MASTER'S THESIS REVIEW

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Thesis Title: **Audiobook player for older adults with vision impairment**
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Assignment

The assignment of the thesis was to develop a specialized device to play audiobooks (and other content in audio form). This assignment is part of broader research activities conducted at our department focused on visually impaired older adults living in residential care institutions. It was assigned to follow the User-Centered Design methodology and base the implementation on the Raspberry Pi platform.

Technical Manuscript

The thesis is written in proper English; it is structured into six main chapters. The main content of the thesis is on 62 pages; there are also another more than 60 pages of appendices. There are 102 references (57 scientific papers).

The first chapter comprises a comprehensive introduction into the matter. The motivation is structured very well including references to demographical data about the target group mentioned above. When compared to works on similar (MSc.) level, there is also a comprehensive description of the methodology used during the development. The first chapter is concluded by the statement of eight primary goals of the thesis.

The analytical part of the work focuses on specifics of visually impaired with a particular focus on older adults. This part represents a comprehensive study focusing among others on specific changes in senses, cognition, behavior and emerging specific abilities, needs, and preferences. Follows analysis of related research papers and existing devices that can be potentially used for the intended purpose. The thesis also mentions legislation (mostly the copyright law and its exceptions for those with disabilities). The intended development platform — Raspberry Pi is also mentioned. The analytical part is concluded by the description of user research (N = 9), its results and statement of related design requirements.

Following two chapters focus on the design and implementation of several prototypes of the device. The development was strictly based on User Centered Design methodology [1]. The design starts with a description of related "model user" (Persona) and specification of six scenarios that illustrate the usage of the device in several use-cases. There are also very nice story-boards as well as formal specification of use-cases (in the appendix). The design of the physical form of the device stated started by the creation of several sketches. There were also different low-fidelity prototypes made from paper and high-fidelity prototypes created by 3D printing. The design of the prototypes is well documented including the explanation of design decisions. There follows the description of the implementation of prototypes on both high- and low-fidelity levels. The text proves the complexity of high-fidelity prototype that required implementation of a physical enclosure, hardware implementation and software implementation on non-standard platforms.

The usability and accessibility of the prototype have been formed and proved by comprehensive formative evaluation. The prototypes of the device have been evaluated with 16 visually impaired participants in total. The findings from the evaluation were clearly reflected in the design.

The final two chapters of the thesis comprise detailed discussion with several references into the literature. The conclusion is very clear, individual goals set for the thesis are discussed in detail followed by the statement of the future work.

Implementation

The implementation of the audiobook player prototypes required the development of physical enclosure, installation of interconnected HW components and development of necessary software. Each stage has been addressed at an excellent level. The low-fidelity prototype has been hand-created from an actual book. The corresponding interface to conduct experiments based on the Wizard-of-Oz method has been developed in Python. The high-fidelity prototype is complex. The final enclosure resulted from several development iterations. It was created using a 3D CAD system (Fusion 360) and 3D printing. The HW implementation is also quite complex. There are several HW components — micro-computer (Raspberry Pi Zero W), micro-controller (Arduino Pro micro), rotary switch, several buttons, battery (including battery management circuit), amplifier and loudspeaker. The software implementation comprises micro-controller firmware (Arduino, Processing language) and software of actual audiobook player for Raspberry Pi (Python). The implementation is expensive and functional.

Questions

1. Do you plan to follow up your work, e.g., try to bring it to the market?

Master's thesis of Barbora Endrštová is extraordinary from several perspectives. The assignment itself is very demanding — development of a functional prototype of an interactive physical device based on requirements of very specific target user audience. The manuscript surpasses comparable works in extent, structure, scientific quality and number of references. Furthermore, the implementation proves exceptional effort put into creating a functional prototype requiring high skills not only in mechanical engineering (3D design) but more importantly in hardware and software implementation. A scientific paper [2] based on results of the thesis has been already presented at a prestigious international conference.

I assess the thesis with mark A (excellent).

In Prague, January 29th, 2019

Ing. Miroslav Macík, Ph.D.

References

[1] DIS, ISO. (2009). 9241-210: 2010. Ergonomics of human system interaction-Part 210: Human-centred design for interactive systems.

[2] B. Endrstova, M. Macik, and L. Treml, "Reprobooktor: A concept of audiobook player for visually impaired older adults", In Proceedings of the 9th IEEE International Conference on Cognitive Infocommunications (CogInfoCom), 2018, IEEE.