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Roadmap to Smart Cities in Saudi Arabia: Key Challenges and Opportunities

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Abstract: - Technologies are constantly evolving and finding applications in both business and government organizations for various purposes such as improving operational efficiency, increasing customer satisfaction, and reducing the cost of transactions. Technology adoption is a well-researched phenomenon in the academic world. Based on the current state of e-governance in Saudi cities and the potential of Artificial Intelligence (AI), Internet of Things and Blockchain in e-governance, this research study aims to study factors influencing the adoption intention of AI and Blockchain technologies in citizen services delivery within a smart city in Saudi. This article explores AI, IoT and Blockchain technologies adoption intention in the context of smart cities within a developing country like Saudi. Finally, the study provides a set of practical recommendations for smart city officials while planning to launch service applications using AI and Blockchain technologies. More specifically, the study emphasizes the importance of ethics, data privacy and security, and transparency in building trust between smart city systems.

Keywords: Smart City, Artificial Intelligence, Blockchain, Internet of Things, Privacy, Security

I. INTRODUCTION

Saudi is one of the world's fastest growing economies, with an estimated 31 percent of its people living in the urban regions as per the census, which may have now climbed to 45 percent based on satellite data and would reach 60 percent in another three decades [1]. Various social and economic factors, such as industrial growth, urbanization, agricultural productivity, level of employment, life expectations etc. indicate the overall development of a nation. Among these indicators, urban development has been regarded as a crucial factor as it easily reflects the growth of a country's economy and the citizens' quality of life. While urbanization is a sign of economic progress, the main concern with such expansion is the uncontrolled or unplanned nature of the urbanization, which subsequently leads to many problems, such as environmental pollution, infrastructure bottlenecks, and service delays. To address these issues, the Government of Saudi has launched the ambitious Smart Cities Mission (SCM). The primary goal of this mission is to improve people's quality of life and promote economic development in many cities across the country using the advances in Information and Communication Technologies (ICTs).

II. SMART CITY COMPONENTS AND VARIANTS

Sustainable Cities and Communities is as one of the sustainable development goals (SDGs) to transform the world. Globally, the smart city narrative is more or less centered around the guidelines and norms prescribed as part of this SDG. Yet, the term smart city signifies different things to different individuals, and there is no universally accepted definition for this new urbanization trend. The definition varies depending on various human, institutional, and technical aspects, such as the nation's growth stage, transformation goals, public expectations, digital literacy, and available resources.

Generally, the smart cities are expected to have cutting-edge technological systems in order to raise the quality of life for their residents. Yet, there is a considerable cost associated with smart city initiatives, and a cost-benefit analysis is required for such capital- intensive projects. Developed nations have the necessary budgets and resources to build entirely new smart cities or make existing cities smarter [2]. When contrasted to developing countries, the availability of resources reduces drastically. Mostly, a developing nation's budgets are limited, which need to be managed properly in order to focus on a few projects that have maximum impact on the broader population. This entails town planners in emerging economies to be extra careful while defining and planning for the smart cities. Consequently, the term smart city may have a different connotation in developing nation like Saudi than in other parts of the world. According to SCM of Saudi, a smart city is one that meets the infrastructure requirements and service delivery levels as desired by its citizens.

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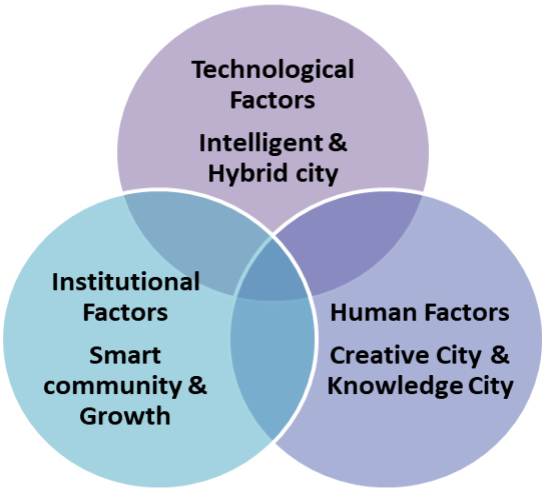

Figure 1. Smart City Components and Variants

Smart City Scenario in Saudi Vision 2030

Smart City Solutions and Traditional Urban Settings

According to Smart Cities Mission, a smart city is differentiated from traditional urban settings in the following ways [3]:

- Shift from unplanned urbanization to planned urbanization with the use of ICTs
- Create a plan for unplanned areas with flexible bylaws for use and construction
- Housing schemes for citizens across all economic strata promoting inclusiveness
- Congestion-free, pollution-free, sustainable, secure, and walkable neighborhoods
- Interconnected network of roads for pedestrians, cyclists, and vehicles with traffic signs
- Mixed land usage for identified areas in a way to make efficient use of available land bank
- Eco-friendly open spaces that reduce the urban heat effect
- Multiple options for mobility with last-mile destination support
- Parks and playgrounds for external activities for a better quality of life
- Citizen-centric e-governance that brings transparency and accountability
- Online channel for receiving citizen feedback, suggestions, and grievances
- Achieve better infrastructure and services deliveries using smart solutions
- Focus on city strengths and provide a unique identity to the city based on its culture.

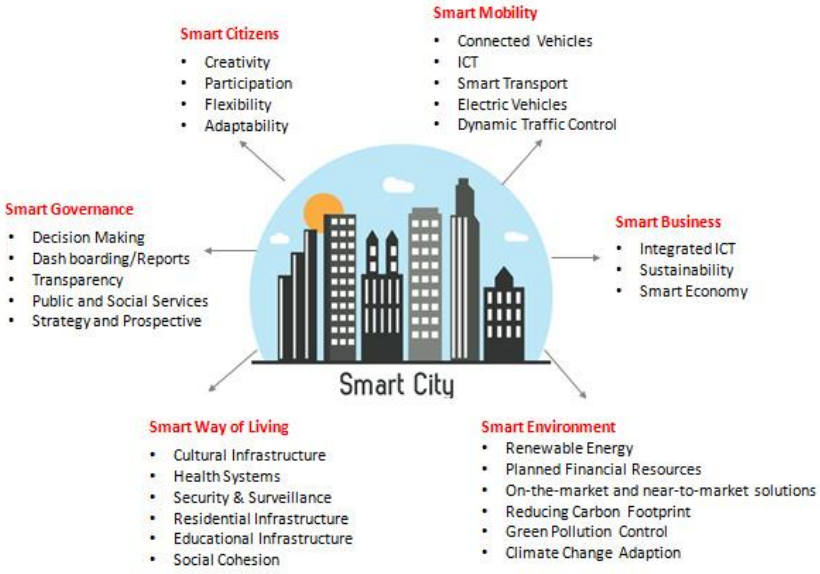

Figure 2. Smart City Solutions Based on Saudi Mission 2030

The SCM of Saudi wants to build cities with proper infrastructure that gives a decent quality of life and a cleaner environment for sustainable living using the smart ICT solutions. The approach adopted by SCM is to develop a replicable model area inside a city that will serve as a beacon for the rest of the city in terms of overall sustainable and inclusive development. Two components that will play an important role in converting a city into a smart city are citizen involvement and technology infrastructure [4]. As part of citizen involvement, residents of a smart city should actively engage in urban reforms and monitor city governance in order to realize their own aspirational smart city. There are many ways to participate in municipal governance.

Citizens may engage in decision-making as well as defining various governance features, such as picking relevant development projects, choosing smart technologies, coming up with new possibilities, and ensuring process adherence. The increased public participation will lead to more sustainable smart city development. As a result, the Saudi Government has directed smart cities to establish special purpose vehicles comprised of representatives from district administration, members of parliament, members of the legislative assembly, the city mayor, and members of resident welfare associations and non-governmental organizations to facilitate active citizen participation.

Similarly, technology is crucial in achieving the stated aims of enhanced quality of life and economic growth within a smart city. When deployed in the city, the ICT infrastructure will generate a considerable amount of data, which must be safely kept, handled appropriately, and processed intelligently in order to improve the smartness of citizen service delivery. However, the current online governance (e-governance) framework is focused mainly on maintaining electronic records along with physical paper records. This approach should evolve towards the complete digitalization of government services by adopting the latest advanced ICT technologies and making services accessible anytime, anywhere. Among the latest ICTs, it is observed that Artificial Intelligence (AI) and Blockchain technologies have considerable potential to improve citizen services and make cities smarter, which further forms the basis for this research study. Table 1 to emphasize the key features of a smart city.

Table 1. Smart City Definitions

Smart City Elements	Definition	Reference
Economy, People, Governance, Mobility, Environment, Automation	The smart city is considered as a city that is managed in a forward-looking way in the economy,people, governance, mobility, environment and it is built autonomously, independently and consciously based on the intelligent combination of citizen activities.	[5]
Infrastructure, Social, ICT	A city is smart when investments in traditional infrastructure, social development and modern ICT communication infrastructure fuel sustainable growth and a high quality of life, with wise management ofnatural resources.	[6]
Human, Social, ICT,Sustainable	We believe a city to be smart when investments inhuman and social capital and traditional (transport)and modern ICT communication infrastructure fuelsustainable economic growth and a high quality of life, with a wise management of natural resources, through participatory governance.	[7]
Human, Social, Natural, Economic, Technology	A Smart City is a system that enhances human and social capital wisely using and interacting with natural and economic resources via technology-based solutions and innovation to address public issues andefficiently achieve sustainable development and a high quality of life on the basis of a multi-stakeholder, municipally based partnership.	[8]
Technology, resources, efficiency	"A city that uses technology to transform its core systems and uses its vast resources to optimize the efficiency.	[9]

Cities that are less urbanized can benefit from smart city initiatives to promote citizen involvement and participation in government. To better provide a comprehensive and thorough evaluation of smart city features, a unique 'Smart Cities Wheel', as shown in Figure 2 was presented by Boyd Cohen (Cohen, 2013) as a measurement criteria framework.

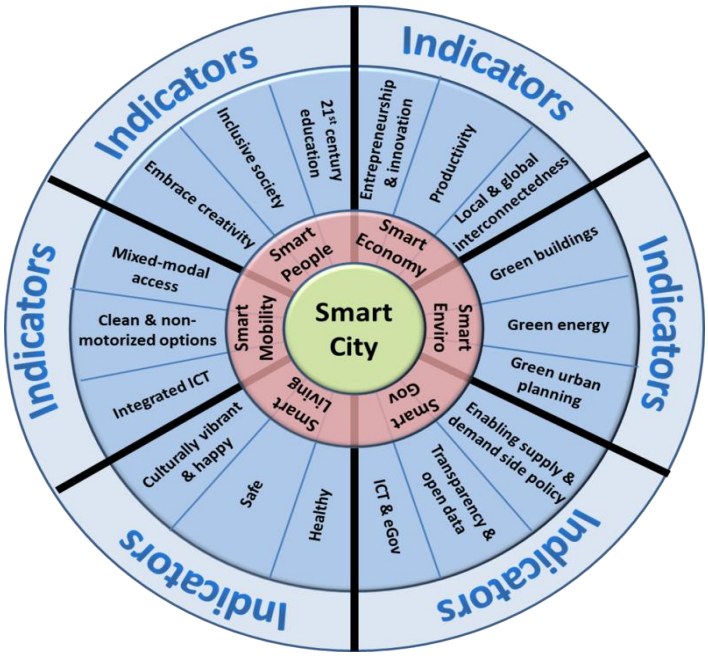

Figure 2. Smart Cities Wheel

This framework consists of following six domains: (i) smart government component addresses online public services that improves information exchange and responsiveness between government and citizens, (ii) smart economy element promotes businesses to create new offerings while also increasing productivity and competitiveness, (iii) smart environment constitutes green construction, energy efficiency, and urban planning to establish more effective control over municipal resources, (iv) smart mobility covers utilization of satellite technology and geographical images to respond quickly to the movement of humans or goods through a variety of forms of transportation, (v) smart people component looks at a continuous learning platform for residents and then they can use the internet-enabled systems to participate in public policy issues, fostering a feeling of shared identity and goal, (vi) smart living stresses increasing citizens' quality of life through smart homes and have a more enjoyable, secure, and healthy life.

Citizens are the end-users or consumers of smart city services. In [10] agree that cities should regard inhabitants as consumers and use customer satisfaction metrics to enhance service delivery. Residents of the cities will be satisfied in a social environment that is both citizen-centric and economically beneficial. Service quality is often used as a powerful indication when comparing different services, and it may assist governments in understanding public satisfaction levels and the issues that come with it. Aside from service quality, a smart city's smartness and service maturity levels must be measured during its development phases. Customer-centricity, or customer orientation is one strategy for governments to provide greater service quality. When it comes to citizen-centric service delivery, many other scholars hold similar perspectives [11]. This entails government departments to focus on areas of customer or citizen interaction such as ease of use, experience, and connectivity. Overall, all prior studies appear to agree that a smart city must offer smart services in a way that increases the quality of life and makes the living environment smarter.

Furthermore, the smart city concept may be thought of as a novel paradigm that considers urban development based on sustainability. Because the smart city and sustainable cities will be inextricably linked, it is critical to comprehend their connection and how they support each other throughout the city's transformation [12]. Therefore, even the European 2020 strategy mentions that the smart city development needs careful consideration of a variety of factors, including ICT infrastructure, technical skills, sustainability approach, living conditions, and corporate support. According to [13] and [14], an ideal smart city creates a balance between all three components of sustainability:

environment, economy, and social, and also relates it to inclusive growth. smart cities must demonstrate observable changes to inhabitants in terms of outputs rather than simply build ICT infrastructure.

Numerous scholars have presented several descriptions to better comprehend smart cities based on infrastructure and municipal administration point of views [15]. For example, smart city is a city with a strong technological base for connecting citizens, exchanging information, enhanced transportation, and smart buildings to improve people's quality of life [16]. According to [17], a smart city may be imagined by combining the newest ICT technologies with energy grids, improved building methodology, and sophisticated research techniques for an effective city administration. Consequently, such a smart city ecosystem can keep a constant watch within certain legal framework on the working of its infrastructures such as highways, railroads, airports, hospitals, shopping, and entertainment facilities. Similarly, in [18] states that smart city governance is an important aspect as well and seen as a dynamic system that involves interactions between social behavior changes, acceptable use of technology, and government regulations support. Overall, it is thus imagined how municipal corporations can become smarter by embracing not just technological advancements but also focusing on social, governance, and regulation aspects [19].

The smart city definitions indicate that technology remains a key component of the smart city. However, technology-led smart town planning and more traditional sustainable urban development do not have to be mutually exclusive, and several research studies have shown that the two methods may coexist. In [20] mention that the smart cities are the adaptation of ICT advancement to a city's social and economic activities. ICT is a rapidly evolving field with key breakthroughs seen in the recent decade, such as the smartphone and social networking, which in turn have a significant influence on social behavior [21]. ICT can help cities become smarter by addressing essential necessities like water management, transportation management, natural resource management, and education management, as well as services like healthcare, security, e-governance, and education. Past research studies have also shown the growing influence of ICTs on people’s daily lives.

According to [22], ICT adoption not only enhances service delivery but also contributes to increased gross domestic product (GDP) and wage growth. Similarly, data offers a foundation for municipal corporations to innovate and learn, resulting in a higher quality of life for their citizens. Studies by [23] and [24] found that different cities have varied approaches to serving their citizens, such as employing big data ICT technologies to improve service efficiency or preserve openness in government data or facilitating increased levels of citizen engagement in municipal operations. According to research by [25], ICT-led administration is a critical element in driving economic development, social transformation, and administrative changes in the government sector. In [26] found that e-governance has a positive influence on service delivery and supports more interactive administration between governments, individuals, and organizations.

Few other studies have linked ICT to e-governance and urban development advances that can lead to smart city goals [27]. They discovered a complicated interaction between numerous smart city stakeholders that cannot be resolved by technical solutions alone. The interdependence of these entities, as well as social and political variables, have an influence on the whole ecosystem. In addition to data gathering and analysis methodologies, technology governance become a critical component of service delivery. Past studies have also found that e-governance adoption may contribute to long-term socio-economic growth [28] backed by an innovation culture [29], both of which are essential for the smart city idea. These studies were often conducted with the goal of discovering and understanding the role of technology in government for improving service delivery and departmental internal working, resulting in improved quality and effectiveness of government efforts.

AI and Blockchain technologies are examples of advanced ICTs that may become strong instruments for delivering superior services to society and enterprises. According to [30], if AI is developed correctly, it can free up a lot of time from repetitive or manual tasks. Similarly, Blockchain can attain democratic goals if it is implemented and regulated properly. Both these technologies together can eliminate friction between different parties and provide better services to citizens without the need for middlemen and also minimum human errors. We discuss AI and Blockchain literature in next section.

Artificial Intelligence for Smart Cities

With recent ICT developments (in computing, storage, and processing power), many theoretical AI algorithms may now be implemented in less time for scientific, economic, and social applications, thereby unlocking value from massive datasets. Leading governments throughout the globe have recognized AI's promise and have launched AI

initiatives with estimates that AI would account for 10 to 20% of their GDP by 2030. As a result, their respective government departments are actively involved in developing AI policies in areas like agriculture, healthcare, transportation, and education.

According to [31], AI has begun to gain traction in municipal corporation management. The sophistication of AI-based software systems can lead to increased efficiencies in smart cities, such as improved traffic management, better energy & water distribution, and eventually, make cities more sustainable. AI has the capability to automatically adapt to changing external conditions based on real-time sensor data and user behavior [32]. Smart city planners would miss out on a great opportunity if they do not analyze the continually generated stream of data from sensors and consequently making it more difficult to meet smart city goals. As many citizen services may benefit from data insights, [33] endorse the notion of using data processing techniques for potential benefits such as improved social interactions, better administration, higher economic growth, and effective infrastructure management.

However, AI differs from previous generations of technology in terms of both system design and implementation. Traditional technology system parameters are frequently well known and defined from the outset, with no need to examine them later in the system's lifespan [34]. The AI algorithm's parameters and bias terms, on the other hand, must be re-evaluated on a regular basis because the output may change over time for the same input data. Bias is a key concern area for AI development [35]. It is to be noted that AI solutions will not remove all biases; instead, the system should be judged on whether it improves the present service significantly or not. To reduce biases, AI system development teams must be diverse in terms of gender, age, thinking, and background, among other things, and should reflect a range of viewpoints [36]. There is a possibility that there is an AI solution that is adequate and works fairly in theory, but it can become biased and unjust in practice.

Additionally, AI relies on historical input data, algorithms, and output which are fed back to an algorithm to deliver more accurate results. Hence, it is important to know how AI algorithms are conceptualized and designed since they may have societal ramifications. Often, managers and developers of AI algorithms strive to increase the accuracy of the system in order to fulfill particular assessment criteria. Still, there is a trade-off between the AI algorithms' accuracy and their explainability [37]. For end-users, AI algorithms are frequently a black box with little explanation. As a result, users of the AI applications may be willing to accept lesser accuracy in exchange for better explainability rather than higher accuracy in exchange for no explainability. Although, it may be possible to assess the explainability of an AI model in certain cases, the ownership and responsibility of providing the explanation needs to be clarified. Furthermore, AI system requires proper development and operational model to ensure it makes sound judgements. This then needs to be supported by protocols that encourage thoughtful thinking at every stage of the process, from AI solution conception through its implementation. Similar to algorithm selection, there is a possibility of using an incorrect method for the data processing or selecting attributes from available training data that aren't appropriate for the broader population. In addition, context is important while deciding when and where an AI solution should be used. It is essential to know what the AI application is and what the desired result is. The trade-off between the possible harm an AI system can cause and the potential benefit it can provide must be thoroughly researched. One way is to inform end-users clearly about the way the AI system is conceptualized. For example, the reason for which face recognition is being used should be disclosed. Similarly, differentiation made using age, and gender data should be clearly explained in scenarios such as AI-based medical systems and not in other places where age or gender equality is crucial. This entails putting procedures in place to ensure that the outcomes are, in fact, consistent with AI system objectives. Not only outcomes but the entire process of AI also needs to be transparent and clear. Thus, including explainability in the AI system begins with algorithm creation and continues throughout its lifecycle.

Societal values play an important role in technological adoption as well. These values are typically the fundamental views about what is morally correct. The norms of behavior that point to how one should act and what is fair and just are known as social values. In other words, they serve as the central tenets for the moral judgments and behaviors humans display. Because different people have different opinions, social values become very contextual and subjective. As a result, there is no one set of rules, but there should be a systematic approach to making excellent and sensible judgments regarding AI systems. Subsequently, the trade-off between risk and reward for a specific job, which is facilitated or automated by AI technology, should be effectively handled. According to [38], if the assessment is morally correct and adheres to our ideals, the technology solution can be deployed. The

aforementioned discussion on AI literature brings out advantages, disadvantages, and its differentiation from traditional ICTs.

III. BLOCKCHAIN FOR SMART CITIES

The Blockchain appears similar to a digital version of physical ledger of records. Consensus plays a key part in maintaining integrity and reliability in a decentralized network with no central authority. Before appending the transactions to the Blockchain or distributed ledger, it is therefore verified using a one of the available consensus procedures. Consensus differs amongst Blockchain networks; each consensus mechanism has advantages and drawbacks depending on distinct properties, such as transaction speed, scalability, energy needs, and difficulty level set as per resistance to censorship and tampering requirements. When the majority of node members within the Blockchain agree on transactions via the consensus mechanism, those transactions, along with a timestamp and the previous block's hash, are combined to create a new block on the Blockchain. Thus, Blockchain offers a transparent, immutable, and fully auditable transaction recording platform, thereby allowing peer-to-peer transactions in the absence of any single trusted party.

Blockchain technology is characterized by the following unique fundamental properties as mentioned by several past researchers: (i) Distributed or De-centralized administration: Unlike conventional systems, in which transactions are verified by a trusted and central authority, each participating node in the Blockchain network is capable of validating transactions and maintains an exact same copy of the ledger. This eliminates the need for a central authority, adds resilience to the network, and makes it difficult to hack the network. (ii) Immutability: The combination of a consensus process, a time stamp, a hashing mechanism, and a digital signature ensures that incorrect transactions are not allowed and that existing transactions cannot be edited, deleted, or copied. These characteristics of the Blockchain provide unique capabilities such as non-modification of records after the fact and asset ownership verification. (iii) Identity and Privacy: Blockchain can provide semi-pseudonymous identity to users. Users can also control who can see their data providing identity privacy. And the public- private keys for each user id ensure user authentication during peer-to-peer transactions. (iv) Auditable Records: all transactions on a Blockchain are recorded chronologically using hashing technique, which makes it difficult to break the chain. Thus, past transactions can be readily audited and traced using this property of a Blockchain.

These major qualities of Blockchain technology offer possible advantages for the public sector in terms of service improvement. More specifically, non-editable records and shared data features are beneficial in the fight against rampant corruption and manipulation of records within government departments (Batubara et al., 2018). Moreover, government operations can be transparently managed to boost public trust in government agencies while providing citizen services. Consequently, such systems have the potential to be transformative since they would disrupt the present process of government-to-citizen transactions.

When it comes to public administration, Blockchain-based solutions are being considered by governments throughout the globe. Blockchain technology is regarded to have significant potential advantages for the government in terms of providing transparency, data validity, corruption reduction, manipulation prevention, and increased trust. These potential advantages have prompted governments in a number of nations to increase openness and eradicate corruption. Numerous governments worldwide have launched Blockchain efforts to aggressively investigate the technology's potential applications in government services. Certain potential advantages, such as decentralized trust and openness, may be particularly useful to developing nations, which are more susceptible to fraud, manipulation, and corruption compared to rich and advanced nations.

Many past studies have focused on the usage of Blockchain in Bitcoin-like cryptocurrencies applications. In contrast, there have been fewer studies on the use of Blockchain in other ecosystems. A study by [39] emphasized the necessity of multidisciplinary research in exploring the possible applications of Blockchain technology in e-governance. They advocate for more study into the potential for employing Blockchain technology in the government departments to enhance citizen services and address some of the present governance issues, including corruption, fraud, and inefficiency.

When it comes to the application domain, researchers discuss the broad application of Blockchain for e-governance, including the concept, prospective advantages, present challenges, potential usage, strategy, and assessment of technology acceptance. Other researchers focused their studies on Blockchain's role in community healthcare to enhance the reliability of individual medical data. Meanwhile, few other researchers evaluated the application of

Blockchain technology in educational services to bring veracity to educational records that are currently prone to fraud and manipulation. Additionally, few studies advocate Blockchain implementation in the context of smart cities and examine government supply chains with private businesses. Other studies are devoted to the tax system, e-voting, and digital identification.

The literature also indicates that Blockchain adoption in the e-governance sphere is still rather restricted. Not all usual applications for recording transactional data such as certificate and permit issuance, land or vehicle ownership, and other critical information have been examined. This indicates that the Blockchain-based applications have not yet been fully implemented in the government sector, most of the proposed ideas are conceptual in nature, and there are no references to empirical investigations [40].

Despite the many potential advantages and application areas for Blockchain technology in public administration, the authors describe a number of problems that must be solved. Researchers highlight the barriers to the adoption of Blockchain technology for public-sector such as security, scalability, and legal infrastructure. According to experts, the advantages of Blockchain adoption in public services should be properly quantified and should outweigh the cost of constructing and operating the system [41]. The design factors for Blockchain-based government systems must be carefully chosen to meet the goals and requirements of government entities.

All of the present obstacles to widespread adoption of the Blockchain can be traced back to the immaturity of the underlying technology. This may be seen as a characteristic of all new technological launches. Few research studies addressed scalability issues by introducing new approaches to consensus protocols that considerably lower transaction processing time and hardware resource needs. Due to the fact that the Blockchain platform needs collaboration between several legal entities, a new process monitoring model may be necessary. Consequently, the process may lead to organizational transformation in order to reap the advantages of distributed computing. However, such transformational change often results in short-term negative emotions inside the organization, which creates a new obstacle in adopting the latest technologies.

Since Blockchain technology is still in its infancy and its adoption beyond the cryptocurrencies has not been clearly shown, acceptability issues might arise from the skeptical end-users. One way to remove those concerns is to provide proper legislative and regulatory assistance from governments. Consequently, users of the Blockchain network will be aware of the jurisdiction and the laws governing such a system in the event of any disputes. Finally, [42] studied the accessibility of technology or the digital divide for lower Blockchain adoption.

Interoperability Challenges between AI and Blockchain

In terms of security and scalability, Blockchain has a lot of room for improvement. On the other hand, AI has its own set of problems when it comes to fairness and transparency. AI and Blockchain can change the next generation of the digital technology landscape if they are applied together [43]. As a decentralized platform for different components of AI, the Blockchain network can be a powerful tool in this endeavor to reduce dependency on any single party. Thus, Blockchain could help in developing AI applications that are fair, transparent, and built using consensus algorithms for higher trust in the system [44].

On the other hand, a large set of criteria must be configured for running a Blockchain network. These choices may be made easier with the help of AI, which can automate and optimize the Blockchain for improved governance and performance. The data and transactions can be authenticated and validated by AI before being submitted to the Blockchain network. In addition, given Blockchain data is publicly accessible, AI could play a critical role in ensuring user anonymity and privacy [45].

Internet of Things in Smart City

This section confers to the idea of prodigious application of IoT acting as the boon in the development of modern infrastructure at discrete levels that includes:

i) City Level

ii) Domestic-Commercial level covering up particular consumers per necessity

iii) Bucolic or pastoral area

It also underscores the desideratum of energy conservation and optimum utilization of the available energy, so that it can be preserved for future generation. Success of IoT in smart city depends on the problem solving capability andtendering up of comforts to the user. For implementation of IoT to develop the module following key technologies have been taken into consideration is depicted in Table 2.

TABLE 2 TECHNOLOGY TAKEN INTO CONSIDERATION FOR IMPLEMENTATION OF IOT

S. No	Technology Taken Into Consideration
A	A uniquely identification technology
B	A proper and well defined IoT architecture.
C	Bidirectional communication technology in between applications andintermediate hardware
D	A well-defined network technology
E	Dynamic network identification technology
F	Application softwares with efficiently implemented algorithms.
G	Heterogeneous data and signal processing technology
H	Methods equivalent to search engine functionality.
I	Management scheme to manage various sub-networks
J	An efficient security and privacy enabled system
K	Power monitoring, controlling and storage technology.
L	It must follow the world-wide standards.

The concept of the development of smart cities depends on the following steps as shown in Table 3.

Table 3. A step-by-step approach employed for development of smart city

STEP 1	Setting the vision for an efficient, habitable and sustainablecity.
STEP 2	For improving the efficiency of the urban system integratehardware and software solutions in it.
STEP 3	Integrate information and all operations of a city for improvingthe overall city efficiency.
STEP 4	Incorporate new innovations to make the sustainable andluxurious future.
STEP 5	Trace and perform collaborations among the globally bestplayers and local players in the entire smart city.

Instrumentation intelligence forms the backbone of the smart city. An intelligent instrument should have the following three features.

I. A unique IP address and a common protocol.

II. Wireless meters with real-time information processing and transmission device.

III. These smart devices should have a smart energy meter which must be capable of noticing the energy consumption and reducing the wastage of energy.

A smart meter is an example of the high-profile IoT application. A smart meter not only measures the power consumption but also communicate with the utility companies and other attachment devices such as air conditioner. Due to monitoring and controlling of the devices through smart meters, electricity bills of customer reduce and the utility company reduces the wastage of electricity and also provide where the demand is high. So according to the need the supply is transmitted and planned, which is smart step towards energy conservation.

IV. OPPORTUNITIES AND RESEARCH CHALLENGES

In general, a city has to face many challenges such as scarcity of the resources, poor and random infrastructure, shortage of energy, water supply, instability of prices and human health, managing the available resources and services, providing on time medical facilities, preserving resources. Smart cities have the features to provide the related information on urban services to each citizen, [46] and the citizen can also track the effect of resource consumption on the development of the city [47-50]. With an implementation of this prolific technology developed on the basis of the module will not only sort out the necessity to fight resource crisis but would also help to survive up as well as provide different means of comfort to the utmost care and availability. ICT provides the important tools in the development of a city.

These applications need the power supply for its smooth functioning, where IoT plays a vital role to manage it by conferring the interconnection of devices and semi peripherals in the module and help to manage the resource well. Such as in the case of wastage of energy due to an unnecessary operation of loads resulting in wastage of electrical energy and inadequate power supply mechanism is one of the burning issues faced in concern of the smart city. Existing energy management technique work on sense-analyze - respond methodology. A number of sensors monitor the building environment and send the collected data to a server in real-time. The server process and analyse the data related to the building environment and associated devices. After the analysis of the data, servers send instructions to automatic load control devices to optimise the energy consumption. Sensing of entire neighborhood is a difficult task and requires many sensors. Meanwhile, data collection, its transmission to the server and processing of data by the server is a complicated and costly task. It is also a complex task to extract the desired the information from the vast heterogeneous data in a real- time. Thus, the smart energy management requires the solution of the following unanswered or partially answered questions.

The more in-depth and detailed analysis and problem formulation to issue related to management the traffic given in chapter four. As to cope up the proliferation of traffic its really creating a big issue to reach the destination on time and thus making the situation problematic, keeping in mind to which IoT proposes a solution to manage the diversions and maintain and easy going of the traffic. In later problem related to theft and miss- happenings have been taken into account and proposed up with a solution to city security. IoT extends its influence at residential, domestic as well as commercial level involving automation of home appliances, appliances in offices, power management, and optimisation in rented floors and building often when crisis where faced.

Similarly, sufficient availability of water is also a challenging problem for the smart city development. These problems can be addressed by applying the proper monitoring which requires a massive data related to the citizen activity on daily basis. Due to the presence of a large number of citizen, the day to day monitoring is not possible by traditional approaches, thus, we have to rely on some technological approaches. An automatic energy and water monitoring system can monitor, control home appliances and other similar objects. Further, these systems can reduce the wastage of the valuable commodity for a smart city.

At last, a major concern was taken into account as the resource water was squandered in the negligible practice of irrigation. As per the third module which is describe in chapter number five mainly emphasise on proper management of resource i.e water which is wasted as in carrying up the practice of irrigation. The chapter five also juxtaposes the problem of beyond the point operation of Highway and High Mast lamps leading to wastage of electricity as a precious resource which when preserved would suit be very beneficial.

V. CONCLUSION

Smart cities are also becoming popular in urban policy circles across the globe making it as one of the 17 SDGs. Smart cities contribute to socio-economic development and introduce new ways of interaction channels between municipal corporation and citizens. Improved urban service delivery for municipal corporation and a higher standard of living for citizens are two primary goals of smart cities. We developed a conceptual model that incorporates these independent and dependent factors and their relationships. The model was then validated through quantitative analysis. Further, the results were triangulated with case studies from global six smart cities. Finally, this research study makes policy suggestions for governments and service providers with regards to AI and Blockchain technology use in public sector. Overall, our research study contributes to the urban administration scholarly literature and offers towns planners and technology specialists practical advice with respect to AI and Blockchain deployment in public-sector. The key role played in all set of module is buttressed by IoT and as far as concerned

to the cumulative development and growth in field of smart city has yet to come and would serve as the zeitgeist of the current and well as generation to come.

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