A Review Paper on IoT Solutions in Health Sector

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Abstract: The past decade has been marked by extensive research in the health services sector and their technological modernization. In particular, the Internet of Things (IoT) has shown potential applications in connecting medical devices, sensors and disparate healthcare professionals to provide quality medical services in faraway places. This has improved patient safety, reduced healthcare costs, improved access to healthcare services, and increased operational efficiency in the healthcare sector. An organization of human body wearable sensors, with each having a very precise identifier, could acquire healthiness statistics that are more detailed than what has previously been available for the regular observed data in scientific/clinical contexts. MIoT statistics when stored, analyzed, and evaluated by comparing with the records from extraordinary human beings, permits the customization and innovation of medical services with significant improvements in reduced costs and results. The current study updates the potential medical services of IoT technologies (MIoT). Here, the progression of the adoption of MIoT was reported in terms of latest technologies, medical care and services to solve various health problems. In summary, the present study serves as a comprehensive source of data on various application areas of MIoT with the aim of helping future researchers interested in this field.

1 INTRODUCTION

IoT is being pushed to play a big role in all facets of healthcare administration because to the rapid development of IoT devices and the desire to make healthcare more affordable, individualized, and watchful. This has raised the expense of healthcare and put a pressure on rural and remote medical facilities. Advances in Internet of Things (IoT) technology and rising needs as well as best practices in smart healthcare have a lot in common.

The healthcare industry has expanded quickly in recent years and is a significant source of wealth and jobs. A few years ago, a physical examination in the hospital was the only way to diagnose illnesses and bodily anomalies. The majority of patients seek their treatment in hospitals. This has increased healthcare costs and has also put a strain on health facilities in rural and remote areas. There are strong synergies between Internet of Things (IoT) technological advances and increasing demands as well as guidelines throughout smart healthcare. The growing development of IoT devices, as well as the intention to make healthcare more cost-effective, customized, and vigilant, are attempting to push IoT to play a significant role in all areas of healthcare administration. It is poised to enable the IoT segment, the Medical Internet of Things (MIoT). MIoT is divided as two subcategories: clinical and individualized/personal. Individualized/personal MIoT incorporates devices consumers use for self-monitoring, such as activity/heart rate trackers, smart clothing, and smartwatches (such as Fitbit [1] and Apple Watch [2]). These general-purpose gadgets are not subject to stringent regulation and are designed for consumer usage without the assistance or advice of a doctor. Clinical MIoT devices are specifically designed for health monitoring with physician guidance and engagement. Examples comprise connected inhalers [4] and smart continuous glucose meters [3]. Strict regulations apply to these devices, which are only permitted for use after being clinically validated. An overview of the developing field of clinical MIoT is given in this study.

A convergence of both technological and social factors is driving the development of Internet of Things technology in the medical field (Figure 1).

Figure 1: Advancement of Internet of Things technology in medical field.

The elderly citizens in Western countries are burdened to have physical facilities, and treatment costs are rising far faster than the general inflation rate [5]. Since many healthcare facilities are already online, they may benefit from the expanded access to high-speed connectivity, low-cost cloud computing, and in-depth data analysis. In this new scenario, MIoT technology is attractive. Not only will it enable the personalization of clinical care delivery, enabling significant cost savings, however it will also make it possible for better results by enhancing flexibility, personalization, and the efficient use of data obtained. MIoT reduces the duration it takes to detect medical conditions [6], provides efficient and high-quality care that reduces hospital costs [7]. By connecting to MIoT, patients can give doctors continuous feedback and track their own improvement to increase the involvement of patient and their happiness. The extensive collection of historical data collection from numerous resources enabled with the introduction of MIoT also creates new opportunities towards extending the common screening approaches used by practitioners (Figure 2).

3 RELATED WORK

Several recent studies have addressed components of MIoT devices. MIoT systems focused on individualized medical centers [8] and infant/kid apps [9] were explored. Technologies in remote health surveillance systems which includes high fever monitoring and aged care [10], as well as technologies for Ambient Assisted Living (AAL), smartphones, and wearable devices have all been thoroughly studied [11]. Focusing with a goal of improving healthcare in underdeveloped nations, MIoT applications in rural healthcare are also reviewed [12]. Other reviews include research papers concentrating on connectivity [13], safety and confidentiality facts of MIoT devices [14,15]. MIoT in home automation [16], elevated surroundings and security sector [17], and MIoT-services for mental illness [18] have also been the focus of several reviews. Unlike the previous studies, this paper specifically focused on clinical aspects of MIoT and covered them comprehensively.

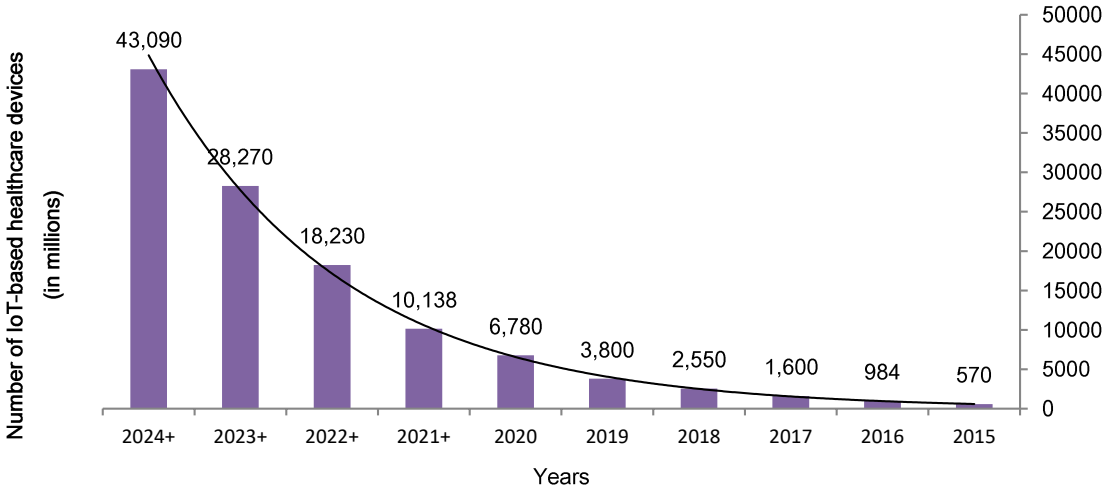

Figure 2: Estimation of IoT devices in future.

Authors in [19], created a process known as We-Care. The system aims to collect data and monitor the overall health of the aged using MIoT technology and provide health alerts to medical teams via sensors worn as watches. The vital signs of the elderly are gathered by We-Care and sent to the medical staff. The system is created to be user-friendly, economical, and energy-efficient. Both medical teams and older people have found this technique to be effective. The technology also supplied a better substitute for conventional healthcare and elderly tracking techniques as well as a dependable way to alert in an emergency. Most significantly, fewer trips to medical facilities are now necessary.

In [20] HEARTFAID aims to develop an innovative service platform for early detection and effective treatment of heart disease in the elderly. Its creative computerized systems can help improve processes such as diagnosis, prognosis, and treatment delivery, and can be applied to EHR, remote monitoring, signal and image processing, and pattern recognition of previously collected data. It offers services such as targeted clinical decision support for heart patients, analysis and decision of interventions for them.

The creation of an early detection and warning system for elderly people who experience a stroke abruptly while exercising was discussed by researchers in [21]. The described solution connects the senior to his smart devices in order to accomplish this purpose. This intelligent device is Self-learning and wirelessly connected to your computer, The system is made up of a number of fundamental parts, including a knowledge base, a real-time patient monitoring interface, self-learning devices, and a number of parts that guard the network against outside threats. Despite the fact that this study is sound in theory, it only looks at older athletes.

Authors in [22] proposed the development and deployment of an MIoT healthcare tracking device. This is quite helpful for many rescue services. This article described the development of 2nd generation Intel GALILEO to support intensive care units, Critical care units, and as well as other services.

The usage of digital handheld electronic components has suggested to improve the standard of patient care (Table 1). Recent research has focused on integrating navigation and location systems into these wheelchairs in [23]. The idea is to connect a real-time obstacle avoidance system with a MIoT steering system. When actual data is captured and examined using image processing techniques, GPS devices can identify barriers.

Table 1: Related work of various healthcare techniques.

No.	Authors	Sensors Used	Diseases	Description
1	Varathar ajan, R et al.[27]	Human Wearable sensor devices	Fever, Diabetes, Blood Pressure and Heart rate	ECG, EMG, pulse oximeter, mica2 motes and SpO2 sensor were used to continuously monitor individual health conditions.
2	Gia, T.N et al.[28]	Arduino Due, Blueto oth, Wi-Fi, ZigBee or 6LoWPAN.	Heart Issues	A health monitoring system that employs secondary network infrastructure based on Internet of Things and contains multiple sensing devices including Wi-Fi and Bluetooth.
3	Rahulamat havan, Y et al.[29]	Body sensors	Health criticality of any patient	Criticality Aware data transmission (CARE) is a scheme proposed in CPS-based medical systems for boosting the computational frequency of patients sensed physiological attribute values.
4	Mukherj ee, A et al. [30]	Body sensors	Intensive care patients	The proposed "DROPS" scheme recognizes radio protocols dynamically in a resource smart Wearable medical system.

Wheelchair monitoring has become more involved and simple for patients because of mobile computing [24]. Through the integration of numerous sensors, mobile technology, and cloud computing, the described intelligent wheelchair was created. A mobile app that is part of the system enables patients to communicate with their wheelchairs and carers. The software also enables caretakers to keep an eye on wheelchairs from a distance. In [25] Insulin is a state in which glucose levels in the body rise for an extended period of time. This is one of the most common human ailments. In general, there are three main types of insulin: Type 1, type 2 , gestational. Diseases and their types can be identified using three tests: A randomized plasma glucose test, a fasting

plasma glucose test, and an oral glucose tolerance test. However, the most common diagnostic method for detecting diabetes is "fingerpicking" followed by measurement of blood glucose levels. Recent developments in MIoT technology have been leveraged to create a variety of non-invasive, friendly , affordable, and reliable wearable glucose meters. An M-IoT-based non-invasive blood glucose meter has been proposed for real-time blood glucose monitoring. In order to detect cardiac problems in real time, researchers in [26] presented an Internet of Things (IoT)-based ECG monitoring system made up of a wireless data gathering system and a receiving processor. ECG, EMG, pulse oximeters, mica2 motes, and SpO2 sensors among other sensors in [27] used to continuously monitor patient health parameters. The authors in [28],developed a health monitoring system that makes use of IoT secondary networks and has numerous sensors, including Wi-Fi and Bluetooth. Researchers in [29] ,developed Criticality Aware Data Transmission (CARE) as a method for accelerating the processing of a patient's sensed physiological parameter values in CPS-based healthcare systems. Mukherjee et al. [30] recommended "DROPS," as a method that dynamically chooses radio protocols in a wearable IoT healthcare system with limited energy.

3 CONCLUSIONS

Internet of Things technology is a technological innovation which provides improvements and easy alternatives in areas of healthcare such as hospital record keeping, sample collection and device integration. The use of IoT technology offers an excellent opportunity to lower surgical risks in complex cases The MIoT system was analysed from a variety of perspectives in the recent review. Information on existing health services where MIoT-based solutions have been studied is included in this study. Keeping these ideas in mind, MIoT technology has aided medical practitioners in the monitoring and diagnosis of several health issues, the measurement of numerous health indices, and the provision of diagnostic resources in remote areas. Due to this, the healthcare industry has changed from being controlled by hospitals to become more patient-centered. MIoT addresses the right strategy for information systems to manage global results and promotes hospital system transformations, this information-based service offers up new potential in healthcare. When used properly, MIoT can assist in precisely resolving a various medical challenges such as speed, price, and complexity.

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