POSSIBLE USES OF INTERACTION DESIGN TO SUPPORT PARTICIPATORY PROCESSES IN PUBLIC SPACE AND PRE-TESTS BASED ON VISUAL ATTENTION

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ABSTRACT

Technological developments have affected people's daily lives, triggered the production of hybrid experiences in urban space, and pioneered innovative methods in participation processes. This research aims to understand the potential of digital tools in urban space to support participation processes and consider interaction design as a way to establish a participatory relationship between citizens-technology-space. The literature on human-computer-built environments and urban interaction design has been examined briefly in this direction. International examples have been detailed through the aim, technology, user, and participatory aspects. Inspired by the examples, three design proposals were developed on the Kabataş-Ortaköy axis (Istanbul-Turkey), and proposals are positioned on a pixel-based imagery editing program. Concerning the evidence-based design approach, 3M VAS software is used to detect the possible visual interaction of proposals through heatmaps, hotspots, and gaze sequences. As a result, it has been determined that interaction design approaches in public spaces have the potential to boost the hybrid public space experience for participatory purposes, and proposals can attract the users' attention visually as a part of the awareness process, which is also critical in deciding on the site.

KEYWORDS _ *Interaction design, Digital and Technological Solutions, Participation*

Introduction

Information communication technologies (ICT) affect society's life dynamics and are hybridised human interactions with space. Accordingly, in urban space, new necessities have emerged to cover these contemporary lifestyles and respond to them accurately (Volpi & Opromolla, 2017). Reflection of this situation in the public space from "design" perspective shows itself in some practices such as media architecture (Behrens et al., 2015), digital placemaking (Stokes et al., 2021), urban interaction design (Brynskov et al., 2014). Related to these concepts, "digital interventions" are implemented in public space through "digital walls, public displays, media facades, installations" as mentioned in the study of Hespanhol & Tomitsch (2015). They mostly have goals like boosting playful interactions, promoting social interactions(Hespanhol & Tomitsch, 2015), enhancing urban life, supporting community engagement and etc. Accordingly, it can be said that these varying types of interventions go beyond aesthetic concerns and work for the public good or societal purpose, such as participatory aspects.

In this research, we focus on interactive applications conducted in public spaces that have the potential to enhance citizen engagement or participation. We operate under the assumptions that the visual attractiveness of intervention can increase engagement, and some of these practices can be costly depending on technologies. Based on these premises, a better understanding of possible impacts of interventions can improve process. In this context, how international practices interact with users in public spaces and their effects have been examined, and as an example, suggestions have been developed on the axis of Kabataş-Ortaköy (Istanbul, Turkey), visually pre-tested and answers to the following questions were sought.

RQ1: How is urban space used as a tool to support participatory processes? Can urban interaction design be a supportive approach to participatory urban design/planning?

RQ2: How do possible uses of urban interaction design to support public participation affect the user experience regarding visual attention in the urban space? What is the possible visual effect of these digital interventions on human spatial cognition?

METHODOLOGY

This research briefly examines the literature on relations between human-computer-built environments and urban interaction design and accepts these concepts as an alternative perspective that can support participation and interaction in the future of society and places. Afterwards, it details international examples [CitySpeak, Smart Citizen Sentiment Dashboard, Climate Wall, Full Body Voting, SMSlingshot, City Bug Report] through the process, technology, user, and participatory aspects. Accordingly, inspired by the examples, three interactive design proposals are created on the Kabataş-Ortakoy axis (Istanbul-Turkey). Blank facades in urban spaces are determined as areas with the potential to realize this interaction. It aims that the developed proposals will support the collection of ideas/suggestions/feedback from the citizens and contribute to local governments' transparency and early participation processes. Even though user awareness related to intervention is a prerequisite for interaction, since no real in situ interventions could be realized within the scope of this research, the experimental effects of these proposals cannot be directly measured. However, preliminary tests are applied to understand the potential through an "evidence-based design" (Hollander & Sussman, 2021) approach. Concerning user awareness, this research benefits from the "visual attention" parameter that is used to understand the initial reaction of humans to proposals in complex urban scenes via images. Proposals are positioned on a pixel-based imagery editing program, and 3M VAS software is used to detect their possible visual interaction; before/after situations are analyzed through heatmaps, hotspots -"probability of someone looking somewhere" (Lavdas et al., 2021)-, and gaze sequences -"most likely gaze zones" (Lavdas et al., 2021)-.

About visual attention analysis via 3M VAS software: Although human perception of the environment

has been studied for decades, the use of eye-tracking approaches to understanding the unconscious visual responses of people in urban studies is a relatively new area. 3M VAS software "eye-tracking emulation software"(Hollander et al., 2021) and "AI application"(Lavdas et al., 2021) capture viewers potential first glance (3-5 seconds) with %92 accuracy by algorithm based on eye-tracking studies through edges, faces, color intensity and color contrast features (3M Visual Attention Software (VAS)., 2017; Hollander et al., 2021, p. 4; Lavdas et al., 2021). Hollander et al. (2021) have considered this tool as promising for urban design purposes; in another paper, they have tried to understand human responses to traditional neighborhood elements (Hollander et al., 2020); Salingaros & Sussman (2020) have used this tool to compare traditional and contemporary facades' engagement, and Lavdas et al. (2021) have analyzed different buildings facades and geometric patterns via it. Accordingly, this research analyzes possible scenarios through this software, uses visualization techniques with a different theme, and compares street view and manipulated images.

LITERATURE REVIEW

Houghton et al. (2014, p.32) define the "potential of ICT for planners" in three categories "technology for analysis, technology for enhancing place, and technology for community engagement". Relatedly, in this research, we consider interaction design as an approach to establish or support community engagement practices in situ-related places, at the intersection of the second and third categories. To conduct interactive practices with these aims, physical systems in urban spaces such as responsive facades, urban displays, media façades, digital walls, spatial augmented reality/video mapping, laser holograms, interactive facades (Behrens et al., 2015; Hespanhol & Tomitsch, 2015) or integrated technologies on urban objects/furniture (Salim & Haque, 2015; Stokes et al., 2021; Suurenbroek et al., n.d.) in public spaces come fore as creation tools & devices that can be used for these experiences.

From a conceptual point of view, Human-computer interaction (HCI) is one of the bases for these practices. It is a multidisciplinary research area that emerged in the 1980s (MacKenzie, 2013, p. 2) and contains topics such as user behaviour, cognitive processes, tasks, and artefacts. With the impacts of computerization everywhere, HCI has become more interested in human experience in and around space (Brynskov et al., 2014; Çildir, 2020; Zhou & Jiang, 2018). Relatedly, the urban dimension has become more prominent; it is accepted that HCI and architecture together impact social interaction and behaviours in urban space (Behrens et al., 2015). Accordingly, "new interdisciplinary urban design practices"(De Waal et al., 2020, p. 33) have emerged like urban interaction design (Brynskov et al., 2014; Çildir, 2020; Wang et al., 2019). In the phrase, "urban" focus on societal issues in urban society and all relevant actors; "interaction" is related to networked technology; "design" refers to the construction of experiences or process in a multidisciplinary way (Brynskov et al., 2014, p. 10). In that sense, the importance of these practices can be listed as follows: they provide tools to active citizens can benefit, promote sharing, adopt a human-centric perspective, "look for creative value", "go beyond bottom-up versus top-down and encourage integrated systems" and so on (Brynskov et al., 2014, p. 84).

In terms of participatory aspects connected with interactive practices, it is already clear that interactive practices with technical possibilities can create a dialogue environment between the city and its inhabitants (Wang et al., 2019). However, we cannot categorize all interaction design practices in a single category. Like the ladder of participation, it is possible to mention different interactions and levels of participation. Relatedly, Liu et al. (2019) have defined the taxonomy of public engagement with the Internet of Things (IoT) through headlines, such as "triggering social interactions, raising awareness, inviting citizen participation, building communities, addressing matters of concerns". Also, Foth (2017) has highlighted that urban interaction design accepts users as "city residents" and explains new roles of citizens and city governments. In his study, one of the highest stages tends to consider citizens as a co-creator and emphasizes the importance of urban computing to the creation of new civics politics for better cities.

Figure 1: (a) CitySpeak (Lewis & Lévesque, n.d.), (b) Smart Citizen Sentiment Dashboard (Behrens et al., 2014), (c) Climate Wall (Dalsgaard & Halskov, 2010), (d) Full-body voting (Hespanhol et al., 2015), (e) SMSlingshot (Fischer & Hornecker, 2012), (f) City Bug Report (Korsgaard & Brynskov, 2014).

Based on practices conducted in this field, most of the practices are unique, task-oriented, and experimental. Accordingly, six practices with a dialogue environment between citizen-city or raise transparency in urban issues are examined (Figure 1). In order, Cityspeak is a practice that allows citizens to send messages via SMS or web-based forms and see them in a visual display. It has the potential to create a dialogue environment in scenarios that are used in public spaces (Lévesque et al., 2006; Lewis & Lévesque, n.d.). Smart Citizen Sentiment Dashboard (SCSD) is an interactive installation produced for the media façade festival. Via a mediator, users can select categories and state their ideas/modes related to defined urban categories. During the study, researchers realized that users check screens to see their input on visualization. Also, in outdoor experiment, the visibility of facades and mediators is determined as an important experimental issue (Behrens et al., 2014). Climate Wall is an interactive wall in public space that allows users to create statements related to climate discussion with their bodies and raise awareness(Dalsgaard & Halskov, 2010). Full-body voting is an urban screen in a public space that enables voting via body movements about urban issues (Hespanhol et al., 2015). SMSlingshot is a tangible interactive practice that boosts social interaction in public spaces; users can type their message via a designed slingshot and shoot it to the facade (Fischer & Hornecker, 2012). In their study, including SMSlingshot's details, Fischer & Hornecker (2012) also have mentioned that the visibility of interactions and the location of interfaces have an impact on boosting interactions and performance. They even categorise space through display, interaction, activation, potential interaction, etc. abilities. As a last examined practice, City Bug Report is a media façade that highlight importance of transparency of "policy and notions" between citizen and municipality (Korsgaard & Brynskov, 2014). More detailed information on the examples can be found in Table 1.

Similar to these, also several experts have examined different types of practices via different lens and parameters. For instance, Hespanhol & Tomitsch (2019) have discussed properties of plug-in and blended interfaces(Hespanhol et al., 2015) that are used for community engagement, Çildir (2020) has examined urban interaction design practices (The peep show, city fit path, SMSlingshot, Aarhus by light etc.) through parameters such as being tangible, situated, gamified, and technology; and "Civic Interaction Design" book is being traded as almost a catalogue for various interaction practices with different purposes (De Waal, n.d.).

INTERACTIVE DESIGN PROPOSALS IN KABATAS-ORTAKOY AXIS FOR SUPPORTING PARTICIPATORY PROCESSES

Kabataş-Ortaköy is a continuous axis, parallel to the coastline combining unique spaces such as Dolmabahçe and Çırağan Palace, Beşiktaş Square, Beşiktaş Stadium, both in terms of cultural heritage and daily uses. The area hosts various user groups in İstanbul. Within the scope of this research, the regular pedestrian flows in the area are considered in selecting this axis, and three blank façades on the axis were identified as potential areas where the proposals would be positioned. The spatial aspects of the three locations and their details can be seen in Figure 1.

Table 1: Examples from Interaction Design Practices in Public Space that Contain Participatory Aspects

	CitySpeak	**Smart Citizen Sentiment Dashboard**	**Climate Wall**	**Full Body Voting**	**SMSlingshot**	**City Bug Report**
Main Sources	(Lévesque et al., 2006; Lewis & Lévesque, n.d.)	(Behrens et al., 2014)	(Dalsgaard & Halskov, 2010; Fritsch & Dalsgaard, 2008)	(Hespanhol et al., 2015; Tomitsch et al., 2015)	(Çildir, 2020; Fischer et al., 2013; Fischer & Hornecker, 2012)	(Korsgaard & Brynskov, 2014)
Year / Location	2006/- Several place	2013, Sao Paulo, Brazil	2009, Aarhus, Denmark	2014- several places	2009-2010 Several places	2012, Aarhus, Denmark
Aim	Boosting individuals' intervention on public space and raise public voice and reflect them via led screens	gathering citizens' modes about urban problem categories& visualizing them on the media facade	giving citizens to the opportunity of being part of ongoing climate discussions	Discovering public polling interfaces for community engagement in urban space	Vision is about allowing public speak up and reclaiming public space.	Visualisation of actual data based on communi-cation between the municipality and citizens on the city hall tower for digital transparency
Technology	LED Display, SMS & Web based platform integration	RFID, LED media façade, switch and control buttons	Projectors, webcams, designed software	surveillance camera, public screen + computer vision & tracking techniques	Projection + device with transmitter, microproce-ssor, LCD display, laser module	Web based platform integration & LED
User & usage relations	Citizens can send their messages via SMS or web-based platforms and display them on visually animated screens.	Participants can choose topics related to urban by switching a knob in the situated device and they can select their reactions via RFID; after that, it has projected to public media facade.	People can create climate statements by positioning the words projected on the wall with their bodies.	There are simple yes/ no questions for people who use public space, and the system recognises their body movements and allows them to vote by waving their arms.	Using a designed wooden slingshot with a display screen, users type their message, select a colour and aim a spot -being aware of the direction with a laser beam- to transmit their virtual message to the facade.	Citizens' requests to the municipality and their responses are visualized in the context of color codes and flows. + The user interacts and views the city bug report interface over the internet.
Participant Aspects	This installation is used as a combination of the dialogue box or bulletin board for citizens.	People can express their opinion (limited way) with defined topics, and it supports social encounters	Raising awareness about climate issues, let the people create their statements	People can vote about urban issues with a screen as well as other vote-as-you-go interfaces	Letting public "speak up" & express their thoughts	Public disclosure of real data based on the principle of transparency + city bug reporting tool

Subsequently, during the design of conceptual proposals, some principles related to literature, local participatory and spatial dynamics are settled. Firstly, based on the Fischer & Hornecker (2012) statements, ground-level interventions boost interactions more instead of site selections of advertisements that prefer more long-distance visibility. Accordingly, all three proposals are located at ground level, where high pedestrian flows have occurred. Secondly, proposals inspired by listed examples rather than suggesting technically unsolvable practices; thirdly all proposals (Figure 2) focus on supporting the participation processes of local governments or encouraging local citizens to share their ideas in public space, since the culture of participation is not well-established in Turkey and existing practices, although supported by law, are often inadequate (Tekeli, 2017). As a continuation of the last principle, the proposals are conceptually linked to ongoing digital and active practices across the city.

Figure 2: Location of selected blank façades & conceptual interactive design proposals

Local Dynamics Map Screen is an interactive map proposal that visualizes urban requests from citizens to municipalities. Although it has a similar intellectual basis to City Bug Report (Korsgaard & Brynskov, 2014), "raising the transparency of urban dialogues between -the local municipality and citizens", it is thought that simple colour codes [red(no answer)-yellow(in progress)-green(solved)] and mapping locations of related problems will increase comprehensibility in short-term interactions via legend. Since it is located in both pedestrian and vehicle-dense areas, it will reach many people using that axis differently. Additionally, such an interactive map can gather data from solution centres that both Istanbul Metropolitan Municipality and Beşiktaş or Beyoğlu municipalities already have.

UrbanVoice, is intended to reflect citizens' individual statements and ideas through fragmented led screens, aims to be the users' voice in the urban space, inspired by the CitySpeak installation (Lévesque et al., 2006; Lewis & Lévesque, n.d.). It is thought that a spatial representation of user-city dialogue outside the screen can be created by positioning speaker-like urban furniture in the space. These elements can support the use of dictation to translate sounds into text and project them on the screen. Also, installation can be integrated into web-based or mobile municipal applications via a simple interface that collects texts directly, and all these integrated systems serve as a new-generation local bulletin board.

urbanACT Wall aims for the pedestrians to be followed by the controversial urban agenda as a part of their walk along the axis, inspired by Climate Wall (Dalsgaard & Halskov, 2010; Fritsch & Dalsgaard, 2008). The problems in participation practices and neo-liberal policy-oriented urban structure cause fragmented spatial transformations in Istanbul that draw reactions. Although there are urban solidarities (such as Haydarpaşa Volunteers, Northern Forests Solidarity…) against the processes of different transformations in the city, these are relatively fragmented and limited. This idea is proposed to function as a digital intervention encouraging active citizenship and surface that directs people to digital platforms of solidarities for controversial issues in the urban agenda to boost bottom-up participatory aspects.

VISUAL ATTENTION ANALYSIS OF INTERACTIVE PROPOSALS

The interactive map of the local dynamics' proposal is located in a relatively more hidden area than other proposals (Figure 3). Some parts of the possible interactions -mostly the part containing lighting- raise the probability of visual fixation from %20-30 to %40-50 in some points on the facade at first glance. On the other hand, differentiations can be made regarding scale, site selection and colour contrast, etc. to increase visibility.

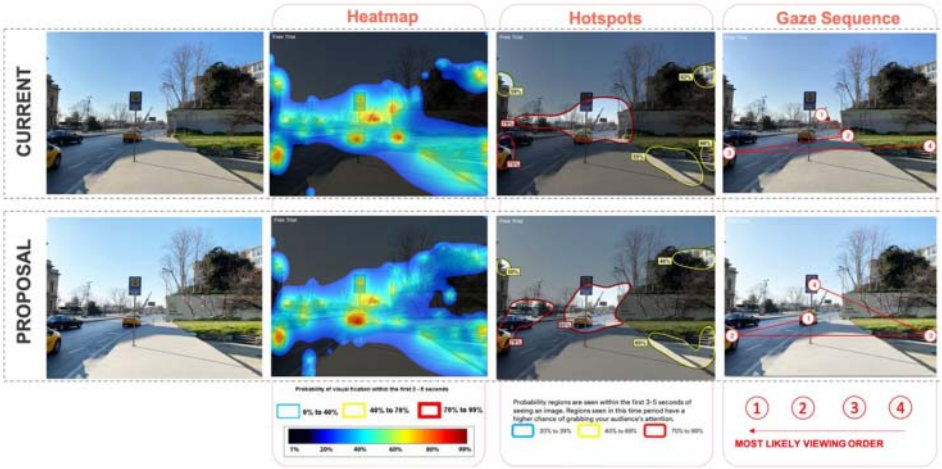

Figure 3: Comparisons of Current/Proposal 1 [Local Dynamics Map] with 3M vas visual attention software

Digitally manipulated images with urbanVoice proposal has raised the probability of visual fixation on the facade at first glance from approximately from %30-40 to %70s which can be detected through heatmaps (Figure 4). Visibility probability regions in the hotspots started to include the façade with the proposal, and the viewing order (gaze sequence) related to the façade became second with it. Additionally, speaker-like urban furniture planned to support the experiment becomes another sub-attraction zone in the manipulated picture.

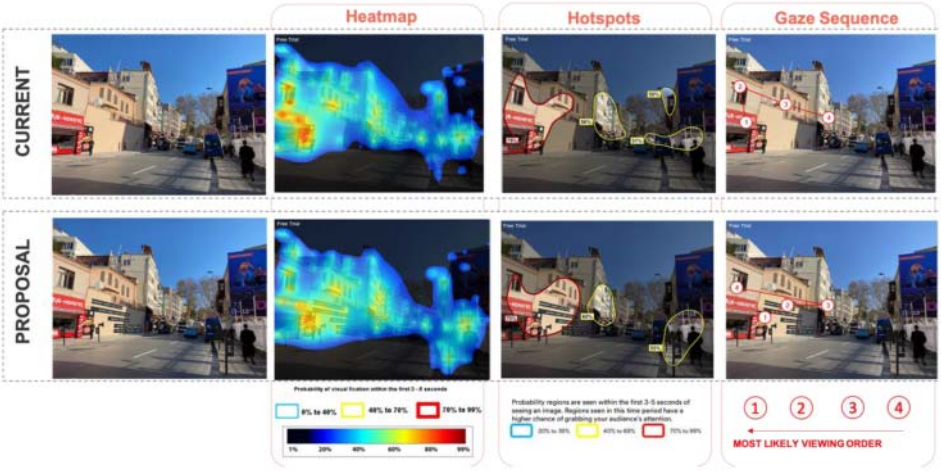

Figure 4: Comparisons of Current/Proposal 2 [UrbanVoice] with 3M vas visual attention software

The digitally situated urbanACT Wall proposal is in the third location shown in Figure 5. A comparison between the current situation and the proposal indicates that the wall's visibility at first glance (3-5 seconds) has risen from %20-30 to %80+ in some points. The façade on which the proposal is being implemented is currently (in real) not in the top four of the gaze sequences and is located in a secondary probability region category in hotspots analysis. However, this situation has changed significantly in the image where the proposal is positioned, and the interactive proposal has become one of the first visually striking elements in the area. The authors believe the impact will be more intense if the proposal is implemented, given its follow-up feature.

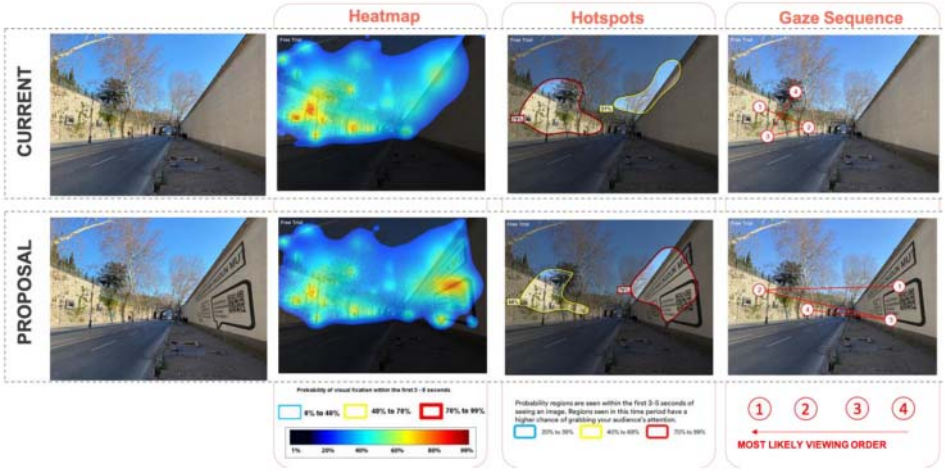

Figure 5: Comparisons of Current/Proposal 3 [UrbanACT Wall] with 3M vas visual attention software

CONCLUSION

Based on the related literature, interaction design, and digital interventions can be used in several creative ways for participatory purposes. And they can boost citizens' participation by drawing attention, adding game elements, and supporting playful social encounters. On the other hand, the spatial dimensions of these practices continue to exist as a relatively less elaborated subject. In general terms, the literature exists through fragmented experiential practices, and visibility is a critical issue in this, as can be seen in some of the relevant examples. Accordingly, this research has examined the potential use of visual attention parameters concerning display space in the context of a pre-test of participatory urban interventions. Proposals designed for the Kabataş-Ortaköy axis are pre-tested through visual attention software to understand how they affect citizens' visual perception. These tests were implemented on the basis that they would allow testing of the effectiveness of display space before interventions are carried out, and visibility is a critical parameter for the onset of the engagement process. As a matter of fact, in these three comparisons, it was concluded that the interventions made the relevant facades more visually attractive. However, the dynamics, such as the positioned area and the density/color contrast of the designs, should be considered as factors that change the degree of impact. For example, within the scope of Proposal 1, the intervention in a more concealed area is relatively less noticeable than the others.

This study also has some limitations, such as evaluating visual change via singular perspective per proposal and ignoring other types of interactions (such as follow-up interactions of humans) that can be observed in real practice. Both as self-critic and recommendations for future research, we suggest that the development of the conceptual proposals phase should also be carried out in a participatory way, using additional eye-tracking techniques to validate results and multi-perspective analysis of proposals.

REFERENCES

- 3M Visual Attention Software (VAS). (2017). *3M Corporation*. https://vas.3m.com/
- Behrens, M., Fatah gen. Schieck, A., & Brumby, D. P. (2015). Designing media architectural interfaces for interactions in urban spaces. In *Citizen's Right to the Digital City: Urban Interfaces, Activism, and Placemaking* (pp. 55–77). Springer Singapore. https://doi.org/10.1007/978-981-287-919-6_4
- Behrens, M., Valkanova, N., Schieck, A. F. G., & Brumby, D. P. (2014). Smart citizen sentiment dashboard: A case study into media architectural interfaces. *PerDis 2014 - Proceedings: 3rd ACM International Symposium on Pervasive Displays 2014*, 19–24. https://doi.org/10.1145/2611009.2611036
- Brynskov, M., Bermúdez, juan C. C., Fernández, M., Korsgaard, H., Mulder, I., Piskorek, K., Rekow, L., & Waal, M. de. (2014). *Urban Interaction Design Towards City Making*. https://civicinteractiondesign.com/features/urban-interaction-design-towards-city-making/
- Çildir, Ç. (2020). *Kentsel Etkileşim Tasarımı için Disiplinler Ötesi Bir Deneme* [MSc Thesis]. ITU Graduate School.
- Dalsgaard, P., & Halskov, K. (2010). Designing Urban Media Façades: Cases and Challenges. *CHI 2010: Public Displays*, 2277–2286.
- De Waal, M. (n.d.). *Civic Interaction Design Shaping Public Life*.
- De Waal, M., Suurenbroek, F., & Nio, I. (2020). Responsive public spaces: Five mechanisms for the design of public space in the era of networked urbanism. In *Shaping Smart for Better Cities: Rethinking and Shaping Relationships between Urban Space and Digital Technologies* (pp. 33–54). Elsevier. https://doi.org/10.1016/B978-0-12-818636-7.00009-3
- Fischer, P. T., & Hornecker, E. (2012). *Urban HCI: Spatial Aspects in the Design of Shared Encounters for Media Façades*. 3228.
- Fischer, P. T., Hornecker, E., & Zoellner, C. (2013). SMSlingshot: An Expert Amateur DIY Case Study. *TEI 2013*.
- Foth, M. (2017). Participation, Co-Creation, and Public Space. *The Journal of Public Space*, *2*(4), 21–36.
- Fritsch, J., & Dalsgaard, P. (2008). Media Facades Beyond Interaction: Position paper for Workshop on Public and Situated Displays to Support Communities. *OZCHI 2008*.
- Hespanhol, L., & Tomitsch, M. (2015). Strategies for intuitive interaction in public urban spaces. *Interacting with Computers*, *27*(3), 311–326. https://doi.org/10.1093/iwc/iwu051
- Hespanhol, L., & Tomitsch, M. (2019). Power to the People: Hacking the City with Plug-In Interfaces for Community Engagement. In *The Hackable City*. Springer Singapore. https://doi.org/10.1007/978-981-13-2694-3
- Hespanhol, L., Tomitsch, M., McArthur, I., Fredericks, J., Schroeter, R., & Foth, M. (2015). Vote as you go: Blending interfaces for community engagement into the urban space. *ACM International Conference Proceeding Series*, *27-30-June-2015*, 29–38. https://doi.org/10.1145/2768545.2768553
- Hollander, J. B., & Sussman, A. (2021). *Urban Experience and Design; Contemporary Perspectives on Improving the Public Realm*.
- Hollander, J. B., Sussman, A., Lowitt, P., Angus, N., & Situ, M. (2021). Eye-tracking emulation software: a promising urban design tool. *Architectural Science Review*, *64*(4), 383–393. https://doi.org/10.1080/00038628.2021.1929055
- Hollander, J. B., Sussman, A., Purdy Levering, A., & Foster-Karim, C. (2020). Using Eye-Tracking to Understand Human Responses to Traditional Neighborhood Designs. *Planning Practice and Research*, *35*(5), 485–509. https://doi.org/10.1080/02697459.2020.1768332
- Houghton, K., Miller, E., & Foth, M. (2014). Integrating ICT into the planning process: impacts, opportunities and challenges. *Australian Planner*, *51*(1), 24–33. https://doi.org/10.1080/07293682.2013.770771
- Korsgaard, H., & Brynskov, M. (2014). *City Bug Report: Urban prototyping as participatory process and practice*. 21–29.
- Lavdas, A. A., Salingaros, N. A., & Sussman, A. (2021). Visual attention software: A new tool for understanding the "subliminal" experience of the built environment. *Applied Sciences (Switzerland)*, *11*(13). https://doi.org/10.3390/app11136197
- Lévesque, M., Bélanger, L., & Lewis, J. (2006). p2P: Cityspeak's Reconfiguration of Public Media Space. In *Journal of the Mobile Digital Commons Network* (Vol. 1).
- Lewis, J., & Lévesque, M. (n.d.). *Cityspeak, Citywide A Mobile Digital Commons Network Project*. http://obx.

hybrid.concordia.ca/research/nexttext/research_nextext.htm

- Liu, C., Balestrini, M., & Vilaza, G. N. (2019). From social to civic: Public engagement with iot in places and communities. In *Internet of Things* (Vol. 0, pp. 185–210). Springer International Publishing. https://doi.org/10.1007/978-3-319-94659-7_10
- MacKenzie, I. S. (2013). *Human-Computer Interaction: An Empirical Research Perspective*.
- Salim, F., & Haque, U. (2015). Urban computing in the wild: A survey on large scale participation and citizen engagement with ubiquitous computing, cyber physical systems, and Internet of Things. *International Journal of Human Computer Studies*, *81*, 31–48. https://doi.org/10.1016/j.ijhcs.2015.03.003
- Salingaros, N. A., & Sussman, A. (2020). Biometric Pilot-Studies Reveal the Arrangement and Shape of Windows on a Traditional Façade to be Implicitly "Engaging", Whereas Contemporary Façades are Not. *Urban Science*, *4*(2), 26. https://doi.org/10.3390/urbansci4020026
- Stokes, B., Bar, F., Baumann, K., Caldwell, B., & Schrock, A. (2021). Urban furniture in digital placemaking: Adapting a storytelling payphone across Los Angeles. *Convergence*, *27*(3), 711–726. https://doi.org/10.1177/1354856521999181
- Suurenbroek, F., Nio, I., & Waal Martijn. (n.d.). *Responsive Public Spaces*. Amsterdam University of Applied Sciences.
- Tekeli, İ. (2017). *Katılımcı Demokrasi ve Sivil Toplum Örgütleri*. Sosyal Demokrasi Derneği Yayınları.
- Tomitsch, M., McArthur, I., Haeusler, M. H., & Foth, M. (2015). The role of digital screens in urban life: New opportunities for placemaking. In *Citizen's Right to the Digital City: Urban Interfaces, Activism, and Placemaking* (pp. 37–54). Springer Singapore. https://doi.org/10.1007/978-981-287-919-6_3
- Volpi, V., & Opromolla, A. (2017). The role of design in supporting the continual emergence of hybrid spaces of interaction within the city. *Design Journal*, *20*(sup1), S3569–S3577. https://doi.org/10.1080/14606925.2017.1352859
- Wang, H., Yan, M., Xie, H., & Fu, Z. (2019). Urban Interaction Design Supports Modular Design Practice for Urban Public Space. *Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*, *11577 LNCS*, 241–254. https://doi.org/10.1007/978-3-030-22580-3_18
- Zhou, Y., & Jiang, N. (2018). The research and co-creation model for urban interaction design and practices. *Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*, *10912 LNCS*, 444–454. https://doi.org/10.1007/978-3-319-92252-2_35