Exploring gestural mode of interaction with mobile phones

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Abstract
The study explores the users' perceptions to a novel interaction method with mobile phones. We study responses and reactions of participants towards gestures as a mode of input with the help of a low fidelity prototype of a camera mobile phone. The study uses an approach inspired by participatory design to gauze the acceptance of gestures as an interaction mode.

Keywords
Gesture input, mobile devices

ACM Classification Keywords
H5.2. User Interfaces: Input devices and strategies, Interaction styles.

Introduction
Novel methods of interaction are needed to counter the limitations posed by input and output modes i.e. small screens and keypads of mobile devices [1]. The GUI model proves to be insufficient for interaction with handheld devices because of their limited screen size and input capabilities [3]. The keypad mapped menus and directional navigation for mobile devices are hardly user-friendly or efficient [4]. The modalities available for mobile devices limit their usability [1].

Figure 1. The prototype of mobile phone

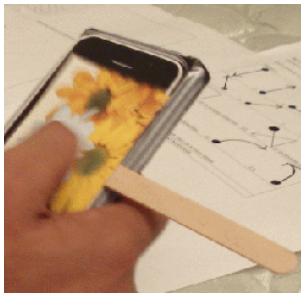

Figure 2. The prototype with an image on screen

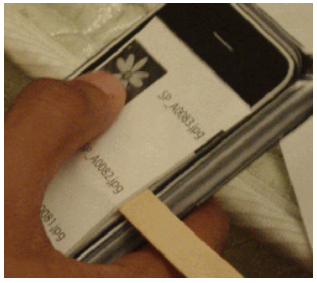

Figure 3. The picture directory on the prototype

In this study we explore gestures as a form of input for mobile devices like mobile phones. Gestures are not neutral. They hold a real life implication for people [6]. Many studies have already started focusing on affect produced by manual controls due to intimacy caused by sustained physical contact with them [2]. Gestures too hold a power for creating a feeling of flow and emotion while usage. The study [5], Affective Messaging Service for mobile phones relies mainly on affective gestures and pulses of a user to determine the sentiment to be echoed in a text message. The commercial world too has realized that the leverage gestures provide to interaction with mobile devices. Samsung has already released two gesture controlled models of mobile phones (SPH-S4000 and SCH-S400).

We conducted semi-structured interviews involving an essence of participatory design to determine reactions and acceptance of people towards using gestures for interacting with their mobile phones. For this study we selected two functionalities of a mobile phone which we think are effective ones to explore the gestural input interactions, including the camera functionality and the picture management functionality. Participants were asked to generate their own ideas of gestural interaction with mobile phone for the allotted tasks.

We find that gestures as an interaction mode add more meaning to usage of a mobile phone by empowering people to explore and achieve a task in ways the current modalities do not allow. In the following section of the paper, we present our user research process, results of the user study, and analyze and summarize our initial findings.

User Research

We created a low fidelity but high resolution prototype of a mobile phone. As we were solely focused on studying the effect on gestures on camera operation and picture management of mobile phone for users, a prototype consisting of a big screen and no keys sufficed us. A prototype resembling Apple iPhone fitted our requirements well (Figure 1). We created several screen shots corresponding to various inputs and outputs required by tasks (Figure 2) carried out by participants as explained later. One of the researchers acted as a computer carrying out transitions in the mobile phone in response to the interaction of a participant with the prototype.

We recruited ten participants of which five were males and five were females. Their ages ranged from 22 to 37 years old. They had owned a mobile phone from 1 to 11 years and all of them except one had camera mobile phones. However, they rarely used the camera and photo functionality of their mobile phones. They mainly cited problems uploading pictures from their camera and the poor resolution of photographs as reasons for low usage of the camera and photo management functionality. However, they agreed that the camera and related functions were not easy to use in a mobile phone, hence they were discouraged to use them.

Our interview primarily consisted of a set of eleven tasks. Out of eleven, nine tasks were the usual tasks found in almost all camera mobile phones while two tasks were functionalities that most of the mobile phones usually do not carry. For these two tasks, participants had to zoom in a particular section of picture, and edit the picture to look blurry and submerged in water (Figure 12, 13 and 14). These two

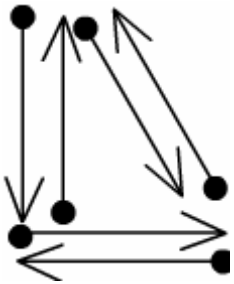

Figure 4. Directional gestures

Figure 5. Curve and Circular gestures

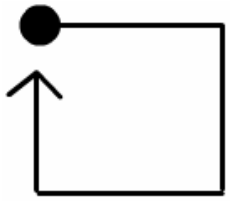

Figure 6. Rectangular Gesture

tasks were meant to observe participants' comfort and readiness to use gestures for tasks they were not accustomed to and did not have much prior experience to relate to.

The participants were also given a list of 21 predefined gestures. These gestures included touching of screen with fingers, movement of fingers across the screen, and moving the phone prototype in several directions. The finger movements included movements in all directions (Figure 4), some geometric figures (Figure 5,6), and figure "X" (Figure 7). The gestures also included tapping on phone with differential pressures (Figure 8). The gestures relating to phone movements included shaking phone sideways (Figure 9), forwards and backwards (Figure 10), and half rotating it on its axis (Figure 11). Before carrying out tasks the participants were asked to practice gestures once on the prototype to get them introduced with gestures.

The participants were asked to carry out tasks with the help of these gestures (Figures 4 to 11). They were free to invent their own single touch gestures if they found none of the predefined gestures suitable for a specific task. Multi touch gestures are conveniently enacted by two hands whereas one handed interaction for mobile devices has proven to be more beneficial by imposing less physical and attentional demands on a user [7]. Our aim was neither to find out the most popular gesture for a particular task nor to map gestures to any of the tasks. Participants were told this fact to ensure they do not feel pressurized to choose the correct gesture for a task. They were told that they would be designing gestures for the mobile phone. This ensured us the most natural and intuitive response of participants towards gestures.

Results

In this section we present the response of participants to the tasks.

Shooting a picture and selecting a picture from directory: All the participants tapped the screen to shoot a photograph. They considered it to be the easiest and most intuitive gesture. One of the participants mentioned "…since clicking photos would be the most common thing that I would do, I want the associated action to be simple and easy to use". We found that all the participants used the same gesture for this action because it is the easiest gesture and the task is most primary. A screenshot of photograph directory was put on the screen of prototype (Figure 3). All the participants tapped at a picture in the photograph directory. They all reasoned it to be a familiar action from their computer. A participant expressed, "…this gesture naturally maps to what I want to do, unlike buttons whose positioning can be confusing…".

Deleting a picture: Six participants drew a "X" (Figure 7) to delete the picture. One of the participants commented that cross signified wrong things and hence she chose to cross-out to delete the picture. Other participants used a gesture to brush off the picture from the screen. One of them mentioned it was like brushing off dirt from the table while another participant felt she was dragging the picture away from the screen.

View next and previous pictures: Participants actions were evenly distributed between scrolling pictures up or down, and left or right direction. Participants who scrolled up and down commented that their documents were arranged in the same way on their computer while

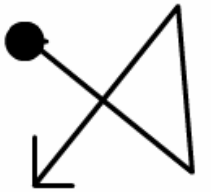

Figure 7. Gesture representing figure "X"

Figure 8. Gesture representing differential pressure tap on the screen

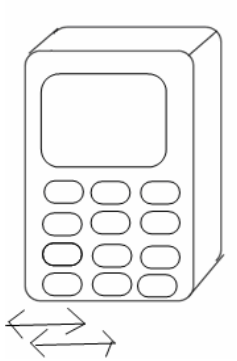

Figure 9. Shaking phone sideways

other participants felt that pictures were part of a book they were reading. All the participants liked the fact they could use opposite gesture to view next or previous pictures. However, 2 participants commented they would keep moving forward rather go back till they reach the photograph they wanted to see.

Zoom in and out of a picture: Four participants zoomed into the picture by pulling out a corner sideways (Figure 4) by using a diagonal directional gesture. They commented their action was similar to expanding a picture in MS Paint. One participant stretched out the picture in all four directions i.e. up, down, left, and right. He chose the particular action because zooming in a picture seemed like unfolding a blanket to him. Two participants drew a circle in a clockwise motion (Figure 5) on the picture. It made them feel that they were unscrewing or "opening up" the picture to make it bigger. All these participants used opposite gestures to zoom out of the picture. Two participants chose to press the screen very hard so that the picture expands under the pressure exerted by their thumbs. They chose to tap the screen many times to zoom out the picture. Participants commented that gestures allowed them to control the rate and amount of expansion and contraction of the photograph. The additional feature discovered by the participants excited them very much. Participants were also asked to magnify a certain part of the picture. Though, distinguishing sectional zoom from overall zoom confused them a bit, they enjoyed doing this task. A participant wanted to do this with his friends' and politicians' photographs and have fun with them. Six participants traced out a part of picture to zoom in it by drawing a square or a circle around it (Figure 5 and 6) and tapping inside the marked boundary. However, one participant stretched a corner of the marked boundary of the picture. All these participants found this activity similar to "crop" functionality of tools like Photoshop.

Start a slideshow: Two participants half-rotated the phone on its axis (Figure 11) while one shook it sideways (Figure 9). These participants enjoyed these gestures very much although one of them commented that his action might trigger off slideshow by mistake. One participant shook the phone in forwards and backwards (Figure 10) direction but he could not connect the gesture with the action he intended. One of the participants felt that the motion gestures were an enhancement to the rest of gestures. He mentioned touching the screen made him feel he was directly in contact with the picture, and therefore gestures requiring touching of a screen should be reserved for tasks involving individual pictures. He further reasoned that complex tasks such as those acting on a group of pictures should be dealt with motion gestures. All these participants liked the practicality of being able to control speed, motion, direction of slideshow by directly applying relevant motion gestures. The participants who chose the motion gestures became very fond of them. They were reminded of Etch A Sketch®[1] toy [8]. They grew nostalgic and could not stop themselves playing with the prototype. Three participants drew a circle on the screen of phone. They felt that their action suggested enclosing and grouping photographs together which according to them is the essence of a slideshow.

[1] Etch A Sketch® is a mechanical drawing toy having a user controlled stylus whose movement is plotted on a powder coated screen. The stylus is hidden under the screen while knobs to move stylus are placed over the screen. To restart drawing, Etch A Sketch® toy needs to be shaken.

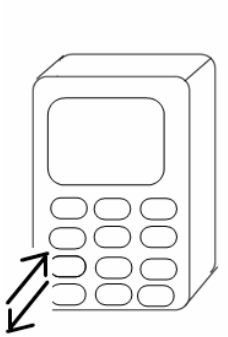

Figure 10. Shaking phone forwards and backwards

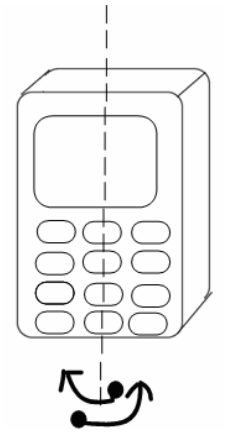

Figure 11. Rotating phone on its axis

Pause the slideshow: Almost all participants (except one) chose to tap the screen to pause the slideshow. They all felt that it was the most intuitive way to interrupt the slideshow. One participant decided to shake phone again to pause the slideshow. The participants found tapping on the screen similar to action of pausing the slideshow on computer.

Edit a photograph: Participants were taken by surprise with this task because of its unexpectedness. Two participants even mentioned that they would expect such functionality from a digital camera and not from a mobile phone. Other two participants found the possibility of this functionality in a mobile phone very appealing. Six participants shook the prototype in various directions to edit the pictures. Most of the participants felt that rather than editing a picture, there should be a functionality which applies different filters to a photograph. They preferred to move the picture from one state to another and ultimately choose the one they wanted (Figure 12, 13, 14) where each state represented a particular look of the picture. Participants mentioned that they did not expect any sophistication from this functionality but they loved the idea of moving their pictures through various states. Six participants again mentioned that shaking the prototype sideways to move the picture through various states reminded them of Etch A Sketch® toy. These participants could not stop playing with the prototype. They all felt very nostalgic and childlike while doing this. The fun aspect of shaking pictures to see a transformed picture enthralled and captivated them. Participants felt an emotional bond with the usage of the shaking gesture. These participants also said that the shaking gesture kind of jumped at them. Two participants chose to rub the screen with series of small gestures in a quick fashion to achieve different visual effects on the photo. One participant chose the circular gesture. She said she felt like she was going from one possible stage to another. She found this gesture/action very appealing and termed it smooth and “non interruptible”. She was pleased with it and said she would like to use it on her phone.

Analysis

In this study we were basically concerned about the users’ perceptions and acceptance towards gestures. We found that gestures appealed more to the participants than the key-clicking modes of interaction for mobile phones. Gestures let them connect the examples from their real life to the task at hand. Metaphors of unfolding a blanket, scraping off the dirt from surface, opening up a picture to zoom in it, and crossing out wrong things were brought up by participants themselves. To be able to connect to their usual activities made gestures more appealing to them. The examples given by participants helped us realize how they visualize digital data in their minds. Gestures also ushered in the feeling of flow and non interruption during the task. Participants also mentioned they will not have to spend much time figuring out how to input.

Gestures also enabled participants to achieve the task with more finesse than they thought. Additional features and uses of gestures were discovered by participants themselves. For example participants mentioned they could control the rate and extent of zoom, speed and direction of slideshow. Such uses were not foreseen during the beginning of the study. We feel gestures definitely allowed participants to explore tasks more and decide what they wanted out of them.

Figure 12. Original image for "Edit photograph" task

Figure 13. Participants were asked to edit photograph in Figure 12 to look like this picture.

Figure 14. Participants were asked to edit photograph in Figure 12 or Figure 13 to look like this picture.

The study helped us conclude that gestures help make interaction easier, more intuitive, and more enjoyable.

Besides, ease of use and efficiency, what attracted the participants most to gestures was the fun they had while using it. Some of the actions like shaking the phone were extremely liked by the participants. The gestures involving movement of a phone proved to be very attractive. Participants could not resist themselves from shaking and moving the prototype again and again. One of the participants mentioned he wanted a phone enabled with such gestures to make his neighbors envious.

Conclusion and Future Work

Looking at the study, we conclude that gestures are not neutral or dull. They appeal to users to a big degree largely because they enable the user to be more efficient, expressive and add an element of fun. The gestural mode of interaction lets users directly connect with the data they are using. This makes gestures highly evocative. Gestures have a power to keep users engaged. The movement based interaction holds more meaning for a user [9].

In this study, we explored the richness created in interaction with a mobile phone. We looked at gestures as a mode of interaction. While this study provided us with insights and validated our claim, we plan to chalk out an exhaustive and consistent list of gestures for various tasks on a mobile phone.

Acknowledgements

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