

“Sousveillance”

Inverse Surveillance in Multimedia Imaging

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ABSTRACT

This is a personal narrative that began 30 years ago as a childhood hobby, of wearing and implanting various sensors, effectors, and multimedia computation in order to re-define personal space and modify sensory perception computationally. This work involved the creation of various computational seeing aids that evolved into a new kind of visual art, using multimedia cyborglogs. Becoming at one with the machine, the author was able to explore a new humanity at the nexus of cyberspace and the real world. The author presents what was discovered accidentally, as a result of facing “cyborg discrimination”. In particular, over the past 30 years, peer discrimination has decreased, while institutional and organized discrimination has intensified. Most notably, it was discovered that cyborg discrimination was most intense in establishments having the most surveillance. Rather than avoid such establishments, the author was able to explore and capture unique aspects to understand surveillance in new ways. The word *sur-veillance* denotes a God’s eye view from on high (i.e. French for “to watch from above”). An inverse, called *sous-veillance* (French for “to watch from below”) explores what happens when cameras move from lamp posts and ceilings down to eye level. Finally, it is suggested that new personal multimedia technologies, like mass-produced wearable cameraphones, can be used as tools for artists to explore “*equiveillance*” by shifting this equilibrium between surveillance and sousveillance with inverse/reverse accountability/recountability/continuability of continuous sur/sousveillance.

Categories and Subject Descriptors

J.5 [Computer Applications]: ARTS AND HUMANITIES—*Fine arts*

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What is sousveillance?

SURveillance (“eye-in-the-sky”) versus SOUSveillance: bringing cameras from the heavens, “down to earth”.



The word “Surveillance” is French for “to watch from above”. It typically describes situations where person(s) of higher authority (e.g. security guards, department store owners, or the like) watch over citizens, suspects, or shoppers. The higher authority has often been said to be “Godlike” rather than down at the same level as the individual party or parties under surveillance [Foucault 1977]. In this paper, surveillance is defined as the capture of multimedia content (audio, video, or the like), by a higher entity that is not a peer of, or a party to, the activity being recorded.

The author has suggested “*sous-veillance*” as French for “to watch from below”. The term “*sousveillance*” refers both to hierarchical sousveillance, e.g. citizens photographing police, shoppers photographing shopkeepers, and taxi-cab passengers photographing cab drivers, as well as personal sousveillance (bringing cameras from the lamp posts and ceilings, down to eye-level, for human-centered recording of personal experience).

It should be noted that the two aspects of sousveillance (hierarchy reversal and human-centeredness) often interchange, e.g. the driver of a cab one day, may be a passenger in someone else’s cab the next day.

Thus a main feature of “*sousveillance*” as a tool for multimedia artists is effortless capture, processing, storage, recall,

and transmission of an activity by a participant in the activity.

Disclaimer the role of the individual artist and personal passion outside the traditional academic laboratory: Because this paper describes the author's own personal experiences of inventing, designing, building, and living with a variety of body borne computer-based visual information capture, processing, and mediation devices in everyday life, there is a necessary narrative element that would be diminished if it were forced to conform to the objectivity usually found in a scholarly article.

The practice beginning in the author's childhood, involved 30 years of bearable (wearable, implantable/dermaplantable, and body/brain modification) systems and devices. This practice would outstrip a normal ethics review process, so a certain element of this work reaches beyond the traditional manner of scientific explorations, perhaps more into the domain traditionally reserved for the Fine Arts. The arts is one of the few places where there exists an accepted practice of performance art, body art, body modification (like the sex change experiment of Professor Sandy Stone, Eduardo Kac's microchip implanted in the body¹, the "Cyborgian Primitives" movement), and the like.

0.1 Computer Mediated Reality

Since the 1970s the author has been exploring electronically mediated environments using body-borne computers. These explorations in Computer Mediated Reality were an attempt at creating a new way of experiencing the perceptual world, using a variety of different kinds of sensors, transducers, and other body-borne devices controlled by a wearable computer [7].

0.2 Practical Applications

Early on, the author recognized the utility of computer mediated perception (computationally modified presentation of sensory data). For this kind of work, the author invented a device that intercepted rays of eyeward bound light, and resynthesized (typically with a computer-controlled laser) substitute rays so that the resynthesized rays could be collinear with the measured rays. This resulted in a device where three elements existed at the same point in space: (1) the effective center of projection of a camera or other sensor; (2) the convergence point of the above collinear rays of light; and (3) at least one eye of the wearer. Thus the device is equivalent to putting both a camera and a display inside the eye. Such a device, fitted to one or both eyes, is called an EyeTap device [7].

EyeTap devices can be used for electric seeing aids, or when used together with a similar device called the EarTap, for converting the body, in effect, into a camera phone.

0.3 Personal Safety Device

The author's mediated reality devices also included the capability of lifelong capture and transmission of physiological signals together with the EyeTap signal. Capture of the data can allow such a system to function much like the "black box" flight recorder in an aircraft that provides evi-

¹Others, such as Kevin Warwick, have also followed in Kac's footsteps, some for artistic reasons like Kac, and others for more utilitarian reasons.

dence as to why an accident or deliberate violent act occurred.

To protect the data of the "black box" life recorder from accidental or malicious damage, the data has generally been transmitted and recorded at remote locations. Additionally, for example, transmission of synchronized timestamped ECG data allows a remote physician to observe not only the electrical heart activity, but also the visual environment which may provide clues as to environmental causes of ECG irregularities such as arrhythmia.

When it is worn continuously (e.g. out of medical necessity to capture valid data) the long-term adaptation to seeing through the device also provides a unique opportunity to capture, process, store, and recall visual memories. Unlike a mere wearable camera, the EyeTap, because it becomes a manner of seeing, captures exactly what the bearer does see. This results in a new kind of EyeTap cinematographic vision, together with a serendipitously generated logfile that happens without conscious thought or effort.

A cyborg (in the Manfred Clynes sense of a technological synergy that doesn't require conscious thought or effort), can thus generate a lifelong logfile for personal experience capture. Such a logfile is called a cyborglog (<http://en.wikipedia.org/wiki/CyborgLog>).

Later with the advent of the World Wide Web cyborglogs also became weblogs [Ito 2004], an example of which is shown in Fig 1.

Ironically, the coverage of the East Campus fire (Fig 1) resulted in negative press

Wearable Web Camera Goes Too Far, Anders Hove, Executive Editor,

www-tech.mit.edu/Issue/V116/N28/mann.28c.html from the very paper that might have used the pictures captured in the cyborglog. It is interesting to note that Hove's first main objection was the strange physical appearance (to use his words it's "worse than Spandex, tweed, and bell-bottoms combined"), rather than the privacy issues. This was an objection also raised when the author had driver's license pictures and passport pictures taken, and finally succeeded in making a legal argument as to why self-modification of physical appearance must be accepted, after which a number of passports and driver's licenses were issued with the author's newly created physical appearance.

In particular, living within a permanently installed/institled photographic perspective allows the bearer to capture precious yet serendipitous moments in life, such as the birth of a newborn, or baby's first steps.

0.4 Related work

Despite the initial negative reactions, a lot of good came of the explorations in web-based cyborglogs (time-stamped diaries of serendipitous personal experience recordings made available to the world). Others are also now proposing similar projects. Industry is also recognizing the importance of inverse surveillance. For example, the Hitachi Design Center in Milano recently sponsored an event entitled "*Applied Dreams Workshop 3: 'Surveillance and Sousveillance'*".

Nokia is planning a "life 'blog" (lifelong weblog) product similar to the author's life 'glog (lifelong cyborglog) project. Microsoft's "sensecam" and "MyLifeBits" projects (<http://research.microsoft.com/CARPE2004/>) and Hewlett

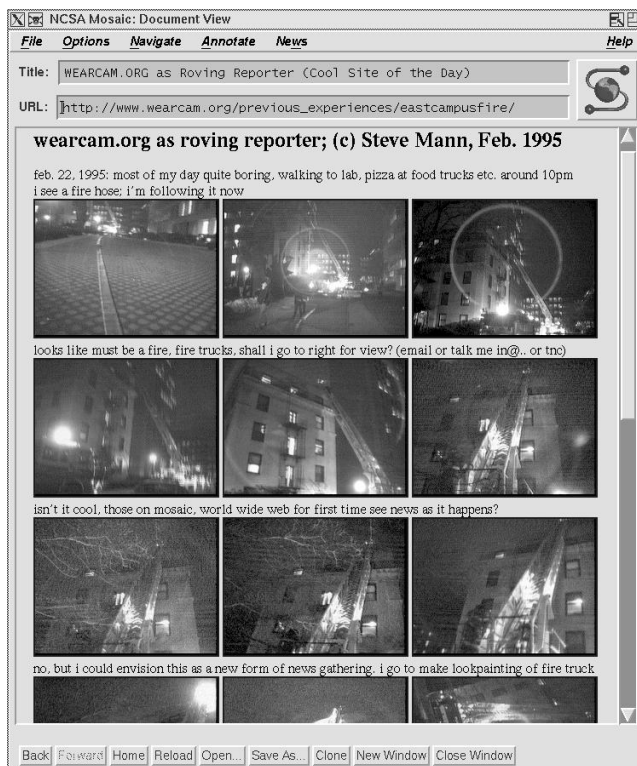


Figure 1: In this cyborglog, the author encountered an event serendipitously through ordinary everyday activity. As it turned out later, the newspapers had very desperately wanted to get this event covered, but could not reach any of their photojournalists in time to cover the event. The author, however, was able to offer hundreds of pictures of the event, wirelessly transmitted, while the event was still happening. Furthermore, a collaboration with a large number of remote viewers enabled a new form of Computer Supported Cooperative Journalism.

Packard's "Casual Capture" project also build upon various concepts of sousveillance.

Sousveillance is related (even if by inverses) to the tradition of surveillance, and to the artistic practice explored by artists, such as Julie Scher, and the Surveillance Camera Players, among others, working in the medium of surveillance.

Organizations such as Future Physical are also "stretching technology a human adventure" and developing "cultural program exploring boundaries between virtual and physical", e.g. "How will the human body interact with digital tools in the future?". See for example, Wearable Computing Links, www.futurephysical.org/pages/content/wearable/links.html

In relation to the Fine Arts, the continuous nature of sousveillance (i.e. continuous archival of personal experience) is very much like the concept of "living art". Tehching defined "living art" performances as being of one year in duration (e.g. Tehching Hsieh and Linda Montano held opposite ends of a rope but never touched each other for one year), although other durations are possible (e.g. Montano's 14 year long clothing colour experiments, wearing only one colour of clothing for each of the 14 years, etc.). The author's 30 year long exploration and 20 year long actual experiment in bridging the gap between cyberspace and the

real world by living day-to-day life through the electric eyeglass is thus an example that might also be considered part of the tradition of "living art".

Moreover, recently there has been a growing sousveillance industry, with three workshops, organized independently, but around the same time:

- International Workshop on Inverse Surveillance (IWIS 2004), April 12th. This workshop is based on 3 years of planning and previous "inverse conferences" entitled DECONference 2001, DECONference 2002, and DECONference 2003. See, for example, <http://wearcam.org/iwis/> and <http://deconference.com>
- Memory and Sharing of Experiences, in cooperation with Pervasive 2004, April 20th, 2004, Vienna, Austria. See, for example, www.ii.ist.i.kyoto-u.ac.jp/sumi/pervasive04/ Sumi, for example, makes the distinction between surveillance (sensors in the environment) and sousveillance (sensors attached to persons) through the use of "the term 'ubiquitous' to describe sensors set up around the room and 'wearable' to specify sensors carried by users"[9]. Some of this work also relates directly to computer mediated reality [4][2].
- Continuous Archival and Retrieval of Personal Experiences (CARPE 2004), New York, New York, October 15th 2004, held in conjunction with the conference in which this paper appears (ACM Multimedia).

The work presented in this paper is distinct from that of the sousveillance industry which is not focused on art, or the related philosophical and technosocial issues. Likewise, much of the existing work in performance art, and body art is not directly connected to the sousveillance industry, in terms of tools for art and **intervention**. Thus there is a largely unfulfilled need for such tools.

While it is well known that technology influences art, (e.g. Scher's surveillance-based art is obviously influenced by surveillance technologies), it is hoped that art will also influence technology [1], and in particular, it is hoped that art will influence the growing sousveillance industry as much as the surveillance industry has influenced art.

1. COMPUTER MEDIATED REALITY AS A TOOL FOR TRANSFORMING EVERYDAY LIFE INTO VISUAL ART

Stepping beyond the obvious practical uses of Computer Mediated Reality, there is a more existential motivation regarding how we, as humans, are able to choose the manner in which we define ourselves [10]. The lifelong cyborglog recorder is more than just a visual memory prosthetic. It is also a new tool for the visual arts.

One of the author's original goals of Computer Mediated Reality was to create a body-borne wireless sensory environment which, although technically sophisticated, would function more in the spirit of an artist's personal notes or a painter's canvas. Thus computer-mediated reality was a form of artistic exploration.

In the early 1980s the author was asked to exhibit his computer mediated visual experiences in various art galleries, resulting in a genre of photographic memory characterized by the computer mediation, capture, sharing, recording, and processing of everyday visual experiences. See Fig 2.

These images were created using a concept of vector spaces made from photographic quantities, that the author called "painting with lightvectors".



Figure 2: Living in a computer mediated environment as a new way of seeing the world as visual art (a) A mid 1980s view of a corridor at McMaster University, and (b) of the Mann residence. (c) Computer mediated view of a television placed on an easel at the base of a commonly photographed space, Niagara Falls. Reality once mediated through television, is again mediated through the wearable computer, as a form of social commentary on what is reality.

Briefly summarized, lightvector paintings are made by combining differently illuminated exposures of the same subject matter, as illustrated in Fig. 3.

This process of “painting with lightvectors” was also possible with a group of people wearing computerized seeing aids that were tuned to the same virtual channel, so that there was a shared computer-mediated visual reality. In this way, the team experienced a collectively modified view of the world, in the production of visual art. Such early apparatus was more cumbersome, however, and thus perhaps less well suited to widespread use as a tool for multimedia artists. (See Fig 4(a).)

More recently, versions of this system have been made available for others to use, with computer programs that can be downloaded from comparametric.sourceforge.net and run on less cumbersome systems, easily made from mobile (small 12 volt automotive) computers, as shown in Fig 4(b). This new tool for artistic exploration is very easy to use, and can be taught in just a few minutes, to anyone with no prior experience. The new hand-held form factor can also be passed around quickly among a group of individuals, so that they can all feel like they are participating in the use of the tool. The grip, similar to the rubber grip of a hammer, makes the tool easy to pass from one person to another, and thus it is very suitable for teaching large groups of students.

2. CYBORG DISCRIMINATION: ACCIDENTAL DISCOVERIES IN SOUSVEILLANCE

By the summer of 1985 the author had built a wearable computer mediated reality system into a jacket, which he wore in much of his day-to-day life.

This resulted in two kinds of public reactions:

- peer discrimination from individuals, either to the outward appearance while wearing the entire system, or the discrimination that remained when the outwardly visible portions were removed, leaving only the permanently attached electrodes, subdermal and dermaplant² portions of the apparatus (e.g. with regards

²Dermaplants refer to devices such as subdermal electrodes,

to the portions of the apparatus that are permanently attached to the body being seen by others during communal change of clothes for high school gym class, the need to wear a full-body bathing suit to cover dermaplants during swims, or the like);

- official discrimination by representatives of large organizations, allegedly acting on the wishes of the organization. This discrimination pertained to both the unusual outward appearance of the apparatus, the functionality of the apparatus (evidence capture, live transmission of visual images of the official and the officials establishment, etc.), as well as the inward appearance of the body even when the main portion is removed (permanently attached electrodes, subdermal and dermaplant portions of the apparatus that might become visible in an airport stripsearch room).

The author discovered these various elements of discrimination by accident, simply through the process of living the bearable (wearable/implantable) computing lifestyle. Of the various forms of discrimination, the author could foresee the day when the apparatus would no longer have an unusual appearance, because miniaturization would some day allow all of the apparatus to be implanted (and concealed) within the body. Ten to twenty years later, this vision was to have been realized simply by the miniaturization of the apparatus into what appear like ordinary clothing and eyewear (Fig 5).

To achieve such a concealment opportunity, the author invented a new kind of eyeglass design in which the frames come right through the center of the visual field. With materials and assistance provided by Rapp optical, eyeglass frames were assembled using standard photochromic prescription lenses drilled in two places on the left eye, and transdermal wound closure, connections on deliberately self-inflicted wounds for purpose of making better connections, and other devices permanently attached to, on, or below the surface of the skin. The author finds that Dermabond (TM) wound closure material manufactured by Closure Medical is often useful for making, growing, or maintaining dermaplants.

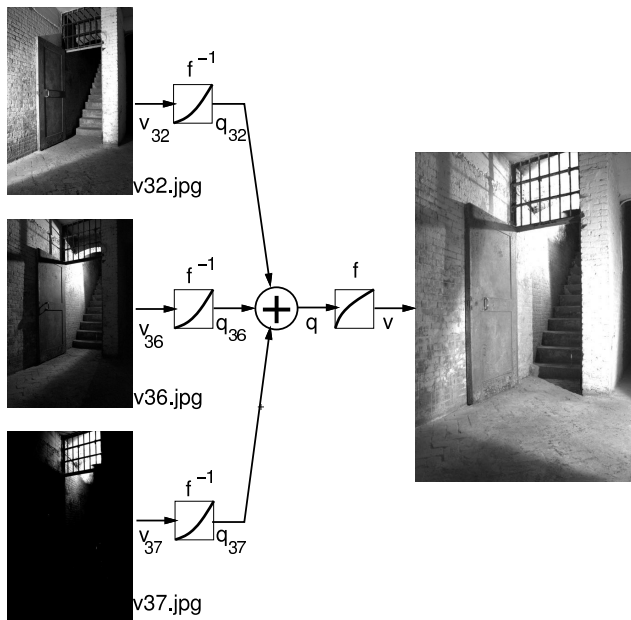


Figure 3: Painting with lightvectors: A lightvector painting is made from various exposures to different sources of illumination. In, for example, v32.jpg, the open basement door under cell block “A” on Alcatraz Island, is exposed to light from a flash lamp held to the left. The flash lamp is then moved to the right, to illuminate the scene from the right, in exposure v36.jpg. Finally, exposure v37.jpg captures light coming from upstairs, beyond the jail bars above the door. Each such picture is displayed on the eyepiece of the author’s wearable computer, as the author walks around in the space, illuminating the space from various viewpoints. These pictures are then converted into lightspace by applying an estimate of the inverse of the camera’s photographic response function[6]. The resulting photographic quantities are added together, and the combined exposure is then converted from light space back into a picture. (C) Copyleft, S. Mann, 1993.

four places on the right eye, to accommodate a break in the eyeglass frame along the right eye (the right lens being held on with two miniature bolts on either side of the break). The author then bonded fiber optic bundles concealed by the frames, to locate the camera and aremac in back of the device.

The eyeglasses of Fig 5 were crude and simple. A more sophisticated design uses a plastic coating to completely conceal all the elements, so that even when examined closely, evidence of the EyeTap is not visible.

The peer discrimination by the masses was also simply seen as a matter of education and acceptance. The author found that this form of discrimination began to decline sharply in the mid 1980s (beginning around 1984, amid the new-wave androgyny where transhumanism began to take acceptance first in the transgender community and then in society as a whole).

By the 1990s, such peer discrimination had largely disappeared, yet the organizational discrimination continued to increase and intensify. For example, recently, the author was physically assaulted by a number of security guards at the Art Gallery of Ontario. Rather than asking the author to leave, the guards simply pushed the author out of the gallery. The author later asked the Chief Curator as to the

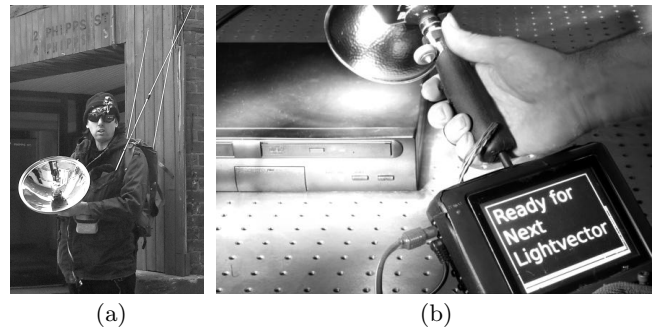


Figure 4: (a) **Early tools for lightvector paintings:** Jacket based computer system that was completed in the summer of 1985 was used in conjunction with a 2.4 kJ flashlamp in a 14 inch (356mm) reflector. Three separate long communications antennas are visible, two from the backpack and one from the jacket based computer. (b) **A user-friendly mass-produced tool for artists to use provides clear step-by-step instructions on a TV screen that’s attached to a light source.** The TV (a standard NTSC TV) attaches to the bottom of the handgrip, and a standard electronic flash attaches to the top. A mobile (12 volt automotive) computer at the base station and the TV on the hand grip eliminate the need for a cumbersome wearable computer system typical of the 1970s and early 1980s lightvector painting systems. Computer programs to make it work are freely available at comparametric.sourceforge.net

reason for this action. The reason given was a possibility of copyright infringement.

This raises an important question as to the right to fair use of one’s personal environs, and personal experiences, especially in view of an acquired dependence on computerized visual memory. It seemed the author had unwittingly come to confront, explore, and understand issues concerning the ownership of space and whether such ownership should provide an advantage in perpetrating copyright infringement (i.e. what if their surveillance cameras capture a picture of art that a patron is wearing, such as a painting on a T-shirt — does that justify the patron smashing up their surveillance cameras because of the mere possibility of copyright infringement?). It also raises questions pertaining to the relative worth of humans and walls (e.g. a painting hung on a wall gets more protection than a painting worn on a T-shirt).

Physical assault in response to a mere potential for copyright infringement seems specious at best, given recent Supreme Court rulings allowing photocopiers in libraries, despite the fact that they *could* be used beyond the level permitted by *fair use*.

This response from the gallery, and other similar institutions has actually *increased* not decreased the amount of recording done:

- Before such incidents the author used to make seeing aids that did not necessarily record;
- now any seeing aid that we make in our lab is equipped with a retroactive record capability. This helps the wearer keep an evidence log in case such violence occurs.

The irony, therefore, in such physical assaults is that the fears of the security guards are coming to fruition by way of their own actions. Similarly, one would expect that if people went around smashing up surveillance cameras with baseball bats, this would probably cause more to be installed,



Figure 5: Fully functional electronic eyeglasses built into wire frames. Eyeward-bound light is diverted along the right temple by way of a fiber bundle, into a miniature camera. A laser directs light along another fiber system on the left temple to redraw the modified reality onto the retina. The details are provided in [7].

and would cause more detailed recordings of each one to be made. It is therefore futile to resort to violence as a means of suppressing evidence gathering technologies.

Thus the fundamentally most difficult element of discrimination appeared to be the official discrimination based on functionality of the cyborg.

The author began to understand this discrimination throughout the 1970s and early 1980s, as being correlated to the degree of surveillance present in an establishment. It appeared, for example, that the establishments where official discrimination was greatest, were the very same establishments where the use of video surveillance was the greatest.

Therefore the author, through simply a personal desire to live in a computer mediated world, encountered hostilities from paranoid security guards, seemingly afraid of being held accountable. It seemed that the very people who pointed cameras at citizens were the ones who were most afraid of new inventions and technologies of citizen cameras.

The harsh and sometimes hostile discrimination against the author, by officials, security guards, and representatives of large organizations led the author to begin thinking mainly about official discrimination against cyborg functionality. In order to learn from these hostilities, the author wished to understand this discrimination by applying the scientific method, within an ethnomethodological sense, which evolved into using body-borne multimedia computation as a tool for social inquiry and *action research* [3][8] on surveillance as an emergent agenda. However the unique framework and situation did not conform to a particular academic discipline (psychology, sociology, science, engineering, etc.). Therefore this work was often appreciated more within the arts community, where interdisciplinarity was fully embraced even many years ago.

Various places that the author was most strongly prohibited from entering seemed to include places like mafia run gambling casinos, pawnshops where money laundering

might be taking place, and jewellery stores. Such organizations were ironically the places where surveillance cameras were abundant.

Along another avenue of discourse, the author began to undertake a series of explorations in which he unwittingly became what others referred to as an “artist”, despite having a more science and engineering based background.

This exploration into the Fine Arts arose from a desire to try to understand the reasoning behind such organizational discrimination, rather than simply avoiding it.

For example, as a departure from EyeTap eyeglasses as seeing aids, the author also constructed various forms of cyborg jewellery, in order to test an hypothesis, namely that jewellery store owners would welcome and appreciate having pictures taken by innovative jewellery. Thus the author built Personal Safety Devices (PSDs) into jewellery (Fig. at top of first page of paper). The reaction was quite surprising. Even when blatantly told that the devices contained a camera, jewellery store and pawnshop owners did not object to the device in any way. Although the device does not allow the wearer to live in a computer mediated world, it captures all the elements of paranoia that the officials most feared, e.g. primarily a video captured record of their establishment and activities. Yet they accepted this alternative form of the device without complaint, largely because it so nicely landed within **their** genre. Indeed, many of the jewellery store owners wanted to commercialize and sell the sousveillance necklace and other domewear products.

The sousveillance necklace established a more inclusive narrative that treated the store clerks and security guards as colleagues. As a sharp departure from 20th century “us versus them” thinking, the cyborglog jewellery created a new kind of artistic practice and discourse. By presenting it as an object that the guards and shopkeepers could try on, and look at themselves in the mirror wearing, they had no problem with it being in their store, transmitting images to the World Wide Web. It is therefore interesting to note that an inclusionary rather than exclusionary element of sousveillance is possible. While surveillance tends to be exclusionary, and tends to present a very strong “us versus them” directionality, sousveillance can be made to operate much more like Peer-to-Peer, in the sense of creating a level playing field. The sousveillance landscape therefore may include both shoppers and shopkeepers, wearing personal recording devices. Moreover, a shopkeeper may then assume multiple roles, e.g. one role is obedience to a store manager, but another role might be the capture of his or her own personal “day in my life at work” cyborglog to share with friends.

2.1 Schrodinger’s Cam: Nonwillful blindness with the maybecamera

Another aspect of artistic discourse and philosophical exploration was the reflectionism [5] of uncertainty (Fig 6). A large number of wireless webcam shirts were made, but only some of them had cameras in them. They were then shuffled and distributed widely. Honestly not knowing whether or not one was wearing a camera added a new dimension to putting the uncertainty principle into artistic practice. Moreover, consider, for example, the “sousveillance underground” as a probe into New York proposed ban on pho-

