Designing in Personal, Social and Cultural Factors in Shaping the Emerging Technology Applications:
A Case for Visual Lifelogging

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Abstract: In examining ways to incorporate multi-disciplinary considerations in the process of designing innovative technology applications that take into account the personal, social and cultural implications, we use visual lifelogging activity with a wearable digital camera as an example case of emerging novel activity which started on the basis of a purely technological possibilities and yet pertain huge personal, social, ethical and privacy issues. This work is based on our 7-year-long, first-hand visual lifelogging experience and a series of inter-disciplinary discourse between human-computer interaction, social science and cultural geography. Many computational and interactive technologies currently researched and explored to support our future mainstream activities do require, more than ever, a very careful and comprehensive design strategy that integrates a number of disciplinary perspectives to ensure that the products and services coming from these are sensible, privacy-respecting and ethically-sound as to enhance, rather than diminish, the quality of our personal, social and cultural life. How a systematic consilience among these multiple disciplinary perspectives can be achieved in designing innovative future products and services is an increasingly significant design research issue we no longer can afford to ignore.

Key words: lifelogging, social implication, emerging technology, usage scenario design, novel activity

1. Introduction

Research communities in the fields of modern computational technologies such as Computer Vision, Information Retrieval, Artificial Intelligence, Semantic Web, Language Technologies, etc. are aggressively exploring various innovative technological possibilities their new tools and algorithms are envisaged to enable. Today's industry and market opportunities, unlike traditional approaches in developing products and services based on user needs and their requirements, often do not have the luxury of a large existing user base or well-understood work practices to firmly ground their development. And yet, one savvy technological idea can be turned into a highly profitable product or service deployed through now-ubiquitous web and smart phone app stores, creating a completely novel activity and transforming the way people work and play in a matter of a year or two. For example, the activity of "tweeting," which appeared only 5 years ago as a quirky service to enable shorter

but frequent blogging entries, has penetrated into many domains of work practices as an important channel of information including broadcasting industry, product reviews and advertisements.

With the increasing technological possibilities combined with the emergence of novel interactive devices and platforms such as smart phones, tablets, interactive tabletops, public display walls and embedded appliances each featuring novel modalities such as voice, gesture, haptic and bio feedback interactions, various cross-combinations of technologies are today explored in research laboratories around the world in both academia and industry.

The other side of this phenomenon is the fact that as the general public's interests in technology gets heightened, the end-users as consumer population are more and more willing to try out novel IT products and services. This makes the sudden transformation from a technological possibility into a pervasive deployment an increasingly cost-effective and realisable dream.

Most technological experiments that promise such a transformative potential today, however, very seldom have in their design and development processes any mechanism to consider their possible implications and impact on *personal*, *social* and *cultural* levels, even though these are the very ambition that drives many of these explorations. Often a new but useful product or service makes a big hit in the market, transform the current practice in a short period of time, then these other issues that had not been considered in any careful or systematic way start being addressed as those issues are felt as tangible threat as personal, social or cultural problems.

Lifelogging is an emerging novel activity where individual users digitally record all their daily activities spanning a whole life, steadily developing along with a self-recording/tracking phenomenon such as Quantified Self movement[1]. If one digitally records and collects one's day-to-day activities (emails and text messages received and sent, web browsing history, Facebook entries, GPS locations, etc.) over time, the recorded data can be used to help recall, remember and summarise that person's life. This idea makes more sense as our daily activities are becoming increasingly digital. One of the tools that brings this activity to its extreme is a wearable digital photo capture device such as SenseCam and Vicon Revue[2]. Worn around a person's neck, the device automatically and continuously captures snapshots of photos triggered by its in-built sensors without requiring the wearer to press a button. The wearer can go about her daily business as usual while the device keeps capturing what is happening in front of the wearer, in essence chronicling her daily life into a visually-recorded digital archive. Such a visual and continuous lifelogging activity has a great potential to be used in conjunction with already-common social media activities such as blogging, tweeting and Facebook-like activities, to bring the granulairty of our daily recording of activities to a whole new level. As lifelogging research community continues to grow and mature and avid social media users seek new ways to innovate their information dissemination channels, the potential of continuous visual lifelogging and its impact in the future is becoming more intriguing and attractive. At the current technological climate, visual lifelogging makes an ideal case study material for a technologically-inspired novel activity becoming a mainstream practice in the coming years.

Developing further on our earlier work [1], in this paper we use visual lifelogging as an example of such a mainstream practice *to be*, and attempt to address the expected and predicted personal, social and cultural implications and impact *before* such a phenomenon becomes a reality. We do this by reflecting on a pioneering 7-year-long visual lifelogging experience by one of the co-authors combined with a series of inter-disciplinary

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[1] Quantified Self: Self Knowledge through Numbers. http://quantifiedself.com/

[2] Vicon Revue: Memories for Life. http://viconrevue.com/

discourse between technology, human-computer interaction, social science and cultural geography. The activity of visual lifelogging, although intriguing and potentially beneficial, comes with a large number of issues that could, for example, negatively influence a person's life, disrupt our social norms and threaten our privacy. We expect that this paper will serve as an example of how such considerations should be tackled in parallel with the technology exploration and innovation itself, so that the designed products or services will be, among other things, socially-acceptable, privacy-respecting and ethically-sound.

2. Towards Everyday Visual Lifelogging

A passive photo capture prototype device Microsoft SenseCam [2] represented the lifelogging community over the past few years, and today more consumer-friendly products supporting a visual lifelogging activity are appearing in the market, such as Vicon Revue, Augographer[3] and Memoto[4].

These devices are light-weight digital cameras either one wears around the neck (see Figure 1) or clips on the chest, and contain a few environmental sensors such as passive infrared sensor, ambient light sensor, accelerometer and temperature sensor, in order to automatically trigger a photo capture without the person explicitly pressing a button (hence the term "passive capture").

Wearing the device from morning to evening typically results in a few thousand photos. The key to this photo capture activity is that the wearer forgets about wearing the device and simply goes on about his/her day as normal, while the device continuously captures whenever it is a worthwhile moment to capture. At the end of the day, the wearer can download all the photos captured during the day to a computer, and review what happened throughout the day photo by photo.

Figure.1 Wearing a lifelogging device Vicon Revue

The number of photos taken via a passive capture device quickly increases as the lifelogging activity continues day after day (for example, wearing a Vicon Revue typically results in over 1 million photos if used everyday for a year). Making any use of the large amount of lifelog photos in terms of storing, searching and sharing is a significant challenge for the user: storing the ever-accumulating photos will require significant amount of hard disk space and back-up strategy; browsing a few thousand photos taken on a day could easily take 15-30 minutes or more; looking for a lifelog photo taken 3 years ago at a particular event may well be impossible to do among

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[3] OMG Autographer. http://www.autographer.com/

[4] Memoto Lifelogging Camera. http://memoto.com/

millions of photos in the archive. Making sense of all these daily, monthly, yearly archived photos would not be possible without some form of electronic support that look into photo contents to index them.

Various computational technologies currently being researched are catching up to help *automatically* index and structure the exceedingly large amount of photos by applying machine learning techniques, semantic analysis and image understanding algorithms. Event detection, representative photo selection, concept detection, visual summarisation, etc. are some examples of algorithmic techniques and tools that have been experimented and are on-going research topics relating to lifelogging in order to help a lifelogging user access the large amount of photos more easily.

There are a number of application areas and corresponding novel usage scenarios of using such computational technologies for visual lifelogging activity - supporting severely memory-impaired people [3] or Alzheimer patients [4], helping the elderly review their lives [5], helping doctors better diagnose a heart rate irregularity throughout the day [6], as a market research tool [7], and so on.

3. Multi-disciplinary Discourse: Personal, Social and Cultural Implications

While the novel activities afforded by these emerging technologies are being studied and experimented, we need to be aware of the implications of these new activities and the personal, social and cultural impact these will have if/when they become a pervasive, commonly-practiced activity. In this section, we discuss these issues *in preparation for* the visual lifelogging activity, and discuss how some of these issues could be incorporated within the design process from the very beginning in order to shape a better future.

3.1 Reviewing of Personal Daily Life

Reviewing what happened throughout the day is one of the most obvious usage scenarios that visual lifelogging activity allows. Everyday, before going to bed, a lifelogger can download all the photos captured that day and go through them, reminding herself what she did, where she went, whom she met, what she ate and drank, etc. – reviewing all the details of the day. The actual review session, if regularly practiced, helps the person remember the details of the happenings of the day better, allows a deeper reflection on each day, and as a consequence could allow a more meaningful and thoughtful behaviour in the future. For example, one of the co-authors of this paper has been using the passive capture device for the past 7 years, wearing on those days that he thought would be worth recording (travels, visits, meetings, presentations, and reunions with old friends, etc.) amounting to over 1.6 million photos captured as of June 2013. On the evening of the day wearing the device, he reviewed the captured photos. It is noticeable that at each reviewing session, there are always a few events that happen during the day that are definitely worth remembering or at least worth reflecting at least once, which otherwise would have been completely forgotten. How many such small but meaningful moments in each day do we experience that become completely forgotten due to the natural limitation in our memory? How beneficial would it be if we remember those moments and spend 1-2 minutes to reflect and store in our long-term memory so that they could be readily used in our future references and reflection?

While this kind of daily reviewing activity can be useful to help retain more details day by day, recording and reviewing of not only days but weeks, months, and years (and eventually the whole life) can help review and relive one's life in the longer-term scale. The events that are too far in the past are naturally forgotten by human memory but the visual lifelogging activity can help retain such distant memories and more readily access and

replay them, in effect *reducing the temporal distance* of one's life. This is traditionally what a conventional photo-taking activity has been for, but the different scale in terms of the granularity of the capture and the different mindset of the capturer and the captured put the visual lifelogging quite a unique activity. Reducing the temporal distance of one's life with the lifelogging technology can be compared to how the transportation technologies over the past 100 years have reduced the geographical distance on the globe in terms of the time it takes to travel. Reducing the temporal distance of a person's past and present means that with the support of lifelogging technology, we can retain and replay our distant past far better than our natural memory permits.

On the other hands, it could be argued that remembering or archiving everything is not always a desirable thing to do, that there are events and incidents that we do not want to remember, and thus a more considerate digital technologies should support the *forgetting* aspect as well as *remembering* aspect [8] [9].

Also, when a new technology emerges to augment our natural human ability, one of the usual concerns we have is our over-reliance to it. Since the ubiquitous use of clocks and wrist watches, we rely less on our own natural sense of time; since the invention of the pocket calculators, we rely less on our own mental arithmetic ability; since the easy way to find information on the web today, we rely less on remembering and documenting, knowing that the information is only a few keystrokes away. Are these effects in themselves a negative aspect of over-reliance to technologies whereby people become weaker or less intelligent, or a positive aspect whereby the mental resources saved with these tools could be used for something more productive or creative?

In the similar way, practicing the visual lifelogging activity can provide a false feeling of safety that even if I put my attention less to this particular event now, it can always be found later from the archive when I have time to reflect. The knowledge that the experience I am going through now is safely re-accessible for a later reflection can be reassuring. Just like one might become more careless in remembering certain information due to the availability of note-taking device or ubiquity of mobile Internet access, we could live our day with a little less careful thought process in the knowledge that this moment can be reviewed later on.

3.2 When Technology Starts Invading Our Privacy

Needless to say, visual lifelogging comes with it huge privacy and ethical concerns. Wearing the photo capture device throughout the day means that every place the wearer goes and people she meets there will be captured and recorded. Will some of the people who are inadvertently captured be unhappy if they found out? Furthermore, will they know that they are being captured and should they be informed about it? It would be virtually impossible to inform about the capture to everybody the wearer meets during a day. An easily conceivable but disturbing scenario is one in which an individual browses some obscure blogger's site and notices a photo of himself taken a few months ago featuring a rather unflattering or embarrassing pose he happened to show at the time, and not even aware that he was being captured at that time.

Similar to what happened to the increasing use of camera phones over the past 15 years, we might take an optimistic view that people tend to gradually learn to cope with, deal with and live with such technologies – that by trial and error process over time, people will gradually adapt to live with potentially invasive technology, by changing and correcting their own behaviour, developing an adequate etiquette in public places, and accepting other people's use of it. The technology developers also learn in this large-scale trial and error process on how some features or get-around methods could be designed in from the technical point of view, to mitigate some of the privacy and ethical issues.

For example, Vicon Revue device has a "privacy" button on the side, which, when pressed, will stop taking photos for 3 minutes, to be used in sensitive locations such as airport security area, gym and public toilets. After 3 minutes, the device will beep a few times warning that the photo capturing will resume soon. While pressing this button whenever entering a sensitive place will help reduce the situations of the unassuming strangers from being captured, often the wearer of the device forgets to press this button and finds it cumbersome to keep pressing the button if the off-time should last longer than 3 minutes. Such an ad-hoc design solution as having a "privacy" button is against the overall idea of passive capture where one is expected to forget about it while wearing it. A more graceful and integrated solution would be that all sensitive locations are equipped with a facility to emit a particular frequency of signal, which the device can pick up and automatically pause the photo capture at those locations. When the wearer leaves such a location, the signal disappears and the device will resume its usual capture process without requiring any action from the wearer. Designing in such a feature from the very beginning of the system development requires a careful thought and also infrastructural support that could take a lot of resources and time to instrument and deploy.

Being captured by other people's lifelog devices all the time – is it something that people in this new generation should just accept and move on? The prevalence of CCTV cameras in our cities is a good example of people accepting the benefits (crime prevention and urban security) at the cost of loss of privacy. Will the benefits of visual lifelogging (self-reflection, memory aid, etc.) outweigh the loss of privacy in our social settings?

3.3 Unexamined Design Decisions in Technology

Naturally, the way the visual lifelogging applications and systems were designed and programmed has a significant impact on how the lifelog users consume and make sense of the data we access. And yet, this is the aspect that are very much hidden, unexamined and unevaluated today due to the early stage of the technology exploration. For example, ever-so-popular Facebook has its particular ways of recording a user's events and presenting them: connected friends' faces and names appear in all events recorded and their active comments displayed; timeline provides a strong temporal and historical nuance on the person's records and photos rather than geographical or spatial. What we normally assume would be neutral in its provision of such features is in fact full of biases and particular emphases on certain views and inevitably ignores other views.

The way the embedded sensors on the passive capture device trigger the photo capture has a number of technically-oriented assumptions on at which moment in a person's life a photo should be taken. A mere change of ambient light status over a certain threshold value might in some cases indicate a worthwhile moment to remember (e.g. the wearer entering a meeting room) and sometimes not quite so (e.g. the wearer walks out of a poorly-lit corridor). Using a technical mechanism with such an assumption that the light status change would be a good moment to capture would, in the long run, have a significant consequence when archiving, reviewing and re-living our lives in our envisaged pervasive visual lifelogging society.

The computational techniques and tools to help index, structure and summarise the lifelog photos are no exception. For example, My Visual Diary, a web-based visual lifelog photo review application, presents thousands of lifelogging photos in a simple and interesting comic book-style montage by automatically grouping the photos into events and determining relative uniqueness amongst the events [10]. The mechanism employed to undertake this process is never a completely "objective" but laden with the developers' views and assumptions on what a meaningful event is and especially on how computationally these could be determined and achieved. While the

question on the accuracy of such content-based techniques is an important issue for such an approach, even more troubling is the question of how objectively a computer system could determine the boundaries of events that happen in different people's lifelog photos at different times. In that sense, the basic assumptions embedded in computational techniques to handle the diverse, rich and context-dependent lifelog photo archives seem rather flawed regardless of the use of highly-sophisticated, heuristics-rich, semantically-driven and context-adaptive techniques, and yet, making a huge impact on how we could consume and make sense of such data. Many unexamined and unevaluated design decisions embedded in an early prototype system will remain so, probably due to so many uncertainties to be tackled, even after its wide-spread or mainstream use status is achieved, influencing the way people consume the information in that unexamined and unevaluated way.

3.4 Increased Awareness of "Being Seen" and the Emergence of a New Culture

One of the modern views is on how what we see controls and dominates what we understand about our society, culture and environment. Much of our modern society and the activities it affords are visual - posters on the wall, advertisements on TV, signs and banners, and information on the web, etc. John Berger's well-known phrase "seeing comes before words" [11] recognises how powerful the "seeing" is in our cognition of the world. The change of our view from the concept of how we understand and make sense of space to the one of "landscape" [12] also illustrates how the way we interpret our surroundings is built on what we see visually. Much of our daily life is spent without speaking and yet during those speechless hours we constantly engage in cognitive activities by seeing: by seeing we make assumptions and judgments about a stranger passing by us; by seeing babies start perceiving their environment and people in it, well before they learn to use verbal language as the source of understanding. Much of our daily life and the activities we engage in them are largely based on what we see.

In comparison to this, it is possible to foresee how the visual lifelogging activity with a passive capture device that constantly records what is *being seen* around us will have a significant impact on our daily lives and may well give birth to a new culture shaped around those capture activities[5]. This may materialise as a collective development of an additional sense complementing our natural visual sense where the cameras we wear decide the way of "being seen" of people, things and the environment around them. The captured lifelog data (in the form of photographs) will, furthermore, be indexed and classified for the purpose of future access, making those who live in a visual lifelogging world become much more aware of possible consequences of their everyday behaviour such as where they go, who they meet and what they do. How will that awareness, that self-consciousness about being constantly recorded, start being witnessed in our visually-oriented world? Should the device be designed to be smaller, more discreet and unnoticeable for innocent by-passers not to even aware of it, or should it be informing everybody around about the fact that it is capturing?

Today's technology research communities have, by the nature of their pursuit and interest, many limitations on their approach in systematically studying such issues on how our daily lives might transform from human vision to technological vision, and from *seeing* to being aware of *being seen*. We will require more variety of views, interpretations and in-depth studies from cultural and social angles in order to make sense of the possible impact

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[5] According to Raymond Williams's division of the concept of culture as "dominant", "residual" and "emergent" [11], today's emerging lifelogging activity with its imperfect technology may be regarded as a residual culture only used for people with special needs (e.g. memory-impairment), but it may well become a dominant culture as its core technology improves and starts being used as mainstream activity that increasingly aging population in urban cities will benefit from such an activity.

and the consequences of these technological advancements, and furthermore, technology design methodologies that incorporate such studies as an integral design element rather than an after-thought.

While some positive usage scenarios on our behavioural changes and new cultural emergence can be envisaged with these culturally- and socially-enhanced perspective, still the idea of pervasive visual recording of our lives on an unprecedented level of details is a daunting and disrupting concept.

From the discussion so far, the seemingly simple activity of wearing a lifelogging device has apparently much more disrupting and social behaviour-changing consequences than just the matters of preparing for more data storage, cleverer algorithms or better privacy and legal instrumentations in place. It is difficult to predict what our dominant daily lifestyle will be like and whether such an emergence of new "being seen" culture will be a positive or a negative one because we still do not have any insight into what the relationship between what we are seeing (the way our visual culture has rendered itself so far) and what are visually recorded (the way the visual lifelogging activity will use as its primary mechanism to influence our future) is.

4. Conclusion

There are many interesting technological challenges faced as more novel application scenarios and ideas emerge in the domain of visual lifelogging; technologists who develop the techniques, algorithms and tools should continue improving the accuracy, robustness and reliability, in order to deliver the *functionality* to realise feasible applications as envisioned; interaction design researchers and practitioners should re-visit the developed artefact and the application developed by the technologists to refine the user-interaction in order to ensure its *usability* in terms of ease of learning, efficiency and ease of use as well as overall user experience. However, functionality and usability are only two of the many intertwined factors that make up the whole phenomenon of people engaging in a new activity to enrich their lives in their environment. How a novel technology and its resultant applications empower a hitherto limited human memory, how we should interpret such an empowerment, how we steer the direction of refinements and improvements of these applications in such a way as to further suit and fit our desires and hopes, how this attempt and effort influences other people around us, how these might have unexpected consequences on personal as well as societal and cultural levels – these are the issues that are more and more urgently needed to be more systematically considered at today's rapid rate of unexamined and unevaluated new technologies with high potential impact. Envisaging the time when a variety of rigorous tools and methods are available to engage in such potentially far-reaching but not immediately technical considerations as the core part of technology development process, and awaiting a growing body of socially-oriented technology design principles and guidelines to optimally steer the direction of our pervasive computing, the first step will be for individual technology designers and developers and groups to start involving, with a sense of responsibility, expertise from humanity- and social science-oriented disciplines in consilience to help interpret the possible implications and impact *before* the dream of pervasive use of their technology unfolds.

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