

# Chapter 11

## Healthcare IoT Architectures, Technologies, Applications, and Issues: A Deep Insight

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### ABSTRACT

*The internet of things (IoT) revolution is improving the proficiency of human healthcare infrastructures, and this chapter analyzes the applications of IoT in healthcare systems with diversified aspects such as topological arrangement of medical devices, layered architecture, and platform services. This chapter focuses on advancements in IoT-based healthcare in order to identify the communication and sensing technologies enabling the smart healthcare systems. The transformation of healthcare from doctor-centric to patient-centric with the diversified applications of IoT is discussed in detail. In addition, this chapter examines the various issues to be emphasized on designing an effective IoT-based healthcare system. It also explores security in healthcare systems and the possible security threats that may be vulnerable to the security essentials. Finally, this chapter summarizes the procedure of applying machine learning techniques on healthcare streaming data which provides intelligence to the systems.*

### INTRODUCTION: OVERVIEW OF INTERNET OF THINGS

The idea of the IoT was originated and devised with the context of Radio Frequency Identification (RFID), which is used for tracking the objects in various domains like logistics and supply chain management. For example, Automated Teller Machines (ATMs) are interconnected to the bank network, which enables the payments with ATM cards at the point of sales depots. ATM uses the machine-to-machine (M2M) networks and these established a basement for IoT through network connected systems and data. The

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probability of connecting the objects to the network provides tagging, tracking and reading of data from objects that goes hand in hand with greater efforts which would become a promising technology of this era called as IoT.

IoT was first coined by Kevin Ashton in 1999 and developed in analogous to Wireless Sensor Networks (WSN) (Rose et al., 2015). The term IoT refers to the physical devices that are interconnected to gather and share the data with each other via communication technology and cloud computing enables to collect, record and to analyze the data stream more accurately within short span of time. The term “Things” in IoT specifies variety of devices includes sensors, automobiles, buildings, industries, human beings, animals, plants any type of goods. WSNs are assumed to rely on wireless communication technologies whereas IoT does not assumed to rely on specific communication technology. The characteristics of wireless sensors like tiny, rugged, inexpensive and low powered renovated the IoT, facilitates the smallest objects can be integrated with different environments. IoT can be considered as an upcoming evolution of the internet which uses many existing features including machine-to-machine communication (M2M), radio frequency identification (RFID) and sensors.

IoT is defined as an ever growing technology through which computing devices, mechanical and digital machines, physical objects, animals or human beings are interconnected via communication medium provides the ability to exchange information and automate the tasks without human-interaction.

IoT is being labeled by different applications, protocols, standards and architectures. IoT is not just a technology but certainly comprising of different things like data analytics, actuators, hubs, artificial intelligence, communication, wide range of sensors, IoT nodes, gateways, networks, cloud computing, edge computing, processing, optimization, IoT platforms and so on. Connecting the physical things through networks and data stream processing increases the potentiality of IoT by adding intelligence to the systems. The common technologies driving the IoT applications are depicted in the Figure 1.

As IoT can be considered as a fully dependent on the potentials of sensors and other technologies, IoT devices must possess three basic qualities such as:

- **Sensible:** IoT devices must be able to sense and aggregate the data. For example, in healthcare field aggregating the blood glucose, pulse rate and body temperature data via sensors. The data aggregated must be self-directed.
- **Communicable:** The data aggregated must be transmitted to data centers or other devices upon specific conditions via communication medium (i.e. Wireless Technologies).
- **Actionable:** The data aggregation itself doesn't make any sense or change behavior. It must exhibit some actions. For example, if a patient's pulse rate or blood level exceeds its normal range, the IoT system must automatically send an alert message to the healthcare providers for further interventions.

## INTERNET OF THINGS IN HEALTHCARE

The aim of IoT is to connect devices, information and human beings together with respect to local and global scenario. In the sky of various domain, the healthcare is the fastest domain which adopting it's infrastructure to the IoT. The application of sensory capabilities to all the medical devices, gives a pathway and transforming facilities for the whole bionetwork of doctors, patients, medical equipment's and pharmacies. The available infrastructure in hospitals for providing medical services to the patients

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