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# A Comprehensive Survey on Machine Learning Based IoT-Enabled Remote Healthcare System for Older Adults

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**Abstract- The increasing older population, as well as their desire to live independently, even if they have medical conditions connected to their age, necessitates the development of innovative technology to provide maximum improvement of quality for this age group. Increasing the aged population's well-being and quality of life is strongly linked to helping people efficiently manage age-related diseases such as chronic illnesses, as well as maintaining their freedom and self to the greatest extent feasible. This paper presents analyzed technologies used in remote health monitoring systems, especially for diabetics and heart disease, elderly people. In the field of health and disease prediction, numerous methodologies are used. These are Machine learning (ML), cloud computing, Internet of Things (IoT),), big data and), artificial intelligence (AI). Furthermore, the data for a research paper is collected from forty five previously published studies from respectable articles. A systematic review approach is also used in the paper. Moreover, the study was driven by the Internet of Things (IoT) technology, which is commonly employed in remote healthcare. With the help of IoT technology, health metrics may be wirelessly monitored, which reduces unwanted hospital visits and the related expenses of care. we will beable to employ IoT for remote monitoring of old people in the future.**

**Keywords- Remote Health Monitoring, Internet of Things (IoT), Machine Learning, Chronic Diseases**

## I. INTRODUCTION

In recent years, there has been an increasing demand for a long-term system to support an aging population, independent living, and everyday activities for elderly adults[1]. In general, living with chronic illnesses such as heart disease, respiratory disease, diabetes, and moderate mental retardation, which frequently accompany aging, is directly tied to maintaining a particular degree of standard of living[2]. The use of pervasive Remote monitoring and smart technology for elderly care would enhance fragile old people's health care outcomes while also increasing their freedom and the health care services accessible to them[3].

The innovative and breakthrough real time remote healthcare monitoring system for chronic disease persons, a popular component of telemedicine design, is critical for patient confidentiality and privacy, and it adapts multiple sensing technologies via a variety of built-in sensors[4][5]. People who need quick and accurate health remote monitoring aren't getting the help they need. These inconveniences make healthy people even more hesitant to use the service and forget to have their health monitored regularly. Due to the obvious confluence of developing and existing technologies, this is conceivable. When only one technology is used, this is not feasible[6].

In most times, seniors who are capable of living freely are forced to remain in their homes and are

denied any independence by their relatives due to health concerns. Because of their modern and urban lifestyles, the youth does not have time to look after the elderly[7][8]. The capacity of a doctor to observe the elderly from a remote place without using a clinical environment has increased because of remote health monitoring. This is collected health-related information from individuals in a variety of ways, including wearable body sensor applications, and sends it via the internet to doctors and clinicians who are accessible everywhere for evaluation and suggestions[9].

To analyzed positive changes in how healthcare services are offered to the elderly and health care professionals especially for chronic disease people, health organizations rely on the introduction of modern information and communications technologies those are Machine Learning, Internet of Things, Big Data Analytics, Big Data, Cloud computing and Artificial Intelligent [10]. This part introduces remote health monitoring and the uses of Chronic diseases person. Literature review explains other literature on Remote healthcare monitoring systems. The methodology part was explaining the proposed model and the results and the discussion part was analyzed the results of the proposed system, also discusses the reproduction and outcomes from the discussion. The conclusion and future work are described in the conclusion part.

## II.LITERATURE REVIEW

E-health services are provided via customized medical systems to meet the medical and assistive requirements of the elderly society [11]. In terms of independent living, senior persons encounter numerous problems, including a reduction in mobility or cognition, as well as chronic physical and mental health concerns. Parkinson's disease, diabetes, stroke, falls, frailty, dementia, and other illnesses and adverse occurrences are examples [12].

There was evidence that the intervention had a distinct effect on people with heart disease and those with diabetes. Patients with chronic disease may be more likely to benefit from this type of treatment. This is something that should not be overlooked when designing novel methods for chronic illness self-management. Interactions between technology and faraway locations are becoming more advanced. [13] healthcare has resulted in quick advancements in Internet of Things (IoT) innovations, wearable devices, big data analytics and providing good potential for situation-aware healthcare applications [14]. Elders are becoming increasingly worried about this novel approach as the community matures [15]. Authorities are promoting remote monitoring consulting as a cost-effective strategy to give health care to an elderly society with rising long term illness levels [16].

Diabetes is a long-term condition characterized by low or high blood glucose levels. A little blood sample is taken by pricking the skin, but then a test st rip is linked to a device, which measures the level of blood glucose reading using the Alere G1 Glucometer [17]. The current COVID-19 pandemichas highlighted the necessity of telemedicine as a commercial model for increasing healthcare accessibility and enhancing a country's inhabitants [18]. By providing an intelligent framework, the IoT [19] has changed the functioning of next-generation technologies. Cloud and IoT-based systems have been widely employed to provide intelligent automation and services for a variety of applications. Thehealth sector is one of the areas where Cloud, as well as IoT, were actively deployed [20]. Following an introduction to diabetes and glucose sensing, various cutting-edge pipeline devices are examined, with a focus on user convenience and technological advancements like the IoT [21].

The Internet of Medical Things (IoMT) has recently become increasingly important in remote healthcare monitoring. The IoMT is mostly used to collect remote facts for patients via wearable sensors/devices and store it in cloud databases. Clinicians have access to these data in real-time for analysis and utilization. The IoMT is divided into three stages: fog layer, cloud service, and device layer(BSN) [22]. RFID, Sensors, infrared, GPS, and wearable technology are examples of sensing devices and technologies included in the IoT. The Internet of Things (IoT) is a concept that entails equipping everyday objects with sensing, networking, and computing capabilities so that they may communicate with one another and with internet services to achieve specific purposes. [23].

## III.METHODOLOGY

We evaluated over 46 research publications for our study, which stated our aims and

study background. These literature studies, as well as the study's features, were used as secondary data in this investigation. We proceeded with the analysis based on the characteristics to find the solution to the research topic that was described in the introduction section. We selected 45 research articles from a total of 75, based on the following criteria and all papers released based in both conferences and journals.

- Majority of the Published papers between 2018 and 2022
- Only full papers
- Peer-reviewed papers
- Articles is an open access

**1. Research Objectives**

This study consists of only one objective, which is the following:

- To identify advancements in elder assistive technology and aging-in-place technologies
- To Explore how emerging technologies help in the Remote healthcare system for diabetics andhearty person.

**2. Research Questions**

The below table shows the study questions development for the article

- How do emerging technologies used in the Remote Healthcare system?
- What are the most main challenges to implementing new technology in remote health care systems??

## IV.RESULTS AND DISCUSSION

| Main Technology | Included Techniques | Diseases |
|---|---|---|
| Health (Smart Phones) | Gyroscope, Heartbeat sensor, Sensing unit consisting of a pressure sensor, Accelerometer based prototype embed LPC11U24 as the main processing unit. Accelerometer, the temperature sensor. | Heart Beat, Blood Pressure, and Temperature |
| Wearable IoT-cloud based health care monitoring system | BASN, WISE, for real time personal health care monitoring. | cardiovascular disease, diabetes, obesity |
| Sensors Used based on Android App | Data will be collected using wearable devices (microprocessors), sensors as well. GSM, GPS was used to track position and monitor specific actions using an Android app. | All diseases |
| Cloud Healthcare System | Cloud Based Digital Twin | Predicting diagnosing, and monitor all kinds o sicknesses |
| Mobil based system | Wireless network communication, sparse autoencoders- encoders depending on a deep learning model (CSAE) | Disease estimate |
| IoT | Healthcare IoT, SDN, IoT | All Diseases |
| Cloud-Fog | ML, Sensor, GPS | All Diseases |
| IoT | WBAN, SDN, and Network Function Virtualization (NFV) | All Diseases |
| IoT | Advanced Encryption Standard (AES) and Rivest, Shamir, Adleman (RSA) cryptographic algorithms 2D Discrete Wavelet Transform 1 Level (2D-DWT-1L), 2D Discrete Wavelet Transform 2 Level (2D DWT-2L), steganography, and hybrid blending | All Diseases |
| IoT | ANN, cluster heads (CHs) and PSO based Clustering EEPSOC | All Diseases |

| | | |
|---|---|---|
| IoT | Fuzzy Random Forest (FRF), BSN | All Diseases |
| IoT | Genome-wide association study (GWAS) and Reasoning base Intelligence Control (GARIC) | All Diseases |
| Cloud-IoT | e-prescribing system, Electronic Health Records(EHR), Personal Health Records, Clinical Disease Systems and Pharmacy healthcare Framework | All Diseases |
| IoT | BSN | All Diseases |

Different technologies are employed in various research publications, as shown in above Table 1. The [7] used mHealth as the main technology which includes Gyroscope, Heartbeat sensor, Sensing unit consisting of a pressure sensor, Accelerometer-based prototype embed LPC11U24 as the main processing unit, accelerometer, temperature sensor to predict Blood Pressure, Heart Beat, and Temperature. Furthermore, reference [27] also includes a Mobile-medical-based system to predict the disease. The reference papers [24], [26], [29], and [35] are indicating cloud as the main technology.

Also, it contains different types of techniques such as BASN, WISE, for real-time personal health monitoring, Cloud Digital Twin Healthcare, e-prescribing system, Electronic Health Records (EHR), Personal Health Records, Clinical Disease Systems, and Pharmacy healthcare Framework, particularly for all diseases. Other study papers us IoT as a maine technology with varies sub technologies. The reference papers are [28], [30], [31], [32], [33], [34] and [36]. These IoT contains different technologies such as SDN, IoNT, WBAN, SDN and NFV, 2D-DWT-1L, 2D-DWT-2L, AES, RSA, ANN, CHs and PSO based Clustering EEPSOC, FRF, BSN, GWAS, GARIC. The IoT technology used to predict all kinds of diseases as well.

## V.CONCLUSION

The goal of this study was to see what kinds of monitoring technologies are available for older individuals at home and the use of these technologies for chronic diseases older people[37]. We used 45 papers for reviewed and we analyzed remote health care system for elderly rely on the introduction of modern information and communications technologies those are Internet of Things-IoT, Big Data Analytics, Big Data, Cloud computing and Artificial Intelligent[38][39].

Furthermore, Elderly healthier people are more productive and have a significant influence on a state's prosperity. As a result, Various technological solutions are now being researched throughout the world in enhancing Remote healthcare services especially diabetics and heart diseases elderly people [40][41][42][43] . Moreover, the study was driven by the Internet of Things (IoT) technology, which is commonly employed in remote health care. In the future, All patients anywhere at the hospital will be able to be monitored using IoT, and these health parameters will be constantly monitored, with the data being sent to the hospital server. [44][45].

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