

# Praxistemology:

## The practice of authentic inquiry for Technology and Society

At the intersection of practice, theory, and understanding through lived experience (Learn-By-Being), praxistemology is an existential praxis of/and study/inquiry/critique, not a study/inquiry/critique of existential praxis.

Praxistemology is like a tripod that is supported on all three of the following “legs”:

- P** The practice of action, doing, making, or the like, from the Greek word “praxis” which means “practice”, “action”, “making” or “doing”. from Greek “prassein”, meaning “to do” or “to act”.  
Specifically praxis is the particular kind of action, doing, or making, typically found in the field of engineering. Examples include that which is taught in University of Toronto’s first-year Engineering Sciences courses entitled *Praxis I* and *Praxis II* [<http://www.praxis.uoftengineering.com/>].
- E** Existentiality, which embodies three important attributes: (1) existence before essence, i.e. the opposite of problem-solving. Whereas Plato first envisioned a circle in terms of a collection of points equidistant from another point, and THEN reduced it to practice, I believe we should also allow room for doing the opposite:... Let’s sometimes be willing to tinker (build something) first, and then figure out what it is or what it can be useful for afterwards (or maybe never!)! Basically let’s be willing to just tinker without having to make a plan and a Gantt Chart first. (2) self-determination and mastery over one’s own destiny, through personal commitment, involvement, and experience (e.g. “Learn By Being” such as wearable computing as a way of learning about computers by “Being” a computer), and (3) authenticity as connected with creativity, i.e. being true to one’s self. An example of what I mean here is an engineer who loves engineering rather than an engineer working for just the money or out of a sense of duty. To quote Einstein: “Love [of a subject of study or of one’s work] is a better master than duty”. It also means being true (authentic) to one’s self, rather than being driven by trends or fashions. The opposite of this is a “poseur”, or a person who works or studies in a particular field because it is fashionable, trendy, or pays well. Praxistemology is not merely transdisciplinary, interdisciplinary, or crossdisciplinary work, but, rather, trans/inter/crosspassionary. To paraphrase Einstein, **passion is a better master than discipline!** Works by Sartre and Kafka help us understand (often by way of negative examples) existence, freedom, and authenticity.
- Q** The work has an epistemological/pedagogical element that asks important moral and ethical questions, i.e. that embodies critique in the tradition more commonly associated with the arts than with old-school engineering. To quote Baldwin: “The purpose of art is to lay bare the questions that have been hidden by the answers.”

**Leonardo da Vinci** was said to be the best engineer  $\forall$  time. But he was more than just a problem solver. He was also an artist, scientist, and inventor.

Leonardo Journal [1] is the leading journal for the application of contemporary science and technology to the arts.

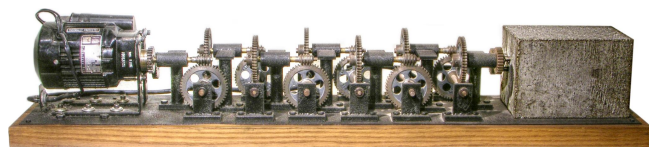
**Marvin Minsky** is the father of AI (Artificial Intelligence) [2]. In addition to inventing AI, he also invented the confocal scanning microscope and many other useful inventions. But Minsky had an amazingly deep

understanding of all aspects of the human condition. My favorite of his inventions was something that has become known as “the most useless machine ever”:



It consisted of a box with an on-off switch on the outside. Whenever you turn the switch on, the box opens and a robotic hand reaches out to turn the switch off. The machine's sole purpose is to turn itself off! Minsky built his machine at Bell Labs with Claude Shannon.

**Arthur Ganson**, a sculptor with the Massachusetts Institute of Technology's department of Mechanical Engineering, who makes artworks with existentialist themes. For lack of a better word, I'd call him a "praxistentialist" — one who engages in the practice of embodied existentialism. The one piece of his that really speaks to this theme is a piece entitled "Machine with Concrete":



A motor is geared down through a series of gears, each turning more slowly (and more forcefully) than the one before it. The last gear is fixed in a block of concrete.

**Albert Einstein** wrote that "The point is to develop the childlike inclination for play and the childlike desire for recognition and to guide the child over to important fields for society. Such a school demands from the teacher that he be a kind of artist..."

Here's another quote from Einstein: "The pursuit of truth and beauty is a sphere of activity in which we are permitted to remain children all our lives."

What separates children from many adults is authenticity versus professionalism. Professionalism is a necessary and important part of society in many fields like dentistry or safety certification of bridges, skyscrapers, and aircraft. But there is, or should be, room in the world for "children" like Einstein. Engineering schools and other universities should encourage fun, frolic, and unstructured play as means for invention of new technologies, as well as new ways of looking at Technology and Society!

In this sense, a praxistemologist is an "inventopher"[3] (inventor philosopher) with the playful childlike scientific spirit of Einstein. — Einstein reduced-to-practice/praxis!

The inventopher combines thinking with making, thus embodying a social awareness of making, such as that fostered by organizations like the IEEE SSIT:

"Scientists think; engineers make." Engineering is fundamentally an activity, as opposed to an intellectual discipline. The goal of science and philosophy is to know; the goal of engineering is to do something good or useful. ... It took until the mid-20th century for engineers to develop the

kind of self-awareness that leads to thinking about engineering and technology as they relate to society. Until about 1900, most engineers felt comfortable in a "chain-of-command" structure in which the boss — whether it be a military commander, a corporation, or a wealthy individual — issued orders that were to be carried out to the best of the engineers technical ability. Fulfillment of duty was all that was expected. But as the range and depth of technological achievements grew, engineers philosophers, and the public began to realize that we had all better take some time and effort to think about the social implications of technology. That is the purpose of the IEEE Society on Social Implications of Technology (SSIT): to provide a forum for discussion of the deeper questions about the history, connections, and future trends of engineering, technology, and society.[4]

See also ISTAS (International Symposium on Technology and Society): <http://veillance.me>

Others have also proposed the combination of thinking and making, which is known as "Critical Making[5]", or, if it contains a political element, "Hacktivism[6]".

**DASTEM:** STEM is an acronym for Science, Technology, Engineering, and Mathematics. A major thrust in the agenda of public education is integrating these four subject areas.

Other interdisciplinary efforts like MIT's Media Laboratory focus on AST (Art + Science + Technology). Publications like Leonardo, the journal of the ISAST (International Society for the Arts, Sciences and Technology) also combine these three subjects [1]. There is also a festival, called "FAST" (Festival of Art, Science, and Technology) [7].

Design is also an important discipline, so we might consider DAST = Design + Art + Science/Sustainism + Technology. (I regard Sustainism as a branch of Science, along the lines of organizations like Science for Peace [8] that address, through environmentalism, nuclear weapons, greenhouse gas, Climate Change, and the like.)

DAST could put a "heart and soul" into the "STEM", e.g. going beyond "multidisciplinary" to something I call "multipassionate" or "interpassionate" or "transpassionate", i.e. passion is a better master than discipline (Albert Einstein said that "love is a better master than duty"). Passion means personal involvement, like we often see in the "DIY (Do-It-Yourself)" social movement, which is about personal empowerment. But that personal involvement often comes through group efforts and from being citizens rather than merely consumers [9][10]. (See also [http://henryjenkins.org/2010/05/why\\_participatory\\_culture\\_is\\_n.html](http://henryjenkins.org/2010/05/why_participatory_culture_is_n.html).)

Thus DIY is typically really DIT (“Do-It-Together”), so maybe it should just be called “Do It” (individually AND collectively)!

I coined the term “DASTEM” to denote Design + Art + Science/Sustainism + Technology + Engineering + Mathematics/Music/Musicology, and some examples of DASTEM were recently published [3].

Praxistemology is an attempt at creating a(n) discipline that is simultaneously both broad and deep, across design, art, sustainism/science, technology, engineering (inventing and making things), and mathematics (of which I regard music/musicology as a branch).

**Mens et Manus:** Minsky and Ganson are both associated with Massachusetts Institute of Technology. Many schools have a latin motto which is often just to sound scholarly but doesn’t mean very much.

But MIT’s motto, “Mens et Manus”, is Latin for “Mind and Hand”. This is the blend of praxis and theory that I think we need to encourage and further develop.

**Copyleft:** In addition to MIT’s blend of praxis and theory, there’s a third branch: inquiry or critique. We have in the above examples a playful sense of awe and wonder, and an inquiry/critique. As an example of the latter, consider Richard Stallman (also from MIT)’s notion of “copyleft”. Stallman’s philosophy formed the basis for both Wikipedia and Linux. This is a playful reversal of “copyright”, and a critique of the power relationships of intellectual property. This is yet another example of deep thinking combined with action.

## GNU/Linux:

Richard Stallman (GNU) and Linus Torvalds (Linux) together created one of the best success stories for DIY (Do-It-Yourself) volunteer-driven hobbyist-driven collaboration — creating what is perhaps the most reliable and capable operating system.

## Wikipedia:




Jimmy Wales built directly upon Richard Stallman’s concept of inverse copyright (“copyleft”) to create Wikipedia, the “largest and most popular general reference work on the Internet”[11], with “23 million articles, over 4.1 million in the English Wikipedia alone, ... collaboratively [written] by volunteers around the world. Almost all of its articles can be edited by anyone with access to the site, ... [there are] editions of Wikipedia in 285 languages. ... having an estimated 365 million readers worldwide. In 2011, Wikipedia received an estimated 2.7 billion monthly pageviews from the United States alone.”[11].

## WebCite:


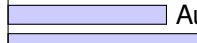

Gunther Eysenbach envisioned doing for recipients (scholars reading and citing information) what Wikipedia envisioned for transmitters (authors wishing to give away their writings for free). Eysenbach’s concept of WebCite enables ephemeral online documents to be reliably cited in scholarly literature [12].

## Praxistemologicality:

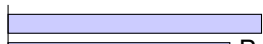

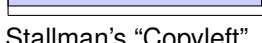
I now express, in my own opinion, an approximate degree of Praxism, Existentiality, and ’Quiry in three of the foregoing examples, as indicated below:

P   
 E   
 Q  Authentic (not job requirement)  
 Appeals to all ages

### Minsky’s “Useless Machine”

P   
 E   
 Q  Beautifully built  
 Authentic in artist’s sense

### “Machine with Concrete”

P   
 E   
 Q  Being free!!!

### Stallman’s “Copyleft”

These “ratings” (opinions) are not meant to be scientifically precise, but, rather, merely to convey, with visual simplicity, an opinion that these great achievements are all high in Praxism, somewhat high in Existentiality, and very high in inQuiry/critiQue/epistemology/pedagogy. I also indicate, in text, my reason for rating them moderately high in Existentiality, namely that they were each created of their creator’s own volition, not to solve a problem that was presented to the creator by an employer or by societal trends and fashions. In this way the work was authentic (i.e. not the work of an employee or poseur driven by job requirements or by trends or fashion).

Of these examples, I believe that:

1. “Machine With Concrete” exhibits the strongest **Praxis** (not surprising, given that Ganson is an incredible sculptor and craftsman);
2. “Copyleft” exhibits the strongest **Existentiality**. Not only does Richard Stallman “walk the walk” of Freedom, but the concept itself has, in many ways, laid the foundation for GNU, Linux, Wikipedia, and much of the Free World. Anyone who’s read Sartre and Kafka will no doubt see that Stallman has a strong sensibility and sensitivity to these issues.
3. “Useless Machine” exhibits the strongest **Question**, i.e. it is perhaps the most pure and simple example that can be used in teaching. When I showed all three to my 5-year-old, she told me she really wants (and needs!!!)

a Useless Machine. The epistemological power of Useless Machine for pedagogy is its universality — immediately understood — and appreciated by people of all ages or disciplines!

## LBB (Learn By Being):

Where the foregoing three examples could be stronger was in their sense of existentiality. Existentiality speaks to authenticity and freedom, as well as to “being”.

An example of “Being” is when we teach our children how to measure something, using anthropomorphic units (measurements based on the human body) (wikipedia.org/wiki/Anthropic units). Examples of such units are inches (width of the thumb) and feet, or “hands” — the units used to measure the height of horses. The human body itself becomes the ruler!

When we learn about rulers and measurement by becoming the measurement instrument, I call this “Learn By Being” (LBB)[3].

So I tell my 5-year-old that when we’re planing flowers in the garden, we’re going to use inches and feet to determine seed spacing, but if we were building a nuclear reactor we might want to use Ångströms or nanometers. A garden is a fun place to be, where mistakes can be made without grave consequences, and a lot of learning can take place!

The very inaccuracy of anthropomorphic units, especially when used across various age groups, is why the concept is so powerful as a teaching tool. It teaches children that it is OK to make mistakes, to take guesses, and to get a rough imprecise understanding of the world around us in our own special units (e.g. our own feet, despite the fact that we all differ).

Making measurements in this way exercises all three elements of praxistemology: putting into practice a personal involvement in the epistemology of measurement.

LBB can be summarized by considering a chronology of learning methodologies:

- Q** Traditional book-learning;
- P** Learn-by-doing, e.g. constructionism, constructivism, PBL (Project/Problem-Based-Learning);
- Ξ** LBB (Learn-by-being), Existential Education, Existemology (existential epistemology).

## Negative examples:

The foregoing examples attempt to illustrate what is meant by praxistemology. It is instructive to also include some examples of what is not praxistemology.

Negative example 1: An Armchair Critic. This is a person who is not engaged in praxis.

Negative example 2: A fast food worker. Such a person often does the work out of a sense of duty, and may be less personally involved. There is some degree of practice and craft, but a lesser degree of existentiality and inquiry.

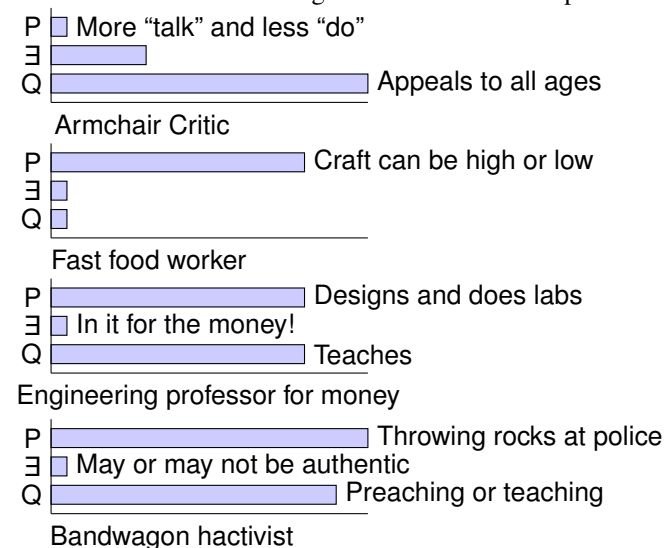
I am not saying that such practice is of lesser value than other practices, — indeed, it may be quite useful to society. I am simply saying that such practice is not praxistemology.

Negative example 3: An engineering professor in it for the money. Whereas such a professor may design labs (praxis) and do teaching (‘quiry), there can lack an authenticity and personal job-transcending involvement.

Negative example 4: Bandwagon hactivist. Political activism and hacking have both become quite fashionable. Numerous “hacker spaces” have emerged to fill a need for people who want to enter the world of hacking. Publications like Make Magazine have begun to take on military funding, and are not as “pure” in their pursuit as they once were.

I am not saying all hactivists lack authenticity — there are obviously some who do — but the numbers of followers have grown tremendously as the “hacker” or “maker” tradition has entered the mainstream, and a surface vivacity of “authenticity” (authenticity as in “hand made” — not in the deeper aforementioned sense) has become fashionable.

Here are some bar-charts to go with the above examples:



Praxistemology is like a tripod: it won’t stand up unless all 3 of the legs (P, Ξ, and Q) are sufficiently present.

## Practice what we preach:

I now describe examples from my own practice of inventions that I hope are authentic attempts at inquiry.

## Wearable Computing:

During my childhood, back in the 1970s (when computers were usually massive machines that required large computer



rooms) I was (as far as I know) one of only 2 children in our city (Hamilton, Ontario) to own a computer. It was one of the first “microcomputers”. I attached it to myself as a prosthetic extension of my mind and body.

For more than 30 years, I lived my everyday life in a computer-mediated world. The pictures below document various stages of my “Augmediated Reality” work that ran from the 1970s to the present:



In the 1970s and 1980s, people thought it was a crazy idea to have body-borne computer. But when I took these inventions and ideas to MIT in the early 1990s, to start a wearable computing project, people eventually began to see the merit in wearable computing through the 1990s. I’ve been recognized as “the father of wearable computing” (IEEE ISSCC 2000), and wearable computing is now said to be a \$241 billion industry. But I was not motivated by money or by trying to solve a specific problem. Instead, the wearable computer emerged more from tinkering than from planning.

For the history of the MIT wearable computing project, in Nicholas Negroponte (Director of the MIT Media Lab)’s own words, see <http://wearcam.org/nn.htm>

For an overview of wearable computing, see [13], [14], and [http://www.interaction-design.org/encyclopedia/wearable\\_computing.html](http://www.interaction-design.org/encyclopedia/wearable_computing.html)

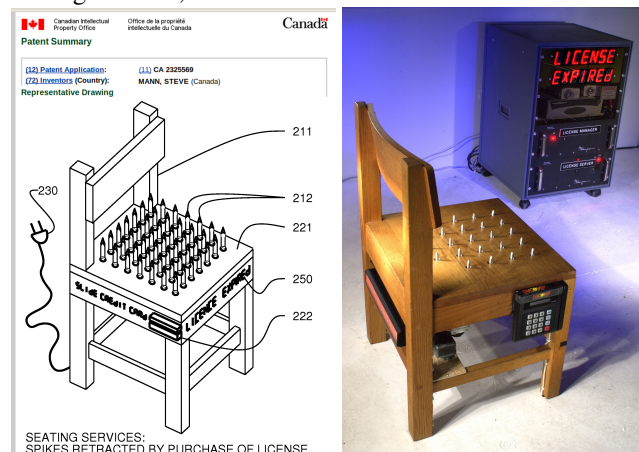
## License to Sit:

Wearable computing brought me directly in touch with a sociopolitical inquiry on intellectual property. With wearable computing, the computer becomes very much a part of the mind and body, and after more than 30 years of having a computer be part of my body, I no longer really distinguish between “thinking” and “computing”.

In the world of computing, software is often protected by patents, copyrights, trade secrets and the like. In the world of wearable computing, these restrictions can have the effect of creating “thought crimes”. For example, if I think of the square root of a number, and part of my “brain” comprises silicon chips, can my thoughts end up being illegal if they drift toward patentable subject matter?

Computer programs are often protected by floating licenses, and each license is called a “seat”. If you manage a large computer network, you might install a “license server” or “license manager” that allows no more than 10 people to use a particular computer program on your network. This is referred to as a “10-seat floating license”.

In the 1990s and early 2000s, my work on wearable computing was shown in various museums such as the Smithsonian, MoMA, Stedelijk, Science Museum, etc.. When asked to produce an exhibit on wearable computing for Independent Curators International, I built a chair with spikes that retract when a credit card is inserted to “download a seating license”, as shown below:



Patently absurd: from patent to product. Exhibit at San Francisco Art Institute, Steve Mann, 2001, along with the use of the patent office as a venue for artistic expression!

With wearable computing, or smartphones, cyborgspace and the real world become one and the same. So in “SeatSale: License to Sit”, I asked what would happen if the real world took on aspects of the virtual world of software, like the artificially created scarcity and “deconomics/sabotage economics” used in software licensing.

## Glass:

My explorations in wearable computing were directed toward a vision aid, and a mechanism for seeing and understanding the world better, through something I called “Augmediated Reality” (AR), as separate from the use of optical-only glass [15]. By this I mean that visual reality can be Mediated, Deliberately-Diminished, or Augmented, in order to see and understand the world better.

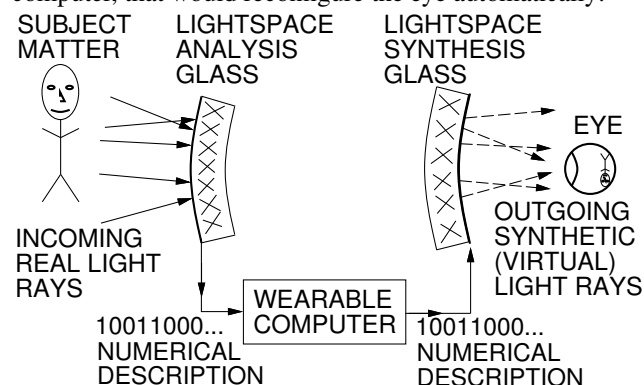
I learned to weld when I was 4 years old (“stick welding” back in those days, but I taught both my children how to TIG-weld by the time they turned four).

In my childhood, I envisioned a glass that would diminish/mediate the bright areas of an electric arc while augmenting the dark areas, thus “augmediating” my field-of-view. I became fascinated with welding glass, and began cutting out pieces of various shades of glass and joining them together to make an “augmediating” glass — the manually reconfigured eye.

Welding glass is well known [16][17][18], and apart from auto-darkening helmets (everything goes dark when the arc

starts), not much has changed in that world.

I formulated a theory-of-glass — a peripheral for the wearable computer, that would reconfigure the eye automatically:



## "DIGITAL EYE GLASS"

Rays of eyeward-bound light strike a "Lightspace Analysis Glass" (which need not necessarily be flat, and is therefore depicted as being curved), are turned into numbers which may then be processed by the wearable computer. The resulting numbers are fed to a "Lightspace Synthesis Glass" to be converted back into light. This allows the wearable computer to become a visual intermediary to for example, diminish the bright areas of the Subject Matter, and Augment/Mediate the bright areas, before resynthesizing the rays of light into the Eye, as shown in the above figure.

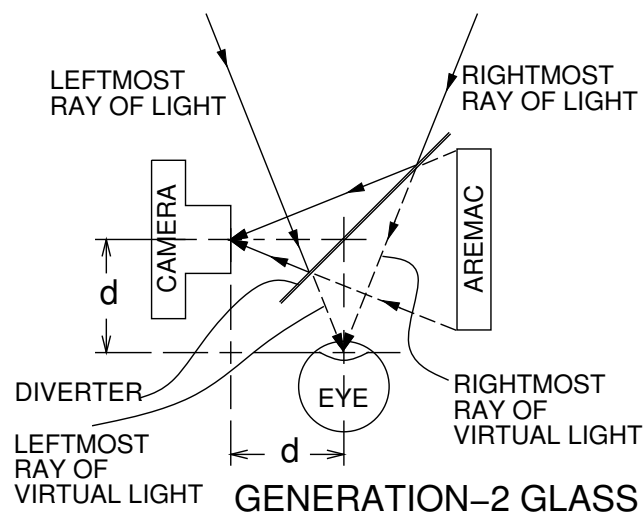
I built a rough approximation to this Glass in 1978, using a television camera as the "Lightspace Analysis Glass" a miniature glass cathod-ray tube as the "Lightspace Synthesis Glass" (over my right eye), and some electric circuits as the wearable computer.

Because the camera was located beside my eye the long-term effects after many hours of wearing the apparatus consisted of an adaptation to this strange way of seeing, and the adaptation persisted after removal of the apparatus.

I'd read about George Stratton's work in 1896 with upside-down eyewear (done optically rather than electrically), but my electric eye glass allowed me to experiment with many different kinds of mappings.

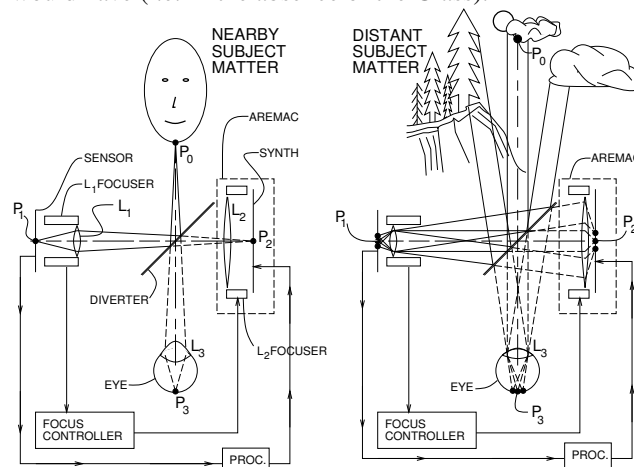
I also observed that mappings that deviate moderately from what the unaided eye would see, were harder to "forget" than mappings that were either closer to or further from what the unaided eye saw. Thus I formulated a theory and practice that suggested one needs to either get the mapping perfect, or make it quite different from normal reality (e.g. present the image upside-down, or backwards, if one can't get close to reality).

I called this Generation-1 Glass, and proceeded to Generation-2 Glass, which causes the eye itself to, in effect, become both the camera and the display:



Rays of eyeward-bound light are diverted into a Camera system that feeds to the Wearable Computer which then drives an Aremac (Lightspace Synthesis Glass). In this way rays of light that would have entered the unaided eye are collinear with rays of light presented by the Glass.

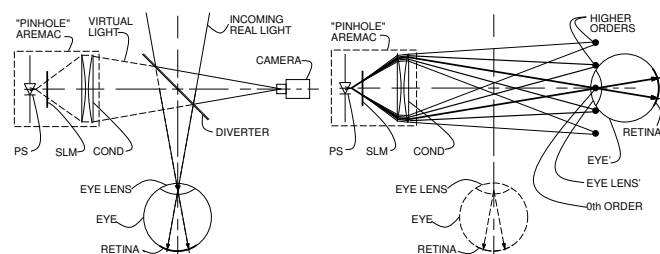
Observing that the focus distance at which objects appear was a problem, I next created Generation-3 Glass which includes a focus control mechanism so that if one looks through the Glass the eye will focus to the same point as the unaided eye would have (i.e. in the absence of the Glass).



## GENERATION-3 GLASS

Finally, I noticed that, while looking at objects in various focal planes, such as looking at a distant object through a nearby screen or chainlink fence, some problems remained.

For this reason I created Generation-4 Glass using a laser light source with a spatial light modulator, and the like, to attain infinite depth-of-focus:



## GENERATION-4 GLASS

Generations 2 to 4 of the Glass were known as “EyeTap Digital Eye Glass” [19] (the word “Glass” appears in singular form, not plural, i.e. “Eye Glass” not “Eye Glasses”).

The result was a natural experience with zero eyestrain which I could wear continuously many hours a day for many years. The Generation-4 Glass was completed in 1999, described in detail in 2001 [20], and featured as the lead article (the cover, first page, and pages 31-32) of Abilities Magazine, Issue 69, Winter 2006:



*Leftmost: Generation-4 Glass completed in 1999. The eye itself is the camera exactly! That is why the “Digital Eye Glass” is also known as the “GlassEye” (The right looks exactly like a camera lens). This eliminates long-term dizziness, vertigo, and flashback effects that can otherwise persist long after the Glass is removed. Rightmost: Google Glass, 2012. The camera being to one side of the eye makes this a Generation-1 Glass. Long-term adaptation issues can result. from effectively moving the eye out of its eye socket and putting it off to one side.*

Commercially made products such as Google’s Glass bear a similarity to this EyeTap Glass (same slender aluminum strip, same two silicone-pads on the nose, similar glass over the right eye), but Google’s Glass is a Generation-1 Glass (camera is to the right of the eye, not the eye itself as in Generations 2-4 of the Glass).

When we wear something, it begins to function as part of us. Digital Eye Glass, for example, affects (modifies) how we see the world around us.

Even regular safety glasses, fitted without the attention to individual customization, can sometimes deleterious effects on balance and vision[21]. For example roof workers often don’t wear safety glasses because the risk of falling off the roof may be worse than the eye injuries that might result.

But more importantly long-term effects of eyewear must also be considered. And we adapt to new and better ways of seeing the world, this adaptation can result in improved quality of life, but it can also result in brain damage and

strange visual “flashback” effects as wearable computing has the possibility to “rewire” the brain, in a bad way, especially if the camera does not align exactly with the eye (i.e. if it does not meet the three “EyeTap criteria”[20]).

As this is a new technology, we do not yet have a huge sample population of users for long-term (many years) user-studies.

One important moral and ethical question: should Glass be mass-produced if it can potentially cause harm due to long-term adaptation, damage to visual cortex over time, etc.? Or should manufacturers provide a Generation-2 or higher Glass to avoid these problems?

A number of companies are making and selling Generation-1 Glass (glass that does not align the camera in a natural eye position, and therefore does not meet the important EyeTap criteria [20]):

**space:** spatial (collinearity) and spatial frequency alignment (orthoscopic and orthofocal);

**time:** orthotemporality [20] and temporal-frequency (non-lagging, etc.);

**light:** comparametric / superposimetic / orthoquantigraphic [22][20].

Glass not meeting the above three criteria could have long-term adverse effects[20][22].

## Internet of People:

The IoT (Internet of Things)[23], has put sensors on the things around us. But now many of us are also putting sensors on ourselves. These sensors-on-people give rise to an **Internet of People, Places, and Things**, not just Things!

Putting sensors on people will create huge strides forward in health and wellness, for individuals who choose self-monitoring. For example, an individual can now transmit live streaming (or captured) ECG (electrocardiogram), together with live first-person video, to a physician who can see what the patient is doing, while examining the corresponding ECG waveforms. This can help to determine the root cause of heart-related problems and identify causes of stress in the patient’s environment.

## Veillance:

Consider, for example, a “black box” health recorder that captures information about a patient and the environment around the patient, much like the “black box” flight recorder of an aircraft. In the event of a physical assault, murder, or accidental death, such a device might help determine the cause of death. In less extreme examples, such a device might also help people improve the quality of their lives by helping them (and others they trust, such as their doctors or health advisers) understand the world around them.

Putting sensors on people raises important privacy and copyright issues in the realm of Technology and Society. For example, is a local capture of data for personal use considered a copy? When widely used as a vision aid, do we need to re-think Open versus Closed (or “Clopen”) to use a portmanteau coined by Vardi [24]) access?

We already accept IoT. And we already accept cameras on things, i.e. **surveillance**. Protecting human life is much more important than protecting merchandise, and putting cameras on people (this is known as **sousveillance**) is a natural and direct way of achieving human security [25][26] — putting people first — in a world that has previously been focused on the security of property (places and things). Thus we’ll see a transition from surveillance to veillance, and a transition in sensing (not just for security but also for quality-of-life, and many other applications) from “things”, to “persons, places, and things”.

This Internet of People, Places, and Things, will create a more complete picture than merely the Internet of Things.

For example, putting cameras on people will give rise to a veillance-society rather than the surveillance-society arising from putting cameras only on property (places and things).

Surveillance is a French word that means “to watch from above”. Police watch citizens. Corporations watch their customers.... But “veillance” (simply “to watch”) means that sensing will occur in all directions, not just top-down.

This transformation in our society is being enabled by the miniaturization and mass-production of society. Cameras that were once big and heavy gave “intelligence” to land and buildings. Now they’re small enough to give that “intelligence” to people. With the growing population of elderly, and as all of us age and our eyesight gets worse, we’ll look to Digital Eye Glass to help us see better. Our eyeglass prescriptions will be adaptive, automatically updating and adapting to whatever activity we’re engaged in.

Giving people the ability to see — is more important — AND LESS PRIVACY INVASIVE — than giving property the ability to see.

## Sousveillance:

The existential nature of Glass (i.e. the everyday use of it, as if part of the mind and body) brings it beyond the borders of a research lab, and out into the real world.

One interesting discovery was the reactions of persons engaged in surveillance. It turned out that peer acceptance was not so much the issue as acceptance by the authorities like security guards and facility owners — very people architecting and maintaining the “surveillance superhighway”. These persons, in particular, objected to Glass out of fear-of-cameras, even though the Glass originally did not record anything (images were merely processed and

passed through to the output side of the Glass).

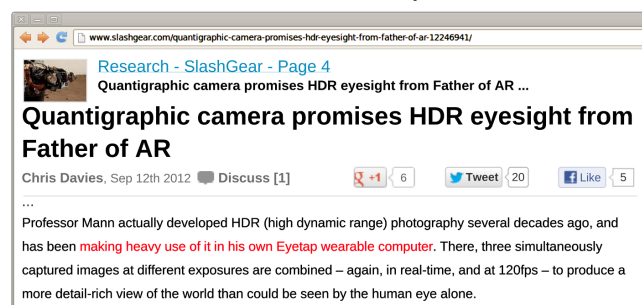
What seemed ironic was that the same persons conducting surveillance were the ones most opposed to something that seemed like the reciprocal of surveillance.

I became fascinated with the otherwise hidden sociopolitical machinery that became very evident to me, as viewed through Glass, but that nobody else could see.

## Sur/Sousveillance:

The word “surveillance” is French for “to watch from above”. The closest English word is the word “oversight”. The logical reciprocal is “sousveillance” and “undersight”, to describe “watching from below” (from the French word “sous” which means “from below”). There are now hundreds or thousands of books, papers, conferences, and projects on sousveillance. Whereas surveillance is dominated by governments, corporations, and organizations, sousveillance tends to be the work of individual people, in a DIY (Do-It-Yourself) tradition that also includes tracking not only the information itself, but also when large organizations choose to destroy or hide information (negative sousveillance) [27].

In addition to publishing this work in scholarly research journals, it also often appears in the mainstream media, because it has a direct affect on society:



Until recently most people had not cared much about this work, or how it might shape society. But recently (in the last 12 years), many people now use smartphones for AR, or simply to help failing eyesight by photographing and magnifying something, or perhaps to translate a foreign restaurant menu into their own language using an optical character recognition app. ... Penny Sheldon, a travel agent from Boise, Id., was physically assaulted by McDonalds staff in Paris, France, because she photographed their menu.

My uniquely personal experiences over the last 30 years are taking on new relevance as Augmented/Augmediated Reality goes mainstream. We are at a pivotal era where **the questions I am asking have become significant to society, and require answers!**

## Forbidden QR codes:

Consider this group of pictures I recently took:





Here the signage on a box of watermelons advises shoppers to use their smartphones to see a sales pitch on the product to help them make a purchase decision. But many of these retail establishments that use QR codes also have signs saying “NO CELL PHONE IN STORE” and “NO CAMERAS/VIDEO”. So participants are **simultaneously required to use a camera, and forbidden from doing so**, in order to see this content. And customers are frequently harassed by store security staff when all they’re doing is trying to experience a little bit of Augmented Reality.

Whereas Glass helps people see better, without *necessarily* recording video, I’ve also been working on other cameras that do the opposite: lifelong video recording without *necessarily* trying to help people see better:



Wearable Wireless Webcam  
1998, Mann

SenseCam  
2004, Microsoft

Lifelogging Camera  
2012, Memoto

This originally took the form of a camera necklace that mimics the appearance of the typical surveillance domes, yet is instead a fully functional Wearable Wireless Webcam for lifelogging (lifelong cyborglogging), also known as lifelogging, moblogging (mobile logging), or the like. In 1998 I built a series of neckworn domes, some with built-in augmented reality and gesture recognition[28].

## No Cameras!

Although there are no laws against taking photographs of private buildings from public spaces (e.g. public roads and sidewalks), there have been numerous cases of security

guards harassing photographers:

*“... [A] simultaneous increase in state surveillance and the restriction of the right to take photographs in public ... monopolize the decision as to who constitutes the citizenry of photography, ... [and raise] questions about artistic and political responses to surveillance and photography restrictions”*

— ‘No Credible Photographic Interest’: Photography restrictions and surveillance in a time of terror, by D. Palmer and J. Whyte, *Philosophy of Photography*, Vol. 1, No 2.

Meanwhile police around the world are installing surveillance cameras throughout entire cities. Computer vision is being applied to surveillance, as well as energy management. Just like there is a camera in most cellphones, soon there will be a camera in most light fixtures, including streetlights, for both occupancy sensing (see <http://www.lsgc.com/pixelview/>) and security (see <http://intellistreets.com/>):

*“THOUSANDS of old-fashioned street lights in Merseyside are set to be dismantled and replaced with hi-tech CCTV-equipped lamps. The £32.7m scheme would see about 14,000 lampposts across Knowsley modernised ...”* — Nick Coligan, *Liverpool Echo*, Nov 29 2007

Total surveillance has crept into most facets of our lives, including surveillance cameras in washrooms, changerooms, and locker rooms. **Even in Canada!** A CBC news headline informs that Alberta’s Privacy Commissioner is in favour of locker-room surveillance cameras: “Cameras can stay in Talisman’s locker room, says commissioner” (See <http://www.cbc.ca/news/canada/calgary/story/2007/03/22/talisman-privacy.html>). And modern automatic flush toilets, faucets, and sensor-operated showers are starting to use more sophisticated camera-based computer-vision technologies (e.g. U.S. Patent 5828793). I call this “liquid surveillance” — surveillance (or internet) of uncountable “stuff” like water, not just surveillance (or internet) of countable “things” like bottles of water. More completely, “fluid surveillance” covers liquids like water, as well as surveillance of air, as can be attained by applying computer vision beyond lighting+HVAC to AWL, (Air, Water, and Light) to achieve a total (sur)veillance of persons, places, things, AND stuff [29].

But when citizens point their cameras at the architects of the “surveillance superhighway”, or simply when photographers take pictures of bridges, buildings, or surveillance cameras, they often come under attack, especially as police have placed photographers under suspicion:



Police advertising campaigns promote surveillance (leftmost), but also ask people to **report anyone “taking photos and making notes about security”** to the police. Thus a professor or student simply studying surveillance is likely to be harassed, investigated, and possibly harmed. (Leftmost: Creative Commons, by 2.0, flickr user Toasty Ken. The text in the rightmost 2 images has been accessibilized.)

This comes at a time when innocent suspects have been roughed up by police. Some have even been killed as a result of heightened suspicion and mistaken identity, e.g. Jean Charles de Menezes, a Brazilian electrician, was shot to death by police in a London subway. And police seized the CCTV recordings and claimed they were blank! Menezes was shot in a crowded subway car where lots of people could have recorded the incident. But police and security guards have made people afraid to record what they see. For example, NBC News and the Miami Herald reported that:

*“On Memorial Day 2011, Narces Benoit witnessed and filmed a group of Miami police officers shooting and killing a suspect ... He was then confronted by officers who handcuffed him and smashed his cell phone, but Benoit was able to sneakily preserve the video ... he discreetly removed the [memory] card and placed it in his mouth.”*

It is noteworthy to consider some of the spaces in which I have been (and many others will be, as the technology becomes widespread) forbidden from entering, or where problems were encountered:

Location	Notes
Public street	Perp. of car accident got angry
TTC (public transit)	Guard enforced nonexistent law
AGO (Art Gallery Ont.)	Physical assault by guard
Changerooms + showers	Issue: privacy
Public washrooms	Issue: privacy
T&T Supermarket	Handheld magnifier forbidden*
McDonalds	Vigalante (in)justice by staff**
Casino Niagara	Camera OK if in a dome
Cineplex movie theatre	Issue: copyright
Opera Centre (4 Seasons)	Issue: copyright

\*see <http://glogger.mobi/s/tnt>

\*\*see <http://eyetap.blogspot.ca/>

Of these locations, changerooms and movie theatres emerged as the most inaccessible to the “silicon mind” and “Glass eye”

that many of us will soon embrace.

Accessibility requirements will force changerooms and washrooms to become “universal” (i.e. family-oriented with individual compartments). **Washrooms are a basic need that cannot be denied to those of us who happen to have computer chips on or in our bodies! But movie theatres will remain as the central locus of contention between the “cyborg” and his or her environment!**

The Criminal Code of Canada states:

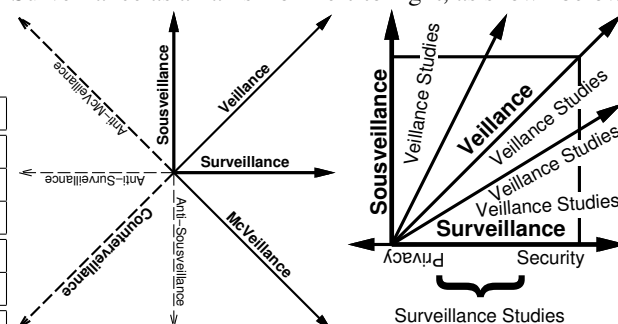
“(1) A person who, without the consent of the theatre manager, records in a movie theatre a performance of a cinematographic work within the meaning of section 2 of the Copyright Act or its soundtrack (a) is guilty of an indictable offence and liable to imprisonment...”

Interpreted most broadly, the human brain is a recording device, and remembering a portion of a “cinematographic work” is a criminal offence. But such a law is likely to be applied in a discriminatory way that criminalizes cyborgs as “existential contraband” (those of us who *are* cameras are, by our mere existence, contraband). As more people use electric eyeglasses, AR, lifelong video capture devices, lifeloggers, Personal Safety Devices, etc., a large percentage of the population could be criminalized for mere memory even if they never disseminated any of their memories!

Thus we can see a number of problems as the interests (some legitimate and some excessive) of copyright clash with the interests of personal use.

## Veillance Studies:

Although there are a number of studies on the topic of surveillance, we need to look beyond surveillance to understand these problems. More generally, consider Surveillance as an axis from left-to-right, as shown below:



We can have varying amounts of surveillance. Privacy activists might wish us to move toward or remain at the origin, whereas security activists might wish us to move further toward the right. A separate axis is denoted for sousveillance (e.g. body-worn or hand-held cameras). The amount of surveillance and the amount of sousveillance can vary independently. Veillance is the total of surveillance and sousveillance. McVeillance is defined as proliferation of surveillance while opposing sousveillance, as denoted on the



diagram at left.

It should be noted that both those in favour of surveillance and those opposed to it, are viewing the world on a one-dimensional axis. Even those who claim to be neutral (i.e. to merely study surveillance without professing a “for” or “against” bias) are seeing the situation from a one-sided “surveillance-only” (i.e. highly biased) viewpoint.

Thus I propose “veillance studies” as a more neutral and unbiased framework than “surveillance studies[30]” which necessarily favours surveillance over other directions of veillance.

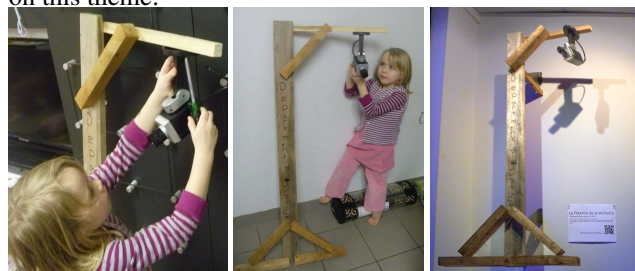
## La Potence de la Veillance:

The French word for the gallows is “la potence”. This word derives from the Latin word for power, “potentia”, from potens, meaning “powerful”. Potence represents the coercive physical and/or ideological enforcement informed by surveillance.

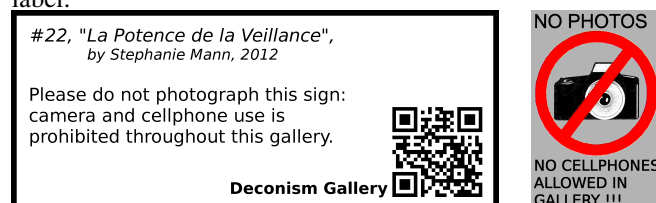
A typical courthouse of days not-long-ago, would have often had large gallows erected out in front of it. Gallows and gibbets were often placed at prominent locations in a city. Examples include the famous Tyburn Tree in London (a massive triple-branch gallows that could hang 24 convicts at the same time), and “Le Gibet de Montfaucon” high on a hill in France.

Foucault’s book “Surveiller et Punir” outlines how surveillance is inextricably intertwined with punishment and power relationships.

Artist Stephanie Mann (age 5) built a conceptual art sculpture entitled “La Potence de la Veillance” (see below) that touches on this theme:



This piece was exhibited in Deconism Gallery in early 2012. Here is the accompanying gallery signage which forbids cameras yet requires cameras in order to obtain additional information about the piece by way of the QR code on the label:



The accompanying gallery signage forbids cameras yet

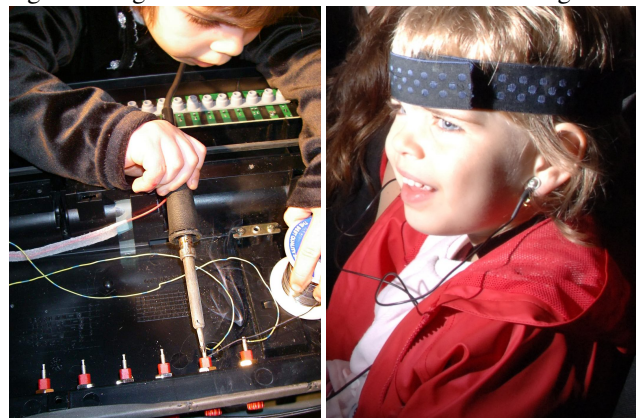
requires cameras in order to obtain additional information about the piece by way of the QR code. The exhibit also includes a scavenger hunt for participants to photograph the artworks and upload the photos to an image-recognition website, in order to find secret messages hidden in some artworks. These photographs of the artworks by the general public also form part of the gallery exhibits. Yet signage in the gallery informs visitors that the use of cell phones is prohibited in the gallery.

## Co-hosting with IEEE ISTAS 2013:

A large “No Cameras Allowed!” exhibit is scheduled to coincide with the IEEE International Symposium on Technology and Society (ISTAS) 2013, June 27-29th, in Toronto, for which I am the General Chair. The topic of this conference is veillance which is the relationship between surveillance and photography. See <http://veillance.me/>

## Community outreach:

Praxistemological activities also include community outreach, e.g. teaching others how to build wearable technologies:



(leftmost) Christina, age 3, has learned the art of “circuit-bending” and tinkering. Here she solders wires to a row of banana sockets after having measured, marked, drilled the holes, and installed them, to “hack” a brainwave interface for a computerized music system. (rightmost) Christina also performing live at the Power Plant Contemporary Art Gallery on a system similar to the one she built.

The Existential Technologies Research Lab (ETRL), located at 330 Dundas Street West, has been running for 12 years, in the context of community outreach:



Here a number of local participants form a “cyborg collective consciousness” with various others around the world, as part of DECONcert, a worldwide web-based collaborative brainwave concert in which the music was generated by a “cyborgspace” collective that also included some Parkinson’s patients in New York City who were able to participate fully in the event. Part of the idea here is that since the process is brainwave-driven, various people, including some with special needs, are able to participate fully.

## The Elements:

When my kindergarten teacher said there are 3 kinds of instruments: strings, percussion, and wind, I questioned why two of these make sound from solid matter and one from gas. “Why is one state-of-matter repeated twice, and what state-of-matter has been omitted?” I asked. This led me to invent the hydraulophone, a musical instrument that makes sound from vibrations in liquids like water.

Hydraulophones create an intimate and disarming experience between members of the public and post-cyborg technology. A number of hydraulophone sculptures have been installed around the world, including Legoland (Carlsbad, California), NASA, Chicago Children’s Museum, Mayborn Museum, the CNIB (Canadian National Institute for the Blind) Alberta headquarters, the Experimentarium (Copenhagen), and the Ontario Science Centre, as the main centerpiece out in front of this landmark architecture building:



The hydraulophone forces us think of states-of-matter, and fundamentals, e.g., solid liquid gas and plasma, which correspond to the Elements, earth water air and fire. The hydraulophone aims at being more than just a new category of musical instrument or public sculpture: the attempt is to raise

environmental awareness.

## Urban Sustainability:

We can map these four states-of-matter to our basic needs, to: eat (solid), drink (liquid), and breathe (gas), and the importance of energy.

The hydraulophone brings awareness of the environment and sustainism, and therefore issues of food, water, and air security.

Ongoing work in this area [31] includes a variety of projects on urban sustainability, urban farming, forestry, and food, water, and air security. See, for example, <http://www.earthcurrents.ca/>

## Conclusions:

Several examples of praxistemology, a praxis of existential inquiry, have been presented as a playful childlike (in the Albert Einstein sense) way of doing basic research that can solve many of the world’s problems without necessarily being solution or problem-driven.

We should encourage people to apply LBB (Learn By Being) in an unstructured and free-spirited way, where lateral thinking, rather than vertical problem-solving, is strongly encouraged.

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