Internet of Things and The Smart City Project Case Study – The Smart City of Tripoli – Libya

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Abstract— The recent increment of population in the urban areas requires well-operated and well managed cities with lots of automation in various aspects of everyday life. The backbone of this smart city is the Internet-of-Things (IoT) technology. Smart city concept has gained importance in urban development literature and there have been many initiatives and projects around the world implementing the smart city concepts.

The urgent need for development and expansion in the city of Tripoli requires us to shift to the smart city model, with its attendant challenges. As well as laying the basis for a new service to be added to the smart city project so that it can be used as much as possible

The city of Tripoli has gone through many political and economic eras, which affected the course of its development and created some obstacles. In this paper, we explained the smart city project for the city of Tripoli and what has been achieved from it so far with the design of a new service for the smart city of Tripoli.

Keywords - smart city, internet of thibgs, Tripoli

I. INTRODUCTION

Internet of Things refers to a type of network to connect anything to the Internet based on the stipulated protocols through information sensing equipment to conduct information exchange and communication in order to achieve intelligent identification, positioning, tracking, monitoring and management (Domenech, et al. 2019). The smart city refers to the city based on a correct technological basis, including regulation and coordination between government services and the development and coordination of its infrastructure in a way that provides the greatest level of welfare for citizens (Pereira, et al. 2018).

The Internet of Things (IOT) was coined by a member of the RFID development community in 1999, and it has only recently become more relevant in the real world, thanks to the growth of mobile devices, embedded and ubiquitous communication, cloud computing, and data analytics (Ovidiu, et al, 2013).

The Internet of Things (IOT) is a network of physical objects, according to the most common definition (Lytras, et al. 2020). The internet has evolved into a network of devices of all types and sizes, including vehicles, smart phones, home appliances, toys, cameras, medical instruments and industrial systems, animals, people, and buildings, all connected, all communicating and sharing information based on predetermined protocols in order to achieve smart reorganizations, positioning, tracing, safe and control, and even personal real-time online monitoring, upgrade, and proc (Ovidiu, et al, 2014).The researcher defines IOT into three categories as below:

Internet of things is an internet of three things:

1. People to people
2. People to machine / things
3. Things / machine to things / machine, Interacting through internet.

The Internet of Things (IoT) is a concept and a paradigm that considers the pervasive presence in the environment of a variety of things / objects that can interact with each other and cooperate with other things / objects via wireless and wired connections and unique addressing schemes to create new applications / services and achieve common goals. The research and development challenges to create a smart world are enormous in this context. A world in which the real, digital, and virtual collide to create smart environments that improve energy, transportation, cities, and a variety of other areas (Ovidiu et al, 2013) and (Ovidiu, et al, 2014).

The term "Internet of Things" refers to a broad concept of things, particularly everyday objects, that are readable, recognizable, locatable, addressable via information sensing devices, and/or controllable via the Internet, regardless of communication means (whether via RFID, wireless LAN, wide area networks, or other means). Everyday objects include not only the electronic devices we encounter or higher-tech products such as vehicles and equipment, but also things we don't normally think of as electronic - such as food, clothing, chairs, animals, and so on (Ovidiu, et al, 2013). (Ovidiu, et al, 2014).

The goal of the Internet of Things is to allow things to connect with anything and anyone at anytime, anywhere, and using any path/network and service (Hussein, et al. 2019).

The Internet of Things is a new Internet revolution. Objects gain intelligence and make themselves recog-

nizable by making or enabling context-related decisions, thanks to their ability to communicate information about themselves. They can access data that has been aggregated by other systems or they can be parts of more complex services. This shift coincides with the emergence of cloud computing capabilities and the Internet's transition to IPv6, which offers nearly limitless addressing capacity (Ovidiu, et al, 2013). (Ovidiu, et al, 2014).

More than half of the world's population lives in cities, which are expected to grow by 2.5 billion people by 2050. They must deal with rising environmental pressures and infrastructure needs, as well as residents' demands for a better quality of life at a reasonable cost (Goldsmith, et al, 2017).

Cities can use smart technologies to address these issues, and they are already enabling the next wave of public investment. It all begins with information. Cities generate oceans of it, in all their complexity and scope. Finding insights in all of that data aids municipal governments in

responding to changing circumstances, wisely allocating resources, and planning for the future. Furthermore, providing individuals and businesses with real-time data empowers them to make better decisions and take a more active role in shaping the city's overall performance. Cities become more livable and responsive as they become smarter, and we are only beginning to see what technology can do in the urban environment (Cooke, 2018).

The development that took place in the World Wide Web for information and communication technology on the lifestyle of the population in cities and regions made it easy for them to get community services (cadastral) and infrastructure services (linear) and reflected on the improvement of those services to the cities by connecting those cities enabled ICT, which has the ability to provide real-time information on the various components of the city in time and space through sensing technology that provides decision makers in cities with sufficient information to take the appropriate warnings , The city's population and its territory and that this transformation that has occurred in the cities came as a result of knowledge on the one hand, and techniques that have led to the development of creativity and innovation on the other hand, information and digital data from a third party, and this is part of a new pattern of smart cities, which is a necessity for the future under The challenges posed by cities in the future (Al-Hader, et al, 2019).

Smart city is the place where the movement of individuals, governments and businesses that deal with individuals in the city administration and government companies with smart information technology in an orderly fashion and is linked to these multiple or varied with Internet objects and components city components by sensors and global positioning devices (Basu, et al. 2019).

In this paper, we briefly discussed what the Internet of Things is, and how the Internet of Things enables different technologies, their architecture, characteristics and applications, as well as presenting smart cities, their characteristics, applications, and challenges. We presented the smart city project for Tripoli and what has been achieved from it. As well as the project of the future city of Tripoli and its challenges.

II. THE SMART CITY OF TRIPOLI

1. City Location

Tripoli is the capital and largest city of Libya, with a population of about three million people. It is located in the northwest of Libya on the edge of the desert, on a point of rocky land projecting into the Mediterranean Sea and forming a bay in the coordinates of (32°53′14″N 13°11′29″E) and is 1507km2 in area. It includes the port of Tripoli and the country's largest commercial and manufacturing center. It is also the site of the University of Tripoli.

2. The comprehensive development plan of Tripoli (CDP)

The comprehensive development plan for the city of Tripoli in 2008, which was prepared in 2000, faced a big problem, which is that its proposals and plans were not implemented due to the large number of abuses on the land allocated for its projects. In order to implement this, the Tripoli municipality entrusted the 2015 development plan project to a group of Chinese companies (CCF).

The study included three axes:

1. The regional framework of the State of Libya.
2. Integrated structural plan for the municipality of Tripoli.
3. A plan to update the master plan and land uses for the municipality of Tripoli.

The study focused on the city center of Tripoli, and the Chinese CCF study expected an increase in the population of Tripoli in 2008 from 1.8 million to 3 million in 2015, the study included three alternatives (Tripoli Municipality, 2017):

1. Urban axes that organize development along selected axes towards the main transport routes of the city.
2. Urban edges: They are alternatives to the Tripoli belt to stop the housing expansion.
3. City Center Development: This is to expand the city of Tripoli in a circular motion to include all government institutions and public services.

3. The comprehensive development plan for the city of Tripoli

The Tripoli municipality contracted with a Libyan national company in 2008 to prepare the comprehensive development plan for the city of Tripoli 2030 according to

stages (Tripoli Municipality, 2017):

Stage One	The main report includes a review of past experiences, the reality of the situation and guidance	Jan-2010 (Done)
Stage Two	It includes alternatives to the development plan and outlines of strategies	Aug-2012 (Done)
Stage Three	The restoration of the comprehensive development plan for the municipality of Tripoli and action plans includes: -Preparing a draft of the comprehensive development plan. - Creating action plans	Oct-2012 (Done)
Stage Four	The final version of the master plan includes: - Preparation and execution	Dec-2015 (Not Done)

The civil war and political problems have caused delays in many major development projects in the State of Libya, including the comprehensive development plan for the city of Tripoli, but after the end of the civil war and the country's deviation to a state of peace, development plans can continue again.

4. Smart city applications in Tripoli, Libya

The development and development of the city of Tripoli in order to make the city of Tripoli a smart city born of development and information and communication technology, which is employed for the benefit of the city and its residents through the urban administration implemented by the local authorities in the city. That is why sustainable cities are playing their role through information and communication technology through smart management in the field of linear infrastructure (transport, water, energy and waste), and the smart sustainable city uses information and communication technology to improve the quality of life for city residents (Rabei, 2017).

And development, strategy and technology are all axes that contribute to the growth and development of the city, and there is a rule of Greek philosophers saying (everything changes and everything is in constant movement) and the city changes rapidly and dramatically due to migration from the countryside to the city, especially the capital, which leads to pressure on linear and survey services and the occurrence of problems in the city and requires the development of a strategy that contributes to addressing those problems.

III. DESIGNING A NEW SERVICE FOR SMART CITY TRIPOLI (SMART STREET LIGHTING)

Street lighting is a communal utility that uses a significant amount of electricity. According to research, between 18% and 38% of power resources are used to meet this need. With an increase in demand for electricity and a big disparity between supply and demand, issues such as power outages and inefficient consumption, such as bright street lighting in low-traffic areas, result in huge waste. It is necessary to improve consumption with Smart Street Light without jeopardizing public safety.

The Smart Street Light System is an intelligent street lighting control system that leverages artificial intelligence (AI) to provide automated services.

The Internet of Things (IoT) is principally responsible for enabling the notion of Smart Street Lights by gathering various sorts of electronic data from various physical objects and sending that data to the devices via sensors. The cost of street lights can be greatly lowered as a result of this, and the money saved can be used to invest in other aspects of the country's growth.

IoT technology can overcome various concerns with the current manual street light system, including connectivity challenges, timing issues, and maintenance issues. The technology is based on automation, which reduces the amount of manual labor required.

Many communities are modernizing their street lighting in multiple ways, including switching to LEDs and introducing smart lighting solutions. This smart city IoT use case has a number of advantages, including increased energy efficiency and lower energy and maintenance expenses. Smart lights can alter their brightness automatically in reaction to periods of inactivity, as well as send maintenance information for faster response times.

Figure (1) Smart Street Lighting is depicted in this image. The light gets brighter as the object goes closer to the light pole, and dims as the object moves away from it.

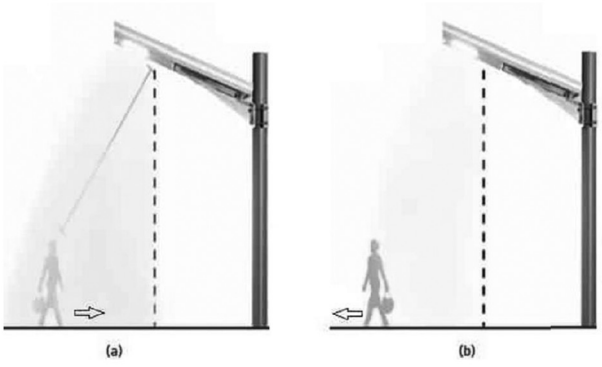

Figure 1 - Smart Street Light (a) Bright Light (b) Dim Light (Saed, 2017)

Architecture of Smart Street Light System

1. Smart Street Light System consists of the following components:

A. IR Sensor

An infrared sensor is an electrical device that detects infrared radiation to identify properties of its environment. These sensors are capable of detecting both motion and the heat of nearby objects. The electromagnetic spectrum's infrared radiation portion has wavelengths that are longer than visible light wavelengths. LED and Receiver are included with the IR Sensor. When the thing gets closer, it detects it and sends an Arduino answer

B. UART

Universal Asynchronous Receiver/Transmitter is the microchip that controls the computer's interface to the attached Street Light System.

C. LDR Input

Light-sensitive devices, also known as photo-resistors, that work with electromagnetic radiation are known as Light Dependent Resistors (LDRs). Because they are constructed of semiconductor materials, they cause significant resistance. It operates on the basis of photoconductivity. When the LDR is exposed to light, its resistance decreases and current flows into the first and second resistors' bases, respectively. The resistance of LDR is quite great when it is maintained in the dark.

D. LED

A light emitting diode (LED) is a semiconductor light source with two leads. The lighting system of the Smart Street Light is represented by these diodes. The quantity of light it emits is proportional to the amount of light it receives. The street light bulb is turned on and off using a relay.

2. Advantages of Smart Street Light system:

1. Street lights that turn on and off automatically.
2. Cost-effective.
3. Communication across the airwaves.
4. The use of less energy.
5. CO_2 emissions are reduced, and so light pollution is reduced.

3. Disadvantages of Smart Street Light System

1. The expense of implementation is substantial.
2. Troubleshooting the system in the event of a fault or repair is difficult.
3. Environmental circumstances have the potential to harm the system.
4. Implementing the service in the Smart City of Tripoli

As part of the transition to a smart city, the city of Tripoli is obligated to use modern technologies associated with artificial intelligence applications such as the smart lighting, and it is considered a part of the smart energy transition process. As been said in the advantages of this service it should mainly reduce the power consumption on the streets which reduces the maintenance cost as so.

IV. DISCUSSION AND IMPLICATIONS

The Tripoli Smart City project is an important project in all respects, whether for the residents or the government itself. Its importance to the government stems from the transition to e-governance, overcoming the difficulties facing future and sustainable development projects, and providing new sources of income while reducing public spending expenses.

It also gives the green light to internal and external investment projects and encourages foreign capital to invest in the city, which creates new and diverse job opportunities and provides opportunities for other projects that were not available before.

The effects of this transformation on the population will be for the better in all cases. The shift to smart systems will ease the difficulties facing the daily tasks of the population and allow them to enjoy speed in completing tasks and obtaining government services.

Smart city services will facilitate the lives of citizens and encourage community coexistence among the residents, which will facilitate life matters and create a suitable climate for both housing and work.

The impact of this transformation will extend beyond the city of Tripoli and will encourage the rest of the cities to turn into smart cities as well, which will create a state of development throughout the country.

V. CONCLUSION

1. The success of smart cities depends on the existence of sustainable development and the continuous provision of electric energy, to connect the smart devices in the city of Tripoli with the global positioning devices.
2. The 2030 comprehensive development plan suffices to make Tripoli a smart city.
3. The city administration does not deal with urban variables that do not cause confusion in the environment of smart cities.
4. The comprehensive development plan for Tripoli 2030 did not include recreational areas, which are the purifying lungs of the city's residents.

VI. RECOMMENDATIONS

1. Since the center of the capital, Tripoli, meets all the requirements of smart cities, it must include all parts of the city and be an experience for the rest of the Libyan cities.
2. It is possible to rely on thermal and alternative energy to fill the shortage of thermal energy in the city of Tripoli.
3. The use of foreign expertise, similar to the countries that have implemented the smart city system.
4. Connecting the city of Baghdad with other cities with express transport lines, and the trip stops in the areas surrounding Tripoli, similar to the lines of Eastern and Western Europe.
5. Establishing a university city outside the capital, where communication and information technology is available to relieve pressure on community services within the city.

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