

# COMPARISON OF TOUCH, MOBILE PHONE, AND GESTURE BASED CONTROLLING OF BROWSER APPLICATIONS ON A LARGE SCREEN

Susanna Pirttikangas,<sup>1</sup> Iván Sánchez, Mikko Kauppila,  
Jukka Riekki

## *Abstract*

*We present a user study where three different controlling methods are utilized to control browser applications on a large screen. The test group consisted of 11 persons. First, the users need to control a browser on a large screen without any initial instructions with touch, performing gestures with a 3D acceleration sensor device and with an NFC enabled mobile phone. After this blind stage, detailed instructions for each interaction method are given (if necessary) and the testees perform a browsing task with each method. All interaction methods gained positive and negative evaluations from the users; the touch screen being the most intuitive, the mobile phone based being the most reliable and the gesture control as the most handy.*

## 1. Introduction

In the cold city of Oulu, we want to install large screens, preferably behind glass windows and we want the ordinary people living in the city to be able to control the information on the screens. Therefore, we made two different kinds of interaction methods - or remote controllers for the large displays. In this paper, we present the results of comparison with touch, mobile phone, and gestural based browser controlling. The purpose was to study how people use the existing technology (touch screen) and how they are able to adapt to new interaction methods in controlling a large display.

## 2. The Technology

In this comparison test, two different methods to utilize browsing on a large screen were made. The users performed touch screen browsing, as well as used a mobile phone and a gesture sensor as a remote controller for browsing (Figure 1).

**Touch Screen Control.** The most familiar for most users all around the world in our setting is touch screen. In our tests, we used DViT (Digital Vision Touch), 50" plasma screen as our display.

**Mobile Phone Control.** For using a mobile phone as a remote controller, we use off-the-self components - namely NFC enabled mobile phones. The services are initiated when a user touches an RFID tag near the large display with her mobile phone. The tag contains the parameters necessary to start a remote service. When the service has been started, the user can control the external display using the

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<sup>1</sup>All authors are from Intelligent Systems Group, University of Oulu, Finland

mobile phone keypad [1].



**Figure 1.** Users performing browser controlling utilizing a touch screen, an NFC enabled mobile phone and a gesture sensor.

**Gestural Control.** The wireless sensor device was built at the University of Oulu. Its 3D acceleration sensors provide the data for the gesture recognition algorithm. The sensor sends data at 50 Hz over radio link to a base station connected to a PC's USB port. The gesture segmentation algorithm relies on the ballistic velocity profile of the signal and the classification is made with Hidden Markov Models. Each recognized gesture is mapped to a browser command through a specialized browser controller. The details of the system are described in [2].

### 3. User Test

The user test was performed in the University premises in front of a large screen on a corridor. The order of performing the actions with different controlling methods was selected randomly.

The user group consisted of eleven testees, six male and five female testees at the age of 22-35. All testees were very familiar with working with keyboard and mouse (average 4.82 in a scale from one (1, very poor) to five (5, very high)). Furthermore, the testees were asked to evaluate their experience in keypads, such as Playstation and Xbox and the average evaluation of experience was 3.36. Browsing with, for example Mozilla, SeaMonkey, was also highly familiar to the users (4.45 average). The lowest experience was regarded to other advanced interaction modes (e.g. speech) with 1.91 average.

The test included two stages: *a blind stage*, where the user was not instructed about how to use the devices (touch screen, mobile phone user interface, sensor for gesture control), but to perform natural browsing on a Mozilla browser. The second was *a task stage* where the users were revealed the correct gestures and functionalities for each browsing command.

The blind stage measured the intuitiveness of the system: how naturally the users utilize the system, and how well the users are able to discover the associated mappings from gestures and mobile phone's UI and the touch screen to browser commands.

The task stage measured the usability and efficiency of the system. The users were given instructions how to utilize the devices and then asked to solve a specific browsing task (find the name of the spouse of Edgar Allan Poe and the colors of the Sami flag on Wikipedia). In this task, the user needed to perform most available browsing commands (selecting and following links, scrolling, and moving in history), and at minimum 14 commands were needed to perform the task.

The time taken for the task stage for each testee was recorded. Naturally, as the tasks were the same

for every method and they were done one after another, the users learned the task and may have performed the last test sequence more quickly than the first.

After the test, the users were given question sheets to give comments and evaluations of the test. The results are presented in the next section. The users were asked about the reliability, easiness, speed, intuitiveness, handiness and cognitive load of the system.

## 4. Results and Conclusions

**In the blind stage**, the touch screen was the most intuitive method for the users. All of the testees were familiar with touch screen, so they did not care if the touch did not initiate any action on the first time they pressed the screen, but rather they self-confidently continued pressing the screen to achieve what they wanted.

For the other two methods, the situation was different. If there was a problem, the users started to look around like being lost and obviously felt helpless. In mobile phone control, most users, when touching a button in the mobile phone keypad, and the corresponding action in the wall display screen was delayed more than one second, pressed again that action button without paying attention to the information in the mobile phone screen (delay caused by GPRS connection).

In gesture control, the subjects had great difficulty to find the gesture-action associations. Most subjects found zero to two such associations, the most common ones being moving between links (gestures “left” and “right”). Surprisingly though, one person found all except one association. This suggests that once the general mechanism (discrete and translational nature of the gestures) is discovered, finding the rest of the gestures becomes easier. Also here, the users were not always aware if an action was performed or not.

Because of the difficulty to understand what is happening in the communication between a remote controller and the display, we can conclude that it is essential to present feedback of the performed actions on the large screen. The most intuitive method is the touch screen as it resembles the utilization of a mouse. Also, mobile phone user interface and usage were regarded as fairly intuitive.

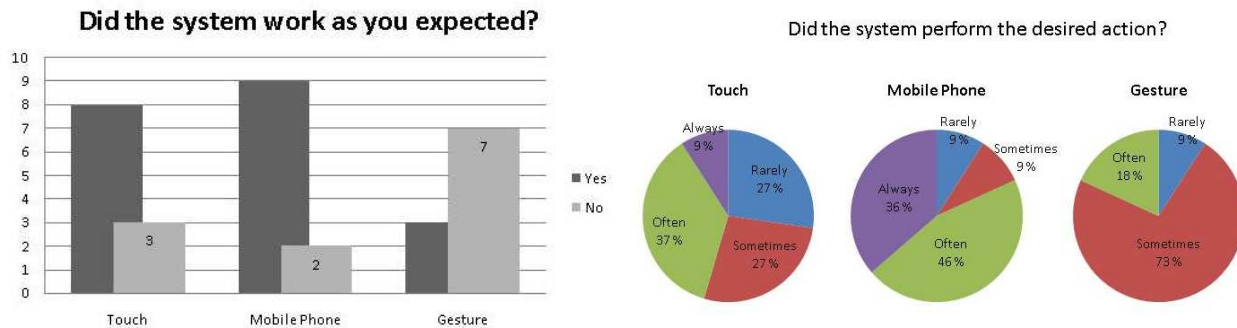
**The second task** of the user test measured the usability and the efficiency of the system. The users performed a specific browsing task after they were instructed about the utilization of the different devices. The average times taken to finish the task were 1 min 22 second, 2 min 19 second and 2 min 24 seconds for touch, mobile and gesture control, respectively. At maximum, the task took 4 minutes and 36 seconds (gesture control) and at minimum 26 seconds (touch control).

Although users had the instructions with the association between button and actions during the second stage using a mobile phone, many of them did not pay so much attention to the instruction sheet. They continued using the buttons as they thought it was correct (even though sometimes they were wrong). This did not happen in the sensor test, where the users continuously read the paper describing the gesture-action pairs. Some users felt that it was not comfortable looking at the mobile phone and the wall display at the same time. They prefer to have everything at the same display. Also here, it became evident that feedback on the large display is essential.

**After the test**, the users were asked if the system worked as they expected and whether the system perform the desired action. The mobile phone was evaluated as the best alternative for both questions

(Figure 2), the touch screen being the second.

The users also needed to rank each method against each other. In the easiness, intuitiveness and lack of cognitive load, the touch screen was clearly regarded as the best one. On reliability, the mobile phone control was considered as number one, but only slightly over the touch screen. Furthermore, the handiness of sensor gesturing and touch were evaluated almost the same, gesturing winning over one vote. All users would rather use touch screen than the other two methods. Touch screen technology has already been adapted by the users, so the results presented here are not surprising.



**Figure 2. User evaluations about the systems performance.**

Some verbal comments were made about the test, also. An interesting point is, that many testees did not like the unhygieny of the touch screen. The other two controlling methods do not pose this problem as the devices utilized are personal.

Nowadays, using mobile phone as a remote control can be regarded as mature technology. The users used words like; reliable, familiar and common about the device. Biggest problem was the slowness of the system - there was quite large delay between pressing a button and action in the mobile phone due to GPRS connection. A solution for decreasing the delay is to use Bluetooth or WiFi, and then it will be a very usable and intuitive way of controlling a large screen.

The gesturing control did not work as most of the users imagined but then again, they mentioned that it is fun to use and some even that it is natural and easy. A negative side effect is that the user needs to move their hands awkwardly in public and this could be embarrassing. Anyway, we believe that once people get used to utilizing gestures for different actions (Wii, gesture phones), this is also a notable way of interaction between the user and a large display.

## References

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