An overview of the Internet of Things in the Health Care and Care of Patients (Algorithm, Challenges, Applications, Benefits)

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Received 19 Jan 2021 ***Revised*** 18 Feb 2021 ***Accepted*** 5 Mar 2021

ABSTRACT:
The Internet of Things is an emerging and growing phenomenon that is rapidly spreading around the world, according to global statistics. The connection of a variety of physical objects to the internet and access to wireless sensor data is called the internet of things, whose achievement is to control the physical world around us. The Internet of Things is constantly offering innovative tools with a variety of capabilities that aim to create an integrated health care system with the vision of ensuring better patient care and reducing costs. Using the Internet of Things in the field of health, many diseases can be identified remotely and part of the treatment process can be done remotely and at home, thus preventing many additional visits to hospitals. The use of IoT technology in the design of health systems reduces human error and increases the level of quality and health safety. Not only is there a search for better solutions, but medical institutions are also looking for solutions to improve economic activity, reduce costs and risks, and increase security to improve the quality of health care. The purpose of this paper is to provide an overview of the IoT scenario and to evaluate its capability in medical technologies using sensor networks, as well as to review the proposed algorithms in this field. We also examine the various aspects of connectivity and interaction that are used in the IoT to exchange information between the users and to examine the applications as well as the implementation of the IoT in the field of medical science. Finally, we examine the challenges of implementation that need to be resolved and examine the future developments approach. The findings can be used as an important study resource for healthcare providers, researchers, technology professionals, and the general public to improve the Internet of Things for healthcare.

KEYWORDS: IoT, IoT architecture, smart health, IOHT, smart medicine

1. INTRODUCTION

The growth and development of the Internet of Things in recent years has expanded the scope of information and data, thus creating a wide range of services; To be effective in achieving scientific goals in all fields. Especially heart diseases that are increasing rapidly in developing and developed countries. The most vital part of the Internet of Things is communication. In fact, the method used for this communication is very important and vital. IoT in general refers to many objects and smart devices in our environment such as refrigerators, televisions, ventilation systems, home and office lighting, etc., Which are connected to the Internet and can be accessed by existing applications. Control and manage on smart phones and tablets. The Internet of Things has also been very successful for many businesses and stores and has shown that a bright future for this technology can be envisioned in the field of commerce. With the pervasiveness of patient health monitoring systems, the recording and exchange of various telemedicine parameters has become commonplace. Using these systems, health care providers are able to diagnose diseases quickly and suggest appropriate treatment options and prescribe appropriate medications according to the specific needs of each person [1]. Studies show that so far different systems have been designed to monitor the physiological parameters of the patient. In most of the studied systems, the system was designed to monitor the health status of chronic patients and the elderly so that medical interventions in emergencies can be performed with the least invasiveness and in the shortest possible time. Biosensors, smart phones and cloud services are among the most common components used in these systems. Patient privacy, massive data volume analysis, and accurate diagnostics are important and challenging issues in deploying IoT-based health monitoring systems. IoT-based monitoring systems facilitate the timely recording of physiological information and its seamless transmission to health care providers, and minimize potential delays in providing immediate assistance to those in need of care. The use of IoT technology in the design of health monitoring systems reduces human error and increases the quality and safety of health care. Accordingly, the accuracy of detection in remote monitoring seems to be very important and necessary [2,3]. The IDC Research Institute says that in 2012, the technology generated about $ 4.8 trillion in revenue for companies around the world that took the technology seriously. Given the growing trend in the use of this technology, researchers from the IDC Research Institute predict that the revenue from the use of the Internet of Things will be about $ 7.3 trillion by 2017, and this figure will reach about $ 8.9 trillion worldwide by 2020. Vernon Turner, one of the directors of this research institute, considers the Internet of Things to be a new solution in communication and information technology that has a high potential for earning money. "It's just liked the tip of an iceberg, much of which is still hidden, to encourage people and companies to become more familiar with the technology and encourage them to," he said. "We need more time to use it, but what is certain is the future of the Internet of Things." This project has a bright future ahead due to the increase in the development of smart cities, cars and smart homes, the improvement of communication infrastructure, as well as the increase in people's acceptance of the use of the Internet of Things. He continues: "Although the popularity of the Internet of Things is growing, but this project is still in its infancy and several factors prevent it from accelerating its progress to bring this dream closer to reality." Some of these factors are related to the lack of necessary standards, the relative lack of knowledge about this project, as well as its benefits. Despite these obstacles, the IDC Research Institute predicts in a new report examining the opportunity and growing IoT market that by 2020, some 212 billion objects worldwide will be based on the IoT. ‘’Markets and Markets’’ predicts the value of the Internet of Things to be around $ 163.2 billion, trade reports claiming to be worth $ 117 billion, and McKinsey estimating the economy to be over $ 170. Cost savings will lead to improved quality of life for patients with chronic disease and health monitoring that prevents disease complications [4] Based on the fact that IoHT will have a major economic impact on the world.

1.1 IOT AND ITS FUTURE PROSPECTS

The Internet of Things was first introduced by Kevin Ashton in 1999 to provide an advanced state of communication between different systems and devices, as well as facilitating human interaction with the virtual environment, and described a world in which everything, including inanimate objects, to have a digital identity for themselves and to allow computers to organize and manage them. According to Kevin Ashton, the Internet of Things is a tool for overcoming the domination of time and space, which was first popularized by the Automated Identification Center. At present, all the people of the world are connected and connected by devices connected to the Internet, and these connected devices are increasing day by day, and many of them are not under the control of any person, and therefore space is being created. It is the formation in which all objects/devices are connected to the Internet, which can be called the Internet of Things. RFID is considered a prerequisite in IoT technology [3]. What is the broader concept of the Internet of Things, called the Internet of Things (IoE), in the

article What is the Internet of things? Has been described [5]. The advancement and convergence of micro-electromechanical systems technology, in other words, wireless communication alongside digital devices, has led to the development of miniature devices. These devices have the ability to sense, calculate and communicate wirelessly. These miniature devices are connected using nodes to form a wireless sensor network [6]. In the Internet of Things, new data streams can be collected, recorded, and analyzed more quickly and accurately by creating devices that collect and share information directly with each other on a platform called the cloud. In such a system, programs can be classified according to the type of network availability, coverage, scale, heterogeneity, repeatability, user engagement, and impact [7]. These programs can be classified into four areas: personal and health care, organizational, water and electricity, and mobile. Objects at the scale of a community, the Internet of Things as a tool on a national or regional scale, and the Internet of Things on mobile have been shown to spread to other areas, mainly due to the nature of the connection and the scale [8].

1.2 SURVEYED THE STATUS OF THE IOHT INDUSTRY

The growth of IoHT is experiencing a great exploration. New companies and multinational corporations have taken steps to reach this giant market and to enable products and improvements. Table 1 presents a set of solutions for a better understanding of existing solutions currently available. For each identified solution, the services provided, the company, and the product are available, as well as a brief description of its features.

1.3 IOT ARCHITECTURE

If we review the history in the reverse direction, we observe that there are many different network domains in regard to the integration of communications, which ultimately created a common design and a common reference model called the TCP / IP protocol. The Internet of things also requires a reference model; a model not only used to direct and accelerate progress, but rather to focus on communication and contribute to the development of different needs [9]. Reference architectures are the best guide in the field of standardization and recommend the necessary policies. The ARM reference architecture was built to ensure compatibility and also providing solutions for various aspects of the IoT. With the help of end-users, an organization of stakeholders and experts gathered to gather the new Internet needs and introduce them in the process of building a major model.

The architecture of the IoT Reference Model is made of these six layers:

a) Power coding layer: The data encoding layer is the basis of IoT work, which has the identification of objects. In this layer, each object is assigned a code as a unique identifier that facilitates the recognition of objects [10].

b) Object abstraction layer: The work of this layer is to transmit the produced data from the perception layer through a secure communication channel to the service management layer. In this layer, data can be transmitted through different technologies such as Bluetooth, Bluetooth, RFID, 3G, Low energy, ZigBee GSM, UMTS, and infrared. Moreover, there are other tasks such as cloud processing and data management process [11].

C) Network Layer: The purpose of this layer is to receive useful information in the form of digital signals from the perception Layer and transfer it to processing systems in the Layer through transmission media such as WIFI, Bluetooth, WiMAX, Zigbee, GSM, 3G, and so on with protocols such as IPv4, IPv6, MQTT, DDS [12].

d) Service management layer: This layer processes the data received from sensor devices [13]. It consists of technologies like Cloud computing, ubiquitous.

e) Application Layer: It is tasked with providing services requested by users and consumers. The importance of this layer for the Internet of things is that it can provide high-quality intelligence services to consumers to meet their needs [14].

f) Business Layer: It manages the Internet of things applications and services and makes responsibility for all research on business models. This layer makes it possible to support the decision - making process in terms of analyzing large data. Besides, it has the responsibility to supervise and manage the top four layers of its level. It also compares the output layer of each layer with the output in the ideal state to improve service quality and protect individual privacy. In Fig.1, these six layers are plotted [3].

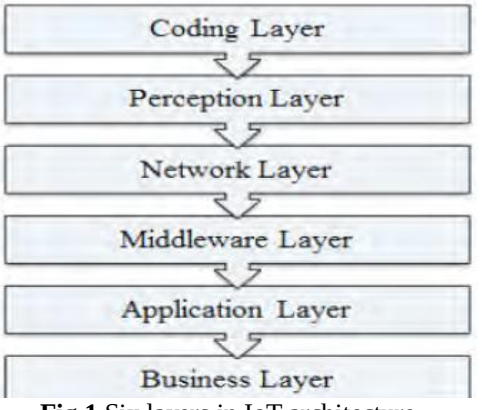

Fig.1. Six layers in IoT architecture

1.4 IOTSERVICE-ORIENTED RCHITECTURE

Service-oriented architecture is recognized as an important issue for service providers and users of the Internet of Things. This architecture, the general scheme of which is shown in Figure 2, ensures the ability to work together between heterogeneous devices. The four main layers in this architecture are the measurement layer (including status sensor hardware objects), the network layer (including infrastructure for wired or wireless communication of objects), the service layer (to create or manage the services needed by users or applications) and the layer Interface includes (methods of interaction with the user or application software) [15].

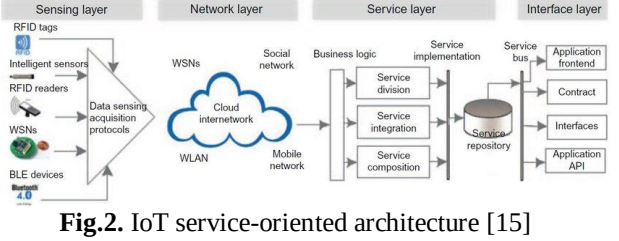

Fig.2. IoT service-oriented architecture [15]

1.5 THE VARIOUS CONNECTION TECHNOLOGIES AND INTERACTIONS BETWEEN DEVICES ON THE INTERNET OF THINGS

The automatic exchange of information between two systems or two devices without any manual entry is the main objective of the IoT. This exchange of information takes place in some specific technologies we describe.

1.5.1WIRELESS SENSOR NETWORK:

The composition of nodes in wireless sensor networks is independent of the frequency and bandwidth of wireless communication. Each node in the wireless sensor network is typically composed of the following components:

1) sensor 2) microcontroller 3) memory 4) radio transmitter and receiver 5) battery

1.5.2 RADIO FREQUENCY DETECTION

In IoT, RFID technology is mainly used in conjunction with each other to interact with each other automatically. RFID tags use radiofrequency waves to communicate and exchange information with each other without the need for arbitrary balance in the same line or physical contact. By using wireless technology, it is automatic to identify and record data. RFID consists of two components [16]:

1) Transmitter 2)Receiver.

1.6 INTERNET OF THINGS IN MEDICAL SCIENCES:

There is no doubt that the Internet of Things has completely transformed the medical industry redefining the role of applications, devices, and the way people communicate in providing medical solutions. IOT continuously offers tools for integrating healthcare and medical systems with more precision and efficiency, thus reducing treatment costs and improving treatment outcomes. IOT can be used in various fields of medicine, including the remote care system, chronic illnesses, and care of seniors, diet and fitness programs, and an alarm system. These can include the heart rate measurement system, the blood pressure measurement system, the pulse rate, and hearing aids. IOT's non - invasive monitoring systems are used most of the time for patients where their physiological condition requires careful attention and constant attention. These monitoring systems use sensors to collect physiological information, store information with various tools, and then send it to controllers for further aggregation. A health expert has to investigate the critical symptoms of patients after regular intervals. Therefore, an automated flow of information is provided that leads to an increased quality of care as well as the continuous improvement of improvements in less time, which in turn reduces the cost of care [17]. There are also programs in which the doctor can control the patient after the patient is discharged from the hospital.

Fig.3. Remote monitoring of patients [17]

2. AN OVERVIEW OF IOT RESEARCH ON HEALTH CARE

In [18], an intelligent energy model is to increase the lifetime of the IoT - based network for intelligent monitoring of the proposed diabetes disease. The input data in this paper are the system signals from patients compiled by embedded sensors. In this paper, the superiority of the proposed method over other methods based on measurement criteria such as the rate of delay of sensor nodes in data transmission and energy consumption of nodes is shown. In [19], researchers have proposed an intelligent system for the diagnosis of heart disease, in which the classification of the logistic regression algorithm is used with a feature selection method. Researchers in this paper believe that some of the properties in the data collection are redundant and that leads to the high complexity of the diagnosis problem and also affects the accuracy of diagnosing the disease. The finding suggests that their approach has detected an accuracy of 84 percent prior to the selection process. While the accuracy of the system after selecting the feature has reached 89%. Other studies also demonstrate the superiority of the proposed method of this paper to the SVM - based approach. The data set of this paper is published in the Kaggle database. in [20, 21], researchers have proposed a new algorithm for the diagnosis of heart disease by combining artificial neural networks and feature selection algorithms, particularly multilayer Perceptron. Neural networks are modern systems and methods for machine learning, knowledge representation, and finally applying knowledge resulting in the prediction of output responses from complex systems. The main idea of such networks is somewhat similar to the way of performing the biological neural system for data processing and information for learning and knowledge creation. The results show that the efficiency of artificial neural networks increases after selecting features in the disease diagnosis process. Also, the computational complexity of the algorithm is reduced. The data set used in this paper is the same set published in the UCI database. In [22], researchers have introduced a new algorithm to select a characteristic with the name (Feature reduction with validation) And then they examined the efficacy of the Bayesian classifier in combination with it to diagnose heart disease. They have evaluated their proposed approach with algorithms such as neural networks and Random Forest and the findings indicate that their proposed method is an efficient approach to the diagnosis of heart disease. The data set used in this paper is the same set published in the UCI database. In [23], researchers have proposed an efficient approach to diagnose heart disease by combining the SVM and genetic optimization algorithms. In this paper, researchers have increased the accuracy of the proposed method in the detection of heart disease by using a genetic optimization algorithm. Researchers in this paper believe that the parameters affecting the performance of SVM are the values of two parameters C and NU. The C parameter is an error controller in SVM. The small amount for C increases the number of training errors and increases a large amount of sensitivity of the algorithm to the allowed errors. The NU parameter also affects the number of support vectors of the algorithm. Therefore, the complexity and reliability of the network depend on its value. Also, there is a relationship between educational noise and NU value.NU parameter modification can be effective in SVM accuracy. Accordingly, regularization of the parameters C and NU is considered as an optimization problem. The findings indicate that the proposed approach to researchers in this paper presents more reliable results than similar tasks. The data set used in this paper is the same set published in the UCI database. In this part, we can improve health and care decision making by physicians in this chapter by collecting the methods carried out by internal and external researchers in connection with the effectiveness of the proposed algorithms for the analysis of the data collected by sensors in IoT، it has a positive effect on patients ' smart care and will also be more effective in monitoring this form of treatment.

3. COMPARISON OF METHODS CONDUCTED IN HEALTH CARE USING THE INTERNET

a number of literatures related to medical care and the results obtained from them are summarized in table 1 to introduce the best-presented algorithms for data analysis. Previous algorithms show that the main focus of researchers in monitoring system monitoring systems is to reduce energy consumption, load balancing, data security collected, and delay reduction in data transmission and little research has been done to improve the accuracy of supervisory information in

order to determine the patient's condition. Recognition accuracy can assist physicians in the decision - making process. Therefore, in the present study, we will try to use machine learning algorithms and optimize an intelligent system to improve patient care systems, particularly heart patients.

4. APPLICATION OF IOT IN THE FIELD OF IOT HEALTH CARE:

1. Supervision for remote health care
2. The health solutions using smart phones.
3. Living with mobility systems for the disabled
4. Wearable devices

The population of the world is aging, in fact, one billion people have reached the age of 65 or older and are disabled on the elderly, so the IoT can significantly improve the quality of the elderly people's lives, for example, when using a small device in wearable clothing, the machine can send an elderly person's vital signs in case of an increase or decrease from the allowed threshold, send a warning to a doctor [24]. One of the most important applications of management of IoT in medicine is to check the vital signs and also specific parameters of people with chronic such as heart disease, diabetes, and respiratory diseases. The following are the reasons for using IoT for the following: Humans tend to spend their day - to - day life without worrying Under the Care doctor or nurse at their home or in good weather villages without having advanced medical facilities, and they don't like to spend long hours in the hospital [25]. Inter-organizational cohesion is another use of IOT that enables access to integrated information systems. This feature permits the access of authorized users (physicians, nurses, radiologists, etc.) to all medical information of a patient at different locations (hospitals, practices, etc.)

5. SOME OF THE BENEFITS OF IOT INMEDICAL CARE AND HEALTH CARE

The use of IoT has a lot of advantages in medicine and we will continue to introduce a number of them:

a) Reduce the huge cost of treatment: Each country's health care sector accounts for a significant portion of that country's costs. The USA Federal Office of Communications has predicted that with a reduction in patients ' inpatient treatment at hospitals and consequently the decrease in infections, and distance - care costs of patients on average will be reduced to $ 12 per patient [26]. In Iran per capita, health expenditure accounts for 6% of GDP, which is equal to 836% [27].

b)Reducing mortality from nosocomial infections: Hospitalization, followed by the onset of nosocomial infections, increases the length of hospital stay by an average of seven to nine days, with about $ 35 billion spent on hospital budgets in the United States to treat these infections [28]. In Iran, no accurate statistics are available, but the rate of the prevalence of hospital infections is estimated at 10 - 15 percent (about 600 thousand people). Therefore, by reducing the length of hospital stay and remote control of the patient, infections and resulting mortality from infections as well as costs can be significantly reduced.

c)Global mortality reduction: According to statistics published by the World Health Organization, there are a large number of deaths in humans due to various diseases, including heart disease, brain, diabetes, respiratory system, high blood pressure, etc., If diagnosed and controlled in time, the death rate of patients decreases. The use of IOT is an essential step to achieve justice in health and health.

6. LEADING CHALLENGES IN USING THE INTERNET OF THINGS

Although IOT has created a huge development in medicine, it has also posed challenges due to its high sensitivity. For example, the diffusion of incorrect medical information causes people to die, and in the next stage reduces the credibility of the health centers. In the following, we address the challenges ahead and solutions to address these challenges:

6.1Standardization
6.2Cost Analysis
6.3Software development process
6.4Operating System
6.5 Integrated technology transfer
6.6low - power protocols
6.7Network type
6.8 Scalability
6.9 Continuous monitoring
6.10 Service quality
6.11 Dynamics
6.12 Security and data protection

7. CONCLUSION

With the continuous growth of IoT technologies, the IoT will soon expand on a huge scale. This emerging network algorithm encompasses all parts of our life, from automated homes to smart health and environmental monitoring.IOT is a new technology and its economic impact is tens of times greater than the impact the internet has since its presence in different countries, and as any other technology has its own challenges. But unfortunately, some countries, like Iran, have never entered into new and sophisticated technology. The fact is that IoT has come sooner or later and it is better to think about its security solutions and invest in it and also create jobs for college graduates. One of the fastest industries to consider this

opportunity is health care, which is called IOHT. This fact has forced researchers to create a comprehensive survey to analyze the current situation. There are challenges in medicine as well as in other fields, but as we tried in this article to show examples of benefits, strengths such as saving the lives of millions of people and preventing human catastrophes with this new technology are undeniable. In this article, we discuss the IoT landscape and provide a well-defined architecture for its deployment. Then the methods performed in health care using the Internet of Things were examined to carefully evaluate the effectiveness of these methods using new technology. In this regard, most of the methods have been applied to cases such as load balancing, data security, and energy consumption reduction finally, the accuracy of the Data transmitted is low, which can be facilitated by applying the right tool.

The reviews in this article may help developers and entrepreneurs come up with solutions for the whole community. In addition, this article can be considered as a source of information for health care providers, professionals, and the general public interested in IOHT.

Table.1. Comparison of the methods conducted in the field of health care with the IoT Use.

Disadvantages	Advantages	illness	Approach	Writers
Lack of focus on the accuracy of the patient's diagnosis	Reduce data transmission delays and improve energy consumption	Diabetes	Increase the life of intelligent patient monitoring networks	Kang (2018)
Lack of focus on the accuracy of the patient's diagnosis	Increase the quality of data collection	The general condition of the patient	IoT-based intelligent monitoring system for monitoring patient information	Gomez (2016)
The high computational complexity of the proposed method	Reduce patient error diagnosis	Heart	Patient status monitoring system during the monitoring period	Yohang (2016)
Lack of focus on the accuracy of the patient's diagnosis	High security of data collection data	Heart	IoT-based monitoring framework for patient navigation	Mobaraki (1396)
Lack of focus on the accuracy of the patient's diagnosis	Increase the quality of data collection	Heart	Intelligent health system based on wireless sensor networks	Mohammadi (1365)
Lack of focus on the accuracy of the patient's diagnosis	Increase network life	The general condition of the patient	Reduce energy consumption inpatient monitoring networks by compressing data	Asghari(1394)
Lack of focus on the accuracy of the patient's diagnosis	Increase network load power	Heart	IoT-based approach to patient navigation	Jalilii (1394)
Lack of focus on the accuracy of the patient's diagnosis	Increase the quality of data collection	asthma	Use body range network	Yaqubi (1391)

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