Article

Big Data Enables E-Government to Implement Sustainable Development

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Abstract: This study explores the theoretical foundations of artificial intelligence (AI) and big data, focusing on their role in the Fourth Industrial Revolution and sustainable development. Despite growing recognition of big data's transformative potential, there is limited understanding of its specific impact on decision-making and societal transformation towards achieving sustainable development goals (SDGs). The research aims to fill this gap by analyzing how big data can support e-government initiatives and development objectives. Using a descriptive and analytical methodology, including a case study approach, the study examines the primary techniques and projects that facilitate large-scale data analysis in digital transformation. Results reveal that big data plays a critical role in monitoring progress, informing decisions, and driving social change aligned with SDGs. These findings contribute to a better understanding of big data's value in modern governance and sustainable development efforts.

1. Introduction

AI is employed by developers to enhance the efficiency of manual activities, facilitate client communication, detect trends, and resolve problems more effectively [1]. To commence the utilization of AI , it is vital for developers to possess foundational knowledge in mathematics and exhibit a sense of ease while working with algorithms. When embarking on the utilization of AI for the purpose of app development, commencing with modest objectives becomes advantageous. Through the construction of a relatively uncomplicated undertaking, such as tic-tac-toe, for instance, one might acquire fundamental knowledge pertaining to AI .

Engaging in experiential learning is an effective approach for enhancing proficiency in several domains, including AI [2], [3]. After accomplishing a series of tiny tasks, the potential for AI's impact becomes boundless. The primary tenet of AI is to emulate and surpass human cognition and engagement with the surrounding environment. The concept in question is rapidly emerging as the fundamental basis for driving innovation. AI technology, via the use of various machine learning (ML) techniques, enhances the operational efficiency and productivity of organizations by automating jobs and processes

that were previously reliant on human intervention. This is achieved by using data patterns to create accurate predictions. AI possesses the capability to comprehend facts on a scale that surpasses human capacity. The capability has the potential to yield substantial advantages for the enterprise.

The notion that our current era is characterized by the abundance and significance of information is centered on the fundamental element of data. In contemporary times, there has been a notable increase in the collection and analysis of data, surpassing previous levels. The advent of big data has significantly transformed several facets of human existence, exerting a profound impact on the global landscape. AI and big data analysis are regarded as developing technologies that have ushered in a novel era of revolution. The Industrial Revolution, commonly referred to as the Fourth Industrial Revolution, is the subject of discussion. The objective of our research is to provide an academic and scientific foundation for understanding the theoretical concepts and principles underlying data and AI.

Additionally, we seek to explore the significant role of big data analysis techniques and their practical applications in facilitating the digital transformation towards an efficient electronic government that meets the expectations and needs of the citizens [4]. The study employed a descriptive analytical methodology in conjunction with a case study. The findings indicate that AI and big data have the potential to revolutionize the notion of services and various industries, leading to more intelligent, precise, and cost-effective approaches. Consequently, it is imperative to devise future strategies that align with these advancements and the associated outcomes of smart technologies. The significance and function of big data have experienced a notable escalation. The promotion of sustainable development on a global scale has been accompanied by an increasing recognition of the immense value of data in facilitating this endeavor.

By using data effectively, society may gain unparalleled insights into many aspects of human life, leading to enhancements in living and working conditions as well as transformative societal shifts. Despite our diligent efforts to acquire and utilize technology, there is a notable deficiency in the allocation of resources towards the processing and analysis of large datasets, impeding our ability to fully capitalize on its potential within our development initiatives. Consequently, the significance of this work arises from the potential of big data to advance sustainable development within society. Given the context, the present working paper seeks to elucidate the significance of processing and analyzing large-scale datasets in a manner that facilitates accurate prediction and informed decision-making, hence bolstering the attainment of sustainable development objectives. The objective of this endeavor is to provide an overview of the key programs and techniques utilized in the analysis of large-scale data within the context of digital transformation, with a specific focus on their contribution towards achieving sustainable development objectives.

Data is widely seen as a critical component in driving this stage, owing to its capacity to offer valuable answers to decision-makers. The exponential growth of data has sparked interest among numerous companies in conducting research to leverage it for profitable purposes. Similarly, countries are also keen on studying citizens' preferences and analyzing their desires to enhance well-being and happiness. This interest is driven by the significant benefits offered by AI, which has emerged as a prominent and increasingly prevalent technology for data analysis and learning. The process of automating and simulating data is facilitated by the human intellect through a technique known as ML and deep learning. This platform offers several stakeholders a range of options to facilitate decision-making and enhance the efficiency and effectiveness of goal attainment.

Data, regarded as a crucial resource in contemporary society, serves as a catalyst for transforming our reality and exerting influence on various aspects of our environment. To effectively utilize data in terms of collection, examination, and analysis, it is imperative to

comprehend its functioning mechanisms. This comprehension is fundamental to comprehending how data is employed to shape the world, thereby constituting the bedrock of progress and transformation in contemporary human understanding and endeavors. This article aims to address the intriguing inquiry pertaining to data, namely: What is the impact of data on the world? The significance of this study lies in the role assumed by developing technologies and their widespread adoption, which has compelled diverse organizations and governments to align their service offerings with enhanced quality and efficiency while minimizing costs. To examine the influence of data on many domains of life, this present working paper also seeks to elucidate the predominant programs and tools that facilitate the analysis of large-scale data in the context of digital transformation, ultimately serving developmental objectives.

The research methodology employed in this study is as follows: The present study employed a descriptive and analytical methodology to examine and evaluate different governmental initiatives pertaining to AI and big data. What are the many domains in which big data is applied? How is it employed within the context of sustainable development? Is big data a factor in the process of decision-making? Given the current state of global interconnectedness, it has become imperative to acknowledge the significance of big data and its ability to expedite advancements.

Nevertheless, despite its significance and potential to facilitate beneficial transformations inside communities, many communities continue to exhibit a significant dependence on big data, mostly because of the scarcity of foundational local data, which has been persistently disturbed. Given the circumstances, the subsequent inquiries could successfully address the research issue. To address these inquiries, the study has been partitioned into three distinct segments. The paper discusses three key aspects: the theoretical framework, including AI and big data; the idea and aims of smart e-government; and the implementations of AI and big data, together with their consequential influence on information.

Artificial intelligence and Big Data

AI refers to the field of computer science that focuses on the development of intelligent machines capable of performing tasks that AI has emerged as a comprehensive categorization including many applications capable of executing intricate activities that were formerly reliant on human intervention [5], [6]. These jobs include but are not limited to online consumer communication and engaging in strategic gameplay, such as chess. The phrase is frequently employed in a manner that is interchangeable with its subfields, namely ML and deep learning.

Nevertheless, there exist disparities. ML is a field of study that centers on the development of systems capable of enhancing their performance via the acquisition and analysis of data. It is essential to acknowledge that while all instances of ML fall under the umbrella of AI, not all manifestations of AI can be classified as ML [7]–[9]. To maximize the benefits derived from AI several firms are allocating substantial resources towards the establishment and development of data science teams. Data science is an interdisciplinary field that integrates statistical analysis, computer science, and business acumen to derive meaningful insights and extract value from diverse data sources.

The implementation of AI Indeed, AI applications permeate several aspects of our everyday lives, necessitating our constant interaction with them. There are several causes that lead to our dependence on it. In this discourse, we delineate three key variables that foster the proliferation of AI among various businesses. The system offers conveniently accessible and cost-effective high-performance computing capabilities. The proliferation of business computing capabilities inside cloud computing infrastructure has facilitated the convenient and cost-effective availability of high-performance computational

resources. Prior to this advancement, the only computing environments accessible for AI were non-cloud-based and incurred significant costs.

One of the key factors in the field of ML is the abundance of extensive datasets that are readily accessible for analysis and training purposes. To create accurate predictions, AI systems must undergo extensive learning from a substantial amount of data. The simplicity of data labelling, along with the cost-effective storage and processing of both structured and unstructured data, facilitates the advancement of algorithmic training and development.

The utilization of applied AI technologies confers a distinct competitive edge. There is a growing recognition among companies of the competitive advantage that can be gained by leveraging AI insights to achieve business objectives, leading to a heightened emphasis on integrating AI as a strategic priority across the whole organization. One illustration of the potential benefits of AI technology is the provision of tailored suggestions, which can assist individuals in making more informed and expedient decisions. Various AI characteristics and capabilities have the potential to save costs, mitigate risks, expedite time to market, and offer several other benefits.

2. Materials and Methods

This study employs a descriptive and analytical methodology combined with case studies to examine the role of artificial intelligence (AI) and big data in enabling digital transformation, particularly in the context of smart government and sustainable development. The following outlines the materials and methods used:

1. Data and Sources
   Secondary Data: This study relies on secondary data collected from a variety of documentary and literary sources, including:
   Peer-reviewed journals
   Government reports on AI, big data, and e-government initiatives
   Publications on digital transformation and sustainable development.
   Case Studies: Specific case studies of AI and big data applications in various countries' smart government initiatives were analyzed. These case studies focus on real-world implementations of big data and AI technologies in public services, decision-making processes, and sustainable development planning.

2. Data Collection Methods
   Data collection was conducted through:
   Literature Review: A systematic literature review was performed using academic databases to identify relevant research, reports, and articles on AI, big data, e-government, and sustainable development.
   Document Analysis: Official government reports, technical papers, and case studies on the application of AI and big data in public administration and policy were gathered and analyzed. Keywords such as "AI for e-government," "big data in sustainable development," and "smart government technologies" were used for the search.

3. Analytical Approach
   Descriptive Analysis: The collected data were subjected to descriptive analysis to summarize and interpret key themes, trends, and developments in AI and big data usage in digital governance.
   Comparative Case Study Analysis: Selected case studies were compared to identify common strategies and methodologies employed by governments in

different regions for integrating AI and big data into their services. This approach provided insights into best practices and potential challenges.

Data Synthesis: The findings from the case studies and literature review were synthesized to form a comprehensive understanding of how AI and big data contribute to achieving sustainable development goals (SDGs) within smart government frameworks.

4. Research Questions

This study was guided by the following research questions:

What are the domains in which big data is applied in the context of smart government and sustainable development?

How does big data influence decision-making processes, and what value does it add to societal transformation towards the achievement of SDGs?

What are the primary tools and methods used to analyze large datasets in the context of digital transformation, and how do they contribute to the implementation of sustainable development initiatives?

5. Methodological Framework

The study was conducted in three stages:

Theoretical Framework Development: Building a conceptual understanding of AI, big data, and their roles in digital transformation and governance.

Case Study Analysis: Analyzing specific examples of AI and big data integration in governmental services, focusing on their contributions to sustainable development.

Data Interpretation and Conclusion: Drawing conclusions based on the comparative analysis of case studies and theoretical insights, aimed at understanding the transformative power of AI and big data.

The combination of descriptive analysis, document analysis, and case study methods allows for a thorough exploration of AI and big data technologies' role in driving digital governance and sustainable development efforts.

3. Results and Discussion

Big data analysis and artificial intelligence

AI necessitates a substantial volume of data to acquire knowledge and enhance its capacity for making informed decisions. In turn, big data analytics uses AI techniques to examine and interpret large datasets more effectively. By means of this convergence, one may effectively utilize sophisticated analytics capabilities such as augmented or predictive analytics, thereby enhancing the efficiency of extracting actionable insights from large repositories of data [10], [11].

By leveraging AI-driven analytics in the context of big data, users are equipped with user-friendly tools and robust methodologies that enable them to extract profound insights at a higher level. The significance is derived from the data. The development of AI is inherently intertwined with the use of large amounts of data [12], [13]. The use of big data technology incorporates the application of theories and methodologies derived from the field of AI .

AI relies on extensive data sets and uses big data methodologies to enhance and advance its decision-making skills. The use of big data and AI is a significant source of power and influence. Companies that use technology and AI will have the capacity to enhance their understanding of consumer requirements and streamline work automation through the utilization of high-performance supercomputers [14]. Netflix, as an illustration, now leverages insights derived from extensive datasets to create and suggest

content that aligns with individual user preferences, as inferred from their past viewing patterns.

In the era of AI and big data, corporations possess enhanced capabilities to effectively forecast customer purchasing behavior in terms of product selection, timing, and quantity. Organizations will utilize this data to develop novel goods and guarantee their accessibility at crucial periods. In the era of modern and rapidly evolving digital technology, the ubiquity of data has grown pervasively due to the exponential growth and widespread use of the Internet and related technologies on a global scale.

The proliferation of digital data in our contemporary society is experiencing exponential growth, leading to a profound and rapid transformation in several aspects of our daily existence. The frequency of data generation, as indicated by research conducted by Forex, occurs biennially [15]. The study reveals that approximately 1.7 megabytes of novel information are generated and uploaded per second for everyone on the planet. Consequently, the domain of data experiences substantial growth, thereby elevating its significance and relevance in shaping the future of our global society and individual lives. Presently, this trend continues to persist. In this study, we go into the field of data science, specifically focusing on the analysis of large data sets and other relevant aspects pertaining to this subject area. We must define big data.

1. **The notion of large data analysis**

Big data analysis refers to the utilization of sophisticated analytical approaches to examine and comprehend extensive and diverse datasets that vary in terms of their formats and characteristics. This discipline of great significance encompasses the examination of organized, semi-structured, and unstructured data derived from many sources and ranging in size from terabytes to zettabytes. This procedure gives researchers, analysts, and prominent business proprietors the ability to enhance decision-making efficacy and expediency. Data analysis is recognized as a fundamental discipline within computer science, technical engineering, and software engineering and is extensively included in the curricula of academic institutions today.

2. **The notion of huge data**

The phrase "big data" refers to a contemporary concept including datasets of substantial size that provide challenges for conventional computer databases in terms of processing, management, and rapid response, particularly when compared to smaller datasets. The phenomenon of big data is characterized by a multitude of intricate attributes that. Analyzing it poses a formidable challenge for conventional computers, owing to the extensive scale and diverse nature of the data, which originates from various sources and encompasses a wide range of types. This data is generated by sensors, video, and audio devices, as well as disseminated through networks, the Internet, and various media platforms, thereby attesting to its ubiquity and prevalence in contemporary times.

Nevertheless, the advent of information and communications technology, along with the establishment of databases, has fostered the emergence of data analysis as a crucial discipline. This development has bestowed upon humanity a multitude of significant advantages, primarily characterized by enhanced expediency and efficacy in analytical processes. Consequently, this has engendered heightened competition among institutions and companies across diverse sectors, compelling them to strive for swifter operations. Herein lie the most salient implications. The method of analyzing big data through the utilization of specialized analytical tools on high-capacity computers with extensive databases and robust computing and processing capabilities offers significant advantages.

a. The use of contemporary big data analysis techniques has resulted in a reduction in expenses associated with the storage of substantial volumes of data. Notably, the utilization of the renowned Hadoop storage cluster has facilitated the organization of data in a manner that is both efficient and advantageous for businesses, hence enhancing operational ease.

b. Enhancing decision-making efficiency: Through expedited and comprehensive examination of diverse data sources, organizations are capable of promptly comprehending and evaluating information to facilitate timely decision-making. This expeditious decision-making process enhances operational efficacy and augments future profitability.

c. Companies possess the ability to comprehend and discern the requirements of customers and ascertain their sources of contentment by means of data analysis techniques applied to product and sales data as well as individuals' opinions. This enables companies to create prosperous products and introduce novel services that are likely to captivate customers and fulfil their expectations.

3. The process of data analysis

Frequently, organizations employ storage systems as an initial repository for storing large volumes of data prior to its transfer to the analytical database. After the completion and preparation of the data, it undergoes analysis using sophisticated analysis software, which is widely available on the market. These programs are equipped with specialized tools designed to facilitate the analysis process. Among the various instruments available, there are a few that stand out as particularly noticeable.

a. Data mining techniques are used to enhance data by effectively looking for various sorts and patterns of data.

b. Predictive analysis uses AI to construct probability models and forecast forthcoming trends, as well as the patterns and dynamics of consumer behavior in relation to their preferences and needs.

c. ML is a computational approach that utilizes sophisticated algorithms to analyze vast quantities of data.

The utilization of software in text mining and mathematical and statistical analysis programs is important in the comprehensive study of big data. These programs are specifically developed using robust and fundamental programming languages within the realm of data analysis and database construction. Programming languages such as Python, R, SQL, and Scala are commonly used in the field of data analysis.

Sustainable development using big data in government

Sustainable development has several characteristics that are crucial for its attainment. These dimensions include the environmental, social, cultural, and economic aspects, all of which are integral to enhancing the overall well-being of society. The concept of sustainable development is founded upon the interplay between the natural environment, economic factors, and societal considerations. Moreover, a recently introduced model known as the "development pyramid" presents itself as a viable alternative [16]. This model encompasses four distinct aspects, namely the economic dimension (representing human-made capital), the environmental dimension (representing natural capital), the institutional dimension (representing social capital), and the social dimension (representing human capital).

Nevertheless, there has been criticism regarding these dimensions, namely concerning the inclusion of all other dimensions inside the economic dimension. Consequently, the individual in question formulated the triangular framework for sustainable development, employing the terms reason, institution, nature, and industry. Various disciplines, including education, scientific research, health, environment, economics, communications, and sociology, might get significant advantages from the incorporation of sustainability principles [17]. These benefits will be elucidated in the subsequent section on the added value component of the data.

The proliferation and accessibility of vast quantities of data from many sources have emerged as significant assets for a society driven by information. If effectively managed, this extensive dataset would make a substantial contribution to the promotion of sustainable economic and social development, as data plays a crucial role in facilitating.

The availability of large datasets allows individuals to acquire the necessary knowledge for effectively using and abstaining from utilizing such data to make informed decisions. This is achieved by enabling individuals to discern insignificant data and enhance its value via thorough analysis, therefore honing their capacity to derive significance from the facts at hand.

This data additionally enables workers to streamline and optimize the effort and time expended throughout all phases of the decision-making process by leveraging the tools and devices at their disposal, encompassing data collection, analysis, and dissemination of the most pertinent information derived from the analysis to authorized decision-makers, thereby fostering novel experiential outcomes. Within these institutions, the outcomes of utilizing these methods may surpass those of traditional decision-making approaches, hence enhancing their effectiveness and credibility.

Big data has far surpassed it at the institutional level. The predominant focus of data analysis pertains to the field of data science, specifically including organizations engaged in the realm of information. Despite the significant investments made in technology and information experts to enhance the decision-making process, they are insufficient. This is because the analysis of big data and centralized decision-making are intricately tied to effective leadership. Leadership plays a crucial role in making optimal administrative and managerial decisions that effectively address diverse problems.

The concept of big data presents a significant and unprecedented opportunity to enhance collective capacities to assist and safeguard human societies. This is achieved through the comprehension of the growing volume of digital information generated by these societies. By engaging international agencies, civil society organizations, and the private sector, governments can effectively monitor progress and ensure that evidence-based decision-making is prioritized. The use of big data possesses the capacity to bring about transformative effects on governmental structures and societal dynamics.

To effectively accomplish sustainable growth, the availability of reliable information is of utmost importance. Without access to data and information, making proper judgements at the most efficient cost becomes challenging. Hence, it is imperative for decision-makers to possess relevant data to undertake the requisite activities towards achieving sustainable development [18], [19]. This data encompasses the analysis of prevailing circumstances, the identification of trends, and the identification of areas of vulnerability resulting from various interactions. Such data serves to ascertain if the chosen trajectory aligns with the desired objectives.

Inclusion of this aspect is integral to the notion of big data, as it pertains to the process is sometimes described as the cultivation of decision-making skills, since research has indicated that the examination of high-quality data facilitates effective, well-informed, unambiguous, and expedient decision-making by those responsible for making decisions, hence expediting the formulation of a plan. Hence, the utilization of data plays a pivotal role in facilitating decision-making processes and tracking advancements towards attaining sustainable development.

The significance of data lies in its ability to inform crucial decisions, exerting a substantial influence on the viability, growth, and establishment of institutions. Moreover, data serves to monitor forthcoming alterations and patterns, thereby aiding decision-makers in their pursuit of informed choices.to use big data to support sustainable development goals The impact of data on society This discourse examines the impact of data on society and anticipates forthcoming transformations.

1. **The influence of data inside the healthcare sector**

     The advent of comprehensive scientific data towards the conclusion of the twentieth century brought about a transformative shift in medical practices, leading to improved treatment approaches and enhanced patient outcomes. Nevertheless, the continuous and escalating input of novel data has presented a significant challenge for medical practitioners and even prominent healthcare

organizations in comprehending the implications and findings derived from this information.

The use of ML and other AI methodologies has facilitated the development of computer systems with enhanced capabilities. These systems employ intricate algorithms to effectively identify certain signals that may elude detection using conventional statistical methods. In addition, the integration of digital imaging with extensive databases might prove to be highly advantageous in the identification and diagnosis of a growing array of medical disorders. Soon, it is unlikely that technologies driven by big data will supplant doctors; yet they do serve as robust systems that assist and enhance their professional endeavors.

2. **The influence of data on urban management systems**

Undoubtedly, the administration of cities is commonly perceived as a formidable issue. However, the advent of big data has engendered novel prospects for enhancing management systems. Cities have the alternative option of utilizing surveys and manual monitoring methods to monitor the movement of individuals within a certain region. This methodology is predicated around the use of data obtained from sensors, hence affording a much-enhanced level of precision.

The process of devising traffic routes, such as through the analysis of data and research of various factors such as congestion hotspots and peak traffic periods, yields concrete enhancements that result in time savings for commuters and an overall increase in quality of life. Furthermore, the use of big data may provide valuable insights to urban planners in their decision-making process on the future trajectory of cities, enabling them to make informed choices prior to undertaking substantial and costly initiatives. City administrators will possess the capability to analyze the data obtained from big data sources to assess the long-term effects and maybe bring about fundamental and dependable transformations in urban areas.

3. **The influence of data on the employment industry**

There exists concern among individuals over the potential displacement of occupations by big data. However, experts hold divergent views regarding the overarching influence of data on employment. It is worth noting that data does play a role in the emergence of novel career opportunities, particularly for those possessing expertise in big data and related technologies.

Data scientists are presented with extensive prospects inside organizations and institutions that heavily depend on data science for their operations. It is anticipated that this trend will gain momentum in the forthcoming years. The implementation of algorithms produced by data scientists and mathematicians in the context of big data necessitates the involvement of software developers. Additionally, the dependability of the intricate computer systems used for running data analysis programs demands the expertise of IT professionals.

4. **The influence of statistics on the management of energy use**

When addressing the issue of mitigating carbon dioxide (CO_2) emissions originating from industrial facilities, the focus is predominantly directed towards novel energy sources and significant systemic changes. Nevertheless, it has been widely recognized by energy experts that enhancing energy efficiency is a highly effective approach to mitigating the impacts of global warming. Big data may provide benefits to all stakeholders involved in waste reduction efforts. Energy firms have the potential to enhance their energy generation and distribution processes by employing smart meters and other sensor technologies.

These advanced tools enable them to more effectively ascertain optimal energy generation timings and destinations, thereby minimizing energy waste. Conversely, government authorities possess the capacity to enhance the

formulation of initiatives aimed at promoting heightened efficacy in energy utilization. In this scenario, the use of big data emerges as a significant asset in the development of these programs. Additionally, the increasing amount of data that energy companies are disseminating may benefit people. This communication aims to provide consumers with comprehensive information regarding their energy consumption patterns and potential strategies to curtail usage by adjusting the time of use.

5. **The influence of data on enhancing the security of technology**

Contemporary global society is experiencing a growing reliance on computer technology, with no indication of this trajectory decelerating within the foreseeable future. Despite the numerous benefits in terms of ease and efficiency that accompany the digital age, it is imperative to acknowledge the substantial hazards it entails.

Preventing breaches that compromise computer programs, particularly database hacking, poses significant challenges. However, the integration of big data and AI has demonstrated considerable efficacy in countering cybercrime, namely electronic piracy. The enhancement of network resilience is facilitated by active engagement in collaboration and the exchange of data. The primary focus of big data analysis is the identification of patterns and the detection of harmful entities based on the traces they leave behind. This capability enables cybersecurity professionals to promptly address cyberattacks, even when security holes are present.

The utilization of data analysis in organizations can facilitate timely responses to minimize or perhaps avert breaches during an assault. However, it is important to acknowledge that the methods employed in big data also include inherent hazards. The vulnerability of sensors to hacking and their potential utilization in botnets or other nefarious endeavors underscores the imperative of safeguarding the security of systems employed in the realm of data science. This is essential for optimizing the advantages derived from big data and its related technologies.

6. **The influence of data on enhancing the relationship between people and computers**

In the realm of telecommunications services, service providers may enhance client interactions by leveraging big data, resulting in improved speed, accuracy, and reliability. This, in turn, contributes to a more seamless customer experience, particularly for consumers who may exhibit little faith in telecom services.

Moreover, these systems have the capability to acquire knowledge progressively and offer expedited support, resulting in a reduction in the financial resources required to deliver exceptional customer care. The utilization of big data in this undertaking encompasses several aspects, since it has the potential to greatly enhance the efficacy of speech recognition technology. The use of data analysis and ML has greatly enhanced the capabilities of computer-based help systems that rely on big data. Consequently, these systems are now surpassing human-managed systems in terms of the quality of services offered to clients.

Smart Government using big data

The concept of a smart government refers to the use of advanced technologies and data-driven approaches to enhance efficiency, effectiveness, and responsiveness. In contrast to the prevailing notion that smart government solely encompasses electronic applications on smart mobile devices, we contend that smart government represents the organic progression of the e-government framework that has been observed over the previous decade. This evolution occurred during a period when e-government primarily

aimed to showcase the provision of public services by the government [20], [21]. The advent of web applications and electronic portals on the Internet has paved the way for the emergence of smart government initiatives. These initiatives aim to enhance the existing infrastructure by providing citizens with a comprehensive range of services, including both personal life events and business-related transactions.

By leveraging these technologies, smart government initiatives seek to establish closer connections with citizens while also facilitating real-time interaction with the vast amount of data dispersed across various sectors of society, such as the economy, social welfare, and security. The integration of Internet-connected smart sensors, such as security surveillance cameras in urban areas, climate sensors, and energy consumption measuring devices linked to the government's Internet network, has facilitated the creation of a novel electronic ecosystem [1], [22]. This development has proven advantageous for the government in terms of enhancing the efficiency and cost-effectiveness of its operations while also reducing the likelihood of human errors or administrative misconduct [23].

The introduction of new advancements will necessitate various adjustments to e-government models, such as the implementation of suitable enhancements to the e-government data consensus architecture, often known as the Government Interoperability architecture. This will ensure that the newly introduced data sources and formats align well with the government's underlying systems. To facilitate the transition from an electronic government to a smart government, it is imperative to undertake comprehensive efforts across several technological, administrative, and legislative domains concurrently. These efforts encompass:

a) Creating a framework for smart government services on mobile phones and how to compile and show them in a way that helps individuals Smart government services can potentially be facilitated through the implementation of a consolidated government application. This application would serve as a platform for integrating public services, allowing for the addition or removal of service elements as needed. Alternatively, the central government may choose to issue comprehensive guidelines and instructions pertaining to the development of preferred services and associated technologies. This would encompass aspects such as service design, content, and security measures (including information confidentiality). Subsequently, individual agencies and ministries would have the autonomy to internally develop their respective smart government services within this framework.

b) The objective of this project is to provide a comprehensive set of rules and templates for the development of smart apps, specifically focusing on applications designed for government use. These guidelines, referred to as the Smart Government Apps Rules, aim to provide a standardized framework for the development process, ensuring that smart applications adhere to best practices and meet the specific requirements of government entities. By establishing these guidelines, developers will have a clear roadmap to follow, resulting in the creation of efficient and effective smart applications that may enhance Many governments have established guidelines for the development of government websites. However, there has been a lack of similar efforts in the realm of smart applications. This is even though citizens spend more time interacting with their mobile devices compared to desktop devices.

c) The objective is to facilitate the accessibility of government big data, thereby fostering the development of intelligent applications by programmers within the community. One instance of this phenomenon occurs when the government releases data pertaining to commercial and economic transactions, transportation, and communication systems, as well as import and export activities in their unprocessed state. Subsequently, an individual may develop intelligent mobile applications to cater to merchants, equipping them with

valuable information to enhance their trade relations with partners situated in foreign nations. The implementation of government data sensor networks is crucial for the acquisition of timely and relevant information pertaining to several domains such as security, transportation, health, climate, environment, and others. This entails the allocation of computational resources and a dedicated facility to receive, analyze, and store the data collected by the sensors. The use of electronic payment methods through smartphones facilitates direct payment of service fees by citizens using the digital wallet on their mobile devices. This includes the ability to pay for services such as transportation buses, the metro, and public parking through their cellphones.

d) Government organizations and ministries are progressively transitioning towards the adoption of cloud computing models to effectively and flexibly secure computer resources and data storage as per their specific requirements. The model has demonstrated its efficacy across diverse business sectors, as numerous organizations have been able to procure substantial computational resources, such as hundreds of servers, to facilitate in-depth data analysis. Subsequently, these servers are decommissioned once the requisite tasks are fulfilled, with efforts underway to recycle and subsequently re-lease them.

4. Conclusion

In conclusion, this study elucidates the critical role that emerging technologies, particularly artificial intelligence (AI) and big data analytics, play in fostering sustainable development within the framework of the Fourth Industrial Revolution. The findings indicate that the effective utilization of these technologies is essential for enhancing decision-making processes and ensuring that services and businesses align with the evolving preferences of individuals and customers. By emphasizing the necessity of cultivating a skilled workforce, particularly data scientists proficient in managing large datasets, this research highlights the importance of equipping professionals with the tools and knowledge required to navigate the complexities of big data. The implications of this study suggest that governments and organizations must invest in training and technology to fully harness the potential of data-driven solutions for sustainable development. Furthermore, future research should explore the long-term impacts of big data and AI integration across various sectors, focusing on best practices for implementation and the ethical considerations of data utilization, to ensure that these innovations contribute positively to societal well-being and resilience.

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