Practice-Led Design Research (I)

Configuring Transit Settings in Public Transportation

Anna-Lena Moeckl, Julian Schwarze, Peter Eckart, and Kai Vöckler

Disciplinary research focused on design pursues different ways of generating and communicating new knowledge. This includes practical design work, which produces knowledge that can be useful not only for the discipline itself but also for other fields; this knowledge is consequently embodied in the design projects. It is also made accessible through explanatory texts and visualizations, as explained in this essay. What is crucial to understanding and assessing the quality of a design project is the elaboration of the conceptual, systemically oriented approach that underlies the design. This design-oriented research perspective will be introduced and further illustrated through design concepts from the field of mobility design.

Practice-Led, Project-Based Research (Research through Design)

Design research distinguishes between three different research approaches: firstly, research *on* design, in which design practice and its results are the object of study (in design theory and history, but also, for example, in art history, sociology, and psychology); secondly, research *for* design, as research in support of design practice, where research and the evaluation of design decisions incorporate research approaches from, for example, the fields of technology, ergonomics, economics, psychology, and sociology, or are conducted through corresponding research collaborations (see the chapters by Schwarze et al.; Albrecht et al. in this volume); and finally, research *through* design as practice-led, project-based research, culminating in a product or system innovation (Frayling 1993; Findeli 2004). The latter process is closely tied to design practice; its research contribution is the design output, which literally embodies this new knowledge. Designing, insofar as it proceeds in a systematic and structured manner, is exploratory, but it differs from scientific research in its focus on the constructive design output, which synthetically brings together the knowledge that has been generated, as will be explained in more detail below.

In principle, the goal of design is to enable new possibilities for perception and action in the application by means of the designed product (object, information, space), as well as to convey meaning beyond concrete usage in relation to the sociocultural context. Design always refers to something that is already there: something given, a circumstance, a problem. A fundamental aspect of any design is that something new is created—an existing state of affairs is transformed into a more desirable one. Accordingly, design is anticipatory, and above all generative (Jonas 2004). Design is enabling. However, the new is not only legible in the degree of product or system innovation (which applies equally to engineering innovations, for example), but also in terms of the extent to which it enables or improves user access to the object, or even creates new systemic access via the product design. In addition, there is the question of how it leads to a new aesthetic experience and to a new semantics (which in turn pertains to the artistic dimension of design). This is in keeping with the dual character of designed products; on the one hand, they are practical products that need to be designed to be functional in their use, and on the other, they are aesthetically and semantically charged products that have to be designed for their effect (Steffen 2011). This constitutes the special nature of the design process; it is highly context-sensitive and situationally oriented, grounded in technical expertise and aesthetic judgment, and at the same time it has to accept uncertainties. After all, the new cannot simply be derived from an empirical analysis.

How can something new be designed? The unique characteristic of design methodology is that a process of reflection on one's own practice takes place during the design work. This is a process that occurs in iterative loops, which resembles a »conversation« between the designer and the object being designed. From an initial assessment and formulation, unexpected resistances and perspectives emerge from the thing being designed, which in turn are incorporated into subsequent design work (on the iterative approach, see Bürdek 1975; on the sociological perspective on a reflexive design practice, see Schön 1983). This iterative procedure also allows for the prototype to be put to the test, so that user feedback can be integrated into the design process. Therefore,

this is not knowledge generation in the scientific sense (knowledge that can be deductively derived, explicated, and correspondingly verbalized, objectified, and formalized), but rather it is embedded, tacit knowledge that is rendered visible through the design output (on tacit knowledge, see Polanyi 1966). In contrast to analysis, which breaks down complexity into more manageable parts, design is always propositional and focused on a totality (Redström and Wiltse 2019). Here, the designed entities and circumstances do not become objects and facts but are part of a shared context: design as the conception of a new, enabling context that is mediated through the designed artifact and creates new access opportunities (in this case to environmentally friendly, intermodal mobility) by means of a systemically oriented design approach.

Whether the design process can be reconciled with the concept of scientific research remains controversial (Maldonado and Bonsiepe 1964; Mareis 2011; Steffen 2011; Bonsiepe 2021). The contribution of practice-led design research to the broader definition of research lies in its independent methodology (the advantages and disadvantages of which will not be discussed further here) and its specific research approach, which operates at the interface of artifact and human being and consequently the (social) context of usage (situational, systemic, and contextual orientation). A contextual and systemic design orientation involves the consideration of the initial situation in its entirety, in terms of its relationships and interactions relative to the underlying question and problem (as identified in the initial assessment). The problem then acts as an orienting and structuring principle and marks the boundaries of the design area to be worked on. Based on actual mobility design projects, the section below will demonstrate how systemic orientation leads to a relevant approach to conceptual solutions and to the design proposal.

Design of Transit Settings within Public Transportation

A central challenge for the design of transit settings within public transportation is the barrier and stress-free routing of users through the transportation infrastructure. On the one hand, this concerns the functional requirements of accessibility, comprehensibility, and usability of the transportation system, such as information on routing in conjunction with spatial elements to ensure trouble-free, seamless movement. On the other, this also involves socioemotional requirements that influence, for example, the feeling of safety or the need for privacy while in transit. From a design perspective, the question therefore arises as to how spaces and paths that connect modes of mobility can convey not only functional but also socioemotional qualities. The aim of this design approach is the avoidance of physical and cognitive obstacles to create a »flow« in the movement (as well as in waiting), to create a connective space that is clearly recognizable to users as a coherent whole and that simultaneously facilitates a positive mobility experience (see Vöckler and Eckart in this volume).

The study »Station of the Future–Offenbach Marktplatz S-Bahn Station« is based on a comprehensive analysis of the current situation from the user perspective.[01] Offenbach Marktplatz is a mobility hub that links an underground S-Bahn (suburban train) station via an intermediate level (B-level) with the aboveground city center, the city bus lines, as well as additional sharing services. The analysis was systemically focused on the user experience along the spatial configuration. It became apparent that the connection between underground and aboveground mobility services was inadequate from the user perspective: necessary information was missing at crucial points along the route. The spatial configuration consisting of an underground S-Bahn station and the aboveground urban space makes orientation difficult and involves high stress potential: underground due to the lack of awareness of the upper level and aboveground due to the lack of real-time information. For wayfinding, it is essential that the necessary information for choosing the desired direction can be found at nodes/decision points. Among other measures, the new concept led to the design of an »information cube« that provides mobility information on all four sides. It stands available to travelers on their way from the city center and

Figs. 1+2 Design and implementation: the »information cube« at the S-Bahn station Marktplatz in Offenbach creates a bridge between two mobility systems (local bus and regional S-Bahn systems) by means of an information element that links them in terms of location and design. (Source: Julian Schwarze/DML – Design Institute for Mobility and Logistics, HfG Offenbach am Main)

bus to the S-Bahn and vice versa thus facilitating orientation. Information is arranged according to need for arriving and departing passengers. On the intermediate level between the aboveground urban space and the underground platform, the cube provides a transition between two different information systems: that of the regional S-Bahn and that of the urban bus lines. The amount and form of the information is adapted to the respective positioning in the mobility chain and reacts dynamically to changes, such as cancellations or delays. The »information cube« was designed to create a systemic link between two mobility services, that of the municipal transport services (buses) and that of Deutsche Bahn (S-Bahn), by communicating a sense of cohesion across the physical distance. Information that is positioned and aligned in the proper place can significantly improve transitions between different mobility services (↳Figs. 1+2).

The investigation showed that the waiting situation on the underground platform was perceived as being unsatisfactory in terms of amenity quality and orientation. Therefore, the platform was reorganized with uniformly distributed benches and information pillars, which previously didn't correlate with what was needed for waiting or dispersing along the platform. The conceptual approach taken here considers movement itself, or being mobile, as an overarching experience even when waiting. Another important insight was that waiting should also be understood as part of movement—that is, of being mobile—and thus becomes part of the design problem. This was achieved by

01 The study was commissioned by Deutsche Bahn (DB Station and Service) in 2019. A team of designers (Mervyn Bienek, Kai Dreyer, Anna-Lena Moeckl, Julian Schwarze, and Luke Handon) developed the concept study. Peter Eckart, Kai Vöckler, and Julian Schwarze were responsible for the project. The complete study can be accessed at http://wwwproject-mo.de/zukunftsbahnhof-s-bahn-station-offenbach.

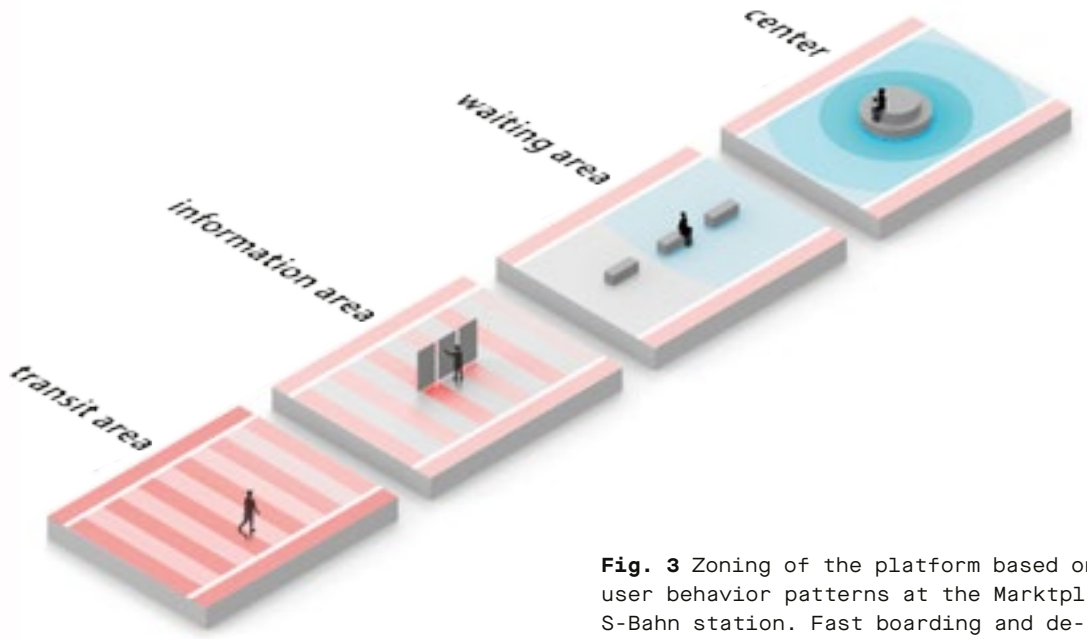


Fig. 3 Zoning of the platform based on user behavior patterns at the Marktplatz S-Bahn station. Fast boarding and de-boarding at the beginning of the platform is facilitated, departure information is clustered, waiting zones are created, and better distribution of travelers along the platform is achieved. (Source: Kai Dreyer/ DML, HfG Offenbach am Main)

zoning the platform so that passengers are intuitively guided to transit, information, or waiting areas based on their needs via appropriately positioned and grouped elements such as information pillars, seating, and leaning areas. Stays in these transit, information, and waiting areas are thus spatially separated, which should make the mobility experience more pleasant and less stressful for users (↳Fig. 3). In addition, zoning can result in improved and smoother traffic flow management, which was seen as a further advantage from the point of view of the operator, Deutsche Bahn. These two concepts have been partially implemented and evaluated by Deutsche Bahn. Further conceptual approaches and designs, as developed in the study, can also be included in future projects commissioned by Deutsche Bahn.

How a transfer situation at a mobility interchange can be optimized through design and at the same time allow for a positive mobility experience was the topic of a semester project at HfG Offenbach University of Art and Design in collaboration with Deutsche Bahn. It focused on the underground platforms at the Hauptwache S-Bahn station in central Frankfurt, with the aim of improving access and egress situations at S-Bahn stations in general.[02] Here, too, the question was how to create mobility flows at the Hauptwache station that would be characterized by trouble-free orientation and accessibility for all users. The starting point was the systemic approach, which does not exclusively consider the spatial configuration in isolation, but rather understands the process of changing trains as part of an overall, interconnected mobility that can be experienced by users as unimpeded »flow.« Rather than isolating single factors associated with the study site, the holistic design incorporates and links the interrelationships among product design, information, spaces, processes, and actions. In our view, the positive mobility experience thus created by the design is crucial for the acceptance of mobility systems. Two examples will be used to show how intuitive orientation can be linked to wayfinding

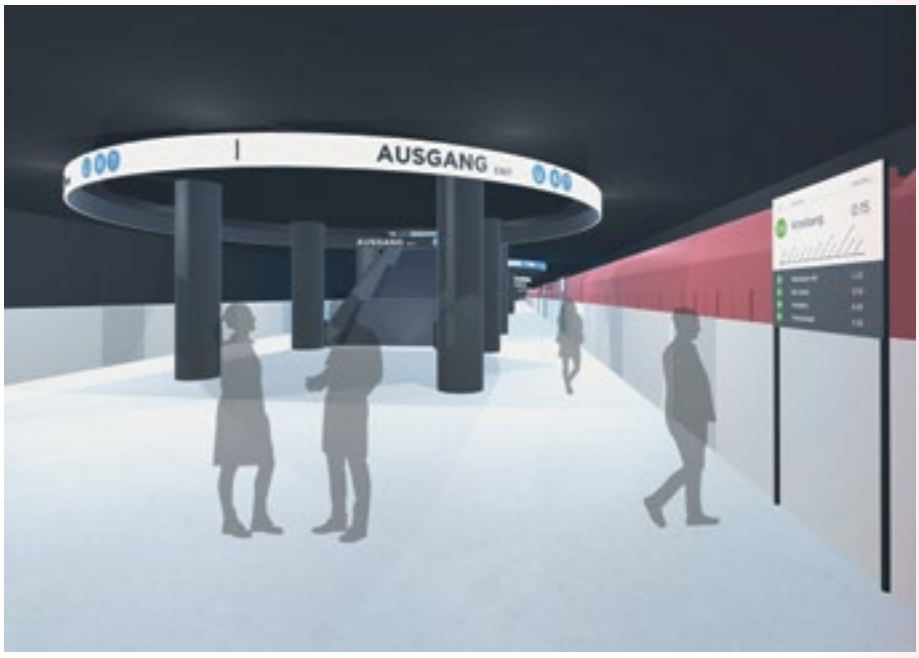


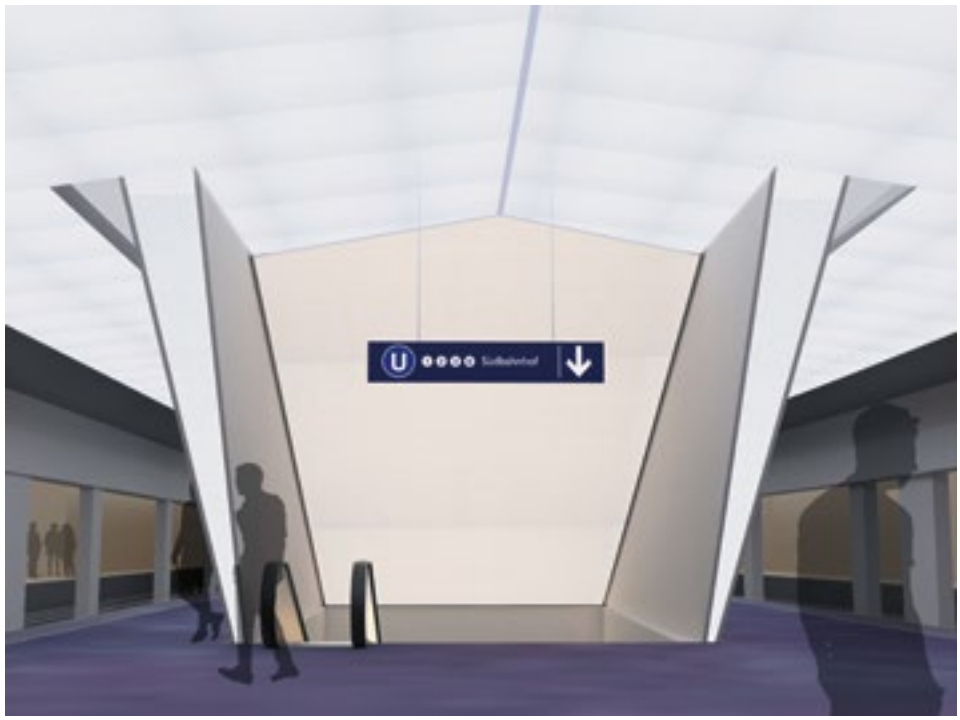
Fig. 4 The »Circulate« orientation system conveys information that can also be perceived from a distance: white information rings point the way out using daylight; blue information rings point to the subway leading down. (Source: Andreas Hildebrand/DML, HfG Offenbach am Main).

information through appropriate spatial configurations and lighting so that the process of changing trains can be perceived without any problem or very much cognitive effort on the part of users. The orientation system »Circulate« (design: Andreas Hildebrand) combines information that is usually separated into grouped elements. The chosen ring shape serves as a spatial orientation point (landmark) and information bearer at the same time (↳Fig. 4). Such an intuitively experienced design, whose information can be read even from a distance, gives travelers a sense of orientation and inspires confidence in their own mobility.

Just as intuitively, the »V.U.I.I.« design (Julia Huisken and Annika Storch) deals with the clear, immediately graspable design of the guidance system, which can be easily comprehended by users even when passing by quickly (»out of the corner of the eye«). This wayfinding system was not conceived separately from the spatial context, but in conjunction with the architectural elements that structure the space. Entrances leading down to the subway symbolically point the way below with the arrow-like design of the architectural elements and their lighting (↳Fig. 5+6).

These design projects are excellent examples demonstrating that design elements can only be grasped in a systemic context. In addition to the consideration of the system that facilitates mobility, however, it is also a question of a coherent user mobility experience. Good design takes into account the functional and socioemotional needs of users and places them at the center. Through design decisions, the configuration influences interaction with the mobility system by allowing users to recognize and comprehend its coherence, while significantly contributing to a positive experience. Thus, new mobility structures are not only more likely to be accepted by people in their everyday lives, but also to be appreciated.

02 The semester project »crossflow_experience« was carried out with design students at the HfG Offenbach University of Art and Design under the supervision of Peter Eckart with Anna-Lena Moeckl and Julian Schwarze in winter semester 2018/2019. Cooperation partners were DB Regio, DB Station and Service, S-Bahn Rhein-Main, and Rhein-Main-Verkehrsverbund.



Figs. 5+6 »V.U.I.I.« incorporates spatial features into the guidance system and provides orientation information that is architectural, graphic, and illuminated. (Source: Julia Huisken, Annika Storch/DML, HfG Offenbach am Main)

Dynamic Signage: The Communication of Distancing Rules in Transit Areas within Public Transportation

During the COVID-19 pandemic (beginning in 2020), informing people about the situation in their own country and around the world became regularly necessary. Given its unprecedented status, the novel virus needed to be understood in new ways and the information conveyed using a wide variety of media and forms. Far-reaching and unprecedented consequences for everyday life followed: behavioral recommendations and rules, mandatory wearing of masks indoors, rapid testing. Above all, the distances to be maintained from other people was, along with the wearing of masks, the most tangible sign of how everyday life was affected by the pandemic. Although distancing of one-and-a-half to two meters was easy to understand, its implementation in everyday life was a challenge. This new knowledge, which was often not yet part of self-evident behavior owing to the lack of an established routine, had first to be integrated into everyday life. How could this important information be communicated in public transit areas so that it was immediately and intuitively understandable for users?

Information is communicated and made recognizable via signs. Signs can be perceived, interpreted, and understood visually, haptically, or acoustically in a wide variety of ways. To communicate distancing rules, for example, signs use figurative language to indicate that distancing must be observed. In addition, there are spatial markings. In supermarkets, for example, floor markings were placed every one-and-a half-meters in the checkout area, or seating areas were cordoned off in public spaces. In a sense, we have become »trained« to maintain a certain distance, and our behavior in public spaces has changed noticeably. Furthermore, the responsibility for communicating distancing rules varied depending on whether the locations were public spaces (for which the public sector is responsible) or privately owned semi-public spaces, such as shopping malls and cafés, or train stations, which in Germany are governed by private law. As a result, there were a variety of generally improvised, frequently incomprehensible, and on top of that, unattractive markings for distance control, which tended to have the negative connotations of hazard markings (↳Figs. 7–11).

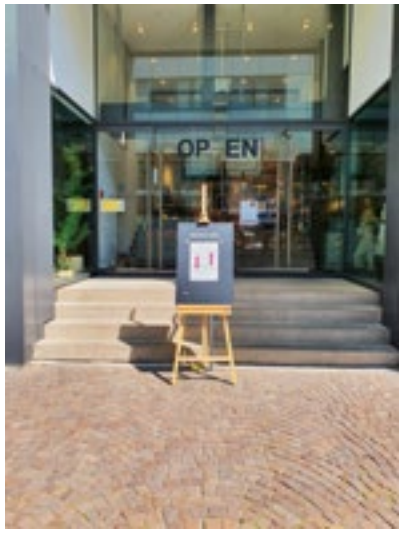
During the COVID-19 pandemic, it became clear how new, individual behaviors were continuously becoming more normalized in society, leading to newly learned routines. In this context, signs function as a means of communicating scientific findings to combat a pandemic, here illustrated by the example of changes in everyday routines. The signs that are used often correspond to visual languages that are familiar and can therefore be easily integrated into everyday routines; others are new, and their meanings must first be learned. Local public transportation systems, in particular, have been and continue to be determined by the issue of how much »closeness and distance« users find pleasant or unpleasant—and not only beginning with the pandemic.[03] This is considered a decisive factor for the acceptance or rejection of shared transportation systems. Against this background, the question arose as to how the necessary distancing rules could be integrated into local public transportation, specifically into waiting and transit situations, such that they are not only intuitively understandable but also generate positive experiences. In this way, they are symbolically associated less with danger prevention and more with an aspect of mobility that is taken for granted.

In her student design project »LINE 39«, Annika Storch addressed the problem of communicating information on maintaining distance in public and semi-public spaces, especially at train stations.[04] Based on her own uncertainty regarding the required distancing regulations, she monitored the behavior of passengers at train stations in the

03 Deutsche Bahn's Idea Trains can be cited as an example. These are walk-in design studies that address individualization and privacy on regional trains. Screened or open seating areas allow for privacy or conviviality. A variety of services and differentiated design can serve individual needs (see Deutsche Bahn's Idea Trains: https://inside.bahn.de/ideenzug-db-regio-module/).





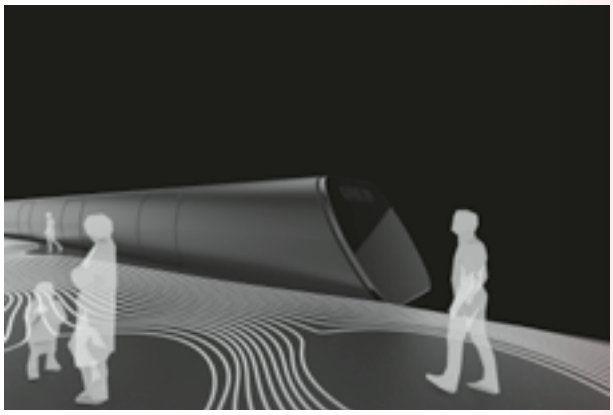


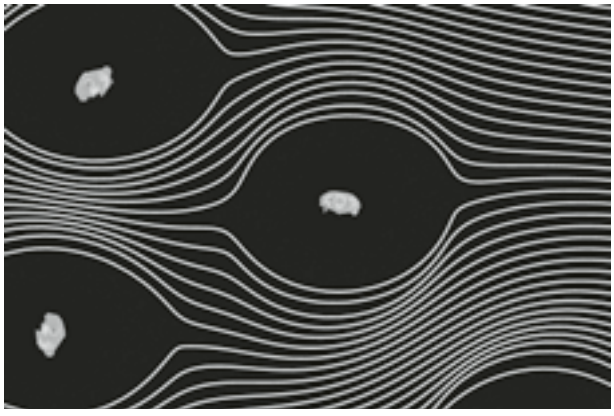
Figs. 7–11 During the COVID-19 pandemic, there was a barrage of improvised information on distances to be maintained, which was often not understandable or even fit for purpose. (Source: Fig. 7 Julian Schwarze; Figs. 8–11 Philipp Kohl/DML, HfG Offenbach am Main)

Frankfurt area and discovered that it was virtually impossible to maintain the required distance to other people (↳Figs. 12–14).

The fundamental concept driving this design project is the use of visual reactive information that responds to the constantly changing distances between passengers waiting and changing trains on platforms, which at the same time communicates to them the required distances to be maintained. An interactive projection of a grid of lines on the floor reacts in real time to travelers and makes the minimum distance of one and a half meters immediately perceptible. This not only warns other users which areas they should avoid entering, but also allows individuals to easily protect themselves. In contrast to current approaches, which use physical objects such as partitions to separate people, »LINE 39« takes a different track and attempts to make people aware of the distances by means of intuitively understandable signs, namely the reactive lines. This enables them to protect themselves and thus determine themselves how to move around.

If a person walks across the platform, the line grid bulges out in a radius of one and a half meters. If two people walking in alignment with the grid come too close to each other, then the line encloses the respective person and signals that the safe distance will soon become too small. If two people walking against the alignment of the line move



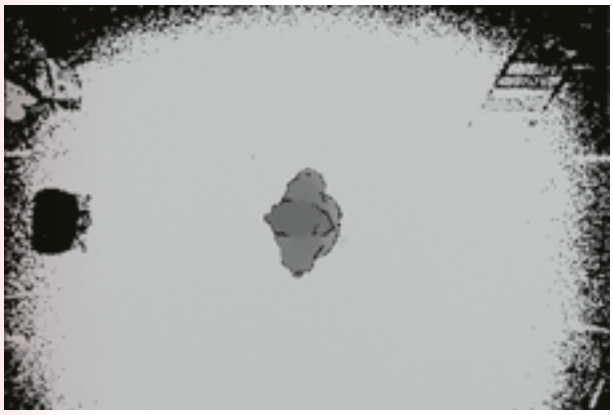


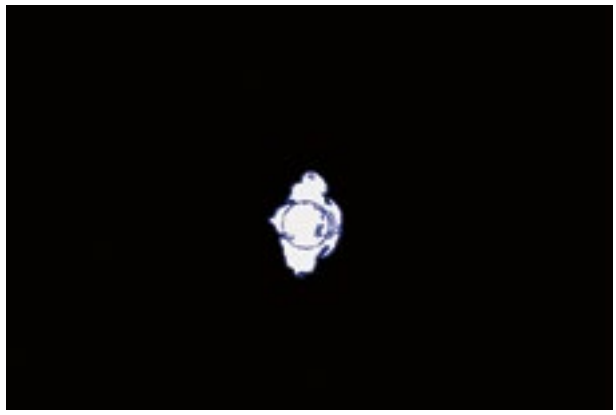
Figs. 12–14 Projected lines react to the passenger volume on the platform and communicate distances between travelers. (Source: Annika Storch/DML, HfG Offenbach am Main)

toward each other, then the lines between the people become denser. This also signals that the distance must be increased. If a person is getting off a train, then he or she is gradually enclosed by the lines and thus incorporated within the system. »LINE 39« makes an otherwise invisible space visible. Technically, this is feasible: a sensor (camera) observes passengers on the platform. A processing code (an object-oriented and strongly typed programming language in the field of graphics, simulation, and animation) interprets this camera data as follows: the pixels closest to the camera are filtered using a threshold filter (a thresholding technique that detects contrasts). A midpoint calculation can then be used to anonymously convert the obtained data into coordinate data. JavaScript (a written code) determines the configuration of the line grid, which is projected onto the platform. Within milliseconds, »LINE 39« shows passengers the correct and currently valid minimum safe distancing between themselves and other passengers (↳Figs. 15–17).

Signs designed to convey information, in this case the pandemic distancing rules, must meet a wide variety of requirements in order to optimally communicate their content. First of all, this is a matter of practical requirements. Travelers moving at varying speeds and high volumes of people at peak times pose particular challenges. By making signs dynamic and reactive in terms of the information they convey, communication can be adapted to the ever-changing use of space, even on an individual basis. An important factor to consider is that cultural diversity in public transportation spaces requires communication that is as intuitive as possible and not hindered by language barriers, for instance. Another important question is how

04 The design project was created as part of the seminar »and now …?« in the summer semester 2020 in the Integrative Design department at HfG Offenbach University of Art and Design (supervisors: Peter Eckart and Julian Schwarze).





Figs. 15–17 1. A Kinect camera (a sensor) observes passengers; 2. a processing code interprets the human(s); 3. JavaScript determines the configuration of the line grid. (Source: Annika Storch/DML, HfG Offenbach am Main)

to impart the credibility of scientifically based distance rules—certainly not through improvised, crudely made distance markers. Information that can be intuitively grasped, which also gives the individual passenger a feeling of being able to autonomously determine the distance maintained, is central to the acceptance of the system. Then there is the aesthetic dimension. The technically advanced, dynamically reactive lighting articulates the space in a way that creates a pleasant experience at the level of perception, while inspiring confidence. Last but not least, the chosen technical design language also has a highly symbolic effect. It stands for progressiveness and fosters acceptance of the scientifically based pandemic distancing rules. But most importantly, a systemic approach has been pursued here. By making the information on maintaining distances dynamic, the transit environment can be experienced in both the transit and waiting areas as part of a comprehensive, intermodal, progressive mobility, which can also be adapted on an individual basis.

Here, as in the design projects discussed above, the specific contributions of practice-led design research become apparent. Starting from a concrete initial situation with a defined question and problem, a systemically oriented design approach leads to product innovations. These are structurally transferable and make the mobility system accessible and more usable, exert a positive influence on the mobility experience, and convey the overall importance of intermodal, environmentally friendly mobility to society.

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