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# Path to Urban Sustainability by use of IoT

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## **Abstract.**

As the demand for good governance and smart cities has grown, so has the desire for the use of new technology, software, and procedures to achieve a more effective approach. The Internet of Things (IoT) is one such example of a driving scientific approach to smart city implementation. This paper will cover the IoT, smart cities, and technological advancements such as Big data and other analytical tools in order to synergize and optimise their use in decision making process. Moreover, the existing usage of IoT around the world will be discussed and the challenges associated with it. As urban planning has vast umbrella of domains which comes into conjunction of people, services, decision makers and the many more, there is a high chance of dynamic data and changing of technologies. Thus, a more efficient way in progress of such application in sustainable manner with real time scenario has to be envisaged. Studying of opportunities and challenges in sustainable urban development and IoT shall facilitate conjunction of various sectors with urban planning.

**Keywords.** Internet of Things, Big Data, Smart Cities, Sustainability, Urban Planning.

## **1. INTRODUCTION**

Sustainable urban and rural planning is a given. The notion of sustainability has evolved to a new degree of development with the rapid expansion of articles related with the Internet and growing awareness of IoT. Many critical issues of urban upkeep, for example, waste management and climate change, may be resolved with IoT for the benefit of humanity [1]. Surprisingly, the number of themes popular in cyberspace has overtaken the global population. The number is predicted to reach 50 million by 2020, as new technology enriches the digital environment [2]. It is a novel idea that combines several achievements to give a holistic foundation for urban regions. This paradigm envisions focusing on personal and resident pleasure. This portion of Smart Cities focuses on the sustainability objectives in metropolitan areas. It also helps individuals in sectors like medical services, transportation, and crisis response to man-made and apocalyptic catastrophes when humans struggle to determine. “**Concept of Internet of Things (IoT)**” – is a rich amalgamation of a wide variety of gadgets like computer peripherals, sensors along with other software mechanisms which endows an advanced substitute to the standard guidelines and associations. “**Pathway to Smart Cities through IoT**” – By the implementation of IoT and services, a smart city can be accomplished. Suppose, with the use of Iot fundamentals, at the cheapest rate a smart city can be designed having the utmost possible efficacies.

IoT allows an object to hear, see, tune in, and communicate all of these capabilities. Making common items smarter by linking their ubiquitous and indispensable processing to installed devices (such as mobile phones or tablets), communication advances and sensor networks together with Internet protocols and applications. This alters behaviour. Currently, the Internet is not considered a computer network. It will be linked to billions of smart devices and implanted frameworks. Because of this, the Internet of Things (IoT) will expand in size and breadth, presenting new possibilities and difficulties. Many countries have created long-standing public IoT execution systems after completing the elusive administrative level. So, for example, Japan's internet connection allows for the development of a correspondence office [3]. We plan smart cities' characteristics and key components like intelligent lighting and smart water supply. Infrared cameras, GPS systems, and other devices will be utilised to progress the city. Information security is one of the smart city problems [4].

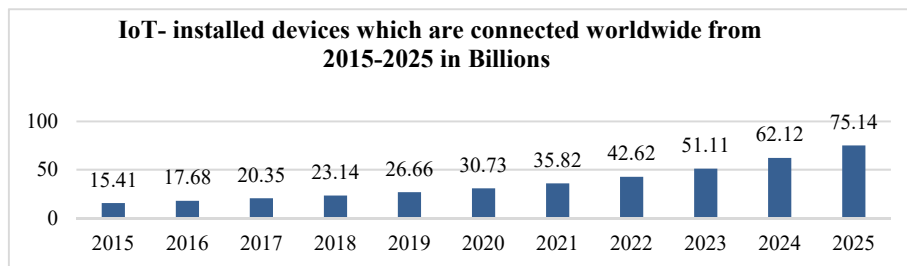
## 2. BACKGROUND

This section introduces ideas for future standards like IoT and Smart Cities. It contributes to the notion of sustainability by describing how computing connects IoT and Smart Cities.

### 2.1. Smart Cities and IoT

During 1990's, the phrase "Smart City" was coined. At that phase, the concentration was on the influence of innovative IT guidelines on the existing city guidelines [5]. "The label "smart city" is used interchangeably with similar terms like "intelligent city" or "digital city" [6]. The notion of Smart Cities has recently garnered significant appeal owing to its potential to help citizens and humankind as a whole. ITC research defines a "smart viable city" as one that integrates both ICTs and other planning techniques, yielding over 120 definitions. To better fulfil oneself, one must also improve one's knowledge of urban activities and government, while addressing current and future financial, social, and environmental issues [7]. The following figure shows that the quick expansion will expand the utilisation of Internet of Things (IoT) by several folds up to 75% till 2025 [8].

Figure 1: IoT- installed devices connected worldwide.



About half of the all-out total populace lives in metropolitan regions forecasted to rise about 70% in 2050 [9]. So, as the urban population grew, the administrations provided to them diminished in both quantity and quality. With a growing population, governments must find ways to provide future places for citizens. So they centre their financial improvement strategies on establishing advanced frameworks to compete. In addition to legislators, citizens are concerned about their future personal fulfilment [10]. For a smart city, existing

research shows distinct transportation viewpoints that should be implanted. A cohesive structure and framework should be created by integrating information into sub-frameworks such as education and waste management [11] & [12]. Cities are also awash with big data, which is derived from sensor data. The Hadoop frameworks are used to manage the data. This section's findings give a detailed technical description of how sensors are deployed and how they produce data. Our suggestion focused on explaining the framework's framework-tier architecture and structure execution [13].

## 2.2. *The Sustainability concept:*

*“The Sustainable Development Goals are the blueprint to achieve a better and more sustainable future for all. They address the global challenges we face, including poverty, inequality, climate change, environmental degradation, peace and justice. Learn more and take action”* The United Nations set 17 goals with 169 targets as part of its sustainable development programme, succeeding the Millennium Development Goals [14] . The concept of "sustainability" is well-known in urban planning. A few definitions and explanations have been written. Despite this, no universal definition exists [15]. Given that this part is about sustainability and the use of IoT to achieve it, focus on the perspective that presents urban growth as a means of improvement that balances demand and supply. Economic planning is expected to produce the following outcomes [16]:

## 2.3. *IoT's role in achieving Sustainability*

Like Smart Cities, this concept aids and extends the potentials of financial losses. It represents a major change in supporting a sustainable approach. The link between smart cities and IoT is also acknowledged. So there's a link between Smart City basics and representative procedures. Smart Cities may be seen as a continuation of reasonable sustainable urbanisation. Sustainable development aims to improve citizens' health and infrastructure while lowering costs and cultural impact [16].

## 3. SUSTAINABILITY CASE STUDIES IN RELATION WITH IOT

The Internet of Things (IoT) and related sciences are currently being discussed and stated. Sensors, wearables, and equipment are widely used. Mechanical technology has influenced every aspect of human existence, notably economic advancement. The IoT may help improve sustainability in several areas. [1]. To help the application region's usage of IoT, the following table provides proof of sustainability.

**Table 1: Sustainability proof to help the utilization of IoT**

SL. No	Cases/Uses of sustainability measures	Data on trends	Sources
1.	Smart Air-Quality-Monitoring-System (AQMS)	Air quality Data which are Real -Time can be gathered by utilising sensors designed to monitor a variety of pollutants. Sensors for detecting libelium have the same sensitivity of 0.1 parts per million.	[17]
2.	Smart Health Care	Healthcare related technological devices are taking advantage of one of the fastest emerging IoT sectors. has the potential to grow to \$176 billion by	[18]

		the year 2026. One of the most well-known examples of IoT in medical services is the use of a distant patient monitoring system.	
3.	Smart Waste Management	The BigBelly Solar wise waste and reusing assortment framework consolidates an incredible administration console, programming empowered organization war room, and group of blend and match squander and reusing stations into a tool stash that empowers districts, schools and colleges, government offices, and other institutional clients to diminish the working expenses related with squander assortment by 80%	[19]
4.	Smart Water Technology & Frameworks	By using smart water systems, utilities may potentially save \$7.1 to \$12.5 billion annually. Using IoT in water management systems results in a 20% reduction in leakage waste	[20]
5.	Smart Streetlights	As per a Navigant Research conducted by a concentrate, an additional saving of about 20% is attained by the usage of regular alteration of light and information.	[21]
6.	Smart Lighting solutions	Smart-LED lights eat half of the electricity utilised by ordinary lighting systems, enModus revealed that sensible frameworks that usage Smart LED lighting can reduce energy utilisation by as much as close to 100 percent	[22] & [23]
7.	Smart Meter	Giving constant information to clients about their utilizations is assessed to affect 40% of utilization designs for a structure	[24]
8.	Smart Grid	The Natural Defence Fund estimates that Smart Grids will reduce air pollution by 30%. Using smart matrices can save energy equivalent to 70 million journeys across the world.	[25] & [26]

#### 4. CHALLENGES OF IOT IMPLEMENTATION

Without a doubt, IoT can significantly improve urban sustainability. But this journey isn't without challenges. This section describes the challenges of using IoT for urban sustainability and provides examples of some solutions [27].

##### 4.1. *Span in IoT*

If the data quality is poor, it will generate needless disruptions and raise labour costs. Locations are decided by application. Policymakers, experts, technologists, and planners will need to approve and advise on inclusion. Consider the IoT's present economic condition to grasp its long-term function. IoT helps collect information to examine framework limits

and deliver predictive or prescriptive solutions for framework needs. So IoT is still acquiring data inside the framework, which is crucial since bad data leads to hopeless inquiry.

#### **4.2. Security**

The IoT platform is more concerned about the platform's safety and security. As the cyberspace expands, so will the dangers. Because data may be readily infiltrated from a single location, organisations involved in backend and programme development for IoT based systems are working to plug the gaps. These expeditions potentially endanger people's lives. [28].

- 4.2.1. **Adding security during configuration stage:** At the starting of the policy framework for IoT, the safety and security measure must have to be present. The provision from end-to-end secure environment and high-level approach to security device must be achieved, this must be made default in every guideline of the policy framework.
- 4.2.2. **Login qualifications ought to never be hardcoded:** Before allowing the device to work, engineers might ask clients to renew their certifications [29]. Clients should renew their accreditations using strong secret word or biometrics. For example, most switches have "administrator" login credentials that many users don't update, leaving them vulnerable to security breaches.
- 4.2.3. **Character/identity of the users:** Detecting and recognising every device immediately is essential to understanding what it is, how it behaves, what other devices it connects to, and what security precautions it requires.
- 4.2.4. **Equipment security:** Making well-designed gadgets will be priceless. The same goes for making electronics alter obvious so they may be easily identified when tampered with. When the systems are used in severe and remotely controlled environments where its very tough to check and keep a need for protection then these components of the following are kept in place of use for better protection and approach.
- 4.2.5. **Networking security:** Ports not kept open, top notch encryption, not sending the port & IP's, port security measures are some of the mentionable approaches for the betterment of IoT, protection of the systems with advances in the firewall, antivirus, and stopping of unwanted and illegal IP's sets a good example that how to take smart security measure for smart business options [30].
- 4.2.6. **Educating the Consumer:** Educating customers on the dangers of IoT and how to stay safe. Clients of IoT play a critical role in keeping devices safe. Taking the

espresso machine as an example, a smart client would know not to install an unreliable gadget on the same company as well-known gadgets.

### 4.3. Privacy

The Internet of Things has extreme security challenges. It outperforms client information security, which is today's main issue. That's why IoT user training is vital. It expands in scope when it comes to delivered client gadgets. Because IoT deals with so much sensitive data (personal, business, etc.) and can regulate the climate, security and protection issues should be taken seriously. Cyber-attacks should be prevented at all costs. [31].

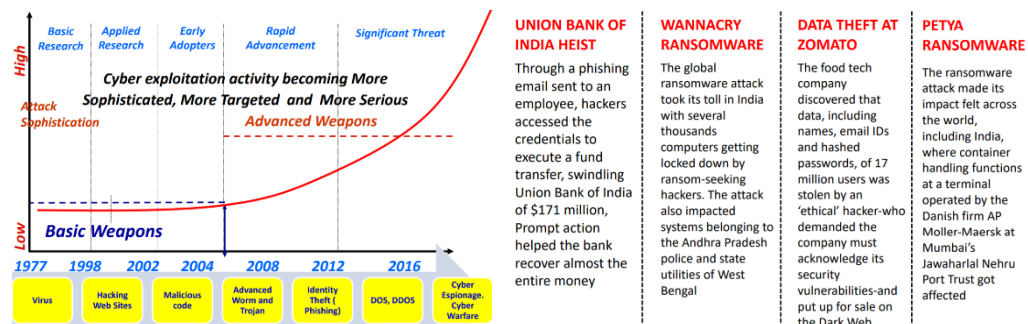


Figure 2: Scenario and Advancement of cyber activity around the world.



Figure 3: Some Major Cyber-attacks in India (2017).

Cybersecurity breaches is not necessarily computer-related, although it is carried out using computer networks and electronic communication channels. It's tough to tell if someone has been hacked, yet hacking can be done simply beyond boundaries. Cyber thieves may now easily conduct crimes from the comfort of their own homes, thanks to technological advancements. The unforeseen threats cannot be removed totally form the cyber space in many ways the cyber space can be misguided, thus need to create a more sophisticated and secure environment for users. In the lower figures we can see from the report of NITI Ayog in 2017, that how the evolution of the threats has increased in decades [32]. Some facts about internet users about India are it ranks 3<sup>rd</sup> in terms of users after USA and China with annual compounded growth of about 44%, also India is among the top ten spam sending countries among the rest of the world parallel to USA [32]. India comes in top five in the world in cybercrime hit-list to be affected by cyber-crime by a report of top cyber security company "Symantec Corp" [33]. Some noted examples are given below of major cyber-attacks in India of the year 2017 [32].

### 4.4. Development and Regulation

Like security, there are a few administrative challenges around the Internet of Things that require valid and smart local consideration. The pace of innovation is faster than the administrative advisory groups can keep up with. This causes the supervising and administrative councils to not think of long-term guidelines. The opportunities in the third world nations which are still under development phase and having economic potential are possible nodes and entry points for the development of ICT & IoT making them smart. Through the measures such as skill development, training of the unskilled, creating more training opportunities and to devise plans for using the full potential in IoT [34].

The table below showcases few examples of cyber related laws and regulations in India:

**Table 2: Cyber Regulations in India.**

Sl.No	Laws/Regulations	Year
1.	Indian Penal Code (IPC) Specific Sections- 383,420, 463, 499, 500, 503, 507	1860
2.	Indian Telegraph Act	1885
3.	Indian Evidence Act	1891
4.	The Companies Act	1956
5.	Copyright Act	1957
6.	Code of Criminal Procedure	1973
7.	The Consumer Protection Act	1986
8.	Information Technology Act (IT Act)	2000
9.	Information Technology Act (Amendment of the IT Act, 2000)	2008

There are many revisions and amendments in the laws and regulations in cyber space and information technology, but we have to keep in mind that the technology is ever changing and its dynamic in nature. Few points are mentioned below which contains lacunas and loopholes which should be addressed in the IT act [35]:

- The Information Technology Act of 2000 is focused with both the correct enforcement of intellectual property rights for electronic data and information. It's indeed divisive, but a key issue related to copyrights, trademarks, and patents has been overlooked by the law, leaving many loopholes.
- It pays no attention to the difficulty with the domain name. It's doesn't address the rights and duties of website domain owners (responsibilities)
- It excludes other types of cybercriminal activities and its manifestations, such as: Cyber Stalking, Theft, harassment, defamation, deformation, cyber frauds, cyber or social media abuses, credit/debit card misuse etc.
- It does not resolve the antitrust issue.
- The rules for electronic payments aren't really clear.

Globally, coordinated work is necessary to address regulatory gaps. This will make fighting cybercrime considerably simpler, since comparable jurisdictions will be able to work together more efficiently. When employing technology, it is vital to understand the issue and establish a safe environment.

#### **4.5. Standards**

The IOT space lacks documentation and local standard practises. This has a huge impact on the Internet of Things, limiting their development and limiting their potential. Lack of a genuine standard encourages unethical IoT device engineers. Without legitimate regulations and guidelines on makers and their assembly procedures, engineers may end up designing goods that operate poorly with little regard for the effects on other devices or customers.

#### **4.6. Lack of Incentive**

It is possible to conclude that the smart city programme is a business-government collaboration. Given the compelling benefit capabilities of such apps, this implies a lack of incentive on the side of the endeavours. To overcome these issues, diverse sectors must work

together to create workable foundations. [36]. Smart homes, smart buildings and ultimately smart cities are built by the policy makers, engineers, architects and urban planners who work closely to optimise every resource and accelerate the sustainable development process through IoT in the cities to be called as ‘Smart’.

#### **4.7. Adversative Technological Effects**

Infrastructures prepared for me urban sustainability envision resident benefits and place them in high demand. However, such frameworks may have unfavourable effects. First, developing sensor networks may require a lot of energy. Using these sensors may also result in increased energy and cost usage [37].

### **5. FUTURE ASPECTS OF IOT AND SMART CITIES**

With the increasing number of sensors and connection options, it is conceivable to expand the IoT organisation even if private clients do not profit from many of the advantages. Many IoT start-ups are still in their infancy, with few sensors, wireless developments like 5G, and other breakthroughs in the pipeline. It's too early to tell which technical advances or organisations will gain the most from IOT adoption. Without adequate legislation, security may remain an issue for some time. [38]. In the near future, smart devices linked to IoT framework will be observed in workplaces and residences, and this development will be welcomed progressively by city people. As a result of the global pandemic of urban sprawl and population growth, cities must adapt their governance and enhance their efficacy. Service delivery, coordination, and management system resilience need a bottom-up strategy that incorporates new concepts and technologies such as IoT.

### **6. CONCLUSION**

7. The Internet of Things (IoT) is the most important advancement in information science and artificial intelligence (AI). While IoT design prioritises data collecting, the numerous and increasing technologies that manage findings and their accuracy put a premium on information accessibility and quality. Many improvements may be used to create assistance-oriented smart cities. A resident administration is required to achieve an urban sustainability plan. Both Smart Cities and metropolitan sustainability seek for a sustainable future. The Internet of Things is being utilised to help create sustainable cities. Internal failure, range, information ownership, and institutional obstacles all arise. The cost savings trade-off associated with IoT deployment will be assessed in future study. In conclusion, smart cities are a terrific idea that benefits everyone if handled carefully. The IoT's issues are usually intertwined. It's easier to deal with them as a whole than Given the complexity of the development process, including commercial, innovation, government, and financial challenges.

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