Message from the Chair:

I am excited to be the new chair for the APA Technology Division. We have grown to over 700 members in Spring 2018. Thank you, Nadar Afzalan, outgoing chair, for continuing his leadership with the division and the newsletter.

In this issue, you will learn from a wide range of topics related to urban innovation and planning. These topics are about (1) emerging issues caused by the development of smart city technologies. (2) application of new technologies in planning including 3D GIS and virtual reality, autonomous vehicles and internet of things and (3) new methods of understanding cities using different data sources such as embedded sensors or crowdsourced geo-data.

APA-Technology Division provides information for its members through publishing articles that intersect planning, design, and technology. We always look for new articles that help professional planners learn about novel experiments and approaches in using digital and novel technologies or strategies. We are especially interested in the following broad topics:

• Digital technologies for connecting urban planning and healthcare organizations
• The use of digital technologies to enhance equity, social justice, and community development.
• The use of new technologies for climate adaptation or disaster management.
• Smart city approaches for planners and plan-making
• Novel interorganizational collaboration approaches for adopting smart technologies
• Critical analysis of using planning support technologies and online tools in collaborative decision making.

We accept case study research, best practice analysis, critical views, idea papers, and review essays. The articles should be between 400–800 words with clear takeaways for professional planners. We do not accept promotional articles at this moment. If you have ideas for a new article, you can contact me at tom.coleman@wsp.com or our newsletter committee chair nader_afzalan@redlands.edu.

I would like to give special thanks to our newsletter layout editor, Jessie Hartmann, whose creativity and efforts are always very helpful for preparing our newsletters.
CommuniDADOS

Honor Award Recipient | National Science Foundation and University of Texas at Austin

The CommuniDADOS study (National Science Foundation and University of Texas at Austin) addressed the lack of transparent empirical data that measures social, spatial, and environmental impacts of informal settlements. This lack of data limits the ability of residents in informal settlements to participate in the planning processes that change their own neighborhoods. This lack of data also limits the extent to which cities in developing urban regions can claim equitable planning practices and outcomes. As a result, organized community groups in informal settlements are restrained from leveraging for housing and other neighborhood improvements, and public knowledge about the efficacy of development in improving urban livability is suppressed. The combined use of assessment criteria, evaluation, and the digital tool iDADOS, which provide an interactive map, lays the groundwork for performing scenario planning analysis for futures that better assimilate social and housing needs. While scenario planning and interactive technologies are novel within the field of understanding informal settlements, the tool’s use of social, physical, financial, and economic data for scenario planning capabilities is rare for all of planning. ComuniDADOS, has significant potential to calibrate Smart City thinking to the context of Latin America, synthesize the efforts of the diverse actors and institutions involved in development, increase citizen participation and project equity, visualize the fusion of policy goals and diverse user needs; and better align the goals and actual achievements of policies that directly affect some of the world’s most vulnerable citizens in and beyond Brazil (Figure 1).

RegenCities Initiative

Honor Award Recipient | Skidmore, Owings, and Merrill LLP

The RegenCities Initiative (Skidmore, Owings, and Merrill LLP) developed a new systems-based methodology for urban planning and design referred to as “Health Topography.” The RegenCities tool functions as a type of urban MRI for communities that combines traditional census tract data with the ever increasing amount of open and big data and analyzes the information through five urban systems: built, natural, infrastructure, socioeconomic and cultural. The tool aggregates the data and represents it to create a graphic map that pinpoints areas of abundance and scarcity within communities. Planners, urban designers and architects can use this layered Health Topography map to better understand correlations and develop regenerative strategies to address issues by leveraging scientific research outside the traditional disciplines of design and applying innovative solutions that improve the health and well-being of the built, natural and social environments.
International Riverside Smart City

Honor Award Recipient | AECOM Urban Analytics

The International Riverside Smart City project (AECOM Urban Analytics) is a comprehensive master plan for a 74 square km (18,285 acres) area in North West Chengdu, China. This project was commissioned with a vision to create a world class innovation hub bringing together high tech-industry (both manufacturing and R&D), the region's top academic institutions, and a high-quality living/working environment that incorporated the latest concepts of smart cities. To implement this vision, AECOM developed an urban design inspired from the region's natural setting and historical connections to water as well as planning insights from successful innovation hubs from Silicon Valley, Boston and other locations. The Plan incorporated the use of ‘smart planning’ - a performance based, data-driven urban design process that used measurable key performance indicators (KPIs) to provide an iterative performance feedback during design development of a high-performing, sustainable and livable environment. Another highlight of the Plan was the development of a comprehensive ‘Smart City Framework’ that guided the plan towards integrating smart infrastructure, both physical (utility and transportation networks) and digital (wireless, IoT sensors etc.), and various smart technologies that leverage data captured from the digital infrastructure to improve the quality of life in the City (Figure 2).

Chula Vista Smart Cities Strategic Action Plan

Merit Award Recipient | City of Chula Vista, CA

The Chula Vista Smart Cities Strategic Action Plan (City of Chula Vista, CA) was created and adopted to serve as a roadmap that outlines priorities and guides the City’s smart city efforts. The Action Plan was developed through a collaborative process across city departments and represents the collective vision of city leadership, department heads, and key stakeholders in the community and region. The Action Plan consists of four goals that are supported by ten objectives and thirty-nine initiatives. The process of developing the Action Plan began with a comprehensive analysis to determine the strengths, weaknesses, opportunities and threats facing the City’s smart cities efforts. The City engaged Madaffer Enterprises to work closely with city staff to conduct individual interviews with all department heads, including Police and Fire. The meetings intended to capture critical input from departments to ensure a collective process in defining the city’s smart cities vision and Action Plan. The City also conducted a public opinion survey with Chula Vista residents to gather input on smart cities priorities to also ensure community input on the development of the Action Plan.
The fight over streets is not new in urban discourse. History witnesses constant battles among street users, policy makers and the automotive industry since the invention of the combustion engine car and its deployment in streets. The tension between cars and pedestrians reaches its peak when it ends in death. To avoid this, many constraints are put on pedestrians and the way they use the street. However, the number of pedestrian fatalities across the globe reveals that the regulations have not been as effective as expected. Furthermore, an increased consciousness toward the social capacity of streets calls into question car prioritization in street regulations. Cities have started to rethink traffic regulations as well as street configuration which they find overshadowed by ubiquitous presence of cars.

Due to the high number of fatalities, the idea of self-driving cars attracts public scrutiny. By being electric-powered, digitally connected and equipped with sensors, their promise is reducing the number of accidents to zero, introducing

Seaport District AV testing area, Boston: Would the intermingling of AVs with pedestrians and bicycles be possible?
Source: https://goo.gl/maps/ooKTgh1QrG8z
a new chapter in energy efficiency and liberating cities from parking spaces.¹ These pedestrian-friendly attributes allow for different kinds of recreational and everyday activities, which were unsafe before, making streets pleasant places for all users and all types of usage. However, the realities of autonomous vehicles (AV) and the questions they raise regarding safety, privacy and urban inequality call for a more skeptical examination of their promises.

It is fundamental to question the prevalent, optimistic views of AV’s ability to address all transportation problems, knowing that their implementation necessitates adjustments to urban form. One example of this is implementing urban facilities that integrate vehicle-to-infrastructure (V2I) or vehicle-to-vehicle (V2V) communication.² However, more challenging adjustments such as managing the relationship between autonomous cars, ordinary cars and pedestrians, needs reconsideration before AVs are released in the market. The coexistence of the above parties could become problematic because of the car’s wireless service, known as DSRC or Dedicated Short-Range Communications, camera and radars. Every time an object such as a bicycle or pedestrian approaches the autonomous car, these technologies stop the car or reduce its speed.³ One may ask if this function is rational in today’s city, or question what changes in the streets would justifi its usage.

A brief study of history shows that it’s not the first time that streets have needed to adjust in response to a new technology. In the early 20th century, the combustion engine car faced the same problem coexisting with people who were used to wandering around city streets freely, paying no attention to the cars. To solve this problem and bring fluidity to car circulation, automobile manufacturers put considerable pressure on policy makers to turn streets into suitable places for circulation so that they could increase profit. However, constraining people was not easy and various socio-technological inventions came into play to prepare society for the pervasive presence of cars. One such invention was the word ‘jaywalker’, which was established in the 1920’s and is still extensively used.⁴ AV manufacturing is thought to be more profitable than normal car manufacturing due to its business model of car sharing. Furthermore, the industry has absorbed enormous amounts of capital on a global scale. Therefore, it seems very probable that investors, who are watching the testing and production of these cars, will come up with ways to make their investments profitable as soon as possible. This means that autonomous cars, in the near future, will be introduced to the streets whether or not streets are prepared for them.

As a matter of fact, we cannot be certain about how the new technology would affect the street life and pedestrian permeability. As history has shown, the power of capital and socio-technological inventions can engender change in cities and adjust the streets to industry imposed conditions. However, these conditions can be mediated by planners, policy makers and pedestrian advocates. During this transitory period and before AVs arrive in our streets, we as street users should raise awareness about our agency to regulate this new transportation system.⁵

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⁵ A list of the regulations in different States can be found in: Anderson, J. M., (2014). autonomous vehicle technology, Santa Monica, CA, Rand corporation., pp.97-110
The soundscape is a rich source of information about city life. It reflects human activity, ecological conditions and is modulated by the physical environment. At the same time, urban noise is a concern for public health and well-being, associated with a range of medical issues including cardiovascular diseases. The sonic environment of the city, however, is still poorly understood by planners and policy makers. Current sensing approaches reduce the complexity of the soundscape to basic noise levels, expressed in a single number. Planners lack an accessible and practical method that enables a more fine-grained understanding of noise characteristics and makes these measurements comparable across time and space.

For this purpose, we designed a new type of noise sensor and deployed a batch of these sensors in a dense network of street lights in the city of Los Angeles. The sensors do not record audio, but instead capture a range of statistical values. As descriptors of the “noisescape,” these indicators support the type of granularity and continuity necessary to glean actionable insights from noise data.

Mounted on the streetlights, the sensors deliver a nuanced representation of the noisescape and its spatial and temporal dynamics. This representation can be used for developing and enforcing noise pollution guidelines, detecting incidents or creating detailed models that support architects, urban planners and policy makers to work with auditory phenomena, address noise pollution and improve the sonic environment of cities.

From September 2016 through January 2017, the Bureau of Street Lighting in Los Angeles supported a pilot project of 30 sensor-equipped street lights in northern LA near the intersection of Santa Monica Boulevard and Virgil Avenue. The area is characterized by a mix of residential, commercial and light industrial land use. Lockwood Avenue Elementary School is also located within the pilot area. We collected several data points:

- Equivalent sound pressure ($L_{eq}$): minimum, maximum and average levels aggregated over 1-minute intervals.
- A-weighted equivalent sound pressure ($L_{Aeq}$): minimum, maximum and average levels aggregated over 1-minute intervals. A-weighting is a frequency weight that simulates the response of the human hearing system, approximating the loudness as perceived by humans.
- Acoustic energy ($E$) in 3 frequency bands: low (<0.4 kHz), middle (0.4 kHz–8kHz) and high (>8kHz), aggregated over 15s intervals to provide additional insights into the spectral and dynamic characteristics of the urban soundscape.

In addition to the sensing experiment, we also conducted an observational study on location to support the interpretation of the sensor values.

During the experiment, we found a number of relevant insights. First, the addition of the three frequency bands enhances our understanding of a busy street: while the traditional sound pressure values show a relatively even noise distribution throughout the day, the frequency bands show a pronounced peak of low frequencies in the afternoon, associated with truck traffic. The data also reveals local differences in the noisescape, which are normally not captured due to the larger distance between sensors. In future work, this allows the detailed study of how architectural design elements such as tall, flat surfaces, or vegetation influence the noisescape. Furthermore, the data contained the signatures of incidental and systematic urban activities are revealed that are often missed by short-term, local noise audits. These include for example the noise generated by waste collection.

We recommend planners take the following insights into consideration:

**Insight 1: Go beyond the typical A-weighted sound frequencies.**

Patterns around spatial and temporal use of the city were revealed by studying other frequency bands beyond the
typical A-weighted frequencies adjusted for human hearing. We have a visceral response to sounds in low frequencies that may impact our well-being more than we think. These types of qualitative metrics could prove useful for planners in making zoning and land-use decisions.

Insight 2: Spatial and temporal density matter.

Planners typically take spot measurements of the sonic environment for specific large projects or as part of new development. However, it is difficult to maintain oversight for an extended period of time to understand the long-term impact of certain development trends. Having access to continuous data provides that oversight. Furthermore, more complex interactions emerge based on seasonal changes, vegetation changes, the choice of architectural materials etc.

Insight 3: More data may have other unexpected outcomes.

As cities like LA aim to make as much data public as possible it is important to consider the possible impacts on urban dynamics. The LA Open Data Policy describes how the city imagines stimulating entrepreneurial activities with ready access to non-personally identifiable data. It is likely that continuous sound data would provide a powerful additional source of inspiration for a community, but requires consideration of data governance and unintended social effects such as gentrification.

Insight 4: Soundscapes should be planned.

The work demonstrates how important sound can be for a reflexive planning practice. In city design, we tend to overemphasize the visual realm with strict signage ordinances and façade guidelines. The availability of noise data could present a new way of designing that goes beyond the visual.

The data can be explored at the website http://noisearray.org. Acknowledgments: Los Angeles Bureau of Street Lighting

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1 See http://www.lamayor.org/garcetti_directs_city_departments_to_collect_data_for_open_data_initiative

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Figure 2. The frequencies recorded on Santa Monica Blvd. show a noticeable bump in low frequencies during the afternoon, which is largely missing from the db(A) values.

Figure 3. The deployment area with recorded noise levels.
Exploring Alternative Sizing-Rebalancing Scenarios in Mobility on Demand Systems

Dimitris Papanikolaou, DDes | Assistant Professor at UNC-Charlotte, School of Architecture and Department of Software and Information Systems

Computational scenario analysis is a fundamental practice in urban planning in which a decision maker formulates a question and a computer model simulates the hypothetical scenario for subsequent assessment. Here, I concentrate on scenario analysis for planning mobility on demand (MoD) systems [1].

Widely perceived as emerging modes of sustainable transport, MoD systems utilize shared vehicles, parking spaces, and advanced information technology, allowing citizens to move from point to point on demand while cities can reclaim back urban land. With an industry nearly doubling biannually, global fleets accounting 104K (2014) and 14M (2017) cars [2] and bikes [3] respectively, and pilot autonomous vehicles (AV) already cruising in streets of cities, MoD systems are one of the most rapidly growing sectors of urban transport.

Unfortunately, MoD systems are also one of the most difficult mobility systems to plan and operate. Sizing and rebalancing is the critical problem of determining the least-cost combination of infrastructure size (number of vehicles, parking spaces, road capacity) and rebalancing work (dispatches of empty vehicles from full to empty locations) to serve a pattern of trips. Increasing one, decreases the need for the other. In transportation research, analyzing such tradeoffs requires discrete micromodels of transportation networks that simulate accumulations of vehicles by first equilibrating route choices [4], [5]. Developing such models is laborious, data intensive, and computationally heavy, without always guaranteeing results.

Unfortunately, there are no simple ways to analyze sizing-rebalancing tradeoffs in MoD systems with micromodeling methods. Estimating rebalancing work depends on routing but routing depends on assumptions about network structure and user trip patterns which are by definition random and unknown.

As part of my research at Harvard and UNCC, I develop novel approaches to analyze sizing-rebalancing tradeoffs by modeling MoD systems macroscopically, as dynamic systems [6]. From a dynamics perspective, trip paths are unimportant. What matters is where and when departures (outflows) and arrivals (inflows) occur and consequently, which locations, at what rate, and to what extent, fill with or empty from vehicles. These fluctuations determine minimum sizing and rebalancing requirements. Recent studies have shown that even though individual trip patterns are random and unknown, human mobility patterns are macroscopically consistent and predictable [7], [8]. By analyzing and comparing real and synthetic trip patterns in bike sharing systems, I showed that vehicular mass always moves periodically between two types of locations (conventionally categorized as residential and commercial) and tends to accumulate between two other types of locations (with positive and negative trends) resulting in four characteristic accumulation patterns. By clustering locations with common patterns, linking inflows to outflows to and from each cluster, and describing gross accumulation levels mathematically as integrals, sizing-rebalancing tradeoffs can be modeled macroscopically without knowing paths of dispatches.

Here, I demonstrate how this method can be used to build interactive data-driven dynamic macromodels that allow planners and decision makers to address questions that would be otherwise impossible to address with current microsimulation methods such as: By how much will traffic, fleet, or parking requirements change for a marginal change in dispatch work? How does system utilization depend on trip patterns? The case study uses two datasets that Hubway, Boston’s bike share system, released in 2013 as part of the “Hubway Data Visualization Challenge”, including 623,509 trips and 32,470,764 occupancy updates from 2012. The examples I show here focus on June 19 during which, Hubway had 61 active stations, 550 bikes in circulation, and two sprinter trucks.

The method is based on five steps: 1) computing inflow and outflow time series data from a trips dataset; 2) computing accumulation time series data by numerically integrating inflow and outflow time series data; 3) classifying resulting accumulation patterns in four types; 4) reorganizing the state space of accumulation time series data into four clusters; and finally, 5) parameterizing and subsequently modifying inflow and outflow equations between clusters to recompute variations of accumulation.

Figure 1: Typical station of a bike sharing MoD system in Boston. Users can pick-up and-drop off from/to any location in the system.
patterns. In the example shown in figure 3, I modify the relative magnitudes of inflows, outflows, and initial accumulation levels at each cluster. However, mathematical expressions can approximate flow rate data between clusters using data mining and machine learning techniques, resulting in more controllable models.

An insight on the resulting dynamics reveals important observations. First, even though trip patterns are random, flow patterns between clusters are predictable resulting in stable ridership. Second, ridership, minimum infrastructure capacity and minimum rebalancing work depend on both trip patterns and sizing-rebalancing decisions; as a result, for each city and trip pattern there may be multiple combinations of infrastructure size and rebalancing work with the same resulting ridership (but potentially different costs).

Results from this work will be published in the upcoming Symposium on Simulation for Architecture and Urban Design (SimAUD 2018) at the Technical University of Delft (TU Delft), Netherlands, on June 04-07 2018.

References


Street network modeling has become ubiquitous in urban planning for analyzing transportation infrastructure, household travel behavior, accessibility and social equity, location centrality, walkability, and indicators of the urban fabric including block sizes, intersection density, and connectivity. However, straightforward, scalable tools for professional planners to automatically acquire and analyze detailed street networks have been few and far between. Planners typically rely on large shapefiles, such as US Census TIGER/Line roads data, loaded into software like ArcGIS to analyze local or metropolitan street networks. Unfortunately, TIGER/Line contains substantial spatial inaccuracies, emphasizes drivable roads over paths available for active travel, and has limited coarse-grained metadata.

OpenStreetMap—an open-source, collaborative, worldwide mapping project inspired by Wikipedia—has emerged as a major player for mapping and acquiring spatial data. Though coverage varies somewhat worldwide, its US data are high quality. OpenStreetMap imported the TIGER/Line roads in 2007 and since then its community has made millions of corrections and improvements. Many of these additions go beyond TIGER/Line’s scope, including passageways between buildings, footpaths through parks, bike routes, and detailed attributes such as fine-grained street classifiers, speed limits, etc. This presents a fantastic data source to answer urban planning questions, but OpenStreetMap’s data have been difficult to work with due to its Byzantine query language and coarse-grained bulk extracts provided by third-parties.

OSMnx offers an easier way. It is a new, free, open-source tool that allows anyone to download walkable, drivable, or bikeable urban networks from OpenStreetMap for any city name, address, or polygon in the world, then automatically analyze and visualize them. OSMnx democratizes these data and methods to help technical and non-technical planners use OpenStreetMap data to model urban form, circulation, accessibility, and resilience. It allows us to automatically:

- Download walkable, bikeable, or drivable street networks anywhere in the world
- Download other networked infrastructure types such as electrical grids and rail lines (where available)
- Download by city name, polygon, bounding box, or address + network distance
- Load street network data from a local .osm file
- Visualize street networks as static plots or interactive web maps
- Simplify and consolidate intersections for accurate counts/densities
- Conduct topological and spatial analyses to automatically calculate dozens of indicators
- Plot figure-ground diagrams of street networks and/or building footprints
- Download elevations to calculate street grades and assess flooding vulnerability
- Calculate and plot shortest-path routes with various impedances
- Visualize travel distance and travel time with isoline and isochrone maps
- Calculate and visualize street bearings and orientations

OSMnx is written in Python and requires minimal technical experience to use. In just two lines of code we can download and calculate any city’s intersection density, average block length, street circuity, distribution of intersection types, and dozens more variables. Instead of a city name, we could pass in a list of polygons such as neighborhood shapes, addresses and buffer distances, etc. Or we could pass in a list of 100 (or 100,000) city names or polygons to automatically download all of their street networks, analyze them, and create a table of variables.

We are not limited to drivable networks: we can instead get walkable, bikeable, or everything all together. Given OpenStreetMap’s vast repository of walking paths and bike routes, we can easily model how trip distances and times, routing options, and accessibility change from one mode to another. OSMnx has built-in shortest path calculators to...
find the network distance between any two addresses or points. Beyond the basic network stats common in urban morphology and design, we can just as easily calculate advanced topological measures such as closeness centralities, clustering coefficients, PageRanks, etc. Such measures have arisen recently from the study of complex networks in statistical physics, and provide insight into a street network’s structure, performance, and resilience.

OSMnx can help easily communicate urban design decisions and alternative street layouts. Allan Jacobs’ classic book *Great Streets* featured dozens of hand-drawn figure-ground diagrams depicting one square mile of cities’ street networks. Holding these cities at the same scale provides a revealing spatial objectivity in comparing their street networks and urban forms. We can automatically re-create these with OpenStreetMap data for any city in the world, using OSMnx. These visualizations show us how different urbanization patterns and paradigms compare at the same scale. This can serve both as a tool for comprehending the physical outcomes of planning and informal urbanization, as well as a tool for communicating urban planning and design in a clear and immediate manner to laymen.

OSMnx unlocks new data for walkability studies, circulation modeling, and computational urban design. Even if you are new to Python, OSMnx offers an easy way to start working with this rich dataset. To get started, visit https://github.com/gboeing/osmnx. For an example study using OSMnx in action, visit https://arxiv.org/pdf/1705.02198.

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In the spring of 2017, led by Dr. Ming-Chun Lee, a group of urban design students from the School of Architecture at the University of North Carolina at Charlotte took on the challenge to re-envision the future of an old urban renewal site in the City of Atlanta: a neighborhood called Buttermilk Bottom. The main idea for this academic project was to learn from the City of Savannah in Georgia about how the class might use the design principles observed in the plan for Savannah’s historic district to redo what was badly done three decades ago in Buttermilk Bottom. The class also intended to explore the potential of new geospatial technologies in the study of urban form and its related issues. Several 3D GIS tools were put to use in this urban design project, including: 3D geometry extraction from LiDAR; 3D procedural modeling; virtual reality; cloud-based GIS.

The project started with collecting GIS data from online open data sources. A series of basemaps were then constructed by combining datasets in both ArcMap and ArcGIS Pro, two dominant GIS applications developed by Esri, to create a digital representation of the existing urban structure for both two cities. The students then created detailed 3D models for both two sites to display existing buildings, trees, and accurate terrains to represent the existing landforms. This was done by using ArcGIS Pro to extract 3D features from LiDAR point cloud data, which is a type of optical remote sensing technology. The class first used ArcGIS Pro to reclassify LiDAR tiles based on heights and building footprints. They then used ArcGIS Pro to process all reclassified LiDAR tiles to extract buildings and trees in 3D. This step also produced digital terrain models (DTM) in the .tiff file format to represent the bare ground terrain for both two sites.

To enhance the visual quality of these resulting 3D models, Esri’s CityEngine, a rule-based procedural 3D modeling program, was used to add details, such as architectural structures and textures, landscape features, street markings and pavements, transportation features, vehicles and human figures. Light effects were also added to enhance the level of realism in the models. The class first used ArcGIS Pro to prepare a File GeoDatabase to package needed GIS datasets for CityEngine modeling, including 3D buildings extracted from LiDAR, DTM as .tiff images; tree points (also from LiDAR); streets, building footprints, aerial photos of the site as .tiff images. After importing GIS datasets into CityEngine, the students then used the Street-Creation tool in CityEngine to generate streets. This step was done based on street types that were identified from the sites by the class. All the details associated with the streets, such as vegetation, signs, pavements, vehicles and human figures, were added by using CityEngine’s Complete Street Rule Package. The class then used CityEngine’s Urban Design Rule Package to generate 3D buildings with architectural details and textures. Esri’s CityEngine allowed the class to create large-scale city models to visualize existing urban structures as well as future urban design solutions. These CityEngine models in turn enabled the students to examine and compare the spatial qualities of the two sites.

The class also tested the potential of using virtual reality to explore urban design solutions. They exported their CityEngine models as .fbx files and then imported them into Unity, a game engine, to create their virtual reality scenes. Unity allows additional light effects and environment rendering options to enhance the appearance of the models. It also enables virtual reality settings that allow a user to use a typical game controller, such as an Xbox controller, to walk virtually around 3D scenes that were generated by CityEngine.

To conclude the project, the class took advantage of Esri’s ArcGIS Online, a cloud-based GIS platform, to share data and contents within their user group. They used this online platform to generate web maps and 3D web scenes, which included detailed streetscapes, buildings, and spatial analysis results, to visualize and explore urban structures and design solutions. The class also used Esri’s Story Maps templates, a feature in ArcGIS Online, to present their project outcomes. Their story maps contain various forms of media, including photos, graphs, diagrams, text narratives, interactive maps, and 3D scenes that reveal urban structures of the two sites.

This class project offered an opportunity for the students to explore the possibilities to use new geospatial tools and visualization media to study urban design and its related topics. These tools and media, including 3D procedural modeling with GIS, LiDAR data processing, cloud-based GIS platform, and virtual reality, represent many major development trends in the geospatial technology industry and its related fields. These tools present opportunities to urban planners and designers with these advantages: quick 3D form extraction from LiDAR; urban structure exploration with 3D procedural modeling; easy access to accurate terrain elevation data and global satellite imagery; easy data sharing and presentation over the Internet through cloud-based platform; new ways to experience urban spaces through virtual reality. As these digital tools are becoming more and more advanced, planners, designers, and researchers interested in understanding the dynamics of urban development processes should explore new methods and establish new work flows to utilize these tools to advance their work.

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Image 1. The class used ArcGIS Pro to reclassify LiDAR point cloud data and extract 3D features from the LiDAR tiles.

Image 2. A CityEngine model shows two future development scenarios for the study site.

Image 3. Virtual reality scenes, converted from CityEngine models, allow viewers to experience urban design solutions in an immersive way.

Image 4. The class created a series of story maps to organize maps and 3D web scenes for documenting their spatial analyses and urban design solutions.
Invisible People; An Urban Responsive Digital Interface

Noushin Radnia | UNC-Charlotte, Digital Arts Center

The smart city strategies and the Internet of Things (IoT) have an inevitable impact on the individual and social behavior in the context of a city. They have influenced our daily lives and our way of engagement with the city. However, there is a gap between smart city proposals and people experiencing homelessness (PEH)—the most vulnerable citizens as the users of the public space.

This paper presents Invisible People; a social awareness project that gives its users an ability to engage with the community they live in. It targets to improve the connectivity between PEH and the rest of the society by providing a crowdsourcing platform for communication. In particular, it utilizes a responsive digital interface that broadcasts stories put into the system by the homeless population in designated public spaces. Personal stories are integral units of social awareness that catalyzes this system and encourages empathy and community engagement through innovative and artistic ways. The smart system presented in this article aims to integrate the audience feedback and help as an input to complete the flow by connecting two distant populations.

Invisible People is seeking to highlight its manifesto by synthesizing Awareness, Communication, and Engagement. The design considers a bottom-up approach by considering the city as a social media and promoting the citizens responsibility, which resembles an exercise of the right to the city.

**Design and Methods**

Invisible People is a system that is designed to integrate and combine the outspread and missing components of the current system. It includes a chain of stories that starts by PEH to explain themselves and their need. This chain will keep going among people who are part of the society. They will add to this chain by their help, feedback and communication. The raw recordings happen in shelters or other venues, which can move around town to various locations. For editing of content, a collection of online resources will be used—volunteers with expertise who take recorded content or stories and edit into complete and refined stories.

The architecture of the system covers cell phones, smart phones, laptops, desktops, and designed urban furniture with available software both in web app and mobile app formats. The flow of the system considers PEH restrictions to internet and cellular access and facilitates it by accepting the stories in any format (text message, multimedia).

The components of the system (Figure 1) include:

1. **Storytelling**: PEH are the engaged users in this stage. The system provides different text, image, audio and video format to write, record, and tell the stories. For the design of this phase, restrictions such as location, internet access, and devices have been considered to make it practical. The system syncs users based on their ID/RFID tag to gather and store the input and update it in the cloud database.

2. **Editorial**: This is an optional stage where the stories will be polished based on their need. This phase is based on a volunteer work to organize and refine the collected stories for the best output. The contents of the stories will be monitored at this stage for quality and targeted distribution.

3. **Data Collection**: The processed data is stored in the appropriate and needed databases for future reference. This specific design is a framework for data collection for any possible future data mining and applications. This can include the dataset used by Urban Ministry, The City, and related non-governmental organizations.

4. **Publishing Platforms**: At this stage, the collected stories will be displayed in different mediums using different stations provided in the system. Using different devices that are compatible with IoT allows the stories to be seen and heard by general public and the target audience.

5. **User Experience**: To complete the flow of the cycle in the system we intentionally focused on having audience feedback. This completes our mission that aims to highlight Awareness, Communication, and Engagement. The possible means of feedback includes charitable donations, one-to-one communication with PEH, and service quality reviews.

**Prototype**

The prototype allows PEH to share their stories in a digital medium. Access to this system is possible through their RFID tag that syncs them to the main database.

The initial proposal started with responsive rectangular digital displays that will react to the potentials of the neighborhood being installed. This configuration allows different mediums of output such as sound, newsfeed, and interactive display. (Figure 2)

The next integration of the prototype (Figure 2) points out audience’s engagement and feedback with the system. This design creates an opportunity to attract potential audiences by providing a responsive display. In addition, an interactive display stands out as an iconic and unique experience for the general public.

This paper aims to represent how the use of IoT can create a qualitatively different urban sociality. It explains how the use of connectivity in smart cities, IoT, and available technology has the potential to demonstrate an improved social fabric.
in the cities. It points out to PEH as a marginalized social class in the cities and tries to design a system with the help of IoT technology and interactive systems to improve their life quality. It ties PEH back to cities with considering three main criterias; Communication, Connectivity, and Engagement. The design proposal contains a responsive urban furniture that allows PEH share their story and with the use of technology displays it in an engaging way. This engagement involves the interactions of the audience in different user experience format to complete the system. The hope is that the introduction of Invisible People as an Internet of Things system starts a conversation on how these technologies can help people that are most in need of change.

Figure 1. The flow of the system.

Figure 2. Detailed Prototype designs.
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