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CHALLENGES RELATED TO PATIENTS' SPATIAL ORIENTATION IN A HOSPITAL ENVIRONMENT AND TECHNOLOGICAL INTERVENTIONS – THE SOCIAL ASPECT

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Purpose: The purpose of the paper is to analyze the challenges of hospital wayfinding faced by patients and to evaluate the potential of technological interventions in supporting navigation. The study aims to demonstrate how integrating social research with technical design can contribute to creating more intuitive and user-friendly navigation systems in healthcare facilities.
Design/methodology/approach: The research was conducted by an interdisciplinary team using a methodological triangulation approach. Methods included exploratory walks, covert and overt observations of patients, semi-structured interviews, focus groups with hospital staff, and surveys. A prototype of a mobile wayfinding application, developed in Unity with the Vuforia Engine, was tested in real hospital settings. Both qualitative and quantitative data were collected and analyzed.
Findings The study identified key spatial areas that caused patient disorientation, primarily due to complex layouts and inconsistent signage. Testing the mobile application confirmed its effectiveness in reducing navigation errors and lowering patient stress levels. Participants positively evaluated the application's usability and clarity, while also suggesting enhancements such as voice assistance, interactive maps, and detailed location descriptions.
Research limitations/implications: The research was limited to one hospital route (registration–mammography) and a relatively small group of participants, which constrains the generalizability of findings. Future studies should employ larger samples, longitudinal designs, and advanced quantitative tools such as eye-tracking or digital trace analysis to capture navigation difficulties more comprehensively.
Practical implications: The findings emphasize the importance of integrating architectural solutions with digital tools in hospital wayfinding design. Designers are encouraged to adopt user-centered approaches, test solutions in real-world conditions, and develop hybrid systems combining physical signage with digital navigation support.
Social implications: Improved hospital wayfinding systems can enhance patient comfort, reduce stress, and foster inclusivity, particularly for vulnerable groups such as older adults and individuals with cognitive impairments. Enhanced navigation support can also improve hospital efficiency and patient safety.

Originality/value: The paper contributes original insights by combining social science methods and user research with the design and evaluation of technological solutions for hospital wayfinding. It demonstrates an interdisciplinary framework that can inform both academic inquiry and practical implementation in healthcare design.
Keywords: wayfinding, hospital navigation, mobile applications, user-centered design, patient experience.
Category of the paper: Research paper / Case study.

1. Introduction

Wayfinding, i.e. the process of orienting oneself in space and making decisions about the direction of movement in a hospital environment, has been the subject of interest of researchers from various fields for many years – from environmental psychology, through architecture, to universal design and ergonomics (Carpman, Grant, 2002; Devlin, 2014). As hospital structures become more complex, the risk of disorientation among patients, visitors, and medical staff increases. Difficulties in finding one's way around healthcare facilities can lead not only to organizational delays, but also to increased stress and reduced satisfaction with care (O'Neill, 1991; Hölscher et al., 2012).

Previous studies indicate that an effective spatial orientation system should take into account both architectural aspects (clarity of spatial layout, reference points, color contrast) and psychosocial aspects—the diverse cognitive abilities of users, their experiences, and emotions associated with navigating a difficult environment (Marquardt, 2011; Noraslı, Çınar, 2024). However, the literature tends to focus on the design and technological perspective, while marginalizing research on the actual behavior of patients and their opinions on orientation in the hospital space. This approach leads to the creation of solutions that are visually appealing but not always effective in clinical practice.

Contemporary concepts, such as wayshowing (Mollerup, 2013), point to the need to move from analyzing the process of finding one's way to examining how space and visual communication tools actively support users in making navigational decisions. This type of approach requires the integration of multiple research perspectives and the systematic involvement of patients and staff in the process of testing proposed solutions. Social research in the context of wayfinding is crucial to understanding how users perceive and function in public and private spaces. It allows us to identify non-obvious barriers to orientation, such as stress, disorientation, feelings of confusion or uncertainty, which can affect both well-being and the effectiveness of movement in a given space. Wayfinding is not just a technical issue – it largely depends on the individual experiences, perceptions, and emotions of users. From a spatial design perspective, understanding users' subjective feelings, their aesthetic and functional assessments, and observing their behavior as they move through space allows for the creation of more intuitive, comfortable, and safe environments.

The aim of this article is to analyze the challenges related to patients' spatial orientation in a hospital environment and to assess the potential of technological interventions supporting the wayfinding process. The study, conducted by an interdisciplinary team, is based on an approach combining social methods (observations, interviews, focus groups) with testing a mobile application prototype in real-life conditions. The results obtained aim to show how the integration of user research with the design of technological solutions can contribute to the creation of more intuitive and user-friendly healthcare spaces.

2. Literature review

The growing complexity of healthcare buildings means that patients, visitors, and even medical staff are exposed to difficulties in finding their way around complex spatial structures. The literature indicates that the lack of effective solutions in this area can lead to delays, increased stress and confusion, as well as a decrease in overall satisfaction with medical care (Carpman, Grant, 2002; Devlin, 2014).

Classic works in environmental psychology have already emphasized that spatial orientation is a complex phenomenon, dependent on both architectural configuration and the individual cognitive abilities of users. Carpman and Grant (2002) point out that wayfinding should be treated broadly—as a cognitive and social process, not just a technical signage problem. In this approach, it is crucial to take into account the diverse needs of users: the elderly, patients with limited mobility, and people with cognitive impairments.

A.S. Devlin (2014) also made a significant contribution to the development of knowledge. Analyzing research in the field of environmental psychology, she pointed to the role of perceptual and emotional factors in the process of finding one's way. She emphasizes that an effective spatial orientation system in healthcare facilities must take into account both visual elements (color, contrast, symbols) and factors related to stress reduction, including the legibility of space, the logical placement of reference points, and the consistency of visual messages.

An important aspect of research on spatial orientation in hospitals is also the analysis dedicated to specific user groups. G. Marquardt (2011), focusing on people with dementia, emphasizes the role of architectural design in facilitating movement and maintaining patient autonomy. The author's review shows that elements such as clear landmarks, contrasting colors, natural light, and an intuitive corridor structure have a significant impact on the effectiveness of orientation. In this sense, research on wayfinding becomes part of a broader discussion on inclusive design and patient-centered care (Morag et al., 2016).

From the perspective of architecture and design practice, the studies by B.J. Huelat (2007) and P. Mollerup (2013) are particularly valuable. Huelat, drawing on her experience in implementing wayfinding systems in healthcare facilities, presents a set of guidelines for the implementation of signage, visual information systems, and spatial planning. The author emphasizes the need to integrate design solutions with organizational processes in the hospital. Mollerup (2013), on the other hand, proposes the concept of wayshowing, which broadens the perspective of research on spatial orientation. According to the author, it is not enough to analyze how users find their way (wayfinding), but it is necessary to examine how space and its elements "show the way" to users. This shift in emphasis is important for the interdisciplinary design of healthcare spaces.

Among empirical studies, O'Neill's (1991) work is of classic importance, as he demonstrated that the configuration of spatial plans and the presence of signs have a direct impact on the accuracy and speed of orientation in buildings. These results are confirmed by contemporary analyses, such as a study of a Turkish hospital in Konya (Noraslı, Çınara, 2024), which indicates that the colors and textures in the circulation areas of the hospital significantly affect the effectiveness of finding one's way. Researchers who used spatial analysis tools such as space syntax described the degree of complexity of the architectural layout and predicted potential points of disorientation (Hölscher et al., 2012; Mazurkiewicz, Sitek, 2024). These findings are particularly relevant in the context of growing interest in technological solutions, including mobile applications and augmented reality systems, which are increasingly being integrated into the physical architectural environment (Ženka et al., 2021).

The presented literature review clearly indicates that spatial orientation in hospitals is an interdisciplinary problem (Borges, da Silva, 2015). The research combines psychological, architectural, ergonomic, technological, and humanistic-social perspectives, with a common denominator being the diversity of research methodologies. Psychology uses laboratory experiments, memory tests, and virtual reality studies; architecture and ergonomics use spatial analyses, case studies, and field observations; technology uses digital experiments and analysis of data from mobile devices (Harper et al., 2020); and social sciences use qualitative methods, interviews, and ethnographic research. Such a wide range of methods not only allows for a better understanding of the mechanisms of spatial orientation, but also for the formulation of practical recommendations for designers, decision-makers, and healthcare institutions.

Despite the multitude of research approaches and the interdisciplinary nature of the analyses, several significant research gaps can be identified in the literature. Firstly, research conducted in laboratory conditions or strictly controlled environments (e.g., virtual reality, simulation experiments) predominates, which limits the ability to fully capture the complexity of the real experiences of patients and visitors in hospitals. Second, although many studies focus on specific groups, such as the elderly or patients with cognitive impairments, relatively few integrate these findings with the perspective of medical staff, whose orientation and mobility are critical to patient safety and work efficiency. Finally, although many studies emphasize the

need for interdisciplinarity, in practice most research remains rooted in a single field – psychology, architecture, or ergonomics – without fully exploiting the potential for collaboration between these areas. This gap opens up space for projects that systematically combine the knowledge and tools of multiple disciplines, engaging both researchers and students from different fields in research on creating more user-friendly and accessible hospital environments.

3. Methods

The aim of the research was to broaden knowledge about the problems patients face in finding their way to important areas in hospitals and to present how to combine social science methodology with the design of technical solutions. The information obtained was used to construct a tool to help patients find their way around the hospital on the route: main entrance – registration – mammography room. As a result of the project, a prototype application was created using the Unity 6000.12 engine with the Vuforia Engine plugin based on a point cloud representing a fragment of the building. The proposed solution was then tested by end users on the hospital premises. The study, conducted by an interdisciplinary team of researchers and students as part of the PBL (Project Basic Learning) project, included both qualitative and quantitative methods, which made it possible to capture both the subjective experiences of users and the objective difficulties that arise in the process of spatial orientation. Social research constitutes a large part of the search for knowledge about the relationship between the user of a space and the space itself.

In order to identify the essence of the problem, the following research methods and techniques were used in the module on social issues:

- Research walks – researchers (22 people) walked the route. The aim of this stage was to familiarize themselves with the route and to identify and evaluate the functionality of direction signs and landmarks. This method helped to predict difficult places on the route to the destination.
- Covert observations of patients' behavior while finding their way to the mammography room (10 patients). To deepen the analysis, covert observation of patients independently searching for the mammography room was also used. Without revealing their role, the researchers recorded difficulties in spatial orientation based on a specially designed observation questionnaire, which included, among other things, the time taken to complete the route, places of disorientation, patients' emotional reactions, ways of searching for information, and interactions with staff. This type of methodology allowed the orientation process to be captured in situ, i.e., in the natural context of space use. This observation allowed natural behavior to be captured, unaltered by awareness of

participation in the study, providing an important supplement to the results of the research walks.

- Unstructured interviews with patients after completing the route (8 interviews) made it easier to identify the significant difficulties patients had in finding their way, orienting themselves in space, remembering elements of space, and preferences in ways of obtaining information in hospital facilities. This research method allowed for a comparison of patients' previous experiences and perceptions with the actual spatial layout of the hospital in Gliwice.
- Focus group interview with hospital staff. Another element of the research was a focus group involving hospital staff, including registration staff and medical personnel. The group discussion made it possible to gather knowledge about the staff's experiences with common problems patients have in finding their way around, as well as their expectations regarding potential tools to support the navigation process. Analysis of the data from this stage allowed the organizational and ergonomic perspectives to be taken into account in the design of the application.

In the next stage, the usability of the proposed solutions was tested. The following methods were used for this purpose:

- A survey after patients completed the route using the prototyped application. After developing the initial version, 14 research walks with patients were conducted. Each participant was tasked with finding their way using the application and then taking part in a questionnaire-based interview assessing, among other things, the intuitiveness of the interface, the usefulness of the directions, the level of stress reduction, and the ease of completing the route. The use of this tool enabled a systematic comparison of participants' experiences and the identification of key elements requiring improvement in subsequent versions of the app.
- Open observations of patients using the prototype app on the route from registration to the mammography room.

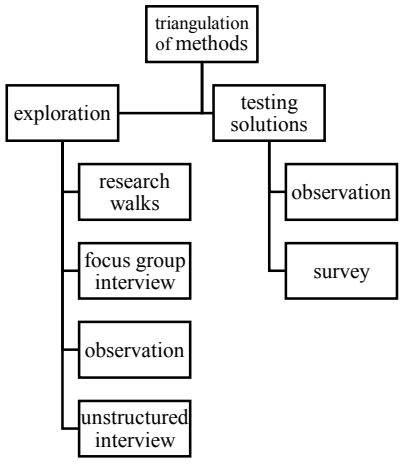

Figure 1. Methods used in the orientation study.

All stages of the research were planned in accordance with the principle of methodological triangulation, combining field observations, qualitative interviews, and group focus discussions. This made it possible to obtain a more complete picture of the phenomenon: from the individual experiences of patients, through the organizational perspectives of staff, to the functional testing of the technological tool. The collected qualitative data (interview transcripts, focus group records, observation notes) were subjected to thematic analysis using open and axial coding procedures. Quantitative data (e.g., number of confusion points) were analyzed using basic descriptive statistics, which allowed for a comparison of objective difficulties with participants' subjective assessments.

4. Results and discution

During their research walks, the researchers were able to experience the physical space of the hospital in which patients move around and the difficulties encountered by anyone who has to find a specific location in it for the first time. The preliminary conclusions facilitated the preparation of a route diagram and the creation of an observation sheet with the most problematic locations marked (Figure 2).

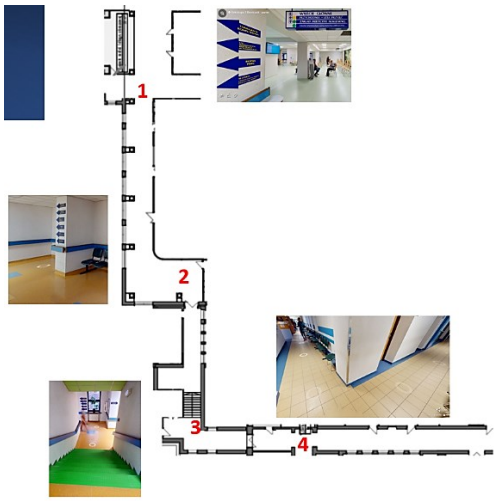

Figure 2. Diagram of the route under investigation.

Source: Prepared by B. Rożałowska.

During the focus group stage with staff, the key links between the various functional areas relevant to contact with patients using the breast clinic were examined, and characteristic points within the hospital where contact with individual medical procedures takes place were defined. The expectations of the staff regarding the most important functionalities and features of the application were also determined. As a result, it turned out that due to time pressure, the need for an effective hospital navigation tool was much greater than the capabilities of the design team. It became necessary to limit the scope of the work and determine the area that could be

developed. Reducing the scope of the research to a single route in the hospital: registration-mammography also had educational benefits. It allowed for a more detailed examination of the problem and provided valuable guidance for possible future actions.

The data obtained during patient observations, interviews, and research walks identified the most important points of misinformation that require architectural intervention and special attention when designing an application to support patients on the registration-mammography route.

The conclusions from the observations indicate that one of the most difficult moments on the route is at the registration desk on the first floor. From there, patients are directed to the mammography room. Both observations and interviews prove that this is the point where confusion about the route occurs most often. Among the 10 people observed, as many as 4 chose the wrong direction. The main reason for these mistakes is related to the physical characteristics of the space and the misplacement of directional signs. There are many corridors in this area, and the directional signs on the side wall are often overlooked. In addition, patients misinterpret the instructions given by the registration staff, which is due to their different positions in the space and their inability to objectively describe the spatial situation (Figure 3).

Figure 3. The beginning of the journey from registration to mammography.
Source: Photo: B. Rożałowska.

Figure 4. An additional corridor on the route making it difficult to choose the right path.
Source: Photo: B. Rożałowska.

Another difficult place for patients is the additional corridor with another set of green stairs visible behind glass doors. After being instructed by staff to follow the green stairs, patients had trouble choosing which way to go (Figure 4, Figure 5).

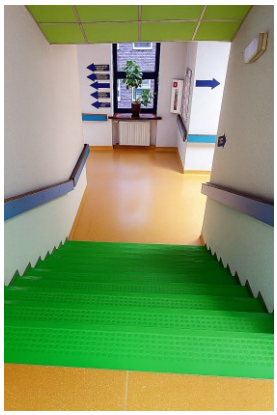

Figure 5. Green stairs as an element of space identification.

Source: Photo: B. Rożałowska.

Furthermore, the subjects rarely looked at the direction signs at the end of the corridor (Figure 5). Too much information causes confusion, resulting in errors of perception. This leads to choosing the wrong direction or increased uncertainty about the correctness of the choices made.

The schematic diagram shows the most difficult moments on the route from registration to the RM office (Figure 6).

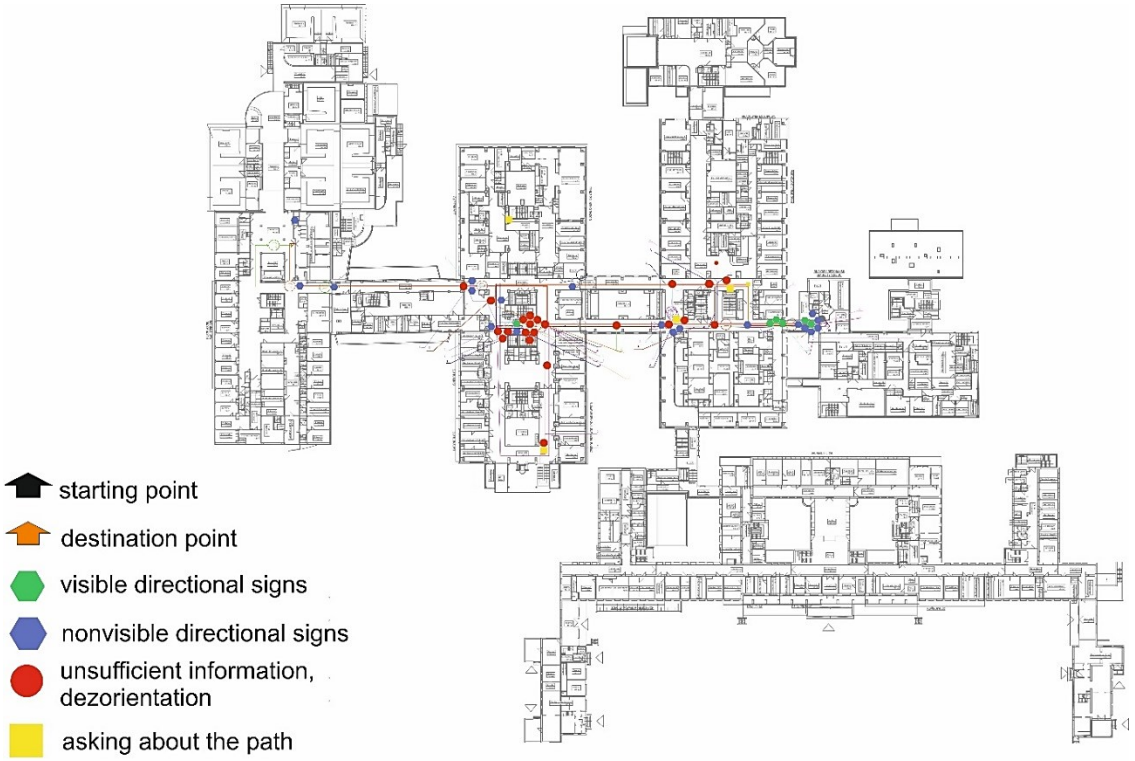

Figure 6. Results of behavior mapping for the route leading to Magnetic Resonance Imaging.

Source: Compiled by A. Szewczenko.

The results of the study indicate that the starting point is the most problematic part of the route. This is where there is the greatest lack of clear information on how to find the direction leading to the destination. Another difficult section of the route is in the middle, where there is also a lack of clear directional signs. Another problem occurs at the end of the route, where there are many signs, but they are not clear enough.

During the focus group stage with staff, the key links between the various functional areas relevant to contact with patients using the breast clinic were examined and characteristic points in the hospital space where contact with individual medical procedures takes place were defined. The expectations of the staff regarding the most important functionalities and features of the application were also determined.

Fourteen patients were involved in testing the usability of the application showing the way to the mammography room. The interface had previously been tested for legibility, aesthetics, and ergonomics. An example of the application screen is shown in Figure 7.

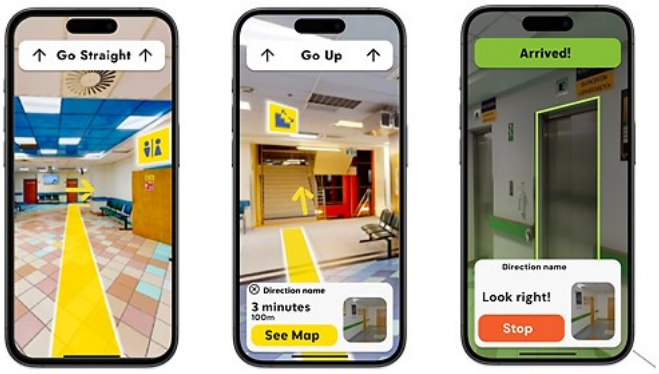

Figure 7. Sample views of the application interface.

Source: Developed by Z. Ścibura, P. Olszówka.

The results of testing the route using the app indicate a significant improvement in spatial orientation. The ease of use of the app and the clarity of the messages displayed were rated positively. Importantly, respondents also suggested adding additional information such as: department names, office and floor numbers, a voice assistant, a search tree for objects, and a map of the facility. Considering these suggestions should increase the usability of the app in the future, if the project is developed further.

The above research can serve as inspiration on how to improve navigation within the hospital on particularly difficult routes, where the direction of travel and floors change several times. Adopting a user-centric approach is essential to understanding the inconveniences encountered along the way, related to the characteristics of the terrain and the existing signage. Messages directing users to their destination should clearly appeal to the user of the space and not require additional thought or experimentation. The transition from the concept of wayfinding (how users find their way) to wayshowing (how the space shows users the way) is the essence of actual improvement in spatial orientation.

5. Summary

The research conducted confirmed that spatial orientation in hospitals poses a serious challenge for both patients and medical staff. An analysis of user behavior showed that key difficulties arise in areas with complex spatial configurations, where signage is illegible or overly scattered. The identified areas of confusion require both architectural and informational intervention, including better placement of signs, simplification of visual messages, and consistency in the signage system.

Testing of a prototype application supporting the process of finding one's way showed the validity of using technological solutions based on a user-oriented approach. The use of a digital tool contributed to a reduction in the number of orientation errors and stress among patients, while also pointing to directions for further development, such as the implementation of voice functions, extended location descriptions, and interactive maps.

One of the key problems with spatial orientation systems in hospitals is an excessive focus on the architectural design process or the implementation of technological solutions, while neglecting research into the actual experiences and behaviors of patients. As a result, the solutions created are often highly aesthetic and modern, but they do not fully meet the real needs of users – especially the elderly, those with cognitive impairments, or those with reduced mobility. The lack of systematic involvement of patients in the design process leads to navigation tools that are ill-suited, which in practice can be unintuitive or generate additional stress.

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