

IOT for Healthcare

Matthew N. O. Sadiku^{#1}, Shumon Alam^{*2}, Sarhan M. Musa^{#3}

^{#1,2,3} Roy G. Perry College of Engineering, Prairie View A&M University, Prairie View, TX 77446, USA

Abstract

Internet of Things (IoT) is the global interconnection of several heterogeneous devices. It allows people and “things” to connect anytime, anywhere using a variety of wired or wireless communication networks. It will have its presence in all sectors of human lives including healthcare. The market for the IoT in healthcare is growing steadily. IoT healthcare helps in effectively managing health and thus improving the quality of life. This paper provides a brief introduction into IoT healthcare or the use of IoT in the healthcare domain.

Keywords — Internet of things, healthcare, Internet of medical things, Internet of healthcare things.

I. INTRODUCTION

Healthcare is an essential part of modern life. As they say, “Health is wealth.” Unfortunately, the healthcare industry faces a lot of challenges: expensive services, the aging global population, and a rise in the number of chronic diseases. Also, present approaches used for monitoring a patient in hospitals are time-consuming. The Internet of things (IoT) (also known as the Future Internet) can resolve these issues quite well. It could be a game changer for the healthcare services [1]. It makes it now possible to process data and remotely monitor a patient in real time.

The Internet of things (IoT) allows all entities to be connected through wired or wireless communication means. IoT has been gaining popularity rapidly since its inception into the IT world and is being used in healthcare, education, gaming, finance, transportation, and several more. The healthcare industry is among the fastest to adopt the Internet of things. The primary goal of IoT in healthcare is to connect doctors with patients through a smart device. Healthcare providers are expecting the IoT to revolutionize the gathering of healthcare data and care delivery.

II. INTERNET OF THINGS

Internet of Things (IoT) is a worldwide network that connects devices to the Internet and each other using wireless technology. IoT is expanding rapidly, and it has been estimated that 50 billion devices will be connected to the Internet by 2020. These include smartphones, tablets, desktop computers, autonomous vehicles, refrigerators, toasters, thermostats, cameras, and pet monitors, alarm systems, home appliances, insulin pumps, industrial machines, intelligent

wheelchairs, wireless sensors, mobile robots, etc. There are four main technologies that enable IoT [2]:

- (1) Radio-frequency identification (RFID) and near-field communication.
- (2) Optical tags and quick response codes: This is used for low-cost tagging.
- (3) Bluetooth low energy (BLE).
- (4) Wireless sensor network: They are usually connected as wireless sensor networks to monitor physical properties in specific environments.

Other related technologies are cloud computing, machine learning, and big data.

The Internet of things (IoT) technology enables people and objects to interact with each other. It is employed in many areas such as smart transportation, smart cities, smart energy, emergency services, healthcare, data security, industrial control, logistics, retails, structural health, traffic congestion, manufacturing, industry, security, agriculture, environment, and waste management.

IoT supports many input-output devices such as camera, microphone, keyboard, speaker, displays, microcontrollers, and transceivers. It is the most promising trend in the healthcare industry. This rapidly proliferating collection of Internet-connected devices, including wearables, implants, skin sensors, smart scales, smart bandages, and home monitoring tools has the potential to connect patients and their providers in a unique way. Through the IoT, anything in the healthcare system can be identified and monitored anytime anywhere. Monitoring the health parameters (such as blood pressure, heart rate, temperature, and humidity) of a patient remotely is achieved by IoT healthcare. A typical IoT healthcare system is shown in Figure 1 [3].

The narrowband version of IoT is known as narrowband IoT (NB-IoT). This is an attractive technology for many sectors including healthcare because it has been standardized [4]. The main feature of NB-IoT is that it can be easily deployed within the current cellular infrastructure with a software upgrade.

III. APPLICATIONS OF IoT IN HEALTHCARE

Applications of IoT in healthcare are numerous, ranging from remote monitoring to smart sensors and medical device integration. The applications benefit patients, families, nurses, and physicians. IoT healthcare is applicable in many medical instruments such as ECG monitors, glucose level sensing, and oxygen concentration detection. IoT in healthcare helps in [5]:

- Reducing emergency room wait time
- Tracking patients, staff, and inventory
- Keeping patients safe and healthy
- Enhancing drug management
- Ensuring the availability of critical hardware
- Saving doctor's time and work
- Enabling nurses, doctors, and other team members to connect and communicate in real time.
- Receiving critical information at the point of care without unnecessary alerts

Wide ranges of wearable IoT healthcare applications have been developed. Wearable devices allow the transfer of patient personal information between different devices [6]. The body sensor network (BSN) technology is another IoT development in the healthcare system, where a patient can be monitored using a collection of tiny-powered and lightweight wireless sensor nodes. It is essentially a collection of intelligent, miniaturized wireless sensor nodes used in monitoring the human body functions and the surrounding environment [7]. It opens the possibility for monitoring systems to operate wirelessly using low-cost wearable sensors. Other applications include people with disabilities, tracking and monitoring of objects and persons, identification and authentication, transport and data collection, clinical care, and continuous cardiac monitoring [8].

A. Benefits

Integrating IoT features into healthcare devices greatly improves the quality and effectiveness of service. IoT healthcare should provide better healthcare services to people at any time, from anywhere in a friendly manner. The IoT promises to make healthcare cheaper and better. IoT allows real-time monitoring of connected smart medical devices, and this can save lives in the event of an emergency. IoT healthcare principles are already being applied to improve access to care, increase the quality of care, and reduce the cost of care. Applications deliver care to people in remote locations and monitoring systems that provide a stream of accurate data for better care decision making [9]. The IoT connected devices can collect health data (such as blood pressure, oxygen and blood sugar levels, weight, and ECGs) and use a smartphone to transfer the data to a doctor who may be several kilometers away. This makes healthcare service effective. Figure 1 shows a typical application of IoT healthcare.

B. Challenges

While IoT opens doors of opportunity for greater connectivity in healthcare, it also creates some points of vulnerability. A significant challenge that IoT poses is of data security and privacy. The data that is being shared across the IoT devices are sensitive. Security and privacy of patients' medical data are crucial for wide acceptance and use of IoT in healthcare. Security solutions must be resource-efficient since medical

sensors have limited processing power, memory, and communication bandwidth. Many countries prohibit privacy violations.

There is also an ambiguity about data ownership and a lack of EHR integration. This allows attackers/hackers to wreak havoc on the network. It is the responsibility of IT staff to bring more awareness to the health professionals about the challenges in supporting IoT devices. Other issues that negatively impact the adoption of IoT into healthcare include laws and policies, insurance coverage, standardization (lack of standards), data integrity, interoperability, compatibility, and cost [10]. These challenges may prevent healthcare from fully adopting the IoT technology.

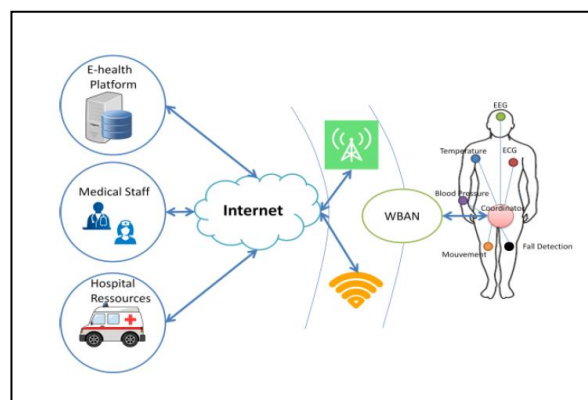


Fig 1: A typical IoT healthcare system [3]

IV. CONCLUSIONS

The IoT is the idea of connecting anyone, anything, anytime, anyplace, any service, and any network. The healthcare industry is changing at a fast pace and is adopting the IoT rapidly. It has been long predicted that IoT healthcare will revolutionize the healthcare sector in terms of social benefits, penetration, accessible care, and cost-efficiency. The IoT revolution is redesigning modern health care with extended benefits. More information about IoT healthcare can be found in the book [11].

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