

論文 / 著書情報
Article / Book Information

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著者(和文)	マウリヤ・サントシュ・クマール
Author(English)	Santosh Kumar Maurya
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Category(English)	Doctoral Thesis
種別(和文)	論文要旨
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論文要旨

THESIS SUMMARY

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申請学位 (専攻分野)： 博士 工学
Academic Degree Requested Doctor of (Engineering)

学生氏名： MAURYA SANTOSH KUMAR
Student's Name

指導教員 (主)： Yukio TAKEDA
Academic Supervisor(main)

指導教員 (副)：
Academic Supervisor(sub)

要旨 (英文 800 語程度)

Thesis Summary (approx.800 English Words)

The concept generation process is essential for innovative product development that results in high user satisfaction, often validated through design prototypes, which are implemented at the end of the product design process. Changes at later stages require effort and may result in loss of high-potential design solutions due to the designer's trade-off among the generated ideas, to achieve the results. Hence, the early-design phase is important as the degree of freedom for design solutions is high even though the fidelity of ideas generated is low. The abstract nature of the early-design phase makes it difficult to introduce a supportive design tool which can provide higher fidelity design outcomes and is adaptable for different design problems.

This thesis explores methods/tools to facilitate the generation of concept designs that result in enhanced user experience and satisfaction. The target was to enrich the experience at the early design stage for both designers and end-users, by enabling them to focus on the design part through reduced existing technical/knowledge gaps for/among them. For this purpose, ways to implement mixed reality and user-centric approach for the early stage are proposed and implemented in this thesis. It starts by establishing the needs and discussing the key aspects to consider from literature and practical perspective. From the literature perspective, the effect of active involvement of end-users, existing knowledge gaps for designers/users and the need for addressing the intangible design needs at the early-design stage are discussed. The practical perspective establishes the requirements for digital implementation of design methodology/scenarios for users and designers. Based on this, three subthemes for establishing immersive-experience based design methodology are implemented.

Firstly, the thesis addresses intangible problems. Such problems emerge once the real product has been created and used by the user themselves in a real-life

scenario. To improve the impact of immersive-experience design tool, the need to identify hidden design metrics was established and an exploratory study was conducted to present a framework to generate relations among different design characteristics: device, user or environment. The framework is presented through implementation in the field of assistive technology, that addressed the issues with communication among caregivers and wheelchair users. Strong correlations among caregivers and wheelchair user's daily activity and communication behaviour were observed and the design needs for improved experience were inferred. The implementation of the MR tool with these identified design metrics is left for future research.

Secondly, the thesis establishing requirements for mixed-reality based design tool that lets end-users perform creative design tasks, enabling them to be active participants in the design process to co-create with designers. This design tool implementation is evaluated empirically through a Furniture Arrangement usage scenario for providing a high level of control along with a high level of immersion to the end-users. It showed positive effects on design activity and satisfaction for the end-users when they actively performed the design tasks as compared to when the designer performed the design task based on the end-user's instructions. Based on this work, further research was conducted to improve the mode of interaction with the concept of the designed prototype for the end-users, in the form of gesture-based interactions vs physical interactions. The implementation was tested with an interactive use case of Intelligent Lamp scenario. The results indicated gesture-based interaction with the virtual prototype were as effective as the touch-based physical prototypes, indicating a balance of these two to be effective for the implemented MR design tool.

Thirdly, the thesis investigated the effectiveness of MR based approach to enhance the design experience for designers facing technical barriers to quickly implement, create and experience their concept ideas. This problem is significant when functional aspects of design are dominant e.g. interactive product behaviour. Here, the MR design tool was adapted to create concept solutions for interactive-product behaviours, by supporting and encouraging designers to ideate, create and revise their concept-solutions, allowing them to experience their creation. The empirical study comparing the paper-based storyboard approach and proposed MR based approach was implemented. The analysis showed the diversifying effect on ideas generated in terms of sensory exploration. It resulted in more ideas getting converted to interactive behaviours, showing lesser abandoning of ideas and ease of creation.

Diversifying effect on types of revision being performed were also observed as participants were motivated to experience their creations and revise more often. Resultingly, improvement in the creativity of the generated solutions using MR design tool was observed, and the participant rated the MR implementation to be innovative and appealing.

Overall, this thesis assesses the impact of the implemented design methods on respective generated outcomes, giving insights on what metrics to consider while designing new tools/methods for the early-design phase targeting the needs, the designers and the end-users. It also highlights the limitations that can be addressed to improve the experience of early-stage designing.

備考：論文要旨は、和文 2000 字と英文 300 語を 1 部ずつ提出するか、もしくは英文 800 語を 1 部提出してください。

Note : Thesis Summary should be submitted in either a copy of 2000 Japanese Characters and 300 Words (English) or 1copy of 800 Words (English).

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