Hats off to LiLiPUT: Experiences with Lightweight Lab Equipment for Portable User Testing

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Summary

We share hands-on experiences with LiLiPUT (Lightweight Lab Equipment for Portable User Testing), a custom-designed wearable user testing system. In three Mobile HCI studies, we evaluated the degree to which LiLiPUT currently meets the requirements for mobile applications testing and research. Learnings and suggestions for further improvement are provided.

Towards mobile user testing equipment – requirements and approach

Our notion of computer use is quickly diversifying beyond the classical desktop-based setting. With the transition towards mobile and ubiquitous computing, it is important to also think about new ways of user-centered research. Whereas for web sites and office software, a broad choice of validated design guidance is available, methodologies for design and evaluation of mobile applications and services are still unsatisfactory. On the other hand, for many recent ubiquitous applications and services, the classical stationary usability lab is simply not any more the adequate research environment.

Mobile user testing equipment for telecommunications applications has to fulfill a number of challenging requirements (compare [2]). Most obviously, it needs to be portable. This requirement imposes strong demands on the form factor and power consumption of cameras and recording devices. Mobile user testing must also take account of the various context factors affecting the user cognition and behavior, such as the environment currently visible, weather conditions, the current location, or the noise level. The recordings need to have the same richness, accuracy, and reliability as standard stationary labs. For example, the mobile device screen status should be recordable. Additionally, one of the most important requirements is to enable a natural and seamless usage behavior, without impeding the user by too much observation technology. For instance, the mobile device should be freely movable in every direction and the observation equipment should not be experienced as heavy. It is quite evident that today's solutions for user testing only partly fulfil these requirements (compare [4]).

ftw.'s wearable mobile user testing prototype LiLiPUT (ibid) is designed with the ambitious goal to satisfy all of the above requirements. As Fig. 1 depicts, all the user wears is a hat, which is equipped with small video cameras and a microphone. The captured data is transferred via wireless link to the accompanying observant's backpack. All data – four videos showing the front view, the face view, the remotely captured mobile screen, and the observant's camera, as well as the microphone input from the user's hat and the observer's shoulder – is mixed into one video file and saved on a standard dual core high-speed notebook. In this way, LiLiPUT is able capture much of the mobile context in an accurate and efficient way, while still facilitating a seamless and natural usage situation.

Experiences with LiLiPUT: three case studies

We have used the LiLiPUT prototype throughout the last 18 months in several research and consulting studies to validate our general approach, to investigate its application potential, and to further refine the system design. While of course significantly advancing in terms of technical maturity (e.g. how to avoid noise in wireless transmission in urban environments), we especially wanted to assess users' reactions towards LiLiPUT, as compared to more standard research environments. In the following, three case studies are outlined in order to exemplify our learnings.

A field experiment on contextual factors of Mobile Interactive TV

Contextual factors have a strong influence on how a mobile application is used and perceived. LiLiPUT was used to investigate the user experience of Mobile Social TV, a new application concept which aims at enabling a joint TV viewing experience for remote viewers by using text and audio chat [5]. Three typical mobile situations were of special interest: sitting in a crowded café, walking along a street, and standing at a bus stop. It was evident that – apart from the reactions to Mobile Social TV - these mobile situations also had a different effect on the handling and user perception of LiLiPUT itself. Compared to the stationary café setting, the walking situation required much more attention of the observer to orient herself towards the test subject, in

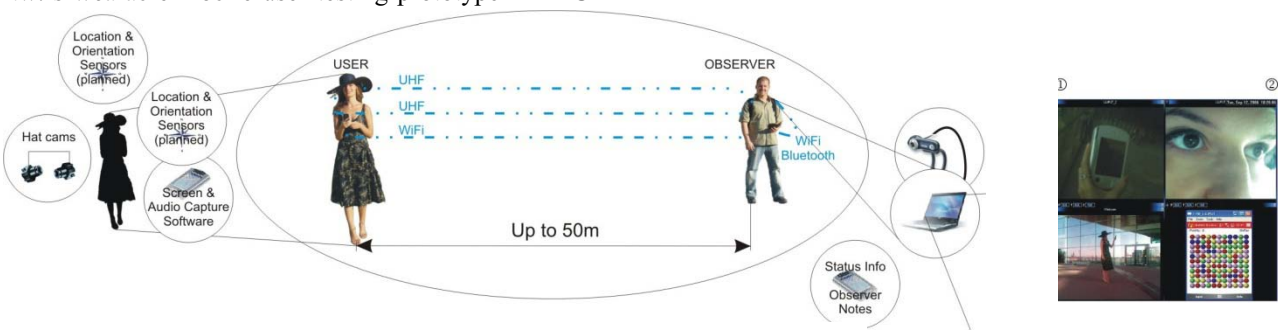

***Figure 1**. Architecture of the LiLiPUT System*

order to ensure that all important information is captured. The monitor of a small backup recorder helped us to quickly adjust to the best position. We also learned that weather conditions should strongly taken into consideration in test preparation: the availability of umbrellas and further utensils should be ensured well in advance. When asked about the hat while walking, all test participants felt comfortable. However, in the café, when people are close to each other and social awareness is higher, users mentioned to be embarrassed by wearing the camera-mounted hat.

An outdoor experiment with a ubicomp application

In an outdoor study, we compared different visualization methods for accessing nearby points of interest with a mobile device (see [3] for a description of the visualization methods). While undertaking a 2 hours tour through the city together with the test facilitator, the test participants were asked to complete tasks with different visualization versions. In order to evaluate the subjective experiences towards LiLiPUT, the tests were partly conducted with typical mobile HCI equipment (using a standard DV camera) and the LiLiPUT prototype. When asked in the final interview, it is notable that all participants rated both methods very positively. They neither felt disturbed in using the mobile application by the test equipment (all gave the best rating of 7), nor did they report to be embarrassed by being filmed or wearing the LiLiPUT hat in public streets (mean values of 6.6 and 6.3). Participants did not feel physically annoyed by the hat during the first part of the test (6.75). A drawback, however, is that in the final phase of the 2 hours test, this decreased significantly (3.5), apparently caused by muscular tiring effects. In later test sessions, these problems could be relieved by putting the hat off during the change of test setups, e.g. when walking from one test point to the next one.

A comparative indoor user study on the acceptance and quality of 3G mobile video streaming services

Unexpectedly, although explicitly intended for outdoor studies, LiLiPUT was has also found considerable appreciation for studies in the stationary lab. In a comparative study on the ease of access and the quality of service of circuit-switched and packet-switched mobile video streaming systems [1], LiLiPUT enabled the efficient and simultaneous analysis of the mobile screen display, the test person's facial expressions, and the overall situation. However, in these stationary testing situations, the weight of the hat seems to have more subjective significance for users than in mobile situations.

Conclusions

We are convinced that wearable user testing equipment is a highly important building block for conducting valid Mobile HCI user studies. The case studies reported above should be regarded as a starting point towards a broad and systematic investigation of future behavioral measurement methods.

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