

# Camera Use in the Public Domain: Towards a “Big Sister” approach

Manon van der Sar, Ingrid Mulder and Sunil Choenni

Human Centered ICT, School of Communication, Media and Information Technology  
Rotterdam University of Applied Science  
Rotterdam, the Netherlands  
{m.h.van.der.sar, i.j.mulder, r.choenni}@hr.nl

**Abstract**— The use of cameras is growing: not only personal computers and laptops are standard equipped with a camera, but also the public domain is increasingly equipped with cameras. Today’s camera is not merely a pair of eyes. A surveillance camera can see much more than a single person can do. The rapid proliferation of camera technologies makes today’s cameras beyond human vision. Although these cameras have a primarily goal to enforce public safety, the dark side of camera surveillance is often discussed. One could argue that such camera appearance affects human behavior. The current article reports how cameras influence people’s behavior. Our findings are based on a set of exploratory studies. In line with other studies, we find that cameras do influence the behavior of people, and more surprisingly, they evoke emotions. On the basis of our findings, we discuss the potentials and pitfalls of the use of cameras in the public domain and propose a ‘Big Sister’ design approach to enhance public safety that brings value to the citizens and enlightens the dark side of camera surveillance.

**Keywords**-Camera Surveillance, Exploratory Study, Public safety, Perceived Security, Effects of Technology, Human Behavior.

## I. INTRODUCTION

In recent years, there has been a sustained growth in the use of cameras in our society. This is amongst others due to the rapid proliferation of camera technologies and the apparently obvious potentials of the use of cameras. Technologies for image capture, zooming, storage and display get cheaper and more performing. Recent cameras can tilt, pan, and rotate, which makes it easier to follow people throughout the day. In addition, facial recognition software is improving as well. At the same time, cameras have become increasingly ubiquitous and more available in multiple contexts. Cumbersome images have morphed into digital versions, which can be easily distributed and inexpensively stored. Luksch and Patel [8] demonstrated that it is even possible to make a movie using surveillance cameras. Even though, these solutions are far from the full-mature state, their potential is such that these functions can be exploited for enriching social security; envisioning capturing a person’s image from faces in a crowd in order to compare this image against facial images of criminals stored in a database [13] or recognizing people’s emotions [3]. The potentials of the use of cameras are recognized in the private as

well as public domain. Cameras are intended to serve different goals in society, such as to prevent crime, to aid law enforcement, to track and trace persons, to enrich communication, and so on. While cameras are mainly used to enrich communication in the private domain, e.g., during chat sessions, in the public domain cameras are deployed to enforce the public safety. A number of studies have been reported to measure the effect of cameras on public safety [19]. In general, cameras are deployed in combination with a number of other measures to enforce public safety [16].

Therefore, it may be hard to determine the contribution of cameras in public safety. Nevertheless in a systematic review [19], it is shown that cameras have a modest but significant effect on enhancing public safety. Cameras are most effective in reducing crime in car parks targeted at vehicle crimes. Other studies point to the “dark side” of the use of cameras, especially the violation of the privacy of people and ethical issues are discussed [21]. Current discussions are focused on the disclosure of the identity and the tracking and tracing of individuals. Ethical issues that should be taken care of are the norms of appropriateness and distribution. For example, in personal friendships norms of appropriateness are very open and personal information tends to flow freely, while during a job interview more restrictive and explicit norms of appropriateness hold. As norm of distribution, it is for example acceptable that a medical doctor distributes my symptoms or family history to other doctors to aid for in diagnosis, this is not the case if my financial advisor would have or share this information with its colleagues. According to Zimmer [21] the set of norms with regard to the appropriateness and distribution of the so-called contextual integrity should be taken care of in the use of cameras. However, the privacy and ethical issues that are raised are not purely caused by camera technology, but is one of the technologies in combination with other information and communication technologies that give rise to these issues. These issues are discussed from different angles in the context of e-government [6][18]. Whereas knowledge with regard to the use of cameras and research and development of camera technology is growing, the impact of this development in the public domain is still in its childhood.

It can be concluded that often the dark side of camera surveillance is guiding the public debate on public safety. Differently put, still too often, technology is seen as a threat, in

terms of privacy, identity theft, rather than it could enrich public safety. In order to design for public safety we propose a paradigm shift from ‘Big Brother’ to ‘Big Sister’ [9]. This approach is rooted in human-centered design. It optimizes the use of cameras for social values while at the same time it minimizes the dark side entailed with cameras. To realize a “Big Sister” approach successfully, insights in how people react on cameras are required.

The current article is devoted to how people’s behavior is influenced by cameras. In two exploratory studies, we find that cameras influence the behavior of people, and more surprisingly, they evoke emotions. In the first study, 23 employees at a university were asked how they perceived a certain event during an interview. Their reactions were recorded with a hidden camera. The employees at this point did not know they were recorded with a hidden camera. After a while, the same persons were attended on a visible camera and were again asked how they perceived that same event. An analysis of the camera data shows differences in emotion for the hidden and the visible camera. We noticed that the employees became less ‘spontaneous’ in the case that they were watched by cameras. The second exploratory study has as goal to gain insight in people’s attitude towards camera surveillance by means of a questionnaire. The questions focused on camera surveillance at different places in a city and the authorities/people who are able to watch the camera data. Furthermore, some demographic and Internet related questions were also captured in the questionnaire. The questionnaire was completed by 102 persons. Analysis of the results showed us that people do not like to be watched at all by others. However, young people who are using more than average the Internet has fewer problems with camera surveillance. Our findings, so far, are in line with other studies [14][17].

The remainder of this article is organized as follows. In the next section we discuss how cameras have changed our life and report on two exploratory studies on human-camera interaction. In Section 3, we provide building blocks for a “Big Sister” approach. We discuss how the dark side of camera surveillance may become sunny?

## II. HUMAN-CAMERA INTERACTION

Today’s camera is not merely a pair of eyes. A surveillance camera can see much more than a single person can do. The rapid proliferation of camera technologies makes today’s cameras beyond human vision. Despite these developments, the deployment of cameras in public domains is far from trivial. Care should be taken of ethical and privacy issues. Before placing cameras in public domains, important questions that are raised are (1) to what extent ethical and privacy issues are violated, and (2) do cameras outweigh one’s privacy and ethics in public. However, these questions are not only raised for cameras but for information and communication technologies in general [2][6][18][21]. The importance of these questions is widely recognized by citizens, policy makers and researchers. As a consequence, methodologies referred to as ‘value sensitive design’ [10] and ‘human centered design’ (e.g.,[4]) have been emerged. These methodologies differ from traditional engineering methodologies in the sense that they capture ethical and value-laden requirements in the design and

deployment of information and communication technologies. Applications of these technologies in various public domains can be found in scholarly work (e.g., [2][6][11][15][18]. Examples from the context of e-government propose frameworks and/or architectures to prevent the violation of the privacy law and regulations, such as the disclosure of the identity of people [1][6][18]. In other studies privacy concerns of using cameras and solutions to these concerns are discussed in the context of monitoring dementia patients [15] or in the context of public safety [11].

Without going into too much detail, it is interesting to notice a changing attitude towards camera surveillance. Whereas people used to be suspicious towards camera surveillance, nowadays people are more often surprised when images captured do not contain enough details for catching a burglar. Images taken by surveillance cameras are even used in show news programs at television [12]; surveillance cameras from a private parking to announce the break of a well-known couple. Moreover, hidden cameras are increasingly commercially offered as an opportunity to easily and conveniently fulfill security purposes (e.g., <http://www.stopsurveillance.com>). Whether a camera is hidden or not, it can be assumed that the increased density of cameras in public spaces makes people less aware of surrounding cameras and might consequently, affect their behavior. In two studies it is explored how cameras influence people’s behavior in order to contribute to the ongoing debate how cameras can be exploited to enrich public safety. Demographic details are shown in Figure 1. The first study explores how people react to cameras both consciously as unconsciously. The second study looked in more detail at people’s attitude towards camera use in private and public spaces. We conclude with a discussion.

	Study 1	Study 2
<b>Participants</b>	25	111
<b>Male</b>	12	64
<b>Female</b>	13	47
<b>Average Age</b>		39,5
<b>Youngest</b>		19
<b>Oldest</b>		83

Figure 1. Demographic details.

### A. Study 1: Camera Emotions

During a social event for employees of the Rotterdam University of Applied Sciences 25 teachers were asked how they perceived the event so far. Only one question was asked to avoid the discovery of the hidden camera and because of a tight time schedule. In this, the answer to the question (“How do you like this event so far?”) was recorded with a hidden camera. The answers took about 30 to 35 seconds. For the remainder of the interview, participants were asked to answer the same question before a (visible) camera (Figure 2). After answering this question twice, the use of the hidden camera was motivated and participant’s consent was asked. Most participants react surprised, enthusiastic (laugh) and curious. Some participants asked for a discrete treatment of the videos.

None of the participants banned the use of the images. Captured images were used by the researchers only.



Figure 2. Experimental setup (left hidden camera, right visible version).

In order to compare the results from both cameras 11 raters manually coded raw data using facial tracking [5]. The raters were trained to code the videos in a collective session. After rating some of these videos the raters start working on their own. To gain the most reliable results 11 different raters, male and female, all rated the same videos. We used the average of all raters as ‘truth’. All video frames (5 seconds) were described on 2 levels. For the first level a rater could distinguish between: very spontaneous, spontaneous, cautious and very cautious. For the second level categories were: very happy, happy, irritated and very irritated. A 4-point Likert scale was used to force raters to distinguish between these categories and to avoid a neutral choice. All raters received the same instructions and individually coded all data. The results show differences in emotion for the hidden and visible camera. Male and female participants seem to react different to the cameras.

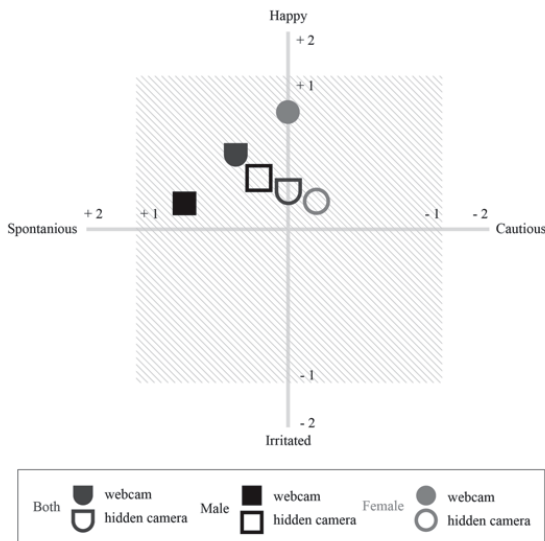


Figure 3. Emotional reaction to cameras.

In Figure 3 shows that coded emotions were by and large positive. Interestingly, initial and concluding emotions were more expressive than those emotions encountered in the middle of an interview. In this figure the average results of female and male as well the results of the total (both male and female) is showed. Figure 3 shows that people react less happy and less spontaneous for a hidden camera instead of a visible camera.

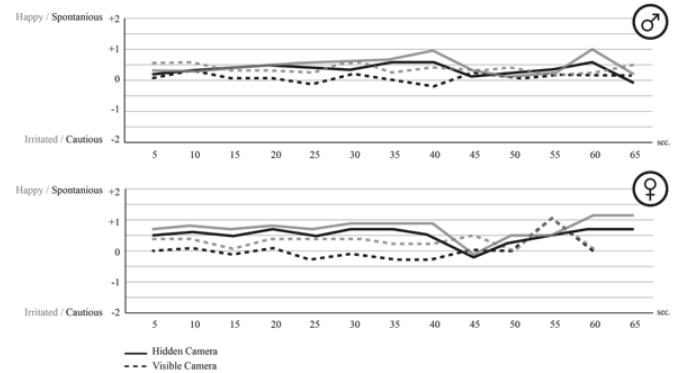


Figure 4. Average results during the test (Top: Male results (n=12), Bottom: Female results (n=13)).

Figure 4 shows the emotional reactions during the test. The two different levels as explained before are being visualized in one figure. Figure 4 illustrates a stable pattern of emotions while answering the question to a hidden camera. However, there seems to be more variation in emotional reactions with a visible camera. People seem to have expressed more emotions at the beginning and at the end of their answer.

### B. Study 2: Camera Surveillance

A survey was used to get insight in people’s attitude towards camera surveillance (n=111). In this survey we addressed six different questions.

1. How would you feel about using a webcam to watch your dependent parents or grandparents in their living room?
2. How would you feel about using a webcam to watch your children in their room?
3. How would you feel about using a webcam to watch your children in childcare?
4. How would you feel about using a webcam to be watched by your parents or grandparents in your living room?
5. How would you feel about the police using a webcam to watch your living room when you are not at home?
6. How would you feel about parents of students using a webcam to watch your lessons?

	Male	Female	Total
Participants	64	47	111
Teachers	32	27	59
Average internet time	4,5 uur	4,4 uur	4,5 uur
Average Age	41,1	37,3	39,5
Youngest	22	19	19
Oldest	63	83	83

Figure 5. Demographic information and Internet use.

Participating teachers of the Rotterdam University of Applied Science could choose from 4 different answers: very desirable, desirable, undesirable and very undesirable. Questions focused on camera surveillance at different places with different observers. We also captured demographic information and time spent on the Internet (see Figure 5). The results show that most people do not like to be watched by others. There is a relationship between age and spent Internet time (Figure 6). Figure 6 also shows a link between more daily spent Internet time per person and the idea of viewing others.

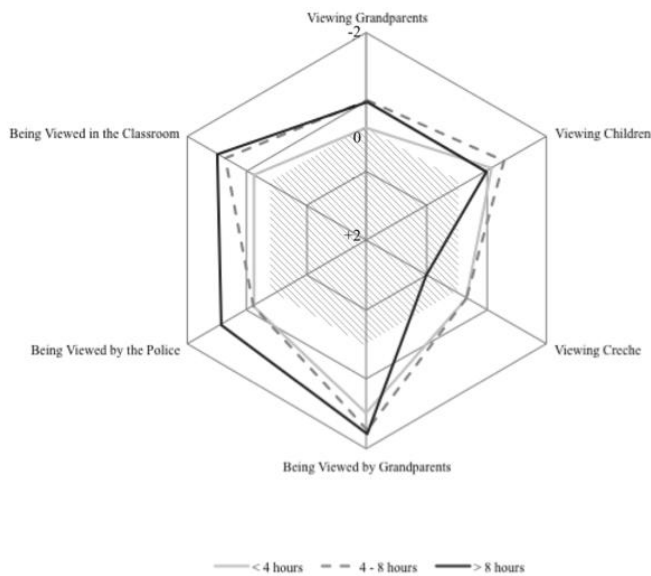


Figure 6. Age versus daily spend Internet time

In Figure 6 both viewed and being viewed is combined. At the top of Figure 4 the average of the answers from question 1 (as explained before) is being displayed. The results from the questions are showed clockwise. The axes represent the possible answers (very desirable (+2) versus very undesirable (-2) and everything in between).

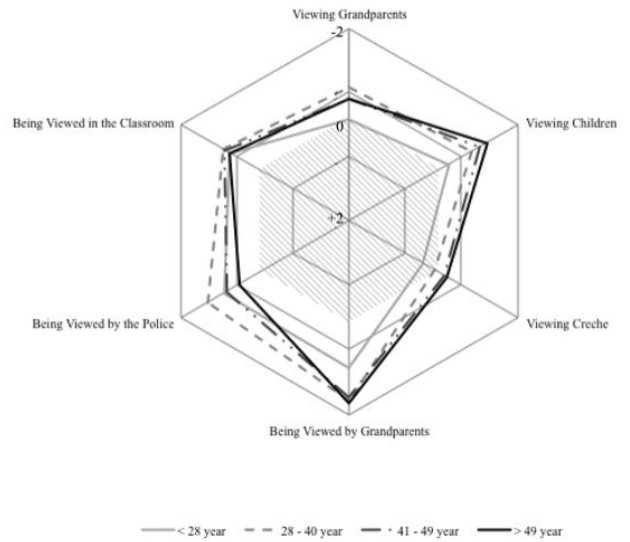


Figure 7. Age versus viewing and being viewed.

Figure 7 shows that younger people are more willing to view and being viewed than older people. Figure 7 shows the average age of the participants. For the youngest group (<28 year) n=25, for the group of 28-40 year n=31, for the group of 41-49 year n=29 and for the oldest group (>49 year) n=25.

Next to age and Internet time spent, also the location of the surveillance made a difference (Figure 8). Figure 8 shows that both male and female do not appreciate watching to grandparents (closed symbols). People particularly dislike the idea that grandparents could watch into their living room (open symbols). The second column shows that people do not appreciate the idea that they could be watched into the classroom by parents of the students (closed symbols). Moreover, both male and female dislike the idea of being viewed by police when not at home (open symbols). The last column illustrates that people are more willing to watch their children then being watched by them.

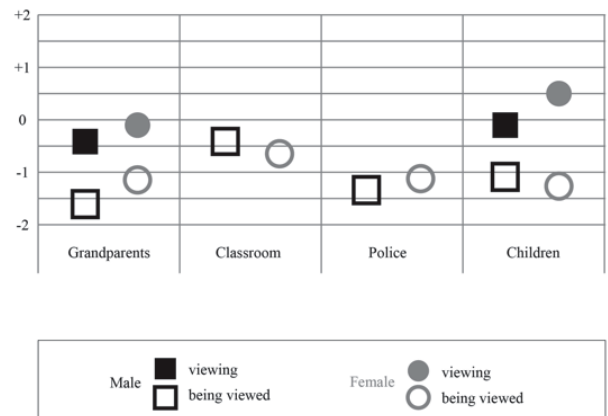


Figure 8. View and being viewed

### C. Discussion and Conclusions

Current findings illustrate that cameras do influence human behavior and more surprisingly, they did evoke emotions. The study also showed that camera surveillance was not so much appreciated. As said before, the aim of our study was to explore how cameras influenced people's behavior in order to contribute to the ongoing debate how cameras can be exploited to enrich public safety. Given the relative small number of the people in the two studies ( $n=25$  and  $n=111$  respectively), we feel that an in-depth statistical analysis of the data will be not very meaningful. However, the studies demonstrate that a large-scale experiment is feasible with additional efforts. In this case, we expect that in-depth statistical analysis may expose more interesting results. Then, the data can be analyzed along different dimensions as well.

Although we did not intend to generalize, findings are in keeping with Teeuw and Vedder's [17] future expectations on security applications. These authors nicely put how present-day speed cameras induce speed-limiting behavior in motorists, even if they do not contain or are not connected to a storage device. It shows the centralizing thrust of disciplining through surveillance, even if there is no central observation tower anymore. In other words, knowing that there could be cameras monitoring their action can cause people to change their behavior. This might be an interesting viewpoint for combining the expressed wish for parental control with children's interest for cameras (Figure 8). Khan [7] discovered also that awareness information between parents and children is very much needed. They also discovered that parents and children like to have a choice in this sharing of information, through camera systems. Their study provided clear evidence that there is a role for awareness systems in supporting the communication needs of busy parents. As stressed before, the daily-spent time at the Internet seems to make a difference in the willingness to watch and being watched. However, being viewed seems to be not appreciated by intensive Internet users. We also notice this appreciation on YouTube. YouTube has 2 billion viewers a day and (only) 150,000 videos are uploaded per day [20]. This might be different for upcoming generations (Y and Z), which are growing up digital. Our study highlighted as well an eagerness of younger people to view and being viewed (Figure 7).

### III. DISCUSSION AND CONCLUSIONS: DESIGNING FOR PUBLIC SAFETY

The previous study was helpful in exploring the value and importance of people's emotions and attitude towards cameras; however, more systematic research is necessary in order to improve public safety. It stressed that people's emotions and their attitude towards cameras play a major role in how they perceive public safety. Research on camera surveillance should therefore take a broader perspective on Human Camera Interaction to signify values and emotions of camera surveillance. Interestingly, intelligent camera systems such as Sound Intelligence (<http://www.soundintel.com/>) and FaceReader (<http://www.noldus.com/human-behavior-research/products/facereader>) increasingly aim to address these

'additional' qualities, by emphasizing the use of sound in artificial intelligence and tracking facial emotions respectively.

#### A. The Dark Side of Camera surveillance

Still too often technology is seen as a threat in terms of privacy, identity theft, rather than it could increase public safety. Consequently, the dark side of camera surveillance is guiding the public debate on public safety. Although, camera surveillance and public safety are often grouped together, one could say they have different roots. Surveillance starts from a top-down perspective, hence the agent controls, whereas a term like public safety refers to the community and would plea for a community-based, bottom-up approach. The aforementioned camera surveillance can be explained in terms of Orwell's Big Brother, which is based on the existence of a strongly hierarchical and controlling (national) structure, in which media is used to control and direct communities. Blinded by this paradigm we tend to neglect that the current wave of emerging technologies is designed from a user-centered approach. Moreover, surveillance cameras are increasingly integrated in our life. At the same time, for young generations currently growing up cameras are not only in the public environment, these are also integrated in their private life; integrated in emerging technologies such as mobile phones and online social networks which are everywhere. In this sense, camera technology is part of their life. What's more, their eyes are focused on the advantages of these emerging technologies. In keeping with Marseille and Mulder [9] we wonder whether Big Brother can become Big Sister? And what can she do for society. How can cameras enhance public safety?

#### B. Looking For The Sunny Side: Designing for Public Safety

When there is a dark side of camera surveillance, there is a bright and sunny side too. A paradigm shift from Big Brother to Big Sister, or differently put, from hierarchy and surveillance to community-driven and human values, opens up bright possibilities for public safety. The so-called Big Sister approach is rooted in human-centered design and optimizes the use of cameras for social values while it at the same time minimizes the dark side entailed with cameras. In this, the approach looks beyond the cognitive engineering approach that emphasizes the interaction between a single human and a single product. A human-centered mindset helps to design for public safety as it takes a broader perspective on public safety. In this, not only the human camera interaction is taken into account, but also the intended impact of phenomena related to camera surveillance. Such human-centered design approach therefore asks for designing with citizens and other stakeholders. The value for society should be leading rather than enabling 'Big Brother's officers' controlling the environment surveillance.

In establishing the sunny side of camera surveillance understanding the context is key before starting a human-centered design process towards creating societal accepted surveillance system. This implies that not only the cognitive performance perspective needs to be understood which emphasizes the interaction between one person and one camera, but that when designing for public safety also interactions of citizens, their feelings regarding public safety,

and the environment need to be taken into account. Thus, the surveillance camera still plays a major role, however when designing for public safety many other stakeholders, products and services play a role as well.

Another difference of this approach is that a limited user-centered design might have asked how can we design a better surveillance camera, whereas a more human-centered approach to designing for public safety explores what value surveillance should have for citizens. Consequently, the focus is not anymore on human-camera interaction, but on what value such a surveillance environment can bring to the citizens.

### C. In conclusion

Still regularly, the dark side of camera surveillance referring to privacy and identity theft guides debate on public safety. In this article, however, we explored the value and importance of people's emotions and attitude towards cameras. Based on these exploratory findings we discuss the potentials and pitfalls of the use of cameras in the public domain and elaborate upon the sunny side of camera surveillance. The main issue in designing for public safety is to understand the context in which humans interact with cameras and with each other. We, therefore, proposed a 'Big Sister' design approach that takes also the interaction between citizens into account in order to enhance public safety, and so, brings value to the citizens and enlightens the dark side of camera surveillance as well.

### ACKNOWLEDGMENT

We are extremely grateful to all students that contributed to the current research project. In particular, we acknowledge trendwatcher Justien Marseille for her inspiring thoughts.

### REFERENCES

- [1] Choenni, S. & E. Leertouwer, Public Safety Mashups to Support Policy Makers. In: Electronic Government and the Information Systems Perspective; First International Conference, EGOVIS 2010, Bilbao, Spain, August 31 – September 2, 2010, proceedings ed. by K.N. Andersen, E. Francesconi, A. Grönlund and T.M. van Engers Heidelberg, Springer-Verlag, 2010 (in print), pp. 234-248.
- [2] Choenni, S., E. Leertouwer & T. Busker (2011) 'Klachten over toepassingen van informatietechnologie. Analyse van een aantal overheidsbestanden' (Complaints about the application of Information Technology: Analysing some governmental databases). In D. Broeders, C.M.K.C. Cuijpers & J.E.J. Prins (red.) De staat van informatie, wrr-verkenning nr. 25, Amsterdam: Amsterdam University Press (in Dutch).
- [3] Datcu, D. (2009), Multimodal recognition of emotions, PhD. Thesis, TU Delft, October 2009.
- [4] Harper, R., Rodden, T., Rogers, Y. & Sellen, A. (Eds.), 2008. Being Human: Human-Computer Interaction in the Year 2020. Microsoft Research Ltd, Cambridge.
- [5] Hill, D. (2007). Emotionomics: Winnig Hearts & Minds. Philadelphia PA: Kogan Page.
- [6] Kalidien, S., Choenni, S. & Meijer, R., Crime Statistics On Line: Potentials and Challenges. In Proceedings of the 11th International Conference on Digital Government Research, DG.O 2010, Puebla, Mexico, May 18 - 21, 2010, ACM Press.
- [7] Khan, V. (2009). Mediated Awareness for intra-family communication, PhD. Thesis, TU Eindhoven, November 2009.
- [8] Luksch, M. & Patel, M. (2007). Faceless: Chasing the data shadow. Ars Electronica 2007 – Goodbye Privacy, 72-85.
- [9] Marseille, J. & Mulder, I. (2009). Friend or Fiend: Co-creation at Coolhaven-island. In: workshop proceedings of Community practices and locative media (Workshop held in conjunction with MobileHCI09, September 15-18th 2009, Bonn, Germany).
- [10] Miller, J., Friedman, B., Jancke, G. & Gill, B. 2007. Tensions in Design: The Value Sensitive Design, Development, and Appropriation of a Corporation's Groupware System. In: Proc. GROUP'07.
- [11] Reichman, J., Driving to the Panopticon: A Philosophical Exploration of the Risks to Privacy Posed by the Highway Technology of the Future, Santa Clara Computer and High Technology Law Journal 11(1), pp 27-44 (1995).
- [12] RTL Boulevard (2009). [http://www.rtl.nl/components/actueel/rtlboulevard/miMedia/2009/week21/di\\_jan\\_yolanthe\\_2.avi\\_plain.xml](http://www.rtl.nl/components/actueel/rtlboulevard/miMedia/2009/week21/di_jan_yolanthe_2.avi_plain.xml)
- [13] Salden, A.H. & Jacob, S. (2004). Videosurveillance – Slapstick of thriller?, Tijdschrift voor de Politie, Maart 2004.
- [14] van der Sar, M. & Mulder, I. (2010). Human-Camera Interaction: an exploratory study on people's emotions and attitude towards cameras. In: Proceedings of European Conference on Cognitive Ergonomics 2010, Delft, pp. 223-226.
- [15] Schikhof, Y., Mulder, I. & Choenni, S. Who will watch (over) me? Humane monitoring in dementia care. International Journal of Human-Computer Studies 68 (2010), pp.410-422.
- [16] Schreijenberg A., Koffijberg J. & Dekkers, S. (2009). Evaluatie Cameratoezicht op Openbare Plaatsen, Regioplan 1814, Amsterdam
- [17] Teeuw, W.B. & Vedder, A.H. (eds). Security Applications for Converging Technologies, Royal Boom Publishers, 2008.
- [18] Warner, J. & Chun, S.A., A Citizen Privacy Protection Model for E-government Mashup Services, In 9th Annual international Digital Government Research Conference, 2008
- [19] Welsh B. & Farrington, P., Effects of closed Circuit Television Surveillance on Crime, Campbell Systematic Reviews, 2008:17, The Campbell Collaboration.
- [20] Wesch, P. (2008) Digital Ethnography: Youtube Statistics. On <http://mediatedcultures.net/ksudigg/?p=163>
- [21] Zimmer, M., Surveillance, privacy and the ethics of vehicle safety communication technologies, Ethics and Information Technology (2005) 7:201–210, Springer.