet of Things in modern health systems facilitate improvements in disease diagnosis and treatment procedures [32]. It is possible to use smart imaging in the Internet of Things to diagnose diseases, especially in medicine, and since there are some limitations in the quality of images, image quality enhancement techniques such as super-definition (SR) are used [32,33]. Internet of Things (IoT) technology, as a technical support platform, provides facilities such as comprehensive diagnosis, reliable information transmission, and intelligent processing to build and implement smart hospitals by connecting various devices to the Internet to provide information exchange and communication, artificial intelligence, tracking, monitoring, and management [34-36].

A large number of researches have been conducted in the field of using the CNN model in image processing, These researches show that CNN models can extract different features by using image processing and use them in different programs such as detection of gaze direction and event detection [37] Advanced IoT technology in the field of health, using sensors and data collected from medical equipment, enables the diagnosis of diseases using machine learning and deep learning methods [33,38]. The use of embedded sensors and smart devices in the Internet of Things to diagnose diseases and perform comprehensive calculations to distinguish between normal and abnormal heartbeats is among the applications of intelligent imaging in the technology field [33,39].

Healthcare monitoring through remote medical imaging with IoT and mobile technology

Some contemporary conversations have centered on the importance of advancement in the field of healthcare monitoring. The Internet of Things (IoT) is enormously proliferating across diverse areas of our daily routines. By leveraging the capabilities of IoT, objects possess the ability to gather, transmit, receive, and exchange data and information within a distributed environment, exemplified by intelligent wearables. With the continual advancement of technology, the Internet of Things has instigated a transformative revolution in the realm of healthcare design, particularly in the context of healthcare monitoring and provision [40,41]. Information technology in radiology is evolving, and advancements have enabled quality control, faster diagnosis, and improved efficiency in patient care [42]. Mobile imaging devices like the MobiUs by Monsanto and specialized radiology apps such as NSF vs. CIN and those offered by RADIOLOGiQ, LLC, are transforming healthcare by providing portable, cost-effective solutions for diagnostics, protocol guidance, and reference material in radiology [43-46] Mobile applications offer affordability, accessibility across multiple devices, and the convenience of preloading onto mobile devices obtained through program purchases [47,48]. Among the leading providers of mobile apps are Apple and Android, which dominate the market [43]. In the domain of radiology education, various types of apps are utilized, including administrative apps, assessment and case presentation apps, and imaging apps [48]. Within medical schools, radiology residency programs, and radiology departments, administrative apps play a crucial role by facilitating tasks such as file sharing, note-taking, scheduling, communication, assignment submission, and classroom management [48-50]. These apps enable users to upload and share large-sized documents across different platforms, including app platforms and any computer with Internet access [50].

The role of imaging in improving health care by connecting things together

The use of new technologies such as the Internet of Things (IoT) in health systems has led to the development of sensors and their wider applications, which can play a fundamental role in improving health care and health services [51,52]. The development of information and communication technology in the field of health has not only changed health systems locally and globally but also emphasizes the need for imaging and connecting objects to improve health care and transformation in this field [53-55]. Artificial intelligence has attracted the attention of researchers and biomedical industries due to its ability to process big data and produce accurate results and control processes to produce the most optimal result, and it plays an important role in improving healthcare by connecting things together [56,57]. IoT and 5G technologies can help improve the health industry and improve health services at any time and place [58]. Electronic health (E-health), which emerged from the expansion of the Internet in the 1990s, helps to improve health services by using information and communication technologies (ICT) and is considered a main research focus. This improvement in the efficient management of health data and improved interaction between the patient and health care provider all contribute to the improvement of health care delivery [53,59]. It introduces the complexities and problems of the expansion of electronic health (E-health) and the need for major changes in systems and communication to achieve a configurable and secure approach to the Internet of Things (IoT), which faces challenges such as Internet access, energy consumption, security, and privacy [60,61]. From the IoT perspective, security includes information preservation, data confidentiality, service access, countering malicious software, privacy protection, access control, and the like, and is considered one of the important challenges of IoT [62].

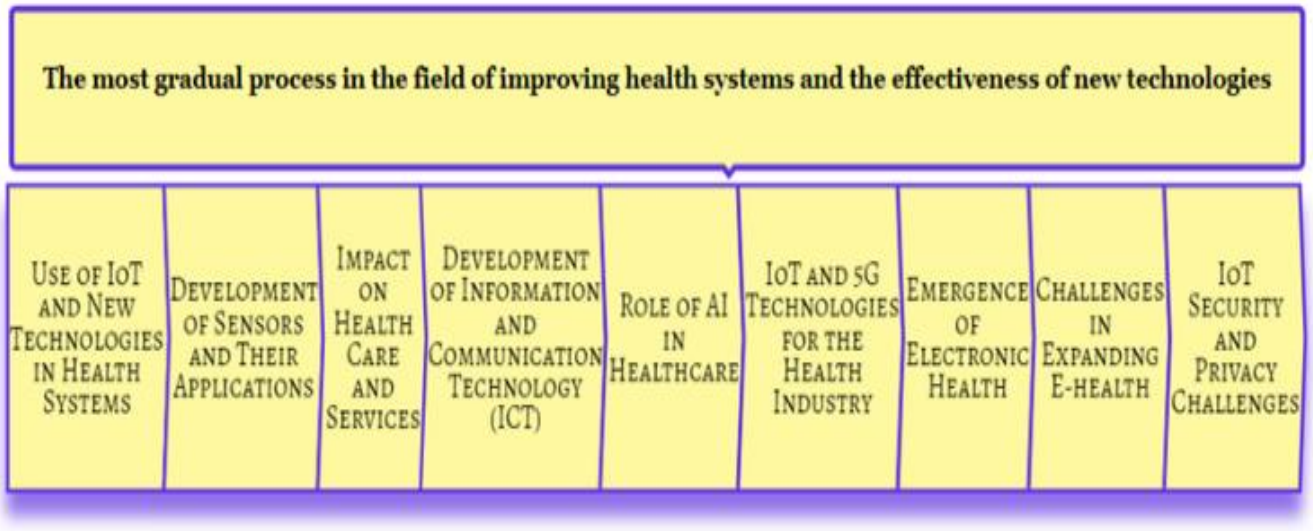

Fig. 2: The Role of the Internet of Things in the healthcare system

Medical data security and intelligent imaging

In order to increase information security and prevent access by unauthorized people, a combination of elliptic curve encryption and cryptographic techniques is used to encrypt and hide information [63]. Through image-hiding methods in smart imaging, it becomes possible to encode and maintain the quality of hidden images of medical information and increase the security of medical data in networks and the Internet [64]. With the development of communication technologies, the transfer of digital data through the Internet in intelligent imaging has become easier, but the security risks of medical data have also increased, and maintaining confidentiality in medical reports is very important [64-66]. In the Huffman compression process in intelligent imaging, it is possible to compress data without losing information as well as encrypting them [64,67]. In the field of medical images and PACS systems, data protection is very important. PACS has introduced a security method using the combination of public key and information embedded in images and provided an infrastructure to implement security in intelligent imaging [68]. In recent times, one of the fastest-growing developments in the world of artificial intelligence imaging is related to medical data security. In case of penetration or change in these data, it is likely to lead to the violation of patients' rights and changes in the medical treatment process. Therefore, maintaining the confidentiality of all patient files, especially medical images, is of great importance, and necessary measures must be taken for the security of these data [69-71]. The use of digital images in the World Wide Web is known to everyone as one of the best ways to share, understand, and remember information, due to its intelligent imaging capabilities [72-74]. In two simple projects using artificial neural networks, the capabilities of experts in intelligent imaging have been tested regarding the diagnosis and prediction of cardiac events in patients with heart failure and the analysis of injection kinetics in PET images using local sensors [75-77]. Artificial intelligence imaging in the diagnosis and treatment of intestinal diseases using tomography of the human body uses water injection instead of air as a preferred method [78-80]. introduced a new architecture called NDN, which in the future ensures the security of medical data distribution in the Internet and Internet of Things (IoT) and is different from the conventional TCP/IP architecture [81-82].

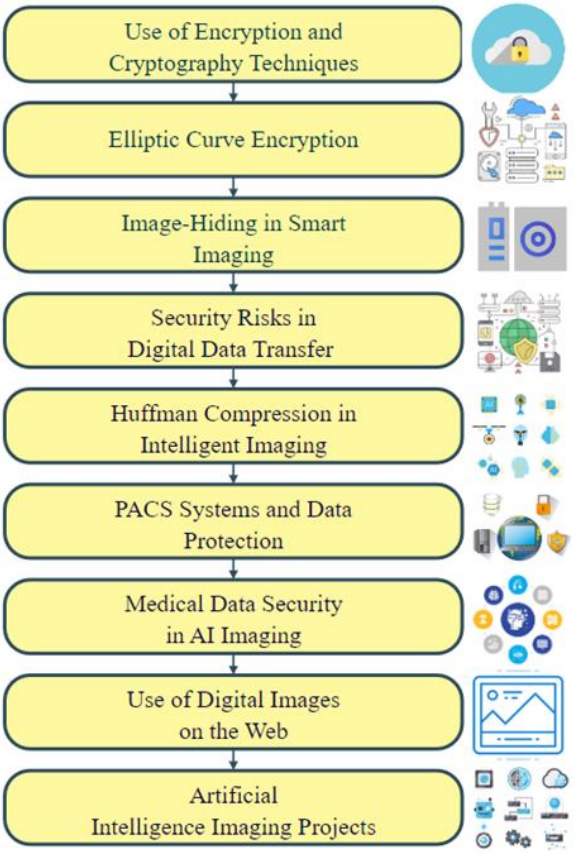

Fig. 3: Providing security encryption and compression of medical data with Internet of Things technology

Feasibility and future of the Internet of Things in medical imaging

In The use of images as an essential carrier of information in medical imaging since the introduction of the first electronic computer and the combination of image technology with computers has led to the evolution of the research field of digital image analysis and processing, especially in the future of the Internet of Things [83-86]. With the continuous progress in digital signal processing technology and communication technology, digital image processing systems are widely used as a technology in various fields such as pattern recognition, medical imaging, entertainment, and military, and the future of the Internet of Things. It opens up new possibilities for medical imaging [87]. The rapid development of the Internet of Things (IoT) and the emergence of new technologies such as image processing at the edge and fog, along with the widespread use of artificial intelligence, have led to the improvement and transformation of medical imaging systems in many fields, and play an important role in the future development of this field Have [88,89]. The widespread use of image recognition with artificial intelligence in the field of medical imaging and drug therapy has led to progress and development, and much research has been conducted in the field of image target recognition [78,90]. Image analysis techniques from digital cameras are used to measure light intensity and reconstruct phase maps in various industries [91,92]. introduces future developments with some IoT applications in health and health care, such as remote health monitoring, fitness programs, chronic disease management, and elderly care [93,94].

CONCLUSION

Considering the significant advancements in Internet of Things (IoT) technology and medical imaging, this research has demonstrated that IoT brings new capabilities to the field of healthcare and diagnosis. It enhances healthcare services and enables more precise disease diagnosis. The importance of IoT in medical imaging extends to safeguarding patients' privacy, allowing secure uploading of medical images with personal data encryption, and improving diagnostic and treatment processes. Furthermore, the utilization of artificial intelligence-based imaging technologies within the IoT framework contributes to better disease detection and the development of more effective treatment approaches. This study has revealed that these technologies can enhance the quality of medical images and increase diagnostic accuracy. The integration of IoT in medical imaging also facilitates remote imaging and enables more accurate patient monitoring. Alongside these capabilities, the significance of data security in healthcare has been emphasized, underscoring the necessity of using encryption and cryptographic techniques to protect vital patient information. In conclusion, IoT plays a crucial role in advancing healthcare through medical imaging, fostering collaboration between devices and medical data. Consequently, it has the potential to contribute to the overall improvement of public health.

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