

## **Analysing The User Experience of Smart City Mobility Through Applications in Istanbul**

### **Authors**

Feriha Öykü ANLIATAMER<sup>1\*</sup>

### **Affiliations**

<sup>1</sup>Master's Program in Interaction Design, Graduate School of Social Sciences Yeditepe University, Istanbul, 34755, Turkey.

\*To whom correspondence should be addressed; E-mail;

[ferihaoyku.yazici@std.yeditepe.edu.tr](mailto:ferihaoyku.yazici@std.yeditepe.edu.tr)

## **Abstract**

In recent years, different ways have been sought to compete in the growing and changing production and consumption environment with technological developments. For this reason, the importance of experience and usage areas in design is increasing.

One of the most widely used models in the world and in our country recently is the smart city, which aims to protect the environment and sustainable development. Smart city aims to use resources efficiently by saving time, energy and labour for limited world resources. Smart cities aim to provide the necessary high quality urban services by utilising the opportunities offered by technology in urban management. Some of the stakeholders of smart city technology are telecommunication networks, mobile devices, digital cameras, sensors in urban areas, public databases, smart cards and social media.

Today, when user expectations are changing, it is important to understand their abstract and concrete needs. This situation creates difficulty for users to express themselves with abstract concepts. In order to create positive product experiences and design products that add value to users' lives, more research and applicable tools are needed to resonate with users. In this direction, this thesis aims to reach the user value created by the user's interaction with the product, to present a framework that design researchers can benefit from the inventions that affect user value, and to present a framework that design researchers can benefit from in user experience and existing product interaction.

**Keywords:** Interaction design; smart city; user experience; urban furniture.

## INTRODUCTION

People have certain expectations regarding the flow of daily life and the use of urban spaces. Constantly changing and developing public spaces are expected to positively affect the quality of life of citizens as well as urban spaces. Many criteria are important for a fast flow of life and meeting the needs of citizens. Urban furniture is also an effective element in supporting the quality of urban space.

In cities with higher population density, smart urban furniture is often located in and around transit centres. Urban furniture supported by smart content includes urban furniture with different features and functions, as well as urban spaces with different types of traffic, such as transport hubs. Within the framework of smart urban furniture design that facilitates the urban life that we interact with the most; information signs showing the arrival time of the subway, boards informing your location, turnstiles, ATMs, transport ticket purchase, loads and refunds ATMs, etc.

On the other hand, users often encounter various problems when using smart city furniture. The main factors behind this are the presence of different user groups due to the international political structure of the city, ergonomic problems that users may encounter, and criteria such as the technical literacy of the users can impose restrictions on the design of such urban structures. Therefore, it is important to determine the limits of these constraints through research in this field.

Interactive urban furniture aims to facilitate the daily lives of city dwellers and help cities become more sustainable. This furniture is often equipped with smart sensors, internet connectivity and other technologies. Istanbul is a densely populated metropolis with different user groups and interactive urban furniture can be found everywhere. The use of interactive urban furniture is more common in densely populated urban areas such as bus stops, touristic areas, parks. The theme of this study is to explore the contribution of user experience in the design of interactive urban furniture.

Within the scope of user experience in smart urban furniture, Istanbul card akbil filling device and mobile application will be considered and a case analysis will be made within the framework of interviews with users in Söğütlüçeşme region.

## **Literature**

### **Smart City Furniture**

Since the day man was born, he has created villages, towns and cities in an effort to organise the environment in which he lives. In this artificial environment, urban furniture in public spaces appear as objects that meet the simple needs of people. City definitions may be abstract and conceptual, but city definitions based on certain criteria in one country may vary greatly in another country. Accordingly, it is defined abstractly as "the city is the environment formed by urban life and the artificial environment is dominated by the natural environment" (Gürel, 1970).

Within the scope of social science standards, a city is a collection of people and structures that are gathered together in a way that can be called large according to the place and time and have some distinctive features. According to the social scientist Wirth, the city is defined as "a relatively large, densely populated and spatially continuous settlement formed by individuals who are socially dissimilar" (Allen and Morris, 1968), while Helle described it as "a ball of communication formed in the mutual interaction of urbanites and maintaining its vitality" (Aydemir, 2003).

In these definitions, urban areas formed by human communities that are constantly changing, developing and communicating include indoor and outdoor areas.

The concept of city has been changing from history to the present day; it keeps pace with the development in order for citizens to live a better, more comfortable life. With the adaptation of information technologies to all areas of life, this technology has entered all common areas, services and services of cities and the concept of Smart City has been formed.

Smart cities are cities that can use limited resources efficiently, invest in information and communication technologies, save money through these investments, provide maximum efficiency and quality of life by offering smart solutions in the city, reduce environmental damage and invest in innovation and sustainable planning process (Ateş and Önder 2019). In the smart city approach; effective use of technology and resources to solve urban problems, producing human-oriented functional solutions, raising the living standards of citizens, minimising environmental pollution and carbon emissions, smart infrastructure and cyber security are the most important issues.

The main purpose of smart cities is to provide maximum energy efficiency and to facilitate the lives of urbanites by producing smart solutions in the city in order to solve the problems caused by the increasing population gathering in cities and to meet the changing human needs with technology.

According to the European Union, there are 3 building blocks that enable the formation of smart cities. Technology, human and institutional factors are the building blocks that enable the formation of smart cities. These 3 factors provide the formation of a smart city by working in interaction and coordination with each other. At the same time, a smart city should have six basic features. Smart economy, competitiveness; smart mobility, transport and information-communication technologies; smart environment, natural resources; smart people, human and social capital; smart life, quality of life; and smart governance, participation. (European Smart Cities, 2015).

Smart city equipments are interactive urban furniture that communicate directly with users, can use renewable energy sources, provide easy access for disabled citizens thanks to their technical equipment, contain innovative and environmentally friendly solutions, and facilitate the lives of citizens. The main purpose of smart city equipment supported by mobile network systems is to produce smart solutions that will meet the needs of modern urban life and social life in the technical context, in accordance with the requirements of the age and to bring its status to the fore (Özdemir, 2020).

The smart city is governed by smart city furniture that offers both economic and technological solutions. Examples of such furniture that facilitate public services are free Wi-Fi internet access, mobile charging cars, interactive city maps, notice boards, real-time and up-to-date city information, solar street lights, smart bus stops, reservations and alarms. Garbage bins, LED and current data traffic lights, solar parking machines, flower pots with smart irrigation system, smart children's playground. In addition, it is possible to obtain air quality, sound and noise data through sensors on urban furniture and to generate traffic data to increase urban safety. There are many examples of such smart urban furniture in public spaces.

### **Interaction Design and User Experience**

The emergence of interaction design as a discipline has been attributed to the development of information and communication technologies, especially the emergence of the Internet, shrinking hardware sizes, changes in the number and profile of users, changes in products, changes in user-product interaction, changes in software and service development activities and the emergence of graphical user interfaces.

Cognitive psychology, social psychology, sociology, anthropology, software engineering and computer science have also played important roles in the emergence of interaction design as a discipline (Preece et al., 1994). It has been found that changes in the focus of software and service development activities and in the field of human-computer interaction have played a role in the emergence of this discipline. Although the infrastructure of this new discipline comes from the dynamics described above, when considered independently of technology, human-computer interaction can be considered as a technical branch of interaction design.

The term “user experience” has been a striking concept for researchers and practitioners of multiple disciplines during the last three decades. Due to its content related with a range of disciplines and its multidisciplinary nature, UX becomes an umbrella incorporating many concepts (Roto et al., 2011; Rajeshkumar et al., 2013).

There are various models that define how UX is to be understood in the context of design. However, their common point is that UX investigates what experience the system or product incites for the user (Kuru, 2013). Furthermore, this experience can be influenced by an external

factor such as a social, cultural or organizational pattern (Arhippainen & Tähti, 2003; Forlizzi & Ford, 2000).

The interactive product design process involves a series of iterative steps to create and develop a product in collaboration with users and stakeholders. Typical characteristics of this process are attention to user requirements and feedback, and a willingness to experiment and iterate until the desired outcome is achieved.

Zimmerman et al. (2004) defined the interaction design process as a process that starts from defining the design problem, which leads to the final solution; it is a process that extends to people's reactions to this solution; this process consists of 5 stages.1 Stage 1; user needs, customer needs and the creation of the user model, Stage 2; users' process models, the relationship between users and context, Stage 3; the relationship between user, customer and context, Stage 4; the performance of the elements in the interface and the evaluation of the relationship with the reuse of the software, examples of processes and flow models that users will and will not accept, Stage 5; opportunities to improve the design process, acceptance of the design in the relevant sector.

Focusing on user effectiveness and efficiency is often considered a sufficient design goal for a product or service to succeed. This shows that designers attach importance to usability testing when developing products. Hasenzahl et al. (2008) argued that utilitarian and hedonic attributes should be considered when evaluating the perceived quality of interactive products. Human-computer interaction researchers believe that product design should not only focus on improving effects and efficiency, but designers should also consider how users experience products and how to design things that are fun to use (Korhonen, Montola, and Arrasvuori, 2009). The purpose is to reconcile the designer's understanding of the role of products in people's lives with people's views on product design.

There are 7 factors that play a key role in determining the effectiveness of a designed user experience. These factors are usable, useful, desirable, findable, accessibility, credible, valuable. By focusing on these key factors, designers can take their designs to the next level and ultimately improve the user experience. The better the user experience, the more popular the website or application will be among users.

## **Universe of The Research and Method**

Methodology is an important factor for developing the necessary findings for the whole process of the research. Within the scope of this study, qualitative research method was used to reveal the underlying reasons for the study. Qualitative research involves collecting and analysing non-numerical data through various techniques such as interviews, observation and document analysis. One reason why qualitative research is useful in theses is that it provides a detailed understanding of the phenomenon under study by focusing on the experiences and perspectives of individuals or groups in the situation in question (Creswell, 2014).

Within the scope of this study, firstly, the concepts of smart urban furniture and interaction design user experience were examined by conducting literature research. Afterwards, the importance of smart urban furniture, which is the focal point of the study, in terms of user experience through ticketmatikler and mobile application was analysed.

In another part of the study, Söğütlüçeşme Marmaray and Metrobus stations are discussed and the process of user experience in urban furniture is analysed. In this context, case study and product analysis have been carried out through urban furniture and mobile application.

Thanks to the data obtained; various interviews and questionnaires were conducted with the users in order to determine the problems experienced by the users using the smart urban furniture and mobile application using the Istanbul card. As a result of the literature research and field research, a product-case study was conducted and these findings were compared and conclusions and recommendations were drawn.

Within the scope of the study, it is aimed to examine the user experiences of people using the biletmatik and mobile application where Istanbul card is used.

As discussed in the previous sections of the study, the aim of this study is to identify the problems experienced by the users of the smart urban furniture and mobile application using the Istanbul card and to provide suggestions on product development. In line with this purpose, answers to the following questions are sought;

- What kind of experience do the users of interactive urban furniture have?



- What kind of problems are experienced in product use?

For this study, interviews were conducted with 32 users between the ages of 20-60. In these interviews, 4 questions were asked to the users.

In line with the answers received from the interviews, it is seen that the answers of the users are concentrated on some criteria. At this stage, various inferences will be made with the user relationship through the answers given to each question.

The summaries of the answers given to the questions asked in the interviews with 32 users are as follows.

During the interviews, it was determined that users mostly use the mobile application to load money to Istanbulkart. When the comments obtained from 32 users are analysed, it can be said that istanbulkart mobile application is preferred because it is easier, more practical and faster. When the users were asked about the problems they experienced in the mobile application, it is seen that the limitations such as the slowness of the NFC card reading system, problems in QR code generation and the late response of the system were mentioned. In addition to these data, it has been determined that users above a certain age prefer ticketmatic instead of the mobile application, and it can be said that loading with cash is an important criterion in the preference of this user group. When the problems experienced by the users who prefer ticketmatic are analysed, the problem that the ticketmatic machine does not accept cash when entering cash comes to the forefront. When the question of the usage areas of istanbulkart other than transportation was asked, it was determined that the participants mostly did not use istanbulkart other than transportation, and it was analysed that they did not benefit from the advantages offered by this system sufficiently.

## **RESULTS**

This study conducted interviews with 32 users between the ages of 20 and 60. In these interviews, users are asked 4 questions.

Consistent with the responses from the interviews, it can be seen that the users' responses focused on several criteria. At this stage, various conclusions about user relationships are drawn based on the answers to individual questions. The answers to the interview questions of 32 users are summarized below.

Interviews revealed that users mainly use mobile apps to recharge on Istanbul Karts. Analyzing the reviews of 32 users, it can be said that the mobile app istanbulkart is preferred because it is simpler, more useful and faster. When users were asked about the issues they encountered in the mobile app, it was noticed that they mentioned limitations such as slow NFC reading system, issues with QR code generation, and slow system response.

Surveys show that users mainly use mobile apps to charge Istanbul Karts. Analyzing the reviews of 32 users, it can be said that mobile app istanbulkart is preferred as it is simpler, more useful and faster. When users were asked about the issues they encountered with the mobile app, they cited limitations such as slow NFC reading system, issues with QR code generation, and slow system response.

## **DISCUSSION**

The interviews revealed that users of Istanbulkart encountered various problems. One of these issues is an issue with the NFC card reading system when using the app. To solve this problem, we can say that NFC system should be developed, this feature should be compatible with every mobile phone used by the user and make more targeted and informative notifications to the user through the application.

When reviewing the findings, it is important that smart street facilities are responsive to user needs with their functionality, have the right infrastructure for technology, are easily accessible and perceptible, are suitable for user ergonomics, and have excellent design that contributes to aesthetic fit with the city. The environment and urban characteristics can become a part and symbol of the city. It has the characteristics of combining humanities with functionality and sociality, ensuring a sense of security and satisfaction in the space.

Research shows that if smart street furniture is given the necessary attention, the right design decisions are made and the right positioning is made, the quality of the space can be improved in any case, taking user experience into account. On the other hand, failure to conduct the above design studies may have a negative impact on the quality of use and user relations of these smart street facilities.

This stage requires a brief answer to the research question posed at the beginning of the study;

- Users may encounter various problems when using interactive street furniture, such as: B. Lack of physical control over interface comprehensibility, and the external shape of the unit not providing enough information about the user's use of the product. However, users
- Due to low technical level, users may have adaptation issues in controlling the interface and interacting with street furniture.

Recommendations for future research can be drawn from the results of this study. It is possible to identify differences in the technical ability levels of users in different cities when using such products, study the design methods used in the design process of such furniture, and conduct research on innovative design methods. At the same time, by studying the designers of these products, the design process of smart street facilities can be examined from a designer's perspective. By conducting such research, it can be said that future product designs developed in this area will move towards a more advanced point in terms of user experience.

## **CONCLUSION**

In cities, different expectations of users emerge over time and some urban furniture is transformed into smart urban furniture to adapt to this process. Smart urban furniture, which aims to provide maximum benefit to users by utilising the opportunities offered by technology, tries to adapt to the conditions of development and change. Such furniture, whose technical infrastructure is supported by software and hardware, is different from urban furniture with these features. It is important to consider all features such as user accessibility to smart urban furniture, perception, visibility or usability of urban furniture, functionality, need-saving features, working / flawless, cleaning, maintenance, scale, shape, colour, texture, usability of different users group, size, etc. In this study, the innovations, possibilities and constraints offered by Smart Urban Furniture to users through examples in Istanbul have been examined

in terms of user experience principles and interactivity principles. For this purpose, the research topic was determined in the introduction part of the research, hypothesis proposal was made and research questions were determined.

As a result of the findings obtained in the research, it can be said that usability plays a positive role on the product according to the literature review. Thanks to the data obtained, we can say that the effect of the interviews about the use of Istanbulkart is as follows. According to the findings obtained from the interviews with the users, 84% of the users prefer the mobile application and the reasons for preferring the application are that it is easier and faster. The remaining 16% of the users said that they use ticket machines to top up their cards. However, it was determined that the age of this 16% was higher.

When reviewing the research findings, it is important that smart street furniture respond to the needs of users with its functionality, have a technology-ready infrastructure, be easily accessible and perceivable, be ergonomic for users, and have features that contribute to urban aesthetics, integration with the environment and the city. The characteristics match, can become a part and symbol of the city, have the characteristics of humanism, functionality and socialization, and provide a sense of security and satisfaction in the space.

Regardless, as research has shown, by giving due attention to smart street furniture, making the right design decisions and making the right positioning, room quality can be improved with user experience in mind. On the other hand, if the above design studies are not carried out, the quality of use and user relations of smart street furniture will be negatively affected.

At this stage, it is necessary to briefly answer the research questions determined at the beginning of the study;

- In the process of use in interactive urban furniture, users may encounter various problems such as the lack of physical controls on the comprehensibility of the interface and the fact that the external form of the units does not provide enough information about the use of the product by the user. However, users

- Users may experience adaptation problems in controlling the interface and interacting with the urban furniture due to their low technological literacy.

Based on these answers, it can be said that the hypothesis of this study is correct. It is seen that Smart Urban Furniture in Turkey puts the user in the background in the design

process in terms of interface and user experience and for this reason, there are various limitations in terms of interaction in the design of furniture.

From the results of this study, recommendations for future research can be drawn. It is possible to determine the differences in the level of technical ability of users in different cities when using such products, to study the design methods used in the design process of such furniture, and to conduct research on innovative design methods. At the same time, by studying the designers of these products, we can examine the design process of smart street facilities from the perspective of designers. By conducting such research, it can be said that product designs developed in this field in the future will move towards a more advanced point in terms of user experience.

Preprint

## REFERENCES AND NOTES

- Ateş, M., ve Önder, D. E., (2019). ‘Akıllı şehir’ kavramı ve dönüşen anlamı bağlamında eleştiriler. *Megaron*, 14(1), 41-50.
- Aydemir, S. (2003). *Kentsel sosyoloji ders notları*. Basılmamış Yayın, Karadeniz Teknik Üniversitesi Mimarlık Bölümü.
- Giffinger, R., Fertner, C., Kramar, H., Kalasek, R., Pichler-Milanović, N., % Meijers, E. (2007). Smart cities ranking of european medium-sized cities. *Centre of Regional Science*. [http://www.smart-cities.eu/download/smart\\_cities\\_final\\_report.pdf](http://www.smart-cities.eu/download/smart_cities_final_report.pdf).
- Gürel, S. (1970). *Kent planlamasına giriş ve çevre kavramı*. Ankara: Sümer Gürel Yayın.
- Gürel, S. (1970). *Kent planlamasına giriş ve çevre kavramı*. Ankara: Sümer Gürel Yayın.
- Özdemir, B. (2020). *Akıllı kent mobilyası kullanımı ve konumlandırılmasının önemi: yenikapı ve üsküdar aktarma merkezleri örneği*. Yüksek Lisans Tezi, Yıldız Teknik Üniversitesi Şehir ve Bölge Planlama Anabilim Dalı, İstanbul.
- Rajeshkumar, S., Omar, R., & Mahmud, M. (2013). Taxonomies of User Experience (UX) evaluation methods. In *Research and Innovation in Information Systems (ICRIIS)*, 2013.
- Zimmerman, J., Forlizzi, J., & Evenson, S. (2004). Taxonomy for extracting design knowledge from research conducted during design cases. In *Futureground '04*. Proceedings of *Design Research Society Conference*. Melbourne, Australia.