Review on IoT Cloud integration for Smart Cities

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Abstract:
Smart Cities has emerged as a result of rapid advancement in recent times. It aims to enhance urban life of its occupants by integrating IoT devices and cloud computing in urban infrastructure. As smart cities relies in interconnected IoT devices and cloud based platforms, the collection of data and management of data becomes a fundamental aspect to impact the efficiency of urban operations and services. This research proposal delves into the integration of IoT and Cloud computing technologies in smart cities, with a specifically focusing on education, tourism, transportation and waste management within the smart cities. This study also aims to assess the potential of IoT and cloud computing, providing an insight into the challenges and opportunities in smart education and smart tourism with the urban setting.

Keyword: *Smart cities, IoT, education, tourism, waste management, transportation*

1 Introduction:
Smart cities are urban residential region that make use of the technological advancement in information and communications technology (ICT) that tends to significantly improve the standards of living for its occupants[1]. Smart cities create a sustainable and efficient environment by integrating various types of sensors and IoT devices for better decision making. The integration of these IoT devices and cloud computing provides inputs and processing of information by these integrated sensors[2].

"Internet of Things" or "IoT" in short, in general refers to devices that have self configuring abilities within a dynamic worldwide network and are capable of smart interface and being integrated as an information network[3]. An IoT environment contains smart devices and sensors connected to internet for gathering information. These devices carry out most of the work without any human interaction. To further process the large amount of data gathered by these IoT devices cloud computing is needed [4].

Cloud computing supplies various computing and storage solution over the

internet as required.The public, private and hybrid clouds deployment models are used based on the setting and environment in which cloud computing services will be used[5]. Cloud service models, such as SaaS, PaaS and IaaS,offers varying levels of control over computing resources. The fluidity of these models allows clients to choose the service that aligns to ones requirement. These model plays a crucial role in enhancing cloud security for both cloud security providers and clients [6].

2 Literature Review:

2.1. Education:

In context of smart cities education can be labelled as "smart education" [7]. "Smart campus" emerged to elevate the overall experience by integrating the advance technologies [8].The concept of smart campus contains four components, Infrastructure, Governance & Management, Services and Education[9]. Deep understanding of smart campus infrastructure is essential in addressing its challenges like security, privacy, reliability, and scalability when integrating IoT and cloud technologies.Educational institutions enhance student learning experiences by combining technologies like learning management system and content management system, efficiently organizing course materials and distributing educational content. The integration of these technologies facilitates personalized and interactive learning, while also monitoring every individual student progress[10]. Most smart learning environment mainly focuses on teaching methodologies that are according to student's individual preferences, which can be challenging due to individual differences. Introduction of e-learning platforms integrated with IoT sensors allows the collection of various types of data, facilitating automatic classification of students and tracking their performance for future reference [11].

2.2. Tourism:

Over the past few decades, tourism industry has seen a rapid growth. By transforming traditional tourist destinations into smart tourist hubs, smart cities leverages information technology to enhance tourist's experience. This emphasizes on the importance of importance of sharing information to significantly improving decision making process and elevating the tourist industry [12]. Smart tourism focuses on leveraging smart technologies throughout the pre-travel, onsite travel and post-travel evaluation stages, adapting to traveller's behaviour and expectation to elevate their experience [13]. To further enhance this experience an IoT enables tourist attraction recommendation system is used which employs deep neural network for recommendations, covering pre-travel and onsite exploration within the smart city [14]. Following a proposed framework of "Point of Interest (POI) recommendation method based on 5G and AI-empowered IoT", which facilitates application like self-guided tours, electronic navigation and smart shopping guides [15].

2.3. Transportation:

Transportation is a crucial aspect of smart cities, addressing traffic challenges and promoting environmental sustainability, safety and urban accessibility. A study introduces paper "Smart Transportation System using IOT" presents a "Smart Vehicle Assistance and Monitoring System (SVAMS)" to address traffic issues and improve the overall driving experience [16].A "Smart Vehicle Assistance and Monitoring System (SVAMS)" combine real time traffic monitoring, vehicle tracking and emergency assistance services to enhance

transportation system safety and efficiency. It also addresses the issue of parking space management in smart cities by proposing IoT enabled smart parking solutions designed to optimize space utilization [17].

2.4. Waste Management:

Waste management has emerged as a major challenge in the development of smart cities due to rapid urbanization leading to increased pollution. In smart cities various types of waste such as electronic, medical, industrial,biodegradable, plastic, and food waste contributes to environmental degradation and disrupts natural ecosystem [18]. The rapid growth of population in smart cities is a major contributing factor in increased waste production, but the use of IoT devices offers efficient solution to manage waste effectively and promoting sustainability in urban environments. Smart garbage bins equipped with sensors enables collection vehicles to optimize routes based on fill levels, therefore enhancing waste management efficiency. The increase in the use of technology in waste management system contributes to a more sustainable development[19]. This technology enables the efficient management of in the rural areas as well where waste management poses a major challenge.

Name of Paper	Author's Name	Year	Advantages	Limitations
"Cloud-Based IoT Applications and Their Roles in Smart Cities" [1]	"T. Alam"	2021	Cloud based IoT technology enables smart city environment.	
"Role of IoT-Cloud Ecosystem in Smart Cities : Review and Challenges" [2]	"R. Rani, V. Kashyap and M. Khurana"	2022	Discusses IoT and Cloud ecosystem that's transforming cities into smart cities	Less emphasis was given on real time systems.
"The internet of things: a survey" [3]	"S. Li, L. D. Xu and S. Zhao"	2015	Significant role of IoT in service oriented architecture.	
"A review and state of art of Internet of Things (IoT)" [4]	"A. A. Laghari, K. Wu, R. A. Laghari, M. Ali and A. A. Khan"	2021	Discusses IoT in detail mainly how sensors are an important part of IoT.	Concerns regarding security and privacy of IoT applications.
"A survey of fault tolerance in cloud computing" [5]	"P. Kumari and P. Kaur"	2021	Paper explores cloud in detail and how fault tolerance policy makes cloud computing reliable.	
"A Systematic Literature Review on Cloud Computing Security: Threats	"B. Alouffi, M. Hasnain, A. Alharbi,	2021	Mainly explores the several security risks involved in cloud computing.	Concerns revolves around proper implementation of security

and Mitigation Strategies" [6]	W. Alosaimi, H. Alyami and M. Ayaz"			policies.
"Smart cities education: An insight into existing drawback"s [7]	"A. Molnar"	2021	Explains how education is an important part of smart city.	Lack of initiative in education.
"Smart University: A Review from the Educational and Technological View of Internet of Things" [8]	"D. Rico-Bautista, Y. Medina-Cárdenas and C. D. Guerrero"	2019	Analysis the ecosystem of smart university and policies of implementing these technologies.	Lack in the standardization in implementing smart technologies.
"Role of cloud computing in management and education" [10]	"A. Gupta, B. D. Mazumdar , M. Mishra, P. P. Shinde, S. Srivastava and A. Deepak"	2023	Shows how ICT and cloud computing is changing the educational landscape.	Lack in proper policy making for implementing these technologies.
"IoT enabled e-learning system for higher education" [11]	"K. Kumar and A. Al-Besher"	2022	Highlights the importance of IoT in learning.	
"SMART CITIES TO SMART TOURISM DESTINATIONS: A REVIEW PAPER"[12]	"A. Jasrotıa and A. Gangotıa"	2018	Explains in detail how smart city act as a prerequisite for establishing smart tourism.	
"Smart Tourism City: Developments and Transformations" [13]	"P. Lee, W. C. Hunter and N. Chung"	2020	Emphasizes on how ICT improves the living environment and improves the standard of living in these smart tourist destination.	Limited knowledge in designing a sustainable smart tourism city.
"Deep learning and Internet of Things for tourist attraction recommendations in smart cities" [14]	"J. C. Cepeda-Pacheco and M. C. Domingo"	2022	Recommended a tourist attraction recommender system that uses deep neural network for recommending activities and tourism sites.	
"Smart	"Deeplax	2021	1. Gain knowledge about the	The SVAMS can

Transportation System Using IOT" [16]	mi V. Niture, Vivekanand Dhakane, Piyush Jawalkar, Ankit Bamnote"		Smart Vehicle Assistance and Monitoring system (SVAMS) and how it can address traffic-related issues through an intelligent transportation system. 2. Learn about the various components of the SVAMS, such as the Zigbee module, GPS module, and cloud server, and how they work together to provide real-time monitoring and assistance to vehicles.	be integrated with smart city initiatives to provide a more comprehensive and sustainable transportation system.
"Smart Transportation System Using IOT" [17]	"Saarika PS,Sandhya K,Dr. Sudha T"	2017	1. Improved traffic flow and reduced congestion 2. Enhanced safety for drivers, passengers, and pedestrians	1. High implementation costs 2. Dependence on reliable and secure communication networks
"IoT based Waste Management for Smart"[18]	"Padmakshi Venkateswara Rao, Pathan Mahammed Abdul Azeez, Sai Sasank"	2020	1. Improve public health: waste management helps to prevent diseases. 2.cost efficient	
"Cloud-based Smart Waste Management for Smart cities" [19]	"Mohammad Aazam, Marc St-Hilaire, Chung-Horng Lung"	2016	1. Efficient waste collection: This system allows real time monitoring of the bins. 2. This system enables waste collectors to plan better and fuel-efficient routes and also reduces unnecessary visits and optimizing resource management. 3. Smarter handling and disposal of waste	1. The proposed system is designed for urban areas and may not be suitable for rural or remote areas

3 Proposal:

Smart cities will see an enormous increase in innovation in every field, as the IoT and cloud technology continues to grow at a fast rate. Developing a smart learning environment enhances the learning experience of individuals based on their preference. IoT technology can provide seamless communication among students and educators. Many studies mainly

focuses on the teaching and learning methodology and very fewstudies have focused on management and governance aspect of smart education. Smart education also involves dealing with management and governance factor to effective deployment of educational technologies. These management and governance aspects include factor such as, resource management, data privacy, policy development, among others.

In peak season when there is a rush of tourist in these cities there appears a disruption in normal transportation and parking demands within the smart city. In response to this growing demand, a parking reservation service model that reserves the parking space in advance that include an OTP validation method in this parking reservation service model. This model will allow users to reserve and view the availability of parking spots in real time. The inclusion of OTP validation method will ensure that only the authorized user may occupy the spot designated to them. This validation method willaid in upholding the simplicity, effectiveness and security criteria.In the event of an unauthorized access to the designated parking spot, fines may be imposed to discourage the unauthorized use of the facilities.

4 Conclusion:

This research provides an insight into how IoT and cloud computing helps in enhancing in smart cities. It holds a vast potential to transform various sectors, including education, tourism, transportation and waste management. These technologies enable the efficient urban environment that enhances the quality of living.

The smart learning environment aims at traditional teaching and learning methodologies by providing personalized learning experiences that are according to individual preferences. And addressing a notable gap in management and governance aspect in smart education will be significant in ensuring efficient and sustainable deployment of educational technologies by managing the factors such as, resource management, data privacy and policy development.
By addressing these factors institution can effectively implement smart education initiatives and maximizing the benefits from these technological innovations.

Furthermore, the challenges posed by the increase in tourism activities and transportation demand in smart cities, a IoT enabled parking reservation service model can help lighten the excessive load and enhance the visitors experience. The addition of OTP validation system in this service model will ease up the parking process and will also ensure the security and accessibility of users.

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