Internet of things (IoT) in Yemen: Untapped Challenges and Opportunities

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ملخص البحث

ABSTRACT

Everyone can currently easily access the essential application environment, including all the necessary information about work areas, due to modern smart technology and the Internet of Things. This has made it possible to use various IT services and software more successfully. It has also contributed to the existence of connections between millions of devices, including mobile phones and devices that can connect via wireless networks, which has led to the development of smart environments that enhance virtual design, digital technologies, and contemporary effective experiences. These experiences have helped a variety of industries find new ways to adapt to and take advantage of the opportunities presented by these emerging technologies. In this paper we present primarily examined in terms of the opportunities and challenges that Yemeni companies may experience while increasing the application of Internet of Things on the banking sectors, telecommunications companies and universities. We suggested an improvement of review of different factors, security concerns, and issues based on levels of IoT approaches used to improve the system. The approach concludes by addressing broad IoT concerns and issues and exploring their consequences in the context of developing countries.

Keywords
IoT, Cybersecurity, Data Analytics, Challenges, Wireless.

1. INTRODUCTION

In this era, the incorporate of Digital media and IoT are the fascinating scientific area which falls under the umbrella of smart technology. The smart technology has become very popular and characterized by some methods of automation, which is rapidly gaining momentum driven by developments in sensor networks, mobile devices, Wireless, and cloud network. There will be nearly 50 billion devices/peripherals connected to the Internet which means you can easily program them through an easy-to-use application interface, monitored and controlled remotely through Wi-Fi, Bluetooth or Long Term Telecommunications Network Technologies (LTE). The LTE indicate as a new standard for fourth generation networks communication, which is known as smart devices.

The various organizations have played a key role in providing smart technology solutions via Internet of Things (IoT) devices, commonly referred to as networked Internet of Things devices. These devices are use chips, sensors, internet connectivity and analytics, as well as software to help provide smart applications that make energy, logistics, industrial control, commerce, retail, agriculture and many other fields.

[1] For instance, The process of Internet of Things communication linking interconnected physical objects with each other and connected via the Internet Protocol, objects and network of devices that are independently capable of sensing, monitoring, or interacting with the surrounding environment to collect and transmit data. [2] Security issues of IoT technologies have become an important during the storing and transmission of digital data. The security of IoT is an application layer technology to guard the transmitted information against unwanted disclosure as well as to protect the data from modification while in transit. There are many real life applications of cyber security issues used [3].

The science of the Internet of Things and smart devices is used to design and develop of technologies that enable computers to have an algorithm of deep learning to extract useful information from data related to smart devices, update and develop them so that they match the behaviors required.

It is allows the automation of daily tasks and enable monitoring and control for connected devices and provide solutions based on the Internet of things. [4] The IoT components are described as:

- **IoT device**: IoT devices are any items or things having sensors attached to them, allowing them to detect, regulate, and keep track of actions as well as share data with other connected devices and be processed by the system's processing components.
- **Communication infrastructure**: The communication component enables connections between Internet of Things (IoT) devices and remote computers or cloud servers. Communication protocols for the Internet of Things (IoT) typically function at the data connection, network, transport, and application layers.
- **Services:** An IoT system offers data processing, device modeling, and device control among other services to IoT devices.
- **Security and management:** To protect the IoT system, security components make use of features including message integrity, content integrity, privacy, authentication, authorisation, and data security. The IoT system is managed and controlled by the management unit.
- **Application:** The technical and symbolic act as an interface between users and IoT systems. Users can view the system state in the present context and evaluate it, and it occasionally predicts the future.

The IoT technologies can addressing as:

- **Radio-frequency identification:** RFID is used to wirelessly and line-of-sight identifies items.
- **Wireless sensor networks:** It enables low-power integrated circuits and wireless sensors (WSN).
- **Addressing schemes:** IoT mostly uses uniform resource names (URN) as its addressing technique.
- **Data storage and analytics:** The effective data processing and storage require two different types of software, middleware and applications. [2,3,5]

According to Statista, there will be around 30 billion connected devices worldwide by 2020 -2025. There will be 75 billion connected items, as seen in Fig. 1. (Statista is a well-known internet statistics service.). All of these

gadgets will generate a ton of hot data for real-time applications. IoT actually improves real-time application response and awareness. Real-time processing can improve service, output, and safety in sectors such as oil, manufacturing, transportation, mining, utilities, gas, and the public sector. IoT technology is now employed to protect wildlife & Smart Travel [2,6,19].

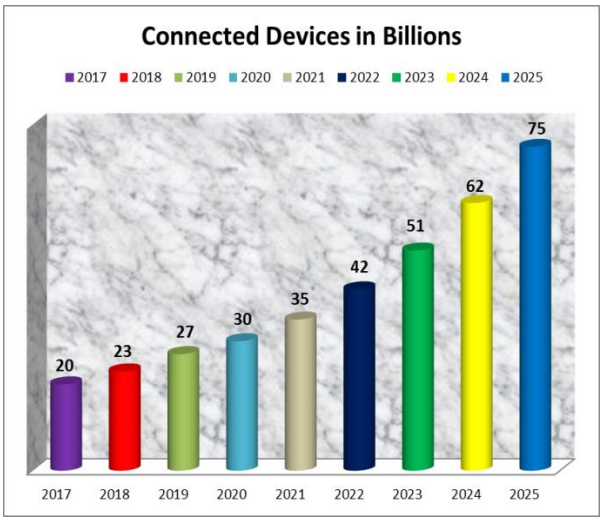

Fig 1: Interconnected devices worldwide from 2015 to 2025 (in billions)

2. LITERATURE REVIEW:

Through accessing digital multimedia of worldwide data and improves the techniques reliability and allows for more efficient storage and transfer in response to increasing internet of things system Monitoring, safety, reduce the cost, Facilitation and maintaining cybersecurity. The Internet of Things (IoT), is a major aspect for managing the system that when connected creates an ecosystem. In this experiment, regions were divided and local health care providers were identified. The techniques are then assessed in terms of physical representations to find the final system was developed for their needs after the collected data was entered. [2, 3]. For the difficulty of delivering good collecting and providing a literature analysis of the majority of strategies, we address a massive data stream to detect a literature review of most of techniques used. The health care system is one of the most significant concerns and difficulties facing the majority of the world, particularly emerging countries. A Various benefits can be attained, and some aspects IoT devives, such as better connections and access to

make smart technologies and with good higher-quality medication, are targeted to all people. The application of IoT system is a specialized one which variety of specialists in many sectors who facilitate things and provide the required of smart technologies. This system comes with certain complications, though, The cooperation between the devices and outside users, which work very hard to provide the services with the appropriate connections [4, 5, 6] With the recent introduction of IoT technology into various sectors in several nations throughout the world have become the most dependent system, as indicated in M. Roopa et al [17]. The body weight of the exerts pressure on a mattress that has been carefully built, and suggested a way to quantify this pressure and utilize it to monitor devicese. Additionally, he uses alorithms to check its value that indicates great detection accuracy. He also stated that this work's goal was to lower storage requirements and calculation costs [20]. Njoud AlMansour et al. examined the IoT Healthcare Infrastructure and provided a sample of their research on Saudi Arabia in their discussion [22].As shown by Wazir Zada Khan et al. in shown the differences between IoT and SIoT, provided an ategorize the trust management solutions that given six years and discuss the challenges and requirements in the emerging new wave of SIoT [1]. As indicated by Chopra et. al. in their research, basic underlying workflow of IoT is discussed and useful technologies so issues and challenges in implementing the IoT are briefly discussed. [4]. Despite the difficulties in the world, Dr.R Ravinder Reddy et al. discussed the concepts Machine Learning algorithm with new Trends and Application so give the Challenges with data to make the device or thing intelligent by learn the data or objects [5]. The used of Service Oriented system and IoT systems, along with their amazing services, is what makes the global IoT system possible. According to Zinal D. Patel objectives to design a Service Oriented Architectures for the efficient communication and privacy by utilizing the concept of the internet of things and and analyze the (SOA) [6]. The researcher believes that familiarity with the use of the Smart technology system will play an important role in giving Opportunities, Applications in Saudia arabia that issues of IoT [7]. In order to create a better IoT by Q3 system, Lei Yu et al. pointed major Technological challenges of IoT of a smart devices that is based on the internet of things for business and societal [8]. Mahdi H. Miraz et al. author has review the techniques of Internet of Things (loT), Internet of Everything (loE) and of Nano Things (loNT) system for analysis and future of both of them [10]. The effective and speedy sharing of objects information via telecommunications systems has been made possible by the rising and rapid use of Internet networks and network information systems

[13]. This includes allowing the use of wireless communication devices, access to all information systems at any time, and the use of wireless devices. In order to improve and give a new options for acquire important information through the use of connectivity feedback in order to enhance self-management, due to the fact that it incorporates a wide range of technology services and applications for all users and objectives. The state is using technology more and more frequently, and new technology can have a significant impact on any industry. Finally, as we will show later in this study, the IoT system might provide a number of benefits [15, 16].

3. INTERNET OF THINGS DATA SCHEME

Internet of Things is an internet-connected platform for embedded devices so, information can be gathered and shared between the devices and makes it possible for things to communicate and work together. IoT analytics is made up of three key parts: computing infrastructure, communication infrastructure, and collection of data (things or objects) [2,5,8]

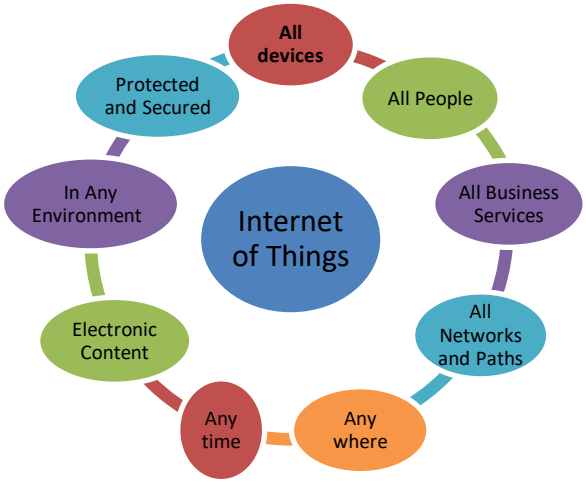

Fig 1: Internet of Things environments scheme.

3.1.IoT Applications:

The Internet of Things technology applications are currently the most important topics, allowing for the development of smart technology trends to correspond with human daily life and engagement with Internet of Things applications.

- **Internet of Things in our homes:**

By 2022, there will be at least 63 million smart homes in America, according to Swedish research company Berg Insight. Nearly every smart environment will be present in these homes, and every feature, including internet-connected light bulbs, smart TVs, and thermostats, will be automated. Smart door locks, smart washing machines, smart external cameras to remotely monitor homes while occupants are away, smart kitchen appliances, etc.

- **IoT use in the health sector:**

The adoption and deployment of smart technology and Internet of Things (IoT) applications in the healthcare sector are attracting a lot of attention from scientists , such as smart insulin pens, continuous glucose monitors (CGMs), and ingestible sensors (Digital Proteus Health), Additionally, intelligent (asthma) inhalers, like GlaxoSmithKline's Diskus inhaler, are equipped with unique sensors that produce vital data as IoT applications start to shed light on regulating and treating their symptoms.

- **Internet of Things in the Industry Sector:**

The Industrial Internet of Things (IoT) or Fourth Industrial Revolution refers to the applications of smart technology in the industrial or commercial environment; this concept is very similar to home automation or the Internet of Things for consumers and includes the use of numerous sensors, wireless networks, analytics, and big data. Various business processes must be measured, examined, and improved. For instance, smart technology must be used to ensure real-time material delivery, efficient operational management of production from start to finish, as well as increased workforce productivity, significant cost savings, and worker safety in potentially dangerous environments like gas, oil, power plants, and chemical fields.

- **Internet of Things in Smart Cities:**

The Internet of Things has many advantages and uses in smart cities, some of which include: enhancing traditional public services, such as smart parking, smart waste management, and smart traffic control systems; monitoring and maintaining public spaces; determining whether buildings and facilities are suitable for use as workplaces; and reducing the energy consumption of the city from where smart city lighting is used.

- **Internet of Things in Agricultural Sectors:**

Due to the large increase in the population, it has made it difficult to meet the needs of people in the agricultural sector, so that applications for Internet of things technologies have been found. Improved operational performance resulted from the regulation of irrigation, fertilizer, and pesticide systems as well as the gathering of meteorological data using climate-smart heating as opposed to depending on changing weather patterns, crop health, and soil quality.

3.2.IoT architecture:

It is composed of five layers: the perception layer, the network layer, the middleware processing layer, the application layer, and the business layer [13].

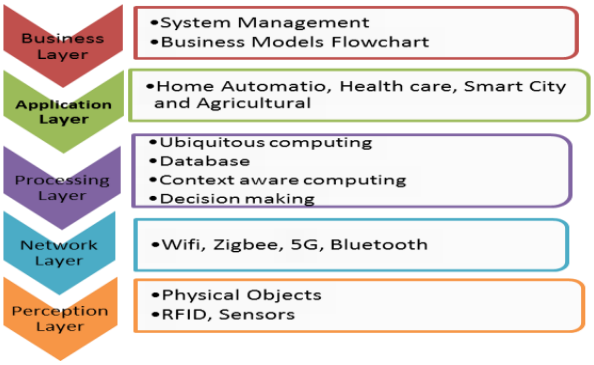

Fig 2: Generic architecture of IoT (five-layer).

Multidisciplinary sectors:

In this section, we will discuss in detail the overall view of Participating in the world of modern technology (internet of things) is entering all sectors, which contributes to raising the level of efficiency, protection, administrative and economic development. As the Internet of Things and smart technology close the technological gap Through the Internet of Things ecosystem, entrepreneurs, investors, and technology thought leaders to communicate and develop ideas, discover potential opportunities and establish smart businesses to contribute to the application of smart technology and the Internet of Things. The following chart illustrates the participation of a variety of smart technology and IoT manufacturers, service providers, smart businesses, and IoT beneficiaries. Fig.2. illustrates the overall view of the Internet of Things with different technical sectors [9, 16].

Fig 3: Internet of Things with different technical sectors.

4. The Need of Internet of Things Technologies for Smart Governments in Yemeni:

The governments of Yemen have created strategies as a result of having to deal with more complex socio-technical concerns in recent years. The governments of Yemen planning to develop policies that make innovative and inventive use of sophisticated information technologies (ICTs) to implement public policy, enhance public participation, or provide all-encompassing services. The public and private sector represented by Yemeni companies and institutions is witnessing economic development

and diversification, which has led to the need to implement the Internet of Things in various aspects of electronic business by aligning companies with international partners and comparing them, so that companies benefit from the opportunities available in international companies and apply them in the Yemeni environment to publish solutions Smart through projects providing infrastructure, communication between devices and the use of Internet of things applications and cybersecurity applications, which requires the participation of systems integrators as well as telecom network operators between local and international companies, through the search for excellence and survival and to keep pace with developments in the Internet of things, this case It also applies to the various institutions that are witnessing successive developments in the era of smart technology, as they are institutions concerned with communication and dealing with Internet of Things applications, and the needs and interests of the beneficiaries have become constantly changing and renewed, and thus these aspects stimulated the need to conduct this study and know the outstanding aspects in terms of challenges and opportunities The application of smart technology and the Internet of things in Yemeni companies, which helps in A greater understanding of the areas of benefiting from these smart technologies in meeting the needs of beneficiaries and providing them with interactive and fast services [1,7].

5. The Communications and Information Technology Commission and its role in implementing IoT:

The Communications and Information Technology Commission is responsible for monitoring the development of information technology and emerging technologies. To do this, it implements policies, regulatory documents, and approved programs, establishes appropriate procedures, suggests relevant regulations and their amendments, and works to adopt them from the relevant authorities. It has given a provision of the right environment to draw in local and foreign investors, as well as the provision of Internet of Things applications to improve performance, productivity, flexibility, and quality of services, are all necessary in addition to enabling and ensuring a fair competitive environment in the market and issuing the necessary licenses in accordance with the relevant terms and regulations.

6. Challenges and future directions:

This section outlines the main challenges faced in the intelligent domain. These problems affect both technology and business-related issues. our aims to show how easy it is to identify and resolve technical issues with Smart IoT devices and the Internet of Things when used in various Yemeni enterprises. We have provided a set of recommendations and suggestions that can be presented so that the appropriate authorities and researchers can take advantage of and consider them while planning, reviewing, and developing the company and other enterprises of a similar nature [2, 10, 21]

- **Infrastructure:** IoT platforms, access technologies, data processing, analytics, and security are some of the components in many different countries that are infrequently connected to the national infrastructure.
- **Cyber Security:** It has elevated in importance as a result of the millions of electronic devices connected via communication networks. The field of technology known as "IoT security" is focused on protecting connected devices and internet of things networks (IoT). The efficiency of the overall system's safety, security, and reliability is expected to be significantly increased by effectively addressing issues with the security requirements, network vulnerabilities, attack countermeasures, secure communication protocols, and architectures in the IoT environment.
- **IoT data:** IoT data sources, such as sensors and other internet-connected devices, can be difficult to access and manage. It provides autonomous and real-time management of the electrical networks ensures the efficient connection and usage of all production instruments. This gives operators the potential to improve present services, and improve reliability.
- **Communication Issues:** There will always be a need for communication technologies that enable the integration of large amounts of distributed resources into electric generation and distribution systems. Wireless connection is essential for the intelligent IoT to work, as is very high utility efficiency.
- **Socio-economic:** The adoption and success of any IoT technology depend heavily on the socio - economic environment. In more practical terms, a technology is no longer relevant if it is unable to attract users or

investors, which may lead to the failure of pilot projects, the denial of new technology, etc.

- **Regulation and Policies:** Despite the fact that each country has its own specific set of rules and regulations, there are some significant similarities and contrasts across the various countries. Each of them has a fundamental framework that sets the overarching objectives, strategies, and guiding ideals for rules and objectives.

Recommendations and Suggestions as future directions:

Based on the challenges from the previous study, the researcher made the following recommendations [12, 14].

- The necessity for an authority to regulate the Internet of Things via the Communications and Information Technology Corporation in order to display business and integrate companies, institutions, and government agencies with the concept of (the Internet of Things) across various sectors.
- Identifying the interests of technology solution providers and those who enable them in a variety of fields, due to their significant impact on work automation and facilitating operations, manufacturing, and productivity.
- The need to complete the construction of an architectural structure for infrastructure, communication networks, the Internet, and smart tools in accordance with Internet of Things applications in various sectors.
- The necessity of training and qualifying workers specialized in technology in terms of networking and the use of smart technology and the Internet of Things that support sensors in various fields within institutions will have a significant impact on increasing expertise and finding new revenue sources.
- Working with government agencies to create a stimulating environment for investors by adopting smart technology and the Internet of Things, as well as expanding the horizons of partnership between companies, developers, and innovators both internally and externally to exchange experiences in order to increase the value of investments within the country.
- Concentrate your efforts to selecting the most important applications, software, and modern technology, particularly protection systems related

to the Internet of things, and providing solutions through which computing can use smart technology and the Internet of things to increase the efficiency of Yemeni companies in order to keep up with global developments in smart technology and the Internet of things.

- Constantly reviewing and adopting the fundamental requirements for smart technology and the Internet of Things in order to stay abreast of the latest developments.
- Develop national regulations and policies to define the organization's objectives, roles, and responsibilities in terms of cyber security, and ensure the implementation of cyber security requirements by establishing clear security policies to reduce security threats in various environments.

Conclusion:

The emerging techniques are new internet technology called the Internet of Things (IoT) connects all smart things to one another. This has greatly increased the internet's potential and made the world a smarter and better place. In this paper we have discussed many aspects as Yemeni perspective, it evaluated some of the most important IoT issues, application, architecture, opportunities, challenges, Recommendations and Suggestions as future directions for successful IoT-based settings in Yemen. So, if The Internet of Things (IoT) is successfully deployed, it has the potential to provide a range of benefits for individuals, professionals, and businesses.

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