

Connected Cameras – Evaluation and Development of Usability in Cameras with Internet Connection

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Abstract

Nowadays it is common to share photos on the Internet. Social image sharing sites such as Facebook and Flickr are frequently used by people worldwide. Today's advanced mobile phones have contributed to that immediate sharing of images has become more common. However, this is not possible with digital cameras that on the other hand deliver much better image quality than camera phones. The camera user is therefore forced to choose between quality and immediacy when taking a photo.

A number of attempted solutions to this problem can be found on the market today. We have chosen to call these solutions "connected cameras", implicating digital cameras with Internet access that provide the functionality to upload pictures to sharing web sites. However, none of these cameras have yet had a major impact on the market.

The aim of this project has been to find out why there is no larger demand for connected cameras and how a connected camera should be designed to be usable. The investigations of this project has consisted of two focus groups, a workshop and a questionnaire study. Mostly students, but also photographers participated in our studies.

We have found that one reason to why immediacy has had no success among digital cameras is that the products available today have a too limited Internet access. In order for a connected camera to be useful it must have wide and easy access to Internet so the user can share photos when they are still fresh. Another reason is that the interface for the current solutions lacked functionality and therefore we have concluded a set of functions required for a connected camera to be useful. The necessary functions are: adding text to photos, editing photos, effective uploading and the opportunity to choose which website to upload the pictures to. In order for these functions to be easy to use the connected camera should also have touchscreen.

Based on the results from our investigations we have developed a suggested solution, with the necessary functions and a useful interface, that would suit users of a potential connected camera.

Sammanfattning

Idag är det vanligt att dela med sig av sina bilder på Internet. Sociala bilddelningssidor som Facebook och Flickr används flitigt av människor runt hela världen. Dagens avancerade mobiltelefoner har bidragit till att även omedelbar bilddelning har blivit vanligt. Denna omedelbara delning är inte möjlig med dagens digitalkameror, som däremot bidrar med avsevärt mycket bättre bildkvalitet än kameran i mobiltelefoner. Kameraanvändaren tvingas därför att välja mellan kvalitet och omedelbarhet vid ett fototillfälle.

Ett antal försök till lösningar på detta problem finns på marknaden idag. Vi har valt att kalla dessa för "connected cameras", vilket innebär kameror med en Internetanslutning som möjliggör uppladdning utav bilder till nätet. Dock har ingen av dessa kameror haft någon stor genomslagskraft på marknaden.

Detta projekt har gått ut på att genom undersökningar ta reda på varför connected cameras inte har en större efterfrågan och hur en connected camera bör vara designad för att vara användbar och då bli mer framgångsrik. Arbetets undersökningar har bestått av två fokusgrupper, en workshop samt en enkätstudie. Främst studenter, men även fotografer har deltagit i våra studier.

Vi har kommit fram till att en anledning till varför omedelbar delning inte har haft någon framgång bland kameror är att de produkter som finns idag har för begränsad uppkoppling. För att en connected camera ska vara användbar måste den ha nästintill obegränsad uppkoppling så att användaren kan ladda upp bilden på plats när den fortfarande är aktuell. Vi har även kommit fram till ett antal funktioner som krävs för att en connected camera ska vara användbar, dessa funktioner saknas helt eller delvis i dagens connected cameras. De nödvändiga funktionerna är: tillägg av text till bilder, redigering av bilder, snabb uppladdning direkt efter fotografering samt möjligheten att välja vilken hemsida bilderna ska laddas upp till. För att dessa funktioner ska vara användbara bör en connected camera även ha en touchscreen med ett enkelt gränssnitt designat efter dess kontext.

Utifrån resultaten från samtliga undersökningar har vi slutligen utformat ett förslag på ett användbart gränssnitt som skulle passa för potentiella connected cameras.

Table of content

1 Introduction	1
1.1 Background	1
1.2 Aim	1
1.3 Problem formulation.....	1
1.4 Limitation	2
2 Background	3
2.1 How and why do people share their pictures today?	3
2.1.1 Internet and photo sharing.....	3
2.1.2 “Why?”	3
2.1.3 Distant closeness and photo exhibition.....	4
2.1.4 Camera phones and immediacy	5
2.1.5 Adding text to pictures.....	5
2.2 On the market today	5
2.2.1 Wi-Fi cameras	6
2.2.2 Eye-Fi.....	6
2.2.3 Camera phones.....	6
2.2.4 Other products	7
2.3 Wireless connectivity	7
2.4 Technical limitations for small size cameras	8
3 Method.....	9
3.1 Human-computer interaction as our framework.....	9
3.1.1 Early focus on users.....	9
3.2 Target audience.....	10
3.3 Focus groups.....	10
3.4 Design workshop	11
3.5 Questionnaire study	12
4 Results.....	13
4.1 Focus groups.....	13
4.1.1 Camera use	13
4.1.2 Quality vs The Power of Now	13
4.1.3 Evaluation of and discussion about current products.....	14

4.1.3.1	The Sony DSC-G3 digital camera	14
4.1.3.2	The Eye-Fi memory card.....	14
4.1.4	Other opinions.....	15
4.1.5	Summary of results from focus groups	15
4.2	Workshop.....	16
4.3	Questionnaire.....	17
4.3.1	Picture sharing	17
4.3.2	Text with pictures.....	18
4.3.3	Photo editing	18
4.3.4	Uploading to several websites.....	19
5	Analysis and discussion.....	20
5.1	The design process.....	20
5.2	Why is instant sharing important?	20
5.2.1	The power of now.....	20
5.2.2	Development of immediacy in cameras.....	21
5.3	What additional functions are needed to make connected cameras usable? ...	21
5.3.1	Text.....	21
5.3.2	Editing.....	22
5.4	What kind of technology is needed to satisfy the user and make the product convenient?	22
5.4.1	Connectivity	22
5.4.2	Touch screen	23
5.4.3	Image quality.....	24
6	Suggested solution.....	25
6.1	How should the interface be designed to make the product efficient and usable?	25
6.2	Storyboard of suggestion	26
7	Conclusion.....	28
7.1	Why have immediate uploading of photos been a success on the camera phone market and not yet on the camera market?	28
7.2	What functions are needed in connected cameras to make them usable?.....	28
7.3	Future work	29
8	Literature.....	30
8.1	Books.....	30

8.2 Articles	30
8.3 Web pages.....	31
Appendix 1 - Questionnaire (in swedish).....	33
Appendix 2 - Workshop design A.....	34
Appendix 3 - Workshop design B.....	36

1 Introduction

In this chapter we introduce the background and aim of the project. We also declare the problem formulation and limitations of the work.

1.1 Background

Since the first analog consumer cameras, photographs has been shared by the photographer to friends and family through slideshows or by showing prints. Sharing of personal photographs is therefore no new phenomena. When digital cameras were introduced image sharing became easier and more immediate since no development of film was needed and the pictures could be shared as soon as a computer was reached. With the growing popularity of mobile phone cameras, immediacy has a new meaning. Sharing pictures the same day is no longer "immediate". Now, immediate means instantaneously sharing a picture just a moment after it is taken.

Picture sharing online has today grown to be a common practice. Websites like Facebook and Flickr make it simple to share photographs with friends or to the whole world. The ability to instantly take and share pictures when a picture opportunity rises is a strong drive behind why the camera phone has had a big impact. A picture capturing a happening "now" will not be as interesting if not shared "now". This immediate sharing, possible with camera phones, is today not possible with regular digital cameras. At some occasions, when camera owners want to instantly send pictures to someone/somewhere, they therefore choose to use their camera phones instead of their digital cameras. However, it is not physically possible for a camera phone to provide as good image quality as a digital camera with a larger sensor and finer optics. The user is therefore forced to choose between quality and immediacy when photographing.

Today, a few attempted solutions to escape this forced choice between quality and immediacy can be found on the market. One of these solutions is based on built-in Wi-Fi in the camera which allows the user to upload photographs to social picture sharing sites and/or to the home computer. Other solutions are third-party products that adds wireless functions to a camera. This paper will focus on what we have chosen to call "connected cameras", cameras with the ability to instantly share pictures. None of the today existing connected cameras have had an impact on the market yet. This is obvious on "Amazon Bestsellers Rank" where the most developed Wi-Fi cameras, Samsung CL65 and Sony DSC-G3, are ranked #8,778 and #4,519 (Amazon, 2010). This kind of cameras are not even sold in stores in Sweden today. We find this interesting when immediacy seems to be important when sharing pictures.

1.2 Aim

Our aim with this paper is to investigate why connected cameras does not have a larger impact on the market. We will do this mainly by doing research on how, when and why users photograph and share pictures. We also want to find out in what situations a camera phone is chosen before a digital compact or SLR-camera and vice versa, then use this information to investigate what functions would be required and how a usable interface would look like. Based on this we will analyse the usability of the existing connected cameras and from our results we will develop a new usable solution.

1.3 Problem formulation

In this project there are two main questions that we want to answer:

1. Why have immediate uploading of photos been a success on the camera phone market and not yet on the camera market?
2. What technology and functions are needed in connected cameras to make them usable?

To answer these questions and achieve the goal of the project we have formulated subquestions concerning existing products that allows a camera to upload photos and the development of a new one:

Picture Sharing:

- How and why do people share their pictures today?
- Why is instant sharing important?

Products Today:

- How usable are the products that exists today?

New Product:

- What kind of technology is needed to satisfy the user and make the product convenient?
- What functions are needed to make a connected camera usable?
- How should the interface be designed to make the product efficient and usable?

1.4 Limitation

We have decided to limit our study to consumer products and have therefore not examined the more expensive and advanced products meant for the professional market. We have also chosen to focus on examining the interface and how users interact with the current consumer products. The research will be concentrated on social sharing of pictures rather than local file transfer. We briefly mention what technical hardware can be used as means for a camera to communicate wireless with the Internet, such as Wi-Fi or 3G, but we have purposefully left out which solutions could solve these problems. How to implement wireless connectivity into a camera could be several papers by itself and for us to stay focused on our problem, we chose to solely work with the interaction with connected cameras.

We selected one connected camera of those on the market that we will focus our interaction research on. We have examined what products available and chosen the one we thought was the most developed. The Sony DSC-G3 was selected because of its built-in web browser, ability to log in to protected wireless networks and for having the option to upload to many different websites.

2 Background

In this chapter we present theories about photo sharing and what immediate sharing solutions available on the market today. We also describe different methods for wireless connectivity in mobile devices and clarify the technical limitations for small cameras.

2.1 How and why do people share their pictures today?

Below we identify different reasons and motivations for people to share their pictures with others. We also present side activities that comes with online photo sharing.

2.1.1 Internet and photo sharing

The combination of digital photography and Internet has resulted in new ways of sharing pictures. Before Internet, photos were printed and put into albums. These albums were usually kept in the house and therefore restricted to people who came to visit. In a research made by Van House et al. (2004) this was discussed: *"Interestingly, while all participants enjoyed sharing prints with other outside of the home, people didn't take their photo albums to other people's houses, but would show them to visitors."* Nowadays photo albums are available outside the home by getting digitalised and shared on the Internet via e.g. Facebook, Flickr and photoblogs. The sharing happening at Facebook alone amounts to *"More than 25 billion pieces of content (web links, news stories, blog posts, notes, photo albums, etc.) shared each month."* (Facebook, 2010). If only a small percentage of this is picture sharing, there still is a huge amount of photographs being shared all over the world every day.

2.1.2 "Why?"

It is obviously important to understand what users do with their pictures to make sharing easier and more efficient in a new system. What they want to do is also important, however this part might be a little trickier because a wish might not be realistic. A user could think that a certain function would be interesting and amusing when there might not be a need for it and consequently it will not be useful in a system designed for that specific user. It is therefore not only important to observe how people use the technology right now, but also to ask *why* they do it. Van House et al. (2004) mean that *"By uncovering the underlying social uses that digital imaging technologies can address, we can design technologies that people actually want and use.(..) social uses are an essential construct for user-centered inquiry. To design technology to be useful and used, we need to understand not only what users are doing but also why."*

There can be many reasons to why immediate photo sharing is important. The reasons are very dependent on the picture itself and the photographers feelings about it. A cucumber on a subway station, a newborn baby, a couple of friends lost on a hilltop during a trip or results from a competition may all have very different motivations behind why that picture is shared. Some pictures, like the one capturing a cucumber, may not be interesting at all if shared at a later time, since the sight is funny just that moment. A picture of a newborn is something that the parents are very proud of and therefore might want to share their happiness with their close ones. This will also give friends and relatives the opportunity to

congratulate the new parents. Similar reasons may be motivation for instantly sharing a competition result. In the case of the friends lost on a hilltop, the picture captures the feeling of excitement that the friends feel during the moment. The excitement can include an eagerness to share that feeling with friends at home.

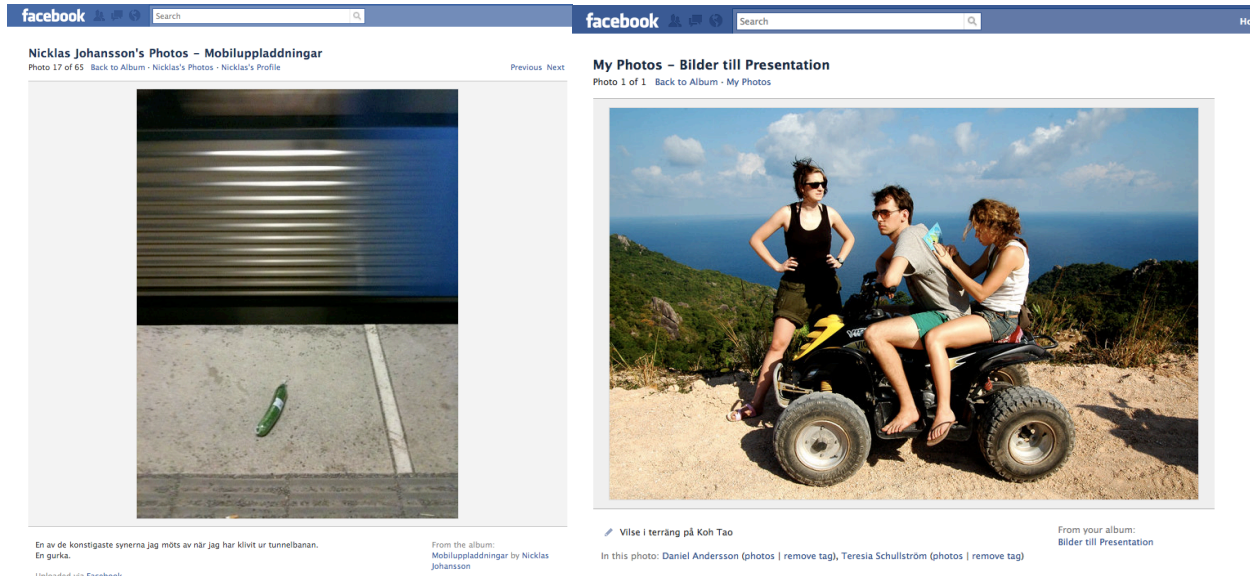


Figure 1 (left) Moment picture of a cucumber on a train station taken and immediately shared by one of the participants in the focus groups. Figure 1 (right) Picture of friends lost on a hill in Thailand, taken by the authors.

2.1.3 Distant closeness and photo exhibition

In an other article Van House (2007) has summarised the motivations for photo sharing into two main motivations: *distant closeness* and *photo exhibition*.

Distant closeness imply that one can stay close to friends and family by frequently updating each other with new pictures and albums. This way one will keep others informed about one's own life and follow developments in others lives. According to Van House (2005), shared pictures mostly capture friends and family and are often taken during social events. The images could also picture things that the owner find amusing or interesting and therefore want to share and discuss with friends. The photos can serve to create and maintain relationships: "Photos are used, not just to remember people and events, but to maintain existing relationships and even create new ones. Photos were valuable not only for themselves but for the connections among them and among the people represented, and for the active role they played in relationships" (Van house et al., 2004). Online sites that can be used for this are e.g. Facebook, Flickr other online albums. Pictures sent by e-mail also count for this purpose (Miller and Edwards, 2007).

Photo exhibition imply that the photographer proudly can exhibit his/her own photographs and admire others. Photos meant for exhibition are usually used as self-expression and are often fun or artistic which make them more likely to be meaningful even to strangers on public photo sites (Van House et al., 2002). Miller and Edwards (2007) mean that photo exhibitionists focus more on artistic pictures and how to improve their technique. This by exhibiting their pictures on e.g. Flickr and discuss them with other users that they may not know outside of the online community.

2.1.4 Camera phones and immediacy

Camera phones are getting more and more common. They outsold the digital cameras worldwide already in year 2003 and the quality is only getting better (Van House et al., 2004). The availability of a camera in the mobile phone results in a new photographing behaviour and more casual photos from everyday life. *"..the ubiquity of camera phones is creating a 'new kind of personal awareness' and changing the nature of the images that get captured—they are more likely to be casual, immediate moments of beauty or interest."* (Van House et al., 2004). The technology in the cell phones also gives the possibility to instantly share photos which then lead to new habits and demands. *"Camera phone users talked of sending photos sporadically throughout the day just to make the other laugh. The sense of real time capture and sharing (i.e., the 'Power of Now' we identified in our focus group studies [40]) was important to the senders."* (Van House et al., 2004).

2.1.5 Adding text to pictures

When sharing pictures, regardless of the format, the image might not be enough to convey the whole message one wants to send. Descriptions can be used to help a viewer to understand the context in which the photograph was taken or to simply describe what is in the picture. Tags (or "keywords") are mainly used for organising pictures, both for oneself and other users who wants to find the pictures. According to Ames and Naaman (2007) users have four main motivations for tagging pictures (gathered from a study on the photo sharing site Flickr.com). These are:

	<i>Organisation</i>	<i>Communication</i>
<i>Self</i>	<i>Retrieval, Directory Search</i>	<i>Context for self Memory</i>
<i>Social</i>	<i>Contribution, attention Ad hoc photo pooling</i>	<i>Content descriptors Social signalling</i>

Table 1.

These motivations are divided into social vs. personal and communication vs. organisation. Ames and Naaman (2007) suggests that organisation for other users might be the biggest motivator, with self-organisation and social communication coming second. Global picture sharing sites like Flickr gives the possibility to share pictures to people all over the world. Tags and descriptions will increase the possibility of users that are not familiar to the photographer to find his/her photographs. A study by Nov, Naaman and Ye (2008) shows that users that are members in larger number of Flickr groups tend to use more unique tags than those who are in less groups. In other words, the larger social network online, the the more motivated one is to tag pictures.

2.2 On the market today

Today there are several solutions that makes it possible to upload photographs from the camera to the Internet without cables and even without a connection to a computer. There are complete package solutions like Wi-Fi cameras or camera phones and there are other solutions that add wireless transfer functionality to cameras that lack this. Below we present some of the most prominent ones.

2.2.1 Wi-Fi cameras

Built-in Wi-Fi in cameras is not a new phenomena. It has actually been used in some digital compact cameras since 2005. Kodak EasyShare One (Kodak, 2010) was the first model with this feature. However, the Wi-Fi in the camera was only used to connect to the home computer without having to use cables. More recently, in the year 2009, a new generation of camera models with integrated Wi-Fi was born. The model with the most features, Sony DSC-G3, can not only connect and transfer pictures to the home computer but also share them on the Internet. It has a built-in web browser that enables the camera to connect to the Internet when the camera has access to a wireless network. While connected to the Internet the user can upload pictures to several picture sharing sites. It is also possible to use it for surfing the web, although Sony does not market this feature (SonyStyle, 2010).

2.2.2 Eye-Fi

Eye-fi is another solution to transfer photos. However, this technology is built into the memory card instead of the camera. The Eye-fi card is a regular SD memory card (SDHC) with the extra function of built-in Wi-Fi that uses wireless networks to transfer photos to the Internet or a home computer. To enable the card to connect to a network the card first has to be plugged in to a computer were one configures up to 32 networks that the Eye-Fi card should be able to communicate with. During the setup the user can also customise where the photos will be sent. The user can choose to automatically upload the pictures to different social websites and/or to the home computer. After the memory card has been inserted into the camera it will instantly upload the pictures after they have been taken. If the card does not have access to a wireless network while photographing it will automatically start to upload the pictures once getting the access to one of the specified networks. There is also a setting were the user can choose which photos to upload to sharing sites by using the protect image function in the camera on those specific pictures. This way the user does not have to share all the pictures taken, only the selected ones. (Eye-Fi, 2010)

Some newer cameras, e.g. compact camera Canon Powershot SX210 IS and system camera Nikon D3000 have the feature of being able to communicate with the Eye-Fi cards. These cameras stay powered until the wireless photo upload is complete. Some camera models also offers an on-screen icon on the uploaded pictures and the ability to enable the Wi-Fi in the Eye-Fi card through the camera menu (Eye-Fi, 2010).

2.2.3 Camera phones

A camera phone can be used when there are no other solutions available if one want to transfer pictures wirelessly. This requires that the photograph is taken with the camera phone (no camera we have found today can send images directly to a phone) so that the image is stored in the phone's memory. The camera phone need to be able to send data to the Internet and be able to connect to a desired upload destination either via an application in the camera or through a website if it has a web browser. Many camera phones are also able to edit or apply colour filters to pictures before uploading them (iPhone, HTC Desire, Nokia N95 et al.).



Figure 2, Photos taken with iPhone, filters applied in the application "CameraBag". Filter names from left to right: "Original"(none), "Colorcross", "1974" and "Silver".

One thing that needs to be mentioned is that there are countless different models of camera phones on the market. They come as smart phones which have the same functions as a computer, to simple phones that may be able to take pictures in 640x480 resolution but have no way to upload them. When we refer to camera phones, we refer to phones such as the iPhone that can upload pictures directly to different social sharing sites.

2.2.4 Other products

There are some other solutions to wirelessly transfer pictures from the camera that will not be discussed further in this project. One is the battery grips from both Nikon and Canon that automatically send pictures via Wi-Fi to a preset computer. Another solution is Wi-Pics Mobile (United Imaging Solutions, 2010) that is a small device with a screen and transmitter that can be connected to a camera through the USB-port. From the device the pictures can be wirelessly transferred to a computer. The main uses for these products are to upload pictures to computers for instant previewing on large screens or for sending pictures to news stations when photographing in the field. The reason for not investigating the use of these solutions is because they are targeted at professional photographers.

2.3 Wireless connectivity

There are different methods for connecting to the Internet with a mobile device. The most common options in mobile phones today are 3G and Wi-Fi. Most smart phones and more advanced camera phones today have both 3G and Wi-Fi as well as the older EDGE/GPRS. 3G (3rd generation telecommunication) is a collection of telecommunication standards, created for wireless services like voice telephone, video calls and data transfer on mobile devices. It is also possible to use 3G as an access point to Internet, for example to connect a PC to the web with a USB dongle 3G modem. 3G has a top-down access model, where a company provides access to the 3G network to the end-user who pays for the service (Lehr and McKnight, 2003).

Wi-Fi is the most common name for the IEEE 802.11 WLAN standard. There are different protocols in the standard, the most common today, 802.11g, offers speed up to 54 Mbit/s (IEEE-SA, 2007). Devices with Wi-Fi capabilities can access the Internet as long as they are connected to a wireless local area network (WLAN) with an Internet connection. WLANs can be private, commercial or completely open. Any private person can set up a WLAN at home to which they can connect all their Wi-Fi devices, such as mobile phones, notebooks, mp3 players, cameras etcetera. Some companies and organisations, like airports and coffee shops, provide free Wi-Fi to attract clients. There are also commercial hotspots to which a user can get access to by subscribing to a service (e.g. Telia HomeRun or AT&T Wi-Fi).

A drawback of Wi-Fi is that its range is short compared to 3G or other telecommunication options. This makes it hard to stay connected to the Internet with Wi-Fi if moving from place to place. There are

methods for creating larger wireless networks, for example by setting up multiple access points or using Wi-Fi amplifiers to boost the signal strength. These methods work well when creating networks for medium area environments like campuses and malls, but are hard to implement city or nation-wide.

The common name for the collection of the “new generation” of wide area wireless technologies is 4G. The technology standards LTE and WiMAX fall under this category. To be able to be classified as 4G the standard must support peak data rates for up to 100 Mbit/s for devices used in high mobility, e.g on a train (ITU-R, 2008).

We have not delved into how and if it is possible to implement all these wireless technologies, but mentioned them to give a perspective over what wireless technologies are available now and in the near future. The fact that they can be implemented in mobile phones indicates that it is at least physically possible to have the same functionality in digital cameras.

2.4 Technical limitations for small size cameras

The biggest reason for camera phones not being able to compete with digital cameras in image quality is because smaller image sensors are implemented into camera phones. Below we explain why a smaller sensor equals lower image quality.

The image sensor in a camera consists of many different pixel elements that record how much light reaches them during exposure. Each pixel converts the amount of photons that it registers to electrons, which are then measured by the camera and put together to an image. The size of a cameras sensor and the amount of pixels it has affects the picture quality. When increasing the amount of pixels on a sensor without making the sensor larger, every pixel will be smaller. Theoretically, this increases the ability to record higher spatial frequencies in the image. Practically, smaller pixels on the sensor put higher demands on the optical sharpness of the lens compared to a sensor with larger pixels.

The amount of photons each pixel can record during an exposure is heavily related to the area of the pixel. A metaphor that describes this rather well, is a bucket which get filled with water during rain. The bigger opening the bucket has, the more rain it can collect per second. The amount of photons a pixel can store is called well capacity, which can be compared to the volume of the bucket with rain water. Lower well capacity means that fewer brightness levels can be recorded.

Noise is electrons that the sensor registers but are not part of the picture the user takes. There are three different kinds of image noise: electronic noise from components in the camera, statistical fluctuations in the dark signal and statistical fluctuations in how many photons hits a pixel during the exposure. Dynamic range (DR) is one measurement of noise. DR measures the ratio between the highest and lowest exposure, where the lowest exposure is just above the noise level during dark exposure and the highest is just below overexposure. DR gives a number for how many levels of brightness an image sensor can collect. The higher noise level, the lower DR. Image noise is a problem for small sensors since the amount of noise collected during exposure is percentually higher than for larger sensors with higher well capacity. The dynamic range is therefore lower for smaller sensors. A disadvantage from this is lower image quality for photos taken in low light environments.

Thus, the small sensor found in camera phones can never provide as good quality as the larger ones in compact and system cameras.

3 Method

In this chapter we declare what methods that have been used for the empirical part of the project. We introduce the target audience and explain how and why each method was performed.

3.1 Human-computer interaction as our framework

We have written this paper with a Human-computer interaction (HCI) approach. The methodology we have used are based on the principles written by Gould and Lewis (1985). These principles are put together as a guide for developing a useful and easy computer system and are easily applicable to other digital systems such as mobile phones or cameras. These principles are now accepted as basis for user-centered approach. A summary of the principles follow:

Principles for a useful computer system

1. **Early focus on users and tasks** - First understanding who the user is. Start by observing users doing everyday-tasks and the nature of these tasks. Then involving the user in the design process.
2. **Empirical measurement** - Early in the process observe the intended users reactions and performance to scenarios. Later on let them interact with prototypes, while they get observed, recorded and analysed. It is important to identify and document the users' goals.
3. **Iterative design** - See if problems really are prevented after the first iteration. Iteration allows designs to be redefined based on feedback and is inevitable since designers never get it right the first time.

3.1.1 Early focus on users

Preece et al. (2007) extend the first principle about early focus on users and tasks into five additional principles. A summary of these principles follow:

1. **Users' tasks and goals are the driving force behind the development.** Not technology. Do not say "Where can we deploy this new technology?". Say "What technologies are available to provide better support for the users goals?".
2. **Users' behaviour and context of use are studied and the system is designed to support them.** Capturing the goals, also how the users perform at their tasks.
3. **Users' characteristics are captured and designed for.** Humans are prone to making errors and have certain limitations, cognitive and physical. Take these limitations, such as memory, attention and perception, in account when designing a product.
4. **Users are consulted throughout development from earliest phases to the latest and their input is seriously taken to account.** However, the designer is the leader and has to be respected by the users.
5. **All the design decisions are taken within the context of the users, their work, and their environment.** This does not mean that a user has been involved in all the decisions. It is just important to have the user in mind when making the decisions.

Inspired by these principles we chose to involve users early in the process. This by using the qualitative methods focus groups and workshops. The reason for this was that we wanted to develop a usable product. To do this we needed detailed information about the behaviour of the intended users to conclude if connected cameras are interesting and how they would want to interact with them. The

results from the methods was later completed with a quantitative method, online questionnaires, to survey if the qualitative data were demonstrative for a larger group of people.

3.2 Target audience

Our hypothesis is that the future consumers of connected cameras already have experience of photographing and sharing pictures. We also believe that experienced users would contribute with the most ideas and inspiration during our data gathering methods. Based on this and the information gathered from the focus groups we defined the target audience of connected cameras as:

People that uses a system- or compact camera on a non professional level. Sometimes or more frequently they also share their pictures on social websites, such as Flickr, Facebook or photo blogs. From our focus groups we have identified several reasons to why connected cameras would suit these users:

- The user has a need or wish to share the pictures instantly after they are taken.
- The user wants to share pictures but rarely does it because of laziness or lack of time.
- The user wants to upload photos but is unaccustomed to technology and would perhaps rather not use computers at all (Miller and Edwards, 2007).
- The user is familiar with the uploading process as it is now, but would not mind it to be more efficient.

3.3 Focus groups

According to McDonagh and Bruseberg (2000) a focus group is a good way for developers to get a deeper understanding for the user experience which is necessary for the designing process. Rogers et al. (2007) concludes that focus groups also are time efficient since information about several users is gathered in a short time. Another benefit of using focus groups instead of interviews is that discussions can be raised and the participants might discuss issues that otherwise would be missed. Based on this we decided to arrange focus groups early in the design process to get to know potential users and learn about their habits both when it comes to photographing and sharing photos.

When selecting people to participate in the focus group it is important that they are selected to be representative of the intended users of a product (Preece et al., 2007). We therefore focused on our target audience when we hand-picked 17 people who we sent invitations to. Ten of them were students from KTH and seven employees from the photo store Scandinavian Photo. Seven from KTH and five from Scandinavian Photo accepted the invitation, a total of four women and eight men. We organised these people into two focus groups. One of the focus groups consisted of the students from different years on from the Media Technology program. The other group included the staff from Scandinavian Photo plus one of the students. All of the participants from Scandinavian Photo work as professional photographers parallel to their job at the store. The student who participated in the photographer group also worked as a photographer. The reason why we chose to arrange two different homogeneous groups was that the students might feel inferior to the photographers and therefore the discussion could easily be dominated by the opinions of the photographers.

We divided the sessions into four main parts:

- Group discussion about how the participants currently use their cameras and their picture sharing habits.

- Group discussion about picture sharing directly from digital cameras and how future products could work.
- A video demonstration (Jacobowitz, 2009) of the uploading function in the Sony DSC-G3 digital camera and then review and group discussion.
- A video demonstration of the Eye-Fi memory card and then review and group discussion.

A method called the funnel-method was used during the focus group. We started with open questions to get the participants warmed up and talkative. Then we gradually narrowed them down during the session to concrete questions about the demonstrated products.

One of us had the role as moderator that lead the focus groups while the other one was taking notes, the whole session was also recorded with the permission of the participants. The sessions was about two hours long, including the showing of the two video clips.

3.4 Design workshop

A prototype produced early in the design process in cooperation with the users will capture their basic needs and demands. This can be made by gathering users for a workshop where the aim is to, relatively impartially, design and try different solutions to the given problems. The artefacts produced during the session becomes the foundation to the first mock-ups of the user interface (Gulliksen and Göransson, 2002). Based on this we started our design process of the user interface with a workshop. The predefined problems that were about to be solved during the session were based on the analysis of the results from the focus groups. The setup of of the workshop was shaped after this recommendation from Gulliksen and Göransson (2002):

A typical setup for a workshop:

- Start with a specification of some common user scenarios that represent the most important and critical user situations.
- Use easy tools to design mock-ups of the user interface in parallel groups.
- Discussion about the different designs in the whole group.

The workshop hence started of with a presentation of written and drawn scenarios. These scenarios were:

- A person photographing at a party or a dinner. After the night he wants to but also feels pressured to share the pictures with his friends while they are still fresh.
- A person on vacation who wants to share pictures with friends and family at home. Internet cafés are slow, unsafe and sometimes not even available.
- A person takes one funny or special picture, for example a picture on the first outdoor bath of the year. He wants to share this one picture immediately because it would not be as interesting if he waits.

After a short discussion about the scenarios the group was split into two smaller groups that each got a different task. One group got to design the interface and decide what functions that were required in the first scenario, the second group got to do the same thing for the third scenario. The results from the focus group indicated that touchscreen and wide and easy access to the Internet would be required in a connected camera. The groups could therefore assume that the camera had these features when designing the interface. We as the moderators placed ourselves one in each group to help and ask about things and functions that the participants might not think of. During a workshop it is important that it is as easy as possible to create and modify the designs (Gulliksen and Göransson, 2002). Therefore simple, modifiable artefacts in forms of sketches and paper drawings were produced. To facilitate the sketching for the

participants we prepared several paper templates of the LCD-side of a Nikon D90 beforehand. A hole was cut in the location of the screen. This to enable the participants to view their design in a “camera” by putting it underneath the template. As recommended by Weiss (2002) the camera template was scaled 1.5 times the regular size to make it easier to fit text and pictures when drawing by hand.



Figure 3. The prepared template of a D90 scaled 1.5 times, with a cut whole as the screen. A paper drawing of a interface made by a participant in the workshop is placed underneath the template to simulate it's screen.

When both groups had created a design, one representative from each group got to present their design to the other group. The groups put the others design in their scenario to see if it would satisfy their requirements.

After the presentations there was a group discussion about the differences, pros and cons with the two designs.

3.5 Questionnaire study

After the workshop we had some ideas of functions that seemed important in a camera with uploading opportunities. A questionnaire to a large group of possible users could confirm or discard these ideas (Preece et al., 2007). Since we wanted as many answers as possible we made a very short online questionnaire with only four, carefully composed, multiple choice questions. The questionnaire was emailed to approximately 400 people. A large majority of them were students of Media technology on KTH and the rest were other potential users. We were only interested in the answers from potential users of our product. Therefore we started the questionnaire with the question *if* the person shared photos on the Internet. The answers from the participants who answered “never” on the first question were not used when compiling the remaining results. The reason was because they were not a part of the target audience. We deemed that all other participants gave valuable information.

See appendix 1 for the original questionnaire in swedish.

4 Results

In this chapter we present the results from the empirical studies. We do this by concluding what the participants discussed during the focus groups and what they designed during the design workshop. We also post diagrams of the results from the questionnaire study.

4.1 Focus groups

In this chapter we conclude what the participants in the two different focus groups expressed. The focus group with KTH students is called group A and the group with photographers called group B.

4.1.1 Camera use

All the participants were owners of at least one camera, most of them owned several. In that case usually the combination of one SLR-camera and a compact camera and/or a camera phone. Some of them were photographing professionally but also with their friends and family. Other participants only took pictures at special events and during trips while some were photographing more frequently and also took more artistic pictures. SLR-cameras were used at jobs or during occasions where the user wanted high quality pictures, photo trips or vacation pictures for example. Compact cameras were used on occasions where the user wanted fine pictures without having to carry around a heavy and expensive camera, parties was a common example of this.

All of the participants sometimes used the camera in their mobile phones. Some of them just used it once in a while and some used it frequently. Reasons to why they used the mobile phone were its availability and connection to Internet. Pictures taken with the phone were often funny or special in another way and shared through MMS, Facebook or Twitter. A motivation to why they wanted to share their pictures instantly was to get direct responses from friends.

Most of the participants emptied their memory cards after every photo occasion. Reasons for this was to back-up the pictures, empty the card so it is fresh until next time and also curiosity about how the pictures turned out. The ones who did not instantly empty their cards most often wanted to, but lack of time or laziness held them back.

4.1.2 Quality vs The Power of Now

The participants agreed on that the importance of image quality is depending on its context. A photo taken with an SLR-camera has higher expectations on image quality but does not need to instantly be uploaded. *"The better picture quality, the longer one can wait before uploading the pictures. It is common that one wants to edit those pictures, and that takes more time."* (Participant 1, group A). The participants agreed that pictures taken with an SLR-camera often got edited before shared. *"If you take a pictures with a system camera it is almost required that you also edit the pictures."* (Participant 2, group B).

When it comes to pictures taken with a camera phone the importance of the quality is much lower. Some participants argued that people are used to low quality and do therefore not expect anything else. *"One has gotten used to the bad quality of the pictures and has accepted it, so it does not matter. If it is that kind of a picture, for example of where you are and what you are doing right now."* (Participant 3, group A). The group recognised that they choose the mobile phone before the camera if they quickly want to upload a picture.

In that case quickness is more important than quality. The reason for this is that a picture of something that happens “right now” loses its value if it gets uploaded later. As Van House (2004), we call this phenomena “The power of Now”.

4.1.3 Evaluation of and discussion about current products.

To try to answer the question “How usable are the products that exists today?” we let the participants of the focus groups discuss the functionality of some of the current products on the market that makes it possible to share pictures instantly from ones camera.

4.1.3.1 The Sony DSC-G3 digital camera

After watching the Sony G3 demonstrational video the participants agreed on that the product had many flaws. An advantage some participants found with the camera was the possibility to upload photos without access to a computer if one is located in an area with open wireless network. However, they realised that that kind of situation is rather rare, more hypothetical than real. Another advantage was that one could upload photos to the Internet in an home environment without having to use cables and in that way save trouble and time. After realising that it took about three minutes to upload one picture, the they agreed that they would actually save more time if they used those cables, especially if they wanted to upload more pictures. A function the iPhone owners in the group liked with the camera was that one could upload many pictures at the time. An iPhone only allows to upload one picture at the time.

The main shortcoming of the Sony G3 was without doubts the long uploading time. Especially since photographing while the photos are uploading was impossible. It would be better if the camera would not be occupied during the uploading. The participants also agreed on that there were to many clicks to get to the actual uploading. *“The upload has to be instant, otherwise you get irritated.”* (Participant 2, group B). Another disadvantage was that the size and quality of photos could not be reduced before uploading. That would shorten the uploading time significantly.

An opinion from several users was that Wi-Fi might not be enough. *“It is rare that you have access to Wi-Fi when you are in those kinds of situations.”* (Participant 4, group B). Thoughts about a camera with 3G, 4G, WiMAX and bluetooth connected to the mobile phone were discussed. The conclusion from that discussion was that a connection is needed everywhere, first then can a camera compete with a camera phone.

The general understanding of the Sony G3 in the group can be summarised with this quote: *“This solution feels half done. It was a good idea, but a bad implementation.”* (Participant 5, group A).

4.1.3.2 The Eye-Fi memory card

When evaluating the concept of Eye-Fi SD memory card two different general standpoints developed in the two different focus groups. The participants in group A were at first sight skeptical to if it really works. They thought that it seemed complicated with all the pre-settings that one had to on a computer before use. *“Good if it works”* was the common opinion. In that case, especially for wireless transfer of pictures to the home computer. Group B had a more positive attitude to the memory card. They did not question the technology but rather believed that it would be an effective way to transfer photos from the camera, if not to the Internet at least to the home computer.

It was important that one could choose which pictures to upload if uploading to a website, therefore the upload by protect function was appreciated. However, the automatic uploading was also valued by some

of the members. This function was usable when uploading pictures to the home computer and when photographing for a job. *“Automatic uploading would be efficient when photographing weddings, interior design and journalistic jobs.”* (Participant 6, group B). All the participants agreed on that it was good that the pictures uploaded in the background and that the user could keep on photographing. Since one had to do the pre-settings on a computer the Eye-Fi card needed much fewer clicks than the Sony G3 which was appreciated. Some participants saw a problem in that the Eye-Fi card was only available in SD format, since they used Compact Flash cards in their cameras. These participants wanted the same solution for CF cards or a solution that fits all memory cards.

Many participants liked the Eye-Fi solution for local file transfer to the home computer. However, for picture sharing to the Internet they found that some important functions were missing. Some participants argued that they would not use the online sharing function since they wanted to edit the pictures before uploading them. Text to uploaded pictures was also necessary in some situations to explain the context of the picture.

A wish most participant had was to integrate the uploading function in the interface of the camera. That way one could choose which sites to upload the pictures to and get feedback on if the pictures have been uploaded.

Other weaknesses with the Eye-fi card was, as with the Sony G3, the incapability to reduce image size and the restriction to Wi-Fi networks. An extra disadvantage with the Eye-fi card was that even if one knows the password to a network a computer is still needed to get the card connected to that network.

4.1.4 Other opinions

Overall the Eye-fi card was more popular among the participants compared to the Sony G3. Some of them could even consider buying it, if the price would have been better. Some of the participants argued that the quality of the camera in a mobile phone will improve in the future and that they believed that camera phones will replace digital compact cameras.

Questions about shorter battery life was also brought up since the uploading must get energy from somewhere. Using power to transfer the pictures leads to shorter battery life for photographing. This could be critical if photographing on the field.

A problem discussed was how the implementation of the text would work with today's cameras. One of the participants suggested an on screen alphabet where the user scrolls between the letters and press enter at the right ones, others argued that that kind of implementation was too slow and meant that touch screen or a projected key board were the only acceptable solutions. The participants then agreed that a touch screen would facilitate implementation of text significantly. However, they did not want the touchscreen to replace the original buttons on their system camera since they needed them when photographing.

4.1.5 Summary of results from focus groups

Camera use:

- The camera in the mobile phone was used for its availability and connection to Internet
- Motivations to share pictures instantly was to share moments and to get direct responses from friends
- The importance of image quality of a picture is depending on its context

- A photo taken with an SLR-camera has higher expectations on image quality and therefore often got edited before shared
- Camera phones are used instead of digital cameras if immediate uploading is wanted

Functionality present in either solution:

- A touch screen facilitates implementation of text significantly
- Ability to upload several pictures at once
- Ability to upload pictures in the background while using the camera
- Manual selection of which pictures get shared

Lacking functionality:

- The coverage for Wi-Fi networks is too limited
- No option to edit pictures before upload
- No option to add text to pictures before upload
- No option to decrease file size

4.2 Workshop

The results from the workshop were two mock-up designs of how the interface and the flow would look like in a connected system camera with touch screen and unlimited Internet connection.

Group A designed an interface that would benefit a scenario were several pictures were uploaded. Group B designed for a scenario were one picture was uploaded.

Some parts of the two designs turned out to be quite alike. A reason to this was probably because they both were relatively conventional designs, inspired by the interface of iPhone/camera phones and system cameras today. Both groups made it efficient to quickly upload a picture from preview-mode, an uploaded picture were only three clicks away. This meant that user name and password for the different sites had to be pre-typed and saved. Besides this mutual function group A focused on how to sort pictures and mark several pictures in the preview mode. This was made by letting the user be able to create folders to save the pictures in. Another function was to star mark favourite pictures and being able to filter the pictures in preview mode so that only desired pictures were shown. Group B focused on what to apply to a picture before uploading it. Some functions reachable directly from preview mode was therefore introduced. These functions allowed the user to add text to the picture and also to edit them before uploading.

During the discussion held after the presentations of the design the participants got to express what they liked most about the designs. Design A was liked by the other group for its folders, the possibility to star-mark the pictures and its simple design. Group A themselves were most content with the simpleness of their own design. This referred to that there were only two choices at the beginning, no superfluity. Design B was commended for the possibility to name, edit and crop the pictures. Also this design were liked for its simpleness/ease-to-use. Group B themselves liked the editing function since it was "real" editing not only adding a filter to a picture. Also that there were only three clicks until the picture was uploaded.

Storyboards of the designs can be found as appendix 2 and appendix 3.

The most important functions we concluded from the workshop:

- Few clicks from preview to upload
- Editing before uploading single pictures
- Sorting and organising pictures in the camera
- Adding title and description to pictures
- Ability to select upload destination

4.3 Questionnaire

243 people participated in the questionnaire. A total approximately 400 people was asked to participate. 13 of the participants answered that they never shared pictures on the Internet and were thereby not a part of our target group. Therefore the answers from these persons were not taking into account on the remaining questions.

4.3.1 Picture sharing

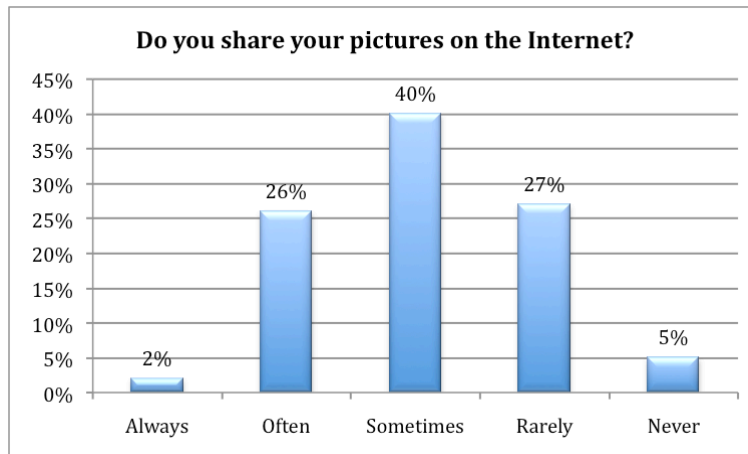


Diagram 1.

The purpose of this question was to filter the answers from respondents not suiting our target audience. As seen in the diagram only 5 percent never shared their pictures on the Internet and are therefore not potential users of connected cameras. The questionnaires were sent to people who we expected to be a part of our target audience. This is probably the main reason for the high percentage of potential users among the respondents.

4.3.2 Text with pictures

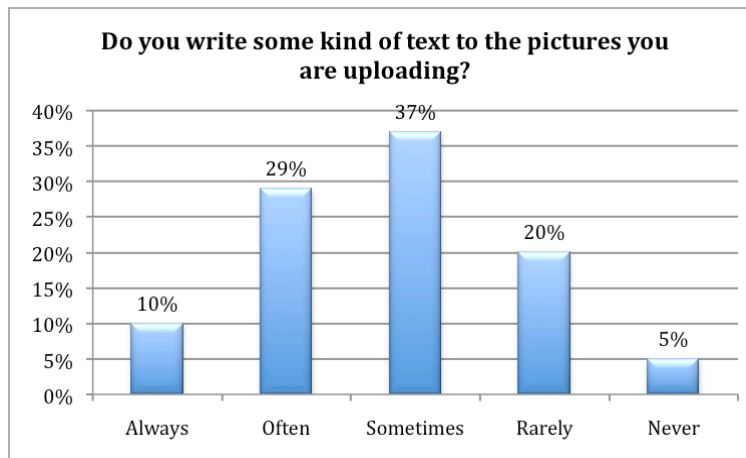


Diagram 2.

75 percent out of the 230 respondents that shared pictures on the Internet answered that they sometimes or more often add text to their uploaded pictures. Only 5 percent never add any kind of text to their pictures. This confirms what was found in the focus group and workshop: that additional text to a picture is important to describe its context.

4.3.3 Photo editing

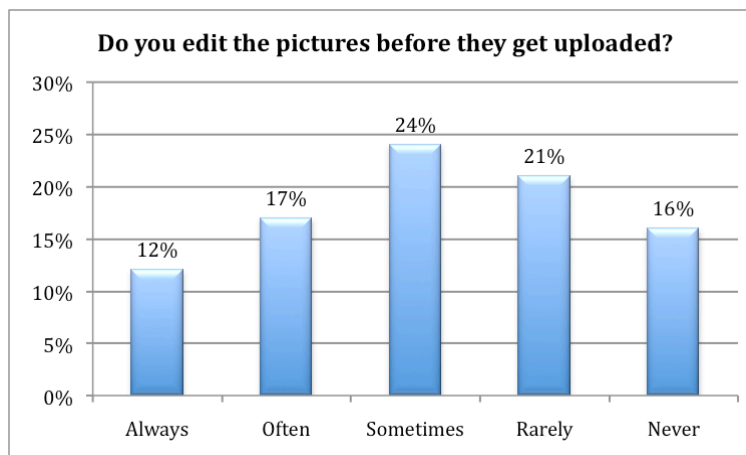


Diagram 3.

63 percent of these respondents sometimes or more often edit pictures before they get uploaded. This would mean that a connected camera without that function would not be completely usable for these people.

4.3.4 Uploading to several websites

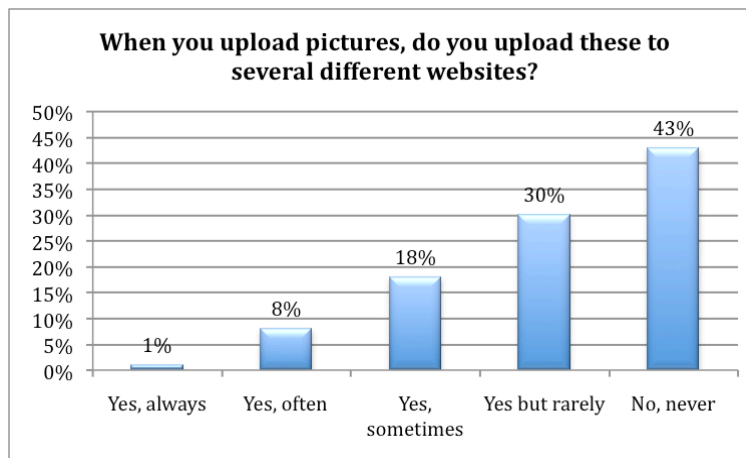


Diagram 4.

Sharing pictures on several sites at the same time were demonstrably not common among the respondents, as many as 43 percent answered that they never did it. We can therefore establish that most people that share their pictures on the Internet often sticks to uploading to one website a time. However, 57 percent must at least have uploaded their pictures to several sites at some occasions and 9 percent use this function often. This also indicates that at least 57 percent are members on several different picture sharing sites.

5 Analysis and discussion

In this chapter we present the analysis and discussion of the results reached in the empirical studies.

5.1 The design process

We believe that it is important to involve real users in the design process. To use an imagined user can be effective when designing a system. However, it can never have the same perspective as a real user that uses the system for real tasks with real goals (Peerce et al., 2007). A possible risk if not involving users is that we as designers will imagine and prevent difficulties that are not even problems for the user or be blind to the real problems with systems. Another possibility is that we could develop a product without a market, because it does not fit the expected users demands.

One of the principles written by Gould and Lewis said that users tasks and goals should be the driving force behind the development, not technology. This principle reflects how we have worked during this project. We have found a behaviour of the intended users, they share their pictures with friends and sometimes also strangers on the Internet. We have also seen that there often is a need of sharing the pictures instantly. We believe a part of this need of immediacy is born from the use of new advanced mobile phones such as iPhone. Inspired by this we have done research on technology that possible could fulfil these needs also in a quality camera. The development of our system therefore started with a need from the user, and have grown from there.

5.2 Why is instant sharing important?

In this section we cover reasons why immediate sharing is important, how picture sharing practices have developed in the past and how we think it may develop in the future.

5.2.1 The power of now

Both from the literature study and focus groups we found that the immediate sharing is important and in some cases even necessary for the relevance of the picture. We have come to the conclusion that a reason for this is that some pictures are only newsworthy for a short period of time after they have been taken. During this critical time the picture captures what happens right at the moment without the knowledge of what will happen next. The photographers feelings about the situation are still fresh and he/she is eager to share that feeling before losing his/her enthusiasm. After that critical time the photo is just a memory. The feelings can still be there, however, not as strong and fresh as before. The desire to share the pictures fades with those feelings.

Another reason for immediate uploading that came up in the focus groups was the wish for immediate response on the uploaded pictures. This could take form active actions as in people commenting on the picture or in passive ways like statistics on how many people have viewed the picture. This motivation is connected with the above reason of newsworthiness. We believe that a comment on something that happens at the moment or just happened is worth more since it is happening during that critical time when the feeling is still fresh. A photo that is immediately shared will allow others to participate in something that happens at the moment. An immediate comment on a picture will give the photographer feedback on that the moment is actually shared and experienced by others.

5.2.2 Development of immediacy in cameras

As shown in the focus group and literature study it is a fact that a lot of people already share photos in an immediate way with their mobile phones. We believe that people generally have got or soon will get used to this. Once they are, it will feel slow and old fashioned to share these “in the moment”-pictures from their digital camera. Even if a photograph is of better quality, the moment is “gone” when coming back home to the computer to upload it. Several individuals in our focus groups explained that this is how it is for them right now.

We compare this development with the transfer from analog to digital photography. During the era of analog photography people were used to the waiting time from a taken picture until one could actually see it. We believe that this changed when the first commercially available digital cameras appeared in the beginning of the 90s (Kodak). The resolution in the cameras was low and the sensors produced images with much lower quality than film in analog cameras. However the digital cameras still outsold the analog ones. We believe that a major reason for this was the new possibility of immediacy. One did not have to wait until the film roll was finished and then go to the lab to develop the photos anymore. With the digital camera one could see the picture on the small LCD screen right after it was taken, and the pictures could easily be shared the same day. Demonstrably immediacy is and has been significant to camera users. To some users more significant than image quality. To connect this to the development of products today, this is exactly what is happening with sharing of “in the moment”-pictures, with camera phone users as early adopters. Immediacy is again chosen before quality. As shown in the focus group, the users are used to the bad quality and have therefore accept it. This is probably what happened with the first digital cameras too. However, nowadays when the quality of the pictures taken with a digital camera has improved a lot people are used to both the quality and the amount of immediacy they can provide. We believe that history will repeat itself and people will desire even more instant sharing of their pictures.

In the same way that image quality got better in digital cameras, we think that image quality will be combined with this new kind of immediacy. Not by mobile phone cameras becoming as good as cameras, but by cameras gaining the wireless connectivity that mobile phones have. When that happens the user will not have to chose between quality and immediacy. The camera phone might be enough for some more casual users, but for photographers that appreciate the artistic parts of photography it is not. These users should not be left behind when technology creates the opportunity to instantly share pictures to friends and other people in the world.

5.3 What additional functions are needed to make connected cameras usable?

In this chapter we conclude what additional functions other than uploading that are needed to fulfil a potential users needs, based on the results from our methods.

5.3.1 Text

From our questionnaire we found that over 75 percent sometimes or more often add text to their images when they upload them to online services. This combined with the studies of Ames and Naaman (2007) have led us to the conclusion that a well designed text input system is needed if an uploading interface for digital cameras will be able to compare to camera phones.

For sites like Facebook and Flickr, tagging is an important part of sharing that many users take advantage of. Tags of people on Facebook makes it easy for friends to easily find pictures from events they have been to. Tagging images on Flickr increases the chance of other people finding the picture when key-word searching for images.

The capabilities of writing text already exists in cameras with upload capabilities today (Sony DSC-G3) but there are improvements to be made. When designing on-screen keyboards one has to think about how, where and when the user will use them. One problem with the Sony camera is that the only text field was “album name” for the album on the sharing site. Another problem is that there is no function to add text, such as title or description, directly to images and thus impossible to add text to a picture just for personal organising or for later sharing.

5.3.2 Editing

From the focus group we found that the users wanted to edit photos taken with a system camera before uploading them. This because the expectations on the pictures quality were higher. In the questionnaire study we found that 63 percent sometimes or more frequently edited their photos before sharing them. The desire of editing before uploading the photos could be a reason for the user to not wanting to upload photos directly from the camera. The user would then rather postpone the sharing until after the photos has been edited in the computer.

Advanced mobile phones such as iPhone and Android have several photo editing applications that allows the user to modify the picture directly in the mobile phone. A similar function would be usable in a camera that allows immediate upload. That way, the user can improve the picture before uploading and does not have to chose between immediacy and editing. While camera phones often include several filters and effects that can be applied to hide the bad quality of the picture, we believe that an editing function in a camera would include more advanced functions more likely to be found in Adobe Photoshop or similar programs. The reason for this is that it will give the user more options and an opportunity to make the photo feel more complete before sharing it.

5.4 What kind of technology is needed to satisfy the user and make the product convenient?

This is one of our sub-questions which aim to describe what kind of technical functionality a connected camera should have according to our results.

5.4.1 Connectivity

The biggest factor for immediate picture sharing in a camera is that it must have Internet access over a large area. A big problem with only having Wi-Fi as means of communication for a camera is that wireless networks often are unavailable when out of the home. This was confirmed in the focus groups. One seldom has access to a wireless network when out of the home and a photo sharing opportunity might be interesting. Some participants told that they often upload fun pictures of random things they see when moving about the city. When traveling on the subway or even when walking around, one easily leaves the coverage of the wireless network one are connected to, if one even manages to find an open network in such environments. The coverage has to be better if these functions should be interesting for users, since they expect to be able to share their pictures when they want and not wait to find a WLAN to

connect to. Here we can look at mobile phones and learn from what technology makes it possible for them to maintain connectivity in large areas, 3G for example.

One of the problems we found when researching the Sony G3, was that the Wi-Fi connection was very slow. Even though the camera was close to the access point it took several minutes to upload one picture. The Eye-Fi card was faster but lacks an in-camera interface and thus makes it impossible to upload pictures when in an area where you have not setup a Wi-Fi connection.

We believe that the amount of devices with the ability to access Internet will continue to increase with the development of 4G and we definitely think that the possibilities to implement upload or download functions in cameras will be much more rewarding when bandwidth increases. 4G, the collection of new cellular wireless standards, has peak downstream bandwidth a minimum of 100 Mbit/s (ITU-R, 2008) which makes it possible to upload large files in seconds. There is of course a problem in that the battery time will go down when the camera has to maintain a connection to the Internet, but we believe that this factor plays a minor role if the interface and uploading works efficiently. Manufacturers of cameras with these function must optimise how and when the camera connects to the Internet, so that the battery is not used more than necessary during this process.

We have purposely not delved into how to solve the technical implementation for connectivity in cameras since we do not have the expertise and knowledge in this kind of hardware. We do believe that it is possible to further implement Internet connectivity in cameras based on other products that are available today, such as mobile phones, the iPad 3G (Apple, 2010) and 3G usb modems. We believe that more and more devices will be connected to the Internet in the future and that cameras is high up on that list of devices.

5.4.2 Touch screen

From our focus groups and workshop we found that the participants had a very positive attitude towards a touch screen interface, as long as it does not replace buttons that they are used to find without looking where they are. We believe that buttons with tactile feedback are needed when photographing with a system camera, since one looks through a viewfinder when taking a picture. Replacing hard buttons with soft buttons would force the user to stop looking through the viewfinder if he/she wants to change settings while taking a picture. This would be time consuming and good photo opportunities can be missed if the photographer has to look at the screen instead of the object.

For uploading related functions, such as writing text, we found that touch screen was a preferable alternative to using hard buttons. During the process of editing or uploading pictures, the user will look at the screen and will be able to see the buttons he/she are pressing without problem.

There are a lot of ideas and research that have lead to how a camera is designed today. It is meant to be easy and fast to take photographs and accessible for users with different experience levels. For instance, most cameras has different automatic shooting modes aimed at beginners as well as manual modes for more advanced users. We believe advanced users are used to interacting with their cameras with their eye in the viewfinder and fingers on the buttons. This is efficient and is not something we want to change, especially for system cameras. Touch screen technology makes it possible to add an uploading interface without cluttering the cameras design with buttons that are not related to taking the picture. Touch screen should be considered as a way to add possibilities to camera functionality, not to replace the old interface.

5.4.3 Image quality

One of the biggest differences from a camera phone and a connected camera is image quality. That is also the most important factor to why one would use a connected camera before a mobile phone when sharing pictures. As we brought up in the background, camera phones have lower image quality since they are limited to smaller lenses and image sensors. The smaller sensors in camera phones will overall produce lower quality images, especially in low light situations. This makes it impossible for them to reach the same standards as digital cameras when it comes to image quality, which some of the participants in our focus groups hoped for. Even if image quality progresses in mobile phones and produce the same level of image quality as system cameras today, the future cameras will also progress and continue to excel.

6 Suggested solution

In this chapter we present a suggested solution of an interface accompanied by necessary functions for a connected camera. The solution is based on the analysis of our results from the empirical studies.

6.1 How should the interface be designed to make the product efficient and usable?

To answer this question we have designed an interface prototype based on the analysis of our results and methodology.

The interface is designed to benefit a potential connected camera with unlimited connection and touch screen. The on screen buttons are big and their locations are adjusted suited to how a user usually holds a camera. In preview mode it is possible to directly share or add text to several pictures at once. There are also sorting and filtering functions available to give the user a overview and easy access to desired pictures. The user can therefore star mark photos and sort them into several albums/folders. In preview mode filters are used to decide which pictures to show.

The share and text functions are also reachable from the preview mode for single pictures. In this mode an additional editing function can be found. The reason for this is because the need of editing is very specific for each unique picture.

When uploading pictures the user already have the account settings saved and can therefore connect to a sharing site simply by checking the corresponding box. The pictures can be placed in new or existing albums when uploading to sites with such capabilities. Only websites that the user already has added account information to are available options to upload to. If the user wants to add a new account he/she can go directly to accounts settings from this page. Since the suggestion does not cover the technical settings of the uploading process, we have not created this specific settings page in our prototype.

This interface includes all functions necessary in a connected camera, but does still allow the user to upload pictures in a fast and efficient way.

6.2 Storyboard of suggestion



Figure 4.1 Nine pictures shown in preview mode. Filter buttons are located to the right and action buttons on the lower part of the screen.

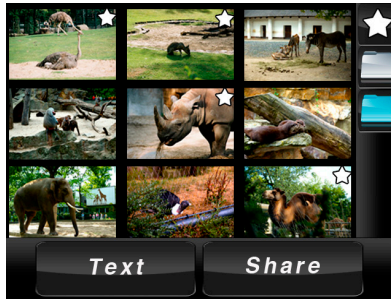


Figure 4.2 If pictures have been star marked this is shown with a star in the upper right corner of the marked picture.

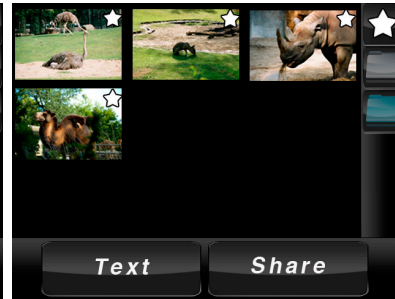


Figure 4.3 The filter is set so that only star marked pictures are shown. The user can filter the pictures depending on star marks and folders.

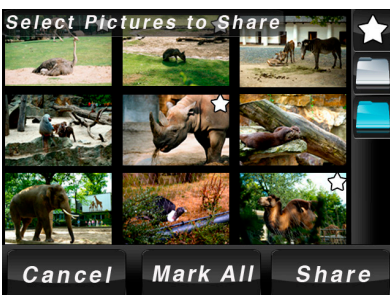


Figure 4.4 When the "Share"-button in figure 4.3. gets pressed, the user gets to decide which pictures to upload.

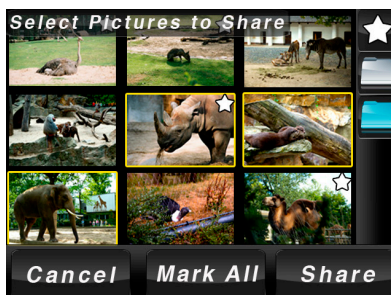


Figure 4.5 The user selects wanted pictures by pressing them.

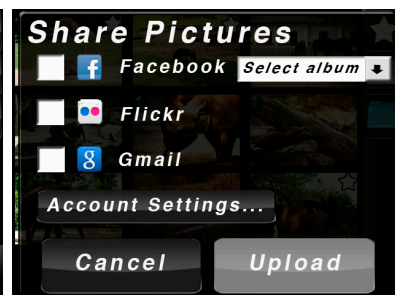


Figure 4.6 The user selects which sites to upload to by checking checkboxes.

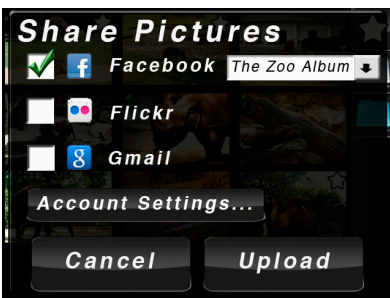


Figure 4.7 Album name for Facebook has to be selected. Existing albums show up in a dropdown menu.

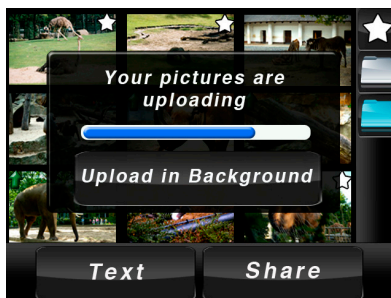


Figure 4.8 After pressing "Upload" a window with uploading feedback pops up. The user can continue photographing.

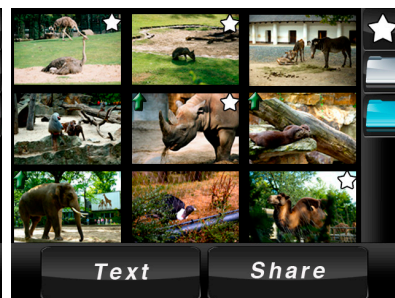


Figure 4.9 The uploaded pictures are marked with a green arrow.

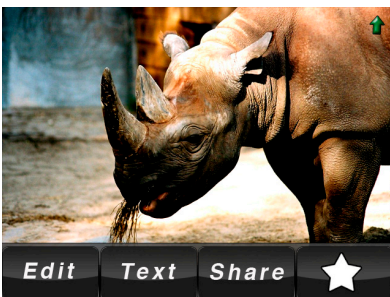


Figure 4.10 By pressing directly on a picture, the user is sent to one picture preview mode.

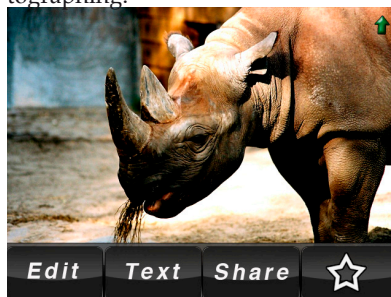


Figure 4.11 It is possible to star mark or un-star mark pictures.



Figure 4.12 Selecting "Edit" will prompt the user to select what adjustment should be made.

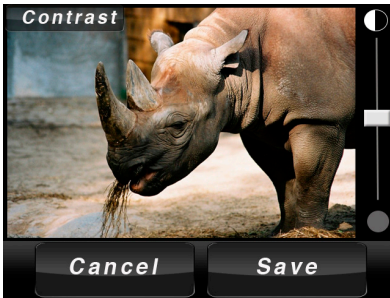


Figure 4.13 In contrast adjustments, a slider to the right adjusts the intensity of the adjustment.

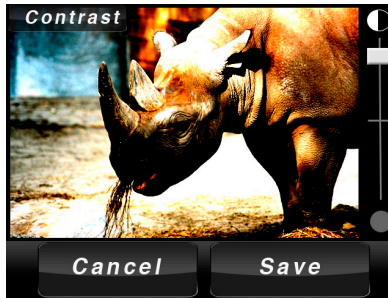


Figure 4.14 If the user do not wish to apply the adjustment the “cancel” button is pressed.

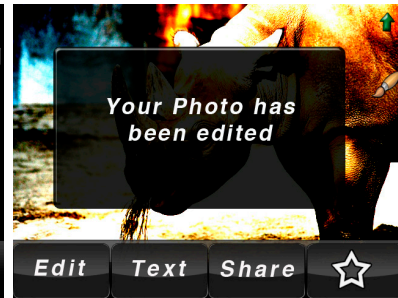


Figure 4.15 After pressing “Save” a feedback window appears.

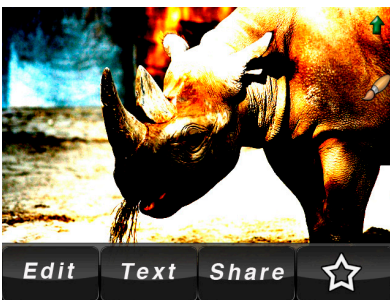


Figure 4.16 A brush icon on the right sides indicates that the photo has been edited.



Figure 4.17 In the “Text” menu the user add text directly to the image file.



Figure 4.18 When the user presses the input box and an on-screen keyboard appears.



Figure 4.19 The user can input desired text. If no text is wanted, one can empty the field by holding the erase button.

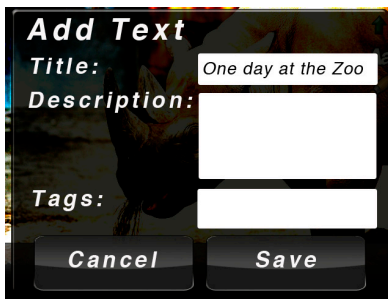


Figure 4.20 Now the user can read what text is written to the file.

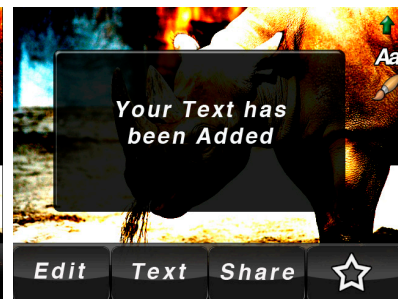


Figure 4.21 After saving the user is sent back to preview mode.

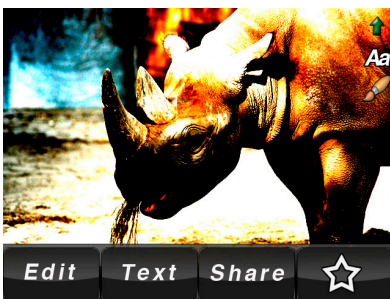


Figure 4.22 A text icon on the right side indicates that the picture has text saved to it.



Figure 4.23 By double pressing the picture, the user can zoom out to nine picture preview or erase the picture.

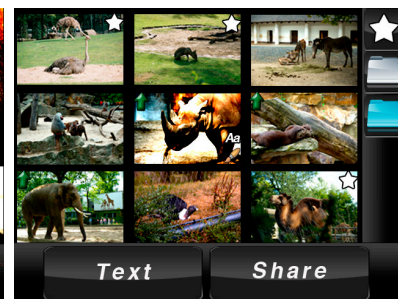


Figure 4.24 The appropriate icons indicates what changes has been made to the different pictures.

7 Conclusion

In this chapter we conclude our work by answering the main questions that constitutes the problem formulation of the project.

7.1 Why have immediate uploading of photos been a success on the camera phone market and not yet on the camera market?

The main reason to why camera phones are often used before digital cameras is their availability. A mobile phone is always carried by the user and therefore accessible when a photo opportunity is arising. As found in the literature study the mobile phone camera has changed the way of photographing to a more casual way where highlights from everyday life are captured. Social picture sharing sites such as Facebook and Flickr contributes to a behaviour of casually sharing photos by making the sharing easy and available. Today, when sharing sites can be reached from camera phones these two behaviours has merged into a common sharing of casual or eventful pictures. This behaviour can be regarded as a newborn need from the mobile phone users. This need can today not be satisfied in a fulfilling way by digital cameras. The Wi-Fi cameras and Eye-fi card that we consider the best current solutions still needs development before being able to compete with the immediacy of the mobile phones. In the case of Wi-Fi cameras, the process is too time consuming and complicated for users to be able to instantly share their pictures without hassle. The interface for uploading has not been implemented as a core function that is well integrated with the system, but as a function separate from the other parts of the camera. The ability to send the picture within seconds after it is taken is therefore lost and with that, the user loses the interest in uploading it. The Eye-Fi memory cards problem is that it has no built-in interface for connecting to new networks, something that is very important when a user wants to upload a picture when they are out of range from their regular wireless networks. A problem both these solutions have is the unavailability of Wi-Fi coverage when moving around. This is purely a technical problem that we believe will be solved with further development of wireless technologies for mobile devices.

An important factor that we have discovered is that users seem to have grown used to lower image quality in pictures that are shared on-the-go. The lack of options for immediate uploading may be why users are accustomed to this.

7.2 What functions are needed in connected cameras to make them usable?

As we found in the focus group, Wi-Fi as the only connection is not enough to make the uploading convenient. As discussed in this paper, we believe that the technology that will allow other ways of Internet connection in a digital camera already exists. The question is when the technology will be implemented into digital cameras and introduced on the market. The usability of a digital camera with sharing possibilities will improve drastically with unlimited Internet access.

In our questionnaire study it was clear that most users sometimes or more often added text in forms of title, descriptions or tags to their photos. This function is important to add context to the picture which in some cases could explain or clarify what the photo is capturing.

The study also showed that many users edited their photos before sharing them. Participants in the focus group felt that they almost were bound to edit pictures taken with a system camera before uploading them. This because they perceived that the expectations on the pictures were higher. In this case the possibility of editing photos is important for a feeling of completion and satisfaction with the picture before sharing it. Because of these reasons we believe that editing functions are necessary in a connected camera. This function is today available in some mobile phones and these can therefore be seen as a source of inspiration. However, the editing functions have to be designed to also suit more advanced photo editing, such as cropping and adjusting colour and contrast.

To allow the user to use these functions in a simple way we believe that a touch screen today is the best solution. Soft buttons can change from one screen to another. In that way only the buttons that fit the context need to be visible which will lead to a cleaner and more usable interface. A touch screen would also make it easier to implement text.

The design of a touchscreen interface in a connected camera should be suited to the context of how it is used. The buttons should therefore be designed for users interacting with their thumbs, since a camera is usually held with both hands.

To allow the user to easily share pictures during the critical time of immediacy we believe that it is important that the uploading function is as available and efficient as possible. Therefore we are convinced that the function should be integrated in the preview mode, rather than placed in the menu. Eventual network settings should be saved on the camera and in that way not bother the user during the uploading process. The uploading will then focus on the social parts of sharing the image rather than the technical aspects. With these qualifications, sharing a picture could happen with only a few clicks.

When a connected camera includes all these functions we will consider it to be usable. First when that is accomplished we believe that immediate upload of photos will be a success also on the digital camera market.

7.3 Future work

There is need of further iterations of the design process to get feedback from potential users about our suggestions and then implementing this feedback back into the interface. Creating a hi-fi prototype, preferably tested in a mobile device with a camera, would also be needed to test the interface in its correct context. Ultimately a goal could be to have this research put into a real product.

Wireless Internet access technologies with large area coverage must be implemented in cameras to make instant picture sharing an interesting function. How to do this is something that is very important for a connected camera. We suggest to research how current and future wireless technologies, such as 3G or 4G, can be implemented into a camera.

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Appendix 1 - Questionnaire (in swedish)

Frågor om uppladdning av bilder till Internet - på 1 minut!

Vi arbetar med att utveckla ett gränssnitt för framtidens kameror. Dessa kameror kommer inte att behöva någon dator för att ladda upp bilder till nätet. Det kommer de att klara helt själva. Svara på fyra snabba frågor för att hjälpa oss att göra gränssnittet för denna uppladdning så användbart som möjligt!

MVH

Teresia och Daniel

* Required

Delar du med dig utav dina bilder på nätet? *

Ex. Enstaka bild med iPhone, bilder från resa på Facebook, fina bilden på Flickr

- Alltid
- Ofta
- Ibland
- Sällan
- Aldrig

Skriver du någon form av text till de bilder som du laddar upp?

Ex. Titel, beskrivning, taggar...

- Alltid
- Ofta
- Ibland
- Sällan
- Aldrig

Redigerar du bilderna innan de laddas upp?

Ex. Öka kontrast, justera färger, retuschera...

- Alltid
- Ofta
- Ibland
- Sällan
- Aldrig

När du laddar upp bilder, laddar du då upp dessa till flera olika hemsidor?

Ex. Flickr och facebook, eller resedagboken, picasa och blogg...

- Ja, alltid
- Ja, ofta
- Ja, ibland
- Ja, fast väldigt sällan
- Nej, aldrig

Appendix 2 - Workshop design A

This interface was designed by group A to benefit a scenario where several pictures were uploaded. Besides being able to upload pictures in a fast, efficient way the group focused on how to sort and mark several pictures in the preview mode. This was made by letting the user be able to create files to save the pictures in. Another function was to star mark favourite pictures and have different filters in the preview mode so that only desired pictures were shown. A storyboard of the interface follows:



Figure 5.1 A list of folders where the photos can be sorted.

To be able to organize the pictures in an efficient way, files were introduced. Before photographing a folder is chosen where all the following pictures will be sorted. When uploading one or several folders can be chosen.

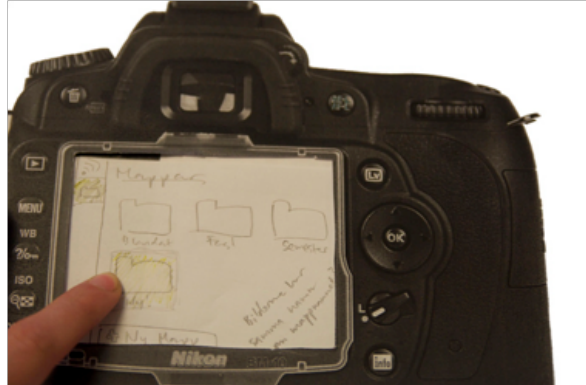


Figure 5.2 "New Folder" is selected.

If none of the existing folders match the photo occasion a new folder can be created.



Figure 5.3 A keyboard is shown on the screen when typing in the name of the folder.

Every time text implementation is needed an on-screen keyboard is shown.



Figure 5.4 Nine pictures shown in preview menu.

In the preview, menu filter-buttons are located to the right and action buttons in the lower part of the screen. With the filter buttons the user can easily decide which pictures will be shown at the moment.



Figure 5.5 Preview mode of one picture. The star button is selected.

In preview mode of one picture a uploading button is located to the left and star mark button to the right.



Figure 5.6 Feedback on that the picture is star marked.

When doing an action e.g. star marking a picture, on screen feedback is shown.



Figure 5.7 The uploading button is clicked on.



Figure 5.8 Facebook is selected and the uploading button gets pressed.

When uploading a picture the user simply mark which site to upload the pictures to and if necessary selects or creates an album. What sites that are shown in this list have already been set by the user in the settings-menu.

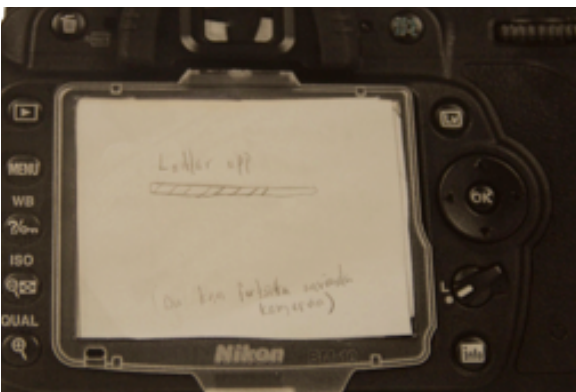


Figure 5.9 Feedback on that the picture is uploading.

While uploading photos the user can keep on photographing with the pictures uploading in the background.

Appendix 3 - Workshop design B

This interface was designed by group B to benefit a scenario where one specific picture was uploaded. This design focused on the ability to upload a satisfying picture in a fast and efficient way. Some functions reachable directly from preview mode were therefore introduced. These functions allowed the user to add text to the picture and also to edit them before uploading. A storyboard of the interface follows:

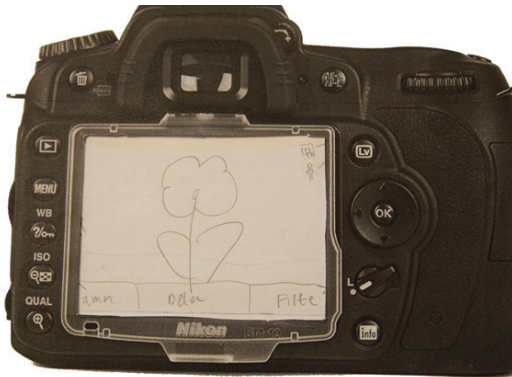


Figure 6.1 Preview mode of one picture.

When tapping a picture in preview mode the three buttons "name", "share" and "filters" becomes visible in the lower part of the screen. If more alternatives the buttons will turn into a scroll menu.



Figure 6.2 The "name"-button is pressed.

The "name"-button is pressed to add text to the picture.



Figure 6.3 A key board is shown on the screen when typing in the text.

Every time text implementation is needed a on screen key board is shown.



Figure 6.4 The filter button gets pressed.

The filter button gets pressed when one wants to edit the picture.



Figure 6.5 Filter menu is visible. "Contrast" gets pressed.

In the lower part of the screen the filters and other editing alternatives are shown. The alternatives are "contrast", "sharpness" and "crop". If more alternatives than the screen can fit it turns in to as left-to right scroll menu.



Figure 6.6 The contrast in a picture gets modified.

When applying an editing filter to a picture the user gets to decide the extent of the effect. This by using the editing bar on the right side of the picture.



Figure 6.7 The picture gets cropped.

When cropping a picture the screen gets shaded except from a square in the middle. The square represents the part of the picture that will be cropped. It can be moved and the size can be adjusted by the upper left and lower right corner.

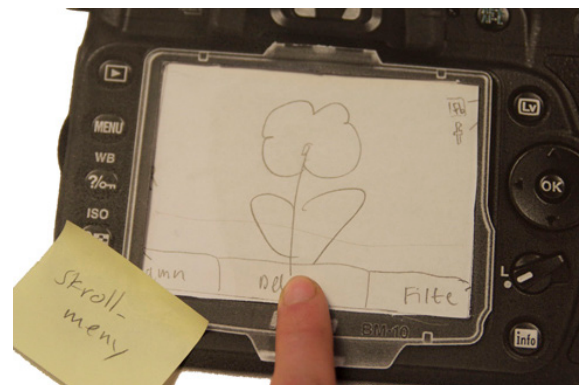


Figure 6.8 The "share"-button gets clicked.



Figure 6.9 The icon for Flickr is marked and the uploading button gets pressed.

When uploading a picture the user simply mark which site to upload the pictures to. What sites that are shown in this list have already been set by the user in the settings-menu. When done selecting site the user presses OK and the picture will be uploaded

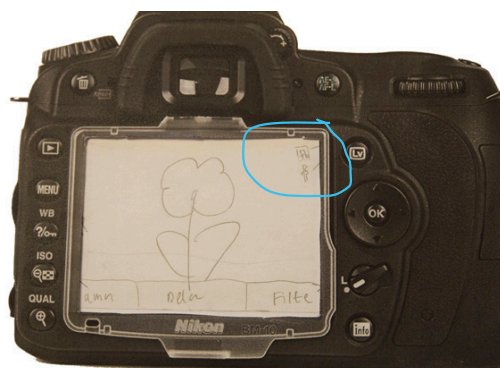


Figure 6.10 On screen icons gives feedback that the picture is uploaded.

While uploading photos the user can keep on photographing with the pictures uploading in the background. When the pictures are uploaded the icon of the selected web site will be shown in the right side of the screen.

