STEAMCITY CURRICULUM

AI ODYSSEY DATAWALK

thematic: artificial intelligence and new technologies

sub-theme: citizen engagement, governance and data

Introduction

Artificial Intelligence (AI) is becoming an integral component of the **urban environments** we live in, influencing various aspects of our daily lives, **even when its presence is not immediately noticeable**.

From **smart traffic management systems** that optimize the flow of vehicles and reduce congestion, to **AI-driven public safety measures** that enhance surveillance and emergency response, these technologies are subtly transforming the way cities function. Additionally, AI plays a crucial role in:

- **Improving public transportation efficiency**
- **Personalizing city services** through data analysis
- **Enabling smart energy management systems** that contribute to sustainability efforts.

To uncover the integration of AI in our urban environments, this protocol offers to explore our landscape thanks to the organisation of a **'data walk'**.

A **data walk** is an engaging and interactive activity where participants actively explore their environment to uncover and understand the various **data sources** that surround them. This hands-on experience allows individuals to see firsthand how different **sensors** contribute to the **collection and processing of data**, which in turn supports the functionality of **AI systems**. A data walk is not just about identifying these sensors; it also emphasizes the importance of understanding the **implications of data collection** and its impact on **society**. This experiential learning approach encourages **critical thinking** and fosters a deeper appreciation for the role of **technology** in our daily lives. For more information, you can visit the link: **Data Walk**.

During this activity, students will explore their school or city to identify various **sensors** that contribute to data processing and support **AI systems**. These sensors can include **cameras, microphones, cell phone towers,** and **electric scooters**. Upon returning to the classroom, they will analyze whether these devices **collect personal data**, identify the **owners** of the devices, and explore how the data may be utilized by these owners.

Interdisciplinarity

technology/engineering

moral and civic education

Sustainable Development Goals

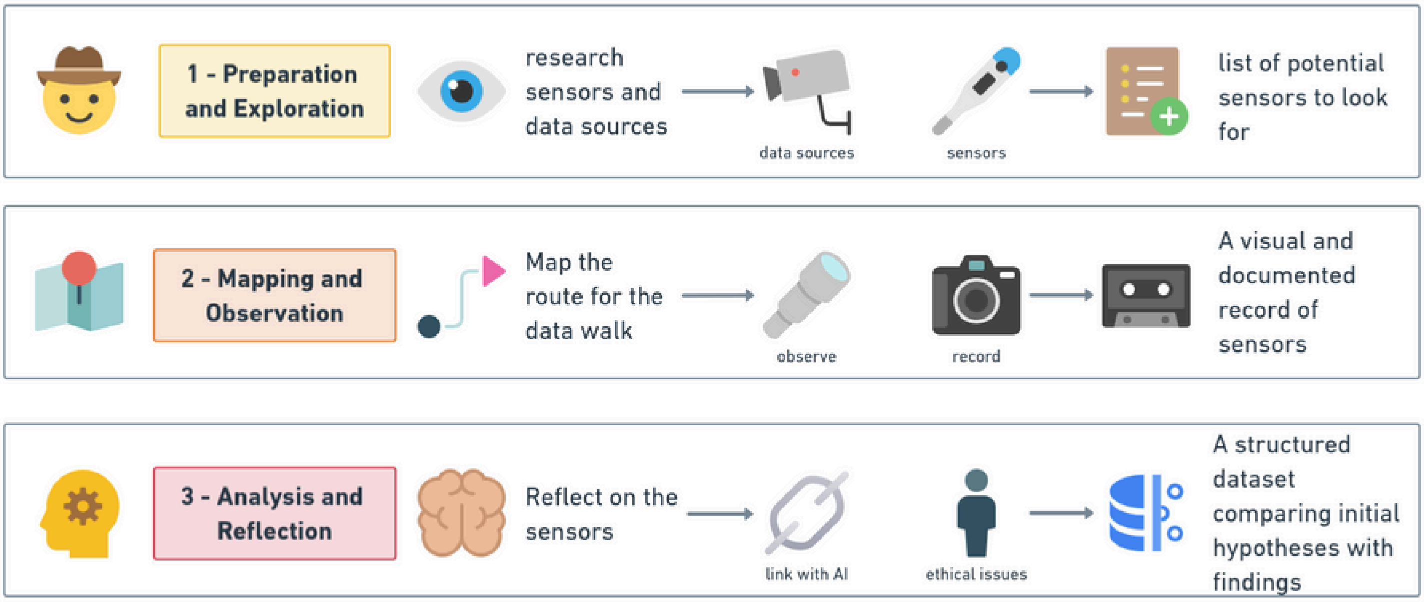
Overview

Protocol Structure

Step 1 - Exploration Phase - Developing Baseline Knowledge Regarding Urban Usages of Sensors
The Exploration Phase begins with classroom preparation where students research and identify potential sensors in the urban environment. Students develop their baseline knowledge by exploring different types of sensors, creating preliminary lists, and establishing clear expectations for what they might discover during their walk. This phase sets the foundation for successful field investigation.

Step 2 - Field Investigation Phase - Practical Experience Bringing Theoretical Knowledge to Life
During this hands-on phase, students actively explore their school/neighborhood/city environment through a carefully planned data walk. They document and photograph previously identified sensors while remaining alert to discover new, unexpected data collection points. This practical experience brings theoretical knowledge to life through direct observation.

Step 3 - Analysis and Reflection Phase - Making Sense of Urban Data Collection
This comprehensive classroom discussion phase involves comparing field findings against initial expectations, cataloging new discoveries, and conducting detailed examination of the AI applications associated with each discovered sensor. Students work together to understand the broader implications of their observations and the interconnected nature of urban sensing systems. To conclude, students are encouraged to critically think about privacy implications. Students evaluate the balance between technological advancement and personal privacy, considering how these technologies shape their daily environment and future urban development.



Following these phases, the experiment aims to achieve key educational objectives:

- **Develop students' critical awareness of urban technology** integration and associated risks through initial research and preparation, followed by direct observation of sensors in their environment.
- **Build understanding of smart city applications and their impact on daily life** by documenting real-world examples during the walk and analyzing their purposes and connections in classroom discussions.
- **Foster critical thinking about personal data collection and privacy preferences** in an increasingly connected world through post-walk reflection and evaluation of the privacy implications of discovered sensors.

Getting started

Duration: Four hours (1 hour for preparing, 1 hour for the walk, 2 hours for debriefing)

Level of difficulty:

★☆☆☆☆

No specific material needed

Glossary

Keywords & Concepts	Definitions
Data	Raw information collected from various sources that can be processed, analyzed, and used to make decisions or provide services. In smart cities, this includes everything from temperature readings to video footage.
Data service	Also called 'data technology', 'smart service' or 'smart solution'. Service in a smart city where (personal) data is collected or processed to provide a service to (a specific group of) users, or to improve existing services.
Data Walk	A Data Walk is an interactive way for community stakeholders, including residents, researchers, program administrators, local government officials, and service providers, to engage in dialogue around research findings about their community.
Open Data	Data that is freely available to everyone to use and republish without restrictions. In smart cities, this often includes public datasets about transportation, environment, or urban infrastructure.
Personal Data	Any information relating to an identified or identifiable individual, such as location data, facial images, or behavioral patterns that can be collected by urban sensing systems.
Sensors	Devices that detect and respond to physical input from the environment, such as cameras, microphones, temperature sensors, or motion detectors. These devices collect data that can be processed by AI systems.
Smart City	An urban area that uses different types of electronic methods and sensors to collect data, which is used to manage assets, resources, and services efficiently while improving the quality of life for citizens.
AI Systems	Computer systems that can perform tasks that typically require human intelligence, such as visual perception, speech recognition, and decision-making. In urban environments, these systems process data from various sensors to provide automated services or insights.

Protocol

Step 1 - Exploration Phase - Developing Baseline Knowledge Regarding Urban Usages of Sensors

Background and description of the problem to be solved in this step: AI systems in cities can collect a lot of data about you as a citizen, without you being aware of it. For instance, thanks to AI, modern cameras can recognize your face, or guess your emotions based on your facial expression. Examples of uses can be the design of a 'happiness index' as in the city of Vilnius (https://eurocities.eu/stories/smile-youre-on-camera/), or face recognition to limit the number of sheets of toilet paper given to a person as in the Temple of Heaven of Pekin (https://www.youtube.com/watch?v=AuxgoNMqLFU). **In this context, this first stage of the protocol aims to discover what sensors can you find in your city/neighbourhood and what data do they collect?**

Learning Objectives: Identify what sensors can be used in a city. Understand that AI systems can process data to extract advanced information (e.g., guess one's mood based on one's facial expression).

Conceptualisation

A Scientific Approach to Urban Data Investigation

This first exploration phase follows the scientific method, where students will build their knowledge systematically before conducting field research. Like scientists who review existing literature and form hypotheses before experiments, students will develop a structured understanding of urban data collection systems before their data walk investigation.

Identifying Key Concepts

Within the whole protocol, students will be introduced to the idea of **data collection in real-world environments**, with a focus on **how data is gathered through sensors embedded in everyday objects or locations**. Students will explore the **implications of sensor data collection and AI integration in urban environments**.

In this first step, to support this exploration, students will compile and structure a **documentary corpus** focusing on urban sensors, AI applications, and their societal impacts. This corpus will include scientific articles, technical reports, and case studies, forming a robust knowledge base. The goal is to provide students with a theoretical framework to understand the role of sensors and AI in cities and to justify the importance of investigating their deployment and data usage.

Understanding Sensors and Data Sources

Before conducting the data walk in step 2, students should familiarize themselves with various sensor types (such as temperature, light, sound, and motion sensors) and understand how each captures data. This preparation will help them recognize and identify devices during their field activity.

Formulating Questions and Hypotheses

Based on their findings, students will brainstorm key questions to guide their datawalk investigation, focusing on identifying sensors in the city, understanding their associated data services, determining ownership of these technologies, and analyzing how the collected data reflects urban patterns and behaviors. Through these questions, students will develop hypotheses about the types of data they expect to encounter and its potential implications for city life.

Students Investigation

This investigation phase focuses on preparing students for the data walk by building their theoretical understanding. Through structured research and discussion, students will develop the knowledge framework needed to identify and analyze urban sensors during their practical field observations in step 2. In the classroom, launch the following activities:

Knowledge Mapping

Begin by exploring students' existing knowledge about sensors in their school neighborhood that could be used by AI systems. These might include cameras, smart bins, and various monitoring devices commonly found in modern urban environments. This initial mapping helps establish the baseline understanding and creates engagement.

For instance, you can discuss surveillance systems like monitoring cameras, which serve multiple purposes from public space monitoring to license plate recognition and building entry control. Move on to communication infrastructure, including cell phone transmission towers that collect mobility data and public WiFi networks that track usage patterns.

Consider urban management tools such as magnetic parking sensors, traffic counters, and citizen science weather stations.

Finally, examine shared mobility systems, including public transportation, bike-sharing, and electric scooter services.

> **Advice for Teachers:** The Knowledge Center, Data and Society in Belgium has designed a document which can serve as a starting point to identify examples of smart sensors in cities: https://data-en-maatschappij.ai/uploads/Databronkaarten.pdf

Data Analysis Framework

Guide students to analyze each sensor type in detail. Consider ownership - who controls these devices and their data? Examine data collection purposes and capabilities.

For instance, modern cameras can perform facial recognition and identity tracking. Cell phone towers can track movement patterns through unique device IDs, potentially revealing home and work locations. Similarly, public WiFi and shared mobility services can build detailed profiles of urban movement and preferred locations.

Resource Exploration

Extend the investigation by exploring open data resources specific to your city. A simple search for 'open data - your city' will typically reveal an online catalogue of available data resources, providing additional context for understanding local data collection infrastructure.

This final step helps students connect theoretical knowledge with real-world applications in their immediate environment.

Conclusion & Further Reflexion

Through thorough research and classroom discussions, students have built a **strong foundation for their field investigation**.

They have created a **detailed inventory cataloging the various data collection devices** they expect to find, developed an **efficient walking route** that covers diverse urban environments, and established **clear documentation methods** to record their observations during the walk.

This preparation ensures a **systematic and productive field investigation phase**.

- **Knowledge Mobilized:** Students drew upon their foundational understanding of urban technology infrastructure, including various types of sensors, AI applications, and data collection methods. This knowledge base encompassed both technical aspects (how sensors work) and contextual awareness (how technology integrates into urban environments).
- **Classroom Implementation Reflection:** Through guided discussion and collaborative brainstorming, students explored their daily interactions with urban technology. They shared personal observations of data collection tools in their environment, fostering peer learning and building collective awareness. This process helped bridge theoretical knowledge with practical experience.
- **General Learning Outcomes:** Students developed critical observation skills, learned to identify and categorize different types of sensors, and understood the interconnected nature of urban data collection systems. They also began to grasp the relationship between physical sensors and AI applications.

Building on this comprehensive preparation, conclude this step by engaging students in **hypothesis generation** regarding:

- **The distribution and density of sensors across different urban zones (residential, commercial, educational)**
- **The correlation between sensor types and specific urban functions or services**
- **The potential relationships between sensor placement and population density or activity patterns**

These hypotheses and preparatory discussions will serve as **valuable starting points** for the field investigation phase. They help students enter the data walk with **clear objectives and expectations**, develop a systematic approach to sensor identification and documentation, and create a framework for comparing **theoretical knowledge with real-world observations**. Students will be prepared to analyze the **spatial distribution of urban sensing technologies**, ensuring they can transition smoothly into the **practical field investigation phase**, equipped with both theoretical knowledge and clear investigative goals.

To guide the **debrief discussion** and help students reflect on their initial research phase, consider asking the following questions:

- How did your initial research change your **awareness of urban sensing technologies**?
- What **surprised you most** about the variety and purposes of different sensors?
- How might sensor placement reflect **social or economic patterns** in your city?
- What **challenges** do you anticipate in identifying and analyzing these sensors during the walk?
- How might different **stakeholders** (citizens, businesses, government) view these sensing technologies differently?

Step 2 - Field Investigation Phase - Practical Experience Bringing Theoretical Knowledge to Life

Background and description of the problem to be solved in this step: Building on the theoretical knowledge developed in Step 1, this stage consists of organizing the data walk. Students will explore the urban environment, observing and documenting the sensors they encounter along the way. They should pay close attention to whether the sensors they find match their expectations from the preparation phase. Students should also make notes about the locations and any AI applications they suspect these sensors are used for.

Learning Objectives: Develop observational skills by identifying sensors placed in an environment. Learn to recognize different types of sensors, such as surveillance cameras, cell-phone antennas, environmental sensors, or IoT devices

Conceptualisation

<u>Planning the Investigation Route</u>
Students will apply their theoretical knowledge to map out strategic routes that maximize their exposure to different types of urban environments and potential sensor locations. This includes:

- Identifying key areas with high likelihood of sensor presence (commercial districts, transportation hubs, public spaces)
- Creating a systematic documentation method for recording sensor locations and characteristics
- Developing observation protocols to ensure consistent data collection across the team

Establishing Research Parameters
Research parameters are specific guidelines and boundaries set for a study to ensure consistent and meaningful data collection.

To ensure the data walk remains a rigorous research activity and not a casual stroll, it is crucial to establish clear research parameters. Building on the methodological framework (a structured way of conducting research) established during the exploration phase, students will develop a structured approach that includes:

- Define specific categories of sensors to look for (surveillance - like CCTV cameras, environmental - such as weather stations, traffic management - like smart traffic lights, etc.)
- Create a standardized format for recording observations and data points (a consistent way to document findings, such as using templates or digital forms)
- Prepare questions to guide their investigation of each sensor's purpose and impact (for example: "What type of data does this sensor collect?" or "How might this affect privacy?")

Setting Investigation Goals
Investigation goals are specific outcomes that researchers aim to achieve through their study. Students will establish clear objectives for their field work, focusing on:

- Validating their theoretical understanding (what they learned in class) against real-world implementations (what they actually observe)
- Documenting unexpected or novel sensor deployments (sensors that weren't covered in their initial research or used in surprising ways)

- Analyzing the spatial distribution (how sensors are spread out across different areas) of different sensor types across urban zones (residential areas, business districts, parks, etc.)

Students Investigation

Before beginning the data walk, students should be properly equipped with documentation tools. A combination of notebooks or digital devices for note-taking, along with smartphones or cameras for photography, will ensure comprehensive documentation.

Some students may find it helpful to use mapping applications to mark exact locations of sensors, creating a digital record of their findings.

Advice for Teachers: For getting inspired in organising the walk, do not hesitate to explore online resources providing several information on logistics and steps for implemeting a “walkshop” or data walk. For instance:

- https://www.datawalking.uk
- https://amai.vlaanderen/activiteit-datawalk
- https://data-en-maatschappij.ai/tools/datawalk-handleiding

Students should work collaboratively in small groups. This approach allows for more effective coverage of the area while enabling real-time discussion of observations.

Groups can implement a rotation system where different members take turns observing and documenting, ensuring everyone stays engaged and no details are missed.

Documentation should follow a systematic approach. Students should develop a simple numbering system for cataloging each sensor they encounter.

When possible, they should capture photographs from multiple angles and document the immediate environment and context. In situations where photography isn't feasible or permitted, quick sketches can serve as valuable alternatives.

The goal is to create a detailed record that can be analyzed later in the classroom.

For each sensing device encountered, students should address the following key questions:

- Where is it located?
- Who owns it?
- What data does it collect?
- For what purpose is the data used?
- Is the sensing device related to an AI application? If yes, what kind of AI applications?

Throughout the data walk, students must maintain professional conduct and ethical behavior. This includes respecting private property boundaries and privacy regulations, avoiding any interference with the sensors they observe, and being prepared to explain the educational nature of their activity if questioned by community members or authorities.

This approach ensures both the safety of the students and the integrity of their research.

Conclusion & Further Reflexion

Through this practical field investigation, students have gained firsthand experience in identifying and documenting urban sensing technologies. Their observations and collected data now form a rich foundation for deeper analysis.

- **Knowledge Mobilized:** Students demonstrated their ability to identify and analyze various urban sensors, applying their theoretical knowledge about data collection systems, AI applications, and urban technology infrastructure. They showed understanding of how different sensors serve distinct purposes in smart city environments.
  Classroom Implementation Reflection: The data walk provided a hands-on experience where students actively engaged with their urban environment, documenting and analyzing real-world examples of sensing technologies. This practical approach helped bridge the gap between theoretical concepts and actual implementations.
- **General Learning Outcomes:** Students developed critical observation skills, enhanced their understanding of urban data collection systems, and gained practical experience in identifying and analyzing various types of sensors and their potential AI applications.

To facilitate reflection on the data walk experience, teachers can pose the following questions:

- **What challenges did you face during the data walk? How did you overcome them?**
- **How did working in groups affect your ability to identify and document sensors?**
- **Were there any unexpected discoveries that surprised your team?**
- **How comfortable did you feel documenting sensors in public spaces?**
- **What would you do differently if you were to conduct another data walk?**
- **How did the preparation phase help you during the actual walk?**

The next step will focus on synthesizing these findings to understand the broader implications of AI and sensing technologies in their community, moving from observation to critical analysis and reflection.

Step 3 - Analysis and Reflection Phase - Making Sense of Urban Data Collection

Background and description of the problem to be solved in this step: In this final stage, students return to the classroom to analyze their findings, reflect on their experiences, and critically evaluate the implications of urban sensing technologies.

Learning Objectives: This stage provides an opportunity for students to make sense of the data they collected during their walk, compare it to their initial expectations, and consider the broader implications of sensor technologies and AI applications in their city. They can discuss and address potential privacy issues in sensor technologies, AI applications, and data collection.

Conceptualisation

Smart city technologies enhance urban services through sophisticated data collection and processing systems. These innovations improve **traffic management**, **energy efficiency**, and **public services** by leveraging interconnected sensor networks and data analysis. However, this widespread data collection poses substantial **privacy challenges** that extend beyond simple data protection. The continuous monitoring of urban spaces creates detailed **digital footprints** of citizens' lives, raising concerns about **surveillance** and **personal autonomy**. Without proper safeguards, this data could be vulnerable to **breaches**, **misuse**, or **unauthorized access**.

Additionally, the aggregation of multiple data sources can lead to detailed **profiling** of individuals, even when individual data points seem innocuous. Cities must carefully balance the benefits of smart technology with robust **privacy protection measures**, including **data minimization**, **encryption**, and **clear consent mechanisms.** The potential for **function creep** - where data collected for one purpose is later used for another - requires ongoing **oversight** and strict **governance frameworks** to protect citizens' privacy rights while maintaining the benefits of urban innovation.

Social Impact

The implementation of urban technologies profoundly shapes community behavior and social interactions. Beyond simple monitoring, these systems can create invisible boundaries that influence how people navigate and use public spaces. The psychological impact of constant surveillance may lead to self-censorship and altered social behaviors. Furthermore, the uneven implementation of these technologies can exacerbate existing social inequalities, creating digital divides between different communities. The challenge lies in balancing the benefits of urban monitoring with the preservation of natural social dynamics and community autonomy.

Distribution and Access

The geographic distribution of technologies reflects and potentially reinforces existing urban inequalities. The deployment of sensors and monitoring systems often follows patterns of economic development, creating technological oases in some areas while leaving others underserved. This uneven distribution affects not only the quality of services but also the representation of different communities in urban data collection. The challenge extends beyond mere physical placement to include questions of data accessibility, technological literacy, and community engagement in deployment decisions.

Environmental Considerations

The environmental footprint of sensors' infrastructure extends throughout its entire lifecycle. From the raw materials used in manufacturing to the energy consumed during operation and the eventual disposal of outdated equipment, each phase presents environmental challenges. The increasing density of sensor networks raises concerns about electronic waste management and energy efficiency. Cities must develop sustainable practices for device deployment, maintenance, and replacement while considering the long-term environmental impact of expanding technological infrastructure.

Public Information Systems

The transparency of urban monitoring systems is crucial for public trust and accountability. The often invisible nature of data collection infrastructure creates challenges for public awareness and consent. Effective communication strategies must bridge the gap between technical complexity and public understanding. Cities need to develop comprehensive transparency frameworks that include clear signage, accessible data policies, and regular community engagement. This includes creating channels for public feedback and participation in decisions about sensor deployment and data use.

Students Investigation

Data Organization, Classification and Analysis

Back in the classroom, create a collaborative inventory on the board to organize your collected data. Categorize the different types of sensors (surveillance, environmental, traffic, etc.) and map their locations. Examine each sensor and its findings by considering:

- Physical implementation and placement in urban space
- Data collection methods and potential AI applications
- Impact on different communities and neighborhoods

Additional parameters to analyze can include energy consumption of sensor networks, sustainability of the infrastructure and environmental monitoring capabilities.

Lead a focused discussion about the discovered sensors. Analyze their functions, ownership, and data usage. Compare your findings with initial predictions, noting any patterns or unexpected discoveries that emerged during the walk.

Synthesis and Reflection

Examine how these technologies affect daily life, particularly regarding privacy and ethics. Consider the insights from your data analysis and identify potential improvements that could enhance privacy protection and technology benefits.

Develop ideas for sharing your findings and promoting community awareness. Discuss privacy risks and ethical challenges associated with urban data collection.

Final Presentation

Working in small groups, present your findings, insights, and reflections to the class.

Share your sensor discoveries, unexpected findings, and analysis of AI applications, privacy, and ethics. Focus on:

- Distribution patterns across different areas
- Technical implementation and effectiveness
- Social impact and privacy considerations
- Proposed improvements and community awareness strategies

Conclusion & Further Reflexion

Through detailed analysis and collaborative discussion, students have developed a **comprehensive understanding of urban sensing technologies and their implications**.

They have successfully **categorized and analyzed their field observations**, examined the **social and ethical implications** of these technologies, and **proposed thoughtful solutions** for improving privacy protection and community awareness.

The analysis phase has enabled students to **bridge theoretical knowledge with practical experience**, resulting in meaningful insights about the role of AI and sensing technologies in urban environments.

This final step ensures that students can **critically evaluate and communicate** their findings while understanding the broader impact of smart city technologies on society.

- **Knowledge Mobilized**: Students demonstrated analytical capabilities in processing and comparing collected data, including understanding of ethical implications of technology, privacy rights, and urban innovation. They applied their knowledge about data collection systems, AI applications, and smart city infrastructure while developing solution-oriented thinking approaches.
- **Classroom Implementation Reflection**: The final analysis phase allowed students to synthesize their findings through presentations and meaningful discussions. Students shared discoveries, discussed patterns, and compared outcomes with initial expectations. Group discussions fostered collaborative learning and helped highlight actionable steps for raising awareness about urban sensing technologies.
- **General Learning Outcomes**: Through this analysis, students gained a thorough understanding of the societal impact of data collection and AI. They developed critical evaluation skills, enhanced their ability to communicate observations effectively, and learned to identify connections between technology implementation and privacy concerns. Most importantly, they discovered ways to advocate for responsible technology use in their communities.

This protocol demonstrates how hands-on exploration of urban sensing technologies can effectively bridge theoretical knowledge with practical understanding. By combining field observation, collaborative analysis, and critical reflection, students develop a comprehensive understanding of smart city technologies and their implications. The three-step approach - preparation, exploration, and analysis - provides a structured yet flexible framework that can be adapted to various educational contexts and learning objectives.

To further extend discussions and critical thinking, consider opening additional discussions using some of these questions:

- **What role should citizens play in decisions about implementing new sensing technologies in their communities?**
- **How can we ensure equitable access to the benefits of smart city technologies across different socioeconomic groups?**
- **What potential future applications of AI and sensing technologies might emerge in urban environments, and what ethical considerations should we anticipate?**
- **How can we balance innovation in urban technology with the preservation of privacy and personal autonomy?**

Exploring the issue through other initiatives

FARI's data walks in Brussels

FARI is an organization focused on exploring the intersection of artificial intelligence and urban development.

In the context of datawalking, FARI invites participants to join guided walks through cities like Brussels, where they can learn about the transformative role of data collection in shaping smart city applications.

The goal of these tours is to deepen participants' understanding of what constitutes a smart city, as well as to examine the opportunities and challenges associated with utilizing data for more efficient and sustainable living.

Going further: https://www.fari.brussels/news-and-media-article/calling-for-participations-in-the-data-walk

Spectre Project & Data Walking

SPECTRE deals with the several privacy implications brought by the development of smart cities. It looks at these challenges through the lens of the disciplines of law, social science and economics. The main focus of the project is to develop a collaborative Data Protection Impact Assessment (DPIA) method for smart cities, which will take into consideration cities' socio-economic interests. We will explore the potential of using public procurements rules to incorporate this new method of DPIA to effectively deal with the privacy impacts of smart cities.

Going further: https://spectreproject.be, https://spectreproject.be/output/downloads-1/spectre-walkshop-report-brussel.pdf

Data walking or Walkshop

This data walking project grew out of a teaching process that encouraged students to observe data mediations in the space of the city. Inspired by Laura Forlano's 'flashmob ethnography' and Adam Greenfield's 'network walkshops' the data walk or 'data walkshop' evolved through collaborations with the Museum of Contemporary Commodities project developed by Paula Crutchlow and Ian Cook of the University of Exeter, and Furtherfield Gallery in London.

Going further: https://www.datawalking.uk