ROOT: A Multidisciplinary Approach to Urban Health Challenges with HCI

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ABSTRACT

With the rise of chronic diseases as the number one cause of death and disability among urban populations, it has become increasingly important to design for healthy environments. There is, however, a lack of interdisciplinary approaches and solutions to improve health and well-being through urban planning and design. This case study offers an HCI solution and approach to design for healthy urban structures and dynamics in existing neighborhoods. We discuss the design process and design of ROOT, an interactive lighting system that aims to stimulate walking and running through supportive, collaborative and social interaction.

CHI'19 Extended Abstracts, May 4-9, 2019, Glasgow, Scotland, UK.
ACM ISBN 978-1-4503-5971-9/19/05. DOI: https://doi.org/10.1145/3290607.3299051

We exemplify how multidisciplinary HCI approaches in a hackathon setting can contribute to real life urban health challenges. This case study concludes that the experimental and collaborative nature of a hackathon facilitates the rapid exchange of perspectives and fosters interdisciplinary research and practice in urban planning and design.

CCS CONCEPTS

• **Human-centered computing~HCI design and evaluation methods**

KEYWORDS

Urban HCI; smart cities; Physical activity; Urban Design; Hackathon; Multidisciplinary research

ACM Reference format:

Ida Damen, Rens Brankaert, Mengru Xue, Xiaoyue Chen, Anne Grave, Steven Vos. 2019. ROOT: A Multidisciplinary Approach to Urban Health Challenges with HCI. In *CHI Conference on Human Factors in Computing Systems Extended Abstracts (CHI'19 Extended Abstracts), May 4–9, 2019, Glasgow, Scotland, UK.* ACM, New York, NY, USA. 8 pages. https://doi.org/10.1145/3290607.3299051

1 INTRODUCTION

The built environment has substantial impact on the health and wellbeing of its residents [2,12,13,16]. With the rise of chronic diseases as the number one cause of death and disability among urban populations, urban planning and design for healthy environments has become increasingly important [3,12]. The primary cause of most chronic diseases is physical inactivity [3], and stimulating physical activity should therefore be key in urban planning and design for healthy environments.

Designing for healthy environments in neighborhoods is challenging, since the options to change the built environment is limited due to existing infrastructures and dynamics. Also, refurbishment of physical infrastructures are often time consuming and costly. This problem is especially pressing for low income neighborhoods, which are the areas that would benefit most from health promoting activities [4,5]. Moreover, lower socioeconomic neighborhoods have less amenities and features that promote physical activity compared to higher socioeconomic neighborhoods [5]. This despite the fact that accessible and attractive public space is associated with higher levels of recreational physical activity [17], thereby supporting healthy lifestyles.

Creating healthy urban environments is challenging because it requires integration of expertise and knowledge from various disciplines and effective collaboration between practitioners, policy makers and researchers [2,13,14]. However, in both research and practice this is still often not the case. Krefis' recent systematic review on the effects of the urban environment on health and well-being shows a lack of interdisciplinary research approaches that convey the complexity of urban structures and health and well-being [12]. More effective translation of research into policy and practice is eminent [13].

Figure 1: Stakeholder map in design phase 1 to understand the different perspectives of the Social Design Challenge.

Human Computer Interaction (HCI) poses an interesting starting point for interdisciplinary approaches to address the current lack of collaboration in the field of healthy urban design. Solutions for urban challenges are increasingly sought in urban technology [10]. This is exemplified by the growing interest in 'smart cities' over the past years [18,21]. Many pilot projects are set up that address for instance safety issues [11,20], social engagement [14,20] and transportation issues [14,20]. Although transportation and infrastructure seem particular popular focus areas in smart city technology, public health issues appear to be less prominent.

Few studies and projects were found that focus on health promotion by means of digital urban technology. One example is the 'From movement to Mozart' project, in which subway stairs were transformed into a real life piano to stimulate stair use [9]. And the use of public space to promote healthy behavior at work [6]. Although these projects provides an illustration of the possibilities of technology, urban technology can play a much more prominent role in urban health promotion [1].

2 DESIGN PROCESS

2.1 The Social Design Challenge

The case study presented in this paper is set in the context of a hackathon. Hackathons can be seen as a participatory design activity over a short period of time to 'support intensive bursts of creativity around technology' [19]. Participants of the hackathon were junior researchers from various disciplines. Four participating researchers that coauthored this paper have a background in architectural design, Human Technology Interaction, urban planning, industrial design and health & life sciences. During the hackathon on vitality, the researchers worked together for forty-eight hours to solve a societal problem that was proposed by the municipality of Eindhoven: *"How can the municipality of Eindhoven retain the social benefits of a local sports club and increase the health of Doornakkers'[name of neighborhood] residents through sports and physical activity?"*.

Doornakkers is known for its many social and economic problems, like the deterioration of public space, unemployment and public safety [7]. To address these societal issues, the city council of Eindhoven presented their new policy 'bewegen door verbinden' ('Activity through connectivity') in 2017. The new policy aims to use sport and physical activity as a means to improve social connectedness, the public space use and individual and communal health. The municipality was interested in an out-of-the-box solution for the pressing local problem in Doornakkers, and therefore collaborated in the hackathon.

2.2 Design Approach

During the design process several design strategies were adopted by the team of researchers to exchange knowledge, insight and skill. The design process was divided into three phases. First, an overview was created to get familiar with the challenge from various perspectives (Figure 1). Second, an on-site exploration was done to gain more in depth knowledge of the setting and gain a common understanding of the context. Third, several design concepts were developed by the team and evaluated with the municipality representative to progress from a preliminary design to a final design concept.

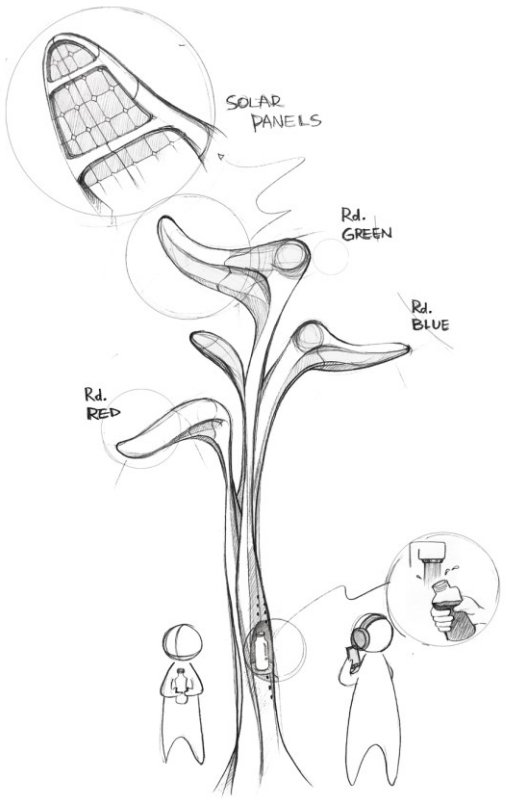

Figure 2: Concept drawing of ROOT, representing people using the walking and running routes through colored light in each of the three leaves.

2.2.1 Design phase 1: general overview. In collaboration with experts the team built an understanding of the proposed challenge. A face-to-face in-depth open interview was conducted with the policy official of the municipality of Eindhoven. Seven interviews were conducted by phone with staff from the municipal policy team, municipal sports practitioners, the chairman of the local soccer club and neighborhood residents to get a better understanding of the different perspectives and views on the neighborhood context. In addition to the interviews, policy documents were collected and reviewed. These insights were shared and synthesized by means of a stakeholder map (Figure 1).

The map was used to bridge different perspectives and create a common reference among the team. Once a shared overview of the problem space was established, the team engaged in a creative phase to find new concepts and approaches. These were shared with the problem-owner for consultation to decide on the most promising direction.

2.2.2 Design phase 2: On site. In the second phase, exploratory fieldwork was carried out as an immersive, contextual method [8]. On site observations by bike and on foot were used to get a better understanding of the Doornakkers neighborhood. Points of interest were captured on film, observations were voiced on the spot and communicated additional insights from their own discipline. The fieldnotes and photos were collected and shared on an online platform for future reference and for communication purposes. The data gathered during the in context observations was used as creative input for further concept generation. Collaborating with different disciplines led to new perspectives to define underlying key challenges. For example, from an urban planning perspective problems were perceived in terms of safety of the neighborhood, while from a design perspective insights were gathered on the limited attractiveness of the location.

2.2.3 Design phase 3: Concept ideation. Based on the gathered information and insights, several design concepts were generated in phase three. We used concept mapping as a sense-making tool to connect ideas, insights and arguments [8]. Based on this process, various concepts were generated and sequentially one concept was selected and developed further by the team. Through sketching, going back to the data and additional consultation with the municipality representative the concept was iteratively developed into a design proposal. Additional information and feedback on the usability and feasibility of the design was collected by means of a stakeholder walkthrough [8]. These were synthesized in a final design, and a storyboard to communicate the design in place. Finally, the design and storyboard were presented at a mini-symposium to share the results of the hackathon with a broader audience. At the mini-symposium the final design was judged by an expert jury. The jury assessed the design on its feasibility, social relevance, effectiveness and potential impact. The design of ROOT was well received and was therefore awarded first place.

Figure 3: The brightness of the tree lights are dependent on the amount of runners and walkers on the corresponding route.

3 DESIGN

3.1 Design Concept: ROOT

ROOT (Figure 2 and 3) is an interactive light system embedded in the public space of a neighborhood as a meeting point and route indicator for walkers and runners. ROOT aims to stimulate physical activity through supportive, collaborative and social interaction and consists of two elements. The first element (Figure 2 and 3) is a tree, with different colored lights that serves as a starting and connecting point for walkers and runners. The second element (Figure 4) is a sets of routes laid out in the neighborhood marked with interactive road lights.

3.2 The tree: An interactive light system

The ROOT tree is designed as a central communication spot for walkers and runners. The system is powered with solar panels (Figure 2) and communicates the real-time use of the different ROOT routes by walkers and runners at that moment in time. Each leaf represents one route, depicted by a color. The colors of the ROOT tree leaves represent the colors of the different routes, resulting in a blue, green and red route. The brightness and intensity of the ROOT tree leaves are based on the amount of people that are using the routes at that time. As illustrated in Figure 3, the lights of the right leaf and left leaf are significantly brighter in the first scenario (top image) compared to the second scenario (bottom image) due to the amount of users that are currently on the route.

The ROOT tree lighting system is placed at an important social node in the neighborhood at the local sports club to attract attention and spark conversation between neighborhood residents. The design is shaped as a tree to match the surrounding greenery, but distinct enough to stand out and serve as a meeting point. To enhance its functionality as a point of interest for walkers and runners, a water tap is integrated into the design (Figure 2). The integration of the tap provides free access to water, which can influence physical activity patterns on site [15].

3.3 The routes: Light patterns

Linked to the ROOT tree lighting system are three distinct walking or running routes (Figure 4), these were carefully laid out with the use of STRAVA runners data. The routes are made visible through integrated road marking lights (Figure 5) creating patterns in three different colors, matching the ROOT lighting system colors. The brightness of the road lights is linked to the amount of people who have passed recently. The lights therefore fulfill a ‘memory function’ by slowly dimming down as time goes by without people passing by on foot. The amount of walkers and runners can be collected using LED-Mark© solar LED panels with anonymous people counting sensors (Figure 5) and be used to influence the brightness of the ROOT tree leaves. The routes are different in length, to serve different user needs, people can choose between a 2 km route, 5 km and 8 the km route.

The ROOT lighting patterns embedded in the ground to indicate the routes serve different functions. From a urban planning perspective it is important to increase the perceived safety of the environment with the additional light.

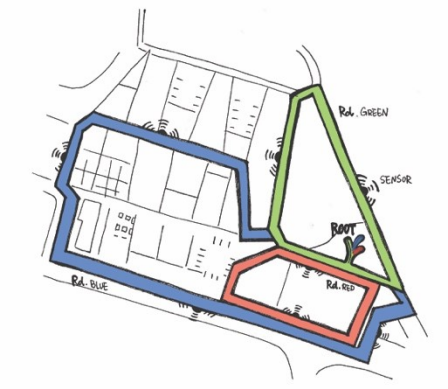

Figure 4: ROOT routes with a red (3km) route, green (5km) route and a blue (8 km) route.

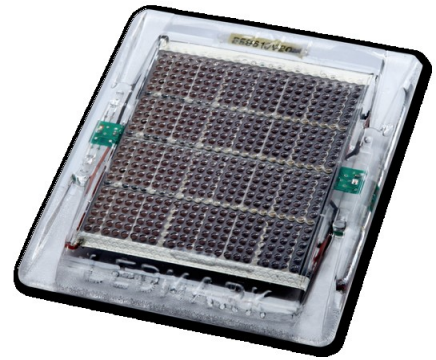

Figure 5: Full LED-Mark© solar LED panels will be used in the interactive road lights and serve as sensors to count the amount of runners and walkers on the routes.

The safety is further increased by adding additional light to draw awareness to other road users and increase attention of for instance car drivers. The perceived safety is of great importance from an urban planning and psychological point of view. From these perspectives the ROOT tree and road lights have an important function as a social indicator that other runners or walkers are making use of the routes and the environment. Seeing that other people are using the routes might provide reassurance and motivation for residents to use the routes. It might increase the motivation of people to start running or walking. Increasing options to stimulate physical activity is an important objective from a health and life sciences perspective. By designing an attractive and user-friendly system, ROOT aims to increase the attractiveness of the location, to attract people and users and increase social interaction among local residents.

4 CONCLUSIONS AND FUTURE WORK

This study set out to explore an interdisciplinary approach to urban design to improve health and well-being in a neighborhood setting. By discussing the design and design process of the interactive lighting system 'ROOT' we exemplify how multidisciplinary HCI approaches in a hackathon setting can contribute to urban challenges, and provide a novel perspective and solution space in enhancing physical activity and connectedness among local residents.

With regard to the interdisciplinary design process several lessons were learned. Firstly, the variation in the team led to new insights, this came forward in the collective on-site analysis which provided a novel shared perspectives on the context with regard to safety. Secondly, the design space of the ROOT concept stretches across different fields, leaning into HCI, urban planning and behavior change, providing an example of how research can be translated into practice.

Although hackathons are no one size fits all solution to real life urban challenges, it can stimulate rapid exchange of perspectives between participants and concept experimentation. Due to the collaborative nature of a hackathon participants are stimulated to work closely together and create a common understanding of a problem. By using this method, different views, skills and insights are intertwined and can lead to quick and social relevant solutions for urban health challenges.

A possible barrier is the short time span in which participants have to get acquainted and get a shared understanding of the problem from multiple perspectives [2]. This process might have been facilitated by the fact that all participants were PhD candidates with an interest in vitality. Future work should assess how the heterogeneity in education level in this respect affects interdisciplinary research and practice. This study provides an answer to the need for experimentation through projects in urban planning for health across disciplines, expressed by Rydin [1]. Another barrier is the realization of concepts resulting from hackathons, various stakeholders might have other priorities and additional funding is often scarce. The next steps to overcome this are explored, and include the development of ROOT in collaboration with the municipality and local residents. Based on this case study we advocate cross-disciplinary collaboration to explore out of the box solutions to complex societal challenges as multiple perspectives are key.

ACKNOWLEDGMENTS

This case study is supported by the Vitality Academy: an initiative by the strategic alliance of Utrecht University, Eindhoven University of Technology and University Medical Centre Utrecht.

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