Senseable City Report

CURITIBA

MIT | SCL senseable city lab.

Introduction

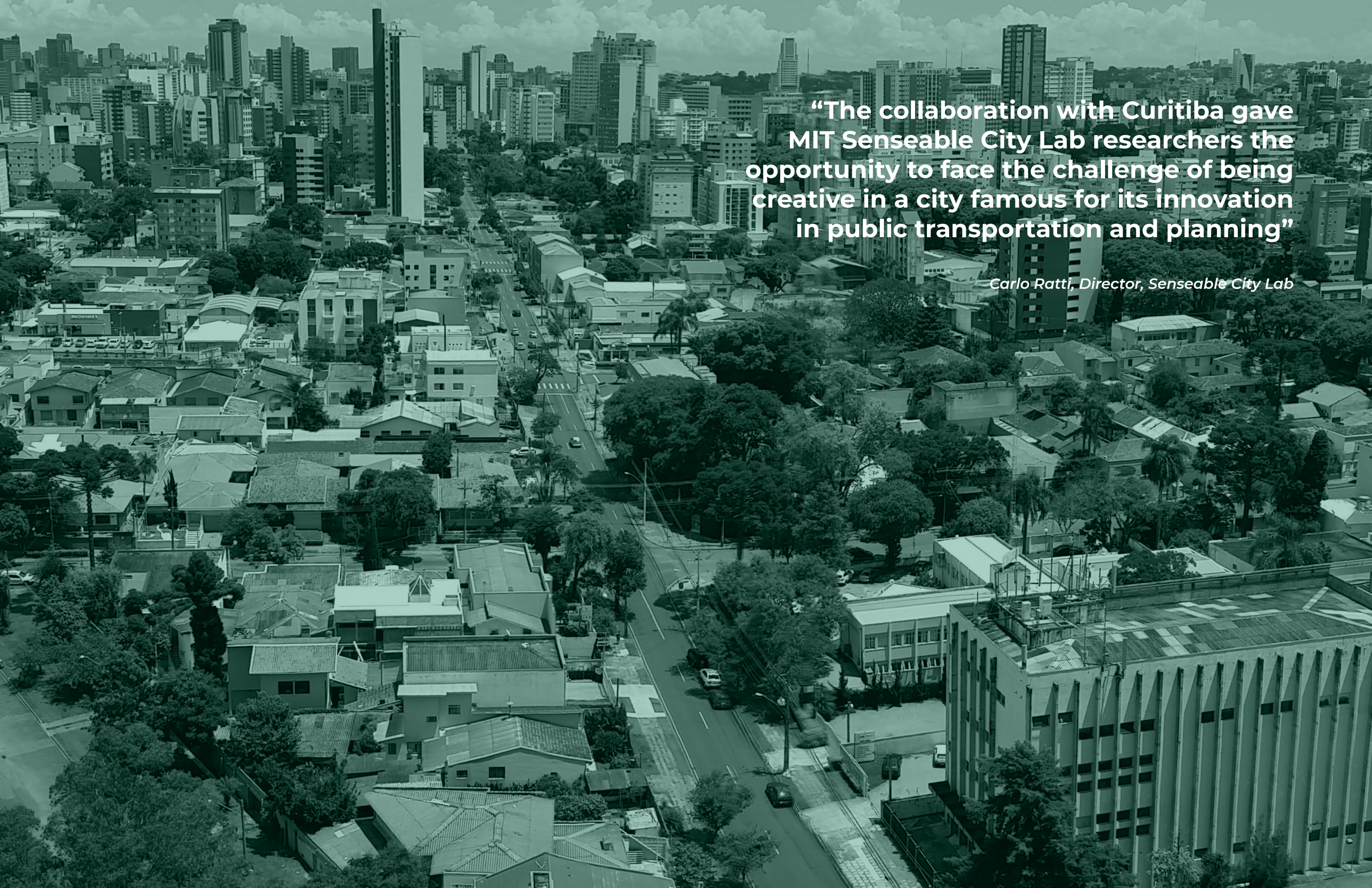
Curitiba | MIT Senseable City Lab

The city of Curitiba and MIT Senseable City Lab (SCL) have collaborated for two years on a project involving research and training activities in devising innovative ways to add value and new uses to Curitiba's famous transportation system. SCL has conducted three main activities during this period: first, a week-long workshop in Curitiba; second, the spring semester Digital City Design Workshop; third, a series of online lectures and workshops.

The collaboration began with a week-long intensive workshop in September 2019 in Curitiba, where technical staff from various departments within the city, faculty from local universities, and SCL researchers developed ideas to re-imagine Curitiba's BRT system using digital technologies. This workshop was supported by Prefeitura Municipal de Curitiba with participation of professionals from IPPUC, URBS, SMMA, UTFPR, UFPR, PUC-PR and UP. The results of this workshop were compiled in the Senseable Local Guide to Curitiba (Link).

Complementing the first year of the collaboration, Curitiba was the focus of the Digital City Design workshop, taught at MIT from February to May in 2020. The workshop was supported by Prefeitura Municipal de Curitiba in collaboration with IPPUC. The results were published in the Senseable City Guide to Curitiba (Link). The guide contains seven proposals developed by graduate students from MIT and Harvard.

Concluding the collaboration, SCL ran a year-long series of workshops focused on building knowledge with 12 technicians from IPPUC and other municipal secretariats, involved in the areas of mobility and management of data. The workshop allowed participants to be exposed to a broader range of research being developed in the Lab, acquire new technical skills, and develop ideas to improve Curitiba's transportation system with novel methodologies and design solutions.



“The collaboration with Curitiba gave MIT Senseable City Lab researchers the opportunity to face the challenge of being creative in a city famous for its innovation in public transportation and planning”

Carlo Ratti, Director, Senseable City Lab

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Introduction

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WORKSHOP

Workshop 1
Innovation by Design

Open Lecture
Oct.15, 2020
Fábio Duarte

W1A: Innovation by Design
Oct.16, 2020
Ricardo Alvarez

W1B Review
Nov.12, 2020
Ricardo Alvarez

W1C Presentation
Dec.10, 2020
Fábio Duarte, Tom Benson

Workshop 2
AI and Mobility

W2A: AI and Mobility
Dec.17, 2020
Paolo Santi

W2B Review
Jan.14, 2021
Fábio Duarte, Paolo Santi

W2C Presentation
Feb.11, 2021
Fábio Duarte, Paolo Santi,
Ricardo Alvarez

Workshop 3
Understand Mobility Pattern

W3A: Understanding Mobility Pattern When Transportation Data Doesn't Exist
Feb.25, 2021
Paolo Santi, Cate Heine

W3B Review and Workshop
Mar.25, 2021
Cate Heine

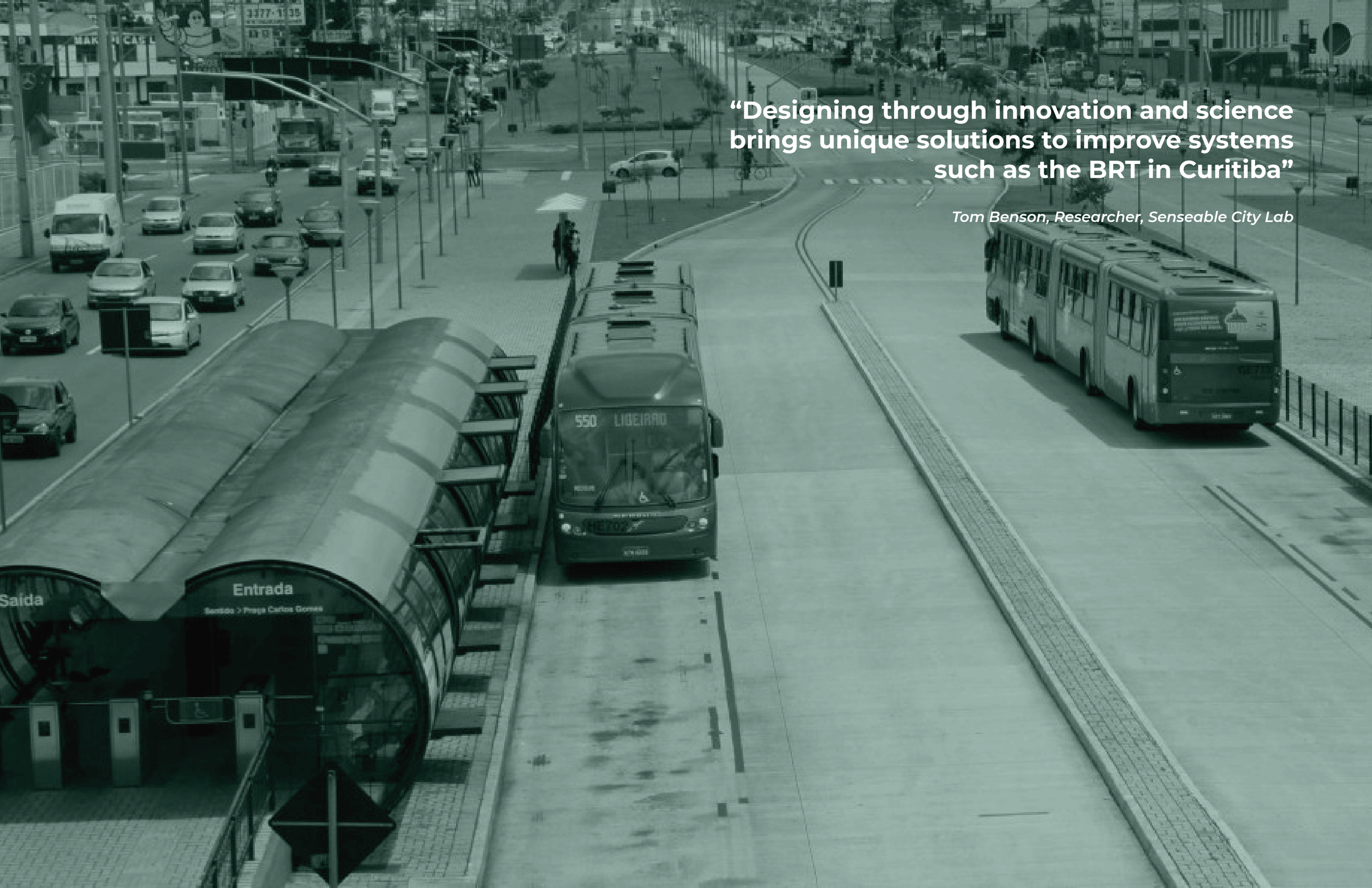
W3C Presentation
Apr.15, 2021
Fábio Duarte, Paolo Santi,
Cate Heine

Workshop 4
Sensing the City

W4A: Sensing the City
Apr.29, 2021
Simone Mora

W4B Review
May.27, 2021
Fábio Duarte, Paolo Santi

W4C Presentation
June.24, 2021
Fábio Duarte, Simone Mora,
Ricardo Alvarez



“Designing through innovation and science brings unique solutions to improve systems such as the BRT in Curitiba”

Tom Benson, Researcher, Senseable City Lab

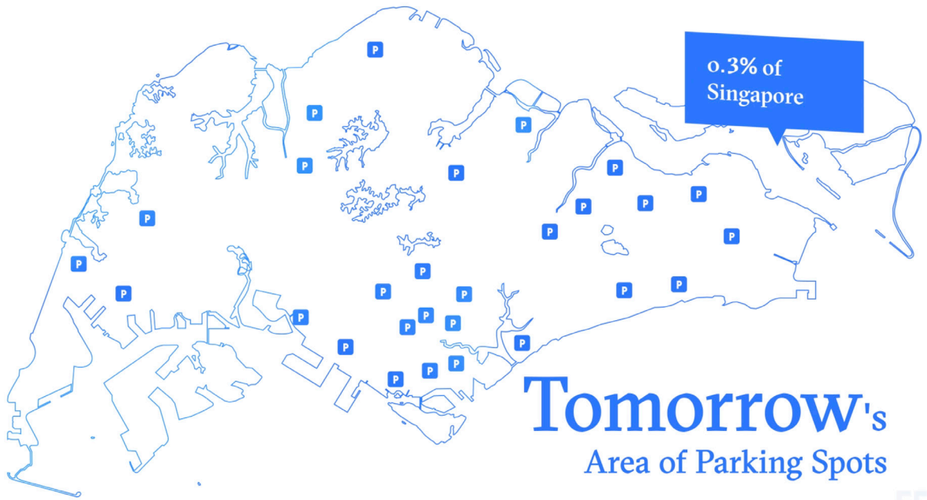
Innovation By Design

How might we use design to drive innovations?

The workshop series began with a lecture showing the wide spectrum of mobility research performed at SCL They continued with four areas of focus: Innovation by Design, AI and Mobility, Understanding mobility patterns when transportation data doesn't exist, and Sensing Technologies.

In Innovation by Design, we presented a methodology that SCL has been developing for years, combining digital technologies and design to address environmental, social, and economic urban issues. The results of this methodology have been compiled in 10 years of Senseable City Guides (Link). Participants were asked to develop initial ideas to innovate Curitiba's BRT system, enabling new forms of efficiency and interaction.

Video Link to Workshop One



“Artificial Intelligence will bring novel ways to understand and promote more efficient mobility solutions. AI is the new frontier of urban mobility”

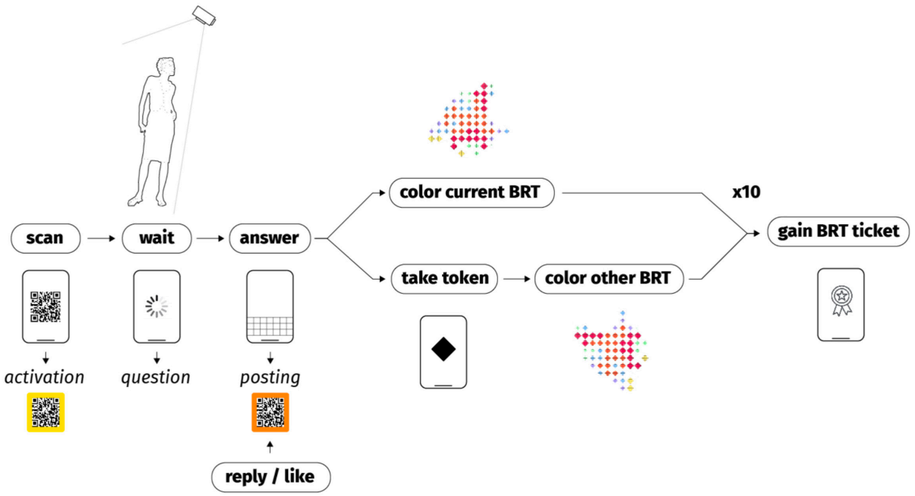
Paolo Santi, Principal Research Scientist, MIT Senseable City Lab

AI and Mobility

Use data to solve urban-scale problem

In AI and Mobility, we addressed how the abundance of data generated by mobility systems (from bike-sharing to bus systems to parking monitoring technologies), combined with new analytical methodologies, can shed new light on how we understand urban mobility. These findings afford the potential to improve transportation planning and management. Participants were asked to collect various mobility datasets in Curitiba and work on a particular problem.

Video Link to Workshop Two



“Social media data is an untapped resource that only recently has been used to better understanding our cities.”

Cate Heine, Researcher, MIT Senseable City Lab.

Understand Mobility Pattern When Transportation Data Doesn’t Exist

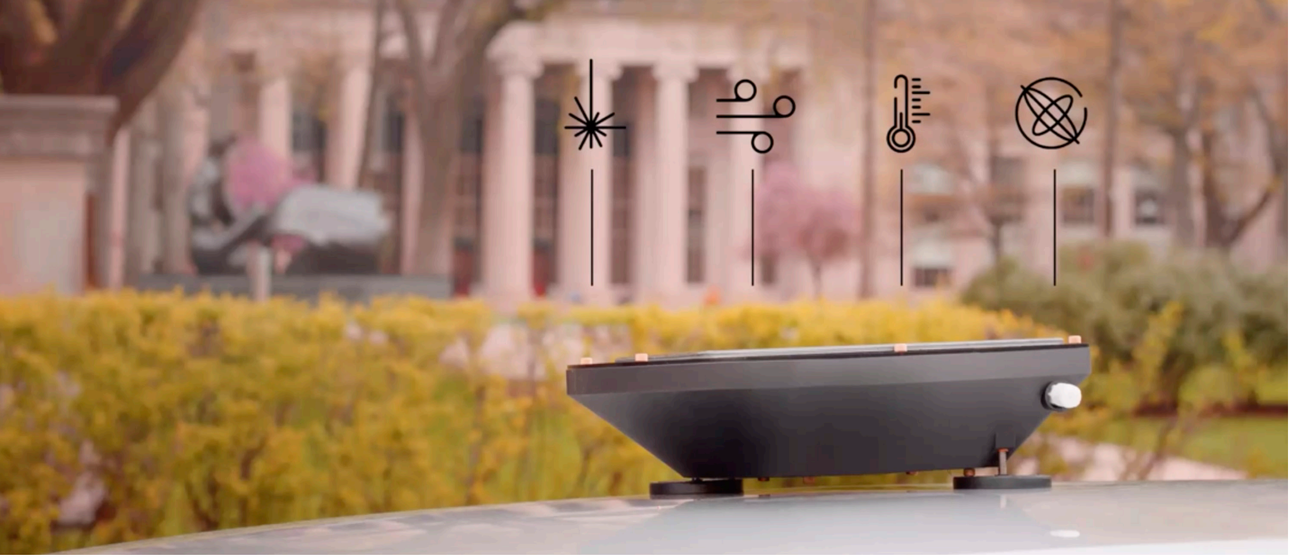
Analysis with Twitter data

Understanding mobility patterns when transportation data doesn’t exist focused on Twitter data. Participants learned how to scrape Twitter data online and how to perform some fundamental data analysis. The goal of this module was to explore various aspects of mobility without relying on traditional data sources (such as origin-destination surveys) or methodologies, which often do not exist or are sparse in space and time.

Video Link to Workshop Three

“Curitiba’s bus fleet can provide public services beyond moving people: it could become a network of environmental sensing platforms”

Simone Mora, Research Scientist, MIT Senseable City Lab



Sensing the City

Explore the senseable city

We concluded the series of workshops exploring what additional services could be added to the transportation system besides transporting people. The focus of Sensing Technologies was environmental monitoring systems, but participants were able to explore other possible uses of technologies to add value to traditional transportation modes.

Besides the educational and training activities (in-person workshop in Curitiba, the MIT course, and workshop series), the MIT Senseable City Lab also included the City of Curitiba in three independent research projects. First, In Shareable Cities (Link) we explore how ride-hailing mobility can impact mobility, improving accessibility and decreasing traffic. Second, Curitiba is one of the eleven case studies in City Veins (Link) in which we calculate the potential of using everyday vehicles as sensing platforms to provide real-time and hyperlocal environmental data to cities. Third, and still under development, we are working on AirLens, a simple device deployed in urban furniture, such as bus stops, that measures air quality data to visualize and inform pollution levels in different parts of the city.

Video Link to Workshop Four

CREATIVE WORKS

Workshop 1

Innovation by Design [SCL - Ricardo Alvarez]

Link to Student Works

DOM - DEMAND ORIENTED MANAGEMENT

Team: Alyson Wolf, Artur Furtado, Daniele Moraes, Mônica Máximo

Curitiba faces a scenario of loss of users in the collective transport system. In addition, the city needs constant and immediate information to manage this system, with cost reduction and environmental sustainability. In this sense, the DOM - Demand Oriented Management emerges a project that aims to collect real-time information regarding the operation of the city's public transport system and present this data for better management of this entire system. The DOM also seeks to provide a greater range of information to the user to decide on his shifts more consciously and planned.

TUBO ATIVO (Active Tube Station)

Team: Karin Gomes, Herick dal Gobbo, Leomar de Andrade e Vilson Kimmel

The Breathing Project provided for a system of tiny tubes with microalgae that purify the air. The greener, the more algae, and the more evidence that the air quality in that area is poor. When the tubes turn very green, it is necessary to replace them.

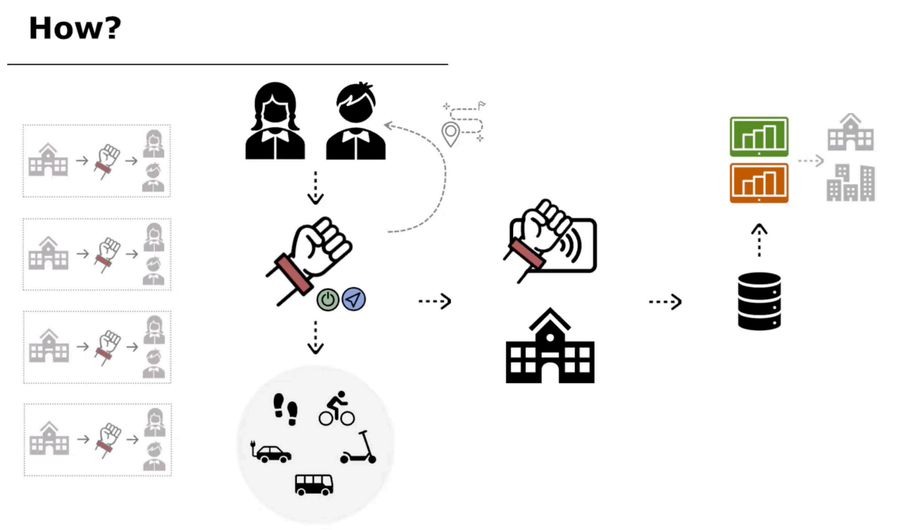
This project aims to encourage low-carbon mobility and citizenship, helping to reduce air pollution and reducing the number of transport users who use fossil fuels.

MOKI (Mobility for Kids)

Team: Lucimara Wons, Nathalia Oenning, Marilia Tavares e Marcio Marcelino

The MOKI (Mobility for Kids) project was developed based on the SDGs and the Mitigation and Adaptation to PlanClima of Curitiba, which pursues one of its goals, carbon neutrality in 2050. In this context, The proposal aims to encourage children aged 6 to 11 years to use, preferably, sustainable modes in their trips to school so that this mobility pattern is consolidated over the years.

The idea is to structure a program initially linked to municipal schools in a gymkhana format.



Workshop 2

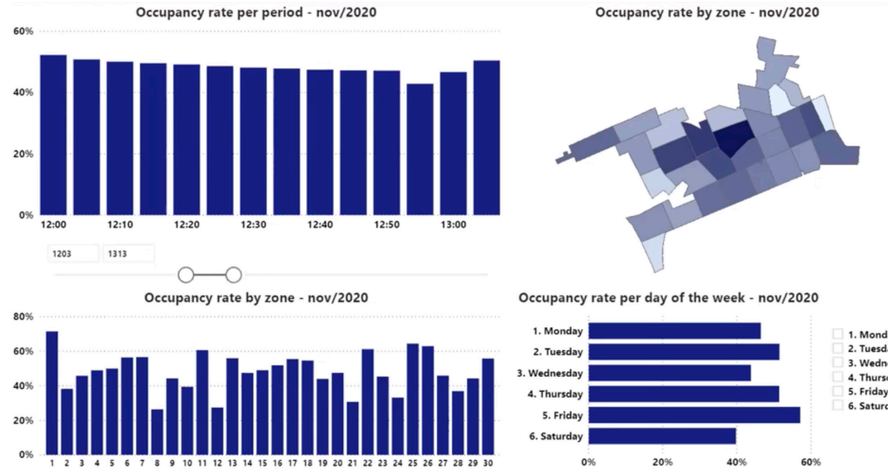
AI and Mobility [SCL - Paolo Santi]

Link to Student Works

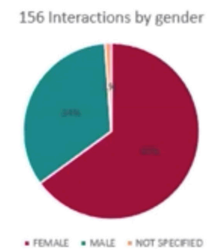
ESTAR OCCUPANCY RATE PREDICTION

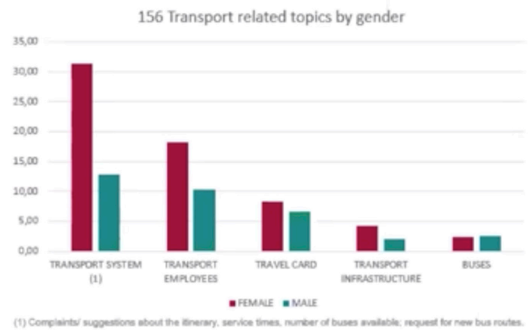
Team: Alyson Wolf, Artur Furtado, Daniele Moraes, Mônica Máximo

The modernisation of the Regulated Parking system (ESTAR) in Curitiba allowed the user to carry out the entire transaction directly in the accredited applications; in addition to the convenience, the new system also allows the storage of all transactions carried out in a database, another advantage is that transactions are georeferenced. In this context, elaborating a forecast of the occupancy rate by location, day of the week, and time could optimize the search process for available spaces, reducing unnecessary displacements.



56 System





Workshop 3

Understand Mobility Patterns [SCL - Paolo Santi]

Link to Student Works

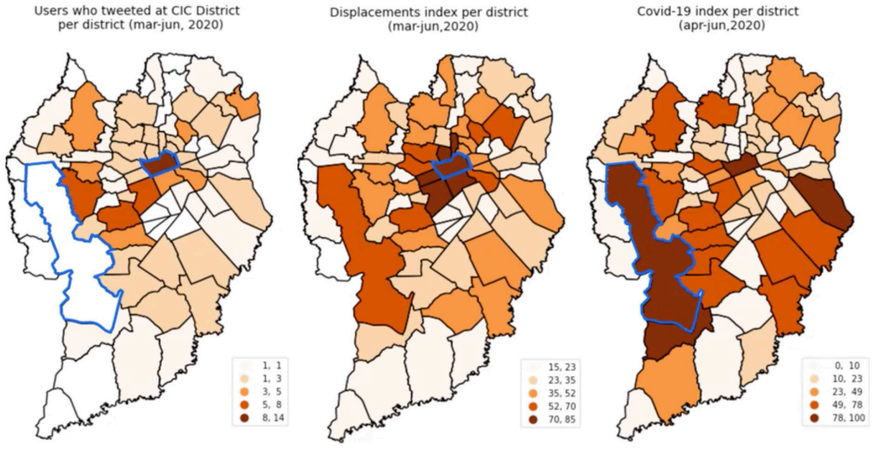
Displacements x Pandemic in Curitiba based on Tweets

Team: Alyson Wolf, Artur Furtado, Daniele Moraes, Mônica Máximo

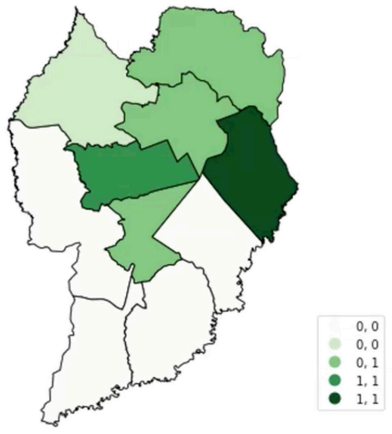
Due to the Covid-19 pandemic caused by the SARS-CoV-2 virus, unprecedented repercussions have been identified globally, concerning the health situation itself and the social and economic order, political and cultural. Mobilized by such impacts, scientists worldwide have been mobilized to produce content that substantiates policies and actions to fight the pandemic and return to normality.

In this regard, a line of research that has been adopted refers to the correlation between population displacement patterns and the prevalence of Covid-19.

Third product: Displacements versus Covid-19 cases



Pearson Coefficient – tweets / covid cases



Workshop 4

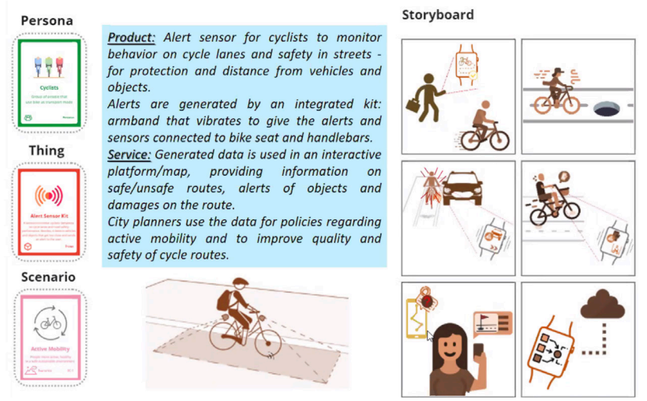
Sensing The City [SCL - Simone Mora]

Link to Student Works

MotoApp – Providing support to APPs motoboys

Team: Alyson Wolf, Artur Furtado, Daniele Moraes, Mônica Máximo

A few years ago, with the wide availability of smart cell phones (smartphones) by the population and the best connectivity conditions, technological evolution had provided comprehensive innovation in various economic sectors, from access to banking services and mobile phone mobility, as well as in the industry of food and deliveries via an app. In this segment, this technological access caused incredible market growth, reducing the barriers to entry for food establishments that want to offer their products via delivery, since they no longer need vehicles and dedicated personnel, being an example in the new shared economy, in which there is a more rational use of resources by society.

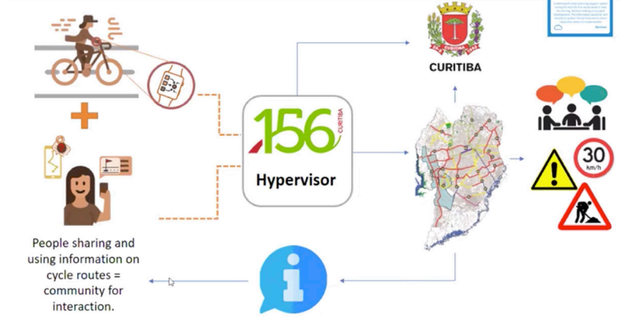


MOBILITY AS A SENSING PLATFORM

Team: Karin Gomes, Lucimara Wons, Nathalia Oenning, Marilia Tavares e Marcio Marcelino

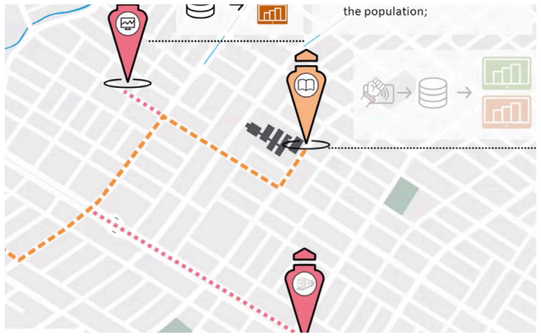
In the exercise proposed for workshop 4, the team worked with the active mobility scenario, selecting cyclists who move around the city of Curitiba as their target audience. Based on mobility as a sensing platform, we proposed the use of sensors attached to bicycles to monitor the behavior of cyclists on cycle paths and road safety conditions.

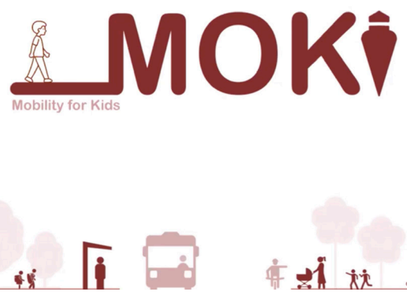
These sensors would be linked to an application with several features that provide information and allow user interaction from the collected data (traffic data, user health and fitness data, log of daily bicycle rides, weather reports).

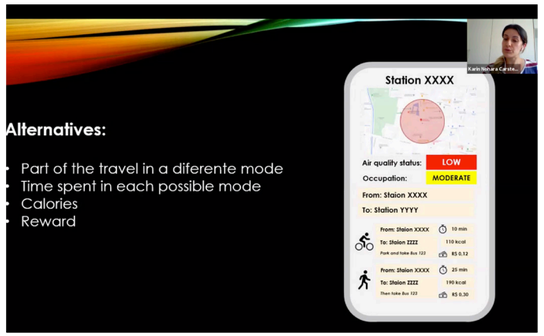


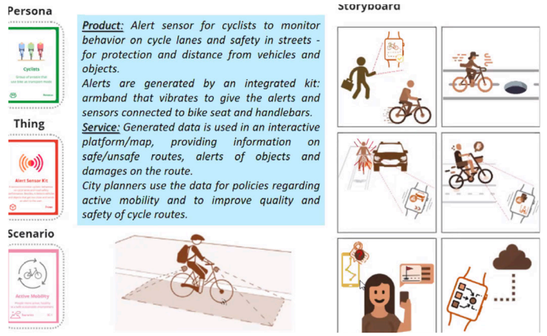
Creative Process Gallery

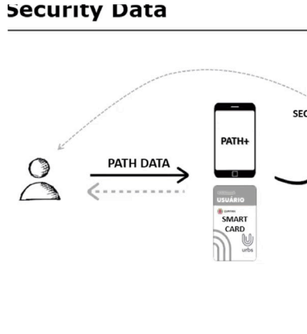
Data-driven analysis and design with Curitiba students

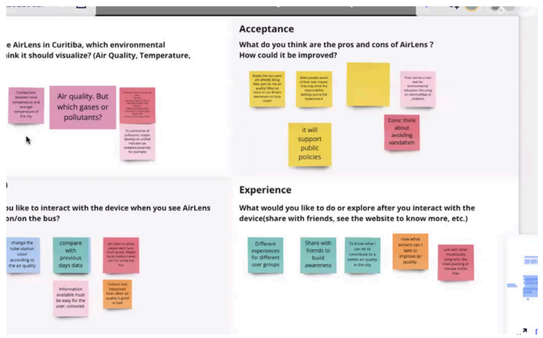


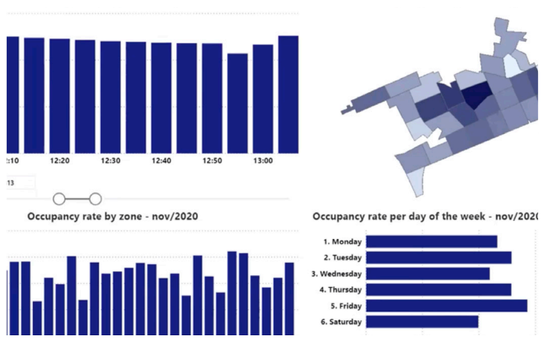


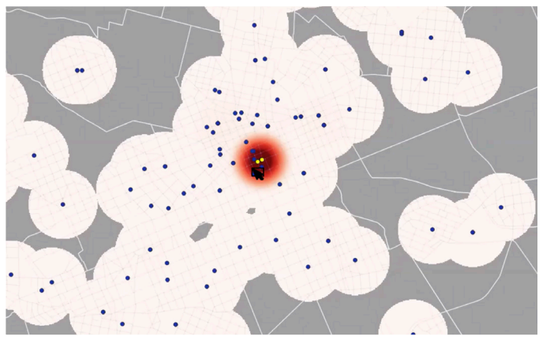


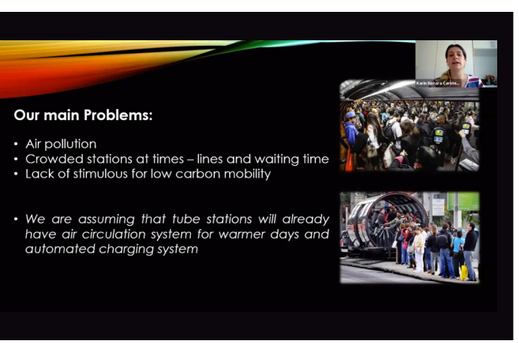


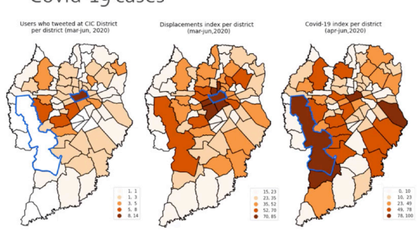


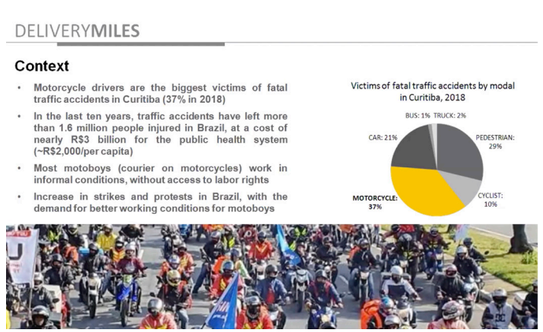


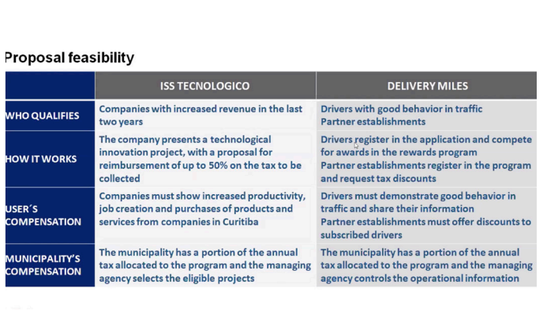


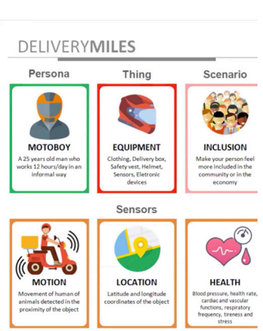








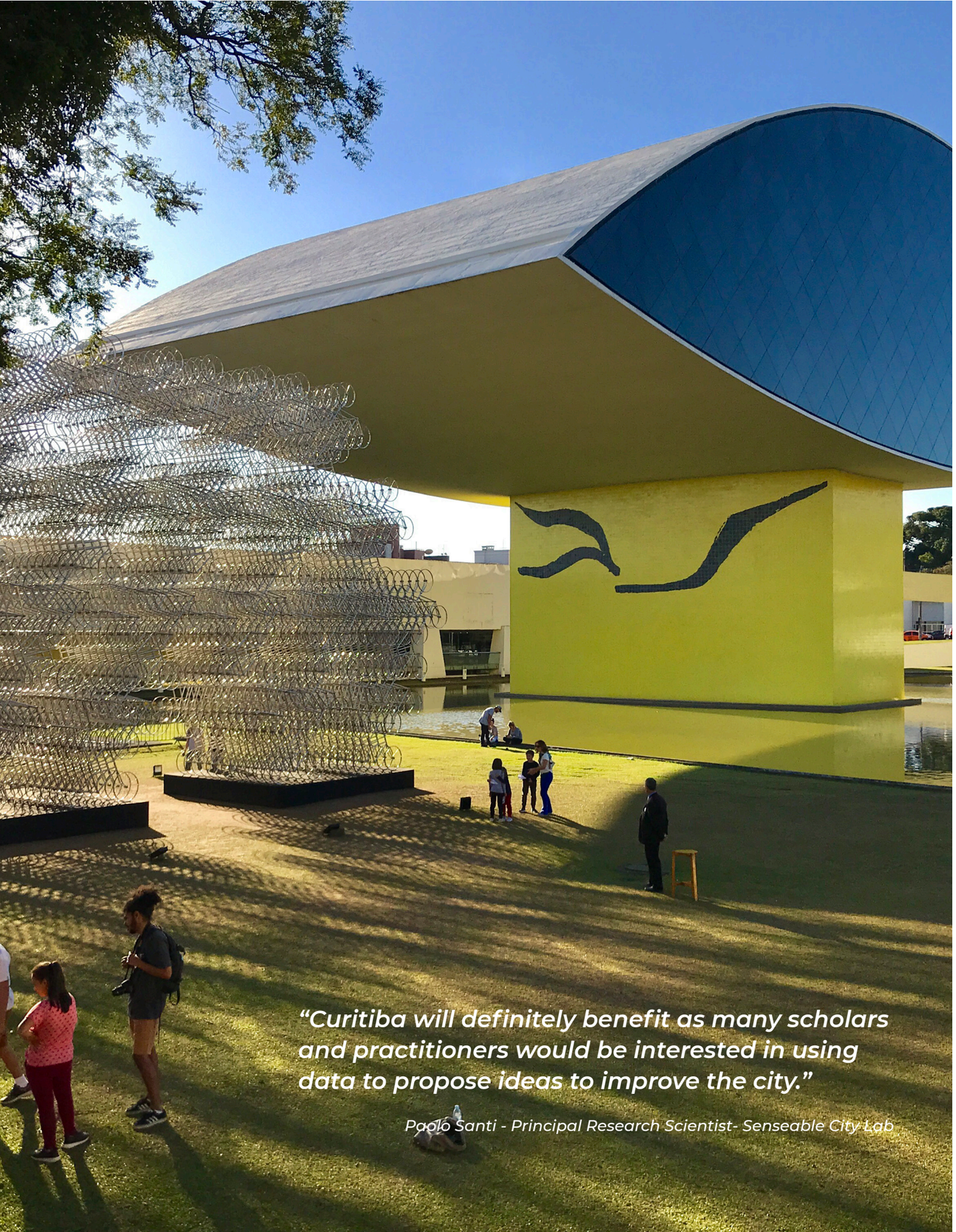




RECOMMENDATIONS

“The workshop participants will play a critical role in pushing data-driven work within the Municipality of Curitiba. The outputs showed how data availability, and master data analytics, can enrich mobility planning and design.”

Fábio Duarte, Principal Research Scientist, MIT Senseable City Lab



Conclusion

What’s next?

1 Transformation through design

We understand that daily workload sometimes hinders creative thinking, but throughout the workshop series and the initial intensive workshop, we could see that focusing on creative thinking and being challenged by an external panel has been highly beneficial to participants. Serving time every year for such activities can boost creative work within the technical team.

2 New technical skills

Another legacy of this collaboration, in particular the workshop series, is the importance of learning technical skills that are not directly connected to the participants’ daily work. Being open to new techniques has helped participants to understand topics of their work in unexpected ways, which might contribute to the search for new solutions to Curitiba’s transportation system.

3 Data availability

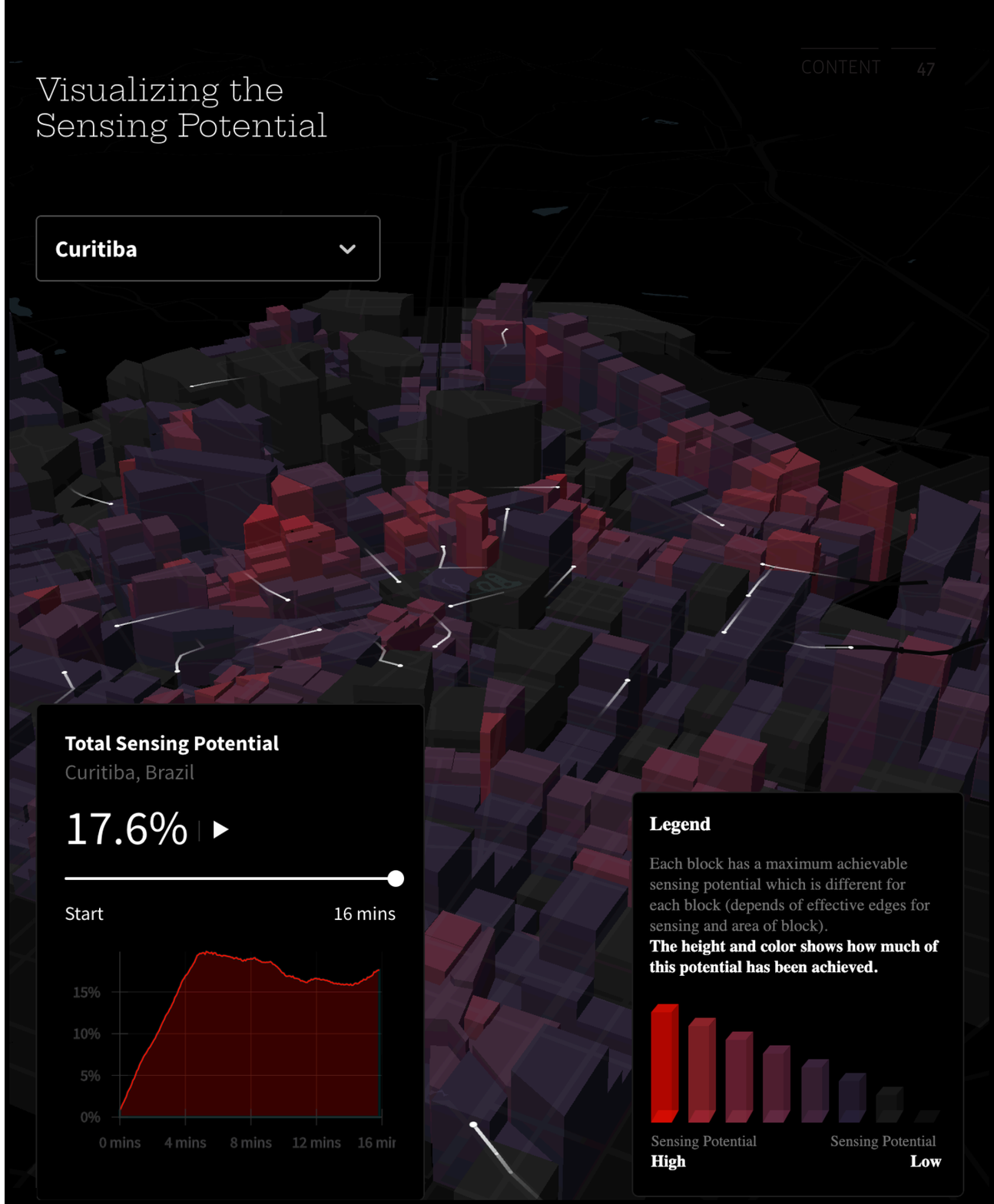
Curitiba is a data-rich city, within the Brazilian scenario. However, often SCL and participants encountered difficulties accessing data that exists. Sometimes the data was distributed among different agencies; sometimes, it took a long time to have it aggregated, but, more often, the main issue is that this data is not publicly available. Participants in the workshop learnt the importance of easily accessing data. During the workshops the city saw how new ideas can emerge from data-driven creative work. If data is available to a larger audience, the city will definitely benefit as many scholars and practitioners would be interested in using this data to propose ideas to improve the city. As a result of the workshop, the SCL believes that participants will play a critical role in leading a data-push within the Municipality of Curitiba. Their work show how data availability, and master data analytics, can enrich mobility planning and design.

CITY VEINS

How efficients is driven-by sensing for real-time environmental monitoring of city?

By deploying such sensors on service vehicles that routinely navigate through city streets, we create a dynamic sensing network that comprehensively and efficiently monitor the urban environment. The drive-by sensing approach developed in City Scanner, complements stationary environmental monitors by providing a flexible and scalable solution with lower deployment and maintenance costs.

Although drive-by sensing offers substantial advantages over traditional urban sensing methods, the data sampling frequency and spatial granularity of measurements are constrained by factors such as street topology and mobility patterns of sensor-equipped vehicles. In City Veins we propose a solution that considers the street network topology and investigates its effect on the quality of data. We also study the temporal aspects of drive-by-sensing approach, using a temporal decaying function that might vary for different environmental properties (air quality information has a higher temporal sensitivity than the road quality, for instance). Combining the street topology, the temporal decaying function of environmental data, and the vehicle routes, City Veins measures the sensing potential of cities. Curitiba's transportation network gives a unique opportunity to create a mobile network of environmental sensors using the existing infrastructure, adding value to Curitiba's famous BRT.



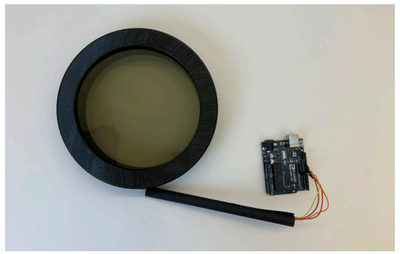
AIRLENS

How might we engage citizens into conversation over air pollution issues?

Poor air quality is a huge public health concern, with 9 out of 10 people in cities worldwide not breathing clean air, and an increased risk of many health conditions as a result of regular exposure. These effects are also extremely unequal, with some groups, such as those from poorer socioeconomic backgrounds and people of color, being much more likely to live in an area with poor air quality.
AirLens provides an accessible way for all age groups to learn more about air quality and its disparities.

We hope to visualize the unseen public health and inequality issues which air quality is entangled with, and encourage citizens and lifelong learners to engage into clean air action.

In Airlens, we use a combination of physical, digital, and educational components to make the invisible visible, and start conversations about the relationship between air quality, public health, and urban inequality.



A glancable, interactive interface, through which we visualize the invisible air pollution level in real time

APPENDIX

Creative Work Package

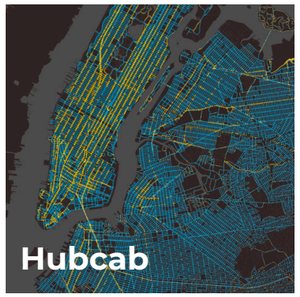
Where the next inspiration from?

Workshop 1

Innovation by Design

Workshop 2

AI and Mobility

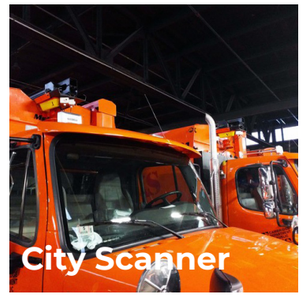


Workshop 3

Understand Mobility Pattern

Workshop 4

Sensing the City



Reference

Introduction

1. Senseable City Guide - Curitiba: http://senseable.mit.edu/papers/pdf/20200811_SENSEABLE_GUIDE_TO_CURITIBA.pdf
2. Senseable City Guide 10 years: https://senseable.mit.edu/senseable-guides/

Workshop

1. Roboat: https://roboat.org/
2. Minimum Fleet: https://senseable.mit.edu/MinimumFleet/
3. Unparking: https://senseable.mit.edu/unparking/
4. Hubcab: http://senseable.mit.edu/hubcab/
5. City Veins: https://senseable.mit.edu/city-veins/
6. Stockholm Flows: https://senseable.mit.edu/stockholm-flows/
7. Liminal Ghettos: http://senseable.mit.edu/porto/
8. City Scanner: http://senseable.mit.edu/cityscanner/
9. Tiles Toolkit: https://www.tilestoolkit.io/
10. Sharable Cities: http://senseable.mit.edu/shareable-cities/
11. Workshop Recording: https://www.dropbox.com/sh/ecluutfb5m0ug9z/AADcFXity-fye5FziQCEhpRRXa?dl=0 v

Recommendations

1. City Veins: https://senseable.mit.edu/city-veins/
2. One Country, Two Lungs: https://senseable.mit.edu/twolungs/
3. Amsterdam 2 - Senseable City Guide: http://senseable.mit.edu/papers/pdf/20170525_SCL_Guide_Amsterdam-Roboat.pdf
4. Melbourne - Senseable City Guide: http://senseable.mit.edu/papers/pdf/20180910_SENSEABLE-GUIDE-MELBOURNE.pdf
5. Cape Town - Senseable City Guide: http://senseable.mit.edu/papers/pdf/20131231_Howe_etal_SenseableCity_SAP.pdf

Visuals

Cover Curitiba Bus Station, https://en.wikipedia.org/wiki/Esta%C3%A7%C3%A3o_Tubo#/media/File:Bus_Stops_2_curitiba_brasil.jpg

Page3 Curitiba Bus Station, https://en.wikipedia.org/wiki/List_of_bus_rapid_transit_systems#/media/File:Linha_Verde_Curitiba_BRT_02_2013_Est_Marechal_Floriano_5978.JPG

Page4 Curitiba City View, Link: https://pixabay.com/zh/photos/curitiba-center-horizon-quality-2778943/?download

Page11 Digital City Design Workshop Student Works: https://senseable.mit.edu/senseable-guides/

Page12 Minimum Fleet Head Picture, Link: https://senseable.mit.edu/MinimumFleet/
Unparking, Link: https://senseable.mit.edu/unparking/
Hubcab, Link: http://senseable.mit.edu/hubcab/

Page15 City Veins, Link: https://senseable.mit.edu/city-veins/
Stockholm Flows, Link: https://senseable.mit.edu/stockholm-flows/

Page16 Interactive Map for Porto Biennale, Link: http://senseable.mit.edu/porto/

Page26 City Scanner, Link: http://senseable.mit.edu/cityscanner/
Tiles Toolkit Set, Link: https://www.tilestoolkit.io/

Page29 City Veins interactive map for Curitiba: https://senseable.mit.edu/city-veins/

Page31 AirLens video clips

Welcome to the Senseable City Lab - a cutting-edge multidisciplinary research group that studies the interface between cities, people, and technologies, and investigates how the ubiquity of digital devices and the various telecommunications networks that augment our cities are impacting urban living.

The Senseable City Report to Curitiba is where we turn our attention to one of the most dynamic cities in Brazil: Curitiba.

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