

doctoral thesis review

Ing. Rudolf KAJAN

Multimedia Data Processing in Heterogeneous Distributed Environment

Brno: University of Technology 2015, 116+9 pages

In ubiquitous computing, which seems to be the most promising application area of imaging, the traditional interaction metaphors like typewriter/CLI, desktop/WIMP both survive partially and do not suffice generally. The author – under the supervision of **Prof. Adam HEROUT** – focused on **Multimedia Data Processing in Heterogeneous Distributed Environment** (study branch/program Výpočetní technika a informatika). The goal of the dissertation is (pp. 2-3) to introduce „ways for the mobile phone user to unobtrusively interact with another device (public display, desktop, tablet...)“, namely, „continuous interaction across mobile and desktop platforms“ and „real-time application state acquisition and reconstruction on target platform“. The author assumes reliable, persistent, and secure connection between the content providing display and the personal (interaction-dedicated) device.

The subject of the thesis is relevant to current needs of the scientific community, which is indicated by three main internationally recognized publications and, moreover, the doctoral thesis research is highly actual for practical use, as well.

The English text of the submitted thesis consists from 8 introductory pages, 7 numbered chapters: 1 Introduction, 2 Interacting in Heterogeneous Environment, 3 Tabs, Pads and Boards – Categorization of Displays, 4 The Anatomy of Interaction Session, 5 On-Screen Marker Fields for Reliable Screen-to-Screen Task Migration, 6 Video Recording – A Promising Metaphor for Inter-Device Task Migration, and 7 Adapting Ex-Post Interaction with Public Display Content using Eye Tracking. The thesis is completed by three unnumbered parts: Closing Remarks, A Publications (an appendix, pp. 101-102, list of 13 published papers), and Bibliography (pp. 103-116, 176 items). This is followed by a Declaration in an unpaginated page (maybe 117). Certain papers in Appendix A (e.g. [1], [3], [5]) are differently numbered in Bibliography.

The methodology of this research project combines selected advantages of well-studied and understood methods, which are fully adequate and fit perfectly to the main stream research in the field (the methodology of mathematic modeling, interactive computer graphics, vision, usability and/or performance evaluation, statistics...). **The methods used in the thesis have been appropriate and led to a successful solution.**

The main goal of the thesis, as formulated in page iii, could serve as inspiration for a more focused title: **„intuitive information sharing“ using „a personal device and a**

situated display". Three novel methods were published in one journal and 2 conference papers [76], [78], [79] (p. 108), resp. [1], [3], [5] (p. 101). These papers form a basis for three chapters 5, 6, and 7. However, there is not clearly separated the personal share of doctoral candidate. The key ideas are original, robust, and well-named – **task migration**, **video recording**, and **PeepList**. There is a remarkable survey of literature in the field. The weak point, maybe prospective for all future journal publications, is the phenomenologic, so to say, extent of experiments and written presentation. Maybe each of the novel concepts/metaphors should be incorporated into a game (recall CLI/Tetris in the past) and the low number of test persons/tasks/questions could be balanced by the future feedback from community. Except for pages 85n, there is neither mathematical model nor exact data flow explained. Even in pages 85n the reader should invent/rediscover, that alpha values are real numbers, with high probability used for a (secret) convex combination of measurements...

The highest impact result will be probably the PeepList solution, which incorporates eye-tracking evaluation of user interest, being probably the first one for given set-up („have not been previously extensively reported“, p. 78). Historically, it can be seen as the in-session complement to engagement factor, measuring virtual museum interestiness over multiple sessions/users using time data, as well. The Task Migration is a sort of case study for two supporting papers [4, 6] (the most cited results of this research group). Again, the personal device, the user, and the situated display, serve for evaluation of a uniform marker field. Video Recording paper was published in WSCG Journal, at a respected international forum. **The dissertation fulfills the given goal(s).**

The work is done and written in a professional quality, but some definitions (study program, coordinate systems, graphical objects, transformations, ISO model of interaction, MPEG-4 model of presentation...) are implicitized in high assumptions put on reader.

The thesis itself, chapter by chapter, satisfies conditions of a creative scientific work and there is observable both deep erudition and rich experimental experience of the author. However, there are some selected possible local improvements:

There are missing the Lists of Symbols/Tables/Algorithms/Pictures. Page iii: the original BETWEEN excludes the user, two devices have no intuition, therefore the abovementioned reformulation: „*intuitive information sharing*“ using „*a personal device and a situated display*“. Page 1: Don Norman, missing reference (and year). Page 1: Informative visualization >> Information visualization. Page 4: maker >> marker, introducing gaze >> processing gaze data. Page 9: Fukasawa, missing reference (and year). Page 11: Muller at >> Muller et. Page 19: form >> from. Page 24: „speed of distal pointing task“? Page 29: solution >> solutions. Page 33: members >> items, parts. Page 52: This a >> This offers a, ... our previous approach, missing reference (and year). Page 54: section >> section 6.4.2. Page 57: „content is much smaller“? Page 59: experiments >> 6.4 Experiments. Page 60: „highly manhattanic world“? Page 68: „initial homography“? Pages 69, 70: section >> section 6.4.1. Page 75: „uncertainty“, missing definition => missing measure. Page 77: „secondary interactions“, „ex-post interaction“, missing definition, based e.g. on ISO model of interaction, standard logical input devices and input data records. Pages 101, 102: Unify writting of author's name, clarify page numbers or give URLs. Pages of Bibliography: incomplete bibliographical records, e.g. 17, 21, 66, 82, 85, missing pages in refs. 22, 27, 34, 57 „-“, 65, 77??, 98, 126, 165, unreadable name in ref. 160. Unify please format for page numbers with journal. These

remarks and a set of evident typo errors (marked in the printed copy) do not decrease the valuable contribution of the work.

The author co-authored 13 published papers (and several software implementations) in the years 2007-2015 (pp. 101-102). One more paper can be found at international conference WSCG or university pages. Three of them are directly related with the PhD topic, two are „supporting“. The publications are comparable with PhD. projects known to me at multiple universities in Central Europe.

In the discussion, it would be desirable to discuss the following questions: 1. What is the author's well-separated personal share within the presented innovations? 2. Why one of the papers [77] and [78] (published at the same WSCG pages) is not enlisted in p. 101? 3. In page 6: What are the „core principles of ubiquitous computing“ and “phenomenology theory“? 4. What mean and what are the alpha values in page 86?

To summarize the required explicit judgements, they are as follows: 1. The thesis topic is very relevant in current state-of-the-art ubiquitous computing research. 2. There are original contributions, as summarized above. 3. The main achievements were properly published at international level. 4. The author is a well informed scientific researcher. 5. Moreover, Ing. Rudolf KAJAN with coauthors achieved tens of Google Scholar evident citations.

Conclusion

The author of the doctoral thesis, Ing. Rudolf KAJAN, proved to have an ability to perform research and to achieve scientific results. I do recommend the thesis for presentation with the aim of receiving the Degree of Ph.D. in the respective doctoral study program.

Bratislava, February 17, 2016