Designing finger touch gestures for affective and expressive interaction on mobile social networking sites

Konstruktion av fingergester för känslomässiga och uttrycksfulla interaktioner på mobila sociala nätverkstjänster

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Abstract

This thesis project is an interaction design study, which studies how finger touch gestures can be used as expressive alternatives to text comments on social networking sites. In the study qualitative research methods and a user-centred approach are used. The study collects literature on how emotion is modeled in Human-computer Interaction and how emotion can be expressed through touch. The popular social networking site Facebook is used as a case study of user behavior on social networking sites and as a starting point for the design of the interaction. A user study was conducted with two participants with much experience of the mobile Facebook application.

The results of the study are five design ideas that are based on previous in the research area and from feedback from the participants of the user study. The interaction of two of the design ideas were developed into simple web prototypes to see if the functionality could be implemented. This thesis project is an exploratory beginning on the use of finger touch gestures for expression of emotions social networking sites. These design ideas will have to be developed into usable prototypes and tested with users in future research.

Sammanfattning


Resultatet av studien är fem designidéer som är baserade på tidigare studier inom forskningsområdet och på återkoppling från deltagarna av användarstudien. Interaktionen från två av dessa idéer utvecklades till enkla webbprototyper för att se om funktionaliteten kan implementeras. Detta examensarbete är en utforskningsbörjan på användandet av finger gester för uttryck av känslor på sociala nätverkstjänster. I framtida forskning kommer dessa designidéer att behöva utvecklas till användbara prototyper och testas med användare.
# Table of Contents

1  Introduction ........................................................................................................................ 1  
  1.1  Purpose and research questions ................................................................................... 2  
  1.2  Limitations ................................................................................................................... 2  
  1.3  Mobile Life Centre ...................................................................................................... 3  
2  Background ........................................................................................................................ 4  
  2.1  Emotion and emotional interaction through touch ...................................................... 4  
    2.1.1  Emotion in HCI .................................................................................................... 4  
    2.1.2  Emotional communication through touch ............................................................ 6  
    2.1.3  Affective computing ............................................................................................. 7  
  2.2  Interaction and expression through social networking sites ........................................ 8  
    2.2.1  Description of Facebook ...................................................................................... 8  
    2.2.2  Why and how people use Facebook ..................................................................... 9  
    2.2.3  Alternative forms of expression in social media ................................................ 12  
  2.3  Touch-screen interaction design ................................................................................ 13  
  2.4  Design studies using mobile devices for emotional interaction ................................... 18  
3  Methodology .................................................................................................................... 22  
  3.1  Pre-study .................................................................................................................... 22  
    3.1.1  Literature review ................................................................................................ 22  
    3.1.2  Pilot tests ............................................................................................................ 22  
    3.1.3  User study ........................................................................................................... 23  
  3.2  Design development .................................................................................................. 25  
    3.2.1  Design idea reflection and sketching.................................................................. 25  
    3.2.2  Interaction designs .............................................................................................. 25  
    3.2.3  Design implementation ...................................................................................... 25  
4  Results .............................................................................................................................. 28  
  4.1  User study .................................................................................................................. 28  
    4.1.1  Pilot test................................................................................................................ 28  
    4.1.2  User tests - Facebook usage ............................................................................... 28  
    4.1.3  User tests - Finger touch gestures on images ..................................................... 30  
  4.2  Design ideas ............................................................................................................... 31  
    4.2.1  Design idea 1 – Swiping and dragging up/down ................................................ 31
1 Introduction

This thesis project is a study in interaction design for touch-based mobile phones (often referred to as smartphones) and social networking sites, which is a branch of social media. More specifically, it is a design study regarding how touch gestures on mobile phones can be used to provide more expressive alternatives or complements to text comments on published content on a social networking site. The study builds on the emerging research fields of affective computing and user experience design, which are subfields of human-computer interaction and interaction design.

The reason for choosing to study social networking sites in this thesis project is because the use of social networking sites today is widespread. The social networking site Facebook is one of the biggest social networking sites in the world with 1.11 billion monthly active users (Facebook, 2013). Twitter, which is a micro-blogging service, has over 200 million users (Qiu et al., 2012). Additional figures show that over 50 percent of Swedish people in the ages between 16 and 74 years used the Internet in the first quarter of 2012 for chatting, blogging, post content on social networking sites and instant messaging (Statistics Sweden, 2013).

Mobile phone usage is also very pervasive in people’s lives. 97 percent of Swedish people used a mobile phone or smartphone during the first quarter of 2012. Many, 45 percent to be more specific, have access to the Internet on their mobile phones via the 3G/4G-networks. It is also common for the Swedish people to access the Internet on mobile phones outside of the home, which 59 percent of the population has done. A common activity when using Internet on mobile phones is to use social media, which was done by 40 percent of the Swedish people aged 16-74 years in first quarter of 2012 (Statistics Sweden, 2013).

The statistical figures presented above indicate that mobile phone usage and social social networking usage is quite common among the Swedish people. They also show that using social networking sites on the mobile phone is also becoming increasingly more common. With these increased and combined usages, new research opportunities are made available with regard to interaction design, especially when designing for affective expressions using gestures. Research in interaction and expression via mobile and social media communication is plentiful. However, research in this field of HCI and human-human interaction, commonly known as affective computing, has been scarce. This point is especially true regarding research on affective expressions using finger touch gestures on mobile phones. In his book “Designing Interactive Systems: A comprehensive guide to HCI and interaction design”, Benyon (2010) points out that affective computing as a research field is an area still in development, and that the innovations made in this field are in their infancy. Benyon (2010) also provides a list of potential areas of impact for affective computing, wherein suggestions for specific research areas in affective computing are provided. One of these areas that are listed is using affect in mobile devices by representing and displaying emotional states. The design research in this thesis work was thus conducted much in an exploratory manner in...
order to find new expressive alternatives for social networking sites by using finger touch gestures.

**1.1 Purpose and research questions**

The purpose of this thesis project is to investigate how finger touch gestures on mobile phones can be used to facilitate more expressive communication on social networking sites. More specifically, the research will look into how finger touch gestures can be used to provide more expressive alternatives to comment on content on social networking sites with functionality resembling Facebook. The research is conducted by using qualitative research methods and user-centred design methods. Since this thesis project is focused on interaction design, the aim of this thesis project in particular is to create specific interaction design ideas that are based on a literature review and the qualitative findings of the study. These project aims lead to the following research questions which will be investigated in this thesis project:

1. How can finger touch gestures be designed to provide expressive alternatives or complements to text comments on a social networking site?

2. What kinds of visual elements and feedback are appropriate for finger touch interaction meant to provide expressive alternatives and complements to text comments on a social networking site?

3. How do users interact with other users on social networking sites and what do they consider as appropriate regarding finger touch gestures as alternative and complements to text comments on a social networking site?

In addition to investigating these research questions, this thesis project will look into different ways to implement the design ideas into prototypes. However, as this is a study in interaction design the technical details will be kept to an appropriate level, with explanations and motivations given when necessary. The definition of user-centred design in this thesis paper is based on the ISO 13407 – Human-centred design processes for interactive services standard as is provided by Göransson and Gulliksen (2002).

**1.2 Limitations**

This thesis project focuses primarily on interaction design ideas which can facilitate expressive options to commenting posts on Facebook. As such, other social networking
services and social media will only be mentioned when necessary. Other forms of mobile communication, most relevantly phone call communication, will also only be mentioned when necessary. Social media and social networking sites incorporate many different kinds of multimedia elements which people can use for expression. This project will, however, focus mostly on images and pictures, and look at other forms of multimedia when relevant.

Additionally, even though Facebook is the starting point for how people express themselves on social networking sites and interact with other people, and also for what sort of interaction options are available, the design ideas derived from this study will not be implemented with the Facebook platform. The reason for this is that the implementation would be too complicated and beyond the scope of this exploratory project, where the focus is on possible interaction design options. The design options derived from this study could be the subject of implementation with the Facebook platform, or other social networking platforms, in future research. As for the finger gesture recognition, focus will lie on existing technology and sensors in smartphones. Extra equipment, such as Arduino-sensors, external pressure sensors and GSR-sensors (for measuring skin conductivity), will not be used.

1.3 Mobile Life Centre

This thesis project was done in collaboration with the research organization Mobile Life Centre, whose research focuses on future digital technology use. As such, this thesis project is part of a larger project involving several researchers. Therefore, responsibilities were shared during user tests and designing.
2 Background

This is a review of literature and other studies that are relevant for the development of this project. It starts with the scientific principles of emotional interaction both in human-computer interaction (HCI) in general, and also through touch and the concepts of affective computing. After that it will go into how people express and interact on social networking sites, using Facebook as a specific case study. Design guidelines for touch-based interactions and interface will also be reviewed. Finally, this review will look into design projects which have had similar goals as this thesis project regarding interaction design for emotion and affect. This is done in order to establish some useful design guidelines for emotional interaction using finger gestures.

2.1 Emotion and emotional interaction through touch

2.1.1 Emotion in HCI

In the context of HCI the term affect is often used to describe emotion (Benyon, 2010). Both of the two terms emotion and affect will be used in this thesis, and the terms will be referring to the same concepts. According to Boehner et al. (2007) there has been an emerging approach to emotion in the field of HCI in general, and affective computing in particular, that differs from the traditional view of emotion. The traditional approach of emotion has been that it is a form of information-processing that works in the context of traditional cognitive behavior. This model of information processing treats emotion as an internal, individual and delineable phenomenon. This model has been used traditionally in HCI because it fits in with existing scientific models of emotion from the area of physiology. Boehner et al. (2007) however argue in favor of the emerging view of emotion, which instead looks at an interactional account of emotion and view it as a product of social and cultural experiences.

In the interactional approach emotion is viewed as culturally grounded, dynamically experienced and to some degree constructed in interaction. This view differs from the informational model where emotion is regarded as internally constructed units of information. In interface construction the interactional approach also differs from the informational model by moving the focus from constructing interfaces that try to accurately understand the emotions of the users to help users understand their own emotions. Another difference between these two approaches to emotion that is quite important to interaction designers is that the interactional approach presents new design and evaluation strategies for computers and other devices. This means that focus has to move from trying to design systems that try to as accurately as possible deduce the emotions of the user and instead focus on creating systems that encourage awareness and reflection regarding the emotions of users (Boehner et al., 2007).
In order to highlight these differences between the interactional approach and informational model of emotion and affect, Boehner et al. (2007) present three pairs of affective computing systems with similar goals but using either an interactional approach or informational model approach. The authors show that these pairs of affective systems produce quite different results in terms of design and evaluation even though they have similar goals and starting points. With these examples in mind the authors highlight five key differences between designing for affect using the interactional approach in contrast to the informational model. These differences highlight the interactional approach as follows:

- The interactional approach recognizes affect as a social and cultural product
- The interactional approach relies on and supports interpretive flexibility
- The interactional approach avoids to formalize the unformalizable
- The interactional approach supports an expanded range of communication acts
- The interactional approach focuses on people using systems to experience and understand emotion

Later on, design examples of both the interactional approach and informational model that are relevant to this project will be presented. While the interactional approach and informational model differ in how to approach emotions in HCI, it is generally agreed among human psychology researchers that emotions have three components. These components are the subjective experience of feeling an emotion (such as feeling fear), the associated physiological changes (such as trembling with fear), and the behavior evoked by the emotion (such as running away) (Benyon, 2010).

A popular model for categorizing different emotional states is the circumplex model of affect, which was defined by Russell (1980). In this model, emotion is looked at in terms of valence (pleasure and displeasure) and arousal which are placed in a coordinate system, see Figure 1. The vertical axis of this coordinate system is the degree of arousal and the horizontal axis is the degree of valence. It was shown using the circumplex model of affect that people have the same idea about how emotions should be distributed in this coordinate system (Fagerberg et al.,

![Figure 1 - An example of the circumplex model of affect from Rusel (1980). The vertical axis represents the degree of arousal of emotion and the horizontal represents the valence of emotion.](image-url)
2 Background

As will be seen later on, this model is widely used when designing affective systems. The popularity of the circumplex model of affect is also recognized by Benyon (2010).

2.1.2 Emotional communication through touch

With regard to how emotion can be communicated through touch, three studies were conducted by Hertenstein et al. (2006) where the authors sought an answer to the question: Can touch communicate specific emotions? As explained in their study, previously two general claims have been made regarding the communication of touch. The first claim is that touch can only communicate the hedonic tone of emotion, that is either positively valenced warmth and intimacy or negatively valenced pain or discomfort. The second claim is that touch only intensifies emotion communication used by other modalities.

The first study performed by Hertenstein et al. (2006) consisted of having two participants at a time sitting at a table which was separated by a curtain so that they could not see each other. The participants were also not allowed to talk to each other for the duration of the test. One of these participants was randomly shown twelve emotion words that this participant then had to communicate to the other participant by making contact with the other participant’s bare arm. The participant whose arm was touched then had to guess what emotion was being communicated. Among the twelve emotions that were tested in the study were six emotions that have been proven to be decodable by face gestures and voice in different cultures (anger, fear, happiness, sadness, disgust, and surprise), three prosocial emotions related to cooperation and altruism (love, gratitude and sympathy) and three self-focused emotions (embarrassment, pride and envy). The second study was procedurally the same as the first except that it was performed in a different cultural setting (the first study was performed in America and the second in Spain). In both of these studies most emotions were decoded at above-chance levels (chance-levels being based on the circumplex model of affect).

In their third study, Hertenstein et al. (2006) showed video clips from their first study to participants. The video clips contained the touch communication used during the first study, of which six video clips were presented to each participant. The participants’ task was to try to observe which emotion was being communicated in the video clips and fill out an answer sheet. The results showed that, for many of the emotions being communicated in the video clips, the accuracy of correct answers were above-chance. The conclusion from these studies is that touch can communicate the emotions anger, fear, disgust, love, gratitude and sympathy, and also that specific touch behaviors communicate distinct emotions (Hertenstein et al., 2006).

Building on the study of Hertenstein et al. (2006), Thompson and Hampton (2011) studied if the context of relationship status had an effect on what emotions could be communicated through touch. The context of relationship status was something that was not studied by Hertenstein et al (2006). The communication of emotion through touch in the context of romantic couples was tested and compared to the context of strangers. The study found that both romantic couples and strangers could distinguish and communicate universal and
prosocial emotions and the self-focused emotion embarrassment. However, romantic couples could also communicate two additional self-focused emotions at above-chance levels, which could not successfully be communicated by strangers. These self-focused emotions were envy and pride. The study of Thompson and Hampton (2011) shows that the context of the relationship between people has an effect on how well people can communicate specific emotions through touch. Another finding from this study was that participants had difficulty differentiating between specific emotions if the emotions were matched along the same dimensions of the circumplex model of affect. For example, the self-focused emotions envy, anger and disgust, which are along the same dimensions in the circumplex model of affect (high arousal, negative valence), were confusing for participants to distinguish (Thompson and Hampton, 2011).

**2.1.3 Affective computing**

In their book, *The Media Equation: How People Treat Computers, Televisions, and New Media*, Reeves and Nass (1996) explain the results of their research as the following:

“In short, we have found that individuals’ interactions with computers, television, and new media are fundamentally social and natural, just like interactions in real life.” (Reeves and Nass, 1996, pp. 5)

Reeves and Nass (1996) go on to explain that media in various forms obey a wide range of social and natural rules that come from interpersonal interactions and from how people interact with the real world. These natural and social rules apply equally well to the mediated world as to the real world. This conclusion leads to the creation of the media equation by Reeves and Nass (1996), which states that media = real life. This equation theory provides an important approach where design is done by following social and physical rules to create more intuitive and enjoyable experiences (Reeves and Nass, 1996).

In HCI and interaction design, the studying of computing systems and devices that deal with emotion is referred to as affective computing. In this research area there are, according to Benyon (2010), three possible categories to consider when designing for affective interaction:

1. Getting interactive systems to recognize human emotions and adapt to these emotions.
2. Getting interactive systems to recreate human emotions to appear more engaging or desirable.
3. Getting interactive systems to elicit emotional responses from people or to allow people to express emotions through the system.
This thesis project falls into the third category of affective computing. An example of the second category is provided by Park et al. (2012), who designed an information retrieval system that provided apologetic display messages. These display messages were shown when preplanned errors occurred in the system. The study found that users who received apologetic display messages perceived the system to be more aesthetically pleasing and more usable than users who received neutral or non-apologetic display messages.

Affective computing is sometimes coupled with user experience design, as is the case in the study of Park et al. (2012). User experience, according to the ISO 9241-210 standard, is defined as “a person’s perceptions and responses that results from the use or anticipated use of a product, system or service”. In the domain of perceptions and responses of user experience design, emotion is a primary factor considered in many user experience frameworks (Park et al., 2011).

2.2 Interaction and expression through social networking sites

2.2.1 Description of Facebook

Before going into the reasons for why people use social networking sites, a brief description of the current functionality of Facebook, which is the focus of this study, will be given. Facebook users can post content which will be seen by their friends. The connection of friends is made by users sending and accepting friend requests enabling both parties to partake of the other’s content. The content of posts can consist of text, photos/images, videos, hyperlinks or combinations of these. Friends can then view these posts in a news feed and comment on them, and press the “Like” button, which has the form of a hand giving a thumb up, signaling positive support for the post. Emoticons can be embedded into both the text posts and comments. A third way of interacting with friends’ posts is to share them with one’s own friends. The posts of users and their friends are shown in a scrollable news feed where the posts can be sorted after time or relevance. Users also have profile pages containing their personal information and all their posts in a feed, which also contains a timeline of all the users’ content. Regarding posting images, users can tag friends, and themselves, in images, which is an action that will relate the tagged image with the tagged users’ profiles. Facebook users can also use instant messaging to interact with each other. A new feature of Facebook, which was added during the course of this thesis project, is the possibility to add emotional tags in the form of feelings in ones posts. Examples of these tags are adding “feeling happy”, “feeling sad”, “feeling annoyed”, “feeling excited”, etc. to ones posts. These emotional tags are included at the end of the text part of the post, and when choosing a feeling, emoticons are displayed together with the feelings to help users choose the appropriate option, see Figure 2. The emoticons are also included in the status post for the users’ friends to see. Having recently added the functionality of emotional tags indicates that Facebook has recognized a
lack in ability for users to express clear emotions on Facebook. Touch gestures are used for

expressing meaning in the photo-sharing social media Instagram, where users can show
support for other users’ photos by tapping photos twice. This gestural interaction will
manifest in the form of a heart briefly appearing on the photo and the people who have shown
this support are listed under the photo. The use of the thumb up symbol in Facebook and the
heart in Instagram are examples of semiotics which is the study of signs and their meanings.
Semiotics will be further examined in the context of multi-touch interfaces in the section 2.3
Touch screen interaction design. For more images of the Facebook interface, both the website
and the mobile application, see Appendix B.

2.2.2 Why and how people use Facebook

Studies that look into the relationship between users’ personalities and how they interact on
social networking sites are also presented in this section. These studies focus on the biggest
social networking site Facebook, which has 1.11 billion monthly active users as of March
2013 (Facebook, 2013). Twitter, which has over 200 million users (Qiu et al., 2012), is also
examined. Additionally, most of these studies use the Five Factor Model. This model, which
is also known as the "Big Five", is considered by many researchers as a good model to
describe personality, and it has been replicated cross-culturally (Seidman, 2013). The Five
Factor Model is a model of the traits openness, conscientiousness, agreeableness, extraversion
and neuroticism (Seidman, 2013; Chen and Marcus, 2012; Qiu et al., 2012).

A literature review of studies that look into why people use Facebook was made by Nadkarni
and Hofmann (2012), in which current literature on Facebook use was searched and analyzed.
In their literature review the authors first conclude that there are demographic socio-cultural
differences in Facebook use both in terms of how often Facebook is used and what functions
of the platform are used more often than others. Many of the studies looked at in the literature review study some of the traits in the Big Five model, mostly extraversion/introversion and neuroticism. In addition to these traits, Facebook use is often studied in terms of self-esteem and self-worth. The authors created a 2-factor model of why people use Facebook. The two factors which Nadkarni and Hofmann (2012) say are the biggest predictors of Facebook use are the need to belong and the need to self-present. Facebook use, according to the authors, can give an increased sense of connectedness and nonuse can cause a sense of disconnectedness.

Citing Nadkarni and Hofmann (2012), Seidman (2013) conducted a study to examine the use of Facebook to fulfill needs of belonging and self-presentation. The study relied on participants self-reporting their Facebook usage habits in order to find out how it is used for belonging and self-presentation. The participants also filled out a survey asserting their personality traits. Participants with high degree of agreeableness and neuroticism were most likely to use Facebook for belongingness. This may be because agreeable individuals have strong motivations for belongingness and neurotic individuals often have social difficulties that can be remedied through the use of Facebook. High neuroticism and low conscientiousness (meaning discipline, responsibility and orderliness) were most likely to use Facebook for self-presentation. This can be explained by that conscientious individuals are cautious as to what they present themselves online and neurotic individuals may use Facebook to present hidden and ideal self-traits (Seidman, 2013).

Also citing Nadkarni and Hofmann (2012), among others, Oldmeadow et al. (2013) look at Facebook use in terms of attachment theory. More specifically, the authors study the relationship between attachment anxiety, attachment avoidance, Facebook use and experience, and social skills. This relationship was tested by sending out questionnaires to participants. The study found that participants with high attachment anxiety were more likely to spend more time on Facebook than other participants. They were also more likely to use Facebook when feeling negative emotions, and express concerns over how others viewed them on Facebook. Oldmeadow et al. (2013) indicate that the behavior of using Facebook when feeling negative emotions is done to feel an increased sense of connectedness and hence improve one’s mood. Another reason for using Facebook so often is in connection to posting content and regularly checking if friends have responded to the content, which can have an effect of feeling popular for the person. Another finding from the study was that the relationship between attachment styles, and Facebook use and experience were independent from social skills. This is an indication that Facebook can serve attachment function for people who have high attachment anxiety (Oldmeadow et al., 2013).

Another study, by Chen and Marcus (2012), looked specifically at students’ self-presentation on Facebook. This study looked particularly at the “Big Five”-trait extraversion, which is the trait describing the degree of direct interactivity that a person is comfortable of having with other people. The study also looked at how students behaving individualistically or collectivistically affected their self-presentation on Facebook. Like Seidman (2013) this study relied on the participants self-reporting their Facebook usage and answering questions about their extraversion trait. The study found that extraverted participants disclosed more
information on social networking sites than in person. It was also found that participants who were low in extraversion (introverted) and were individualistic disclosed the least amount of information online, and introverted individuals who are not individualistic disclose the least amount of honest information (Chen and Marcus, 2012).

For comparison, a study in expression on another large social networking site, Twitter, is presented. Qiu et al. (2012) found linguistic cues to personality traits in tweets (short messages used in Twitter). They did this by analyzing tweets of the participants of the study, and by letting the participants fill out a survey to assess their personality traits. Extraversion was particularly positively correlated with positive emotion words and social process words, and openness was positively correlated with assent words and negatively correlated with function words. Agreeableness was associated with using fewer numbers of exclusive and sexual words. Regarding personality perception, it was shown that unfamiliar raters were able to accurately judge neuroticism and agreeableness on Twitter.

The studies of Seidman (2013), Oldmeadow et al. (2013), Chen and Marcus (2012), and Qiu et al. (2012) use quantitative methods to show a correlation between personality and different reasons for using social networking sites, more specifically belonging and self-presentation. They also find correlation between personality and how much information a person discloses on social networking sites, and correlation between personality and certain linguistic cues. However, these studies do not look at the complex and dynamic interactional relationship users have with social networking sites. This complex relationship is studied by Zhao et al. (2013), in which a qualitative study of Facebook was conducted by having 13 users write a diary about their daily Facebook usage and then interviewing these users regarding their Facebook use. The study identified three functional regions in Facebook where the purposes of the interaction with the platform are different. These regions consist of a performance region, an exhibition region and a personal region. The performance region is used for presentation of recent and context-specific data about oneself. This is done mainly for reasons of impression management. The exhibition region is used for long term self-presentation in which users curate material posted previously. Finally, the personal region is used for archiving personal content. By dividing the interactional purposes of Facebook usage into these three regions, Zhao et al. (2013) show that both space and time are components of how Facebook is used. For instance, the passage of time is one of the factors that shifts posted data on Facebook from the performance region to the exhibition region and eventually to the personal region. Many users in the study of Zhao et al. (2013) also felt it was strange when friends on Facebook interacted with posts that they considered old, which again shows that the time component is an important indicator to acceptable interaction on Facebook.

One observation from Zhao et al. (2013) that is of significance for this study is that users create strategies for managing their material on Facebook for self-presentation purposes. One of the most commonly mentioned types of content which needed the most attention was emotional content, especially in the exhibition region. When emotional content was first posted, in the performance region, it often seemed relevant and purposeful. However, after the context of time and relevance had passed and the content passed into the exhibition region it might become undesirable for the self-presentation of the user. Also, another reason for
managing emotional content was the fear of how others might interpret the content. To quote one of the participants:

“I was in a certain mood right then and I posted something ... I went back and read it I realized that people probably wouldn’t take it sarcastically. That’s so hard about communicating online, is people can’t tell ... your emotion behind stuff.” (Zhao et al., 2013, pp. 5)

The studies that have been brought up in this section show that use of social networking sites is a complex matter. To sum up the studies of Seidman (2013), Oldmeadow et al. (2013), Chen and Marcus (2012), and Zhao et al. (2013), the use of Facebook specifically, and to some extent social networking sites in general, can be based on personality traits of users, attachment styles, needs of belonging (including aspects of self-esteem and self-worth) and self-presentation (including aspects of selective self-presentation), and context (including context of time, and contexts of individualism and collectivism).

2.2.3 Alternative forms of expression in social media

In addition to research dealing with user behavior in communication and interaction on social networking sites, there are studies researching new ways for users to communicate and self-express. An example of these studies is provided by Kim and Lim (2012) who developed a web based social networking prototype called iSpace. The idea behind iSpace is to let users customize interactivity for self-expression instead of the traditional approach of customizing visual elements for self-expression. The authors argue that interactivity is a way to represent ones uniqueness and personality, and that interactivity expressions can elicit abstract emotional experiences. They also argue that interactivity can effectively be used for self-expression and keep the visual design of social websites to a minimum.

The graphical interface of iSpace is based on Facebook and many functions from Facebook are incorporated into iSpace. These functions are the profile wall where users post content, the ability to comment on posts, the ability to send friend requests (which can be done by dragging another user’s icon to a group icon) and to “poke” other users. In addition to these functions, iSpace also incorporates four interactivity customization options for the desktop mouse, which are to be customized by users. These options are cursor response speed, response threshold for the “poke” button, the amount of drag required to send a friend request, and the speed and gravity of scrolling on a user’s profile wall. Kim and Lim (2012) let users test iSpace for two weeks both with and without interactivity customization options. The user study showed that even simple mouse interactivity options allowed users to effectively self-present and self-express to other users. The study of Kim and Lim (2012) shows that interactivity customization can be effectively used as a tool for self-representation in social
networking sites when there is a need to keep visual elements to a minimum. When designing for mobile phones, which have small screens, keeping visual elements to a minimum is important. Therefore interactivity customization could be a possible tool to use in interaction design for mobile phones.

One form of emotional expression often used in computer mediated communication in general, and social media in particular, is emoticons. Emoticons, which are illustrations of facial expressions, can be put into text communication as a way to add emotional cues. In face-to-face communication, there is nonverbal communication present, in addition to verbal communication, serving three basic purposes: providing information, regulating interaction and expressing intimacy. These nonverbal cues are lacking in communication mediated over computers, hence the use of emoticons is compensation for this lack (Derks et al., 2007; Benyon, 2010). Derks et al. (2007) investigate in what social context people use emoticons, both in terms of the valence of the emoticons (positive and negative) and how often emoticons were used in combination with text. The study used short Internet chats that varied in terms of social context, from task-oriented to socio-emotional, and valence, from positive to negative. The chats were presented to participants, who were school students, where they had to reply to the chats using either text, emoticons or a combination of both. The study found that the participants used more emoticons in socio-emotional contexts than object-oriented contexts. The participants also used more positive emoticons in positive contexts and negative emoticons in negative contexts. Comparisons were also made with combinations of type social context and valence, and it was found that in negative and task-oriented contexts participants the least amount of emoticons were used compared to other combinations of contexts. The study of Derks et al. (2007) provides two important indications. The first indication is that emoticons are widely used in many social contexts, both positive and negative. The second indication is that use of emoticons differs in both valence and amount depending on social context of the situation.

2.3 Touch-screen interaction design

Multi-touch interaction design as a research field is still rather new, and while research into specific areas of multi-touch interaction has increased, a standardization for multi-touch interfaces and gestures has yet to be created (Ingram et al., 2012; Derboven et al., 2012). In this section a review of the works of Ingram et al. (2012), who attempt at establishing a framework for intuitive multi-touch interaction design by conducting a literature review of papers on multi-touch interaction, and Derboven et al. (2012), who approach multi-touch interface design using semiotic analysis, is made. Both these studies offer useful guidelines regarding multi-touch interaction for this thesis project, which will be presented in this section.

In their study, Ingram et al. (2012) review current literature on multi-touch interaction. The results of this review are threefold: Establishing current trends regarding what researchers and
users regard as intuitive multi-touch interactions, finding five factors that need to be considered when designing intuitive multi-touch interaction, and what problems that need to be addressed in future multi-touch interaction research. Ingram et al. (2012) found that both developers and users consider one-finger touch and drag gestures to be the most intuitive gestures and that these gestures should be used for selection and movement of objects. They also identify five factors that should be considered when designing multi-touch interactions:

1. Direct manipulation – This is interaction that is defined as physical and performed on continuously represented objects. Direct manipulation interactions mimic the natural laws of real-world interactions by acting physically upon objects over time. Since direct manipulation uses physical touch gestures, the need for extra interaction devices is eliminated, hence making the interaction process simpler. By mimicking natural real-world physical behaviors, direct manipulation knowledge is almost instinctual in users and this knowledge is universal across cultures. Common multi-touch gestures, such as moving, resizing, and rotating, are examples direct manipulation gestures.

2. Physics – Direct manipulation depends on the interaction with the objects in the multi-touch interface to a large degree resembling the natural interaction with real-world objects. Users tend to associate large gestures with large interactional outcomes, much like in the real physical world. For example, Ingram et al. (2012) cite a study where users expected large-scale outcomes from larger hand gestures and small detail-oriented interactions from smaller gestures. Additionally, users associate the speed of their gestures to proportionally affect the speed of the movement of the objects that they are manipulating.

3. Feedback – This is an important aspect for good intuitive multi-touch interaction. Lack of visual and other forms of feedback feels unnatural to users and can cause confusion. Feedback can be used at all stages in a multi-touch interaction: Before the interaction to provide cues of the possibility to interact with the object, during the interaction to indicate that progress, and after an interaction to indicate that the interaction is completed.

4. Previous experience – Knowledge of the physical world is not the only kind of knowledge that is useful for users regarding intuitiveness. Previous experience with multi-touch interfaces helps users learn new multi-touch interactions faster. It is also possible to utilize users’ experiences with other types of technology, such as computers (for example double-clicking or right-clicking with a mouse), even though this type of interaction is not based on direct manipulation. Previous experience is important for multi-touch design because the interaction should not contradict users’ expectations.

5. Physical motion – Users universally prefer, based on studies reviewed by Ingram et al. (2012), using as little effort as possible when making gestures. Additionally, users prefer to use one-finger touches instead of multiple fingers, one-handed gestures
In addition to finding what researchers and users think is intuitive multi-touch interaction design, and providing the five points designers should consider, Ingram et al. (2012) also provide problems that need to be addressed in multi-touch interaction design. The authors identify two specific issues which need to be addressed in future research. The first of these issues is that multi-touch interactions need to be considered in the context of other interactions, especially when the need for more intuitive interactions is greater than the availability of direct manipulation gestures or when there is a need for abstract interactions, which are the opposite of direct manipulation interactions. Ingram et al. (2012) recommend that when designing for these types of multi-touch applications to use one-finger gestures for the most intuitive interactions, such as selecting and moving objects. The authors also recommend reusing these gestures for more than one interaction outcome in order to limit the learning requirements for the users. Abstract interactions and less intuitive interactions can be implemented by using menus and buttons. The second issue in multi-touch interaction design brought up by Ingram et al. (2012) is the lack of research evaluation in realistic environments and that evaluation of multi-touch research is often performed on statistically insignificant numbers of users.

A different approach to providing guidelines for designing multi-touch interfaces is provided by Derboven et al. (2012). As with Ingram et al. (2012), the motivation for their research, according to Derboven et al. (2012), is the lack of standardization for multi-touch interaction design. In their study they attempt to create guidelines for multi-touch user interfaces through the use of Semiotic Engineering. This is an alternative theoretical approach to HCI, which is applied by studying sign systems processes of interfaces. Semiotics as a general research area is the study of signs and their function (Derboven et al., 2012; Benyon, 2010). The idea of Semiotic Engineering is that user interfaces are viewed as metacommunication artifacts through which designers send messages to users. In this way the system contains all the meanings that designers want to provide users. These meanings need to be interpreted and understood by the users in order for them to use the system (Derboven et al., 2012).

As a case study, Derboven et al. (2012) developed a tabletop multi-touch platform called MuTable, which includes a number of applications meant to be used in public spaces, such as schools and museums. The MuTable system was tested by a number of school kids whose task was to create a presentation using MuTable in 45 minutes. Through this case study, Derboven et al. (2012) present four important guidelines when designing multi-touch interfaces:

- Adapt to the user – the interface should allow users to explore it freely without the interruption of user guidance messages from the system. The explanation for this reasoning is that user exploration allows users to find new and creative ways to interact with the system in order to solve problems. However, user guidance should be provided when it is required by the user. According to Semiotic Engineering, the interface needs to communicate all of the designer’s intents and messages. If for some
reason the communication between the interface and the user breaks down, help needs to be provided to the user from the interface.

- Explain gestures – The user guidance of the interface should explain what multi-touch gestures are available in the system. This is especially needed when there are similar gestures which execute different interactions, for example dragging with one finger or multiple fingers may be different interactions in the system. The number of gestures used in the system should be simple and kept to a minimum. Furthermore, when more complicated gestures are necessary, they should be explained in detail, preferably in a non-obtrusive way, or an alternative more common and familiar form of interaction should be offered to the user. An example of a more common form of alternative interactions is buttons. This guideline is similar to the suggestions given by Ingram et al. (2012).

- Explain functionality – The user guidance of the interface should explain the functionality of the system when necessary. For the most part multi-touch interfaces build upon analogies of real-world knowledge, which was also pointed out by Ingram et al. (2012) as requirement for intuitive multi-touch interaction design. However, these real-world analogies often break down. When this occurs, the system needs to explain the exact functionality of interface in order for the user to understand it.

- Explain the user interface language – Multi-touch interaction design does not have the same rich heritage of standard conventions as traditional WIMP-based\(^1\) interfaces do. Even if standardized WIMP conventions are used in a multi-touch interface, it does not necessarily mean that it will be just as understandable for the user. Therefore, it is important that the conventions used in the multi-touch interface are explained to the user by the system.

There is yet to be a standardized way of providing users of multi-touch interfaces non-intrusive instructional guidance. The balance between free user exploration and provision of user guidance is fine (Derboven et al., 2012). This balance is something that needs to be determined for each individual multi-touch interaction system.

In their study Bragdon et al. (2011) set out to find the design space of single-handed touch gestures for mobile devices. They explore this design space by testing different moding techniques and gesture types. Moding techniques are various methods used to switch into different modes on the mobile phone. The moding techniques that were evaluated by Bragdon et al. (2011) were hard button-initiated gestures, bezel gestures and soft buttons. These moding techniques are used to enter gesture mode where users perform a specific touch gesture to perform a task. The gesture types that were evaluated were mark-based gestures and free-form path gestures. These moding techniques and gesture types were combined, as illustrated in Figure 3, to form command invocation techniques which can be used to perform various

\(^1\) Window Icon Menu Pointer (Ingram et al. 2012; Derboven et al. 2012)
tasks. These techniques were user-tested in mobile environments where situational impairment was induced in order to see how well these different techniques could be performed in mobile environments. More specifically, the command invocation techniques were tested with regard to two situational impairment factors: motor activity and distraction level. Motor activity was examined by having users perform the command invocation techniques while sitting and walking. Distraction level was examined by having either no distraction, light situational-awareness distraction or attention-saturating distraction. The findings of Bragdon et al. (2011) showed that gestures could effectively be made eyes-free without having to look at the phone, in contrast to soft buttons were users had to look at the phone 98.8% of the time. Additionally, the tasks with light-situational distraction and attention-saturating distraction were all significantly improved for bezel marks than soft buttons. Hard button marks and bezel paths also performed better than soft buttons, which shows that gestures can reduce attentional load compared to soft buttons. Users also preferred gestures for all environments instead of soft buttons, except for direct usage where half of the users preferred soft buttons. Based on these results, Bragdon et al. (2011) present six design recommendations, which are taken directly from their paper (Bragdon et al., 2011, pp. 411):

- **R1**: Gestural shortcuts/alternatives should be provided for soft button commands.

- **R2**: Users should be able to assign gestures to common action sequences, e.g. “Run Phone App, Call Home” or “Run Media App, Play Classical Playlist” to make them eyes-free. The system could potentially identify such interaction patterns and automatically assign gestures to them.

- **R3**: Mark-based gestures are faster and more accurate than free-form gestures in all the mobile environments tested, so they should be used instead of free-form path gestures unless 2D operands are required.

- **R4**: We recommend bezel moding for design purposes as bezel marks have nearly identical performance to hard button marks; however, users preferred bezel marks.

- **R5**: For space-critical applications, gestures could be used to save screen real estate.
• R6: Because moded gestures are unlikely to be triggered by accident, they could be used to unlock the phone and execute a command, thus eliminating an extra step.”

2.4 Design studies using mobile devices for emotional interaction

There have been quite a few design projects which have similar research goals as this thesis project. These projects present useful design guidelines.

Fagerberg et al. (2003) called for a user-centred approach when designing for affective interaction. The authors view emotion as something similar to the interactional approach to emotion by Boehner et al. (2007) where emotion is viewed as formed by social and cultural context and by interactions. Fagerberg et al. (2003) further add to this approach by saying that body movements can generate emotion and that body and mind are intimately connected. The authors create a model for creating affective gestures to be used in an interactive mobile application. This model is comprised of the circumplex model of affect defined by Russell (1980), which is used to analyze emotion and Laban’s Movement Analysis, which is language for describing the shape and effort of different movements. The result is a mobile messaging service where users write a text message and then adjust the emotional expression of the message through affective gestures based on the shape, effort (from Laban’s Movement Analysis) and valence (from the circumplex model of affect). The gestures are based on different hand pressure and shaking movements which are inputted on mobile phone’s screen. These emotional expressions are presented back to the user from the system by displaying the expressions in different colors, shapes and animations. To further obscure the emotional data, the user’s pulse is used to adjust the strength of the color that is presented back to the user. This utilization of ambiguity in the feedback from the system is to keep the interaction in line with the interactional approach to emotion, which states that affective systems should support interpretive flexibility, as stated by Boehner et al. (2007). One idea that is brought up by Fagerberg et al. (2003), which is also used in their mobile messaging application, that is of some to this thesis project, is the idea of the affective loop. This concept deals with how the emotional input from the user is presented back to the user and with this further affect the user’s emotional state. The method of design used by Fagerberg et al. (2003) is summarized in four design principles:

• Embodiment – embodiment of the actual physical interaction with the system and the embodiment of these interactions in the system presented back to the user

• Natural but designed expressions – designed expressions based on shape, effort and valence in order to resemble natural movements

• Affective loop – The system presents the user’s emotional interaction back to the user as feedback and so further affects the user’s emotional state

18
• Ambiguity – The feedback of the user’s emotional state is obscured in order to achieve interpretive flexibility

An example of affective mobile interaction design based on the informational model of emotion from Boehner et al. (2007) is provided by Park et al. (2010). They designed an interaction technique for mobile phone communication called CheekTouch. This interaction technique aims to facilitate more emotional communication while speaking on the mobile phone. CheekTouch uses multi-touch finger input to deliver non-verbal cues in the form of vibro-tactile feedback on the cheek. The reasoning for using vibro-tactile feedback, according to the authors, is because it does not disturb the verbal communication of speaking on the phone, and because it allows for the user to maintain the natural posture of speaking on the phone. While holding the phone against the cheek the user can provide multi-touch finger gestures on the back of the phone with the same hand that is holding the phone. These gesture inputs are then mapped by the phone to a predefined tactile pattern which is then delivered to the cheek of another user with whom telephone communication is used. Six different touch patterns are used in CheekTouch for the multi-touch gesture communication: Patting, slapping, pinching, stroking, kissing and tickling. Each of these patterns corresponds to a group of emotional meaning. For example, according to Park et al. (2010) patting can be used for comfort, love, farewells and for concentration. The examples of CheekTouch and the system developed by Fagerberg et al. (2003) show that by using different models of emotion (the informational model versus the interactional approach), different results in design will be apparent even if the goals of the systems are similar.

A design project with very similar goals to this thesis project is the PIXEE-system, which stands for Pictures, Interaction and Emotional Expression created by Morris et al. (2013). The purpose of PIXEE is to promote greater emotional expression and interpersonal connectedness in social media. Similar to this study, the PIXEE-system is built on users interacting with images on the biggest social media by using their mobile phones. However, in order to support greater interpersonal connectedness, the system is designed to display images captured by and shared from users’ mobile phones on large public display surfaces. PIXEE is meant to be used at events with large groups of participating people. The participants share images to the system by posting them on the social media services Twitter, Instagram and Weibo using a hashtag referencing the event. The shared images are projected onto one or several walls in the event where about 70 images are shown at any given time with thousands more picture available in a timeline. The projected images contain the caption text and user name of the posting participant. The images are given an emotional classification based on sentiment analysis performed by the system on the caption text. This emotional classification is manifested in the color of the frame of each image, see Figure 4. The researchers behind PIXEE modeled the interaction design with the interface of the system after modern smartphone usage in order to make the interaction as intuitive as possible for the users. The display surface of PIXEE responds to three types of gestures. The first gesture is swiping to allow navigation of archived images in the timeline. The second possible gesture is touching an image which made the image enlarge along with enlarging images with a similar
emotional classification. The final possible gesture is long touch on an image which makes it possible for users to change the emotional classification of the image. Both the sentiment analysis and emotional reclassification by users are based on the circumplex model of affect created by Russell (1980). For the sentiment analysis the system tried to find exact matches between the caption text and the sixteen terms mapped out in the circumplex model of affect. Additionally synonyms of these sixteen terms were added to the system as possible search patterns. These synonyms consisted of English, Chinese, Korean and Brazilian terms which are frequently used in social media. Lastly, emoticons and colloquialisms common to each of the cultures were added with mappings to the circumplex model of affect. The emotional reclassification interface consists of a two dimensional grid with sixteen cells. Each cell is associated with an emotion term and a color. The user moves an icon around in this two dimensional space in which the interface fills the center of the space with the color and term of the cell currently highlighted by the user. The emotion selected by the user then changes the color of the image frame to the emotion color chosen by the user. The colors chosen to represent the emotion frame were based on meanings and associations of colors and emotion in Western culture (Morris et al., 2013).

PIXEE was used over the course of seven months at nine events in six different countries. During this period of time the system was tested, and the design of the system was refined in iterations based on observations made during the events. In these iterations more functionality was added to the system. In the first iteration of the system the emotional reclassification interface did not contain axis labels or text describing the emotions. The selection of emotional state only changed the color of the interface. In this iteration the participants actively explored the different color options. However, it was not clear for the participants that the color selection represented selection of emotional state. Therefore the emotion terms and axis labels were added in the next iteration. Other features which were added in
subsequent iterations of testing were the addition of musical feedback for the emotional reclassification and the possibility to “peek” under photos to see their city of origin (Morris et al., 2013).

The functionality in PIXEE where users can reclassify the emotional state of images by changing the color of the image frames is similar in concept to the affective loop implemented in the affective mobile messaging service created by Fagerberg et al. (2003). After all, the purpose of PIXEE is to affect participants’ emotional states by using images and having them express these emotional states on the images. These expressions of emotions then have the possibility to affect other participants’ emotional states. Also, pictures in PIXEE can have an effect the original poster’s emotional state who will then reclassify the picture’s emotional classification. Specific examples of this are provided by Morris et al. (2013) and it furthers the idea that PIXEE utilizes a form of affective loop.

In a study by Vetere et al. (2005) different methodologies are explored in order to effectively study acts of mediated intimacy. In broad terms, their research methodologies consisted of conducting cultural probes combined with contextual interviews, focus groups and iterative designing of concepts. The study was divided into two phases where the first phase consisted of using a number of cultural probes that were given to six couples who were in long-term relationships. The cultural probes were used by the participating couples to document their acts of intimacy. The contextual interviews were conducted with the participants during the probe activities in order to discuss the use and collection of probe material. Also, at the end of the first phase focus groups were conducted with the participants. In the second phase of the study, workshops were conducted which consisted of brainstorming sessions, a design workshop with HCI-experts and participatory design workshops with the participating couples. The result of the second phase of the study was several concrete design ideas (Vetere et al., 2005). This kind of research design, where several qualitative methods are combined, proves useful for this thesis project. The reason for this usefulness is because, similarly to the research aim of Vetere et al. (2005), the aim of this thesis project is to design for previously unexplored design research areas in order to create concrete design ideas.
3 Methodology

In this section, the different methods used in this thesis are presented, and their use is motivated. Since this thesis project is of an exploratory nature, qualitative research methods were used. Qualitative methods are appropriate to use for studies where there is a need to describe and explain relationships and individual experiences. Qualitative methods are also appropriate when the study design is iterative and there is a need for flexibility in some aspects of the study, for example changing interview questions between interviews (Mack et al., 2005). The research is divided into two sections: the pre-study, which consists of the literature review and user study, and the design development.

The overall methodology used in this thesis project is inspired, to some extent, by the methodology adopted by Vetere et al. (2005) in their study of mediated intimacy. The authors adopted a two-phase design methodology, where in the first phase current practices were determined by using qualitative methods of cultural probes and interviews applied to the participants of the study. The second phase of the study consisted of design workshops with HCI-experts and the participants of the study. The end result of the study was several design ideas, some of which were developed into prototypes. This thesis study adopted a similar approach, where the first phase is the pre study, in which current practices are determined, and the second phase is the design development, which are based on design idea workshops based on findings from the pre-study.

3.1 Pre-study

3.1.1 Literature review

The literature review, which is provided in the Background section, was done continually during the thesis project. The purpose of the literature review was to find relevant theoretical models and design guidelines for emotional and expressive communication through touch gestures, mobile communication, and guidelines for finger touch gestures on mobile touch screens. In addition, studies of why people use social networking sites (with Facebook used as a specific example) and how they express themselves on these sites were presented. Examples of alternative ways to express emotion and intent on social networking sites (emoticons and iSpace) are provided. Also, design projects with similar goals as this thesis project were reviewed. These projects serve to show examples of possible design options, and to serve as inspiration for this project.

3.1.2 Pilot tests
The pilot study was performed in Mobile Life Centre facilities with three researchers from that organization as participants. The decision to do a pilot test before the user study was made because this thesis project is exploratory, and so there was some initial difficulty in determining test procedure methods and interview questions. For these purposes a pilot test is very appropriate (Rubin and Chisnell, 2008). The primary purpose was not to gain information about current practices. However some insights into user behavior were gained from the pilot test anyway, which are provided in the Result section of the thesis. During the pilot test the testing environment and procedure were very controlled. Structured interviews were used, which are interviews using only predetermined questions and follows wording exactly (Benyon, 2010). Random images taken from the Internet were presented on a smartphone with a touch screen with which users interacted by drawing marks on them using touch gestures. The participants were asked to imagine that the images on the smartphone were either posts from friends on a social networking site or posts that the participants themselves had posted. Because of the exploratory nature of the pilot test, third party software was used, instead of developing a prototype based only on assumptions on user behavior.

This section contained only some details about the pilot test because the purpose of it is mostly to declare that a pilot test was conducted to determine appropriate test methods and interview questions. A detailed description of the actual user tests are provided in the next section.

3.1.3 User study

After the pilot test, considerable changes were made to the test procedure. Interview questions were modified, and questions were added and others were removed. Also, changes were made from structured interviews to semi-structured interviews. Semi-structured interviews are very common to use in interaction design, and consists of prepared questions, which can be changed and reworded, and new questions can be added during the course of the interview. This allows for exploration of new topics and themes (Benyon, 2010). For these reasons the semi-structured interview method was more appropriate for the user study of the project than the structured interview method, because of the increased possibilities of exploration and interaction between interviewer and participant. The user observation part of the pilot test was also changed from using third party software for interaction, and random images to interact with. Instead, the participants used their own smartphones and the Facebook mobile application. This change was made because participants would in this case interact with content that held some sort of contextual meaning to them, instead of random images from the Internet which were taken out of context. The choice of using interviews and user observations as methods for the user study was because these are user-centred research methods in which direct participation from users is utilized (Gulliksen and Göransson, 2002). Also, these two research methods are among the most common qualitative research methods (Mack et al., 2005).
For the user study, two people who are active on Facebook (daily users) and experienced smartphone users were recruited among the researchers’ acquaintances. The first participant (Participant 1) was female, 22 years old and a resident of China who is in Sweden for exchange studies. The second participant (Participant 2) was male, 21 years old and a native resident of Sweden. Both participants were students at Kungliga Tekniska högskolan (Royal Institute of Technology) in Stockholm. At the start of each test the participant was seated at a table with their own smartphone. A video camera was placed close to the participant and zoomed in on their hands and smartphone. Another video camera was placed to film the entire room as the test progressed. A moderator sat beside the participant during the test and interviewed them about their interaction behaviors, see Figure 5 for an illustration of the experimental setup. In the first part of the test, the participant started the Facebook mobile application on their smartphone and was asked to perform tasks such as finding a friend’s wall on Facebook and asked to interact with some of their posted content. During this part of the procedure the moderator asked the interview questions to the participant. The second part of the test involved users reviewing 12 photos from the International Affective Photo System (The Center for the Study of Emotion and Attention, University of Florida, 2013). The participant viewed the images one at a time in a gallery on a smartphone provided by the researchers, which was a Google Nexus 4 running the Android 4.2 operating system, and could switch between them by using a one-finger horizontal swipe, which is the default gesture for navigating photos in the smartphone. The participant was then instructed to interact with images they found interesting, and express a comment on these images by using finger touch gestures of their own choice, without any visual feedback from the smartphone. The motivation behind this exercise was to find what gestures were the most intuitive for the participants. The user tests took about 50-60 minutes and during the entire test the participant had to use the so called think-aloud method. This user study method is another user-centred method which utilizes direct participation from users (Gulliksen and Göransson, 2002). The think-aloud method has participants continually verbalizing thoughts, ideas, assumptions,
expectations, hesitations and discoveries about the system as they are performing the tasks of the test. This method provides useful insights into participants reasoning and how they solve problems, which will show if the system works as intended by the designer (Gulliksen and Göransson, 2002; Benyon, 2010; Rubin and Chisnell, 2008). Note-taking was done during the course of the user tests and the videos of the tests were reviewed afterwards.

3.2 Design development

3.2.1 Design idea reflection and sketching

Shortly after the user study was done, the researchers of the project reflected on the results of the user study. During these reflection meetings, design idea sessions were performed and all the interface ideas were noted and made into simple sketches. The sketches were also made into digital sketches for documentation and presentational purposes. The tool used for the digital sketching was Adobe Illustrator Creative Suite 5.

3.2.2 Interaction designs

The interface ideas and sketches were reworked into interaction design scenarios in which descriptions are provided for how the interaction would work in the interfaces. The idea behind these scenarios is to showcase interaction options in terms of current mobile technology. They are also showcasing how the interactions can be used in a specific social networking site, which in this case is Facebook.

3.2.3 Design implementation

The functionality of some of the design ideas were implemented into simple web prototypes. The idea of these web prototypes was mostly to see if the functionality of the different design ideas could be implemented by using current mobile technologies, without any external sensors. In this section, the technical details of the prototypes will be explained and discussed.

The web prototypes were implemented by using the HTML5 canvas. The images that were used in the prototypes were loaded onto the canvas, which allows for interacting with the images using visual markers. For the gesture recognition, navigation through the web prototypes and animations triggered during selection, the JavaScript libraries jQuery Mobile and QuoJS were used.

Attempts were initially made to make these prototypes by using the Android Standard Development Kit, which is the toolkit used for making applications for the Android operating system. The reason behind this initial development decision was that making a an application
for the Android operating system would give full control and flexibility over which touch gestures can be implemented and the interactions that they trigger. Also, it was thought that this method of implementation of designs would provide easy means to implement visual elements and feedback. An Android-based application could also implement support to import Facebook information.

Some initial implementation of code for an Android application was made. However, the idea of implementing prototypes as Android applications was discarded in favor of web-based prototypes. From experience, web prototyping is faster than application prototyping because of the many existing JavaScript libraries and plugins which can be easily implemented into any web-based prototype. As such, there are JavaScript libraries that simulate native smartphone applications. For example, there are now JavaScript libraries that allow developers to utilize the vibrator in smartphones (Walsh, 2012). For the purposes of this thesis project there was a need for implementing different touch gestures that trigger different interaction outcomes. For this functionality jQuery Mobile was used for the most part, and to some extent also QuoJS. These JavaScript libraries provide built-in functions for simulating many different kinds of finger touch gestures. Some examples of these built-in touch gestures for jQuery Mobile are tap, double tap, press, swipe and finger drag movement (jQuery Mobile, 2013a). There are also built-in animations for transitional animations, such as fade in and out, and sliding. (jQuery Mobile, 2013b). Currently jQuery Mobile does not have any built-in support for multi-touch. However, there are other JavaScript libraries that have support for multi-touch gestures. QuoJS, for example has support for pinching, rotating with two or more fingers, and recognizing gestures executed with different numbers of fingers (QuoJS, 2013). One advantage to using different JavaScript libraries is that they can be implemented into the same web prototype where their unique functionalities complement each other in order to create a complete application. Testing the prototypes on smartphones is easier when the prototypes are web based, which only requires exporting the prototype to a server. This would make the prototypes available for all devices, mobile and otherwise, that have web browsers. For Android however, the application must either be exported to each smartphone via USB or distributed via Google’s Play service. Also, Android applications may not work on all Android-based smartphones since they run on different versions of the operating system.

Creating layouts for web prototypes are also easier make than for Android applications. While layouts in Android are formatted in Extensible Markup Language (XML), web-based layouts are formatted in Cascading Style Sheets (CSS). The difference lies in not only syntax but also how elements are treated. In the XML-based layouts of Android development, if some element needs to be altered in appearance or placement, then the change must be done to the XML structure. In contrast, CSS is used in combination with HTML, and when a change must be made, it is done in the CSS. The structure in the HTML is left as it is. The CSS is basically a list of how elements in the HTML should appear and where they should be placed. CSS can also work with XML-based languages (Harold and Means, 2004). However, they are not possible to use in the XML-layouts in Android applications.
The HTML5 canvas is optimal to use for the purposes of this thesis project. It offers possibilities to load images with which there are a wide variety of interaction options. There are both built-in interaction options, such as drawing certain shapes (rectangles, circles etc.) on the canvas, and interaction defined by developers. The HTML5 canvas also works in combination with JavaScript and CSS making it possible to develop web applications that are similar in functionality to native applications.
4 Results

In this section, the results of the design study are presented, from the user study, to design idea sessions and sketching, to interaction design descriptions. This section is structured in the following way: first the results from the user study are presented. Then, all the different design ideas are presented and described, and the interaction design of each idea is explained in detail. Sketches and images of the design ideas are provided for each idea. Some of the design ideas are based on the user study and some are based on findings from the literature review. The purpose of the different design ideas is to showcase interaction based on different parameters. Note that the design ideas are presented with no specific order in mind. Also, in this section of the report only the pure functionality of the design ideas are described. The design choices and their motivations are explained in the Discussion section.

4.1 User study

4.1.1 Pilot test

As mentioned in the Methodology section, some useful insights into user behavior were gained from the pilot test, which are presented in this section. In the pilot test there was a large amount of reluctance from the participants to interact with the images that were provided, and uncertainty of what gestures to use because of the uncertainty of the interactional outcome and lack of visual feedback of drawing marks. Also, since the random images did not have any contextual meaning, it was hard for participants to express responses to the images. Also, the participants thought that drawing marks directly on the images would ruin the aesthetics and meanings of the images, especially if they had been posted by friends.

4.1.2 User tests - Facebook usage

The lack of ability to express oneself when a clear social context was missing (even though an imaginary scenario was provided) with regard to the randomly taken images in the pilot test brought forth a change in the test procedure for the user tests. Therefore, participants in the user tests had to use their own smartphones and their own Facebook accounts, see Figure 6. Participant 1 started using Facebook recently (less than a year ago) when she came to Sweden from China, and is more experienced in using social media focusing on video and music. The motivation for Participant 1 to use Facebook was stay connected with her friends back home and also to share her activities with her friends. Participant 1 uses the mobile Facebook application more than the Facebook website, and uses Facebook on her smartphone as a way to pass the time, for example while on the subway.
Both of the participants often used the “Like” button on Facebook. Participant 1 used the “Like” button often as a way to show support for her friends and as a way to acknowledge that she had seen her friends’ posts. Also, for both participants, using the “Like” button was preferred in most cases in favor of commenting on posts because it is easier and faster to perform. For Participant 1 the “Like” button was not too general with regard to communicating specific intentions. For both participants the “Like” button was seen as a good enough way to interact with others’ Facebook posts because it often expresses positive feedback with intent clear enough to be interpreted correctly by the original poster. However, both participants felt that the “Like” button in some cases was too ambiguous, and using it in such cases might cause confusion or misconceptions with regard to the intentions of the participants. In these cases the participants would rather comment on the posts in order to communicate their intentions as clearly as possible. When posting content on Facebook, Participant 1 sought to get exclusively positive feedback from her friends.

Participant 1 rarely used emoticons when writing on Facebook, and Participant 2 never used emoticons. The reason for Participant 2 not wanting to use emoticons was because writing is the most expressive alternative when communicating on the Internet. Trying to be as expressive as possible through writing text, according to Participant 2, produces more serious communication in terms of expressing emotion compared to using emoticons. When asked for possible finger gestural options to interact with friends’ images on Facebook, Participant 1 took some time to think and then said out loud that she would really like to use the “Like” button. After a while, Participant 1 gave as gestural alternative drawing marks on the pictures in the form of smiles, stars and hearts. Drawing marks on images was the only real alternative for Participant 1 with regard to finger touch gestures. When asked if the “Like” button and commenting were the only necessary interactional alternatives, Participant 1 said that she would like more buttons in addition to the “Like” button. These buttons, according to
Participant 1, should have clear and unambiguous emotional values. Participant 1 wanted more buttons for interaction because they would be quicker to use than commenting. Since Participant 1 preferred to use the “Like” button in favor of commenting whenever possible, increasing the number of button options would minimize the amount of posts where commenting is necessary. Also, Participant 1 preferred to communicate with face-to-face with other people instead of communicating through Facebook. The reason for this was that Participant preferred the efficiency of face-to-face communication over the asynchronous nature of Facebook.

At first glance, Participant 2 thought it was difficult to interact directly with images in the scrollable Facebook news feed since the screen of the smartphone reacts to all the finger input. Participant 2 thought it would be easier to first select the image by tapping it on the screen, which is a built-in function in the Facebook application. This is also referred to as moding (see section 2.3 Touch screen interaction design in the Background section). This selection highlights the image out of the news feed into a static page where finger touch gestures can be used. In similarity with Participant 1, the alternatives for finger touch gestures for interaction suggested by Participant 2 were drawing marks on pictures and using heart symbols. Also, Participant 2 suggested highlighting interesting parts of pictures.

4.1.3 User tests - Finger touch gestures on images

During the second part of the user tests the participants were asked to look through images provided on a smartphone and only use finger touch gestures to comment on images of their choice, see Figure 7 for a screenshot of this part of the test. Participant 1 found it difficult to use only use finger touch gestures to express specific comments on the images. The reason for

Figure 7 – A screenshot from the video of the user test of Participant 2 where expression through touch gestures are given by the participant on the IAPS photos.
this is that Participant 1 often wants to ask questions when commenting on other friends’ posts, which is was especially difficult to perform exclusively with touch gestures. The finger touch gestures used by Participant 1 on the IAPS images were grounded in two directions: positively valenced gestures and negatively valenced gestures. More specifically, Participant 1 wanted to use a swiping gesture with her thumb up to signal that she liked an image, and swipe down to show that she disliked the image. In return, Participant 1 wanted the system to present a smiling face back as visual feedback as a way of thanking the participant for the gestural input. Other gestural inputs made by Participant 1 were drawing smiling faces, hearts and check-hooks on the images.

In this part of the user test Participant 2 often highlighted parts of the images that he found interesting by dragging circles around the interesting parts with his thumb or index finger. Highlighting parts of images was the preferred way of interacting with images using touch gestures for Participant 2, especially when no visual feedback was given. Participant 2 often chose to interact with images depicting a person or several people, and chose to highlight facial features, as can be seen in Figure 7. When asked what sort of visual element would best represent the highlight, Participant 2 responded that a glow effect or a heat map based finger imprint on the highlight was preferable. Similar to Participant 1, Participant 2 also suggested that drawing hearts on images to show support for the image as an interactional alternative. According to Participant 2, drawing hearts, and other symbols, on images represents specific emotions. This feature was favorable to Participant 2 since the affective interaction should represent real-life behavior. Another suggestion provided by Participant 2, which is also similar to a suggestion by Participant 1, was to use the thumb to vertically drag up or down to express attitude toward the image. However, unlike the suggestion from Participant 1, where there is only two interactional options (swipe up for “Like” and swipe down for “Dislike”), the suggestion from Participant 2 involves a continuous scale, from top to bottom, with several options. Participant 2 thought it is important for a system that implements finger touch input to ask questions to the user in order to make sure that the interactional outcome of the touch input is correct.

4.2 Design ideas

4.2.1 Design idea 1 – Swiping and dragging up/down

This design idea is based on the responses from the participants of the user study who interacted with IAPS images by using sweeping motions with a finger on images. Also, this design idea is based on the participants of the user study preferring to use buttons on Facebook in favor of commenting due to simplicity and efficiency, and seeking after more emotional buttons.
At first, the user needs to select the image to interact with by tapping on it once. This initial interaction will highlight and separate the image from the rest of the content in order to make it possible to interact with this image, and not with any of the other posts. This sort of action is referred to as moding by Bragdon et al (2012).

There are two somewhat different approaches in which the interaction of this idea can be implemented. The first approach is to only have two interactional outcomes: a positively valenced outcome, for example liking an image on Facebook by swiping up, and a negatively valenced outcome, for example disliking an image on Facebook, by swiping down. For each image, information about the number of people who like and dislike an image is given below the image, similar to how information about the number of people who like an image is given on Facebook, see Figure 2. The functionality of this approach was developed into a web prototype (Figure 8) where at first an image is selected. The user can then swipe up and get a thumb up as feedback or swipe down and get a thumb down as feedback. The swipe up and down functionality, which does not have support in jQuery Mobile, was possible to implement by using QuoJS. The image of the thumb was retrieved from Facebook’s brand resource web page.

The second approach is to have a continuous scale of emotional words, from which users can select the emotional word most appropriate to their feelings toward an image. This vertical scale of emotional words would be neutral in the middle, positively valenced when dragging in the upper half of the image and negatively valenced when dragging in the lower half of the image. Also, the level of arousal of the emotional words is determined by how high or low the user sweeps or drags on the image. As the finger drags in a direction the emotional word in the scale in closest relation to the finger appears next to the finger as feedback to the user, see Figure 9. As seen in Figure 9, in this approach the vertical scale is shown when the finger is in contact with the image. The vertical scales in these two different approaches are based on the circumplex model of affect, except for this design idea there is only one axis for both valence and arousal. In order to maintain simplicity in the interface and efficiency in communication, and to prevent cognitive overload, the number of emotional words should be limited to a specific number. In HCI, the number of items that the human short-term memory can store id
often considered to be around seven plus-minus two items (Benyon, 2010). Therefore, the number of words to use in this design idea should be six or eight, using three or four positive words and three or four negative words. The information about what emotional words people have used for an image is placed to the side of an image. This information is manifested in a vertical scale with a marker placed at the emotional average of all the touch gesture responses to the image, and also with the emotional word of the average showing, see Figure 10.

**4.2.2 Design idea 2 – Highlighting parts of images**

This design idea is based on the behavior of Participant 2 from the user study, who highlighted parts of images by dragging circles around the parts which were interesting. As with Design idea 1, at first there is a moding need, in which an image is selected by tapping it.
with a finger. After that, there are a number of approaches in which this design idea can be made both in terms of different finger touch gestures and visual elements. The simplest approach is to highlight parts of images is to let users drag circles around interesting parts of images using a finger. When the user releases contact with the screen, the system will draw a circle around the area that user marked, see Figure 11. The circular marks can have different colors and thickness depending on user preference. The number of options should, for the same reasons that were specified for Design idea 1, be limited to six to eight options.

Another approach is to leave an imprint on images by holding a finger or thumb on the interesting parts of an image for a longer period of time. These imprints can be represented, in terms of visual elements, by a glow effect or a heat map imprint, which was suggested by Participant 2. The size of the imprints is determined by the duration of contact maintained between fingers and image. The shapes of the imprints can be implemented in different ways. Simple shapes, such as circles and ellipses, are built-in functions in HTML5 and can be implemented easily. Custom and complex shapes require implementation of mathematical
functions, for example Bézier curves, which correspond to the desired shape. A web prototype was made using the built-in circle shapes in HTML5, where the color of the glow effect can be chosen by the user. However, the prototype only supports tapping interesting parts of images to apply a glow effect, and does not support holding fingers on images to increase the size of the glow effect, see Figure 12.

For the glow effect the color of the glow can differ based on user preference. In accordance with the requirements of simplicity and efficiency, and other reasons which will be brought up in the Discussion section, the number of colors to choose from is eight.

For the heat map finger imprints, the colors used for the imprints will differ based on how long the user has finger contact with an image. The longer the user has contact with the image the color of the imprint will go from red to yellow to blue.
In order not to maintain the aesthetics and meanings of the original images in which highlighting of interesting parts have been made by other users, users can view all the gesture interactions in layers. With this function, users can choose to view whichever previous interactions they want, including none at all (meaning viewing only the original image).

4.2.3 Design idea 3 – Changing color of frames

This design idea is based on the PIXEE-system by Morris et al. (2013) in which emotional classification of images is determined by the color of the frame around each image (Figure 4). As with the previous design ideas, this idea starts out by the user selecting an image to interact with. After that, the user can select an emotional classification word in a similar way to the PIXEE-system. The user can choose between sixteen emotional words that are placed in a two-dimensional coordinate system that is based on the coordinate system of the circumplex model of affect. The interface for the selection of the emotional words consists of two axes, where the horizontal axis represents valence of emotion and the vertical axis represents arousal. The interface is placed on top of the selected image, and can be activated in two ways. The first way to activate the interface is to hold a finger or a thumb against the image and the second way is to press a button underneath the image. When the emotion word selection interface is activated, the user can drag a finger around in a circle in the coordinate system of the interface. When this gestural interaction is being performed, the emotional word most appropriate to the position of the finger is displayed next to the finger. Also, as the movement of the finger changes the emotional word, the frame around the image changes color to the color that is associated with the emotional word, see Figure 13. When the user has chosen the word and frame color that feel the most appropriate, they release their finger from the image on the screen. Before sending the user’s interaction to the networking site, a confirmation box appears in which the user must confirm the interaction in order to complete it.
Each individual image on the networking site will have a color frame where the color of the frame is determined by the average value of color from all the gestural interactions for the image. The valence of the emotional word decides the color and the arousal of the emotional word decides the brightness of the color.

### 4.2.4 Design idea 4 – Categorical tags

This design idea is based on the preference of Participant 1 from the user study to use buttons in favor of commenting when interacting on Facebook. It is also based on the use of emoticons and other symbols, such as hearts, to convey emotion in communication on the Internet, as described by the participants of the user study, and from the study of Derks et al. (2007).

When the user selects an image to interact with, tags appear at each side of the image in the form of half-circles. The number of tags is four, meaning there is one tag for each side of the image, see Figure 14. These tags are buttons, which open up categorical menus of various interactional options when pressed. These interactional options can vary depending on user preference, where users can customize what each tab should contain. This approach has full flexibility for users to select the interactional options of their choice. The options can be

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**Figure 13** – Illustration of the frame color design idea where the user can select an emotional word and frame color by moving the finger around in a coordinate system similar to the circumplex model of affect.
anything from the other design ideas to a variety of emoticons to various other emotional buttons and symbols.

4.2.5 Design idea 5 – Drawing marks

This design idea is based on responses of the participants of the user study where both participants suggested that drawing marks on images were the best ways to represent finger touch input on mobile touch screens.

This design idea is the simplest of all the ideas specified in this thesis project. The user first selects an image to interact with. After that the user selects a color and thickness for the marks and can then draw marks on the image. The number of colors to choose from is, for reasons similar to Design idea 1 and Design idea 2, limited to six to eight colors. Before the gestural interaction is sent to the image, the user must confirm the interaction in order to send it, similar to Design idea 2. Also similar to Design idea 2, the users can view the interactions in layers.
5 Discussion

In this section, all the design decisions of the design ideas in the Results section are explained and motivated with regard to the studies and guidelines from the literature review in the Background section. Also, the research questions of the thesis are discussed in this section, one at a time, with the findings in the Results section in consideration.

5.1 Design ideas

5.1.1 Image selection

The one feature shared by all the design ideas is the selection of an individual image by tapping it with a finger. This moding is necessary since the social networking application needs know with which content the user interacts with. This is especially true for networking applications where all the content is initially displayed in a scrollable feed, such as the news feed in Facebook, where all the touch input is registered and movement is executed. This interactional aspect was pointed out by Participant 1 in the user study. As stated in the Background section of this report, the study of Bragdon et al. (2011) showed that moding techniques using gestures reduced attentional load compared to soft buttons, and could be performed successfully eyes-free. Indeed, in the study of Bragdon et al. (2011), gesture-based interaction was preferred in all but one case, which was direct usage. In the case of direct usage, half of the users of the study preferred soft buttons. For the purpose of this thesis, where the focus lies on direct usage, being able to successfully select an image eyes-free is quite irrelevant, since the user, when interacting directly with the phone, presumably desires to look at the screen of the mobile phone. It is worth to note that soft buttons utilize one-finger touch gestures. Since soft buttons were preferred for direct usage, and it is already the moding technique used in the Facebook application, in which the image itself can be seen as the soft button, the selection of images in the design ideas in this thesis study is based on selection in the Facebook application. The use of soft buttons is also motivated by the guidelines provided by Ingram et al. (2012) and Derboven et al. (2012). Ingram et al. (2012) explain that both developers and users consider one-finger touch and drag gestures to be the most intuitive, and that these gestures should be used for selection and moving objects since these are the most common direct manipulation interactions. Other interactions that are less common and more abstract can utilize buttons and menus. Derboven et al. (2012) suggest that buttons can be used as an alternative interaction to gestures. The Facebook mobile application is a good example where the guidelines of Ingram et al. (2012) and Derboven et al. (2012) can be seen. One-finger touch for selection and soft buttons are the most common features of the Facebook application, and this is true for more than just selecting images. Therefore, the use of one-finger touch for selection is used in all of the design ideas in this study.
5.1.2 Design idea 1

For Design idea 1, there are two different interactional approaches. The first approach is to swipe up or down on an image to give a thumb up or thumb down. The main reason for using these gestures was from the feedback of Participant 1 in the user study. However, using this sort of gestures is also supported in the literature of the Background section. Derboven et al. (2012) suggest that the number of gestures should be kept to a minimum and that the gestures used should be kept as simple as possible. Bragdon et al. (2011) suggest that mark-based gestures are more accurate and faster to perform than free-form gestures and therefore recommend mark-based gestures. It is worth to note that the aspect of efficiency when communicating on Facebook was an important factor for both participants of the user study. According to the guidelines of Ingram et al. (2012), users prefer to make as little effort as possible when gesturing. Also, as already mentioned, one-finger touches are preferable to multi-finger touches, and fast and small gestures are favored instead of larger gestures. Ingram et al. (2012) also explain that intuitive direct manipulation interaction requires that the interaction on the touch screen resembles interaction in the real physical world. The swiping gestures of this approach meet all the requirements of the mentioned guidelines. The gestures are simple, kept to a minimum, efficient, mark-based, one-finger, and small and fast. Also, when performed with a thumb, the gestures resemble actually physically making a thumb up or down. This is also an example of “natural but designed expressions”, which was one of the guidelines by Fagerberg et al. (2003). The visual feedback, which is an important aspect for intuitive touch interaction according to Ingram et al. (2012), in this approach, is simple and based on already existing metaphors in Facebook. The thumb up icon in Facebook represents the “Like” button, which is a positive symbol. Therefore, the natural counter-symbol is the thumb down, which is represents “Dislike”. This set of metaphors was also suggested by Participant 1.

The second approach employs a vertical scale in which users can select between six to eight emotional words to express their feelings toward an image. This interaction is done by dragging a finger up or down the vertical scale. Half of these emotional words are positively valenced and the other half is negatively valenced. This second approach is not as simple as the first one in terms of gestures, visual feedback and previous similarity to Facebook. However, this approach offers more emotional interactional options, which was a suggestion from Participant 1 from the user study. The choice of emotional words can vary depending on the social networking site and its specific purpose. Considering Facebook as case study, the emotional words that could be used, if this interactional approach was to be implemented, could be based on the emotional words that were recently added to the Facebook platform in the form of feelings. Both of the approaches could potentially be used with dynamic forms of media, in addition to the static format of images, such as videos. This is possible since the gestures are not used to interact directly with image, unlike the interaction in Design idea 2.

There is another interesting aspect not yet discussed in this thesis project that could contribute to decide which emotional words can be used. This aspect is the pressure of the human hand
on a mobile phone. This interactional aspect was not brought forth in the literature review of the Background section because pressure sensors are not a standardized feature in mobile phones on the market currently. The limitations of this thesis project prevent consideration of sensors that are not already common mobile phone features. However, this does not prevent discussion of future possibilities as mobile phones get more sensors, and therefore more possible interactions. Also, for the case of pressure, there are alternative ways to access pressure information on a mobile phone without adding external sensors to the mobile phone. An example of this is provided by Heo and Lee (2011), who in their study developed a new type of gestural input for mobile touch screens, called ForceTap. This new input method can differentiate between a gentle tap, which is basically a generic one-finger touch event, and a strong tap (a ForceTap), in which the user adds more force to the tap gesture. This differentiation is made by using accelerometer data, which is a common feature on most mobile phones. When a user taps the screen of a mobile phone, the mobile phone briefly moves in the direction of the force of the tap movement. For a mobile phone with ForceTap implemented, this movement can be measured by monitoring the acceleration of the mobile phone in the direction perpendicular to the screen of the mobile phone (Heo and Leo, 2011). Another study, by Stewart et al. (2012), explores how movement and sitting can have an effect inadvertent variations in hand grip pressure on a mobile phone, partly by using accelerometer data. This study showed that grip pressure is related to movement. Shanabrook et al. (2012) implemented a mathematical problem-solving application for the iPad tablet, which uses the touch input as a predictor of effort and affective state of users. This application predicts effort partly based on accelerometer data as pressure data in the iPad. If access to the pressure data of the hand on the mobile phone had been a common feature, then this data could be used by the networking application to select what emotional words from which the user can choose when interacting with others. This is a way of adding dimensions of both ambiguity and affective loop, both of which are design guidelines for creating affective systems provided by Fagerberg et al. (2003).

The use of negatively valenced metaphors and symbols creates some problems for the purposes of self-presentation on Facebook. The study of Zhao et al. (2013) show Facebook can be seen as performance and exhibition regions used for impression management by users. Also, the studies of Seidman (2013) and Nadkarni and Hofmann (2012) showed that use of Facebook was related partly to high neuroticism in users, who used Facebook for purposes of belonging and self-presentation. The study of Oldmeadow et al. (2013) showed that people with high attachment anxiety often express concerns over how others view them on Facebook, since high attachment anxiety means increased sensitivity to criticism. Oldmeadow et al. (2013) also found that people with high attachment anxiety also often use Facebook in connection to posting content to check if friends have responded to the content. This can have an effect of feeling popular for people with high attachment anxiety. Based on these studies, many users of Facebook presumably post content to get as much positive response as possible. Additionally, Participant 1 of the user study said that she exclusively wanted positive responses from her friends when posting content on Facebook. Therefore, it might not be appropriate to use negatively valenced metaphors and symbols as interactional options. Instead, the low end of the scale should perhaps consist of neutral metaphors positively
valenced metaphors which are low in arousal. This issue is something that needs to be tested with users should this design idea be implemented.

5.1.3 Design idea 2

For Design idea 2, there are three different approaches given in the Results section. The first approach is to highlight interesting parts of images by dragging circular paths around the interesting parts. The mobile application system would then draw a circular mark around the highlighted part. As with the swiping approach of Design idea 1, this approach uses a minimum amount of gestures, specifically one type of gesture. The gesture is also simple, efficient, mark-based, fast and small.

The second approach is to highlight interesting parts of images with a glow effect by holding a finger to the interesting parts. The glow effect increases in size depending on how long the user keeps contact between the finger and the screen. This approach also meets the requirements of the guidelines for designing gestures on touch screens as mentioned for the first approach.

The eight colors that were chosen for this the first and second approaches, and for the prototype of the second approach, were red, green, blue, cyan, magenta, yellow, black and white, see Figure 12. The reason for choosing these colors is because they are the primary colors used in additive (used in computer monitors, printers etc.) and subtractive (used in print) color systems to recreate all colors (Fraser et al., 2005). Colors have different meanings in different cultures, and can even have different meanings to various groups within the same culture (Benyon, 2010). Therefore, the color selection of these approaches needs to be tested with different groups of users in order to make certain that they are appropriate.

The third approach is similar to the second approach except that instead of glow effects, this approach implements a heat map effect of the finger touch input. The duration of time for how long the user holds a finger against a part of an image will decide the color of the heat imprint and the size of the imprint. The colors of the heat imprints go from red to yellow to blue based on duration of contact. The choice of these colors is based on the wavelength spectrum of visible light where red light has longest wavelength, and therefore the least amount of energy, yellow light is in the middle, and blue light has the shortest wavelength and therefore the most amount of energy (Fraser et al., 2005).

All the approaches of Design idea 2 do not use any emotional words, which is a way to add a level of ambiguity to the interactions, which is guideline to consider when creating affective systems according to Fagerberg et al. (2003). Similar to Design idea 1, additional dimensions of ambiguity and affective loop could potentially be added if hand pressure data was available. Pressure data could be used to, for example, decide the saturation of colors, the speed of growth of the highlights or the thickness of the circle lines.
There is an issue with this design idea, which is that the interaction is done directly to images. This might cause reluctance for users to interact with images using the interactional options of this design idea, as could be witnessed from the pilot test. The reluctance to interact directly with images is rooted in not wanting to ruin the aesthetics of the original image. This is the reason for implementing the gestural interactions as layers, where users can choose to filter out gestural interactions made on the images. It is also worth to consider if this sort of interaction is inappropriate for existing social networking sites, such as Facebook, which is used for self-presentational purposes by content posters. Perhaps it is better to implement this sort of interaction in a new social media site where users know from the start that this sort of interaction is a central feature of the service.

5.1.4 Design idea 3

For Design idea 3 there is only one approach to consider, and it is similar in concept to the PIXEE-system by Morris et al. (2013). As with the PIXEE-system, the interaction in this design idea is highly based on the circumplex model of affect. The circumplex model of affect is used in Design idea 3, and in an alternative form in Design idea 1, and also in many other affective systems cited in this thesis study as this is a good model to use for affective systems. According to Reeves and Nass (1996), valence and arousal, which are the two parameters of the circumplex model of affect, are very appropriate to use when emotionally classifying images in affective systems.

There is only one kind of gesture used in this design idea, which is a one-finger drag gesture. The gesture used in this design idea is dragging a finger or thumb around in a circle in a two dimensional coordinate system. This means that the gestures are kept to a minimum, and is also simple to perform. However, the gesture is not mark-based, and not small and fast. Hence, the gesture used in this idea is an aspect that needs to be tested with users if it were to be implemented as an application.

One aspect in Design idea 3 that differentiates it from the other design ideas is the implementation of sixteen emotional words as potential interactional items, instead of six to eight items. This is purely based on the fact that Morris et al. (2013) used sixteen terms for the PIXEE-system. If Design idea 3 was to be implemented as an application, the number of words from which the user can choose will have to be tested with users.

The emotional words that are used as interactional options in this design idea can vary depending on the social media that implements it. For the case of Facebook, the emotional words can be based on the recently added emotional words. Similar to the colors of the glow effect in Design idea 2, the colors of the image frames in this design idea are based on the primary colors of additive and subtractive color systems. These colors are red, green, blue, cyan, magenta, yellow, black and white (Fraser et al., 2005). As mentioned for Design idea 2, colors have different meanings to different people, which means that the colors to use for emotional expression needs to be tested with users. The study of D’Andrade and Egan (1974) provides an important finding to consider when using colors for emotional interaction. This
finding is that emotional association to colors does not seem to primarily be based on the hue, or wavelength, of the light, but rather on the degree of saturation and brightness of the color. For example, if users seem to associate the color of an object as “cheerful”, it is not because of the hue of the color, but rather because the object is light and saturated (D’Andrade and Egan, 1974). The implication of this finding for using colors in the design ideas in this thesis project is that positively valenced interaction options should be light and saturated, and negatively valenced interaction options should be dark and unsaturated. As with the other design ideas, there is a potential to add dimensions of ambiguity and affective loop in this design idea if pressure data was available. The pressure data could be used by the application system to select which words the can be used. Also, the pressure data could be used to adjust the color of the image frame to something that better matches the user’s emotional state.

There is a positive aspect, similar to Design idea 1, to this design idea, which is that the color frames that are used to for emotional classification of images, can be used for other forms of content, such as videos and text. Other forms of interaction, such as the highlighting in Design idea 2, where the user interacts directly with the content require static forms of media, while the color frames surround the content. This means that they can also be used for dynamic media forms, such as videos.

5.1.5 Design idea 4

Of all the design ideas, Design idea 4 is the one that offers the most freedom to the users in terms of preferences and options to customize interaction. However, this freedom of choice also means that Design idea 4 has the least defined interaction design of all the design ideas. The problem with this lack of description of the functionality in Design idea 4 is that this design idea might not be appropriate to implement in existing social networking sites. Instead, it might be more appropriate to implement in a new social media where users are aware of this type of functionality from the beginning.

Another possible approach to this idea might be to find out what type interactions are among the most preferred by users, and implement the four most preferred into the tabs of this design idea.

This design idea uses the guidelines of Ingram et al. (2012) and Derboven et al. (2012), who suggest using one-finger touch gestures for the most common interactions and using buttons and menus for less common and abstract interactions. This design idea uses one-finger touch to press the tabs, which is the most common interaction, and menus for selecting the user-customized interaction options.
5.1.6 Design idea 5

Design idea 5 is arguably the simplest of all the design ideas, since interaction consists of using fingers to draw marks on images. Both of the participants in the user study thought that this type of interaction was appropriate to use for expression of finger touch gestures. One possible reason for the appeal of this form of interaction is that marks that are drawn onto an image represent the direct input of the fingers that are in contact with the touch screen. Another possible reason is that drawing marks allows for creative possibilities for users since users can choose to draw anything. Yet another possible reason is the factor of previous experience with regard to intuitiveness when using multi-touch interactions, as described by Ingram et al. (2012). This factor explains that previous experience of multi-touch interactions will help to form users’ intuitions about touch interactions. Commercial mobile drawing applications where users draw marks using finger touch input are quite common, which might have had an effect on what users consider to be the most intuitive way of expression using finger touch gestures.

5.2 Research question 1

The first research question is asked as:

1. How can finger touch gestures be designed to provide expressive alternatives or complements to text comments on a social networking site?

In this thesis project, the finger gestures that were used as expressive alternatives in the design ideas were exclusively one-finger touch and drag gestures. The reasons for using these gestures are that they are the most intuitive types of gestures to use for touch-based interfaces for both users and developers (Ingram et al., 2012). Also, these types of gestures were the most preferred for both of the participants in the user study of this thesis project. One-finger touch and drag gestures also meet the requirements of other touch screen design guidelines, such as direct manipulation, simplicity, efficiency, small size and fast to perform (Ingram et al., 2012; Derboven et al., 2012).

A discussion as to why one-finger touch and drag gestures are the most intuitive gestures is worth having. It is also worth discussing whether or not these types of gestures are the best ones to use for expression and emotional communication. As stated by Ingram et al. (2012), desktop computers have used the WIMP-interface, and mouse and keyboard as interactional tools for decades. These tools use one-click or double-click with the mouse for selection and holding down a mouse button to move around elements in the interface. One possible reason for why one-finger touch and drag gestures seem to be the most intuitive to users could be that users apply their previous knowledge from desktop computers to touch interfaces. Indeed, previous experience is an important factor to consider, both in terms of previous experience.
with multi-touch interfaces and also WIMP-based computers, when designing touch interfaces, according to Ingram et al. (2012). Previous experience from desktop computers can be utilized when designing touch-based interfaces by using analogous interactions from computers (Ingram et al., 2012). This approach to designing touch screen interactions is evidenced in the JavaScript libraries used to simulate native mobile applications. In these JavaScript libraries, such as jQuery Mobile, the names of the event handlers for interactions are analogies to event handlers for WIMP-based computers. For example, in jQuery Mobile a one-finger touch selection event is referred to as a “virtual mouse click” and dragging is referred to as “virtual mouse hold”.

The case can be made for trying to get away from touch interactions that are based on interactions on computers, especially because of the direct manipulation capabilities of the multi-touch screens of smartphones. Derboven et al. (2012) encourages in one of their design guidelines for multi-touch interfaces to design interfaces that encourage user exploration. This is to allow users to find creative ways to interact with the interfaces. Another guideline from Derboven et al. (2012) is that gestures and functionality of touch interfaces should be explained, in non-intrusive ways, to users when necessary. This guideline allows for encouragement to developers to design interactions that do not solely depend on one-finger touch and drag interactions.

As for expressive alternatives to comments, the design ideas in this thesis project shows that users can potentially be more expressive with the designed finger touch alternatives to text commenting, just by using one-finger touch and drag gestures. Though future research will have to verify which of the design ideas are actually appropriate to use in a real social networking application.

5.3 Research question 2

This second research question is asked as:

2. What kinds of visual elements and feedback are appropriate for finger touch interaction meant to provide expressive alternatives and complements to text comments on a social networking site?

In this thesis project, there are a number of different visual elements and feedback used for the design ideas. According to Ingram et al. (2012), the visual feedback of a touch-based interface is a very important factor to consider. The visual elements can be used directly on images or in connection to images. In this thesis project the visual elements that have been used are thumb up and thumb down, which are especially appropriate for the specific case of Facebook since it already has implemented the thumb up symbol. Other visual elements that have been used, not necessarily with Facebook in mind, are highlighting by using glow effect imprints with different colors, highlighting with heat map imprints, one-dimensional coordinate system consisting of emotional words, two-dimensional coordinate system where the position in the
coordinate system decides an emotional word and a color frame, and drawing marks on images to form symbols such as hearts and smiling faces. Future research will have to determine which of these different visual elements are appropriate to use as visual elements in a real social networking application with finger touch expression. Emoticons have also been mentioned as a possible alternative to use for visual feedback, since users tend to use them in both positive and negative socio-emotional contexts (Derks et al., 2007). However, emoticons as visual symbols for finger touch gestures have not been explored in detail due to the lack of use by the participants of the user study.

An interesting aspect to explore in future research is how to interact with finger touch gestures using feedback that is not based on visual symbols. The study of Kim and Lim (2012), who created the iSpace social networking prototype, showed that it was possible to self-express by allowing users to customize interactivity settings, such as scroll speed and gravity, and response speed and gravity of moving the mouse. Since much of finger touch interaction is based on WIMP-interactions, perhaps it is possible to self-express by customizing interactivity settings of touch interfaces.

### 5.4 Research question 3

The third research question is asked as:

3. How do users interact with other users on social networking sites and what do they consider as appropriate regarding finger touch gestures as alternative and complements to text comments on a social networking site?

This thesis project has used Facebook as a case study of social networking sites, and from the literature used in this study it is shown that users interact with Facebook in particular by regarding it as a space of belonging and to self-present. The amount to which users interact with others on Facebook is to some extent dictated by the personality traits of extraversion and neuroticism, and also by attachment anxiety. Another aspect of Facebook use that was shown in the literature was that use of Facebook often gives a sense connectedness, whereas disuse of Facebook gives a sense of disconnectedness (Nadkarni and Hofmann, 2012; Seidman, 2013; Oldmeadow et al. 2013; Chen and Marcus, 2012).

The factor of belonging is manifested as interacting with other people’s posts on Facebook by either liking them or commenting on them. As explained by Participant 2 in the user study, liking friends’ posts on Facebook is a way for users to show support and to acknowledge that they have seen friends’ posts. The acknowledgement of seeing friends’ posts can be seen as a way of staying connected with other friends.

The factor of self-presenting is manifested in posting content on Facebook. According Zhao et al. (2013), Facebook can be viewed as a space of performance and exhibition when interacting with other people. This study showed that users often create strategies for
managing their content on Facebook for self-presentational purposes. The type of content that often needed the most attention was emotional content. Oldmeadow et al. (2013) found that people high in attachment anxiety often use Facebook when recently having posted content to check if friends’ have responded to it. This is a way for users to feel more popular. This aspect has support from the user study where Participant 2 expected exclusively positive feedback on the content she posted on Facebook.

As for what users consider appropriate regarding finger touch gestures, the participants in the user study preferred different types of interactions. The first type of preferred interaction was to swipe or drag a finger up or down to show positive or negative emotions. The second type of preferred interaction was to draw marks on images in the shapes of hearts, smiling faces and other symbols. The third type of preferred interaction was highlighting interesting parts of images by drawing circles around them.

The first type of interaction is an example of the informational model of emotion where a specific number of emotional interactional options are available. The second and third approaches are examples of the interactional approach to emotion where the communication of affect is done entirely and freely by the user. It would seem from these results that users do not seem to prefer one of the approaches in favor of the other. However, the participants of the user study wanted the interaction on Facebook to fast and efficient, and not lead to misunderstandings in the communication between users. Also, the participants preferred to interact with friends’ content with buttons rather than commenting. This preference makes the case for using the informational model, and its clear choices of interactions, when designing for expressive finger gesture interactions on Facebook. Also, as Participant 2 pointed out, the “Like” button in Facebook could be used in most cases where there is a need to express positive emotions, and did not think that the “Like” button was too general. Therefore, even if finger touch interaction is based on limited number of interactional options, the interaction could still be rich in expression depending on the social context between users. The context of the relationship between users plays a part when communicating emotion through touch when face-to-face, as shown by Thompson and Hampton (2011). The same perhaps could be said when communicating via finger touch gestures on social networking sites.

5.5 Research critique

This section is used to critically discuss the research of this thesis project. The first, and biggest, criticism is the low number of participants in the user study. Zhao et al. (2013) showed that useful qualitative insights can be obtained with relatively low numbers participants. Still, in their study they were able to have thirteen participants. The two participants in this user study gave very useful feedback regarding what finger touch gestures and visual elements to use. However, in order to draw useful conclusions into user behavior and to be able to call the study truly user-centred, a larger number of participants is necessary.
Also, the user study was conducted in a lab environment, which does not always accurately portray users’ real and natural behaviors.

Another criticism of this study is that the web prototypes that were developed to test functionality of the finger gesture interaction were very simple, and they were not tested with users. The reason for this is mainly due to this study focusing on developing theoretical interaction designs which can potentially be developed and tested in future research.

A third criticism of this study is that the design ideas developed in this thesis need to be discussed further with users in order to improve them in an iterative way. Also, the research results about user interaction are highly based on specific case of Facebook. The results in this thesis are not applicable generally to all social networking sites.

Finally, the design ideas and prototypes in this thesis project mostly cover how to interact with images and other multimedia elements on social networking sites by using finger touch gestures. Therefore, the design ideas are really describing emotional interaction using gestures rather emotional communication and affective loops. This thesis project can thus not be said to be directly studying emotional communication.

5.6 Future research

In future research, the interaction design ideas constructed in this thesis project need to be discussed with users in order to build them further. The design ideas also need to be implemented into interactive prototypes that test all the aspects of user interaction on a social networking site, including the finger touch interactions of the design ideas. These prototypes should therefore also test whether an affective loop can be created between users. This must be done in order to be able to say that the design ideas produce emotional communication. Also, there is a need for further user testing in order to find general results about user behavior with regard to finger touch gesture expression on social networking sites using mobile technology. All these aspects that need to be researched also need to be researched in general with regard to social networking sites (and other social media for that matter), and not just with regard to Facebook. Also, as Zhao et al. (2013) explained, the parameter of time seems to be an important factor when interacting on Facebook. This parameter was not researched in this thesis project, and it would be an interesting aspect to study in future research.


6 Conclusion

This thesis project has presented different interaction design ideas to use finger touch gesture as expressive alternatives for interaction on social networking sites. The design ideas are centred on simple one-finger touch and drag gestures, and the interactions in the design ideas are based on both interacting directly on images and in connection with images. The thesis project also found that users prefer fast and efficient ways to communicate on Facebook, by preferring buttons in favor of commenting. Through the literature review it was found that users interact on Facebook in order to fulfill needs of belonging and self-presenting, and that users spend time and effort to manage their Facebook content for self-presentational purposes.

In conclusion, this thesis project has only scratched the surface of the potential ways to use the multi-touch screens of smartphones for expressive and affective options to interact on social networking sites. This thesis project has, however, presented concrete design ideas that can potentially be developed into real social networking applications in future research.
7 References

7.1 Articles


### 7.2 Books


### 7.3 Conference papers


### 7.4 Documents

7.5 Websites


Appendix A – Test procedure for user study

Write test procedure on white board.

Explain test procedure to participant.

Play with system: 15 minutes

1. Show the participant their personal FB page and discuss

2. View friends’ Facebook pages:
   - Ask them how they would to react with: like, comment and emoticons.
   - They also have to interact with the pictures with their touch.
   - They explain out loud the gestures and what feedback should be displayed for themselves/to the other user.

3. Pictures from IAPS on a mobile phone.
   - Ask them to comment on those pictures with finger touch.

Discussion questions for the focus group: 30 minutes

- How do you use social media on your phone? User experience of FB on mobile phones? How often do you comment or reply? Why?
- How often do you update? What kind of feedback do you expect? (Go to his FB page)
- How do you use emoticons? In what context or scenario would you use this kind of interaction? With what kind of people?
- How do you use like button? what context or scenario would you use this kind of interaction? With what kind of people? Or do you need more expressive buttons e.g. Dislike Button?
- What would you think could be more expressive alternatives on self-expressing and communicating on social media? In what social context or scenario would you use this kind of interaction?
• How do you communicate differently face-to-face from online?

• How do you think the finger gesture interaction with the touch screen should be displayed? Should be on the status update or used below it (as the “Like” or “Comment” buttons?)

• With what kind of people would you use this kind of interaction? (How would you publish the photos and who do you want to see it?)

• What would be the most convenient way for you to send this kind of interaction to another person?
Appendix B – Screenshots of Facebook interface

Interface of the newsfeed of the mobile Facebook application (in Swedish):
Interface of the newsfeed of the Facebook website:
Interface of the profile page of the Facebook website: