

Data Ethics in Smart Cities

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ABSTRACT

Smart cities are an emerging trend across the world,

CCS CONCEPTS

- **Human-centered computing** → HCI
- **Security and privacy** → Human and Societal

KEYWORDS

smart cities, data privacy, human-computer interaction, computer science ethics, data collection ethics

ACM Reference format:

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1 Introduction

Smart City initiatives are a growing trend across the world, and city planners are increasingly interested in finding ways to incorporate data-driven optimizations to existing city design problems. Utilizing data for urban planning has been popular long before the recent Smart City trend, but technological advances which have decreased the cost and

size of data collection systems have opened up new possibilities in design.

The incorporation of these data collection systems into urban environments allows cities to collect massive amounts of data in real time, ranging from traffic patterns, utilities usage, consumer practices, and even real-time location data of every resident. The volume and breadth of data collected allows for cities to become more efficient in the way resources are allocated, and also potentially allows them to become more environmentally friendly.

However, the scale of this data collection also raises a number of potential data security issues, at a level only previously seen in Big Data companies like Google. The ethics of both the way the data is collected, and also how the data is used have been an ongoing debate throughout the lifespan of these Smart City projects.

SMART CITY ECOSYSTEM



Figure 1: Smart City Structure

Source: iiot-world.com

2 Cities Of Tomorrow

These projects promise a wide range of potential benefits, and have the capability of solving or at least significantly easing problems which have plagued urban centers since the dawn of civilization. Issues of how to most efficiently allocate resources, such as water, food, electricity, or even

internet bandwidth. Common issues like traffic congestion could be reduced significantly by monitoring the flow of vehicles through the city, and altering the patterns of stop lights to match the pace and flow of traffic. Some proposals have shown drafts of parking being monitored across the city, allowing drivers to be seamlessly directed to open spots on demand.

Other proposals have included camera surveillance technology to be deployed across the city, which in communication with law enforcement could significantly reduce crime by creating a constant deterrent to illegal activity, and making the process of collecting evidence far simpler.

2.1 Smart Technologies in the Developing World

While in the US we may take for granted having regular access to basic amenities such as food, clean water, and electricity, and in many parts of the developing world, these things are not assured to people. For instance, many cities across the world struggle to intelligently allocate electricity where it's needed, leading to blackouts in some areas, and an excess in others.

Using Smart City technologies, these issues could potentially be observed and mitigated in real time using the large volume of data collected by sensors installed across the infrastructure of the city. While these cities themselves likely lack the funding to support a project of this scope, it would take no more than a humanitarian effort from a sufficiently generous organization to fund such a project, and potentially improve the quality of life of thousands of people for generations to come.

2.2 Boosting the Economy

Another benefit of this technology lies in the fact that, in addition to being a massive project in terms of construction, these projects would require the contribution of countless engineers, computer scientists, and city planners in order to work. The scope of these projects will on average far exceed that of a traditional city design, which generates a variety of employment opportunities for workers across a number of fields.

Additionally, the general marketability and media hype surrounding these projects could provide a boon to businesses operating in the city, both through the increase in tourism, and through an increased connection to the consumer base driven by increased access to data on consumer habits. For instance, a business could use data to

determine which locations across the city are most frequently traveled, potentially allowing advertisements to be more targeted in how they promote their businesses. Further, if social media data is tied in to the data collected, this information can allow local businesses to have their pulse constantly on the interests and needs of their customers.

3 Big Data Issues

Despite all of the exciting features that these cities can promise, it is important to acknowledge the potential risks as well. Even if these risks are not sufficient to warrant cancelling any given project, they should at least be recognized and accounted for by engineers and programmers that develop the accompanying systems.

A primary point of concern from data privacy advocates is centered around the sheer scope of the data collected from these cities. Data collected from residents of these cities can range from movement patterns (tracked from smartphones, from license plate scanning technology, or from public transit use), consumer behaviors (from businesses in the area, or from certain smartphone apps), or even video recordings at certain areas of the city to track traffic flow, and observe the composition of the traffic.

This data is often stored in a way which lends itself more easily to access and analysis, and can be collated and analyzed in real time. The speed of access is a major factor in not only the utility of this data, but also its potential danger. For instance, a malicious actor could potentially gain access to these databases, and have access to massive quantities of sensitive information, captured and analyzed in real time.

3.1 Security Issues With Big Data

Any person that has actively followed the news surrounding large data collecting companies is aware that security breaches are alarmingly common, even among very large businesses such as banks, credit card companies, and major software companies. While measures can be taken to reduce the chances of a security breach, and further measures can also be taken to reduce the impact of a potential breach, there will always be an inherent level of risk involved in collecting and storing large quantities of data. Critics of these projects question whether a few extra conveniences are worth this cost.

Indeed, some of these projects have even been scaled back in the face of backlash and concerns regarding the

collection of this data. The original Smart City proposal for the eastern part of Toronto was originally planned to span nearly 190 acres of land. Following a large amount of backlash from residents of the area, and from data privacy advocacy groups, the scale of the project was limited to 12 acres of land.

3.2 Who owns the data?

A major point of contention across many of these projects is the question of who should own and control the data that is collected from the variety of sensors, trackers, and cameras installed across the city. In the case of Toronto, the original proposal was for data to be controlled by a private tech company, which was a subsidiary of Google. Naturally, these companies have argued that they have the expertise to collect, collate, and process this data more quickly and efficiently than a government agency can.

Data privacy advocates have argued that these companies have nothing more than a profit motive, and under the current laws, particularly in the US, would have far too little oversight on how this data is collected and managed. One critic of Toronto's 190 acre project referred to it as an attempt to create a "corporate surveillance state".

3.3 Government Oversight

So on the one hand, if the data is owned by private corporations, without significant oversight or regulation, the data could be potentially sold off or leaked to other private corporations, violating the privacy of citizens residing in the city. On the other hand, if the local government were to control this data, this also raises a number of potential issues. As we have seen across a number of different governments across the world, many governments are fully willing to skirt or outright violate the law when it comes to data collection and privacy.

In the wake of the 2020 protests surrounding issues with discrimination in law enforcements, many local and federal agencies are responding with force to these protests. Certainly, if these agencies had access to wiper-scoped surveillance technology with little to no oversight on how the data is used, these could be used to quell protests and to coordinate the legally questionable and violent crackdowns on protests. For instance, the cameras and tracking technology could be utilized to surveil and potentially retaliate against people participating in demonstrations.

3.4 Illegal Access

Setting aside the issues of privacy, and assuming that the data is used for neutral or benevolent purposes, there are other issues that can arise from the collection of this data. A large database and "internet of things" that naturally accompanies Smart City developments is a prime target for hacking, either for the purpose of stealing the collected data, or in order to disrupt the vital technological systems of the city itself.

Due to the fact that each of these development projects handles the management of the data differently, sometimes being handled by governments, sometimes by private companies, and sometimes both, the risk profiles of these projects can vary widely, and even depends on the company that is contracted to develop and deploy the surveillance systems. In 2014, a cyber security expert named Cesar Cerrudo led a study which exposed major security vulnerabilities in traffic control sensors installed in many major cities across the US. If even simple technologies such as this are exploitable, then the much more complicated web of technologies involved in Smart City projects could contain major vulnerabilities.

Perhaps the most alarming aspect of these security flaws is that a malicious actor could exploit these to cause extreme danger to huge numbers of people. For instance, manipulating the patterns of traffic lights, targeting the distribution of utilities to certain areas, or manipulating the appearance of digital roadway signs.

4 Conclusion

Having reviewed the scope of these projects, and looking at both the pros and cons of the general Smart City movement, it is challenging to draw hard conclusions in either direction. On the one hand, the benefits in terms of sheer convenience passed on to residents is significant, and these technologies have huge potential for innovations which have currently not even been considered. These projects promise benefits for already highly developed cities simply looking to use data to make the daily lives of their residents more convenient, but also show significant promise to cities still in development, even in less wealthy regions of the world. The potential humanitarian benefit of these projects alone could make them worth pursuing.

On the other hand, as we explored earlier, the sheer scope of the data which could be collected, and well as the general lack of oversight on the companies involved in these projects leaves a lot to be desired from a data privacy

and data security standpoint. While these Big Data collection technologies allow local governments to make better decisions about their city, they also create potentially huge vulnerabilities for malicious actors to attack and disrupt cities in ways which were simply not possible with a more analog city design.

Whether the pros outweigh the cons will be something which can only be decided on a case-by-case basis, and each project would require oversight from not only cyber security experts, but also would require ethical oversight to ensure that the scope of data collected does not exceed that which is absolutely necessary for the functioning of the project.

Overall, these projects show great promise for the future, and with most budding fields of technology, there will likely be many stumbles and setbacks before the average citizen gets to reap the rewards. However with enough planning, oversight, and ingenuity, Smart Cities could very well be the way of the future for human civilization.