VR UNMATCHED

Leveraging Non-experts as Co-Urban Designers

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Abstract. The recent development in Virtual Reality (VR) allows for novel engagement in participatory urban design. Despite that any design approach cannot include and address all items that are relevant or needed during a design process, social VR design instruments offer additionality via their real-time generation and visualisation possibilities that are unmatched in conventional realms. The research employs an anthropogenic approach to design research to engage end-users in the design process. An Immersive Virtual Environment (IVE) instrument 'SketchPad' allows laypersons to design successfully urban forms. SketchPad engaged laypersons in a meaningful design discussion and generations of urban spaces. The research discusses the findings of the experiments. The paper concludes with a reflection of how non-experts as co-designers can use IVE instruments to drive change of their neighbourhood proactively and to positively impact on the liveability of their neighbourhood.

Keywords. SketchPad; Co-design; Layperson; Design Participation; Urban Design.

1. Introduction

Involving non-experts with an enhanced communication instrument in a design process brings their imagination to an understanding level of interpretation for themselves and the experts. In an urban design decision-making process, public participation is an established method to bring accountability (Healey 1998; Murray et al. 2009). However, due to the lack of a suitable design communication instrument, in most cases, the design ideas stay in assumption (Al-Kodmany 2001). Also, the lack of suitable visual information and instruments in the design process prevents the non-expert stakeholders from taking part in design with sufficient perceptual understanding of the design context. On the other hand, the conventional urban design process does not allow them to take part in the design ideation and generation stage. Therefore, the research speculates that an Immersive Virtual Environment (IVE) instrument called 'SketchPad' (Innes et al 2017; Innes 2018) can enable non-experts to actively take part in the early stage of an urban design process.

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The research starts with understanding the urban design situations of a case study in Karori, a suburb of Wellington, New Zealand. A series of surveys and experiments are set up to investigate the scope of non-experts' active design ideation, generation and collaboration in neighbourhood design. The methodology incorporates a preliminary survey of urban design consultation, developing the VR instrument, engaging laypersons in IVE urban design, a survey on IVE experiment, an audio recording of the design conversation, transcribing recorded data, protocol analysis and expert evaluation (Figure 1). An extended report of the protocol analysis and the detail of the development of 'SketchPad' are published in Chowdhury and Schnabel (2019) and Innes (2018) respectively.

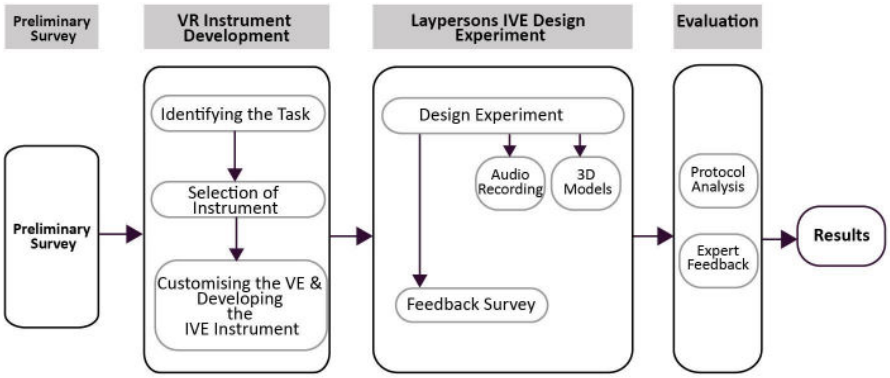

Figure 1. Research Methodology.

The results of the design experiment show that the Virtual Reality (VR) design setup provides effective perceptual affordance for laypersons to take design decisions on urban forms. The designers get into design discourse through the frequent insertion of design ideas and accepting one another ideas. The virtual perceptual environment is helping them to initiate new ideas and got into design discourse. It also shows that the design conversation extended beyond the task-related conversation, which indicates the continuity of the conversation was natural instilling flow. Occasionally, through the inclusion of jokes, the designers instigate new design ideas, which give opportunities to act socially with fellow design members. In the end, the research hypothesises that the design setup also can be useful to involve diverse stakeholders along with urban professionals in the discussion of urban design.

2. Using 3D Artefacts in IVE Design Collaboration

Traditional artefacts such as drawings, product samples, models, and now virtual artefacts as 3D models are used to mediate the journey of a building concept to the actual built form. Most often, these artefacts are produced for different purposes and obviously for people with different levels of understanding of the design and construction process. Luck (2007) argues that design practice using physical artefacts at the early stages of building design is appropriate for design

conversation, as it develops users' understanding of the design. The design conversation builds the user's confidence in the appearance of the design, rather than only by the ability of the artefacts to represent a future reality. The artefacts embody the current knowledge of the design in its present status, but during a conversation, it prompts discussion of ideas to modify the design. 'The act of interpretation' is acting as a part of the design process.

Design is a series of decisions which expose the relationships of geometries, materials and performance (Kan and Gero 2017). Designing as a cognitive activity entails the production of sequential representations of mental and physical artefact (Goldschmidt 2004). Designers always seek suitable means to construct imagination, express design concepts and turn the concept into visible artefacts (Chan 2011). Brown (2003) argues that the design representation is coupled with the content of the virtual environment, which involves perceptual experience, and the design generation of 3D artefacts involves direct manipulation of mental images. Abstract 3D artefacts represent instant design ideations and generations. The abstract format of the design representation instigates a meaningful urban design discourse between laypersons. It does not consider another format of design representation like paper-pencil methods, 3D models, or computer-generated images.

One of the prime factors in IVE assisted design collaboration is perceptual awareness (Maher 2011). Participants in the collaborative design process coordinate and inform their activities through peripheral awareness of the surrounding context and one another's activities. Designers move fluidly from individual working status to collaborative working status. IVE offers an active interaction with the design, therefore presenting an authentic feeling of being in the environment (Schnabel & Kvan, 2003). It leverages users to create, communicate and collaborate during the design process. Spontaneous generation of 3D artefacts in IVE enhances the design collaboration with acts of design actions and simultaneous discussion as reflections.

Portman, Natapov, and Fisher-Gewirtzman (2015) argues that the dimensions of immersion and interactivity of VR with 3D artefacts allow new possible ways of "exploration" which fits with the characterization of environmental planning and landscape architecture as a tool that enables going beyond, in some sense, existing reality. Such exploration empowers designers to express and explore their imagination with greater ease.

3. Experimental Procedure, Task and Participant

An experimental setup is developed to facilitate design collaboration. In Figure 2, the design unit is formed between the two participants and how technology is used to facilitate the design, communication and socialisation - the first participant designs by being immersed in the environment via a Head-Mounted Display (HMD). The second participant experiences the whole scenario in real-time on the 80-inch display screen. All participants are local residents who were recruited through social media and poster billed in the neighbourhood. The in-situ experimental setup is shown in Figure 3.

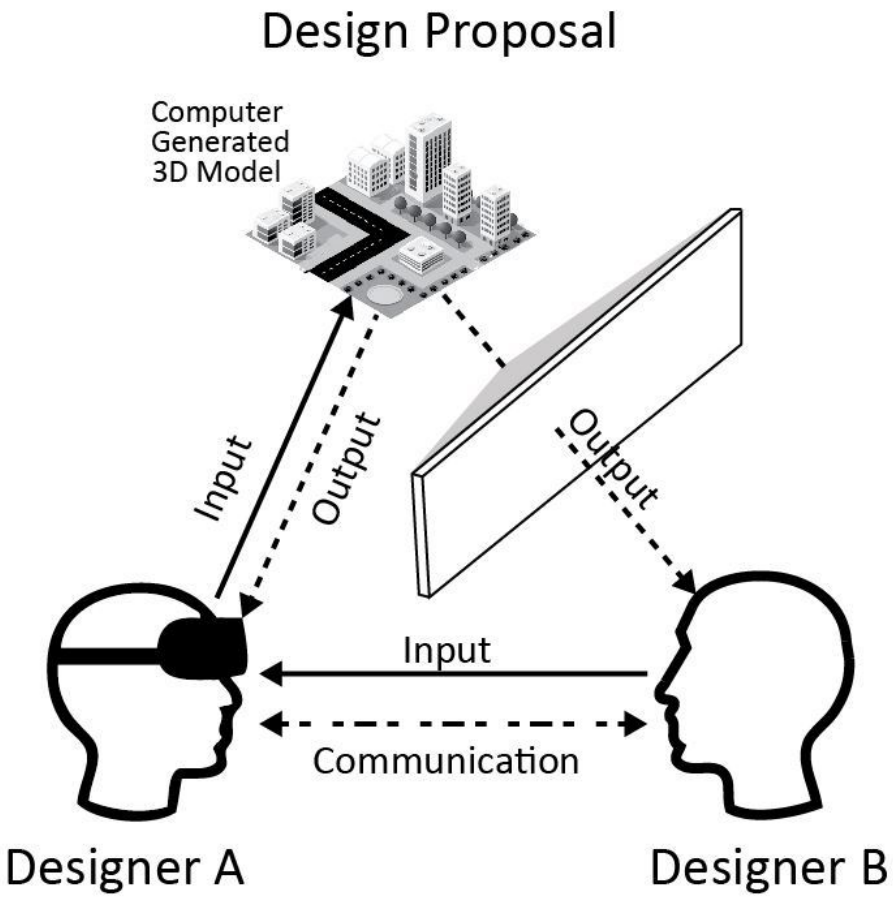

Figure 2. The design unit.

Figure 3. The in-situ experimental setup.

The design task was an actual and current urban development scenario of Karori. The participants were asked to design building blocks on an empty corner plot in Karori's Centre (Figure 4). The participants were introduced to the instruments and site conditions via a map laying out the urban conditions. The design conversations were recorded for protocol analysis, and the urban design proposals were saved for experts to evaluate. The total number of participants is 17. Figure 5 shows the generated design options.

Figure 4. Design experiments in Karori Community Centre. .

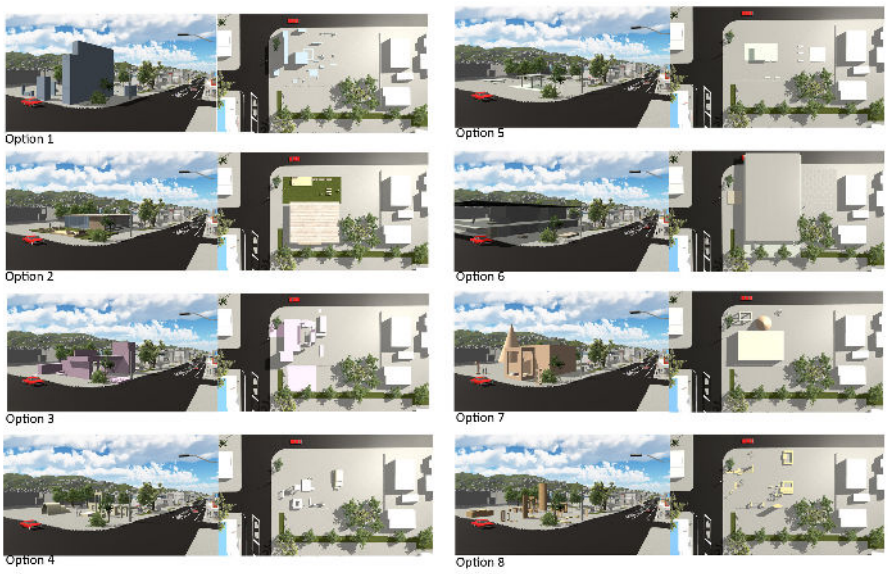

Figure 5. Generated design options.

4. Design Communication

The recorded conversation is transcribed to analysis the design conversation through protocol analysis. Based on Tsai et al. (2009), a coding scheme was developed to evaluate virtual design communication and collaboration. The four major categories of the scheme are i) Communication control, ii) Design communication, iii) Social communication and iv) Communication technology. Please refer to the details of the coding to Chowdhury and Schnabel (2019).

The result shows that there was clear evidence of successful design communication happened between the participants (Figure 6). Around 62.37%, 62.79% and 46.51% of the conversation respectively for Options 2, 4 and 7 happen about deriving the design concept. It indicates that the experiment facilitated the scope of collaborative design ideation. Similarly, frequent non-task-related of social communication took place that supports the presence of social communication (Figure 7). Almost 75.76 %, 16.67% and 80.52% of the conversation respectively for Option 2, 4 and 7 occur as non-task related social communication. It indicates the design actions generated by Designer A is successfully communicated to Designer B and vice versa leading to a meaningful

overall outcome.

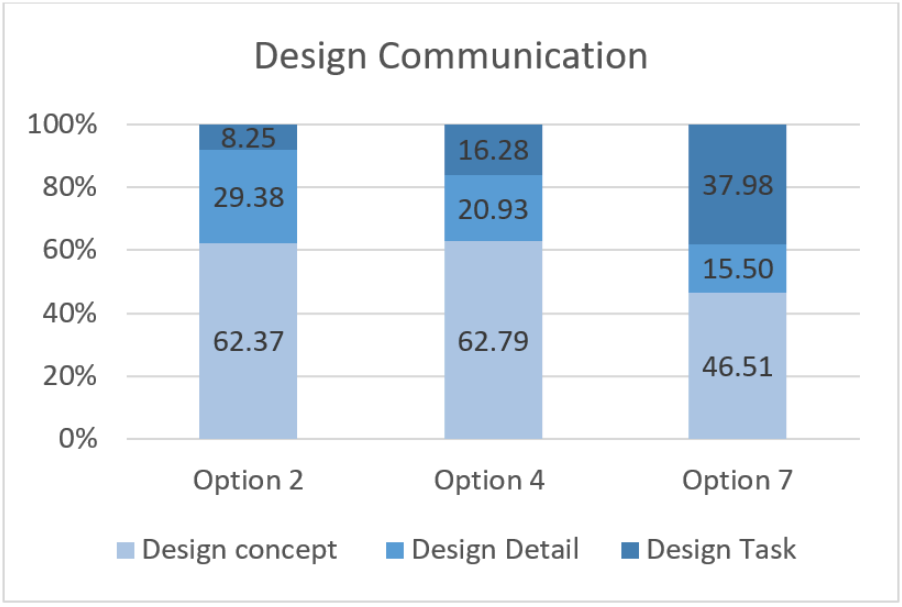

Figure 6. Design Communication.

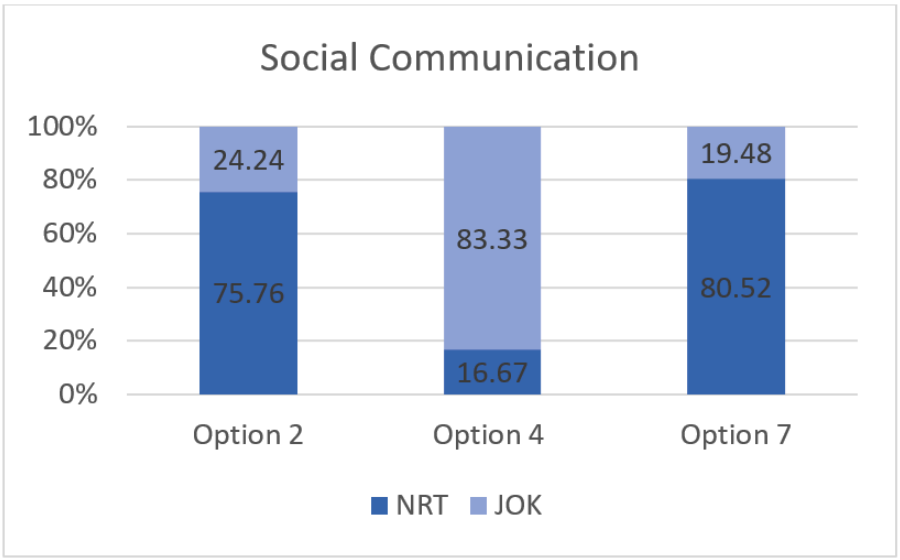

Figure 7. Social Communication.

5. Design Interaction

The IVE instrument SketchPad is designed to produce iterative 3D artefacts through design interaction and collaboration. Design imagination happens due to the contextual information, iterative production of 3D artefacts, and the user-friendly nature of SketchPad. The continuity of design production can be traced in the verbal conversation. The designers form internal mental models of themselves by interacting with the environment, with others, and with the artefacts of the technology. According to Norman (1988), such a process of mental modelling is one kind of interaction. In the line of Norman's concept, the employed immersive iterative 3D artefacts provide predictive and explanatory power for understanding the interaction.

The design discussion progressed when every action of a designer produced visual information and initiated the next level of design action. This can only be done if the design communication media provide continuous visual feedback to the designer. It informs successful design interaction. Following Fuchs et al. (2011) interaction techniques for 'Virtual Behavioural Primitives', the design interaction occurs in all of the four categories, where the designers observe, move, act, and communicate with others and also with the application for its virtual interface. It is the result of successful completion of the loop between "perception, cognition, and action." Also, this aligns with Brown (2003) arguments that interaction between the designer and graphical physical descriptions is a necessary part of an effective design process. Here, the designers' ability to produce urban forms meet the performance goals to a certain level including visual, technical, cultural, and social.

The employed VE design process reflects through action and negotiation between designers. According to Schön (1983), the design process is fluid and determined upon the designers' knowledge and experience, where designers continuously reflect on their strategies and actions to change the design situation. Design communication happens due to the presence of design interactions. It is the result of human-computer interactions, where the computer is producing 3D artefacts in the IVE and provides visual feedback of the design actions and initiates design discussion among designers. The assigned design tasks and limitation of the instrument helped the designers to formulate new design alternatives for Karori's centre.

6. Discussion

Through engaging non-experts, the research impacts on the perceptual affordance created through the interaction of virtual 3D artefacts, immersive, non-immersive visual information and verbal conversation. Participants actively take part in the design ideation and generation stage. In between their conversation, the computer produced 3D urban forms which provide visual feedback to continue the discourse. In contrast to Lefebvre, here the non-experts are designing in the abstract space, where they usually participate in concrete space (Luck, 2007). That means the VR instrument SketchPad is facilitating design participation, which is re-joining the scope of non-expert's role to the expert's role. The report of the protocol

analysis also shows that design communication happened regarding task-related design actions. It means the participants took design decision through their actions. Moreover, the experts' evaluation legitimises the design outcomes as products of meaningful design participation.

Conventionally, participatory design activities are dealt with urban professionals in a media either resembles a 'paper and pencil'-method, models or a non-immersive game-based virtual environment. On the contrary, the research shows that the end-users are actively and constructively involved in the discussion by being perceptually inhabited in the urban context. The IVE instrument Sketchpad and the anthropogenic experiment's set-up helped laypersons to decide on specific perceptual qualitative parts of urban form through collaboration. The research facilitates design discourse through visual and verbal interaction. The here presented participatory design setting empowers the participants to design building forms, shapes, textures and also their placements in the real contexts. So, end-users are acting as a co-designer together with experts of an urban design process. It seems the roles of designers and laypersons are coming to a level where the laypersons can create and propose design ideas through collaboration with lay- and expert-designers. The participatory mindset values people as co-creator in the design process. This participatory and anthropogenic design approach is bridging the gap between designers and users.

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