GRAVITATING THE COMPONENTS, TECHNOLOGIES, CHALLENGES, AND GOVERNMENT TRANSFORMING STRATEGIES FOR A SMART BANGLADESH: A PRISMA-BASED REVIEW

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Abstract

This paper aims to establish a technologically advanced and environmentally sustainable country that efficiently utilizes resources, fosters citizen participation, and stimulates economic development to transform a Smart Bangladesh. This review study, based on the PRISMA framework, seeks to analyze the elements, technologies, difficulties, and governmental approaches. Researchers conducted a systematic evaluation of relevant papers and studies to thoroughly analyze the present status and future potential of Smart Bangladesh. The researchers utilized the PRISMA 2020 platform to identify and choose relevant 150 studies and 17 reports from indexed publications, including Scopus, Web of Science, PubMed, DOAJ, and other sources. The key findings of this paper highlight the importance of constructing a nation that is both technologically advanced and environmentally sustainable nation. Bangladesh encompasses a holistic perspective on the advancement of technology, efficient utilization of resources, active involvement of its citizens, and effective implementation of government regulations. The assessment examines the fundamental elements of a technologically advanced Bangladesh, including developing technology, encountered obstacles, and governmental measures employed to realize this objective. The relevance of this comprehensive review contributes to a deeper understanding of the potential opportunities and obstacles associated with the process of transitioning towards a smart nation.

Keywords: Smart Bangladesh, Emerging Technologies, Government Initiatives, Transforming Strategies, PRISMA-Based Review

Authors' individual contribution: Conceptualization — M.R.I.B. and L.M.; Methodology — M.R.I.B. and M.N.U.M.; Software — M.M.I.; Validation — R.H.; Formal Analysis — L.M.; Investigation — M.M.I.; Resources — M.M.I.; Data Curation — L.M.; Writing — Original Draft — M.R.I.B., R.H., M.M.I., and L.M.; Writing — Review & Editing — M.R. and M.N.U.M.; Visualization — M.N.U.M.; Supervision — M.N.U.M.; Project Administration — M.R.; Funding Acquisition — R.H. and M.R.

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1. INTRODUCTION

Within the framework of the 'Smart Bangladesh' program, Honorable Prime Minister Sheikh Hasina is putting Bangabandhu's vision into action. The philosophy and spirit of Sheikh Mujibur Rahman in the Smart Bangladesh-2041 vision aims to create Bangladesh as a knowledge-based economy and an innovative nation to put Smart Bangladesh-2041 into action (Pal & Sarker, 2023). Bangladesh, a country known for its ability to recover quickly and achieve rapid development, has embarked on a transformative journey to become a 'Smart Bangladesh' (Khatun et al., 2023). According to Choudhary and Bansal (2022), the vision involves leveraging technological innovations to improve personal satisfaction for its occupants, enhance governance, and promote durable economic development. This study assessed the existing technical landscape, political initiatives, and societal integration to determine the barriers hindering the achievement of a fully smart nation. Furthermore, the study evaluated deficiencies in policies, limitations in infrastructure, socioeconomic obstacles, and citizen participation (Kim, 2022).

The objective of a study undertaken by Akhter and Biswas (2016) was to provide a design roadmap for implementing a smart grid in a South Asian country. The study specifically focused on the functional and technological problems associated with its implementation. This essay analyzes the operational capabilities of smart grids from a national perspective. The main technological obstacles related to the deployment of this cutting-edge intelligent grid, together with their respective solutions, are presented. The study also showcases Bangladesh's smart grid initiative (Akhter & Biswas, 2016). Ahmed et al. (2023) used a comprehensive analysis to evaluate Bangladesh's progress towards a 'Smart Bangladesh'. The qualitative study used secondary data to draw conclusions. The overview shows a shift from computerized to savvy in Bangladesh. It breaks down the advancement strategies utilized in this progress, analyzes the most common way of changing computerized Bangladesh into shrewd Bangladesh, and examines the job of brilliant advances, including the Internet of Things (IoT), blockchain, man-made intelligence, and enormous information examination. The research also highlighted Smart Bangladesh implementation challenges (Ahmed et al., 2023). Multiple studies have been undertaken on Smart Bangladesh, exploring various emerging technologies and viewpoints. No research has been undertaken using a PRISMA-based systematic review approach from a viewpoint standpoint. The primary study deficiency lies in the utilization of PRISMA 2020 to delineate the constituents, obstacles, and governmental tactics for implementing and envisioning Smart Bangladesh (De Filippi et al., 2020).

As stated by Pal and Sarker (2023), the current government of Bangladesh has expressed its aspirations to transform the nation into a developed and sustainable country by the year 2041. This vision is to be achieved through the implementation of the innovative concept known as 'Smart Bangladesh'. The recent development plan is an integral component of the current development agenda of the government of Bangladesh, which is commonly referred to as 'Smart Bangladesh Vision 2041' (Khan, 2021; Islam, 2022).

The objective is to analyze the transition process and identify key solutions, challenges, and opportunities for attaining a technologically advanced and sustainable Bangladesh. The research objective aims to provide valuable insights, analysis, and recommendations to policymakers, government agencies, private sector organizations, academia, and other stakeholders involved in the process of change. The objectives of Smart Bangladesh's vision encompass the utilisation of empirical data to inform decision-making processes, the implementation of effective strategies, and the execution of initiatives under the guidance of the esteemed Prime Minister Sheikh Hasina. It has been proposed by the Prime Minister of Bangladesh that the establishment of Smart Bangladesh will be determined in the year 2041. The research objectives are presented below:

RO1: Analyzing the four pillars of Smart Bangladesh with emerging technology applications.

RO2: Identifying potential challenges and government initiatives for implementing Smart Bangladesh.

Based on the PRISMA framework, this review study examines the elements, technology, challenges, and government policies involved in Smart Bangladesh. To assess Smart Bangladesh's current and future potential, researchers used PRISMA to evaluate relevant publications and studies. The researchers used PRISMA 2020 to find relevant papers and reports from Scopus, Web of Science, PubMed, DOAJ, and other sources. This paper emphasizes the need to build a technologically advanced and environmentally sustainable nation like Smarty. Bangladesh has a holistic approach to technology, resource efficiency, community participation, and government regulation. This detailed assessment enhances understanding of smart nation transition prospects and challenges.

The rest of this paper is structured as follows. Section 2 reviews and analyses the literature. Section 3 describes the methodology of the study, which involved the use of a PRISM-based platform to carry out the research. The results and discussion are addressed in Section 4. Section 5 concludes the paper the paper.

2. LITERATURE REVIEW

According to Ikizer (2022), initiatives for the development of intelligent cities examine the smart city programs and projects in Bangladesh, including Dhaka Smart City, and analyze their goals, implementation tactics, obstacles, results, and how these projects incorporate technologies and innovations to enhance urban planning, transportation, infrastructure, energy management, and citizen services (De Filippi et al., 2020). Utilization of the IoT analyzes the adoption and integration of IoT technology in several sectors of Bangladesh, such as agriculture, healthcare, transportation, energy, and environmental

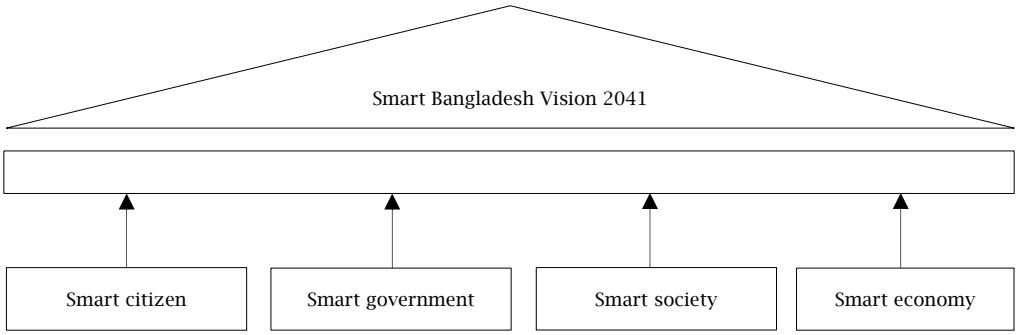
monitoring. It evaluates the influence of the IoT on enhancing effectiveness, environmental friendliness, and excellence of services in these industries (Cae-Li et al., 2019).

Çekerol (2020) suggests reviewing Bangladesh's information and communications technology (ICT) competency development and labour force training activities and evaluating how education, training, and capacity-building programmes prepare workers for the digital age and advance a technologically sophisticated nation. Equal digital access and participation examine Bangladesh's digital access measures to ensure fair and equal access to technologies and services (Arora, 2020), marginalised, rural, and underserved community activities to promote digital inclusion and close the digital divide, and the policy and regulatory framework for technological advancement in Bangladesh. Government ICT, smart city, data privacy, cybersecurity, and innovation policies should be reviewed. The current framework support of intelligent enterprises should be assessed (Makhdoom et al., 2019). Bangladesh's intelligent initiatives' ecological viability and environmental impacts should be examined. Energy efficiency, renewable energy, waste management, and environmental monitoring efforts as well as how intelligent technology can solve environmental issues should be assessed (Afshan et al., 2022). The social and economic impacts of intelligence initiatives in Bangladesh should be analyzed. These efforts, whether they have increased economic growth, employment, public services, citizen involvement, and Bangladeshi well-being should be assessed (Milusheva & Bedoya, 2023).

2.1. Components of Smart Bangladesh

According to Zakai (2022), Bangabandhu Sheik Mujibur Rahman, also known as the 'Father of the country', had a fantasy about living in a nation free from poverty, where fiscal and social reasonableness is the norm, and where everyone shares in the success. As part of its efforts to actualize Bangabandhu's ideal and to work on the personal satisfaction of individuals in Bangladesh, the government of Bangladesh has been adapting and executing various initiatives on a schedule. According to Bangladesh's ambitious socio-economic strategy, which was presented in the 2021–2041 prospective plan, the country would have to make the transition from 'digital' to 'smart' to achieve its goals. Moving forward from the Computerized Bangladesh Vision 2021, Vision 2041 has the explicit objective of eradicating outrageous neediness and accomplishing the situation with Upper Center Pay Nation (UMIC) constantly 2031 and high-income country (HIC) by the year 2041 and beyond (Hussain & Suma, 2023). Technology will play a significant part in the realization of the Smart Bangladesh Vision 2041, and it will be integrated into the four essential pillars in Figure 1, which are as follows:

Figure 1. Components of Smart Bangladesh



Source: Authors' elaboration.

2.1.1. Smart citizen

Digital literacy programmers and driving initiatives under the smart citizen pillar aim to provide Bangladeshis with a digital-first mindset and improve their abilities (Choudhary & Bansal, 2022). Intelligent people will use digital technology daily in 2041 and collaborate with the government and industry to create services and regulations. Major programmes in this pillar include General Advanced ID, Resident Upskilling, Computerised Cooperation Stages, and the Brilliant Bangladesh Mission (Bhuiyan & Akter, 2024). Smart citizens use technology and innovation to enhance their lives and others. They use mobile phones and the internet to learn, contribute, and improve their lives (Xu et al., 2023). Intelligent people use technology to get services, communicate with businesses, and make smart decisions in the digital economy. Shopping, banking, and sharing are done on internet platforms and smartphone apps (Bhuiyan et al., 2023). Intelligent people use technology to communicate with their elected leaders, participate in online forums and discussions, and advocate for their own interests (Zhao, 2021). They also volunteer and work on community projects using technology (Zhao, 2021).

Table 1. A list of smart citizen approaches

Name	*Description*	*Source*
Universal digital ID	Universal digital identity will enable Bangladeshis to use many applications across their lives. A universal computerized ID might boost Bangladesh's gross domestic product (GDP) by 6% by 2030, according to benchmarks. For social government support, financial openness, and duty collection, a computerized distinguishing proof is essential.	Castillo et al. (2023)
Digital skilling	The prospective plan 2021–2041 presents a three-fold approach to transform Bangladesh into a pioneering economy: 1. Advancement in software and the digitization of services. 2. Combining the benefits of a skilled workforce with advanced technological innovation. 3. Utilizing the Fourth Industrial Revolution (4IR) to enhance competitiveness and promote a low-carbon economy.	Kamaruddin et al. (2021), Bhuiyan et al. (2023)
Citizen upskilling	This plan is broken up into three distinct sections. These include: 1. Digital literacy encompasses digital literacy at every level of society. 2. Digital curriculum. 3. Access to smart devices.	Bhuiyan (2024)
Digital curriculum	Bangladesh's Vision 2041 relies on digital literacy to develop a digital society, promote technology-driven industrialization, and foster an innovation-based economy that uses 21st-century human resources. From an early age, digital literacy, skills, and competencies must be developed throughout sectors and society. This includes ensuring that everyone can use smart devices and computers and cultivating a digitally savvy community.	Amin et al. (2024)
Smart Bangladesh campaign	The computerized development of Bangladesh has laid out the vigorous foundation for Vision 2041. A fundamental aspect of Digital Bangladesh is the initiative to 'Connect citizens', in which Bangladesh has achieved significant advancements in giving admittance to advanced innovation through public undertakings like Data Sarker and Association Computerized Focuses. Nevertheless, to achieve Vision 2041, Bangladesh must cultivate citizens who possess not only digital access and abilities but also a sense of empowerment.	Milusheva and Bedoya (2023), Smucker (2021)
Digital collaboration platforms	As part of Bangladesh's Vision 2041, efforts are being made to establish strong connections between citizens and both the government and other citizens. The goal is to foster innovation and enhance governance. This includes initiatives such as facilitating meaningful connections between citizens, implementing citizen-centric civil administration, and promoting democratization and decentralization.	Zhao (2021)
Smart device access	The ubiquitous availability of intelligent devices such as smartphones, computers, and, what is more, tablets will be critical in understanding Bangladesh's Computerized Vision 2041. The utilization of intelligent gadgets is anticipated to experience significant growth in the forthcoming years. Nevertheless, current levels are rather low nowadays, and the distribution of smart gadgets is predominantly comprised of lower-tech models.	Ali and Khan (2023)

Source: Authors' elaboration.

2.1.2. Smart government

The Brilliant Legislature of 2041 should be able to implement 'undetectable administration' with 100% paperless workplaces and hyper-customised administration stages in need areas like medical services, training, farming, income, the board, public security, etc., according to Çekerol (2020). Bangladesh will engage in proactive and collaborative policies to advance frontier technologies (Kampová & Madleňák, 2023). The smart government will include initiatives across ministries and divisions and national platform efforts like a public e-obtainment commercial centre, a computerised work stage, and others (Milusheva & Bedoya, 2023).

Smart healthcare: Bangladesh has laid out elevated well-being objectives for 2041, including an eight-year expansion in the future, significant decreases in maternal and newborn child death rates, and extending healthcare coverage inclusion to encompass no less than 75% of the populace. To accomplish this, Bangladesh should carry out critical upgrades in the openness, inclusion, cost, and nature of medical services. Digitalization will play a crucial role in facilitating these dimensions, and Bangladesh should prioritize the establishment of an ecosystem that places the digital system at the core of the future healthcare system (Zhao, 2021).

Blended learning: Bangladesh aspires to achieve a top-tier, all-encompassing education system, viewing it as a crucial goal in its own right and as a strategy to leverage its demographic advantage. Blended learning, which combines digital technologies and tech-enabled methodologies, can be crucial in tackling the obstacles that Bangladesh encounters in achieving high-quality and equitable education (Choudhary & Bansal, 2022).

Smart social safety net: According to Ikizer (2022), the implementation of digital technologies in Bangladesh's social safety net would provide rapid, efficient, and comprehensive responses to any potential crises, thereby benefiting the vulnerable population. Mobile money facilitates the transfer of cash, while digital biometric identification numbers are used for authentication purposes (Ghouzali, 2022). Employment opportunities in the public works industry can be generated by leveraging computerized individual ability profiles and low-expertise gig stages. Utilizing a remote drone to distribute food and clothing in an emergency circumstance. Credit ratings for micro, small, and medium-sized enterprises (MSMEs) are led by mobile money. Data on health and education can be integrated with incentives for education, health, and housing. Utilizing artificial intelligence (AI) prediction and management technology to coordinate response operations for natural disasters (Choudhary & Bansal, 2022).

Police modernization: According to Choudhary and Bansal (2022), crime prevention involves the utilization of predictive analytics to forecast future dangers. Crime detection through the use of intelligent video surveillance systems and AI.

Identification and prevention of crime through the use of intelligent digital solutions, facilitated by community interaction (Wood & Thompson, 2020). Efficient crime response is achieved by the utilization of resource deployment optimization software and capacity building, enabling the fastest possible reaction to cyber threats. The investigation was facilitated by the use of digital case files and biometrics (Dawson, 2018). Utilization of a computerized criminal records database and cooperation technologies for the management of police administration. Intelligence gathering and analysis are facilitated by an advanced AI-powered monitoring system and big data analytics (Ikizer, 2022).

ICT policies: It is vital to have rules on ICT to maintain transparency and accountability among individuals, the government, and enterprises to accomplish some of the goals of national development. Several recent trends indicate that Bangladesh needs to take into account policies regarding cybersecurity, emerging technologies (especially AI), and the simplicity of conducting business in the ICT sector (Çekerol, 2020). Policies pertaining to data protection and cybersecurity: there has been an increase in the frequency of data breaches and thefts of personal information, as well as an increase in the utilization of open-source and free software as a platform (Berberi & Roche, 2022).

Digital Leadership Academy (DLA): Çekerol (2020) claims that the Computerized Administration Foundation (DLA), a government-led initiative, will have two key goals as its focal point. At every level of government, from local government representatives to members of parliament, digital upskilling and reskilling are being implemented. Through the expansion of solutions to select c-suite executives across priority industries, the capabilities of digital transformation in private sector leadership can be unlocked (Busulwa, 2022).

2.1.3. Smart society

With regard to smart Bangladesh, the expression 'smart society' alludes to a dream in which technology and innovation are utilized to enhance the general standard of living, effectiveness, durability, and inclusiveness for the people of Bangladesh (Khan, 2021). Below are a few crucial elements and probable domains of concentration for the establishment of a smart society in Smart Bangladesh. Ensuring universal access to inexpensive and dependable internet connectivity is important for the establishment of a smart society (Park, 2020). It is imperative to exert efforts to narrow the gap in access to digital technology, especially in rural and marginalized populations. Enhancing the broadband infrastructure, promoting digital literacy, and ensuring the availability of affordable equipment are all ways to achieve this (Arora, 2020).

E-governance and citizen services: According to Shenkoya (2022) implementing intelligent governance systems can improve the transparency, efficiency, and accessibility of government services. Introducing e-governance initiatives, such as online platforms for government services, digital identification systems, and electronic payment methods, can simplify procedures and enhance interactions between citizens and the government (Li & Kostka, 2022).

Smart healthcare: The utilization of technology to enhance healthcare services is a fundamental element of an intelligent society. Integrating electronic health records, telemedicine platforms, remote patient monitoring systems, and health data analytics can improve healthcare accessibility, quality, and efficiency.

Smart education: Incorporating technology into schools can revolutionize conventional teaching methods and foster individualized and all-encompassing education. Smart classrooms, digital learning platforms, e-books, and online educational materials have the potential to improve access to high-quality education and promote chances for lifelong learning (Choudhary & Bansal, 2022).

2.1.4. Smart economy

Tareque and Islam (2024) say a smart economy would alter Bangladesh's ready-made garments and textiles, light engineering, agriculture, and other industries. The ICT business will be worth $50 billion, and startups are strong. These will advance Bangladesh's technology and industrialization (Rahman, 2021). 4IR technological accelerators, including sophisticated robots, additive manufacturing, and augmented reality (AR), are changing the global industry. ICT GDP might reach $50 billion by 2041, increasing its national GDP contribution from 1% to 2–3%. Bangladesh has supported ICT with financing, people, policy, and infrastructure (Kwon et al., 2022). Thus, manufacturing, service, and financial technological advances necessitate skilled workers. Insufficient expertise and research and development (R&D) make it hard to produce qualified workers and access technology domestically. Bangladesh must resolve three challenges shortly to maximise industrialization. Kids need the skills and knowledge to succeed in a globalised environment as Bangladesh enters a revolutionary phase (Bhuiyan et al., 2023).

3. RESEARCH METHODOLOGY

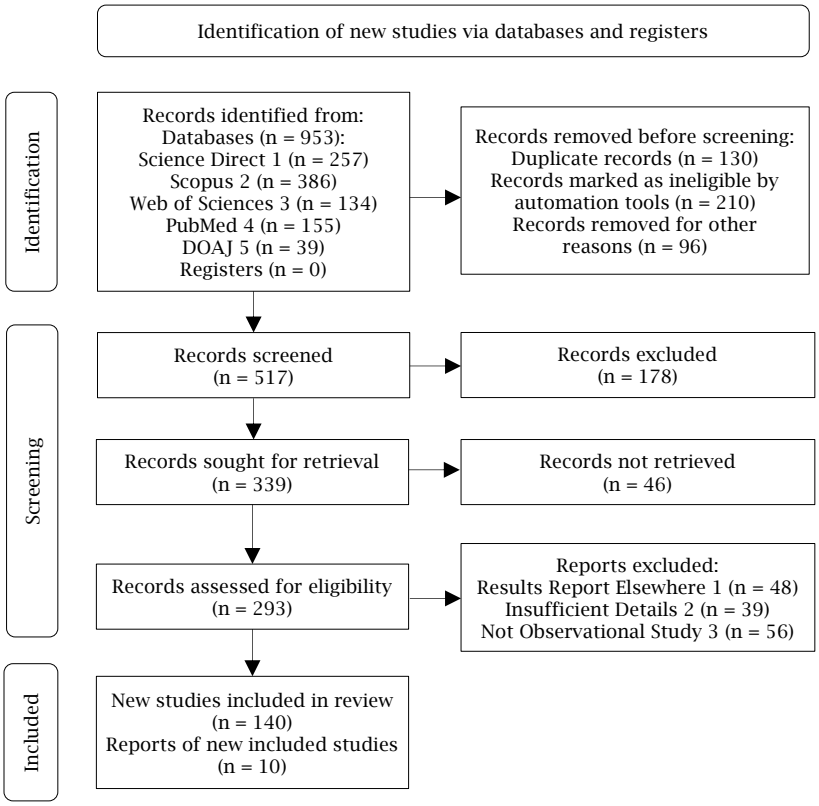
The research is conducted on a primarily secondary data-based technique, where different papers, journals, websites, newspapers, online portals, television broadcasts, etc. were considered to collect data for the completion of the investigation. The study examined the fundamental keywords such as Smart Bangladesh pillars, new technology, potential hurdles, and government initiatives for 2041 implementation. Following the 2020 PRISMA statement, Science Direct, Scopus, Web of Sciences, PubMed, and DOAJ were searched (Bhuiyan et al., 2023). The PRISMA standard defines critical features for reporting good evidence-based systematic reviews and meta-analyses (Molla et al., 2023). PRISMA prioritizes randomized trial reviews in Figure 2. It can also be used to publish systematic reviews of other studies, such as therapy assessments (Bhuiyan et al., 2023). For customers to assess the review's credibility and usefulness, systematic review methods and results must be thoroughly described.

Alternative techniques may be suitable for doing research on the transformation of Bangladesh into a smart nation. To conduct this study, it is

imperative to conduct thorough case studies on specific initiatives or projects that are pertinent to the advancement of intelligent urban areas in Bangladesh (Bhuiyan et al., 2023). Conducting this study can be accomplished by designing surveys or questionnaires to gather data from diverse stakeholders, including government officials, industry professionals, academics, and citizens. Experts in the fields of technology, urban planning, environmental sustainability, and governance could participate in organized or semi-structured interviews to conduct this study. Researchers may be undertaking a comparative investigation with other countries or regions that have seen similar transitions towards the establishment of smart cities (Rahman, 2021).

The research study examined crucial keywords such as the pillars of Smart Bangladesh, emerging technologies, potential challenges, and government strategies for implementing Smart Bangladesh within 2041. Any irrelevant records are excluded, based on the above keywords, from retrieving information (Ahmed & Sobuz, 2020). When deciding whether or not to reject publications and reports, additional considerations that should be taken into account include the availability of insufficient data, papers published in categories of articles, numerous languages, a variety of outcomes, and disconnected impacts and findings. During the course of the investigation, the researchers came across an additional 150 publications and 17 reports (Figure 2).

Figure 2. PRISMA 2020 flow diagram



Source: Haddaway et al. (2022).

4. RESULTS AND DISCUSSION

Following the guidelines outlined in the 2020 PRISMA statement, a comprehensive search was conducted across multiple academic databases, including Science Direct, Scopus, Web of Sciences, PubMed, and DOAJ. The PRISMA standard, also known as preferred reporting items for systematic reviews and meta-analyses is a set of guidelines that outlines the essential components necessary for the accurate and comprehensive reporting of evidence-based systematic reviews and meta-analyses. These guidelines are crucial in ensuring the transparency and reproducibility of such studies, as well as facilitating the assessment of their methodological quality. By adhering to the PRISMA standard, researchers can effectively communicate their findings and enable readers to evaluate the validity and reliability of the reported evidence. The PRISMA framework places a high priority on the inclusion of randomized trial reviews, as depicted in Figure 2. This tool's use extends beyond its primary purpose, as it can also serve as a platform for disseminating systematic reviews of various studies, including evaluations of therapeutic interventions. Throughout the duration of the investigation, the researchers encountered an additional 150 publications and 17 reports.

The researchers present the facts regarding the potential difficulties associated with adopting Smart Bangladesh. Furthermore, it involves significant steps taken by the government to strengthen the nation to transform Bangladesh into a smarter version of itself, known as Digital Bangladesh.

4.1. Potential challenges of implementing Smart Bangladesh

The implementation of a 'Smart Bangladesh' plan, which entails the incorporation of technology and data-driven solutions to improve several facets of the country, might provide numerous advantages (Bhuiyan, 2017). Nevertheless, it also presents its own array of difficulties. The Digital Bangladesh Vision 2021 was introduced in 2009. In 2022, 13 years from now, the government aims to develop a knowledge-based economy that can adapt to the rapidly evolving global environment. The ultimate goal is to transform Bangladesh into a technologically advanced nation by 2041, known as Smart Bangladesh (Islam, 2022). Smart Bangladesh is an extension of the Digital Bangladesh Vision, encompassing a broader range of objectives. Smart Bangladesh would prioritize AI, robots, IoT, and cyber security as its primary focus areas (Bhuiyan et al., 2023). Nevertheless, there are several concerns that need to be addressed for the successful implementation of this plan.

Infrastructure development: Securing sufficient funds for infrastructure expansion, technology adoption, and capacity-building programs will be a problem. To address budgetary constraints, Bangladesh must explore novel financing strategies, engage in public-private partnerships, and foster international cooperation (Bhuiyan et al., 2023).

Digital divide: While digital expansion has significantly impacted several aspects of the lives of the Bangladeshi population, not all individuals are experiencing the advantages of this advancement in an equitable manner. The disparity in access to digital resources is impeding a sizable portion of the population, especially the disenfranchised (Singh & Thapa, 2023). As per the BBS's January 2023 study titled 'Survey on ICT use and access by individuals and households 2022', the internet utilization rate in rural areas was markedly lower compared to metropolitan areas. In contrast to people living in metropolitan areas, who used the internet 66.8% of the time last year, only 29.7% of people in rural areas did so (Bhuiyan et al., 2023).

Slow internet rate: The internet, which acts as the main driver of technological advancement in Bangladesh, nevertheless lacks in terms of speed and efficiency. According to Hossain (2024), a multinational company that specializes in internet speed analysis, Bangladesh's mobile internet speeds were the 111th fastest out of 142 countries worldwide in September 2023. Despite an improvement in average download speed to 38.65 Mbps and upload speed to 39.91 Mbps as of October 2023, Bangladesh's global position in broadband internet speed has declined. Bangladesh's global rating for broadband internet speed has declined from 102nd to 108th since November 2022. Bangladesh has a worse ranking than India (89th) and Nepal (87th) in terms of broadband internet speed in South Asia.

Skills development: Adept personnel are essential to fully exploit the potential of a smart nation. Bangladesh should prioritize the development of proficient workers who possess the necessary digital literacy to become intelligent citizens, as well as essential digital skills like coding, data analytics, and AI, to establish a society built on knowledge (Bhuiyan et al., 2023). Allocating funds to education and training programs that align with emerging technology is crucial to bridging the skills gap and ensuring a proficient workforce (Bhuiyan, 2023).

Power supply and reliability: Power and energy reliability are vital to Bangladesh's intelligent project execution. Intelligent technology like sensors, communication devices, and data centres need reliable electricity. The increased energy demand from these devices can strain the power grid (Ayyanar et al., 2021). Power grid reliability is typically limited in rural areas. Without energy infrastructure, intelligent solutions may be challenging to install and maintain, especially for power-dependent systems. Differences in energy availability between urban and rural settings can impede the installation of smart technology. Bridge this gap to provide fair and equitable access to resources and benefits in different regions. Bangladesh is vulnerable to cyclones and floods (Bhuiyan, 2019). For uninterrupted power provision, especially in critical situations, a resilient power infrastructure that can withstand and recover from such events is essential. A comprehensive approach is needed to address electricity supply and reliability challenges (Bhusal et al., 2020). Infrastructure investment, renewable energy, regulatory reforms, and community involvement should comprise this strategy. Smart initiatives in Bangladesh require a reliable power supply, which is crucial to the country's economic and social advancement.

Financial constraints: The successful implementation of Smart Bangladesh Vision 2041 will necessitate substantial financial resources. Securing sufficient funds for infrastructure expansion, technology adoption, and capacity-building programs will be a problem. To address budgetary constraints, Bangladesh must explore novel financing strategies, engage in public-private partnerships, and foster international cooperation (Bhuiyan et al., 2023).

4.2. Government strategies for implementing Smart Bangladesh

Creating a technologically proficient nation by 2041 requires integrating intelligent technology to improve economic success, education, healthcare, and governance (Molla et al., 2023). The first step is creating a national strategy that uses technology to improve the nation on a smaller scale. The strategy should include the country's strengths, weaknesses, and growth potential (Islam & Bhuiyan, 2022).

Understanding the current landscape: Bangladesh has many economic and social issues. Building an intelligent Bangladesh that can overcome these challenges is crucial. We must grasp the environment before starting this adventure. Economic issues like poverty, income inequality, and unemployment persist nationwide (Ali & Haque, 2021). Social issues, including high-quality education and healthcare, must be addressed. Strategically applying intelligent technologies can solve these issues. We can learn from successful smart city projects like Singapore, Dubai, and Barcelona. These cities use technology to improve living standards, boost economic growth, and promote sustainability. Bangladesh can learn from its experiences in building a Smart Bangladesh.

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E-government and digital services: E-government is essential to building a technologically advanced Bangladesh. The government should be in charge of digital services that encourage efficiency and transparency. This involves making government websites and apps user-friendly and tailored to citizen needs. The government needs digital identity systems for efficient services and citizen authentication. However, data security and secrecy are equally important to build public trust in these systems. E-governance reduces bureaucratic inefficiency and corruption, improving government and public service. Bangladesh may learn from Estonia and South Korea's effective e-governance models (Bhuiyan et al., 2023).

Education and digital literacy: To succeed in an intelligent future, Bangladeshis must prioritize education and digital skills. Technology must be integrated into the curriculum to improve schools (Islam & Bhuiyan, 2022). Teachers should be trained in digital technologies and pedagogies to ensure technology-driven learning. Equally important is digital literacy advocacy. Education and training can help all ages learn technology (Bhuiyan et al., 2023). Advanced software parks and upazila-level fibre access can boost digital literacy efforts. Education and digital literacy will be the driving forces behind the adoption of smart technology nationwide. Digital literacy makes people more open to technological advances and gives them the skills to use them for personal and societal advancement (Khanom et al., 2022).

Healthcare transformation: Healthcare reform is crucial to building a technologically advanced Bangladesh. Technology can improve healthcare accessibility, affordability, and quality. Technology allows telemedicine and remote healthcare to reach even the most remote areas of the country. This assures everyone, regardless of geography, access to healthcare. Through faster medical history retrieval and data-based diagnosis, electronic health records can improve patient care. Bangladesh may solve its healthcare issues with technology, improving residents' health. An intelligent healthcare system can reduce costs, improve patient satisfaction, and improve population health.

Fostering innovation and entrepreneurship: Promoting innovation and entrepreneurship is crucial for the realization of a technologically advanced Bangladesh (Khanom et al., 2022). The government can exert substantial influence by allocating financial resources and offering assistance to businesses and R&D endeavours. Initiatives such as Startup Bangladesh Ltd. exemplify a dedication to fostering a culture of innovation. Furthermore, the establishment of a conducive ecosystem for entrepreneurs, which includes incubators, accelerators, and favourable policies, can effectively propel technological progress. Promoting private sector investment in R&D is of equal significance, as it has the potential to result in groundbreaking innovations.

International funding: Partnerships with international organizations and foreign investments are essential for Bangladesh's technical advancement. Bangladesh can accelerate smart projects with foreign experience and resources (Bhuiyan et al., 2023). Collaborations with the United Nations (UN) and regional development banks can provide funding and expertise for smart initiatives. Partnerships with smart city nations can provide knowledge and best practices. Foreign investment in technology infrastructure, companies, and R&D could boost Bangladesh's technology. Bangladesh may expedite its smart nation development with international cooperation and financial resources.

Cybersecurity and data protection: Cybersecurity is crucial in the digital age to protect a technologically evolved Bangladesh. The nation's data and privacy must be protected as technology becomes more integrated into society. Strong cybersecurity rules and regulations mitigate risks and protect critical infrastructure. Government funding for cybersecurity measures like threat detection and incident response is needed (Islam & Bhuiyan, 2022). Public awareness and cybersecurity education are equally important. Citizens must be informed of the best ways to protect their internet safety and personal data. Training and initiatives can boost cybersecurity resilience in individuals and organizations. Bangladesh can build trust in the digital ecosystem by prioritizing cybersecurity and data protection to protect citizens' data and critical infrastructure.

4.3. Emerging technologies and Smart Bangladesh

The utilization of emerging technologies has the capacity to make a substantial contribution to the advancement of a technologically advanced Bangladesh by enhancing many sectors and elevating the standard of living for its inhabitants (Table 2). Presented below are many crucial developing technologies and their prospective implementations in constructing an intelligent Bangladesh (Table 2).

Table 2. A list of emerging technologies for transforming Smart Bangladesh

List of emerging technologies	*Implementation*	*Source*
The IoT	The IoT facilitates the connecting of devices, infrastructure, and services, enabling effective resource allocation, enhanced transportation systems, and improved public services. In Bangladesh, the IoT can be utilized for several purposes, including intelligent agriculture, advanced urban planning, efficient healthcare systems, and monitoring of the environment.	Kwon et al. (2022), Mittal et al. (2023)
Blockchain technology	Blockchain technology offers a reliable and easily understandable framework for conducting transactions, managing data, and verifying identities. Blockchain technology can be effectively employed in various sectors in Bangladesh, including financial services, supply chain management, land registration, and enhancing transparency in government procedures.	Chen and Zhang (2021)
AI and ML	AI and machine learning (ML) are advanced technologies that have the ability to automate operations, analyze large volumes of data, and offer intelligent insights. In Bangladesh, man-made AI and AI ML can be used in different areas like medical care diagnostics, predictive maintenance for infrastructure, smart energy management, and personalized education systems.	Perkowski et al. (2019), Madejski (2022)
5G network	The execution of 5G organizations can bring about improved information transmission speeds, diminished dormancy, and the capacity to accommodate a critical number of interconnected gadgets. This can facilitate cutting-edge applications such as self-driving cars, intelligent power networks, telemedicine, and immersive virtual reality encounters.	Çekerol (2020)
Robotics and automation technologies	Robotics and automation technologies have the potential to improve production, efficiency, and safety across several industries. These technologies can be implemented in manufacturing operations, agriculture, healthcare, disaster response, and infrastructure maintenance in Bangladesh.	Saha et al. (2024), Bhuiyan et al. (2024)
Cybersecurity	Cybersecurity is crucial as digital technologies become increasingly widespread. Implementing resilient cybersecurity measures and advanced technology is essential to safeguarding vital infrastructure, personal data, and the broader digital ecosystem in Bangladesh.	Kwon et al. (2022)
Big data analytics	The advent of the 4IR has laid the groundwork for significant enhancements in the practical execution of manufacturing and production processes. The initial industrial revolution occurred with the introduction of steam engines. Presently, in the contemporary age, computing technologies have generated vast quantities of data. In the era of Industry 4.0, we have a wide range of sensors available, including vision sensors and vibration sensors. Large amounts of information can be characterized by four key attributes, usually alluded to as the four verses: volume, velocity, veracity, and variety.	Choudhary and Bansal (2022), Kalsoom et al. (2020)

Source: Authors' elaboration.

5. CONCLUSION

The goal of this article is to transform Smarty Bangladesh into a technologically advanced and environmentally sustainable nation that effectively utilizes resources, encourages citizen involvement, and promotes economic growth. Within the framework of PRISMA, this review research aims to scrutinize the components, technologies, challenges, and government strategies involved in Bangladesh's transition to a technologically advanced state. Researchers employed the PRISMA approach to conduct a comprehensive assessment of pertinent publications and studies in order to properly examine the current state and future prospects of Smart Bangladesh. The researchers employed the PRISMA 2020 platform to find and choose previous relevant papers and reports from indexed publications, such as Scopus, Web of Science, PubMed, DOAJ, and other sources. The main discoveries of this study emphasize the significance of building a country that is both technologically sophisticated and environmentally sustainable, akin to the hypothetical nation of Smarty (Bhuiyan et al., 2024). Bangladesh has a comprehensive approach to technology advancement, resource utilization, public involvement, and government regulatory execution. The study evaluates the key components of a technologically progressive Bangladesh, encompassing the advancement of technology, challenges faced, and governmental strategies implemented to achieve this goal. The significance of this extensive assessment contributes to a more profound understanding of the possible prospects and challenges associated with the transition to a smart nation. This is due to the fact that it is a great tool for topic modelling. It is especially important to keep this in mind in circumstances in which the subjects are closely related to one another or overlap. As a result, it is conceivable that this will result in an absence of accuracy in the recognizable proof of subjects (Bhuiyan et al., 2023). The study was limited to investigating articles produced in the English language that were recorded by the most prominent data sets on the internet. In the future, researchers will conduct the study with some standard research models based on primary data on a large scale.

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