Universal Robots Searching for Radical Software

Michal Klodner

Digitisation and digitalisation have become key essentials to memory institutions to adaptation and transformation of their cultural role in the information societies. Not only the collections of art and document archives, but the majority of social representations turned to data formats. Digital media and institutional critique also changed knowledge processes and organisational ecologies. Artists, academic researchers, curators, archives or galleries became content providers to digital distribution channels. Quantity of digital content and large reach and consumer engagement on digital platforms shall be a sign of success. From cultural managers active digital content strategies are requested and digital curation should be the process how to make them happen.
The other side of this picture has also revealed many ongoing and maybe even enlarging gaps and problems calling for critical analysis. At the very heart of this issues are general questions of democracy and equal access to social representation. The architecture of digital infrastructures shape the discourse and our ability to represent minorities and more than human actors. There are unresolved environmental and climate concerns in terms of sustainability of digital transformation. Humanities in general and digital curation of media art are about to embrace new approaches.

The first stage of digital humanities beginning in 1990's was about building repositories and editing metadata. Scholars engaged in wide range of technical to philosophical discussions embracing markup languages and creation of model content types. The power of rhetorical argument was to be embodied in information structures. [1]

The influence of poststructuralism and deconstruction also called for the field to rethink ontological categories of identity, gender, race, nations, authorship, power relations, bodies and subjectivity. What is included and excluded in archives and repositories turns out to be political, or at least matter of collection policies. For all of the novel approaches digital humanities actually depend on their underlying information and knowledge infrastructures, which are not entirely unbiased. Communication channels, data models and visual rhetoric is borrowed from other areas, like commerce a business applications. "We can do what we know how to do: visualize datasets that we inherit from governments, corporations, and cultural institutions, using tools that we have borrowed from corporations. Or we can scrutinize data, rip it apart, rebuild it, reimagine it, and perhaps build something entirely different and weirder and more ambitious. " frames the dilemma Miriam Posner in Debates in Digital Humanities. [2]

Building digital infrastructures and growing amounts of data has its backgroud in material and energy demands which never existed before. According to analysis of IDC there was 500 thousands of datacenters worldwide in 2012. In 2019 it was already 8 millions, which counts for 16-fold increase. The debate in academia facing climate change involved modesty in conference flights. By energy consumption 3% globally digital media already surpassed the airlines industry and the prediction for 2025 is the growth to 5-6% worldwide energy consumption.[3]

1 Johanna Drucker, Humanistic Theory and Digital Scholarship. In: Matthew K. Gold – Lauren F. Klein (eds.), *Debates in Digital Humanities*. Minneapolis: University of Minnesota Press 2012

2 Miriam Posner. What's Next: The Radical, Unrealized Potential of Digital Humanities In: Debates in the Digital Humanities 2016 Matthew K. Gold and Lauren F. Klein (eds.), University of Minnesota Press, Minneapolis London, 2016

3 Lean ICT – Towards digital sobriety , The Shift Project 2018

In 2016 Paris Agreement has formulated long-term goal in climate protection, which is to contribute to limiting the rise of global temperature significantly under 2°C in comparison to pre-industrial period and to strive for keeping it under the level of 1,5°C. Global carbon budget for this goal is shrinking and requires reduction of carbon emissions 6-8% annually. New insights in 2020 indicate that moderate emission reductions are less likely to happen and narrowed the assumed range to 2.3–4.5°C. [4] In Europe, we already experienced, how relatively small wave of refugees can create a pressure on democratic systems empowering authoritarian leaders, xenophobic political forces and racism.

Building of server housing facilities, equipped with cooling systems and power generators, even when using renewable energy, consumes large quantities of material. With the support infrastructure, transport and parking it severely destroys the natural landscape and agricultural soil. Area of server farms goes from the average of 1000 square meters to 12 hectares with energy consumption upto 100 megawatts. We should see them as heavily smoking factories behind our websites and mobile apps. The energy mix in the power grids still contains a major part coming from coal. Average smartphone, during its lifetime generates 33 times more energy consumption in operations in datacenters, than in its own use.

Centralization of information services, marketed as "cloud" not only negatively impacts ecosystems but has a little advantage for lot of organizations. Outsourcing the information technologies to cloud companies is relatively new model which was accompanied by unrealistic expectations. It has its advantage for startup companies without infrastructure, when they need a fast development of service from investment money. Purpose of startup is often just in testing business potential of a product. No permanent infrastructure is needed, company has flat organizational structure and information technologies are bought or rented on time-limited frame of months. Investor interest is driven by affective disposition of consumer desires, often without any relation to real value in product monetization. Obviously, the situation of memory institutions and archives is different. Unfortunately, digitalization of state and public institutions often led to large-scale infrastructures with generic features and the similar problems. Media arts and digital cultural policy could easily fall under research infrastructures financed with the aim of industrial development and competitive economy.

When we think of achieving sustainability, some deeper questions about our society come out. Natural resources are depleted by extractive consumption economy, but obviously, there is a cultural dimension of unsustainability, related to behaviors, social conventions, institutions, values, world-views and epistemological premises. [5] Before I advance towards the questions of digital curation, we need to understand, what are the foundations on which our assumptions about culture and science are built.

Unsustainability: robots and humans

I am writing this text one hundred years after the premiere of the play named Rossum's Universal Robots in 1921 at National Theatre Prague. Media covered this anniversary reminding mostly of the word "robot" which Josef and Karel Čapek brothers invented for subordinate workers. Now it is the buzzword of the newest achievements of industrial developments, together with the artificial intelligence. Just some of the commentaries mentioned that "robots" in RUR were not the mechanical machines but biological creations, which literature later started calling "androids". The story comes out of fictional,

---

4   Pihl et al., (2021). 10 New Insights in Climate Science 2020 – a Horizon Scan, Global Sustainability, 4. https://doi.org/10.1017/sus.2021.2.

5   Sacha Kagan. *Art and Sustainability*, transcript Verlag Bielefeld 2013, p.24

what would now be called "biotechnology" factory, which by a secret formula of elaborate chemical processes can produce living human organisms, undistinguishable from people. There are moments in the script where the characters are surprised when told the people standing by are non-human industrial productions. What sounds familiar now is the proclaimed intent of the managers of RUR factory to solve social issues and inequality in the whole world by producing a cheap work force in thousands and millions of robots, which would lead to cheap availability of food and goods for everyone.

Karel Čapek wrote RUR after the tragedies of World War. The Germans called the Great War "*Materialschlachte*" — a battle of materials. Industrially advanced European powers have built their military forces on industrial capacity against one another and application of mass-production methods. The logic of winning and losing was in quantity of guns and explosives produced and distributed to the frontline. In a single battle of Somme in 1916, there were hundreds of thousands dead on both sides and millions of heavy artillery shells remained like iron monuments long after. In RUR, the mass production novelty of 1920's dream of producing any possible thing in infinite numbers is applied on human bodies. Precisely, no more "human". By the achievements of science, the bodies are made from artificially grown tissues, organs filled with chemical liquids substituting natural bodily fluids, stitched alive by secret formula enzymes.

Looking deeper in the history of literature, one hundred years before RUR, in 1818, Mary Shelley wrote a gothic novel Frankenstein. Dr. Frankenstein was scientist with a strong desire to understand the world. He is obsessed with studying new theories of alchemy and anatomy, he excels at chemistry and electricity, soon developing a secret technique to impart life to non-living matter. Creation of humanoid monster nevertheless leads to disastrous consequences. At the very origin of the production of robots was also a scientist. Čapek's old Rossum discovered the secret of life in the jungle, abundant of yet unknown medical substances. The factory and it's managers had just stolen the formula, in the end nobody of them actually knowing the recipe. Fordistic idea of manufacturing system designed for standardized, low-cost goods where the products are no more handmade, personal or unique was confronted with catastrophic result of this de-humanisation: extermination of all mankind.

In our society horizontal, hyper-consumerist rationality and technicist effectivity replaced other kind of rationality. Vertical, spiritual and substantive rationality, developing critical reflection. By historical developments of science our worldview is atomistic and individualistic. Things are distinct and measurable material entities, people are separated from each other and from their environment. Industrialized western societies are the paradigms of progress and development. Not only writers suggest that there could be something wrong with classical scientific thought and its application. Erwin Laszlo points out how this atomistic view, inherited from the modern scientific method, has its root in the fragmentation of our understanding.[6] Basarab Nicolescu calls it a paradigm of simplicity. By the binary character of classical logic and the rigid norms of truth in science "discipline can pretend to entirely contain all knowledge within its own field".[7]

During the Covid-19 pandemic we experienced every day how specialists cannot talk to each other, with remarks in interviews "I am a clinician, you have to ask epidemiologist", "I am an epidemiologist, you have to ask immunologist", "I am an immunologist you have to ask vaccinologist" etc. Even the environmental subdisciplines, operating just on different scales, like population biology and ecosystem ecology often do not communicate with each other.[8] Moreover, the separated knowledge in biology and ecology does not lead to solutions and applications in agriculture or forestry. Academic domain is

6   Erwin Laszlo. *The systems view of the world : a holistic vision for our time*, Cresskill: Hampton Press 1996, p. 11
7   Basarab Nicolescu. *Manifesto of Transdisciplinarity*. Albany: State University of New York Press, 2002, p. 33
8   Petr Kuneš, Vegetační změny v prostoru a čase. In: Živa 5/2020, Academia, 2020, Prague, p. 215

isolated and people do not read reviewed journals. Introduction of wider reflexivity or the addition of some cultural "added-value" to overall technicized society in some form of artistic patches does not seem to be enough. "This would be like trying to obtain a living tree by juxtaposing roots, trunk, branches and leaves."[9]

Nicolescu further describes this process of Babelisation: „… decision maker becomes increasingly more incompetent regardless of his or her intention […] even a group comprised of the best specialists from all the various disciplines would only be able to develop a generalized incompetence, for the simple reason that the sum total of competencies is not competence: on technical level, the intersection between different domains of knowledge is an empty ensemble". [10] Universal Robots thus can do any expert profession known, nevertheless lack any humanity. The world of specialized science has radically opposite consequence. A multischizoid, complex reality have replaced what should have been the simple on-dimensional reality of classical thought.[11] Despite all the rationality, we are seeing the growth of flat-Earthers on corporate social platforms, rejecting any fact or argument. Q-anon movement and other conspiracy theories accumulated followers by offering easy answers to complex problems. What science cannot explain is replaced by magical thinking and slipping argument targeting affective concerns and behavior. Q-annon snowballed this way other social groups with interest in holistic thinking, yoga or wellness. To prevent this in the digital content domain of arts and humanities, much more consistent, socially interconnected media has to be provided, where exclusive specialized knowledge has to be followed by additional levels of inclusive public discourse.

New media: hi-tech or environment?

After the fall of Iron curtain in 1989, Woody Vasulka with Steina started to come back to Czechoslovakia, which they left in 1965, taking part in the local media art scene. In Brno, first exhibition in series named Hi-Tech/Art began in 1992. They not only exhibited their virtual environments Theatre of hybrid Automata, Brotherhood and Allvision, deconstructing media and technological systems. Also Jeffry Shaw, Peter Weibel or Stelarc presented their work along with czech artists.

Hi-Tech was a trending term in post-communist area, isolated from western world for decades. Vasulkas art in fact should be considered low-tech. Lots of their original devices was found in Los Alamos dumping ground as discarded trash. Hi-tech was not really their story, but it was a suitable appropriation. Hi-Tech /Art exhibition series can represent the technological branch of curation of new media in 1990's. The term "new media" is in the right place here, because it emphasises the technological innovation of media being used. From 1993 until the last edition in 1997 the exhibition was part of the accompanying programme of INVEX trade fair, the main event of digital and computer industries running into backward country. Co-curator of exhibitions was the director of Silicon Graphics subsidiary in Czech Republic. Commercial interest of Silicon Graphics company, later SGI, supported also equipment of labs of the new media educational programmes at Brno Fine Art faculty and at Academy of Fine Art in Prague by high-end computer graphics stations. It was the technology of Hollywood productions not accessible on regular PCs of that time. By reason of this the digital video, 3D graphics and virtual reality emerged. Co-organising the displays of Vasulkas art and realisation of installations incursed more than little expenditures. From the corporate viewpoint the art exhibition was just addi-

---

9   Nicolescu 2002, p. 137
10 Ibid, p. 42
11 Ibid. p. 34

tional charges to trade fair presentation. Vasulkas invoices went for reimbursement directly to Silicon Graphics.[12]

Historically, technological art fit well into the picture of innovation, where specialized knowledge is generated through experimentation, and can be applied in industrial society. Curatorial policy of the technological avant-garde was suitable to art centers, subsidized by technology companies, for which the specialization in recognizable industrial domains went well along with the government's policies of funding art laboratories as centers of excellence. Today, this approach is already being criticized. In a significant text on curating new media Steve Dietz identified more than twenty labels being used as equivalents to „new media", including „computer art", „electronic art", „multimedia", „digital art", „software art", „cybernetic art", „next media", or „variable media". [13] He noted, how new media after 2000 lost their amazing novelty and curators, instead of looking for technologically advanced media, began to work also with strategies making use of obsolete media, low-tech and DIY. Actually, nobody explained what is the medium in case of biological art or research collaboration. More general term of media art embraces any entangled web of media related to each other, their substitutions, including electronic for material, relation of embodied to medial and the like. Digital curation is in the situation to respond and approach wider range of media art strategies overcoming being narrowed to technological industries. In fact, there is a lot to build on in media art itself.

In the original history of videoart, system ecology was rooted already in the 1960s. In the September issue of Artforum in 1968, Jack Burnham wrote in his article Systemic Aesthetics: "Increasingly, products – either in art or life – become irrelevant and different set of needs arise: these revolve around such concerns as maintaining the biological livability of the earth, producing more accurate models of social interaction, understanding the growing symbiosis in man-machine relations, establishing priorities for the usage and conservation of natural resources, and defining alternative patterns of education, productivity and leisure."

The editorial of the first issue of Radical Software, 1970, points to an obsession with hardware in the form of land, labor, or capital. This is contrasted with software, ie access to information and its dissemination. Herein lies the real power: the battle must be fought over information structures. "Unless we design and build alternative information structures that go beyond and reconfigure existing ones, then alternative systems and lifestyles will be nothing more than products of the existing process." Technosphere and cybernetics occupied an equivalent place to natural and organic systems.

The magazine had three sections, Hardware, Software and Environment, and was contributed by key Raindance Corporation members Frank Gillette and Paul Ryan, as well as Gene Youngblood, Nam June Pajk and Buckminster Fuller. This approach differs from McLuhan's technological determinism, and one of the key elements was independent video practice. Artists initiated experiments, which developed the social integration possibilities of video and cybernetic systems. Radical Software magazine, which developed the idea of media ecology and the study of communication media and their effect on other media and society, played a crucial conceptual role in this regard. In conjunction with the then new cheap video technology, artists and activist groups formed local loops of community media. In opposition to the central control of one-way broadcasting of mainstream media, collectives such as Ant Farm, Videofreex, Vasulkas and dozens of others built feedback media ecology of grassroot systems of self-representation.

---

12   Dostupné z: http://www.vasulka.org/archive/Vasulkas3/Installations/MachineVision/Correspondence.pdf (cit.   ).

13   Steve Dietz. Curating New Media. *Yproductions*, 25. 8. 2000, captured February 4, 2021. (http://perma.cc/L43W-2V67).

Gyorgy Kepes, who founded the Center for Advanced Visual Studies at MIT in 1967 in the Arts of the Environment in 1972, wrote that environmental homeostasis at the global level is essential for survival. Creative imagination and artistic sensitivity are the basis of collective self-regulatory devices that help us register and reject what is toxic and find what is necessary and meaningful. Pulsa Group, an interdisciplinary group dealing with the differences between sociotechnological and biopolitical systems, also published in this collection. Researchers in programmed environments, as they were called, proposed to correct systemic breakdowns by creatively expanding the interactive awareness of local media populations, which include feedback principles: environments, program events, cable television, tapes, movies. In one of the projects - Harmony Ranch - they experimented with self-organized collective organic farming to find out about long-term growth rhythms and regenerative changes. Agriculture and the dynamics of group life were part of their ecology of cybernetic systems, whether focused on soil quality and vegetable production, or cooperative social forms and music production with acoustic and computerized instruments. They were visited by Nam June Pajk, Karlheinz Stockhausen or Steve Reich.

In addition to the explicitly political urban New Left of the 1970's, there was also the New Communality movement, which tended to return to the countryside and to internally transformative revolution focused on interpersonal relationships and consciousness. Ant Farm collective, in addition to their media performances, researched in alternative architecture practice and environmental design.
Michael Shamberg, author of Guerilla Television, the major Radical Software publication, describes the word "radical" not in the sense of political revolution and physical disruption of the system, but as a post-political discontinuity with the past, the transition from the old consciousness to the new consciousness through open information tools. Media ecology is at the same time a condition and accompanying phenomenon of the natural ecology.

Today, many of the art projects that Burnham mentions or subsequently emerged are of renewed interest to critics and curators. Hans Haacke's 1972 project, Rhine-Water Purification Plant at the Krefeld Museum, included a device for purifying water from the Rhine river, with functional chemical treatment and water filtration using activated carbon and sand. The purified water was pumped into a large transparent acrylic tank with swimming goldfish, and that way was demonstrated how it is possible to technologically construct a life-supporting system. However, the project also intervened behind the cosmetic patch of restorative eco-aesthetics. Haacke documented the extent of the pollution of the wastewater discharged into the Rhine in Krefeld, which amounted to 42 million cubic meters each year, and quantified the volume and types of industrial and domestic waste, listing the main polluters. It was not only about restoring the degraded ecosystem, but also pointing out the role of the city in pollution, which attracted attention in the local media. He called the political effect of this operation a real-time social system.[14]

Media art conservation needs to address the artworks not as moving images but as an open cybernetic systems involving social actors, or as a living ecosystems. The restoration projects should not be limited to technological structures. Beuys' Acorns, a research initiated in 2007 by Heather Ackroyd
Dan Harvey involved trees grown from acorns collected from Joseph Beuys' 7000 Oaks social sculpture in Kassel. Beuys' artistic vision was a transformation of consciousness, where the biosphere, as a healthy, biological and essential atmosphere would be consistent with human and multi-species needs. Acorns made a tour with discussions in French cites in advance of aforementioned United Nations Conference on Climate Change in Paris, 2016 and continued at various institutions across UK. The

---

14   T. J. Demos. *Decolonizing Nature : Contemporary Art and the Politics of Ecology*. Sternberg Press Berlin 2016, p. 47

saplings have acted as both artwork and catalyst for a public research process carried out in galleries and exhibitions.

Social networks: private or open?

In 2010, in a lecture for the Internet Society New York, Eben Moglen recapitulated the development of networks. From the original ideas of all peers on the same level, changing gradually to omnipotent servers in the cloud and monitored users under the secretive economy of data mining. He called it the architecture of disaster. An increasing concentration of power has emerged without any discussion of the long-term social consequences. The helplessness of weak and thin clients against strengthening servers also means the helplessness of the people who own the client devices. You can't play what you want on your phone, just what the monopoly music publisher gives you. It is no longer the case of software companies, but managements of platform business models. The lecture happened to be the starting point leading to development of public social networks and Moglen's idea of small internet device, a personal mobile server, having all the apps to facilitate the communication among people, called FreedomBox, became reality ten years later.

There was a heated political debate recently over private big-tech platforms and their obligation to moderate content versus their right to moderate content, or censorship versus free speech. The introduction of a standard protocol for social networking is now being discussed among free software developers and some of the politicians. Technical standards are the way how any other media are regulated, being it radio, television or cellphone networks and they are also at the very basics of internet. Meanwhile, with closed private social networking platforms, we are in the awkward situation of emerging new medium. Users of YouTube cannot talk to users of Facebook because it does not fit in the interest of corporations. Imagine we would need different TV sets for each TV channel because broadcasters used proprietary signals to compete. Imagine we could not call a phone number from one network provider to number in the other network. Public institutions and policies should be more concerned about the situation of open internet turning in large parts into proprietary domains of corporations. Corporate content platforms failed to provide a place for cultural discourse or education and became tabloid commerce-driven service for advertisers.

In overcoming the isolation of archive and museum on-line collection portals, on one side the isolation from publics and on the other side the isolation as specialized institutional domains from each other, social networking principles are becoming essential. What determines art is often found in relation to broader social alliances. Annet Dekker argues, that it is not uncommon for networks to form around artworks that are not collected by museums, large institutes or private collectors. "I suggest that such a network could evolve into a 'network of care' that maintains or conserves (parts of) an artwork and consists of a combination of experts and non-specialists and introduces knowledge from a variety of fields and backgrounds." Conservation thus "is less about conserving materials and more about the preservation of social information and relations" [15] In digital editions and virtual exhibitions, for humanities researchers, archivists or historians, becoming part of such network of care with collaborative approach is important to comprehend the natural complexity of networked art. Multi-layered documentation is also playing fundamental role in conveying the significant properties of the work and deeper understanding of its context.

---

15   Annet Dekker Collecting and Conserving Net Art Moving beyond Conventional Methods, Routledge, 2018, p. 14

There are already several open protocols being used by websites to talk to each other, which could connect archive repositories and collection systems. Perhaps the very first node of the independent social network was identi.ca in 2008, based on the StatusNet software and the OStatus protocol. It focused primarily on the free software community. Ostatus, standardised in 2010 by Evan Podromou is the extension of RSS/Atom web publishing protocol, which is still popular in the form of podcasts. With reader app for RSS or podcast anyone can collect interesting news from various places on the internet by subscribing without the need to visit each site again and again. Everything published arrives immediately in your app. But you cannot comment, share or interact and that is why events and their actors were the extension introduced in Ostatus. Evan Podromou continued his work on various social projects and is a co-author of ActivityStreams, a major open format specification for activity protocols, which are used to syndicate activities taken in social web applications and services, already being widely used by websites and decentralized social media hubs.

Moglen's lecture inspired 4 NYU students to a crowdfunding campaign and at the end of 2010 they could release the first version of Diaspora*, which was to replace Facebook with a decentralized network, sponsored by a public institution and not owned by anyone. Diaspora was a media hit before a line of code was written. The youth, inexperience, huge expectations and bugs of the first version left a mark on the project and later it sank into huge difficulties. Ilya Zhitomyrsky, a handsome sympathetic superintelligent mathematician who took these failures to his heart, was found dead several months after saying in an interview that the Diaspora was his work of love. In comments, he was named Ian Curtis of technology.

Mike MacGirvin has been dealing with decentralized protocols for decades. He is now farming in rural Australia and manages the development of projects for decentralized social networks. He goes to throw hay to his horses and listen to what they want to say to him, then responds on the support forum to the issues of Zot users. He has something in common with Steve Jobs. he himself says that they both grew up in the summer of love and are the product of the same cultural influences. Both were in California's Silicon Valley at the same time as microprocessors and the Internet emerged. While Jobs worked on Pong at Atari, Mike worked a few blocks away on silicon wafer accessories.

In the 1980s, he wrote federated software for bulletin boards that provided several services, file downloads, email, games, and news. It was able to send federated messages to FidoNet, Bitnet and ARPAnet. He then wrote email clients and forums for NASA and Stanford, worked in Netscape, took part as member of IMAP protocol standardization committees. He also registered on Facebook, but stopped using it in 2010 and found that there was no decentralized solution to replace it. The diaspora was in its infancy. That's how he wrote the DFRN (Distributed Friends and Relations Network) protocol. Connections to Status.Net via their OStatus protocol, as well as Twitter and Facebook, worked. He later studied the source code and packets of Diaspora*, and thanks to Ilya Zhitomyrsky, succeeded in creating a functional federation module for the Diaspora.

Mike is working on an ethical replacement for toxic online sites. He simply decided to work on the Zot protocol suite of apps and no longer deals with marketing and startups, roadmaps and milestones. With Zot, you have the right to a social identity that is not tied to a specific server, which you're using. Basically, anyone can clone their social channel with all your content and social graph to another server and have them synchronised in more locations, or move to different provider with suitable content policy. Open public standards in federated social networking already provide solutions without the controversies of deplatforming politicians or dividing corporations. And digital curation starts to incorporate them into digital art infrastructures.

Small-tech and public sphere

Small tech: the culture of digital tools is a collection of essays published in 2008 focusing on all kinds of "small" technological objects, cell phones, tablets, P2P systems, games, wearables as items that redefine fundamentally the interaction between the human, the interface and the environment. Editors believed that it was time to overcome the dichotomy between cyberculture studies, which analyze social phenomena related to the Internet, and new media studies, which examine aesthetic and artistic digital products. Three spaces are coming together: the virtual space of the Internet, the enclosed space of the installation and the open space of everyday life. Some of the essays are critical to the "first generation" theory of digital technology, often offering utopian views on cyberculture and new media that have become unacceptably dissociated from the social reality. [16] Today, digital curation naturally takes place in these media ecologies, small devices being used for both curation and reception.

The publishers of Low-Tech Magazine have launched a solar version of their website on a 5W microcomputer board powered by a solar panel and a small battery. They spent a lot of time redesigning the pages to keep the code as small as possible and the images are in monochrome. The page has an indicator of whether the sun is shining and how much energy is available. If the weather is bad for a few days, the website will shut down. You can come another time. Little single-board computers with low demands on resources and low consumption, are suitable for a sustainable model of operation. The sustainability mindset is about to be extended to large institutional systems requiring robustness and high availability. Even that is being achieved with embedded devices. Free software is increasingly easy to manage and selfhost and recently a major shifts happened in clustering technologies, able to connect lots of small computing and storage units together. A little supercomputer is still consuming a fraction of electric power and materials compared to "old generation" server. In National Film Archive in Prague, as part of the acquisition and preservation system for experimental film and videoart, we implemented digital depository interface and a social collection hub on a cluster of Raspberry Pi's. The potential lies also in a large number of interconnected publishing and curatorial nodes, which can mutually back up or temporarily and permanently represent each other in their functions. Small tech corresponds to the organizational model of cooperation between small independent galleries and large cultural institutions in the creation of alliances of care.

In response to global corporate surveillance megastructure and "geopolitical architecture", which Benjamin Bratton called The Stack in 2016, Waag centre for Technology & Society in Amsterdam was working since 2019 on formulation a mission for digital public spaces: Public Stack. The difference is in core values in design principles and the design process itself. Waag came out from feminist hacker movement and Marleen Stikker, its director is one of the founders of The Digital City, a virtual public space based on democratic access. Digital City in 1994 was one of the first free internet providers and also the place where political parties and newspapers made their first digital steps. The municipality of Amsterdam opened its entire administrative information system, becoming the first open government. Public stack is distinguished from the private stack and the state stack, both using closed design process resulting in proprietary technology. The base layer of public stack are common values of fundamental rights, and socioeconomic considerations. The layer of open design process involves all stakeholders and democratic governance of digitalisation. Resulting tech layer is open-source and ethical. There are no users, but digital citizens.

---

16   Byron Hawk, David M. Rieder, Ollie Oviedo (eds). Small tech: the culture of digital tools. University of Minnesota Press, Minneapolis, 2008. Electronic Mediations, Vol. 22.

Leaf is solar-power designed permacomputing server for forest livinglab. Ecosystems and biodiversity are supported with sensitivity to local resources, measured by environmental sensors. During Covid-19 wintertime when sunshine conditions limit outdoor presence, its social network and camera intermediated environmental art experiments from closed exhibition in Entrance Gallery in Prague.

In Rotterdam, artists, media students and theorists formed around the Varia space placed an unusual electronic book into their bookshelve. Bibliotecha proposes an alternative model of distribution for digital texts. It allows specific communities to form and share their collections, through a single-board computer running free software to share books over a local WIFI hotspot. No server farm required.

Although information infrastructures had undergone a long development from monolithic and isolated systems to modular and interoperable, in repositories, they still often remain focused on fixed established media and standard-based archival description. The research field of critical editions as collaborative research environments is open. Johanna Drucker sees the challenge in the shift in humanistic study from attention and reading the *effects* of technology:

> "The cultural authority of digital technology is still claimed by the fields that design the platforms and protocols on which we work. These are largely fields in which quantitative, engineering, and computational sensibilities prevail. Tools for humanities work have evolved considerably in the last decade, but during that same period a host of protocols for information visualization, data mining, geospatial representation, and other research instruments have been absorbed from disciplines whose epistemological foundations and fundamental values are at odds with, or even hostile to, the humanities. Positivistic, strictly quantitative, mechanistic, reductive and literal, these visualization and processing techniques preclude humanistic methods from their operations because of the very assumptions on which they are designed: that objects of knowledge can be understood as self-identical, self-evident, ahistorical, and autonomous. "[17]

Digital curation should be humanistically cognisant theory and practice of critical *making* the media architectures at the level of computing, design, technology, information modeling, data structures, interface, and protocols. Tools of digital humanities should allow critical reading, qualitative approaches, support paratextual apparatus, invite wide performative interaction and discussion as key principles on cultural platforms. Social networking can connect communication and events in thousands of isolated repositories across memory institutions. In Organization After Social Media, Geert Lovink and Ned Rositter describe how organized networks have changed the practices of many types of small institutional forms as they progress from casual friendship and networking to stronger decision-making ability social technologies based on enduring time. [18] Carbon imbalance measures the time to rethink long-term preservation strategies because the only digitisation and long-term preservation projects possible are those within the limits of sustainability. The trustworthy repositories and curatorial practice should be seen from the perspective of their ability to maintain art together with the biological livability of the Earth.

---

17   Drucker, 2012
18   Geert Lovink, Ned Rossiter. *Organisation after social media*, 2018