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A Comprehensive Review Towards Libyan Smart Cities

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Abstract:

Urban regions that make use of cutting-edge technology to improve resident quality of life and streamline city operations for sustainable cities by employing Information and Communication Technologies (ICTs) are known as Smart Cities (SCs). For effective and sustainable urban planning, transportation, energy management, and public services, the idea of the SC integrates a variety of technologies, including the Internet of Things (IoT), big data analysis, and Artificial Intelligence (AI). By increasing healthcare services, promoting energy efficiency, lowering traffic congestion, and allowing citizens to actively participate in civic decision-making processes, smart cities seek to make their environments more liveable and resilient. This article highlights the importance of smart cities as a means to address the challenges of urbanization and promote sustainable development in the 21st century in southern region of Libya. This article is considered as a comprehensive study for proving solution of the challenges in the field. A total of 30 publications are arranged and appended for quick referencing.

Keywords: ICTs; AI; IoT; Libya; Sustainable; SCs

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مراجعة شاملة للمدن الذكية الليبية

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الملخص

تعرف المناطق الحضرية التي تستخدم أحدث التقنيات لتحسين نوعية حياة السكان وتبسيط عمليات المدن للمدن المستدامة من خلال استخدام تكنولوجيا المعلومات والاتصالات (ICT) باسم المدن الذكية (SCs). من أجل التخطيط الحضري الفعال والمستدام، والنقل، وإدارة الطاقة، والخدمات العامة، تدمج فكرة اللجنة العليا مجموعة متنوعة من التقنيات، بما في ذلك إنترنت الأشياء (*IoT*)، وتحليل البيانات الضخمة، والذكاء الاصطناعي (الذكاء الاصطناعي). من خلال زيادة خدمات

الرعاية الصحية، وتعزيز كفاءة الطاقة، وخفض الازدحام المروري، والسماح للمواطنين بالمشاركة بنشاط في عمليات صنع القرار المدني، تسعى المدن الذكية إلى جعل بيئاتها أكثر ملاءمة للعيش ومرونة. يسلط هذا المقال الضوء على أهمية المدن الذكية كوسيلة لمواجهة تحديات التحضر وتعزيز التنمية المستدامة في القرن 21 في المنطقة الجنوبية من ليبيا. تعتبر هذه المقالة بمثابة دراسة شاملة لإثبات حل التحديات في هذا المجال. يتم ترتيب ما مجموعة 30 منشورًا وإلحاقها للرجوع إليها.

الكلمات المفتاحية: انترنت الاشياء، الكلمة الثانية، الكلمة الثالثة، الكلمة الرابعة، المدن الذكية.

Introduction

Smart cities (SCs) are cities that incorporate advanced technologies to enhance the quality of life for their residents, improve efficiency and sustainability, and support economic growth [1]–[3]. Smart home are forms of achieving sustainable developments goals Smart homes [2]. Grid-to-Vehicle (G2V) and Vehicle-to-Grid (V2G) in smart cities [4], [5]. The concept of SC has gained interest worldwide as it promises a better quality of life, environmental sustainability, improved infrastructure, and enhanced economic growth [6]. Libya, being a developing country, can significantly benefit from SCs initiatives. In recent years, some Libyan cities have begun to explore Smart City solutions [7]–[9]. For example, Tripoli, the capital of Libya, has experimented with intelligent traffic management systems to ease traffic congestion [10]. Benghazi is another major city in the country has implemented a smart parking program, and also installed air pollution sensors to monitor the air quality [11]. However, due to the ongoing political situation and economic challenges, the development of smart cities in Libya is still in its early stages and can be hindered by a lack of proper infrastructure, financial resources, and expertise [12]. Moreover, Libya can utilize smart city solutions to overcome some of its current challenges, but it requires significant investment and strategic planning in infrastructure, technology, and policy implementation [13].

The contribution of the article is comprehensively presenting the smart cities comparison between Libya and worldwide countries. The article is organised as follows: Sustainable developments in urban cities are figure out in Section 2. Section 3 presented the renewable energy sources integration forms. While the Challenges and future trends are positioned in Section 4. Eventually, the article closing by the summery of the conclusion then the list of cited recent references.

Sustainable development

Globally, various cities categorized under the smart cities like (Singapore, Helsinki-Finland, Zurich-Switzerland, Oslo-Norway, Amsterdam-The Netherlands, New York-United States, Seoul-South Korea) as demonstrated in Figure 1. Moving towards smarter cities requires a commitment to innovation, collaboration, and sustainability [1].

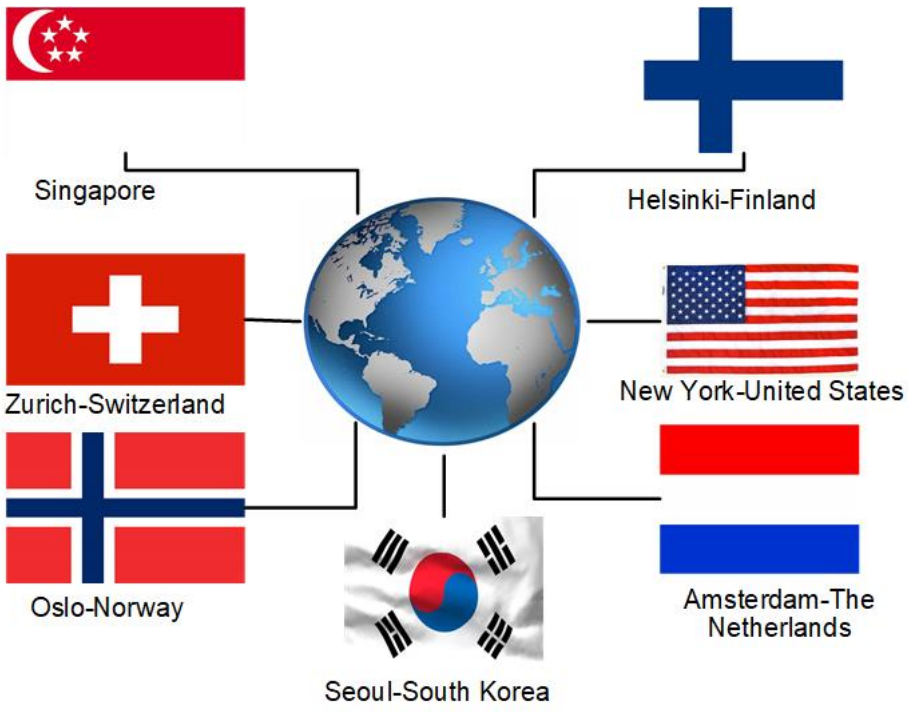

Figure 1 Some world smart cities.

Libya is a country located in North Africa and has a diverse environment with a variety of landscapes including deserts, coastal regions, mountains, and oases [12]. The Sahara Desert covers much of the country and it is characterized by vast stretches of sand dunes and rocky outcrops [14]. The desert landscape is home to a number of unique plant and animal species adapted to survive in the harsh conditions [15]. The coastal regions of Libya include rocky cliffs, sandy beaches, and low-lying plains [16]. These areas are home to rich marine life and bird species [8]. The Jabal al Akhdar mountain range in northeaster Libya is one of the highest mountain ranges in North Africa. The range is home to cedar forests, unique bird species, and other wildlife [17]. Finally, Libya has a number of oases scattered throughout the country, which are characterized by lush vegetation and palm trees [18], [19]. These oases have been important for human settlement and agriculture for thousands of years. Overall, Libya has a diverse and unique environment that is home to a variety of plant and animal species adapted to survive in the challenging conditions of the North African climate [20]. There are many ways that cities can work towards becoming smarter as tabulated in Table 1.

Table 1 Factors towards smart cities [1], [3].

Factors	Feature
Adopting advanced technologies	• Internet of Things (IoT) technologies used • Sensors, and data analytics to improve infrastructure. • Transportation • Energy consumption, and public services.
Developing sustainable infrastructure	• Designed to be more efficient and sustainable. • With energy-efficient buildings • Renewable energy sources • Eco-friendly transportation options.
Improving public services	Improving public services like health care, public safety, and education.
Engaging citizens	• Smart cities involve citizens in decision-making processes. • Making use of crowdsourcing, social media, and other collaborative tools to gather input and feedback.

Table 2 Advantages of Smart Cities [1], [2], [13], [21]

Advantages	Explanation
Citizen Engagement and Participation	• Smart cities foster citizen engagement by providing digital platforms and mobile apps for residents to access services, provide feedback, and participate in decision-making processes. • lead to more inclusive governance, increased transparency, and better alignment between urban development plans and the needs of the community.
Improved Safety and Security	• Utilize advanced technologies (surveillance cameras, sensors, and data analytics) to enhance safety and security. • Enable real-time monitoring, early detection of incidents, and quick response mechanisms, leading to safer urban environments
Enhanced Mobility	• Providing seamless and efficient mobility options. • Involve public transportation networks, real-time traffic management, smart parking systems, and bike-sharing programs. • By improving mobility, smart cities can reduce congestion, promote public transportation usage, and enhance accessibility for all residents
Sustainability	• Smart cities emphasize sustainability by incorporating renewable energy sources, implementing energy-efficient infrastructure, and adopting eco-friendly practices. • Reduce carbon emissions, improved air quality, and a more environmentally friendly urban environment
Improved Efficiency	• Smart cities leverage technology and data to optimize resource allocation • Enhance efficiency in various domains, such as transportation, energy, and waste management. • Reduced traffic congestion, more efficient public services, and better use of resources, resulting in cost savings and improved quality of life for residents

Table 3. Disadvantages of Smart Cities [1], [2], [13].

Disadvantages	Explanation
Privacy and security	• The increased connectivity and data collection in smart cities raise concerns about privacy and data security. • Vast amount of data collected from various sources can be susceptible to breaches, hacking, or misuse. • Ensuring robust security measures and protecting the privacy of individuals is crucial in building trust and addressing these concerns.
Dependency on Technology	• Smart cities heavily rely on technology and complex systems. Technical failures, system breakdowns, or cyber-attacks can disrupt services and lead to inconvenience or potential risks for residents. Having backup systems and robust contingency plans are essential to mitigate these risks.
Cost and Affordability	• Implementing smart city initiatives often requires significant investments in infrastructure, technology, and maintenance. The cost of deploying and maintaining smart systems can be a barrier, particularly for cities with limited financial resources. Ensuring affordability and equitable access to smart city solutions is important to avoid exclusion of certain segments of the population.
Digital Divide	• The digital divide refers to the gap between those who have access to and can effectively use digital technologies and those who do not. • This divide can create inequalities in access to smart city benefits, exacerbating existing socio-economic disparities.
Ethical and Governance Challenges	• The use of advanced technologies in smart cities raises ethical concerns related to data privacy, surveillance, and potential biases in decision-making algorithms. • Ensuring ethical considerations are embedded in smart city planning and governance frameworks is critical to avoid unintended negative consequences and protect the rights of individuals.
Ethical and Governance Challenges	• It's important to note that the advantages and disadvantages of smart cities can vary based on local context, implementation strategies, and community engagement. • Addressing the potential challenges and risks while maximizing the benefits requires careful planning, stakeholder collaboration, and ongoing evaluation and adaptation of smart city initiatives.

Smart forms integration of Renewable Energy Sources

There are various techniques utilized to form smart cities as part of AI smart devices such as [22].

- Smart camera
- Smart metering
- Smart sound deduction
- Smart internet
- Smart lighting
- Smart adopters (plug).

Figure 2 Smart Devices for smart cities.

Challenges of smart cities and future recommendations

Smart cities face several challenges that need to be addressed to realize their full potential in future. Some of the key challenges include [2]. Addressing these challenges requires collaboration among different stakeholders, including government entities, technology providers, community organizations, and citizens. Engaging in comprehensive planning, adopting inclusive and participatory approaches, and continuously evaluating and adapting strategies are crucial to overcome these challenges and create successful and sustainable smart cities as listed below.

- Infrastructure: Implementing smart city initiatives often requires significant investments in infrastructure, including the installation of sensors, communication networks, and data management systems. Upgrading existing infrastructure or building new infrastructure can be costly and time-consuming, especially in older cities or areas with limited resources [23].
- Interoperability and Integration: Smart cities involve the integration of various systems, devices, and data from different sources. Ensuring interoperability and seamless integration between these components can be complex and challenging. Standardization of protocols and data formats is crucial to enable effective communication and collaboration among different systems [24].
- Privacy and Security: The increased connectivity and data collection in smart cities raise concerns about privacy and data security. Collecting and analysing large amounts of data can potentially infringe on individuals' privacy. Furthermore, the interconnected nature of smart city systems increases the vulnerability to cyber threats, hacking, and unauthorized access. Robust security measures and privacy safeguards must be in place to protect data and ensure the trust of citizens [25].
- Digital Divide: Smart city technologies and services require access to digital infrastructure and digital literacy. The digital divide refers to the gap between those who have access to and can effectively use

digital technologies and those who do not. Unequal access can create disparities in the adoption and benefits of smart city initiatives, exacerbating existing socio-economic inequalities [26].

- Stakeholder Engagement and Citizen Participation: Building a successful smart city requires active engagement and participation from various stakeholders, including residents, businesses, community organizations, and government agencies. Ensuring meaningful participation and incorporating diverse perspectives can be challenging but essential for developing solutions that meet the needs and aspirations of the community [27].
- Governance and Regulations: The rapid advancement of smart technologies has outpaced the development of regulations and policies governing their use. Smart cities need clear guidelines and regulations that address issues such as data privacy, security, interoperability, and ethical considerations. Developing appropriate governance frameworks and regulatory mechanisms is crucial to ensure responsible and inclusive deployment of smart city technologies [28], [29].
- Financial Sustainability: Smart city projects require ongoing maintenance and operational costs. Identifying sustainable funding models to support the long-term operation and maintenance of smart city infrastructure and services is critical. This may involve exploring public-private partnerships, innovative financing mechanisms, and revenue-generation strategies [30].

Conclusion

Smart cities are an emerging concept that aims to promote the sustainable development of urban areas through the use of advanced technology and data analysis. The goal is to enhance the quality of life for citizens while improving resource efficiency and reducing environmental impact. Smart cities rely on a network of connected devices and sensors to gather real-time data that can be analyzed to improve everything from traffic flow to waste management. The development of smart cities requires collaboration between government, industry, and citizens to ensure that the technology is implemented in a way that benefits the community as a whole. While there are challenges to implementing smart city technology such as cost and privacy concerns, the potential benefits make it an area of increasing interest for city planners and policymakers around the world.

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