Smart City IoT:

Benefits & Use Cases

https://www.sandtech.com/insight/smart-city-iot-benefits-use-cases/

Since the Internet of Things (IoT) began in the 1980s, the technology has been about efficiency and insights. The first uses were RFID, barcodes and scanners to track goods. Soon thereafter, IoT devices revolutionized manufacturing and supply chains.

Now, IoT extends well beyond the factory floor to just about every area of modern life, from smartphones to smart cities. The core infrastructure for the Internet of Things and smart cities includes ubiquitous connectivity, legions of IoT devices, fast data collection and transmission, and smart analytics.

These technologies work together as the foundation for all endeavors that improve transportation, energy efficiency, waste management, sustainability, public safety and city residents' overall quality of life.

What is a Smart City? Real Examples of IoT in Smart Cities

Currently, 56% of the world's population lives in cities, and that figure will grow to 68% by 2050. With the increased number of city dwellers, there is a pressing need to use the data gathered by IoT-enabled devices to reduce congestion and pollution and improve the quality of life for everyone in these increasingly crowded areas.

Smart city programs require a lot of data. They also demand infrastructure that supports data collection, transmission and analysis.

AI IoT solutions can measure air quality, water pipe health, traffic congestion and more. A technologically advanced IoT smart city can use sensor data to manage every aspect of the municipality, including assets, resources, services and operations.

Some smart cities are already leveraging sensor data for incremental benefits. Smart cities in the U.S. are finding creative ways to use IoT sensor data:

Boulder, Colorado, uses smart parking to reduce congestion in the city San Francisco, California, added sensors to trash bins to minimize unnecessary trash collection Miami, Florida, put IoT and smart sensors on streetlights to save energy.

Starting with projects like these allows smart city teams to learn how to implement the infrastructure and resolve data integration issues. The experience gained will enable teams to scale up to larger endeavors.

Smart City IoT Benefits

IoT puts the "smart" in a smart city. The benefits of IoT and smart cities are endless, but most improvements will come in city infrastructure, public safety, energy efficiency, waste management, and health and wellness. Smart cities use

interconnected technology to achieve highly efficient working and living environments and improve all aspects of city living.

Infrastructure

Connected sensors and devices can improve city infrastructure by analyzing the data collected to improve traffic flow and manage roads and bridges. For example, smart traffic lights and smart parking initiatives will keep traffic moving and reduce congestion, and bridge sensors can help detect maintenance issues before they happen. Connected IoT devices that gather data from government infrastructure can also provide municipalities with insights to help city governments make more informed decisions.

Public Safety

IoT devices can make notable strides in improving public safety. Monitoring potential security issues such as unattended packages and bags or suspicious activity can help prevent crime before it happens. These devices can collect data from cameras to detect possible problems and send alerts to the police when a more significant presence is necessary.

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Energy Efficiency

IoT devices can help governments and businesses improve energy efficiency by monitoring usage patterns to help building owners reduce power consumption. IoT also plays a role in smart grid management by monitoring usage, determining patterns and predicting high-demand periods.

Waste Management

Sensors can optimize trash collection, and when used with AI, they can improve trash sorting, reduce contaminants in landfills and maximize recycling efforts. IoT sensors can also help with wastewater management by constantly checking for pollutants.

Health and Wellness

More connectivity and internet-connected devices will improve citizens' health and wellness. Remote care has already begun, but it will extend to more conditions, helping people monitor health issues wherever they go with automatic alerts to health professionals if necessary.

Use Cases of IoT in Smart Cities

Smart city improvements are possible using technologies like connected IoT devices, data storage, cloud access, edge computing, AI and ML and smart automation. All these technologies work together to ensure that the needed data is analyzed and made

available for better insights, whether telling a passenger that their train is running late or identifying a rising contaminant in wastewater and automatically taking remediation measures.

In the not-so-distant future, smart city solutions will enable city workers to receive notifications before problems arise with infrastructure like water pipes. It will advance sustainability by reducing water and energy waste. And streamlining government services online promotes higher quality-of-life initiatives for city inhabitants.

Smart cities are about efficiency. Citizens in smart cities will benefit in every way, from health services to transportation to entertainment. The most common use cases for IoT smart cities include traffic management and parking, public safety, utility management, public transportation and environmental improvements.

Traffic Management and Parking

Some cities are using IoT sensors to track parking spaces. City commuters spend approximately 17 hours a year looking for available spaces. Knowing where to park will reduce congestion, fuel consumption and harmful emissions from idling vehicles.

Long-term analysis of traffic patterns (vehicles and pedestrians) can help city planners determine future transportation needs, including adding more roads or lanes, buses and pedestrian walking paths.

Additionally, IoT sensors on roads and bridges can monitor the condition of transportation infrastructure and, when combined with AI applications, detect issues before they happen. In the U.S. alone, there are more than 600,000 bridges, 46.4% of which are rated in fair condition and 7.6% rated poor. It is essential to install sensors to help prevent a catastrophic event like the 2007 bridge collapse in Minnesota, which killed 13 people and injured 145.

Public Safety

Monitoring safety and security issues is another area where IoT can improve the city living experience. IoT public safety solutions include analyzing data from cameras throughout the city to detect crime patterns or potential issues. When coupled with automation, that information creates alerts for a more significant police presence if necessary. Facial recognition can identify suspects and send real-time alerts to inform the community to be aware.

Another way IoT can improve public safety is by monitoring for fire and gas leaks. Immediate detection and alerts to fire departments can minimize loss of life and property.

Utility Management

Utility management, from energy to water, is key to keeping cities running efficiently, and IoT devices can help. These devices can monitor utilities and water in real time and detect issues humans might miss.

IoT sensors in smart cities can optimize energy consumption, saving citizens and companies money. For example, leaky pipes waste approximately 90 billion liters of water daily. Sensors in city water pipes can detect problems before a costly issue.

Sensors can help commercial building owners optimize their energy use. Commercial buildings waste approximately 30% of their energy. IoT sensors and automation can turn off lights when a room is empty, and temperature sensors can monitor the number of people on a floor and adjust the temperature accordingly.

IoT can also play an essential role in smart grid automation, including automating load balancing, demand forecasting, and incorporating renewables into the mix.

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Public Transportation

IoT and data will significantly improve public transportation. Sensors can track bus and train usage daily and hourly to help city planners and managers optimize long-term infrastructure planning.

This technology can use travel pattern data to cut wait times and monitor buses and trains to ensure efficient repairs before a complete breakdown, keeping these valuable assets in use.

IoT will improve the experience for public transportation users. Connectivity on buses and trains will be ubiquitous. Using their IoT-enabled phones, passengers can pay fees with digital apps and have continuous access to the internet. Connected cameras will monitor activity, constantly watching and reporting issues to improve passenger safety.

Environmental

Cities and buildings are large contributors to greenhouse gas emissions. As a result, crowded cities can reduce everyone’s quality of life, particularly in terms of air and water.

IoT sensors can monitor air quality and detect environmental hazards. They can also send automatic warnings to officials and help municipalities manage incorporating renewables to reduce their carbon footprint.

Another area of environmental improvement is efficient waste management. IoT can monitor everything in the entire process and initiate automatic remediation actions if contaminants are detected, even those so small that they might go unnoticed in traditional water quality monitoring systems.

Challenges and Future Trends in IoT and Smart Cities

With more citizens choosing to live in cities, smart city initiatives have moved from nice-to-have to necessary for sustainability and quality of life. The global smart city market was valued at $549 billion in 2023 but will grow to $1.1 trillion by 2028. While

cities across the globe are beginning to roll out smart city initiatives, there are challenges to overcome.

Infrastructure

Many cities need more up-to-date technology. They must start by investing in IoT infrastructure and collecting the data required for smart city initiatives. IT planning is also necessary to ensure the infrastructure is scalable and adaptable for future projects and technological advancements.

Interoperability

Unfortunately, there is no standard for data from connected devices. And many municipalities have siloed data, complicating the issue. This fragmentation causes data interoperability. Smart city teams must build data cleaning and integration into their plans to create a single data source.

Privacy and security

Privacy and security concerns exist across the smart city spectrum—collecting, storing, transmitting and analyzing data. Governments have started to address these issues, but smart cities with projects underway should follow existing rules and regulations, institute procedures to review and monitor data governance and be ready to revise processes as the regulations evolve.

Social inclusion and participation

Infrastructure must cover all citizens and allow everyone to participate in their collective digital future. Take steps to gather feedback from citizens. Perspectives and needs vary, and the best solutions come from inclusivity

Vocabulary:

Waste management

RFID – технологія радіочастотної ідентифікації

Public safety

Energy efficiency

Traffic congestion

Smart grid

Environmental hazard

Interoperability – сумісність, здатність до взаємодії

Social inclusion – соціальна інклюзія

Remote care – дистанційна медична допомога

Automation

QUIZ

1. IoT stands for:

A) Internet of Transport

B) Internet of Things

C) Intelligent Operational Technology

D) Interconnected Technical Objects

2. Which of the following is an example of IoT in smart cities?

A) Smart parking sensors

B) Printed books

C) Manual streetlights

D) Paper maps

3. What is a main goal of a smart city?

A) Reduce efficiency

B) Improve citizens' quality of life

C) Increase pollution

D) Remove sensors

4. AI and ML in IoT help to:

A) Cook food automatically

B) Analyze collected data for insights

C) Replace electricity

D) Build houses manually

5. Which city uses IoT sensors on streetlights to save energy?

A) Boulder

B) San Francisco

C) Miami

D) New York

6. Sensors in water pipes help to:

A) Monitor pollution and leaks

B) Cook water

C) Increase water waste

D) Build bridges

7. Which area is NOT mentioned as a smart city benefit?

A) Infrastructure

B) Public safety

C) Telepathy

D) Waste management

8. Interoperability means:

A) Automatic driving

B) Data from devices can work together

C) Pollution control

D) Smart lighting

9. Smart grid technology helps with:

A) Predicting high-demand periods

B) Growing vegetables

C) Building roads

D) Printing books

10. Environmental IoT sensors in cities monitor:

A) Air quality

B) Traffic only

C) Music in parks

D) Phone calls

Questions Related to Electronics, Electrical Engineering, Heat Power, Robotics

1. How can IoT sensors improve energy efficiency in buildings?
2. Which types of sensors are commonly used in smart cities for traffic management?
3. How do IoT devices contribute to the maintenance of electrical grids?
4. What role does automation play in waste management?
5. How can robotics be integrated into public safety systems in smart cities?
6. Which IoT technologies are applied in heat power monitoring and optimization?
7. How do sensors detect potential hazards in bridges or roads?
8. How can AI analyze data from electrical and robotic systems in smart cities?

Dialogue Sample

Roles:

Electronics Engineer (EE) – designs and maintains sensors and IoT devices.
Robotics Engineer (RE) – develops autonomous robots for city services.
Electrical Engineer (EL) – manages electrical grids and energy efficiency systems.
Heat Power Specialist (HP) – optimizes heating and energy supply in smart buildings.

City Manager / Moderator (CM) – oversees the project, coordinates the team.

CM: Good morning, team. Our city wants to implement a new smart infrastructure system. We need your expertise to make it efficient, safe, and environmentally friendly. Let's start with traffic management.

EE: I suggest we install IoT sensors on all major roads and parking lots. These sensors will collect data on traffic flow and available parking spaces.

RE: Great! I can deploy autonomous robots to monitor traffic violations and report issues directly to the city system. They can also deliver small packages or waste collection in crowded areas.

EL: While you handle sensors and robots, I will connect the devices to the smart grid. This will ensure that all devices consume energy efficiently and don't overload the network.

HP: Don't forget heating and energy supply in buildings. We can use smart thermostats and heating sensors to optimize energy usage and reduce waste. These systems can connect to your sensors to adjust heating based on real-time occupancy.

CM: Excellent. How about public safety?

EE: Sensors can detect unusual events, like smoke, gas leaks, or unauthorized access.

RE: My robots can patrol critical areas and respond to alarms automatically, assisting the local police.

EL: We can power these systems reliably using renewable energy and ensure backup energy supply during outages.

HP: Also, if there is a sudden spike in heat demand, my system can coordinate with the grid to prevent blackouts.

CM: Perfect! Let's **summarize:**

Traffic and parking: EE sensors + RE monitoring robots
Public safety: EE sensors + RE robots
Energy efficiency: EL smart grid + HP heating optimization
Waste management: RE autonomous collection robots + EE sensors

CM: **Any challenges** we should anticipate?

EE: Interoperability – all devices must communicate seamlessly.
RE: Security – robots and sensors must be protected from cyberattacks.
EL: Energy peaks – we need to manage high demand efficiently.
HP: Integration with existing heating and power systems may need adjustments.