# Exploring Wearable Cameras for Educational Purposes

Jouni Ikonen and Antti Knutas

***Abstract:*** *The paper explores the idea of using wearable cameras in educational settings. In the study, a wearable camera taking a picture every 30 seconds was used for 68 days. Pictures of three days were selected for closer inspection, and each picture was classified to see how serious privacy issues would appear. A survey was done to get external viewpoints on how wearable cameras could be used in educational settings. The results point out a number of issues which have to be resolved before wider educational use. However, many teachers believe that the technology can be useful in various subjects.*

***Key words:*** *Computer systems and technologies, Wearable cameras, Life logging, Education, Privacy.*

## INTRODUCTION

Many people record their life by keeping personal diaries. They write commonly about their daily life, but the diaries can also be subject-specific, like dreams, weather, exercise or diet. The diaries can be private or public, as some of them are published in blogs. They can also have technical aspects like GPS coordinates and heart rate data from running exercises. A good presentation of diary-based research is offered by Bolger et al. [2]. One of the newest options for keeping a log of one's daily life is automatic photo snapping [7]. This leads to the idea that some diaries may be on the verge of changing from written to photo-based ones. The Google Glass smart glasses and the Narrative Clip photo logger (Figure 1) are examples of devices for automatic photo snapping. Such devices typically include at least a wearable camera and the capability to snap photos to record one's life.

**Figure 1. Narrative Clip camera attached to a shirt, with an additional label to tell that it is a camera.**

There are different levels of technology, from devices that equal smartphones to simple recording devices. Google Glass, for example, has more uses than just snapping pictures or video clips, but it does not have a lot of users, as there is only a limited number of developer test devices on the market. An opposite device in many ways, the Narrative Clip, is specifically designed to be a small wearable photography device, and it is already commercially available. The device takes a picture every 30 seconds by default. As it takes pictures constantly, it can be called a lifelogger, as it captures life as it is lived. Devices like these are likely to raise questions on privacy and how they can be used when they become more common. Google Glass has already raised quite a lot of debate and users have even been removed from movie theatres in the fear that they would record an illegal copy of the movie [3].

Technology can aid us to record our everyday life with photos. This paper describes experiments where people have used a lifelogging camera, and presents an analysis of the captured photos. We have also done a survey with a number of people to find out if such a device could be helpful for learning. The main aim of this work is to find out whether there would be demand for such devices in the educational setting, and what kind of research should be conducted for this purpose.

## EXPERIMENTS WITH A LIFELOGGING CAMERA

The first part of the empirical work concerned trying out a lifelogging camera and seeing what kind of photos it captures. For this part, the Narrative Clip camera was chosen, as it is fairly cheap and easily obtainable. In the experiment, the camera was used for 68 days. During this time the camera took 51255 five-megapixel pictures and used 39 gigabytes of disk space (including metadata). The camera was mainly used by university staff inside the university, but on some days it was used also during free time. If a user wears the camera for one eight-hour working day, and the camera takes a picture every 30 seconds, 960 pictures are taken. Keeping this in mind we selected randomly three days of the days when the camera was used for closer inspection to see what the camera had actually captured. Each of the pictures was viewed and classified by one person.

The pictures were classified into the following classes:

- Nonsensical picture
- Unfocused photo or the lens had been covered
- The number of people in the picture (subclasses 1,2,3,4 or more people in the picture)
- Potential privacy issue due to photo content

The usefulness of the photo content was considered in the classification. The nonsensical picture class was considered to be an image that was unlikely to contain something that the user would save for later. However, this is highly arguable as users have different uses for the images. In our case this included for example a long set of pictures of a wall when the user was reading something. Figure 2 shows an example of a meaningful photo, where the camera has captured a picture of a whiteboard in a meeting between a teacher and a student.

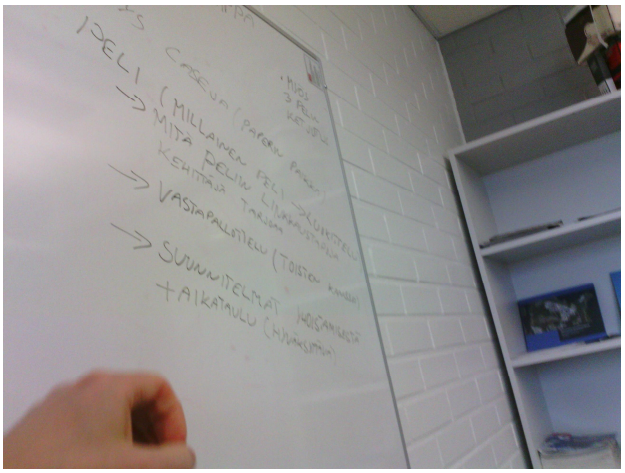


**Figure 2. Lifelogger has captured a picture of an educational setting.**

The number of people in the photos was calculated to indicate how many people can be captured in the photos. A separate class "potential privacy issue" was used to indicate that the photo included something that could be considered sensitive. In this class we counted e.g. pictures of toilet wall (Figure 3), when the user forgot to turn the camera off.

There were also a number of situations where the photos included sensitive information on the user's computer screen (Figure 4).

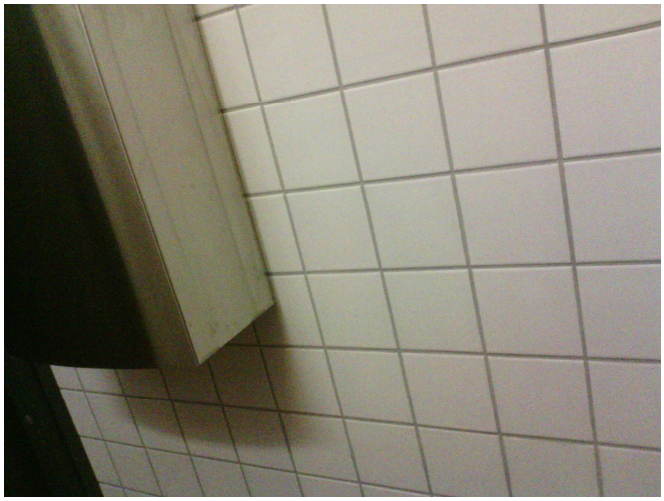

**Figure 3. Potential privacy issue. a photo inside a toilet.**

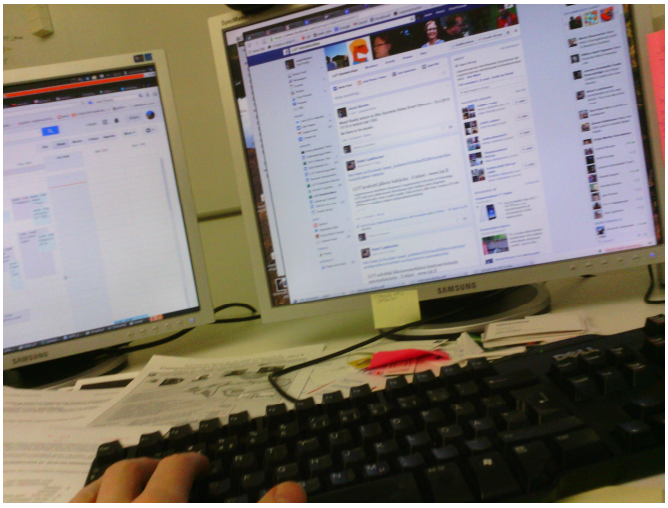

**Figure 4. Potentially sensitive data on a computer screen.**

Photos from the three days selected for closer examination were analyzed by a single person. This person used his personal view to classify the pictures in the selected classes and calculated the number of persons in each photo. The results of the analysis are presented in Table 1. There were altogether 2974 photos taken in the three days. Most of the photos (62 - 78%, depending on selected day) were classified to belong to the nonsensical class. These were situations where the camera captured targets which the analyzer did not consider to provide interesting information. A number of photos (6 - 18%) had technical problems due an unfocused photo, low light or covered lens. Privacy and security issues were identified in about 5% of the photos in two of the inspected days and none in one day. The calculation of people in the photos showed that in some days there were people in more than 25% of the pictures. Just by looking at the number of people in the photographs and privacy issues, it is easy to guess that the person wearing the camera has had different working days. Generally a great number of people in the pictures indicates that some generic usage rules should be agreed on about how the devices can be used.

Table 1. Results of three-day photo analysis.

| | Number of photos | Non-sensical | Unfocused or covered | Privacy issues | 1 person | 2 persons | 3 persons | 4 persons | 5 or more persons |
|---|---|---|---|---|---|---|---|---|---|
| Day 1 | 1053 | 657 (62.4%) | 71 (6.7%) | 54 (5.1%) | 204 (19.4%) | 55 (5.2%) | 18 (1.7%) | 6 (0.6%) | 5 (0.5%) |
| Day 2 | 1193 | 919 (77.0%) | 113 (9.5%) | 69 (5.8%) | 83 (7%) | 15 (1.3%) | 8 (0.7%) | 7 (0.6%) | 15 (1.3%) |
| Day 3 | 728 | 518 (71.2%) | 128 (17.6%) | 0 (0%) | 52 (7.1%) | 2 (0.3%) | 0 (0%) | 3 (0.4%) | 25 (3.4%) |

The reviewer of the photos was asked to construct a list about what the person wearing camera had done during a day. The reviewer was not given any specific instructions on how detailed information we were looking for. The result for day one was a 39-point list, of which the 25 first items are presented here:

1. Breakfast
2. Reading newspaper
3. Breakfast continues
4. Brushing teeth while reading newspaper
5. Arrival at work
6. Computer boots up
7. Work
8. Checking calendar
9. Change of computer terminal
10. Work
11. Coffee break
12. Talking to people
13. Work
14. Coffee break
15. Work
16. Talking to people
17. Solving problems
18. Work
19. Guiding other people
20. Going for lunch
21. Eating
22. Going back to office
23. More work at the office
24. Coffee break
25. Work,
26. …

The general findings of the picture analysis are:

- A lot of pictures are from a single situation (e.g. person in front of a computer or in a meeting)
- The quality of the picture makes it possible to read the text on the computer screen, which can be used to analyze what the person has been doing on the device, which can be a research opportunity or a security threat.
- The narrow field of view of the camera does not necessarily capture everything the user hopes for.
- The camera used in the study required a well-lit environment.
- Pictures of a day could be used to form a diary of the events of the day.
- A great number of pictures will pose a problem for an individual to find meaningful pictures.

## OPINIONS ON LIFELOGGING CAMERA IN EDUCATION

Another question in the study was whether the lifelogging camera could be used in an educational setting. For this a questionnaire was made and distributed via an ICT in an educational Facebook group (in Finnish), which has over 8000 subscribers. The questionnaire was also distributed to friends and colleagues. The facebook distribution started immediately an online discussion on possible privacy issues, but mainly ignoring the question of whether it can be useful.

The questionnaire asked basic demographic information about responder, like age, gender and study or teaching place. There were four main questions:

1. In what kind of situations or matters could lifelogging be useful?
2. In what kind of courses could lifelogging be beneficial?

3. If life logging technology became common, what kind of benefits could you see in it?
4. How about disadvantages of lifelogging?

The questionnaire got 19 responses, but everybody did not answer all the questions. The warm-up question asked how likely it is that the respondent could benefit of using a life recorder in their work or everyday life, on scale 1 to 5, where 1 was very unlikely and 5 very likely to benefit. The respondents gave responses as depicted in Figure 5. The horizontal axis presents the number of responses and the vertical axis the usability score (1-5) given. The respondents were generally positive about the usability of the technology in some form.

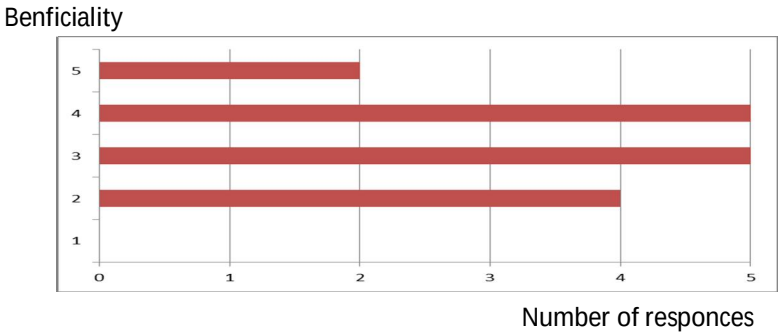


**Figure 5. How confident the respondents were of being somehow able to benefit from using a life recording camera.**

In the question about situations where the life recorder could be useful, the following themes came up:

- Collecting statistical information about one's own behavior, like a writing process or performance.
- Authentic photographs without posing.
- Photographic notes to remember the steps of a task.
- Verifying studying done outside the school room.

Some respondents indicated that they were already using video diaries in their own teaching by making e.g. a recorded summary of what they had done.

For the question about *courses, which could gain from life recording*, some respondents indicated that almost any course could benefit in some way. A number of respondents selected specific subjects, like language courses, computing courses, psychology, philosophy, history, and social studies. Some respondents also specified a reason for their answer, e.g. recording the phases of a recipe (and the result) in home economics, and a language course could use photos as a basis for stories. However, two respondents did not see that life recording camera could be of additional help in any course.

The responses for the question "*What kind of advantages could the popularity of life recording cameras offer"* provided some ideas from the viewpoint of students, teachers and researchers. Some of the points were:

- Students rarely notice their own progress. Recordings could produce facts to show them.
- Analyzing one's own learning, showing things learned out of school. Extending learning taking place out of school, evaluation of learning, and self-evaluation.
- Easier analysis of learning methodologies. Information on how students learn.
- One would see phases of one's own life and events in a concrete way.

- Recording life as lived for generations to come. Historical research.
- Learning diaries and different viewpoints for parties.
- In recording different processes, automated recording is useful, especially if they have to be explained later on.
- Teaches to differentiate which is important and which is less important.

The question about the possible disadvantages of a lifelogging camera raised some very important points. One of the points was how to process the huge number of pictures, and one reply also suggested that it may be better for learning that the user decides actively what to photograph. This might be a problem, however, if there is a lot of data and the student does not know what is important to start with. Ethical and privacy issues were also suggested. Other issues which were brought up included:

- Too detailed recording of life, losing privacy.
- Ethical and privacy issues. Is it OK to record during lessons, work places, etc., especially if the camera is unnoticeable and the others do not know that recording is going on.
- Technical management and shorting the image data. Can anybody look at all the pictures?
- Too much raw data and general privacy issues.
- Recording everything reduces the need to train one's memory.

There are clearly issues which have to be discussed, researched and resolved. The point of this work was not to give any conclusive result showing that such devices are good or bad, but to start discussion on how such devices could be used. If the technology can be seen to be useful, there will be a reason to solve possible obstacles on the way of applying it. There is already work available considering e.g. privacy issues [4][5] and attitudes [6].

## CONCLUSIONS AND FUTURE WORK

The research presented in this paper gives some examples of the pictures and data volume that a lifelogging camera creates by taking a picture every 30 seconds. A questionnaire was used to find out whether teachers and students believed that such devices could be useful in educational settings. The results indicated that teachers believe that such technology could be useful in learning. However, most of the images were in the nonsensical category, which indicates that lifelogging devices should have more context and social awareness in order to capture relevant photos. Initial research concerning lifelogging contexts is already in progress [1]. The research on lifelogging in education should be continued by classroom experiments, where the use of the technology for learning purposes would be studied. Additionally, the arising data processing, legal and societal issues should be investigated in closer detail.

## REFERENCES

[1] Albatal, R.; Gurrin, C., Jiang Zhou; Yang Yang; Carthy, D.; Na Li, "Senseseer mobile-cloud-based Lifelogging framework,", IEEE International Symposium on Technology and Society (ISTAS), pp.144-146, 27-29 June 2013.

[2] Bolger N., Davis A., Rafaeli E, Diary Methods: Capturing Life as it is Lived,Annual Review of Psychology, Vol. 54: 579-616, 2003.

[3] The Forbes, Homeland Security Hauls Man From Movie Theater For Wearing Google Glass, 22.1.2014. Available: http://goo.gl/T85xEN

[4] Hoyle, R., Templeman, R., Armes, S., Anthony, D., Crandall, D., Kapadia, A. Privacy Behaviors of Lifeloggers using Wearable Cameras, To appear in The ACM

International Joint Conference on Pervasive and Ubiquitous Computing,Seattle, WA, USA, September 13–17, 2014.

[5] Templeman R. Korayem M., Crandall D., Kapadia A. PlaceAvoider: Steering first-person cameras away from sensitive spaces, Network and Distributed System Security Symposium, 2014.

[6] Nguyen D., Marcu G., Hayes G., Truong K., Scott J., Langheinrich M., Roduner C., Encountering SenseCam: personal recording technologies in everyday life, Proceedings of the 11th international conference on Ubiquitous computing, September 30-October 03, 2009, Orlando, Florida, USA.

[7] Wolf K., Schmidt A., Bexheti A., Langheinrich M., "Lifelogging: You're Wearing a Camera?," Pervasive Computing, IEEE, vol.13, no.3,. 2014.

## ABOUT THE AUTHOR

Jouni Ikonen, D.Sc, Lappeenranta University of Technology, Faculty of Technology Management, Department of Software Engineering and Information Management, Phone +358 50 555 0665, jouni.ikonen@lut.fi

Antti Knutas, M.Sc., Lappeenranta University of Technology, Faculty of Technology Management, Department of Software Engineering and Information Management