Machine-Assisted Cooking

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ABSTRACT
In this paper we describe the formatting requirements for SIGCHI Conference Proceedings, and this sample file offers recommendations on writing for the worldwide SIGCHI readership. Please review this document even if you have submitted to SIGCHI conferences before, some format details have changed relative to previous years.

Author Keywords
Guides; instructions; author's kit; conference publications; keywords should be separated by a semi-colon.
Optional section to be included in your final version, but strongly encouraged.

ACM Classification Keywords
H.5.m. Information Interfaces and Presentation (e.g. HCI): Miscellaneous

INTRODUCTION
Cooking can be a source of enjoyment and pride and a forum for creative experimentation. Compared to prepackaged and most restaurant meals, homemade meals can be healthier and cheaper. However, developing the proper skills to cook with confidence takes time and patience. The tools, ingredients, motor skills, effective use of heating/cooling appliances, pressures of precise timing, importance of precise timing, as well as several other factors may seem overwhelming to novices. In a world where people are on the run, prepackaged meals, restaurants, and near-instant food delivery are appealing alternatives to cooking.

Many people perceive cooking as stressful and time-consuming or simply not worth learning. We believe the difficulties involved in cooking are primarily due to cognitive overload. Getting your first meal right is almost impossible without help, and failure may discourage people from trying again. There are few resources that currently exist which help mitigate the cognitive load experienced by first-time cooks. For instance, printed cookbooks increase cognitive load, because ingredients and instructions must be memorized in order to cook without interruption. Cooking blogs (e.g., [**?**, **?**]) provide plenty of recipes and guides, but these sources are merely digital versions of printed cookbooks. Cook Assistant Lite is one cellphone application that has made cooking interactive [**?**], but the application requires the user to continually interact with the application, which leads to even more interruptions while cooking.

In this paper, we propose a digital cooking assistant design for novice cooks. Our design focuses on the following points:

- Mitigate interruptions that are due to overutilization of visual input (necessary visual observations while cooking and having to continually read something to determine what to do next) and motor functions (hands are used for cooking and clicking through applications or scrolling on a blog).
- Mitigate cognitive overload that is due to the physical and temporal demands of cooking, which are exacerbated by the memorization of ingredients and instructions.
- Make instructions in recipes more accessible, teach users new cooking techniques, and help users decide what to make with the ingredients they already have at home.

Features of our design include text-to-speech instruction; timers for managing multiple simultaneous tasks; reminders to check oven and stove temperatures; easy-to-read interfaces that display one step at a time with large pictorial, audio, and/or video aids, somewhat reminiscent of turn-by-turn navigation of a GPS; and lifelines to contact other users who have previously tried the recipe.

Our approach is user-centered. We survey both novice and expert cooks in order to identify key differences between skill levels. For instance: What do novice cooks find most difficult about cooking? What prevents them from cooking more often? What motivates experts to cook? Survey results inform our design of several paper-based interfaces. We then conduct a round of in-person questionnaires to obtain feedback on multiple paper-based designs, which help to identify prominent features and issues with each design. We show multiple designs in parallel to each participant. After incorporating feedback on paper prototypes, we implement the digital design leveraging the recipe API BigOven [**?**]. To assess the quality of our digital prototype(s), we conduct a within-subject experiment, comparing user performance on cooking recipes with and without our prototype(s). During the performance phase, we collect qualitative data by observation. After each cooking session, we ask the user to assess their cooking experience based on the following factors (NASA

Task Load Index): mental demand, physical demand, temporal demand, performance, effort, and frustration. Finally, through further user testing and design/development iteration, our final product embodies the features that help first-time and novice cooks succeed in their cooking adventures.

RELATED WORK

Cognitive theory has been extensively studied in the field of instructional interface design. The majority of work is based on Baddeley?s canonical model of working memory as a limited buffer for visual and auditory information [a]. When the buffer is overloaded, possibly by performing complex tasks that involve an ordered series of physical and mental activities, new information can fail to be processed [a, b]. Mayer (2005) expands Baddeley?s model to form a cognitive theory of multimedia learning [c, d]. In his model, information processing is divided into a verbal (not necessarily auditory) channel and a visual channel. Again, each channel has a fixed informationprocessing capacity and can be overloaded. Mayer presents a series of principles for designing instructional multimedia aimed to reduce cognitive effort required from the learner for one or more channels [c]. Over the last decade, similar principles have often been used in the design of multimedia systems for academic or conceptual instruction, e.g., Moons and De Backer (2011), or Wong et al., (2012). However, unlike academics, most activities, cooking included, require less intellectual effort but require coordination of motion and sensation. The requirements on the channels of information processing thus differ. Paas and Sweller (2011) argue that ”biologically primary” skills passed through evolution require less cognitive effort than explicitly learned, often culturally driven ”secondary” skills. Based on time of historical emergence, movement-based activities like sports and cooking should be more primary than many fields of academics. On the other hand, Post et al. (2013) find that gesturing while watching grammar-instruction animations interferes with learning, and grammar could arguably be a primary skill. Moreover, interference from over loading could be bidirectional, for it is well established that secondary in-vehicle activities such as phoning or texting compromises drivers? ability to react to road conditions, leading to injuries and fatalities [f]. Several questions arise, yet few studies have directly investigated the cognitive load effects of teaching tools in non-academic situations. In a rare study, Khacharem et al. (2014) investigate the cognitive load effects of animations used for soccer instruction and find that novice players process both static images better than animations and slow animations better than fast ones, whereas expert players learn more effectively with fast animations. Their results suggest that speed and motion from instruction alone can add additional tolls on cognitive load, but these instructions were conveyed offline, as opposed to during gameplay. The body of literature on cooking is similarly patchy. Recipe recommendation and generation are well documented in the literature [y, u, o]; many such systems have been built (e.g., gg) but do not assist users in making the recipe. Meanwhile, little or no research investigates the cognitive load of cooking, and few systems seek to address the possible overload. Kraft?s iFood Assistant [q] and Quasar Computing?s Cook Assistant Lite [j] seem to share our goals, but their design choices and user test results, if any, are not documented.

FIELD VISIT #1: BLAH

On each page your material (not including the page number) should fit within a rectangle of 18 x 23.5 cm (7 x 9.25 in.), centered on a US letter page, beginning 1.9 cm (.75 in.) from the top of the page, with a .85 cm (.33 in.) space between two 8.4 cm (3.3 in.) columns. Right margins should be justified, not ragged. Beware, especially when using this template on a Macintosh, Word can change these dimensions in unexpected ways. Please be sure that your PDF is US letter and not A4. If your PDF or paper are formatted for A4, the submission will be returned to you to fix.

Contextual Studies

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Paper Prototypes

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Design Observations

Interactive Icons

Speech Processing

RELATED WORK

Every submission should begin with an abstract of about 150 words, followed by a set of keywords. The abstract and keywords should be placed in the left column of the first page under the left half of the title. The abstract should be a concise statement of the problem, approach and conclusions of the work described. It should clearly state the paper’s contribution to the field of HCI.

The first set of keywords will be used to index the paper in the proceedings. The second set are used to catalogue the paper in the ACM Digital Library. The latter are entries from the ACM Classification System [3]. In general, it should only be necessary to pick one or more of the H5 subcategories, see `http://www.acm.org/class/1998/ccs98.html`

CONCLUSIONS AND FUTURE WORK

Please use a 10-point Times Roman font or, if this is unavailable, another proportional font with serifs, as close as possible in appearance to Times Roman 10-point. The Press 10-point font available to users of Script is a good substitute for Times Roman. If Times Roman is not available, try the font named Computer Modern Roman. On a Macintosh, use the font named Times and not Times New Roman. Please use sans-serif or non-proportional fonts only for special purposes, such as headings or source code text.

Figure 1. With Caption Below, be sure to have a good resolution image (see item D within the preparation instructions).

References and Citations

Use a numbered list of references at the end of the article, ordered alphabetically by first author, and referenced by numbers in brackets [2, 4, 5, 7]. For papers from conference proceedings, include the title of the paper and an abbreviated name of the conference (e.g., for Interact 2003 proceedings, use *Proc. Interact 2003*). Do not include the location of the conference or the exact date; do include the page numbers if available. See the examples of citations at the end of this document. Within this template file, use the `References` style for the text of your citation.

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CONCLUSION

ACKNOWLEDGMENTS

Objects	Caption — pre-2002	Caption — 2003 and afterwards
Tables	Above	Below
Figures	Below	Below

Table 1. Table captions should be placed below the table.

We thank CHI, PDC and CSCW volunteers, and all publications support and staff, who wrote and provided helpful comments on previous versions of this document. Some of the references cited in this paper are included for illustrative purposes only. **Don't forget to acknowledge funding sources as well**, so you don't wind up having to correct it later.

REFERENCES FORMAT

References must be the same font size as other body text.

REFERENCES

1. Adobe Acrobat Reader 7. `http://www.adobe.com/products/acrobat/`.
2. Anderson, R. E. Social Impacts of Computing: Codes of Professional Ethics. *Social Science Computer Review December 10*, 4 (1992), 453–469.
3. How to Classify Works Using ACM's Computing Classification System. `http://www.acm.org/class/how_to_use.html`.
4. Klemmer, S. R., Thomsen, M., Phelps-Goodman, E., Lee, R., and Landay, J. A. Where do web sites come from?: capturing and interacting with design history. In *Proc. CHI 2002*, ACM Press (2002), 1–8.
5. Mather, B. D. Making up titles for conference papers. In *Ext. Abstracts CHI 2000*, ACM Press (2000), 1–2.
6. Schwartz, M. *Guidelines for Bias-Free Writing*. Indiana University Press, 1995.
7. Zellweger, P. T., Bouvin, N. O., Jehøj, H., and Mackinlay, J. D. Fluid annotations in an open world. In *Proc. Hypertext 2001*, ACM Press (2001), 9–18.