Lifelogging: You’re Wearing a Camera?

Lifelogging devices are commercially available and usable outside the lab.

Katrin Wolf, Albrecht Schmidt, University of Stuttgart, Germany
Agon Bexheti, Marc Langheinrich, Università della Svizzera italiana (USI), Switzerland

Introduction

The number of surveillance cameras a person encounters on a daily basis is massive. Most of these cameras are owned by businesses and institutions. People generally know about it, but most will not think consciously about it or change their behavior. It seems that our society got used to ubiquitous surveillance cameras, and we may not really expect that the recorded material is ever even looked at.

As surveillance cameras become affordable, more individuals are setting up their own cameras in their personal environment: to monitor their pets, to record out of their car’s windscreen or simply to experience using a wearable camera. The reasons for using such cameras are manifold: to have evidence in case of an unforeseen event (break-in, accidents, assaults, misconduct of officers), to monitor safety-critical processes (elderly relatives, infants, pets), for medical/health reasons (personal memory aids, introspection), or simply to record memorable events (trips, birthdays). While technically similar to the ubiquity of surveillance cameras, their use by individuals rather than disembodied institutions often radically alters perceptions by those who are recorded. Steve Mann, one of the pioneers of wearable camera technology, coined the term “sousveillance” for such recordings (Mann et al., 2003) in order to position it as a distinct grassroots pushback to institutional surveillance with the potential to alter the prevalent power structure of surveillance. However, recent developments in the field have repositioned it from an activist device to a consumer product.

Research in Pervasive Computing has paved the way for such devices. In particular the SenseCam Project (Hodges et al. 2006) has shown how wearable cameras can be realized and how they can aid human memory. Today, a plethora of devices is commercially available that enables ubiquitous image based live-logging. The relatively cheap off-the-shelf devices allow individuals to continuously capture what they see and do and all their encounters with others. In this article we give a brief overview of consumer devices, and reflect on the technical differences and on the implications of such technologies for society.
Lifelogging technologies

Looking at the devices available the space for recording can be structured along the following questions:

- Where is the camera?
  Typical camera placements are on the user's body, mounted to an object or place in the environment.

- When does the camera capture?
  For live-logging continuous capture forms are most relevant. Here the spectrum ranges from cameras that are always recording (movies) over cameras that take pictures in fixed intervals (e.g. every 10 sec) to cameras that are triggered by sensors, events or by user interaction.

- What is recorded?
  Besides images or movies many of the cameras sense further data, such as location, acceleration, and audio.

The devices in figure 1 show a range of devices that can be used for live-logging.

In (a) a set of glasses is displayed, which includes a concealed camera. The glasses are marketed as "spy camera" and record continuous HD-video and audio onto a SD-Card. These devices are available for less than 50 U$, but the notion of spy camera points to ethical, legal, and acceptance issues that arise from their usage.

The narrative clip (b) is a small wearable camera that includes location sensing (http://getnarrative.com/). It is 36x36x9 mm (1.42x1.42x0.35 inches) and weighs about 20 grams (0.7 oz). It takes two 5 Megapixel photos a minute with time and location information, has a storage and the battery runs for two days. The Autographer is a similar device (http://www.autographer.com/). Both are intended as an "always-on" wearable camera with use cases similar to the SenseCam.
The Brinno TLC200 (c) is a stationary time lapse camera. The user can set time for the interval in which photos are taken. With a set of batteries it can capture 270000 frames. This covers a time of about 90 days, when set to an interval of 30 seconds. Typical use cases for such time lapse recording are to create a memory of how a house was built or to capture growing plants.

The GoPro camera (d) provides accessories so that the video camera can be mounted to many different objects, including cars, helmets, kites or skateboards. This allows the users to set up the camera in different ways, including first person view and selfie perspective to capture oneself when driving or when doing sports, such as skating, surfing, and kiting.

Where to Wear your Camera

The position where the camera is worn matters a lot regarding the social acceptance, the usability, and the resulting images, see figure 2. Cameras that are embedded in glasses or attached to cloths are unobtrusive and almost invisible. People recorded may consider this as a breach of trust or even as spying on them, as the continuous recording is not apparent.

The camera position is often driven by product design, such as through embedding the camera into glasses or providing accessories for mounting the camera on various body positions. Comparing the images that are captured with wearable cameras (table below) indicates that different camera positions produce specific image characteristics. For instance, a camera worn on the neck or chest will often capture the hands and arms of the user, while a wide angle camera that is embedded in glasses may accidently capture the user's nose or cap. The most natural images are achieved with cameras that are close to the eyes' position. Mounting the camera on the body will lead to a more stable image as it will miss head movement, but hence not necessarily captures what the users sees.
Figure 2: Where the capture devices is worn strongly impacts the perspective and usefulness of the resulting pictures.

<table>
<thead>
<tr>
<th>Camera setup</th>
<th>Resulting Images</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Eyes</strong></td>
<td></td>
</tr>
<tr>
<td>camera integrated into glasses</td>
<td>pictures taken with a glasses-embedded camera</td>
</tr>
<tr>
<td><strong>Neck</strong></td>
<td></td>
</tr>
<tr>
<td>camera worn on cloths (neck)</td>
<td>pictures taken with neck-worn camera</td>
</tr>
<tr>
<td><strong>Chest</strong></td>
<td></td>
</tr>
<tr>
<td>camera worn on cloths (chest)</td>
<td>pictures taken with chest-worn camera</td>
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**Why to Record your Life?**

Capturing moments of our life has its tradition in souvenirs, diaries, and drawing. Technical inventions, such as photography and cinema allow us to capture situations in real-time and in great detail. Whenever these technologies became consumer products, they were used to capture private moments. Today many digital photos are taken but not even looked at once. Thus, the question is why would you want to capture your live in pictures and what is the benefit of live logging cameras.
People may want to capture their entire life in the form of a video, but obviously nobody would have time to watch his or her life. We hypothesise that we again will use technology that helps us to sort, select, and watch the recordings of the life moments that we desire to remember. Algorithms already enable face and motion recognition. Meta data, such as location, time, and physical state give additional hints to detect life moments of fun, fear or excitement. Thus, our future diaries will be likely multimodal and may be automatically written. They may have search functions and probably enable to remember any moment of life in retrospective.

Looking at live logging pioneers and research in this field, many different motivations can be found. One central theme is to increase our ability to remember, including short term utilitarian tasks (e.g. where are my keys) but also longer term and more fundamental endeavors (e.g. self-reflection across a persons live).

On a scientific scale, revealing more about personal patterns and activities provides the potential to gain entirely new insights into processes. For instance, the cognitive scientist Deb Roy wired his house up with video cameras to catch every moment of his son’s life to understand how children learn language.

Lifelogging technologies not only support episodic memories by helping the wearer review the collected aspects of the past (Hodges 2006), but, memory cues can also be used to motivate future behaviour. (Mathew et al, 2014) did a memory-based experimental intervention to increase exercise activity. As a result, thinking about a positive memory had a significant effect on increasing subjects’ wellbeing. Hence, a systematic exploration on life-logged data and memories of past can affect future behavioural changes.

**Legal and Ethical Issue**

Wearing a camera in public clearly raises ethical, if not legal questions. In many countries around the globe it is perfectly legal to take pictures and video in public places for personal consumption, i.e., for sharing it with friends and family or even posting it online for non-commercial purposes (commercial use is of course a different matter). However, laws vary widely, even within EU member states. For example, while capturing public scenes in Denmark requires no consent at all, the same activity is illegal in Greece. Swiss lifeloggers would in principle require consent, yet not if captured individuals only appear incidentally - which would be the default for such lifelogging images. Wikimedia.org provides a comprehensive overview of consent requirements worldwide for photography at [http://commons.wikimedia.org/wiki/Commons:Country_specific_consent_requirements](http://commons.wikimedia.org/wiki/Commons:Country_specific_consent_requirements). Note that capturing officers, military installations, and personnel and governmental buildings is often not tolerated, even if it would be legal.
However, the fact that something is legal does not make it socially acceptable, as some of Google’s “Glass Explorers” have realized in recent months. While US laws do not require an individual’s consent for images or video taken in public places (note the above caveat regarding less of a tolerance for police officers), many people feel very uncomfortable when encountering automated capture equipment, in particular video capture devices such as Google Glass or Steve Mann’s “Digital Eye Glass”. Mann - a famous pioneer of wearable lifelogging cameras - was assaulted in July 2012 in a fast food restaurant in Paris (http://eyetap.blogspot.ch/2012/07/physical-assault-by-mcdonalds-for.html) for wearing his Digital Eye Glass, and in February 2014 a blogger was verbally abused and physically assaulted for wearing Google Glass in a San Francisco bar (http://www.ilovesocialmediainc.blogspot.ch/2014/03/google-glass-assault-and-robbery-at.html).

It clearly does make a difference whether a device is operated hands-free (and hence covertly) or even functions automatically. In contrast to such “run-ins” a huge number of people take pictures everyday using regular cameras or smartphone cameras - usually without any problems. For instance, traditional video recordings are perfectly tolerated if they occur in a socially acceptable situation, such as school concerts (if made by parents or maybe school staff), on the slope using a mounted helmet camera or at iconic touristic places. Google has published guidelines for its Explorers about the DO’s and DON’T’s of wearing a Glass device, including not being a “Glasshole” (https://sites.google.com/site/glassexplorers) and respecting other’s wishes to take off the device.

Beyond concerns for capturing lifelogging images, sharing, ownership, and security cause questions. Is sharing such picture with “friends” on Facebook already publishing? What if the image gets used in countries with different legal systems that do not consider commercial use of such an image requiring the subject’s consent? Finally, given how small such devices have already become (think Narrative Clip), they easily get lost on the slopes or on the subway. While not as critical as the many governmental USB flash drives that were lost, e.g., in Great Britain since 2007 (see http://en.wikipedia.org/wiki/List_of_UK_government_data_losses) it nevertheless means that the finder of such a device has unrestricted access to potentially very private imagery. Incidentally, Narrative recently posted a blog entry on “The top 4 ways to secure your Narrative Clip and not lose it”: http://blog.getnarrative.com/2014/05/top-4-ways-to-secure-your-narrative-clip-and-not-lose-it/

Note that recording audio is usually much more regulated, in particular as such recordings are often of much more intimate nature and hence would not qualify as “public”. While much easier to hide than camera devices, covert audio recordings are illegal in most jurisdictions.

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**Practical Experience in Wearing a Camera**

In our research with the European Project Recall (http://recall-fet.eu/) we experimented with different wearable and stationary camera setups. The awareness of being recorded and of recording others and the environment fades rapidly. For most participants it took only hours “to
forget" they were recording. Even though signs on bathroom doors reminded people to take off their cameras, many bathroom visits are documented. On a potentially more serious note, one researcher in the experiment was not aware that he was still wearing the capture device when going through airport security - an area where all kinds of cameras are typically forbidden. Luckily security personnel simply asked to take it off, instead of requesting to inspect the images taken.

Wearing cameras in public and semi-public situations, e.g., in public transport or restaurants, prompted several people to inquiry about its function. Telling people that it automatically takes photos every 30 seconds lead very often to rather negative reactions. Even the explanation that the images were only for personal use often did not help to assuage these concerns (cf. [Nguyen et al. 2009])

A further issue that we encountered was data loss, i.e., participants lost their cameras. As wearable cameras are small and lightweight, and some are only clipped to a blouse or shirt, it is hard to notice when they get lost. Losing the camera is bad, but without any sort of authentication and encryption in place, anybody who finds it can access captured personal moments.

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References
5. Mathew J. Biondolillo and David B. Pillemer, Using memories to motivate future behaviour: An experimental exercise intervention