On-site participation linking idea sketches and information technologies

User-driven Customised Environments

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The paper introduces the methodology related to the topic of citizen-driven urban design and revises the idea of on-site participation of end-users, which could prospectively lead to customisation of architectural and urban space in a full-scale. The research in the first phase addresses the engagement of information technologies used for idea sketching in participatory design workshop related to local urban issues in the city of Chur in Switzerland by means of the Skity tool, the sketching on-line platform running on all devices. Skity allows user, which can be individual citizens or a community, to sketch, build, and adapt their ideas for the improvement of an urban locality. The participant is the expert of the locality because he or she lives in this place every day. The content of this paper is focused on the participatory design research project conducted as a study at the ETH Zürich and the Hochschule für Technik und Wirtschaft HTW in Chur in collaboration with Future Cities Laboratory in Singapore, mainly concentrated on the first step of the methodological approach introduced here.

Keywords: responsive cities, urban mass-customisation, idea sketching, ideation, on-site participation, citizen design science

SCOPE OF THE PAPER
The research project introduced in this paper consists of the three phases i) idea sketching, ideation [1] as a supportive method for urban planning processes to deliver citizens’ visuals and ideas to inform experts and stakeholders, ii) prototype development of a preferred solution using fabrication technologies and techniques, and iii) a direct participation of citizens in a building process on-site and in a full scale. The paper content is mainly dedicated to the first phase of the participatory design research project related to engaging and activating citizens in the design and
governance of their city with new-developed online sketching platform *Skity (Sketching the City)* [3][4][5], explained in the *Skity-the Sketching Tool* section. By means of the sketching activity, the citizen as the user produces ideas, simple sketches and drafts, for example as the proposal for a drone port in Africa by Foster and Partners (Deffner et al. 2016).

The paper outlines the methodological approach how it is possible to activate citizens for the discussion and to make them to be aware of their environments they live in. The methodology of the first research phase has been tested in a case study related to the selected problematic urban area of the city of Chur in Switzerland engaging local young people, the students of the Department of Architecture at the HTW Chur. The main focus of the study was to find a way how to improve the livability in a city considering the knowledge and proposals taken directly from local citizens by means of current information technologies and in that way to inform other citizens, experts and stakeholders via publicly accessible platform.

**INTRODUCTION, HYPOTHESIS AND RESEARCH QUESTIONS**

The paper revises the idea of on-site participation of end-users, which could prospectively lead to customisation of architectural and urban space in a full-scale. The idea is based on bottom-up requirements and tailored preferences of people in rapidly changing societies, climate and broader cultural conditions. The strategy refers to the social and environmental needs and the ability of the cities to adapt according to users’ necessities. On the other hand, it presents an usage of a ICT as an advantage which allows collaboration and participation off-site and in asynchronous way. More people can benefit and participate whenever and wherever, and that also allows for people to follow up ideas, post and respond to other’s posts.

The hypothesis of this research is built up on the assumption that on-site participation with lean tools like pen and paper in combination of current advancement in the field of information technologies will yield appropriate results which can contribute to livability of environments in various scales (a building, a neighbourhood, a public space, a district, even an entire city). In order to activate the community to be more engaged with its environments, this particular research will be focused on a neighbourhood scale.

By developing this strategy, we might find answers on the questions already addressed by Verebes (2015, 2016) in regard the problem of mass-customised and adaptive cities and their prototyping: *How, at the start of the 21st century, do we heighten the materialisation of unique spaces and systems? What is the potential of computational prototyping methods for creating diverse and differentiated cities articulated as a “Distinctive Urbanism”?* And other research questions arise subsequently: How can participants directly influence their environments towards better livability in respect to their desires and preferences? What kind of an adaptive or building system allows users to do it? How can an urban neighbourhood be directly influenced by its occupants in a full scale? What is the exact role of digital technologies in this regard?

**PROBLEM STATEMENT**

Our cities, neighbourhoods, buildings, and urban spaces suffer from the problem of standardized production, repetition, uniformity, monotony and similarity. There is a gap between industrially fabricated elements of small scale prototypes (such as cars) to extra-large architectures, urban environments, and cities in general (Verebes 2015). The ubiquitous standards, common production in a building industry and fixed permanent solutions that are no longer actual, can lead to anonymous and estranged life and societies in cities (apart from other social issues e.g. migration, poverty, broader cultural or political crises).

However, a city often changes and is activated from bottom-up and this characteristic of its fluidity and state of continuous flux strongly seeks for a
feature of its adaptability. More specifically, it appeals for such systems that can adapt to local specificities with the impact on their spatial and geometrical qualities and with a consideration to urban density, interstitial space, connectivity, diversity and in respect to differentiated local climate zones (Wein- stock 2013).

Architectural and urban planning is nowadays a highly specialised process, which does not actively engage the users of these spaces in the design process and in consequence to some extent neglects their needs, preferences, and also does not take advantage of their local and living knowledge of a place, which could benefit the design of more diverse, adapted and adaptive environments. However, although participatory processes exist and have occasionally been successfully implemented, generally applicable frameworks or process models are scarce or non existent as well as the tools to support these.

AIM OF THE RESEARCH
Following these questions, the goal is to gain new ideas directly from the citizens and to develop a customised urban environment which is built, modified and adapted on-site in a full scale directly by the endusers. This way of influence for the liveable environment is key to innovation. The results are ready to discuss, to explore, to share and to conduct: digitally, using the application by means of personal digital devices and manually, i.e. physically, haptically, interactively on-site and fully bottom-up in order to empower and activate a local community life, its social character, capacities to participate and its values (Bullivant 2017) with an impact to the environment’s livability.

In so doing, the research in a long term will propose a building system, a prototype, consisting of a set of simple parts leading to a diverse number of more complex architectural and spatial variants which can be achievable and built on-site by the endusers. The prototype will be introduced in a separate article.

STATE-OF-THE-ART
The idea of the on-site participation is actually quite old. Apart from built vernacular structures and urban systems all around the world already explicated by Rudofsky (1964), built favelas in South America with their sheer beauty of architectural spaces (Kerez 2016) or informal settlements in Africa or Asia, there is a plenty of architectural and urban design proposals, sketches and models for systems dedicated to direct on-site participation conducted by architect Yona Friedman (Friedman et al. 2010) starting from late 40-ies in the last century till today (Seraj 2015). Although Friedman’s solutions can be considered as utopian and radical in a way, they show a proper base for a spectrum of possibilities how the combinatoric strategy can be used in an architectural and urban design, concentrating on an adaptability of space, following the simple rules for an assembly and characteristics of improvisation and transformation condensed into simple comic-like explanatory manuals for non-specialists. Taking into account current research in the field of adaptive environments in combination with information technology, the agenda at the AA DRL explores new ways of materiality, responsiveness and prototyping methods using digital technologies in systems that actively seek to engage and participate in their environment (Spyropoulos 2016), started in early 80-ies by Walter Segal and later by Frazer et al. (1995). He continued in Segal’s idea of a self-built housing system, developing the Self-builder design Kit where self-designers were allow to design the building layout before it is built in an interactive electronic way.

It is necessary to combine a direct active role of users together with these abilities of systems to adapt. The users could directly modify the spatial character of the environment which can be stored and learnt by the system itself and which can be offered in different scenarios or modifications.

METHODOLOGY
The research project aims to engage users on three levels: in the design, prototyping, and testing.
pending on what the actual design problem is, it could also include ‘making’ (Greenfield 2017). In a long term, it is conducted as follows:

1.) Engaging analogue and digital techniques allowing sketching and custom-based generative models dealing with combinatory techniques (Bohnacker et al. 2012) to provide spectrum of possible solutions how to assemble and configure the spatial configurations of the architectural or urban space. The spatial system consists of pre-defined shapes, objects, modules and models which users, participants, citizens can interact with. They can model and explore the spatial possibilities according to their preferences using:

- analogue sketching techniques with pen and paper (Figure 1)
- digital techniques by means of using devices (tablets, digital pens, cellphones, computers)
- a physical models in a small scale (3D printed or fabricated models) manipulated and explored during on-site workshops
- building pre-prototypes (small-scaled prototypes) in a full scale

The proposed content, sketches and digital models can be accessible on-line, as an integrated part in already developed Citizen Science on-line applications such as the Skity tool [4], the web-based geometry editor QUA-KIT [2] (Chirkin et al. 2016) or as a stand-alone generative modelling system available for citizens as an application.

The first methodological step introduced in this paper is focused on a local community-based empowerment and includes a development of a workshop framework where a selected local community can meet, sketch, collect, discuss and model the ideas for any improvement of their environment according to their preferences, requirements and knowledge. The research also discusses the relation and differences between digital and analogue approach and compares these two ways of collecting the informa-
tion and creating possible design and improvement solutions.

2.) Based on the results from the previous step, the prototype of a preferred solution in a case study will be made in a full scale using fabrication technologies and digital techniques. This methodological step will be technically the most difficult and will take the most of the effort to develop such a system.

3.) On-site participation and assembling the system in a full scale with participants in a selected urban area in a case study: using the system in a selected space on a community-based scale (e.g. social habitation units, refugee camp study, ephemeral urban solutions, floating units on the water). These assembled systems will be final outcomes of this research.

The detailed explanation of the 2nd and the 3rd methodological steps will be introduced and explained in separate articles.

A Workshop Framework: Case Study in the City of Chur
Following the above mentioned methodological steps towards reaching overall aim of the research, we conducted the first part of our research intention condensed into a workshop with local citizens in the City of Chur. During the workshop, the participants selected and identified problematic urban area in Chur and proposed several ideas how the particular area can be improved, activated or empowered. By means of analogue and digital idea sketching, as a form of off-line and on-line communication, the participants collected ideas as an input data for further discussions, tests and decision-making processes.

The citizens, local university students as a community of engaged participants used the web-based tool Skity [4] for idea sketching. The tool allowed to collect sketches and draft proposals that can be stored as images in a database. Each participant can be aware in what sense other participant contributed to the area as the tool allows the user to observe other proposals directly on the screen of his or her computer or a mobile device.

Workshop tested the efficiency of the digital sketching related to urban environments taking into account individual desires of the participants and their ideas. Furthermore, the technological aspects and current limitations of the developed on-line sketching tool Skity was tested and observed as it was used for the first time among the participants.

Skity: A Web-based Sketching Tool for Citizens
The Skity tool, as a digital sketching platform used in this study, is a web-based application developed for visual participatory design and communication purposes. The tool is based on the java-script libraries: Mapbox, jquery and a modified version of sketch.js with the graphical interface displayed in any web browser. Mapbox provides tiled map service so it can be used in any case studies across the globe and in any urban scale, from the wider relations in strategic planning of territories to small-scale urban details, like streets, squares or public zones (Figure 2).

The user interface consists of navigation buttons related to three spatial scales. There is a switcher between two modes of the digital participation: sketching itself and marking the environment based on various qualitative or quantitative criteria that can be observed by the citizens. Citizens can contribute in ranking and providing the information about public and private traffic, noise level, temperature, pollution, social exchange, vitality, walkability and affordability by marking the issue of the urban space on the scale from 0 to 10 (0 means no issue, 10 means very big issue). This would bring another level of understanding and assessment of the urban areas by engaged citizens that can be taken into account.

The sketching mode allows the user to sketch directly on the displayed map as on the sketching paper into a separate layer and save the image separately. Each user can create his or her own sketch or is allowed to participate on other users’ sketches. The digital pen with a free hand, mouse or even a finger can be used for the digital drawing using any mobile devices or a computer (Figure 3). As the tool is
a newly developed prototype, a proper user administration of the collected data or secure login management for invited participants has not been implemented yet.

**Observations and Results**
The sketches provided by the participants have been stored in the database for further observations and discussion (Figure 4). In that way the group of local participants with their ideas can contribute to the overall discussion and they can share the ideas visually. The visual results are accessible online [4]. Each citizens’ design proposal outlines an individual strategy how to improve the area, e. g., proposing more open public spaces areas in the blocks, better connectivity and accessibility of these public spaces, elimination of parking cars in the area, putting the main traffic flows underground, etc. The variety of proposal can be considered during decision making processes by the municipality and discussed among citizens.

![Figure 2](image1.png)
The graphical user interface of the Skity tool - the marking mode. The users are allowed to mark various urban issues [4].

![Figure 3](image2.png)
The Skity tool - the sketching mode. The user can sketch directly on the map on a separate layer with various colours of outlines and fills [4].
Furthermore, the tool also contributed and initiated discussion among participants, during the workshop. As it has been observed, the digital tool does not take away from or inhibit analogue interaction and discussion.

CONCLUSION AND DISCUSSION
The paper introduces the research initiative of user-driven customised environments and outlines the first methodological step in this regard. This include analogue and digital idea sketching. The sketches serve as a first input to activate the discussion among citizens and experts and can inform the authorities about observed issues of the particular urban area. To have an on-line sketching and communication tool accessible for everyone within the process, the Skity software has been developed for a direct participation.

Skity can serve as a basic and first platform for citizens to contribute with their own ideas about the city they live in. The tool allows the users to input 2D sketches on a map into separate layer that can be switched between sketching mode and the marking mode. As the background map is geo-referenced, it is possible to locate the sketches according to precise geographical reference of the area.

As the observed workshop results show, digital tools if applied and embedded correctly in a workshop context could support and facilitate on-site as well as off-site, synchronous as well as asynchronous interaction and discussion.

Future work
As the study has been conducted with 10 participants only and also the group of participants chosen, i.e. students, is not representative of the local population, it is necessary to test such a participatory tool with higher number of local citizens that can be involved in the design process. This will lead to the question how to observe and evaluate the re-
sults efficiently. High number of sketches, data collected and stored could be explored using machine learning methods and image processing procedures prospectively with a crowd-sourcing implementation based on preferred evaluation criteria (connectivity between public spaces, spatial and temporal accessibility, preservation of valuable spaces, spatial conditions - visibility, openness, closeness, compactness, etc) and any qualitative aspects of the environment based on the principles taken from urban theories with combination of current advancement in the ICT. Furthermore, a proper application of the methodology into a real world scenario would be beneficial in order to inform urban governmental bodies, municipalities and stakeholders. This will prospectively contribute to the urban governance strategies of the near future in the era of responsive cities (Schmitt 2016).

The direct implementation of the on-site participation design strategy can follow after the first methodological implementation in a real case. However, pre-studies and small-scale prototypes are needed to be done to test the possibilities of adaptability, transformations and reactivity engaging digital techniques and preferred technologies together with analogue studies. The proposed full-scale adaptive prototype for a particular urban area expects to reach more diverse unconventional spatial solutions based on citizen’s preferences.

ACKNOWLEDGEMENT
We would like to gratefully thank to all workshop participants, the students at the Hochschule für Technik und Wirtschaft HTW in Chur for their works, inputs, comments and remarks which will inform the future development of the Skity tool.

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