A comparative study on Internet of Things (IoT): Frameworks, Tools, Applications and Future directions

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Abstract

The proliferation of smart and sensing devices in the field of communicating networks support the development of the so-called Internet of Things (IoT). IoT considers a new paradigm for the evolution of internet connectivity. IoT refers to connecting objects around the real world with the Internet to accomplish common goals and monitor these objects via wire/wireless communications. It plays a large and important role in human life through its use in many applications of human interest. Through using a variety of enabling wireless technologies such as Wireless Sensor Networks (WSN), Radio Frequency Identification (RFID), Near Filed Communication (NFC), and barcode in the applications. These technologies will support IoT to transform the internet into a fully integrated future internet. This paper attempts to provide a comprehensive survey of the available literature related to IoT technologies and their applications in many areas of modern-day living. Identify the trend and directions of future research in IoT applications, depending on a comprehensive literature review and the discussion of the achievements of the researchers.

Keywords: Internet of Things (IoT); Radio Frequency Identification (RFID); Near Field Communication (NFC)

1. Introduction

The next revolution in the era of smart computing is quite far from using the desktop and destined for the usage of the Internet anywhere and at any time, controlling and monitoring objects remotely refers to the so-called Internet of Things (IoT). IoT defines as connecting things to the internet and employee that connection to achieve the ability to remote monitoring and control these things. The objects can be supplied with sensing, identifying, networking, and processing capabilities that will allow them to communicate with each other to reach common goals.

Today it is considered a part of many enterprises to provide access to information. It has become the largest computing technology or intelligent technology.

IoT use has been growing rapidly thanks to its technologies. IoT has the capability to collect data from the environment through sensors, operate and interact with the physical world through manipulating collected data, and use Internet standards to communicate and analyze the data for more services.

It is vital at the personal and public levels. On a personal level, it is serving personal purposes such as controlling home appliances, controlling and monitoring the health of patients and the elderly, ..etc.

At the public level, it is serving general purposes where IoT applications are outspread from small object applications to large applications. These applications include the smart industry, Smart connected vehicles, smart grid, agriculture, and other domain.

IoT was initially proposed to refer to uniquely identifiable objects (things) through using technologies as RFID is the widest use in IoT. RFID is used to determine things, retrieve relevant information, and protect properties from theft (especially in the home). Smart sensors are used in many domains such as agriculture to observe and communicate soil formation and irrigation conditions to manage resources accurately Wireless Sensor Network (WSN) is used in many fields like monitoring, tracking, smart grid, smart water, and intelligent transportation systems. The capabilities of WSN and its advanced technologies in wireless communications, made WSN integrated with IoT. WSN and IoT deployments in marketing and other areas.

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In this paper, we represent how IoT emerges and its origin (history) as shown in section two. We discuss several definitions and technologies used in applications of IoT, these technologies helped IoT to spread in many domains and applications as a representative in section three. By interfering with and using IoT in many applications, we can identify future trends and directions for IoT uses in section four. The final section represents the conclusion.

2. History of IoT

In the 1970s, systems for remotely monitoring meters on the electrical grid via telephone lines were already in commercial use. In the 1990s, advances in wireless technology allowed the "machine–to–machine" (M2M) enterprise, which is used in industrial solutions for monitoring equipment and operation to become widespread.
But, this way suffers from limitations in performance and capabilities [1]. These previous issues had been tried to solve through wireless communications, and intelligent technologies have caused in development of miniature devices. These devices have the ability to sense, compute, and communicate wirelessly over short distances [2]. The sensors and communication wireless have a wide range for use in monitoring applications. All of these are due to the presence of a "smart environment" or so-called IoT [3].
The term IoT arise in 1999 by Kevin Ashton through using in supply chain management through using technology as RFID. In the past years, the definition of IoT could exclusive how the computer is used in many applications such as healthcare, transportation… etc [4]. Currently, IoT defines as the ability to communicate and manage a number of automated remote devices over the Internet. Using embedded sensors that allow the communicated devices and objects to send and receive data [3]. This technology saves effort on the human by giving the human rights of opening and locking devices in the home and controlling it remotely without the movement and effort of humans.

In 2011, the concept of a smart environment began to appear on the planet where the number of interconnected devices increased. This increase is associated with the use of terms that have been close to IoT but does not mean exactly the same thing as the following:

- Machine-to-machine communication (M2M): that means one-to-one connection, communicating one machine to another.
- Web of Things: this term focuses only on software engineering.
- Internet of Everything (IoE): it includes all kinds of communications that one can imagine.
- Pervasive computing (Ubiquitous Computing) [5]: it includes embedded devices and systems, and wireless communications, and permits the user to access information services at any time and anywhere.

Currently, the number of interconnected devices has become 9 billion. That means the new phenomena of IoT is an attractive point in the next decade. The researchers expected that in 2020 that 25 billion devices will communicate to the internet through using IoT [6]. Internet of Things considers one of the emerging technologies in IT as mentioned in Gartner's IT Hype Cycle, through measurements of the Google search trends during the last years for the terms Internet of Things, Wireless Sensor Networks, and Ubiquitous Computing as shown in figure 1[7-8].

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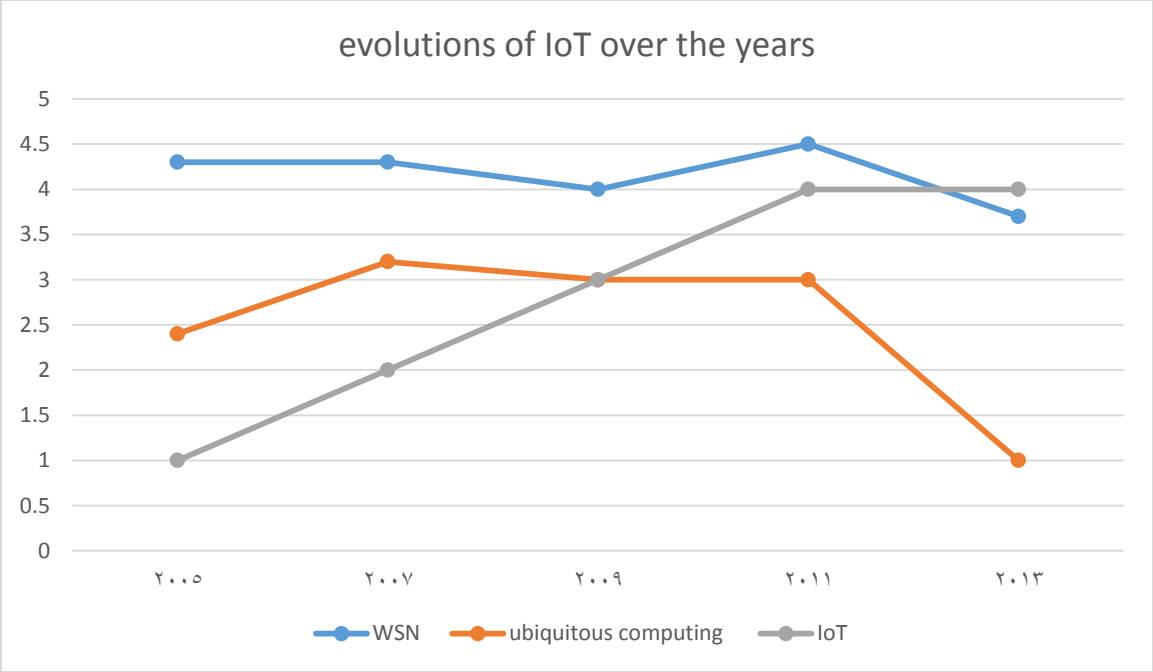

Figure 1: Google search trends in the last years for terms Internet of Things, Wireless Sensor Network, and ubiquitous computing [8]

3. Definitions, Technologies, and Applications of IoT

This section we divide into three sections as the following:

3.1 Definition of IoT

Many researchers attempt to define and describe the concept of IoT through their side view used in their work and application as the following.

Internet of Things (IoT) is described as a combination of three paradigms (1) internet-oriented (middleware), (2) things-oriented (sensors), and (3) semantic-oriented (knowledge) as shown in figure 2 [9].

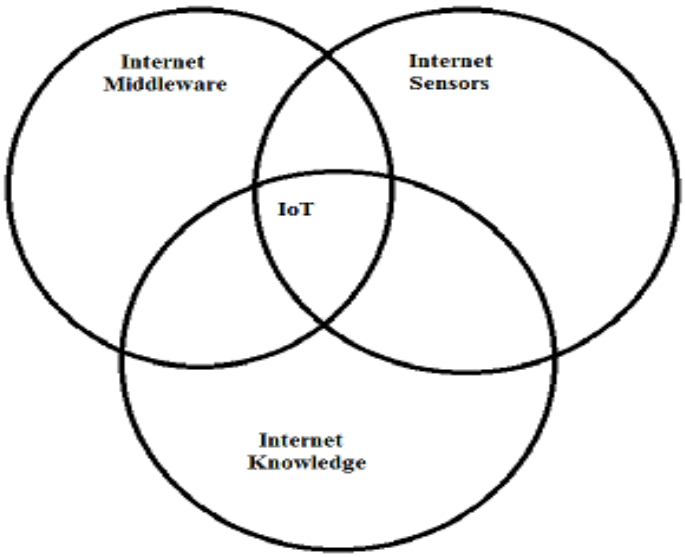

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Figure 2: Internet of Things

IoT is a new paradigm in information technology aimed at building up a dynamic global network infrastructure by connecting a variety of physical and virtual 'things' with the growing mobile and sensors [10]. IoT is a new technology for Internet access. Through IoT, objects recognize each other and they can convey information about themselves [11]. The term IoT refers to this internet-based architecture that encouraged the exchange of services, information, and data among billions of objects. It was first introduced by Kevin Ashton in 1998 and received a lot of interest in industry and academia [12]. IoT refers to devices or smart objects that are connected through inter-networking between devices. These devices are able to collect and transmit data by technologies of the internet. IoT includes the technologies and solutions that enable the integration of data and facilities into information technologies (IT). It connects all things (objects) with the internet, so IoT is sometimes called the "internet of smart objects". It enables the users to communicate with each other in a few time [13]. ToI is a new technology that is gaining ground due to the huge improvements in electronics and wireless communications technologies through collecting various information and analyzing it for application services [14]. It defines a new concept of helping items and sensors within or attaches to these items to connect to the internet by wireless and wired internet connections. It also refers to the use of connected devices and systems intelligently to benefit from data collected by embedded sensors, actuators, and other physical objects [15].
Other researchers describe IoT as the following [16]:

- Interconnectivity: Anything can be associated with the global information and communication infrastructure.
- Things-related services: IoT is able to provide services related to things within the constraints of things, such as protection of privacy and semantic consistency between physical things and their associated virtual things. In order to provide thing-related services within the constraints of things.
- Heterogeneity: The devices in IoT are heterogeneous based on different hardware platforms and networks. They can interact with other devices or service platforms across different networks.
- Dynamic changes: Device status changes dynamically, e.g., connected and/or disconnected as well as the context of devices including location and speed. Further, the number of devices can change dynamically.
- Enormous scale: The number of devices that need to be managed and communicate with each other is massive.

3.2 Architecture of IoT

IoT consists of some elements as shown in the following subsection. These elements are employed in the form of layers with different names according to each application.

3.2.1 IoT elements

There are three IoT component are:

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- Hardware: represented in sensors and actuators that embedded communication hardware.
- Middleware: responsible for analyzing the data.
- Presentation: easy-to-understand visualization tools which can be widely accessed on different platforms and which can be designed for different applications.

3.2.2 IoT layers

IoT consists of a set of layers, each layer includes one of the elements mentioned in the previous subsection. The layers of IoT differ from one researcher to another based on the application to which the researcher applied IoT on it as shown in figures 3, 4, and 5.

Figure 2[15] IoT contains three layers as follows:

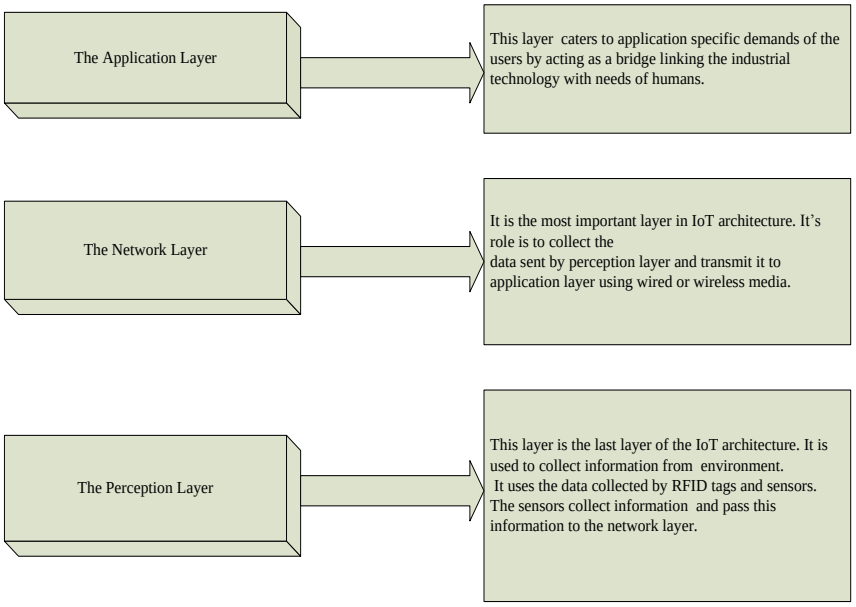

Figure 3: The architecture of the Internet of Things

Figure 4 [17] IoT in high-risk Environment, Health, and Safety (EHS) application consists of three layers as the following:

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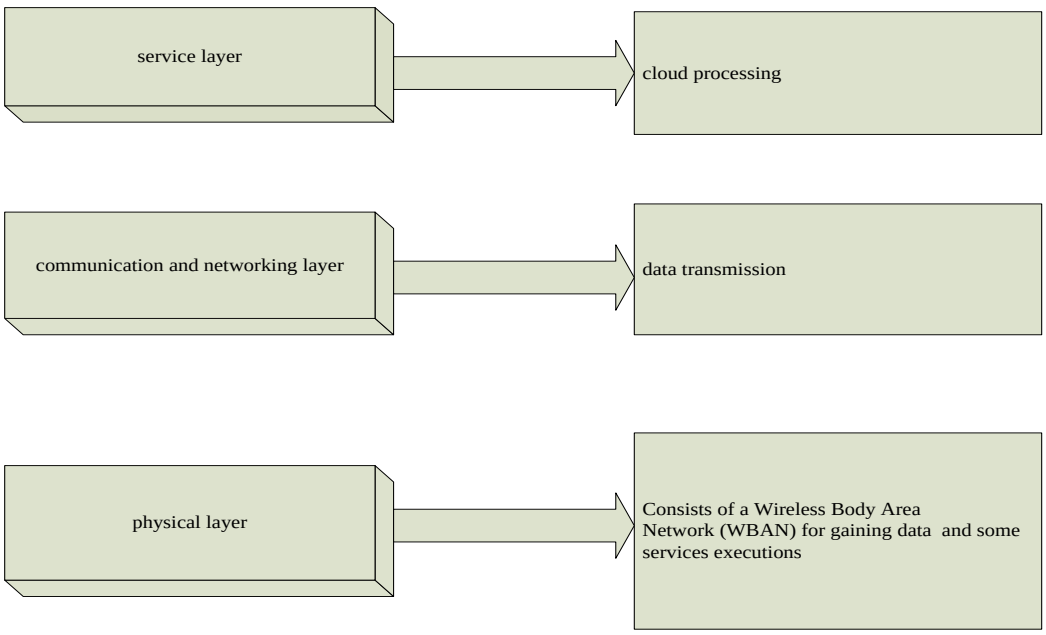

Figure 4: The architecture of the Internet of Things

Figure 5[18] IoT in smart health applications consists of three-layer as the following:

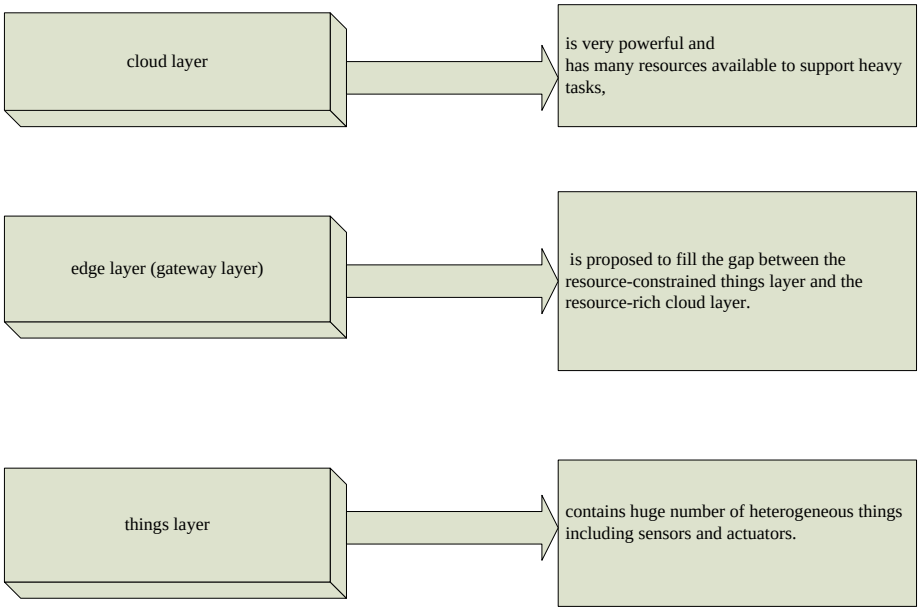

Figure 5: The architecture of the Internet of Things

This phenomenon is growing rapidly in many fields of human life through using many technologies integrated into human activities. RFID and WSN represent the link between the real world and the digital world.

3.3 Technologies of IoT

3.3.1 Radio Frequency Identification (RFID)

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Radio Frequency Identification (RFID) is a system that transfers the identification of an object via wireless radio waves in the form of a serial number. RFID technology plays an important role in IoT to solve issues of identification of objects [6]. Also, it provides benefits, such as asset tracking, safety monitoring conditions, and assistance in preventing counterfeiting. It helps in the automatic identification of anything they are attached to acting as an electronic barcode. Where it is similar to barcode technology and requires a special optical sound reader and markings applied to the products. It requires reader equipment and special tags or cards attached to the products for tracking the products [19]. It is divided into two types. The first type is passive RFID tags are not needed battery powered and they use the power of the reader to communicate ID to the RFID reader. This type is used in retail and supply chain management. The second type is the Active RFID reader has its own battery supply. This type is used in port containers application [20].
RFID has components such as a tag, reader, antenna, software, and server as shown in figure 6 [21]. RFID tag communicates with an RFID reader via radio-frequency electromagnetic fields.

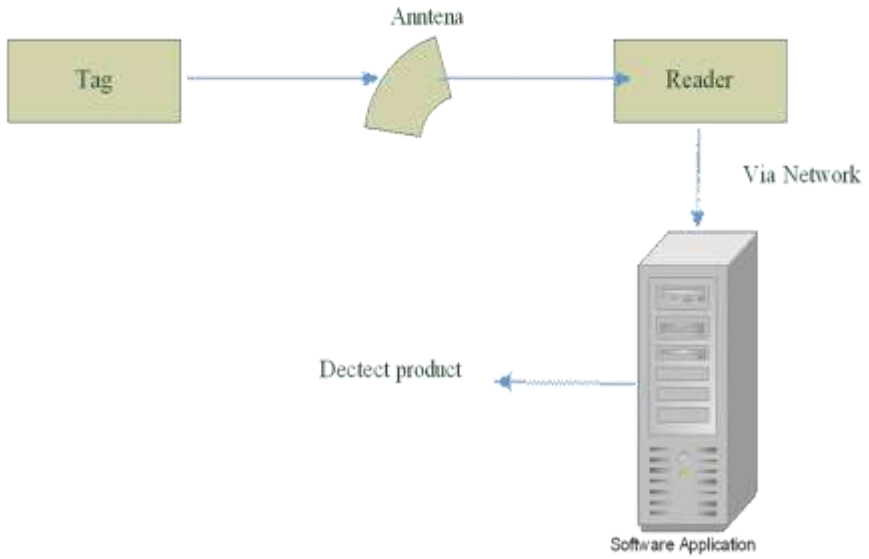

Figure 6: Block Diagram of Radio Frequency Identification

3.3.2 Internet Protocol (IP)

Internet Protocol (IP) is the major network protocol used on the internet, developed in 1970. IP is the principal communications protocol in the internet protocol suite for transmitting data units across network boundaries [21]. There are two versions of IP that are in use: IPv4 support for a group of cohabiting sensor devices that are identified geographically, but not individually.
IPv6 mitigates some of the device identification problems, synchronous operations and convergence of data from devices exacerbate the problem [22].

3.3.3 Electronic Product Code (EPC)

An electronic Product Code (EPC) is a 64-bit or 98-bit code electronically recorded on an RFID tag. It is a code number that gives the unique identification own to a given physical object. The Information of the object can be stored in existing databases on the internet [23]. EPC composes of EPC tags, readers, EPC Savant, Object Name Service (ONS) server, Physical Markup Language (PML), Electronic Product Code - Information System (EPC-IS) servers, and Internet as shown in figure 7[24].

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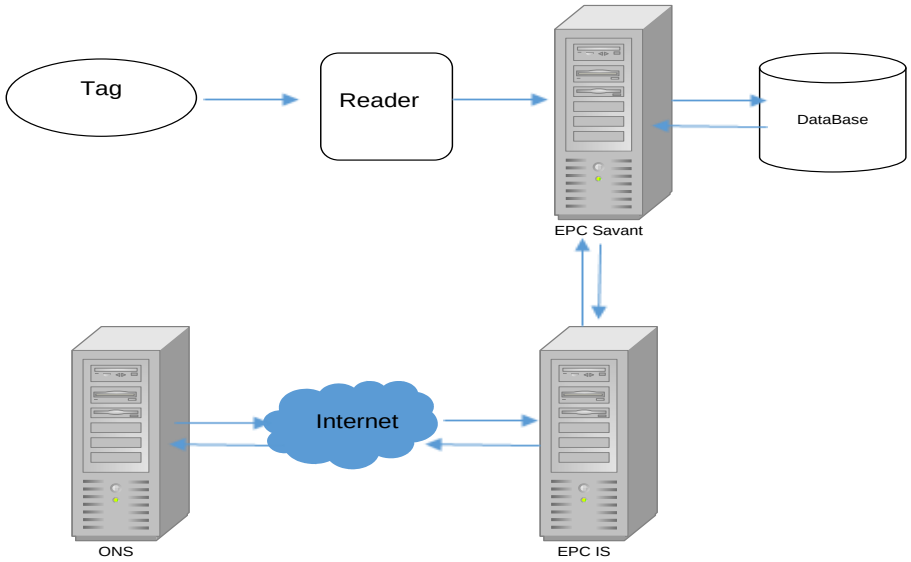

Figure 7: Block Diagram of Electronic Product Code

3.3.4 Barcode

Barcode is another way to encode numbers and letters using a set of bars and spaces with varying widths [21]. It is machine-readable data, where the data usually describes something about the object that carries the barcode. We can say that Barcodes are optical machine-readable labels attached to items that record information related to the item [25]. It becomes successful in the commerce field which is used to automate supermarket checkout systems. There are 3 types of barcodes of Alpha Numeric, Numeric, and 2 dimensional.

3.3.5 Wireless Fidelity (Wi-Fi)

Wireless Fidelity (Wi-Fi) is a wireless technology that allows smart devices to connect to wireless networks and allows the transmission of data at high speed using radio waves over a short range [26].

3.3.6 Bluetooth

Bluetooth is a wireless technology to exchange data over a short distance with a transfer speed of 720 Kbps data per second. It is cheap, short-range radio technology. It appears in 1994 by Ericson Mobile Communication Company [26-24].

3.3.7 ZigBee

ZigBee is one of the protocols developed for improving the characteristics of wireless sensor networks. In 2001 ZigBee Alliance was create ZigBee technology. ZigBee has some features such as low cost, low data rate, relatively short transmission range, scalability, reliability, and flexible protocol design [24].

3.3.8 Near Field Communication (NFC)

It is a set of short-range wireless technology at 13.56 MHz, typically requiring a distance of 4 cm. this technology is convenient for consumers and considers a simple connection method. It is complementary to

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Bluetooth. It is developed by Philips and Sony companies. NFC represents a link between smart devices of IoT and the internet, smart devices send the data to the server [21].

3.3.9 Wireless Sensor Networks (WSN)

A WSN is a wireless network that consists of a separate distribution of independent devices using sensors to observe the physical and environmental conditions in a cooperative manner, such as temperature, sound, vibration, and pressure at different locations. The sensor nodes communicate and cooperate to achieve a special goal. They can be used to collect and process data from the environments of mechanical, temperature, light, radiation, and optical readings [27].

3.3.10 Artificial Intelligence (AI)

Artificial Intelligence (AI) provides various techniques that present the intelligent behavior of IoT. In the realm of surrounding intelligence, devices work in coordination to support people in carrying out their activities and actions [24]. These devices allow the interactions of the users with the smart environment. These interactions allow consumers to get information anywhere and at any time [22]. AI includes many techniques that can serve IoT as CI. This technique provides as shown in figure 8, adaptive techniques that enhance the intelligence of the IoT system.

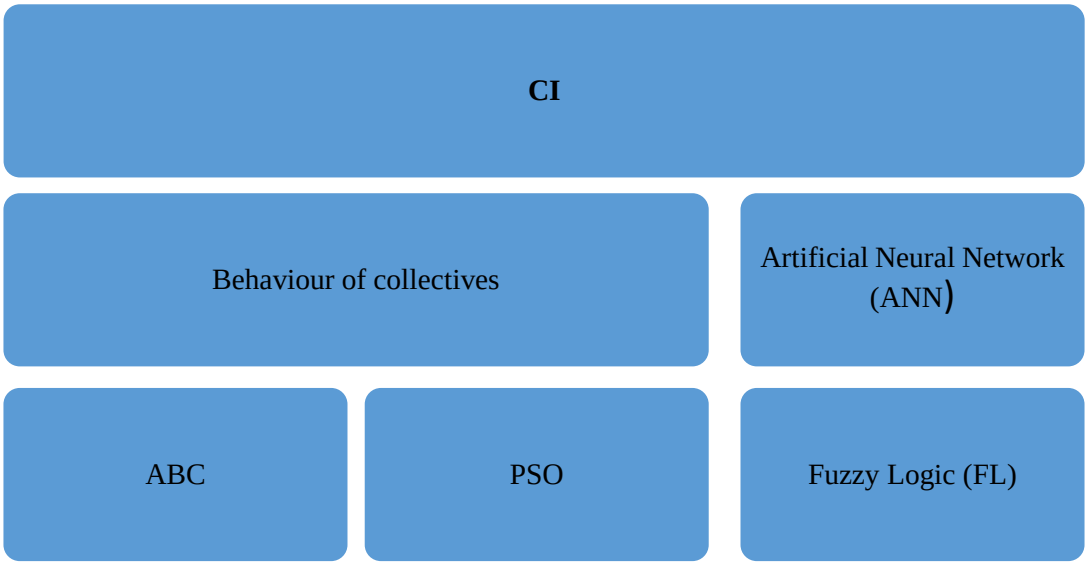

Figure 8: Techniques of Computational intelligent

3.4 Applications of IoT

This section presents several application domains that IoT considers the main factor in these domains. Applications of IoT are divided into personal applications and general applications as shown in figure 9.

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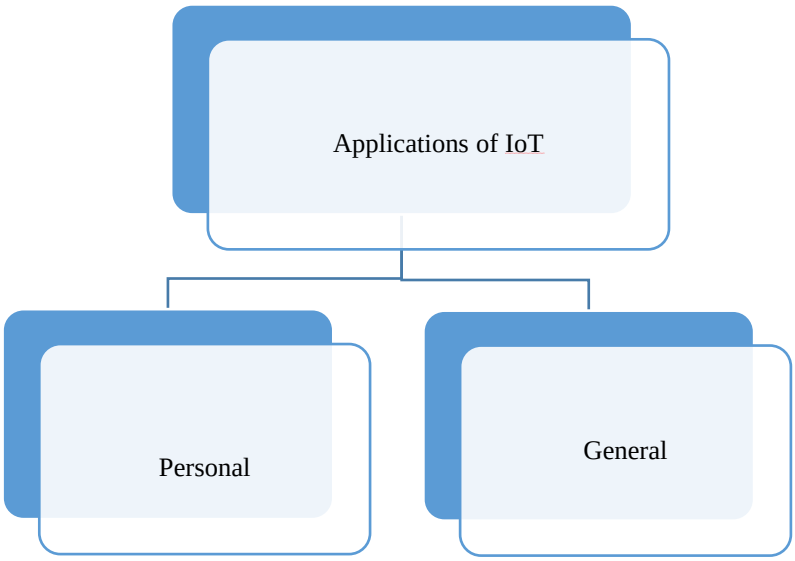

Figure 9: Applications of the Internet of Things

3.4.1 Personal applications

The consumer uses IoT as shown in fig 10 to control (1) home, (2) health for the elderly, and (3) safety.

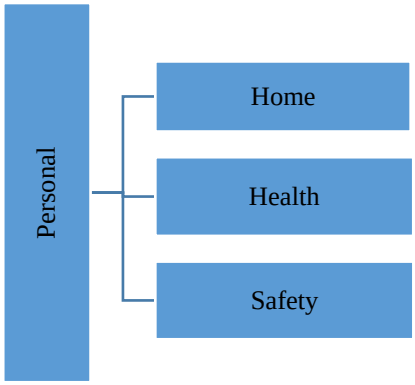

Figure 10: Personal applications of the Internet of

- Smart Home

A smart home allows the user to access and change the status of his/ her appliances i.e. switches it on/off. It also provides an interface for remote household appliances to provide control and monitoring on a web browser [28]. The usage of the technologies become an important factor in IoT, where researchers applied them in their

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experiments. Bluetooth wireless technology is used in home automation. It allows the user to access appliances in the home as well as device control commands, though The Bluetooth antenna picks up the packets sent from the cell phone. Later, these packets contain the status of the device [29]. Home Automation System (HAS) is designed to help users especially the elderly and disabled control their homes. The control system implements through wireless Bluetooth technology that provides remote access from a PC/laptop or smartphone. The user can control his electrical appliances and appliances in the house using a user interface friendly [30]. The following table represents a summarization of previous works for IoT.

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Table 1: Summarization of previous works in IoT smart home

Ref #	Authors Name	Paper Name	Used Technology
[31]	Yepeng Ni, Fang Miao, Jianbo Liu, Jianping Chai.	"Implementation of Wireless Gateway for Smart Home"	ZigBee Wi-Fi network
[32]	Ming Wang, Guiqing Zhang, Chenghui Zhang, Jianbin Zhang, Chengdong Li.	"An IoT-based appliance control system for smart homes"	wireless sensor and actuator network (WSAN)
[33]	Yuanxin Lin, Rui Kong, Rongbin She and Shugao DengResearch,	"Design and Implementation of Remote/Short-range Smart Home Monitoring System Based on ZigBee and STM32"	ZigBee
[34]	Dr. Sharon N. Panth, Mahesh Narandas Jivani	"Home Automation System (HAS) using Android for Mobile Phone"	Bluetooth
[35]	Rakesh Roshan, Abhay Kr. Ray	"Challenges and Risk to Implement IOT in Smart Homes: An Indian Perspective"	WiFi Sensors

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- Health

Medical and health are one of the most attractive applications for the IoT. This technology has the ability to apply in many medical domains such as remote monitoring of health and fitness programs, chronic diseases, and care for the elderly [36]. ToI used in developing medication control system. Using a cog sense device which used to care for the patients by monitoring the caretakers and the doctors for the status of the patients. CogSense device is provided with a specific machine-learning engine to perform patient data analysis and suggest treatment outcomes. IoT device consists of three modules data analysis module, a communication module, and sensor access and signal processing. This device is used to meet the day-to-day needs of home telehealth users [37]. RFID is utilized to give identification own to the user. This technology permits the prescriber to distinguish the patient and monitor him/her remotely [38]. Home Automation System (HAS) is designed to help users especially the elderly and disabled control their homes. The control system implements through wireless Bluetooth technology to provide remote access from a PC/laptop or smartphone. The user can control his electrical appliances and appliances in the house using a user interface friendly [39].

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Table 2: Summarization of previous works in IoT smart Health

Ref #	Authors Name	Paper Name	Used Technology
[40]	Simarpreet Kaur, Kamaljeet Kaur	Future of RFID Technology in Health Care Systems: A Review Paper	RFID
[41]	Samuel Fosso, Wambaa, Abhijith Ananda, Lemuria Carter	A literature review of RFID-enabled healthcare applications and issues	RFID
[42]	Dr. Afsaneh Minaie,, Dr. Ali Sanati,Paymon Sanati-Mehrizy,and Dr. Reza Sanati-Mehrizy,	Application of Wireless Sensor Networks in Health Care System	WSN
[43]	B. Vijayalakshmi, C. Ram kumar	Patient monitoring system using Wireless Sensor-based Mesh Network	WSN

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- Safety

IoT protects the home and humans from death and property damage. WSN is designed using multiple sensors with Global System for Mobile Communications (GSM) for early detection of house fires to avoid false alarms [44].

3.4.2 General applications

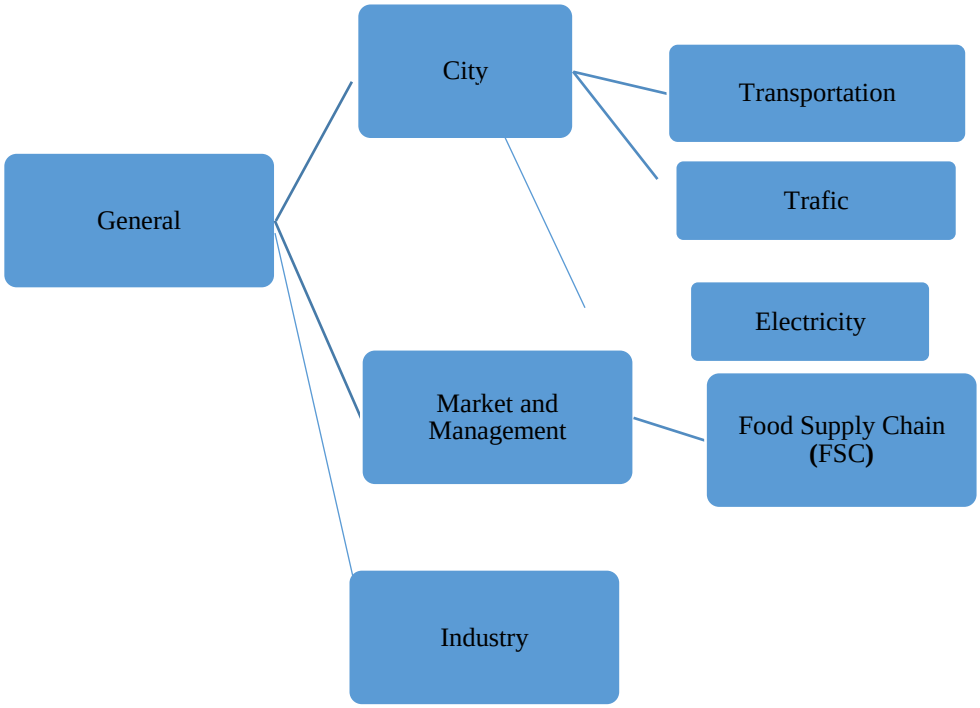

Figure 11: General applications of the Internet of

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- Smart City

The growth of the Internet and Wi-Fi are making the world predict in 2025 that everything will be subject to intelligent technology (i.e. IoT). So that cities become smart through their components as buildings, homes, Transportation .etc. though using the above technologies, which help humans to control anything anywhere and anytime.

- Transportation

IoT became important in the field of transportation systems. The transportation suffers from some problems as there is a lack of information about the arrival time, the passengers do not have the possibility to know the capacity of the bus, they do not know how many additional people
inside the bus so, there is a possibility of having no places so that, there are passenger standing.
These problems can solve by using IoT. That seeks to gather, process, and present the relevant information on transportation for the user. Using ARDUINO, IR Sensor, and Global Positioning System (GPS) Module to develop an intelligent information system to support passengers with information next location of the bus and the crowd inside the bus [45]. IoT attempt to solve another problem facing the passengers is the long waiting time at bus stops. That makes the passengers unwilling to take buses. To avoid such problems IoT used to present a bus arrival time prediction system. This system was developed based on mobile devices GPS enable feature to obtain the arrival time of Bus and predict bus arrival time at various bus stops [46].

- Traffic

This application can obtain traffic information such as states of traffic and locations by tracking location information for a large number of vehicles. Thus, the system helps the driver to select the most effective route [38].

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Table 3: Summarization of previous works in IoT smart Transportation

Ref #	Authors Name	Paper Name	Used Technology
[47]	K. Kotis, and A. Katasonov	"Semantic Interoperability on the Web of Things: The Smart Gateway Framework"	WSN Sensor
[48]	Hasan Omar Al-Sakran	Intelligent Traffic Information System Based on Integration of Internet of Things and Agent Technology	RFID WSN
[49]	J. Gubbi	"Internet of Things (IoT): A vision, architectural elements, and future directions", Future Generation Computer Systems	RFID wireless communication
[50]	Joshué Pérez, Fernando Seco, Vicente Milanés, Antonio Jiménez, Julio C. Díaz and Teresa de Pedro	An RFID-Based Intelligent Vehicle Speed Controller Using Active Traffic Signals	RFID GPS

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- Market and Management

The company can determine which product won the admiration of customers through using IoT technologies. Using barcodes that read the identification code of products, and protocols and using connectivity technology as wireless, which connect the company with its retailers. It allows the manager of the company to follow and monitor product demand. IoT support any company to make a decision about a certain product. Based on these monitoring and scan technologies the company can recommend other products for customers based on recent products.

- Food Supply Chain (FSC)

IoT is used in FSC applications through the supply chain from farms to branches. The chain means that farm production, food processing, packaging, sales & marketing, logistics and distribution, retail, and interactions with consumers. This chain occurs through five stages produce, store, transport, sell and consume [51] as shown in figure 12.

Figure 12: Food Supply Chain [52]

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- Retail

Retailers can use IoT technologies to improve (i) inventory, (ii) store operations, and (iii) services offer to customers [53].

1. Inventory

Using technology such as RFID or barcode to reduce the handwork. In other meaning, shelves become smart shelves that help workers to take stock of the goods through a smartphone. Through the take stock process store managers can make better decisions about orders and detect shrinkage and misplacements.

2. Store Operations

IoT technologies help in providing detailed sales data on items. Such RFID allows the manager to monitor the products on the sales floor. The monitoring process contributes to efficient sales floor operations. This technology avoids making the mistake of the existence of the products in stock but not available on the sales floor on the shelf. Shelves with RFID (smart shelves) can automatically detect misplaced products and direct a worker to correct the placement as shown in figure 13.

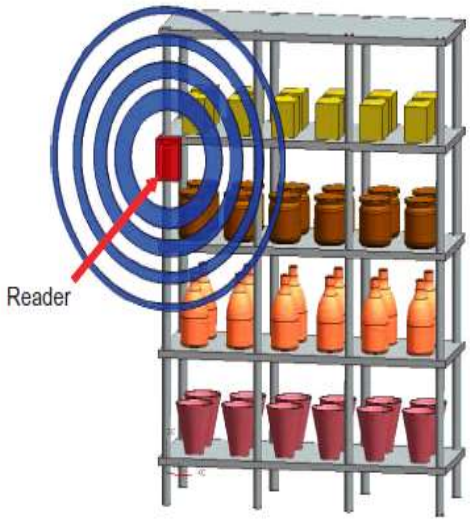

Figure 13: Smart shelves with RFID [53]

3. Services offer to the customer

The customer can use a push cart provided the device has an RFID reader. This device is called an "electronic shopping assistant" which helps the consumer to get detailed information about products. This device makes suggestions about purchases that go along well with already selected items. Also, there are refrigerators equipped with RFID to provide service as observation track of the Purchased products and give warnings when the product becomes expired or close to expiration.

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Table 4: Summarization of previous works in IoT smart Market and Management

Ref #	Authors Name	Paper Name	Used Technology
[51]	Sauro Longhi_, Davide Marzioniy, Emanuele Alidoriy, Gianluca Di Bu`o_, Mario Prist_, Massimo Grisostomi_ and Matteo	Solid Waste Management Architecture Using Wireless Sensor Network Technology	WSN
[52]	Li Zhou, Alain Y.L. Chong, Eric W.T. Ngai	Supply chain management in the era of the internet of things	RFID
[53]	Andhe Dharani1 , Manjuprasad B. , Shantharam Nayak , Vijayalakshmi M. N.	Sensor Networks - An Insight on Market Perspective and Real-Time Border Monitoring System	WSN
[54]	TijunFan,FengTao,ShengDeng,ShuxiaLi,	Impact of RFID technology on supply chain decisions with inventory inaccuracies	RFID

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- Industry

IoT allows companies to optimize their performance by gathering and analyzing data throughout the whole product lifecycle. Using the monitoring technology as WSN. Using such technology which has a sensor responsible for measuring the currents of the main motor drives, and measuring the overall power consumption. The WSN is combined with the use of the DIGI XBee ZigBee RF module. The selection of ZigBee over other wireless standards to its support to various network topologies [55].

4 Future Direction

IoT will be used increasingly over time and can combine with data science techniques to serve many domains in the future.

4.1 Agriculture

IoT can use in many directions in the agriculture domain.

The first direction is, We can estimate future crops/ planets based on many factors such as determining the type of soil, and climate status in many areas based on parameters of weather such as low temperature, high temperature, dew point, humidity,…etc as shown in figure 13.

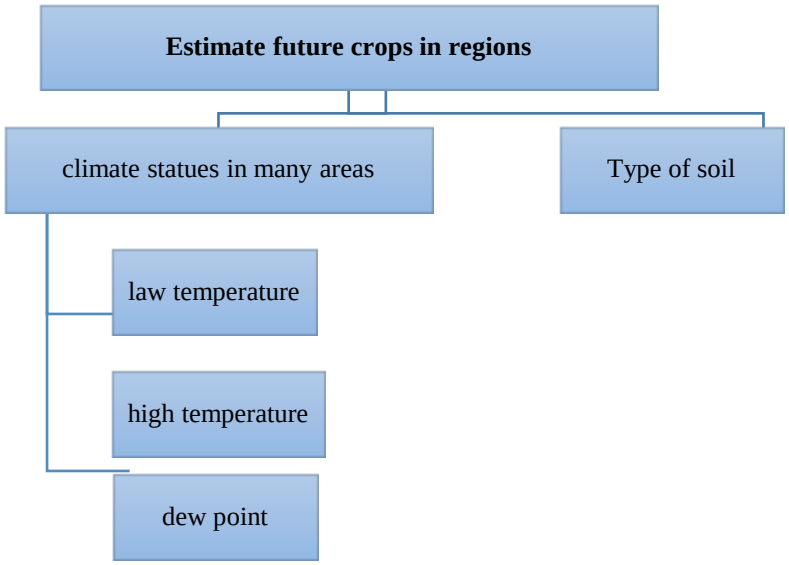

Figure 14: Role of IoT in Estimating Crops

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These parameters measure from different weather stations at different locations.
The information about these factors can be collected by using IoT sensors devices used in the perception layer. These sensors are used to collect information remotely from different locations about the mentioned factors. Transmit the collected data via wireless communication in the network layer. In the data processing layer, applying CI techniques as machine learning to forecast weather in future time based on collected time series for parameters of weather. Based on weather forecasting, the type of crops that shall be grown can be estimated.

In the second direction, IoT will help in monitoring the state of crops and their health of it in the presentation layer. IoT sensors are capable of supplying farmers and agricultural Engineers with information about the crop. IoT supplies the agriculture domain in many directions as shown in figure 14.

1. IoT can manage and help farmers to control and monitor the level of water in the Irrigation Process. When the level of water reaches to determine the level, the farmer sends the order to stop the irrigation process remotely. That can do by using wireless communication as WSN.
2. Farmer monitor and follow the state of the weather and make a decision to protect the crops.
3. Technologies such as sensors and RFID help farmers and agriculture engineers identify diseases in plants and crops. RFID tags send the EPC (information) to the reader and share it via the internet. The farmer or agriculture engineers can access this information from a remote place and take necessary actions, automatically crops can be protected crops from diseases.

In the third direction, the former can control the Irrigation machines without interference from humans. These machines can irrigate the plants and the process of irrigation is stopped by order of the farmer or agricultural engineer remotely.

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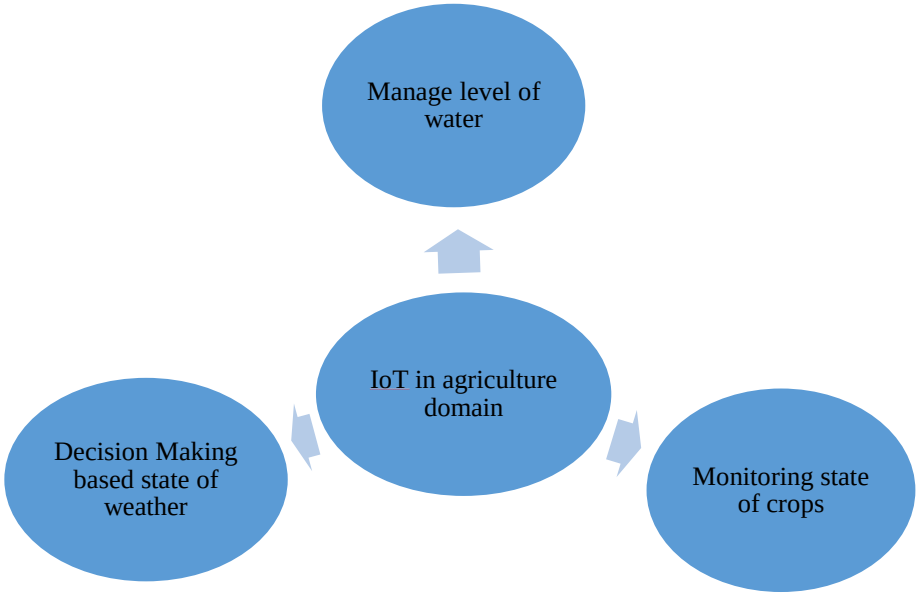

Figure 15: Role of IoT in the agriculture domain

4.2 Military

Military applications are very closely related to wireless sensor networks which use in many directions in that domain.

The first direction is in the field of air defense. The officers can monitor borders to protect the airspace of the state.

In the second direction, the generals can monitor the state of the military battalions.

In the third direction, in cases of wars, the generals can monitor the battlefield remotely and give orders based on their monitoring of the battle.

The fourth direction is the Discovery of internationally banned gases by using sensors which has the responsibility to detect such gases to protect the countries and soldiers.

Fifth direction, using computational intelligence (ci) with IoT to recognize the enemy during the war. Applying face recognition where the generals can follow up on the face of their soldiers on the battlefield through RFID. This technology sends its tags to the reader to identify if the soldier belongs to them or the enemy. RFID helps the soldiers on the battlefield to prevent the suicide of personal enemy soldiers. Using such technology helps them to differentiate between their own warriors from the self-sacrificing enemies and their warriors through military uniforms.

Sixth direction, using sensors embedded in the military tank to sense the mine areas.

4.3 Market and management

Using technology such as barcode and RFID support the manager of the company to monitor and follow sales of the product in different retail stores. These technologies benefit the manager in many directions:

In the first direction, through sales of a product, the manager can make a decision to increase or decrease the amount of product for the retailers.

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In the second direction, the manager can use CI techniques to predict the future profit from sales for certain products through Product turnout.

5 Conclusion

We provided a global overview and works of its usage in our life. IoT allows machine-enabled decision-making with minimal or without human intervention. It has the ability to collect data from sensors, RFID, barcodes, and other technologies mentioned above. These technologies are located in the perception layer. The collected data passes via wire/wireless from the network layer to the application layer. We demonstrated how this new phenomenon is used in many applications through using its technologies as shown in table 1, table 2, table 3, and table 4. For example, in the field of marketing and management, IoT supports making a decision about many products and saving money and time. By using any technology such as Barcode or RFID which attempt to change the way that we shop usually. In case all of the products in retail are tagged and the facility is equipped with reader technology it becomes easier to manage inventory and work at much lower costs than it is today. In the future direction, we can say that smart farming is important and necessary. IoT works in the agriculture sector to improve the efficiency of time, administration of water, monitoring of crops, and control of insecticides and pesticides which cause disaster. These disasters affect productivity in the country. It minimizes human efforts, smart farming can help the market to grow for farmers with minimum effort. From our study for related works about IoT, we concluded that IoT technology offers benefits and facilities for any application to technologies of IoT.

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