

Extended Study of IoT Applications in Healthcare: A Survey

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Abstract: -In recent times, with the invention of efficient sensor devices, the Internet of Things (IOT) applications have emerged exponentially. Thus, this paper has focused on exploring the insight into various IOT uses in the Healthcare and medical fields. The patient's remote health monitoring and patient's emergency treatments during transit using 5G ambulances are a few common uses of IOT in healthcare which are critical to saving human life. Also, early disease diagnosis is one of the major advantages of using IOT in health care. The paper also concluded challenges of future healthcare technologies using sensors

Keywords: - Healthcare, IOT, Patient Monitoring, 5G ambulance, RFID, Sensors.

I. INTRODUCTION

IOT is the emerging field and is the future of the current healthcare system. Huge advancements have taken place in the field of remote patient access. Connectivity between doctor's hospitals and ambulances is the future requirement to minimize mortality rates. Thus, this paper has addressed various developments and studies in the IOT-healthcare field.



Fig.1: Uses of IOT in Healthcare

The wide scope of IOT uses is shown in Figure 1. The major uses are to interconnect doctors and patients with hospitals and to make the major use of telemedicine possible. The data storage over cloud servers for future use is an essential part of the study.

Rehab A Rayan et al. [1] explore the impact of IoT on healthcare for patient assessment, patient care, and investigation has been extensively studied. This significantly advances the area of personalized medicine.

Healthcare practice is utilizing IoT data and analytics as a consumer source data to find new information, detect diseases proactively, and make judgments on life-or-death

circumstances. E-health is being utilized to give personalized medicine services to fulfill people's healthcare demands. The Internet of Things (IoT) is a significant development for such a big data era, which offers a variety of timely technology applications to improve services.

Muhammad S. Al-Khatani, et al. [2] explores, emphasizes, as well as highlights the applicability of IoT health services in order to tackle the problems the healthcare system is facing. It also explains how the IoT is made pervasive, profitable, and accessible at any time and in all locations by combining with smart technologies, which improve computing in addition to doing so. Future success or issues are also highlighted, along with useful suggestions that can assist the entire IoT medical system throughout COVID-19 and in a serious pandemic.

Software as a service that monitors the infant's heartbeat, oxygen saturation, feeling, etc. in real time has been identified by Sankeerthana Neelam et al. [3]. A smart phone application that has already been developed by a company and is being advertised for sale will be informed if the infant encounters any issues.

Numerous recommendations have been made by Ali Hadi Abdul wahid et al. [4]. IoT utilization has provided both patients and doctors with a good amount of convenience, since it is ideal for a variety of medical fields (such as in real-time measures, patient record management, as well as healthcare management). Person's body sensor networks (BSN) technologies are one of the key inventions being used in the IoT development inside the health industry [5, 6].



Fig.2: IOT connected Ambulance

II. SURVEY OF IOT IN HEALTHCARE

IOT for healthcare is examined by Dragorad Milovanovic et al. [7], encompassing services,

technologies, security, and technology for advertising the pertinent services. Additionally, it has covered cloud services, IoT for health, and IoT with medical products. Then, suggestions and current standardization projects are outlined. Recent developments in RFID, smart sensors, modern communications, and networking devices have been hailed as key enablers for the Internet of Things, according to a system created by B. Sobhan Babu et al. [8] (IoT). By connecting physical objects, IoT is expected to integrate diverse technologies to create new applications and support intelligent decision-making. Smart healthcare plays a crucial role within healthcare applications by incorporating sensors and actuators for observing and tracking reasons into patients' prescriptions.

Zainab Alansari et al. [9] Research gives the usage of IoT in the healthcare sector priority in order to promote long-term sustainability. The two parameters of "Financial Prosperity" & "Quality of Life" were met, making them the top priorities for sustainability in the healthcare sector. The top goals for IoT in the healthcare sector were listed as Ultraviolet Radiation, Health In general, and Fall Detection.

In this paper, R. Alekya et al. [10] highlighted the principal distributor to health systems as one of the most prominent uses of IoT. It serves to enhance healthcare delivery by removing barriers linked to time, location, and other considerations, while also increasing its reach and effectiveness. IoT recognizes the need for increasingly integrating the different IoT services and works to create an IoT-based healthcare system that is completely integrated. In regards to the various implementation stages, additional work needs to be done on safety considerations. This article suggests the Internet of Medical Things (IoMT), a healthcare use of IoT technology. It is made up of a network of connected gadgets that can instantly perceive important data. Existing medical devices can be made into IoMT devices that sense real-time data for patient monitoring by adding sensors, signal converters, and communication modems. IoMT devices, which include smart wearables, home-use medical kits, point-of-care kits, and mobile healthcare applications, can communicate with medical experts who are stationed far away.

The research by Gonçalo J. F. Carnaz et al. [11] provides a general overview of some of IoT's implications on the healthcare sector. Given the development of IoT technology, healthcare cannot be an exception to this paradigm. The global network that results from employing advanced Internet technologies to connect intelligent objects is known as the Internet of Things (IoT). It is the group of technologies that are necessary to realize this goal (such as RFIDs, sensing / actuators, machine-to-machine modes of communication, etc.). Hassan, Hadeel Kareem, et al. [12] The availability of portable medical services and mobile health care services, which have both aided in the development of unique

features of healthcare service delivery, were also topics explored in this article. This study also examines the advantages of this technology associated with networking techniques, as well as the possible Internet of things in the healthcare industry.

The existing situation of healthcare services, as addressed by Bikash Pradhan et al. [13], is reviewed in this paper along with IoT-based solutions. Medical professionals have benefited from Internet of Things (IoT) technologies in maintaining and diagnosing a variety of health issues, measuring a variety of health parameters, and offering clinical services in remote locations. Md. Sanju Islam, et al. [14], within the context of healthcare, this article discusses the core concepts of a Internet of Things (IoT). The Internet of Things (IoT) is enhancing our lives in a variety of contexts, such as the workplace, the home, the environment, retail, security, industry, agriculture, entertainment, energy, medicine, and so on. The four-step design has uses, technical advantages, benefits, and limitations. In Sneha Deshmukh et al. [15], this article compares assaults on IOT healthcare systems in terms of efficacy, methodology, and security requirements. By blocking operating systems, stealing information, updating data, altering the data flow, and discarding data, these security concerns have an impact on the system. Implementing specified security criteria is important in order to build a secure health monitoring system.

Shaftab Ahmed, et al. [16], this study discusses several potential applications of IoTs within healthcare with the goal of enhancing quality of life. With a concentration on security concerns along with the importance of investigations and identity authentication for IoT devices for larger societal adoption, the issues and future prospects of research are examined. Shubham Banka et al. [17], In this study, we have suggested and demonstrated a prototype for an automated service that assures continual assessment of a variety of health parameters and early diagnosis of any illness or disease, sparing the patient that discomfort of having to make frequent hospital visits.

In their study, Cheena Sharma et al. [18] gives a quick summary of the most recent advances in patient monitoring as an IOT deployment that has transformed the established healthcare system. Smart healthcare systems have tackled the complexity and challenges of operating in an IoT context.

This survey highlights the persistent threats to researchers' safety as well as the current challenges. The goal of the study by Swapna Kolarkar et al. [19] is to provide a healthcare method of service delivery that will benefit from the integration of the Internet of Things with a 5G network. It is largely concerned with the research literature on IoT and 5G significant health monitoring in different healthcare applications. Domenico Balsamo, et al. [20], this research has looked at a number of modern equipment as well as outstanding problems with potential

IoT applications to healthcare services. Among these energy-constrained technologies, Internet of Things (IoT) technology solutions and IoT data management employing signal process and machine learning approaches are highlighted in particular.

A. Priyanka et al. [21]. In order to comprehend the patient's problem and offer the best treatment, an expert will thoroughly review each reader's personal details and state of health in their paper. A significant amount of data will be moved and stored using the customized relationship record framework. Now, rich data revealing our psychological and physical wellness can be discussed in public places.

Jaimon T Kelly et al. [22] Each reader's personal details and health status will be carefully scrutinized in the paper by an expert so they may completely comprehend the patient's problem and offer the most appropriate remedy. To store as well as move a sizable amount of data, a customized relationship recording architecture will be utilized. In social settings, rich data indicating our wellbeing at the physical and psychological levels can now be shared.

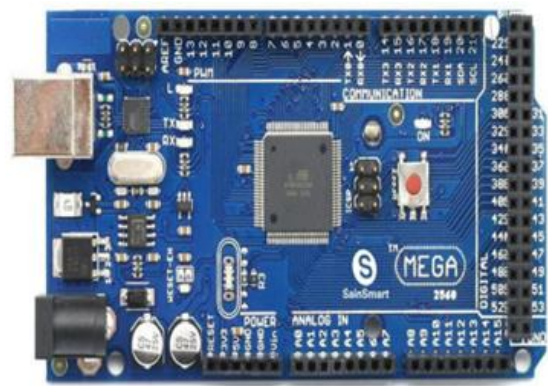
The focus of this study is an IOT-based smart health monitoring kit that was introduced by Vaishali et al. [23]. It contributes significantly to medical emergency services such as intensive care units by using an Intel Pegasus 2nd generation test system (ICU). The patient's vital indicators, such as blood pressure and temperature, should be monitored. This equipment also makes it easier for the patient & his doctor to communicate. This device captures real-time data from a patient and sends it to their doctor for later use.

The importance of IoT in the health-care industry has been disputed, according to Saranya et al. [24]. It would be advantageous for non-ambulatory hospital patients to have access to a disease prediction. One of the most recent trends in the healthcare sector is IOT. This approach will help the doctor and indeed the patient make a quick decision regarding the next type of medical treatment, saving time for both parties. Additionally, they have accessibility to it at all times and locations.

The patient can obtain adequate and efficient medical care by collecting data by using IOT to monitor their present status and storing it in the cloud. The most recent advancements in HIOT System applications are described in full in the study by Amit Srivastava et al. [25]. In addition, HIOT System statistics as well as other potential problems and issues have been provided. The foundation for upcoming development and research initiatives will be laid by these challenges.

The study by Hrishikesh P. et al. [26] is based on the notion that various hospital-related problems can be treated by utilizing Connectivity of Things (IoT) technologies. The amount of electricity used by hospital electrical and hospital equipment is considerable. There are several elements that must be routinely managed in a healthcare system. It includes personnel, patients, and

tools and equipment for medical monitoring. The current status of information technology, according to Mohd Javaid et al. [27], has allowed for innovation in fields including proper medical documents, sampling, adaptation process, and illness causes in daily life. IoT's sensor-based technology provides a terrific solution to reduce the risk of surgery in challenging circumstances and is helpful for COVID-19-type pandemics. Ankush Raina, et al. [28] this essay discusses the Internet of Things and how it can be used in healthcare. The intelligent attributes, supportive accelerators, and operational batch processing of IoT in the health-care industry are discussed using diagrams. In this study, we selected and analysed the most important IoT for healthcare applications, Zainuddin Bin Hassan et al. [29].



(a) Arduino



(b) Node MCU

Fig. 3: Board used for IOT implementation.



Fig. 4: Future IOT 5G connected application.

The study's main search terms for relevant material included healthcare, healthcare system, health as well as

IoT. It's likely that some related articles weren't included in the databases used as a result.

Bikash Pradhan et al. [30], this study gives a comprehensive source of information covering the many sectors of application of IoT in order to assist the research community who are enthusiastic about conducting research in the field, including making improvements.

III. CHALLENGES

There are creative research challenges for the future of IOT in healthcare. The major challenge is the high deployment density and bandwidth limitations. More and more sensors are deployed on the same available bandwidth. But in the future there will be a bandwidth crunch. Designing low-cost devices is an important research challenge. Also, the intercommunication and security issues have to be addressed.

IV. CONCLUSION

This research aims to investigate the perspectives on various IOT applications in the healthcare and medical sectors. Using IOT in healthcare is essential to saving lives since it allows for remote patient health monitoring and emergency patient care in 5G ambulances. One of the main benefits of employing IOT in healthcare is the ability to diagnose diseases early. Challenges of sensor-based healthcare technology were also discussed in the paper's conclusion. Health care is significantly required to improve research on IOT in future to mitigate the challenges.

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