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MODELLING OF A SMALL SCALE SMART REAL ESTATE PROJECT OF 50 DECIMAL PROTOTYPE-LAND: TRANSFORMATION INTO SMART CITY FOCUSING DEVELOPING COUNTRIES

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Abstract

Implementation of the smart city concept now becomes a global challenge across the world. Countries like Singapore, South Korea, and Malaysia have already taken initiatives to transform few of their places and states into smart cities. Most of the countries are still researching on how to implement the cutting-edge advanced technology in urbanization. In this article, a technical investigation is made is on seven multinational companies that are working on various projects on smart cities in different countries. Moreover, research on smart city features has been conducted on three countries namely Singapore, Berlin and Seoul. Next, the entire smart city concept has been segmented into four parts, the details of which have been provided in infographic format. After that, focusing developing countries, Bangladesh has been used as a reference country and the regulatory clauses and facility requirements have been explored and given. Based on that 2D and 3D modelling of a real state land of 50 decimal in a place of Bangladesh owned by Matribhumi Developer and Properties Limited have been designed in accordance with the model town rules and regulations of the government bodies of the country. Lastly, the entire small scale prototype project has been modelled into Smart City with IoT, Sensors, Distributed Renewables, Smart Communication and other essential parts. Other features such as road mapping, traffic circulation, sustainable and renewable platforms, environmental management and smart building management network have been proposed for that smart city with limitations and future work.

Keywords: Smart city, Smart city framework, Smart Real-estate, Smart Urbanization.

1. Introduction

Sustainable cities are currently a goal of future urban development, which is strongly desired. In wealthy countries, the concept of a "smart city" is not new, yet it is still mostly unfamiliar to most people in developing nations. The main components of making a city smart in terms of its administration, mobility, environment, and quality of life include being technologically intelligent, going through the process of automation to make life simpler with a cleaner and greener approach, and having these characteristics in plenty. By monitoring phenomena or other interesting objects, scientists and engineers may make informed decisions that are then used to develop intelligent cities [1-5]. However, creating a workable and affordable plan for urbanizing into smart cities is now necessary, especially for emerging nations.

This study identifies a vacuum in the literature on the provision of detailed instructions to the real estate sector on how to construct a smart city on a barren piece of land. The purpose of this article is to offer an examination of the technical details and relevance of actual examples of smart cities, which various international real estate businesses have chosen to take on as projects in various regions of the world. Additionally, the writers like investigating and contrasting the characteristics of smart cities in a few other nations. Additionally, the research will attempt to incorporate all of the parts and smart city aspects into the suggested modelling. The entire Matribhumi Developers and Properties Ltd. project in Sirajdikhan, Bangladesh is the focus of this research, which is being carried out jointly by the Center for Research and Innovation (CRI), Canadian University of Bangladesh, Matribhumi Group, and iCeOne. It aims to use the prototype land of 50 Decimal0.5 Acre of the project for modelling and designing a smart city with cutting-edge technology.

The developer company's actual constraints will be discussed as part of the modelling process to provide the researcher insight into this real estate sector. The modelling will include a thorough examination of the minimal needs for lands, permissions from relevant authorities, greenery requirements, smart facility requirements, and assistance.

2. Smart Real State Project (SRxP): Case Analysis

2.1. Case 1 : Penang International Commercial City

Introducing Penang International Commercial City, the future center of commerce (PICC). PICC combines digital, architectural, and landscape advancements to highlight better luxury living and eco-friendly lifestyles. Every lifestyle dream can be realized in this location, just outside your front door [5]. Table 1 describes the Penang International Commercial City origin, company profile, current status, duration, and features [5].

Table 1. Penang International Commercial City.

Origin	Malaysian island of Pulau Pinang Lot 6029, Jalan Tun Dr. Awang, Mukim 12, Daerah Barat Daya [5].
Company Profile	Hunza Group's project, Penang International Commercial City, is renowned throughout the nation for its high standards of quality and customer service [5].

Current Status	It serves as a new symbol of Penang's dynamic culture and cutting-edge creativity in the northern part of Malaysia. PICC will usher in a new era of global living with first-rate infrastructure, strategic connection, and integrated convenience with a smart and green concept [5].
Duration	The first two phases are finished, and the third phase will be turned over in 2026 [5].
Features	-Intelligent security, a strong community, and -integration with nature -A constant connection between all of its important spaces [5].

Figure 1 shows the proposed PICC city which is situated in Malaysia.

Fig. 1. Proposed PICC, Malaysia [5].

2.2. Forest City in Johor Bahru - Malaysia

In Johor Bahru, Malaysia, there is a project for a smart, green metropolis called Forest City. The project's aim is to create sustainable approaches that will enable coexistence between the city and its surroundings with amenities like hotels, resorts, and opulent residences, the city was designed with a population capacity of about 700,000 [6]. Figure 2 shows the Forest city in Johor Bahru, which is situated at Malaysia.

Fig. 2. Forest city in Johor Bahru, Malaysia [6].

Table 2 shows the Forest city in Johor Bahru origin, company profile, current status, duration, and features [6].

Table 2. Forest City in Johor Baru - Malaysia

Origin	Johor Bahru, Malaysia
Company profile	The Together with Esplanade Danga 88 Sdn Bhd, Country Garden Group, which is supported by the Malaysian government, jointly created the project (EDSB). A 30 sq km man-made island called Forest City blends cutting-edge technology with the natural environment to create a highly advanced living environment [6].
Current status	On one of the four reclaimed islands of Forest City, towering residential structures can be seen. Compared to the original objective of 700,000, Forest City had fewer than 500 residents as of 2020 [6].
Duration	By 2035, the project should be finished with development [6].
Features	Innovative smart city applications, such as green drip the smart building system incorporates irrigation systems, building automation systems, intelligent security systems, smart meters, emergency systems, and community robots. These technologies include artificial intelligence (AI), the Internet of Things (IoT) sensing platform, and BIM (AI) [6].

2.3. Punggol Digital District- Singapore

PDD will serve as a showcase for how integrated master planning and technology may assist local districts attract talent and stimulate innovation while also helping to build a more living and sustainable environment for the community as Singapore moves toward becoming a Smart Nation [7]. Figure 3 shows the Punggol digital district, Singapore.

Fig. 3. Punggol digital district, Singapore [7].

Table 3 shows the city of Punggol digital district Origin, company profile, current status, project duration and feature 3[7].

Table 3. Punggol Digital District – Singapore.

Origin	Ponggol is a district in Singapore's northeast located on the Tanjong Punggol peninsula [7].
Company Profile	Punggol Digital District (PDD), Singapore's first entirely smart district, is made up of the Singapore Institute of Technology (SIT) campus and the JTC Business Park located in Punggol North [7].
Current Status	In 2022, One Punggol Hub will debut, featuring a 34-stall hawker center and a five-story library [7].
Duration	Starts in 2024 [7].
Features	District Cooling System - Centralized Logistics Hub - Pneumatic Waste Collection - Open Digital Platform - Smart Energy Grid [7].

2.4. G Square City- Tamil Nadu

The first integrated smart city in Tamil Nadu, G Square City is being hailed as a smart community project with plans for a school, hospital, bank, mall, and convenience store [8]. Figure 4 the G square city at Tamil Nadu [8].

Fig. 4. G Square City - Tamil Nadu [8].

Table 4 shows the city of G square Origin, company profile, current status, project duration and feature.

Table 4. G square city- Tamil Nadu.

Origin	Tamil Nadu
Company Profile	G Square City, the first and only integrated smart megacity in Coimbatore, is where people will live in not just the South of India but also in the future. It is a subsidiary company of the G Square group [8].
Current Status	They have currently finished 30% of their project, and 70% will be finished by 2030 [8].
Duration	Project completion is scheduled for 2030 [8].
Features	Visitor management software - License plate readers for cars - Internet of Things-based power, fire, and security system monitoring - E-charging station, Smart bike racks, Surveillant app, Building System, Wi-Fi in Common Areas [8].

2.5. Songdo- Republic of Korea

The smart city project in Songdo International City is carried out in accordance with meticulous and rigid guidelines. Foreign IT, BT, and R&D business is handled by Songdo, aviation logistics, tourism, and recreation are the purview of Yeongjong, and international finance, high-tech industry, and distribution are the purview of Cheongna [9]. Figure 5 the Songdo smart city at Republic of Korea [9].

Fig. 5. Songdo Smart City [9].

Table 5 shows the city of Songdo Republic of Korea Origin, company profile, project duration and feature [9].

Table 5. Songdo- Republic of Korea.

Origin	Southwest of South Korea's Incheon Metropolitan City [9].
Company Profile	As a component of the Incheon Free Economic Zone, Songdo developed into one of Korea's most famous new smart city town is a South Korean government initiative [9].
Current Status	This new city is currently working to establish itself as a global leader in smart cities by actively conducting business conferences and luring IT, BT, and R&D-related facilities to the area [9].
Duration	2008 to 2017 [9].
Feature	Transportation, Disaster preparedness and mitigation - Environment and community engagement - RFID/USN technology, U-bike, U-street, - Unpaid tax cars [9].

2.6. Namyangju- Republic of Korea

The 650,000-person Namyangju metropolis in the Republic of Korea located 25 kilometres north of Seoul. Namyangju has been aggressively developing the smart city project since 2008 with the aim of being a low-carbon green transportation city by 2020. Due to recent rapid population development and extensive housing construction, the city's crime rate has surged by 50% over the past five years while public transportation use has increased to 60%. In response to these social needs, the Namyangju smart city project was launched, with an emphasis on implementing intelligent transportation systems and preventing crime technologies [10]. Figure 6 show smart city of Namyangju at Republic of Korea.

Fig. 6. Namyangju City [10].

Table 6 shows the smart city of Namyangju republic of Korea Origin, company profile, project duration and feature.

Table 6. Namyangju- Republic of Korea [10].

Origin	In the northern-east corner of Gyeonggi Province is the city of Namyangju [10].
Company Profile	The goal of Namyangju City's smart city project is to build a "Citizen Participating Safe City" with the aid of pervasive computing [10].
Current Status	After completing the initial and growth phases of the smart city project, Namyangju has now reached the maturity stage. The implementation of smart city infrastructure is the city's current top priority in order to provide more beneficial and efficient smart city services in a stable and efficient manner [10].
Duration	2008 to 2020 [10].
Feature	existing road Residents may choose the optimal route in real-time thanks to specialized mobile services that make CCTV photos, traffic information, and incident information on regularly travelled routes available. The city provides services like notifying the caregiver of the senior resident's bus arrival time and sending out an emergency alert when the elderly leaves the protected zone in order to protect the safety of its sizable senior population. Bus stops are equipped with contemporary crime prevention technology, such as CCTV and emergency bells. The multipurpose "smart pole," another creative solution offered by Namyangju, combines a street light, CCTV, and traffic signal to encourage effective use of a roadside amenity. The Namyangju City smart city initiative's three categories have been broken down and put into action. The programs known as "Ubiquitous," "Intelligent Transportation Service" (ITS), and "Bus Information Service" (BIS) [10].

2.7. Fujisawa Sustainable Smart Town-Japan

Fujisawa Sustainable Smart Town (Fujisawa SST), a projected smart city project, was developed by Panasonic and other partner businesses in Table 7. It is formally a part of the Fujisawa neighbourhood and is situated in the Japanese prefecture of Kanagawa, around 50 kilometres from Tokyo [11]. Figure 7 show smart city of Fujisawa sustainable smart town in Japan.

Fig. 7. Fujisawa sustainable smart town-Japan [11].

In the given Table 7 describe the smart city of Fujisawa sustainable smart town Japan details like Origin, company profile, project duration and feature [11].

Table 7. Fujisawa sustainable smart town-Japan.

Origin	The Fujisawa Sustainable Smart Town region is located in Japan's Kanagawa Prefecture, around 50 kilometres from Tokyo [11].
Company Profile	The business and public sectors are working together on the Fujisawa smart town project. With an experimental and citizen-centric approach, the project is sponsored by Panasonic and two other local businesses with the goal of developing technology to lessen the influence of humans on the environment [11].
Current Status	After the Fujisawa SST is finished, the town will grow for 30 years, reach maturity for 30 years, and then continue to expand for another 30 years. Construction on the project began in 2008, and it will be finished in 2048 [11].
Duration	2008 to 2048 [11].
Feature	• Users may track their usage time and obtain authorization by just touching a specific card to any available vehicle; Battery technology • Smart network management Solar panels; Self-driving delivery vehicles • High energy density battery production; earthquake-resistant buildings, Electric vehicles and bicycles, Surveillance systems • Robotic automata for home delivery inside Fujisawa SST [11].

3. Smart City Features in Different Countries

Table 8 describes the Smart city features in the selected countries.

Table 8. Smart City features in selected countries.

Country	**Features**
Berlin	1. Power source 2. Systems for removing waste 3. Urban society and smart administration

	4. Intelligent living, mobility, the economy, infrastructures, and public safety.
Seoul	1. Citizen-driven digital governance is the first
	2. Entrepreneurship
	3. The digital business environment
	4. Using digital technology to address urban challenges.
	5. Providing real-time bus timetable information to public transportation.
	6. Access to free Wi-Fi.
Singapore	1. Every resident will have access to an app that lets them keep tabs on their water and energy use.
	2. Stations for charging electric vehicles
	3. A sufficient water supply
	4. ensured provision of electricity
	5. Sanitation incorporating solid waste management, effective public transportation, and urban mobility IT connectivity and digitization that is robust
	6. Its healthcare system was digitalized
	7. Intelligent Transportation System
	8. Taxi taxis contain a network of sensors, cameras, and GPS equipment that monitors traffic.

4. Modelling of Proposed Smart City: Focusing on Small Scale Land of 50 Decimal

4.1. Road networking and traffic circulation

Figure 8 shows the smart city road networking and traffic circulation system.

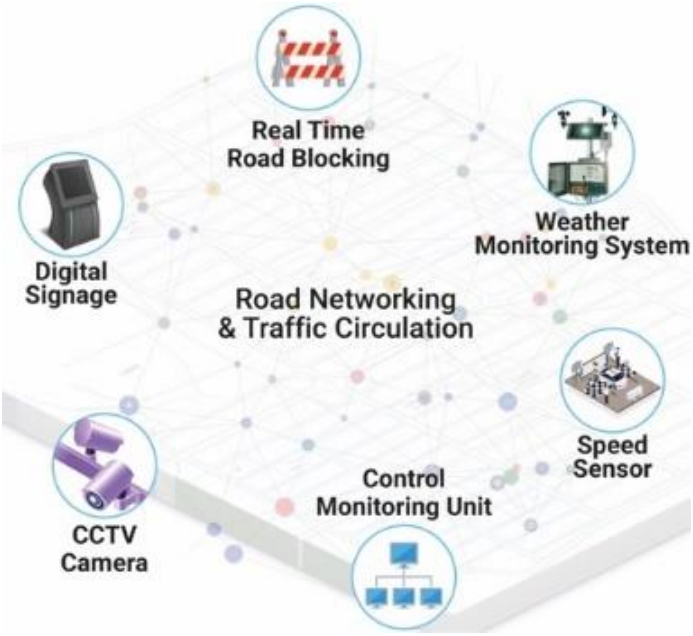

Fig. 8. Road networking and traffic circulation.

4.2. Sustainable and Renewable Platform

Figure 9 shows the sustainable and renewable platform of a smart city.

The term "distributed renewable energy technologies" describes the addition of generators to the current network of the conventional power system, particularly at locations closer to the load. Various renewable energy sources can be used to power these generators. We are adopting this technology in our planned project in Bangladesh as distributed energy technologies are becoming more and more significant in the energy supply systems of many nations. Distributed renewable energy systems will provide energy that is used to power, cook, heat, chill, and distribute services in our city without relying on any centralized infrastructure.

Fig. 9. Sustainable and renewable platform.

4.3. Smart building management

Figure 10 shows the smart building management system of a smart city of a proposed city.

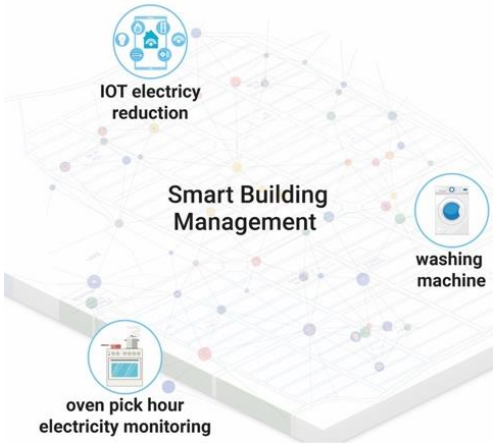

Fig. 10. Smart building management system.

Table 9 shows the smart living features of a smart city such as parking navigation system with video, cleaning based on demand networks of IoT sensors, self-registration of visitors and so many things.

Table 9. Smart Living Segment features.

Parking navigation systems with video	Utilizing a network of cameras to monitor available space, video guidance systems guide vehicles with the help of straightforward digital signage.
Cleaning based on demand	Demand-based cleaning systems can send SMS and email notifications to clean staff's phones to alert them in real time when a restroom genuinely requires cleaning.
Networks of IoT sensors	Real-time environmental data, including occupancy, light level, humidity, and temperature, are provided via high density networks of Internet of Things (IoT) sensors.
Self-registration of visitors	Visitors to a building can self-register their arrival using self-registration kiosks. The visitor's identification or passport is required to pass through the security turnstile and to utilize the elevator to reach their desired floor.
Analytics for the video surveillance system	Pattern recognition is used by video analytics (VA) systems to 'watch' live CCTV video streams, spot suspicious behaviour, and send security personnel to the scene via SMS or other communications channels to act. VA is frequently used to identify intrusions as well as health and safety issues, such as kids going backwards on escalators.
Creating mobile apps for users	Users are able to communicate with their building directly thanks to apps for tablets and mobile devices. Users can adjust local space, lighting, and temperature, reserve parking spaces or meeting rooms, report damages, and more by using the apps that connect to servers connected to the Building Management System, Carpark Management System, and other sub-systems. Users are able to communicate with their building directly thanks to apps for tablets and mobile devices. Users can adjust local space, lighting, and temperature, reserve parking spaces or meeting rooms, report damages, and more by using the apps that connect to servers connected to the Building Management System, Carpark Management System, and other sub-systems.

4.4. Smart security and network

Figure 11 shows the smart security and networking system of a smart city.

Fig. 11. Smart security and network.

4.5. Environmental management

Figure 12 shows the Environmental management of a proposed smart city.

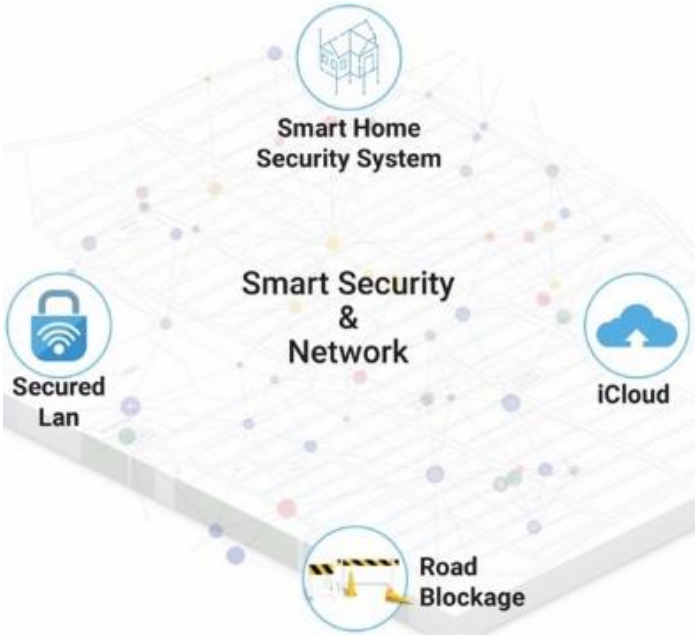

Fig. 12. Environmental management.

5. Proposed Modelling and Design Framework of 50 decimal Small Scale Smart Real Estate Project: Part of Smart City, Reference: Bangladesh.

Table 10 indicates Certificate of Approval and Facility Support: Case Study-Bangladesh, the numbers are indicating the approval, certificates and regulatory body certificate for a real estate model town and the facility are the mandatory parts of a city [13-19].

Table 10. Minimum requirements for a model Town: Reference- Bangladesh.

Requirements	Approval Authority
Trade License	Local government [13].
TIN Certificate	National Board of Revenue [13].
VAT certificate	National Board of Revenue [13].
Certificate of Incorporation	RJSC [14].
Membership	Bangladesh Land Developer Association [15].
EIA Certificate	Department of Environment [16].
ISO 9001:2015	ISO [17].
National Housing Authority-Certificate	National Housing Authority (NHA) [18].
RAJUK Permission	Rajdhani Unnayan Kartipakkha (RAJUK) [19].
Membership	Real Estate and Housing Association of Bangladesh.

A smart city facilities and regulatory part are shown in Fig. 13.

Fig. 13. Facilities and regulatory part of a model town.

Modelling of the 50 Decimal Real Estate Project: Shirajdikhan, Munshiganj, Bangladesh by Matribhumi Real Estate Developer.

A real modelling has been done from the Authors of Matribhumi group who are on the process of designing one of the 1st smart cities of Bangladesh. In accordance with the rules and regulation of the country, 30% greeneries, facilities described in Fig. 8 after getting all the 10-approval mentioned in fig.8, Bangladesh authority will allow to build a model town, a modelling of which has been created in fig. 15 in our research. Fig. 16 shows the building story height regulations as per the land size and the design showcase all the facilities and greeneries which have to be implemented as per the governing bodies of Bangladesh. Figure 13 shows the modelling of the small-scale real estate project with all the smart city features and amenities which will be implemented step by step after the land development, demarcation, road and building construction.

Figure 14 shows the 50 Decimal Real Estate Project of Shirajdikhan, Munshiganj at Bangladesh.

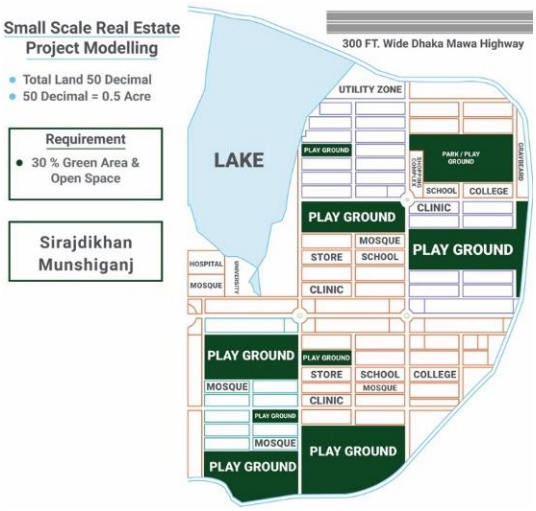

Fig. 14. Small scale real estate project.

6. Limitations

There are some limitations to starting a smart city in Bangladesh which are as follows: a) Start a city by purchasing 10-acre land at a time. Delay to get the city's permission and approval. b) Lack of social control Limited c) difficult to create trust with clients as the market is already disturbed by fake/corrupted companies. d) Fund limitation. e) There is less outreach and branding to senior citizens, and it is very difficult to reach them in this post-pandemic situation because they are not up to date with current events. f) For lack of knowledge, initiators cannot start the proper way. That is why they face lots of problems, and sometimes they fail. For that reason, clients don't want to believe the Real Estate Company and project. Figure 15 shows the proposed 50 decimal real estate small scale smart city project in Shirajdikhan, Bangladesh.

Fig. 15. 3D modelling created by this research with facility and building story height for the proposed 50 decimal real estate small scale smart city project in Shirajdikhan, Bangladesh by Matribhumi Developers.

Figure 16 shows the proposed smart city planning in 50 decimal real estate project.

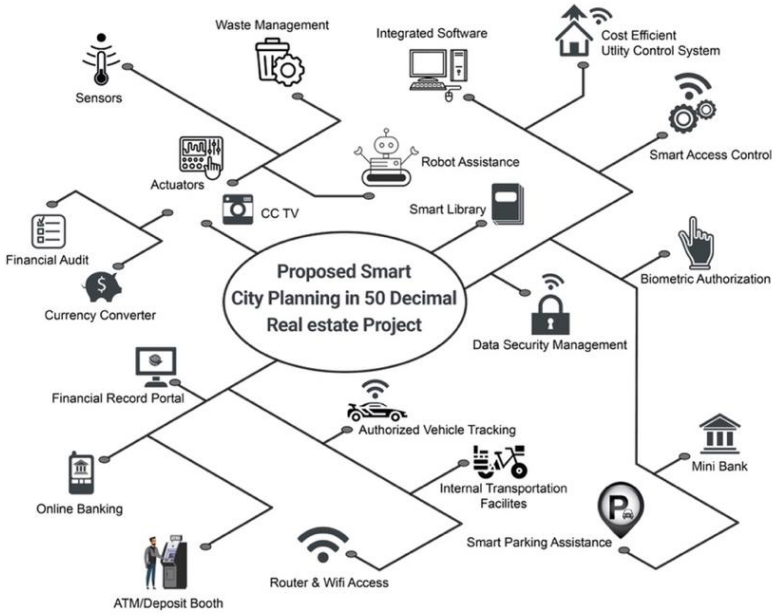

Fig. 16. Implementing smart features for modelling of the 50 decimal small scale smart city project.

7. Conclusion

To recapitulate, the paper successfully provided the technical insight and features of 7 smart city projects and explored 3 countries followed by the segment formations of the smart city based on the findings. The paper also investigated all the regularity body concerns and their approval requirements as well as the facility and support required for a model town focusing developing countries, reference Bangladesh in a systemic approach with info graphic diagrams. Lastly, in reference to Bangladesh, after portraying the rules and regulations of smart real estate project with required amenities and facilities being investigated, the 2D and 3D modelling, and design have been provided in real for a small 50 decimal land project with smart city concept implementation. Limitations and future work have also been described accordingly.

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