# Online Doctor Consultancy Portal

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***Abstract***

The Internet of Things (IoT) makes smart objects the ultimate building blocks in the development of cyber-physical smart pervasive frameworks. The IoT has a variety of application domains, including health care. The IoT revolution is redesigning modern health care with promising technological, economic, and social prospects. This paper surveys advances in IoT-based health care technologies and reviews the state-of-the-art network architectures/platforms, applications, and industrial trends in IoT-based health care solutions

***Key Words***

Internet of things, health care, services, applications, networks, architectures, platforms, security, technologies, industries, policies, challenges.

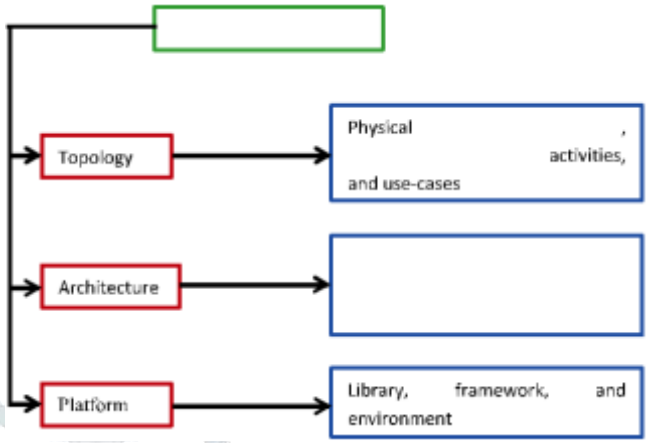
## *1. INTRODUCTION*

The Internet of Things (IoT) is a concept re acting a connected set of anyone, anything, anytime, anyplace, any service, and any network. The IoT is a megatrend in next-generation technologies that can impact the whole business spectrum and can be thought of as the interconnection of uniquely identic able smart objects and devices within today's internet infrastructure with extended bene ts. Benes typically include the advanced connectivity of these devices, systems, and services that goes beyond machine-to-machine (M2M) scenarios Therefore, introducing automation is conceivable in nearly every eld. The IoT pro-vides appropriate solutions for a wide range of applications such as smart cities, traf c congestion, waste management, structural health, security, emergency services, logistics, retails, industrial control, and health care. The interested reader is referred to for a deeper understanding of the IoT. Medical care and health care represent one of the most attractive application areas for the IoT

It should be noted that R&D activities in the eld of healthcare services based on the wireless sensor net-work (WSN)

### *1.1* . IoT HEALTHCARE NETWORKS

The IoT healthcare network or the IoT network for health care (hereafter ''the IoThNet'') is one of the vital elements of the IoT in health care. It supports access to the IoT backbone, facilitates the transmission and reception of medical data, and enables the use of healthcare-tailored communications. As shown in Fig. 2, this section discusses the IoThNet topology, architecture, and platform. However, it should be mentioned that the proposed architectures in [13] and [14] can be considered as a good starting point for developing insights into the IoT network.




### A. THE IoThNet TOPOLOGY

The IoThNet topology refers to the arrangement of different elements of an IoT healthcare network and indicates representative scenarios of seamless healthcare environments. Fig. 3 describes how a heterogeneous computing grid collects enormous amounts of vital signs and sensor data such as blood pressure (BP), body temperature, electrocardiograms (ECG), and oxygen saturation typical IoThNet topology.

It transforms the heterogeneous computing and storage capability of static and mobile electronic devices such as laptops, smartphones, and medical terminals into hybrid computing grids

### *B. THE IoThNet ARCHITECTURE*

The IoThNet architecture refers to an outline for the speciation of the IoThNet's physical elements, their functional organization, and its working principles and techniques. To start, the basic reference architecture in Fig. 6 is presented for the telehealth and ambient assisted living systems recommended by Continua Health Alliance. The key issues have been identified for this architecture [25]: the interoperability of the IoT gateway and the wireless local area network (WLAN)/wireless personal area network (WPAN), multimedia streaming, and secure communications between IoT gateways and caregivers.

### *C. THE IoThNet PLATFORM*

The IoThNet platform refers to both the network platform model and the computing platform. A service platform framework focusing on residents' health information is presented in [39]. This framework shows a systematic hierarchical model of how caregivers or agents can access various databases from the application

layer with the help of a support layer. A similar concept of data center platforms as the middleware between smart objects and the business layer can be found in [40]. The importance of standardizing interfaces across stakeholders of the IoThNet toward the design of an open platform is emphasized in [41]. As shown in Fig. 11, three categories of interface standardization to establish a cooperative ecosystem have been presented, including hardware and soft-ware interfaces, health data formats (electronic health record; EHR), and security schemes.

### *2) IoT HEALTHCARE SERVICES*

The IoT is anticipated to enable a variety of healthcare services in which each service provides a set of healthcare solutions. In the context of healthcare, there is no standard de nition of IoT services. However, there may be some cases in which a service cannot be objectively differentiated from a particular solution or application. This paper proposes that a service is by some means generic in nature and has the potential to be a building block for a set of solutions or applications. In addition, it should be noted that general ser-vices and protocols required for IoT frameworks may require slight modi cations for their proper functioning in health-care scenarios. These include noti cation services, resource-sharing services, internet services, cross-connectivity protocols for heterogeneous devices, and link protocols for major connectivity.

### *A. THE INTERNET OF m-HEALTH THINGS (m-IoT)*

M-health is nothing but mobile computing, medical sensors, and communications technologies for healthcare services. In theory, m-IoT familiarizes a novel healthcare connectivity model that connects the 6LoWPAN with evolving 4G networks for future internet-based m-health services. Although m-IoT characteristically represents the IoT for healthcare services, it is worth mentioning that there exist some specific features intrinsic to the global mobility of participating entities

### *B. ADVERSE DRUG REACTION (ADR)*

An adverse drug reaction (ADR) is an injury from taking a medication. This may happen after a single dose of a drug or its prolonged administration or as a con-sequence of a combination of two or more drugs. Because the ADR is inherently generic, that is, not specific to the medication for a particular disease, there is a need to separately design certain common technical issues and their solutions (called ADR services).

### C. WEARABLE DEVICE ACCESS (WDA)

Various nonintrusive sensors have been developed for a diverse range of medical applications [55], particular for WSN-based healthcare services. Such sensors are prospective enough to deliver the same services through the IoT. On the other hand, wearable devices can come with a set of desirable features appropriate for the IoT architecture.

### *D. SEMANTIC MEDICAL ACCESS (SMA)*

The use of semantics and ontologies to share large amounts of medical information and knowledge has been widely con-sidered [58]. The wide potential of medical semantics and ontologies has received close attention from designers of IoT-based healthcare applications. Placing medical semantics and ontologies on the top of the IoT calls for a separate service called semantic medical access (SMA).

### E. INDIRECT EMERGENCY HEALTHCARE (IEH)

There are many emergency situations where healthcare issues are heavily involved, including adverse weather conditions, transport (aviation, ship, train, and vehicle) accidents, earthen sites collapse, and re, among others. In this context, a dedi-cated service called indirect emergency health care (IEH)

### 3) IoT HEALTHCARE APPLICATIONS

In addition to IoT services, IoT applications deserve closer attention. It can be noted that services are used to develop applications, whereas applications are directly used by users and patients. Therefore, services are developer-centric, whereas applications, user-centric. In addition to applications covered in this section, various gadgets, wearables, and other healthcare devices currently available in the market are dis-cussed.

#### 1) GLUCOSE LEVEL SENSING

Diabetes is a group of metabolic diseases in which there are high blood glucose (sugar) levels over a prolonged period. Blood glucose monitoring reveals individual patterns of blood glucose changes and helps in the planning of meals, activities, and medication times. An m-IoT con guration method for noninvasive glucose sensing on a real-time basis is proposed in [28]. In this method, sensors from patients are linked through IPv6 connectivity to relevant healthcare providers

#### 2) ELECTROCARDIOGRAM MONITORING

The monitoring of the electrocardiogram (ECG), that is, the electrical activity of the heart recorded by electrocardiography, includes the measurement of the simple heart rate and the determination of the basic rhythm as well as the diagnosis of multifaceted arrhythmias, myocardial ischemia, and prolonged QT intervals

#### 3) BLOOD PRESSURE MONITORING

The question of how the combination of a KIT blood pressure (BP) meter and an NFC-enabled KIT mobile phone becomes part of BP monitoring based on the IoT is addressed. A motivating scenario in which BP must be regularly controlled remotely is presented by showing the communications structure between a health post and the health center

#### 4) Body Temperature Monitoring

Body temperature monitoring is an essential part of health-care services because body temperature is a decisive vital sign in the maintenance of homeostasis. In

the m-IoT concept is verified using a body temperature sensor that is embedded in the Tells mote, and a typical sample of attained body temperature variations showing the successful operation of the developed m-IoT system is presented.

## IoT HEALTHCARE TECHNOLOGIES

There are many enabling technologies for IoT-based healthcare solutions, and therefore it is dif cult to prepare an explicit list. In this regard, the discussion focuses on several core technologies that have the potential to revolutionize IoT-based healthcare services.

### A. CLOUD COMPUTING

The integration of cloud computing into IoT-based healthcare technologies should provide facilities with ubiquitous access to shared resources, offering services upon on request over the network and executing operations to meet various needs.

### B. GRID COMPUTING

The insuf cient computational capability of medical sensor nodes can be addressed by introducing grid computing to the ubiquitous healthcare network. Grid computing, more accurately cluster computing, can be viewed as the backbone of cloud computing.

### C. BIG DATA

Big data can include huge amounts of essential health data generated from diverse medical sensors and provide tools for increasing the ef ciency of relevant health diagnosis and monitoring methods and stages.

### D. NETWORKS

Various networks ranging from networks for short-range communications (e.g., WPANs, WBANs, WLANs, 6LoWPANs, and WSNs) to long-range communications (e.g., any type of cellular network) are part of the physical infrastructure of the IoT-based healthcare network. In addition, the employment of ultra-wideband (UWB), BLE, NFC, and RFID technologies can help design low-power medical sensor devices as well communications protocols

### F. AMBIENT INTELLIGENCE

Because end users, clients, and customers in a healthcare net-work are humans (patients or health-conscious individuals), the application of ambient intelligence is crucial. Ambient intelligence allows for the continuous learning of human behavior and executes any required action triggered by a recognized event

## CONCLUSIONS

Researchers across the world have started to explore various technological solutions to enhance healthcare provision in a manner that complements existing services by mobilizing the potential of the IoT. This paper surveys diverse aspects of IoT-based healthcare technologies and presents various healthcare network architectures and platforms that sup-port access to the IoT backbone and facilitates medical data transmission and reception. Substantial R&D efforts have been made in IoT-driven healthcare services and applications. In addition, the paper provides detailed research activities concerning how the IoT can address pediatric and elderly care, chronic disease supervision, private health, and tness management. For deeper insights into industry trends and enabling technologies, the paper offers a broad view on how recent and ongoing advances in sensors, devices, internet applications, and other technologies have motivated afford-able healthcare gadgets and connected health services to lim-itlessly expand the potential of IoT-based healthcare services

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