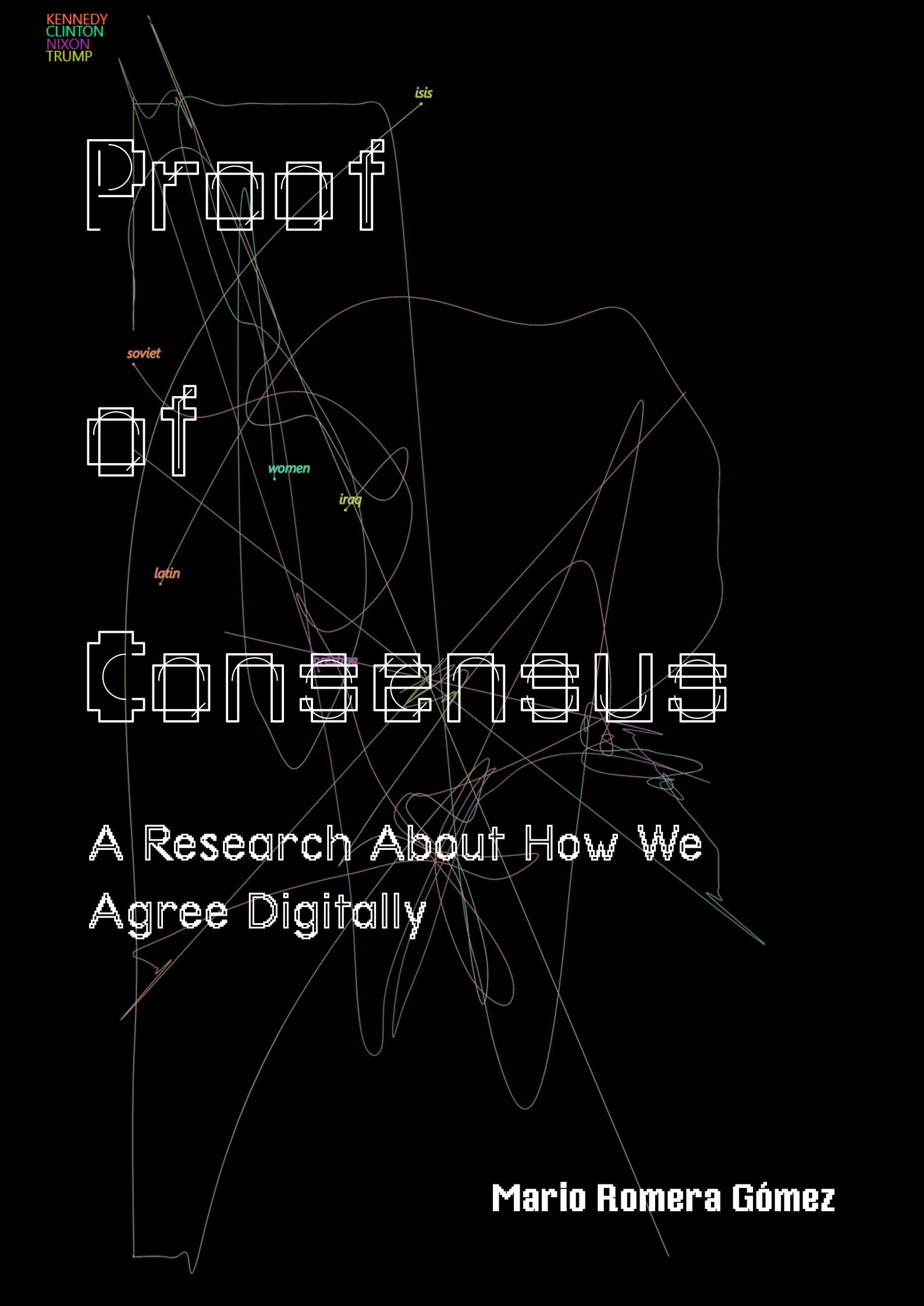

Proof of Consensus

A Research About How We Agree Digitally

Mario Romera Gómez

Cover Picture:

Experiment using text vectorization tool over the Nixon-Kennedy and Trump-Clinton presidential debates to find pattern with TF-IDF and create a visualisation with t-sne.

Mario Romera 2020.

Proof of Consensus

A Research About How We Agree Digitally

A Masters Thesis by

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"Aesthetics promises a non-polemical, consensual framing of the common world."

Jacques Rancière

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In conclusion,

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Table of contents

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1. Abstract

This thesis explores the ways in which information technologies are distributed in regards to control, agreement, agency and consent. In particular it explores what are known as *consensus algorithms*, which exist in order to validate democratically processes, specifically in decision-making, or more commonly, voting. Through an exploration of technical methods, cultural discourse and artistic experimentations, this research compares distributed computing and democratic processes, in order to question the current role of technology in such economic, social and political processes and the issues surrounding this topic.

Today, technology and our understandings of reality and agency are becoming increasingly intertwined, however there seems to be a lack of critical investigation into the consequences of this, in regards to agreement and consent. New technological developments are commonly inspired by utopian ideals, however often then become dystopian in practice, through the pace of their development in relation to our understandings of their consequences. In any utopia, analogies with reality are common as natural creative processes that usually replicate the natural order of things as we perceive them. Art in this context can act as a mediator, through its ability create alternative realities, in which we can critically explore such topics in more detail and therefore become more informed about them. This thesis investigates the ways art can address this political lag with technology, in order to further our understandings and responses to it.

To answer such questions, technological and political decision-making strategies are explored and embedded in examples from both art history and my own artistic projects, that create new, speculative interfaces for resilient participation, enabled collaboration and increases user consensus.

2. Introduction

This research was first inspired by the book named *Utopia* by Thomas More,[1] an example of an idealistic literature that imagines how a society without conflicts would be. Very much like in *Utopia*, many projects have been borne out of idealistic ideas, but sooner or later, are either torn apart by the realities of putting them into practice or transformed into the opposite of what they were originally intended for. Since Plato's Republic, art has been understood to enable our imagination and through creation of images and sounds, allow us to consider different and alternative realities, reshaping the way we define the one we exist in. In his fictional but feasible narrative, Plato builds his theory on top of descriptions of imagined realities. Such a simple manipulation of human perception through media, demonstrates the power that creativity and art has, in this ability to allow us to reconsider the very realities in which we situate. This is achieved through the reconfiguring of the ways we apply language to our understandings of reality, *"if we consider just as we did a moment ago, coming to agreement with one another, we'll ourselves be both judges and pleaders at once"*.[2] To place this in a contemporary context, Trebor Scholz writes in *Net Works*:

> *"Change is also about an imagination of a new political language [...] artworks can play an important role; they can function as incursions that shed light on the conditions of labor and cultural production."*[3]

Technology is of course, historically generally rooted in some form of idealism, including in particular, projects that are dedicated to creating alternative realities. From the utopian inspiration of projects like Fourier's Phalanstère,[4] in which a whole society could live autonomously in a thoroughly planned architecture, to the creation of the companies such as Google or Facebook we see this idealistic approach, in both their attitude to creativity and innovation,

but also in the ways that they market themselves to society. For example, in tits early years, Google served the purpose of organizing, searching for and finding information in more accessible within the vast new world of a young Internet. This evolved into the situation we see today, where Google profits on personal data, silently and exhaustively extracting it in a process that that Soshana Zuboff has called "Surveillance Capitalism."[5] As Zuboff describes: "*Google would no longer mine behavioural data strictly to improve service for users but rather to read users' minds for the purposes of matching ads to their interests*".[6]

The Internet exists as a distributed network of nodes and communication points from which information can flow from server to user and back, allowing us send and receive information that can be maintained and still operate, even if some of the nodes would fail (Fault tolerance). The World Wide Web (WWW) was created by Time Berners-Lee, as another protocol on top of the Internet, this time, to set a basis for spreading information with the values of Decentralization, Non-discrimination, Bottom-up design, Universality, and Consensus.[7] This was achieved by Berners-Lee creating an entirely new language for the exchange of information (albeit an algorithmic one) know as hypertext. It is through this new languaging of information distribution that the WWW can operate, both technically and in practice for end users. This of course has gone on to evolve into an extremely sophisticated and world changing system of online information exchange and distribution, for sure, impacting society as much as any innovation that came before or after it. Of course, artists have flocked to this new and exciting reality, since it's early days in the mid 1990s and this new way of languaging information has facilitated the development of entirely new forms of art and representation that has both redefined the world and created an entirely new reality within it.

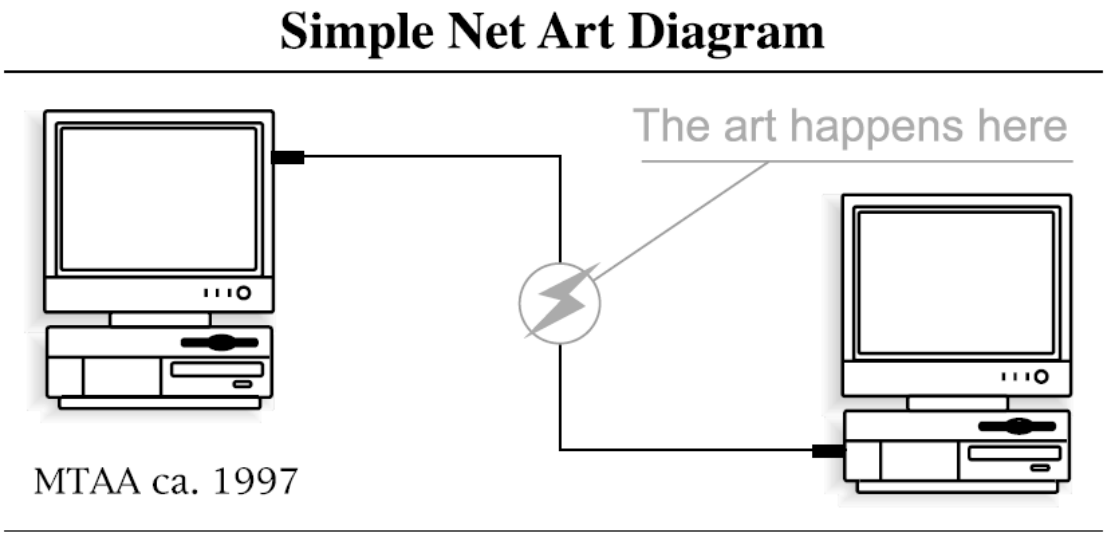

Figure 1 (Galloway, 2004, p. 215)

In Alexander R. Galloway's 2004 text *Protocol: How Control Exists after Decentralization*[8], he references the utopian ideals associated with the invention of the WWW, but in relation to the contemporary values which evolved since: "so the rich and powerful are also profiting from the transition into protocological control".[9]

Information technologies and more prominently the Internet today, differs from their ideological foundations, and warnings about this have been made by multiple scholars and authors. Manuel Castells, who dedicated his career to studying the relations between information technologies and society notes in his 2010 text, *The Rise of Network Society,* in *the Information Age Series*, that social relations shifted intensively from the physical space to social networks, mails, and digital phone calls.[10] More recently, *The Stack: On Software and Sovereignty* from Benjamin H. Bratton (2016) points to a supranational organization of big technological corporations.[11] *The Filter Bubble* by Eli Pariser, involved in several activist projects, suggests that the companies behind surveillance capitalism promote a transparent Internet and a more personalised user engagement, while at the same time isolating our perception of free

information flow, by getting the filtering free service, there is also a loss of other available information. And Whitney Phillips and Ryan M. Milner in its hate speech and absurdity in *The Ambivalent Internet, "even the most unitary democratic system can go either way. Because however inclusive it might appear, in-group unity can come at the cost of ignoring, disregarding, or actively silencing dissenting – and particularly dissenting outsider – perspectives".*[12]

These texts, demonstrate how much technology is shaping our realities, and not necessarily for good. To change the technologies we currently depend on, we would need to achieve technical sovereignty and this topic must sooner or later be tackled.

> *"In an age when analogue reality is increasingly managed and controlled by digital reality, the socio-political sovereignty on both appears to be essential for a better democracy, public accountability, and coordinated cooperation to tackle global problems, to make society fairer, and development at least sustainable."*[13]

To change the role of technology in a democratic process, we need to engage in debate, and take collective decisions based on that process, debating questions such as: "what do we want the role of technology to be?", "How we would take a collective decision?" and "What are the tools to make decisions together?". Art functions as an invitation for society to reflect upon the status quo and can facilitate a first step towards answering these queries, not necessarily in response to the utopian visions associated with their foundation, but rather, shifting the imagination towards alternatives. Luciano Floridi recognizes the creative power that large tech companies have in the creation of their own modified versions of reality, proposing that the "*poietic (that is, creative) power over the digital means that states depend on…"*[14] could also be extracted from a more critical source such as art. As John Maeda states: "Art does that, because art is about asking questions, questions that may not be answerable".[15]

Looking at the art world, very few projects are dedicated to decision-making. There has been a lot written about participative, collaborative, interactive, critical or socially engaged art, but not in direct relation to consensus in previous types of artworks. This thesis aims to throw light on this apparent void by studying the few artists that have contributed to fill the gap, including my personal art practice and projects.

2.1 Motivation

In between utopia and technology, the idea of consensus appears to be one of the threads that links almost all the projects I have made since I have an art criteria. Consensus in a sense of conflicts that can be resolved by doing together, looking at things from a collective perspective and realizing the potential and opportunities that appear when having complications and how valuable is its process.

Having study Utopia in my previous Master thesis, *Art as Utopia for social transformation,*[16] I realized how much potential idealism have, but at the same time, how many times it has been misused. At the same time it empowers bold ideas that empower alternatives to the realities they are born. In this case I wanted to investigate this creative process in a collective way, how can we constantly evaluate and keep building on top of creative decisions, what is at stake in the process.

To do it, there are technically some of the concepts of utopic technologies such as distributed systems consensus algorithms, peer to peer communication, information retrieval and data visualization I wanted to experiment with. Gather this tools and combine them to build a framework and an interface for

decision-making, as it seems to be a difficult matter that has very few attention digitally and less artistically.

After lectures of new media art history, electronics, game theory, performances, experiments and projects created in the time span of the Interface Cultures Master program, looking back to what I have learned and done before it and thinking about the future, the most obvious line to me is the creation of interfaces designed for people to participate collaboratively, interfaces to which one user would feel the correlation with the group. My line of work has mostly been using web and smartphones as popular technologies, by combining both in my artworks I try to create a critical reflection about the interface itself and the topics presented along this research. By doing this research I could realize about the growing tendency of scholars and artists interested in this topics and this pushed me to keep learning and working in the same direction, here is presented a humble approach to the infinite possibilities it seems to lead each of the threads treated.

3. Consensus

Consensus is a wide term that refers basically to two different worlds, decision-making processes, in which people agree with each other to do something together.[17] And consensus related to computer science in which machines that work together must agree on some data to be replicated.[18]

Until the time I started being more interested in peer to peer protocols, where devices connect to each other directly, I only knew of the existence of one type of consensus, this being the one used for deciding and doing, which I have always considered a utopia, but reading and practicing some of the different systems. An example of an exhaustive study of most of these consensus types is represented in the book *Mathematics and Politics: Strategy, Voting, Power and Proof* by Alan D. Taylor and Allison M. Pacelli[19] both mathematicians. As the Arrows Impossibility theorem states, it is hardly achievable to attain a 100% level of fairness and the satisfaction of "reasonable" (accomplish some of the conditions needed to represent social choice) formulas if not impossible: "There is no social choice procedure that satisfies independence of irrelevant alternatives, the Condorcet winner criterion, and always produces a winner" regarding Arrows Impossibility theorem.[20] But still this needs change, in order to make a more resilient governance based in wider and more effective regulatory platforms. Curiously, analogies with distributed systems are made for The Fight for Digital Sovereignty: What It Is, and Why It Matters, Especially for the EU. As this recent paper and scholar on Philosophy and Ethics of Oxford University suggests.[21]

To this extent and in the context of this research, the target of consensus doesn't create a formula but rather it claims that perhaps the combination of certain formulas can help us to achieve a reasonable result from which we can decide things together, by adding value to the process, instead of only the result. Using

such formulas, this thesis points to the different consensus algorithms that exists in both politics and computer science, but especially it focuses the ones to be discovered though artistic practice.

4. Algorithm

> *"A series of steps to be perform in a computer in order to calculate, process data or automate tasks, even including self embed 'reasoning'"* [22]

Some of the most well-known consensus algorithms today, exist in blockchain technologies, a decentralised range of distributed ledgers that record the provenance of a digital assets. The term blockchain, arose in 2008 with the publication by Satoshi Nakamoto of the paper, Bitcoin: A Peer-to-peer electronic cash system[23]. This was the triggering point to try a new utopian paradigm in which transactions between individuals, who would not need any intermediaries such as banks or governments, but could be trusted, due to its cryptographic proof, in other words, the possibility to calculate the history of the chain, previous transactions, by miners (computers dedicated to perform these calculations and verify the transactions), as explained by William Mougayar, in *The business blockchain: Promise, Practice, and Application of the Next Internet Technology*.[24] As stated, a blockchain is a database, where transactions are saved, that maintains a distributed ledger (so to say an accountant book) of the transactions made, that is shared across participants of the network and that can be inspected by anyone.[25]

This is a summary of what blockchain is, but the power of blockchain as an infrastructure is laying on the some of the primary terms used secondarily to describe its capabilities, such as network, distributed and peer-based. With blockchain came another wave of enthusiasts with similar hopes to those put into previous movements, such as the already named invention of the Internet, the Peer to Peer movement and other decentralization movements as Jaya Klara Brekke (an economist that studies the political power behind bitcoin and blockchain) guides the reader through in *The White Paper of Satoshi*

Nakamoto.[26] Described in *Proposing the Satoshi Oath for Developers*,[27] some of the same characteristics that blockchain claim include decentralization, and neutrality.

The main innovations in blockchain are in fact the new consensus algorithms designed for it, such as the one used by Bitcoin, known as "proof of work" in which the chain is proven to be right by the difficulty to redo the chain (of transactions) as it increases with each transaction, allowing in this way to verify new transactions but also protect the transactions that are already verified at the same time. Also in other blockchains, there is the so called Decentralized Autonomous Organization, a set of rules chosen to be followed in case of desynchronisation, failure or attacks, which are one of the core elements for blockchains to prevent malfunctions and keep working.

When thinking a bit out of the box, we could easily imagine that the same principles that apply to machines, could apply to other fields such as democracy, organizations, associations, groups, etc. As an example, Luciano Floridi, makes an analogy between states in the context of the European Union (EU) towards a possible map of digital sovereignty and the blueprint that normally distributed systems have as a network:

> *"In a fully connected network topology, each node enjoys popular + national sovereignty, and the nodes are all linked together for some common purposes. Each node is legitimised by its own popular sovereignty, each node can leave the network at any time (secession), and the network itself lacks its own legitimacy over and above the legitimised nodes. This more distributed legitimacy is what some supporters of a European confederation of national states (the nodes), for example, seem to have in mind. It can be a strong version of intergovernmetalism, which can deal with fundamental issues such as currency, trade, or defence."*[28]

These principles as Bitcoin was expected to do, can challenge current (in this case economical) structures, but at the same time also bring a lot of misunderstanding and misleading connotations, as Brekke suggests in the slides she uses to explain the false assumptions.[29]

Figure 2: Brekke, Jaya Klara. "Disassembling the Trust Machine | Three Cuts on the Political Matter of Blockchain." Accessed October 26, 2020. http://distributingchains.info/.

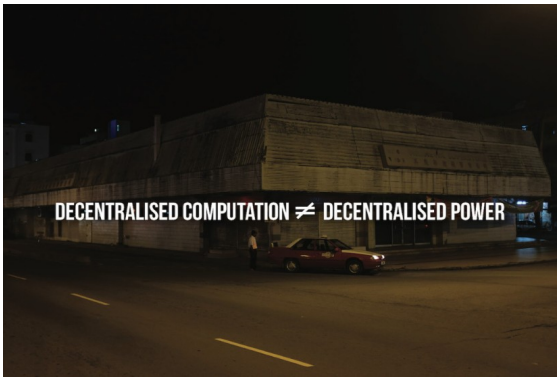

Figure 3: *Ibid.*

Suggesting, a formula to solve consensus in machines cannot translate equally to society, and by having a distributed system such as the internet as we know from Galloway, control can exists after decentralization.

But at the same time, it works as inspirational material when applied to other fields where it can lead to challenging changes. For that reason, here are presented some examples of the algorithms that are innovative enough to propose alternatives to old methodologies or the cases that, perhaps are not so innovative algorithms, yet still contribute to generate better collaboration between peers, or simply are inspirational from their metaphoric character.

5. Consensus algorithms

The algorithms used for distributed applications, programs that run in several machines at the same time with the same responsibility and that share the same state (information to replicate), must at some point synchronize with each other, sometimes recover from disconnection or any type of failures/errors and not only that but also self-protect from attacks. To design these algorithms there are known weaknesses to which every distributed data store(database so to say) must address and comply with, known as the CAP theorem or Brewer's theorem[30] which states that on the design process of the architecture of a distributed system, it is impossible to accomplish and at the same time guarantee in the next instance, that:

- The consistency, the integrity of the data in relation to the rest of the machines.

- The availability the access to the latest data written into the database

- The partition tolerance and the ability for the network to keep working even when some parts (entries, messages, nodes) are missing.

Consensus algorithms aim to solve the consensus problem, in which processes must agree on the replication of values, to do this, there are many replication algorithms, in this chapter we will have a look at some of the consensus algorithms and pseudo-consensus algorithms most influential in distributed systems.

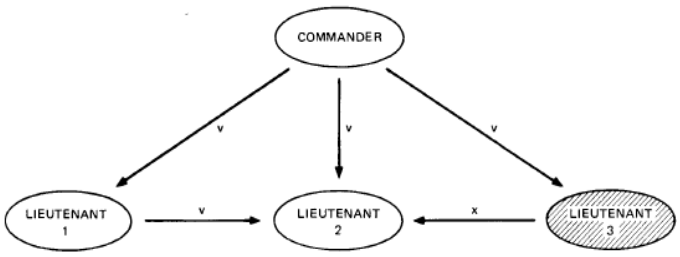

Fig. 3. Algorithm OM(1); Lieutenant 3 a traitor.

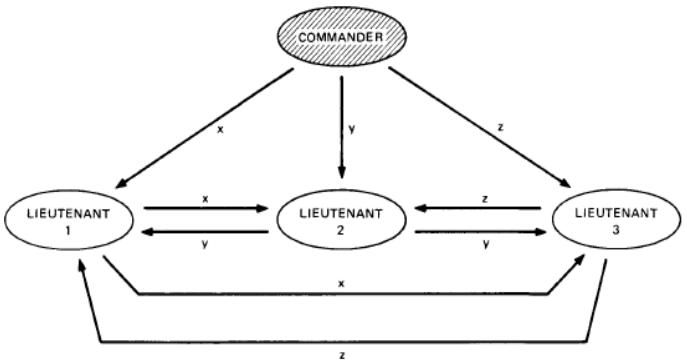

Fig. 4. Algorithm OM(1); the commander a traitor.

Figure 4: The Byzantine Generals Problem, Leslie Lamport Robert Shostak Marshall Pease. ACM Transactions on Programming Languages and Systems | July 1982.

5.1 The Byzantine Generals Problem

Leslie Lamport, one of the main distributed systems contributors, wrote about The Byzantine Generals Problem[31] *a story made up*[32] to explain and prove a solution to the computations in a distributed system where one or more of the nodes can fail, and from that paper on, it is known the Byzantine fault, how distributed systems are develop in order to tolerate this type of failure, Byzantine Fault Tolerance and/or its different versions.

The Byzantine Generals Problem explains how to coordinate an attack in which the situation is as follows: a city is under siege by lieutenants and a general, and the only way they can succeed is by attacking all generals at the same time, to succeed all lieutenants must act in the same way. To achieve this, the generals can only communicate through messengers who may or may not return a response from other generals, they may fail in their mission or some of the

generals may be a traitor. Taking into account that the default plan is to retreat, the algorithm describes how by sending several messages one way to each of the lieutenants and assuming that it is known the property of majority, consensus can be achieved (if there is no majority, consensus is understood as the default plan) This is possible even if the general is the traitor or some of the lieutenants less than the majority send misleading messages.

This metaphor can be also applied to communication and distributed computing in which the nodes of a network must send messages in order to coordinate and then execute the same or part of the logic that it is supposed to happen.

There are of course more advanced algorithms that are used to manage states (data) over distributed systems.

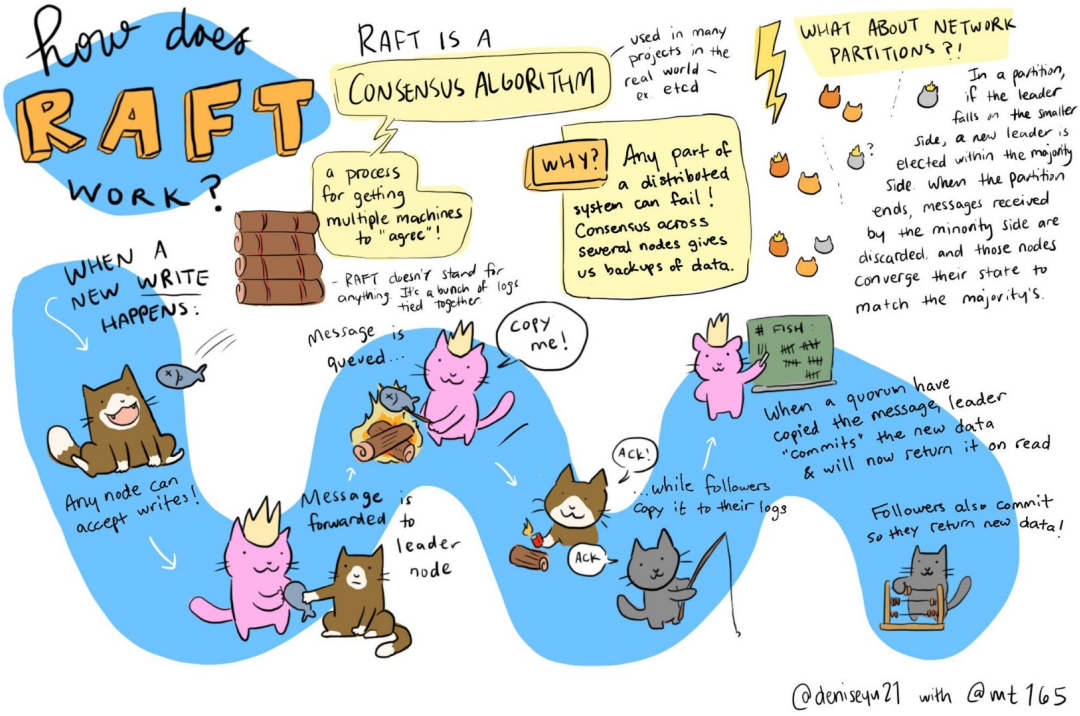

Figure 5: HashiCorp. "You. Must. Build. A. Raft! Consul's Consensus Protocol Explained." HashiCorp: Infrastructure enables innovation. Accessed October 27, 2020. https://www.hashicorp.com/resources/raft-consul-consensus-protocol-explained.

5.2 Raft

The next algorithm is called Raft(Replicated and Fault Tolerant) created by Diego Ongaro and John Ousterhout,[33] this is a consensus algorithm to replicate state machine logs, to keep all the machines performing the same operations and information. The algorithm was inspired by another consensus algorithm called Paxos which will be explained later.

Raft is based on the election of a leader (a node that would act as representative of the network) in terms of efficiency to communicate with the client (the actual call for example from a Web browser requesting some data). Basically there are three roles in this algorithm *followers*, *candidates* and *leader*. Here the algorithm assigns to each node in the network a different random timeout

which for each term(the time when information is coming) each node propose itself as a leader for the log replication following its timeout, as the first timeout finish, that node proposes itself as leader, to which the other nodes would agree if there is no other previous leader proposal, if a leader is not elected, the other timeout would trigger and a new leader proposal with it, if a leader is elected, then it would be the one responsible for retransmitting the information to other nodes called then followers, while the process of becoming a leader a node is called candidate. It is better explained and more attractive in the previous figure.

5.3 PAXOS

Figure 6: Image referencing the story created by Leslie Lamport to explain for first time the Paxos Algorithm. Pinterest. "INDIANA JONES #1 , GREEK EDITION COMICS - YEAR 1986 | Comics, Indiana Jones 1, Indiana Jones." Accessed October 27, 2020. https://www.pinterest.com/pin/559924166158017986/.

We can already appreciate how computer science consensus and political iterations start to mix even if it is just by the naming conventions. Regarding consensus algorithms, perhaps the most notable one is the so called PAXOS, which even the first publication was again a made up story from L. Lamport, of an ancient civilization in the Greek island of Paxos, discover from a fake sort of Indiana Jones, the publication paper of the algorithm describes how the parliament could keep "consistent copies of the parliamentary record, despite their frequent forays from the chamber and the forget-fulness of their messengers".[34] as the name of the paper indicates *The*

Part-Time Parliament, the legislators would only take record of portions of the assembly.

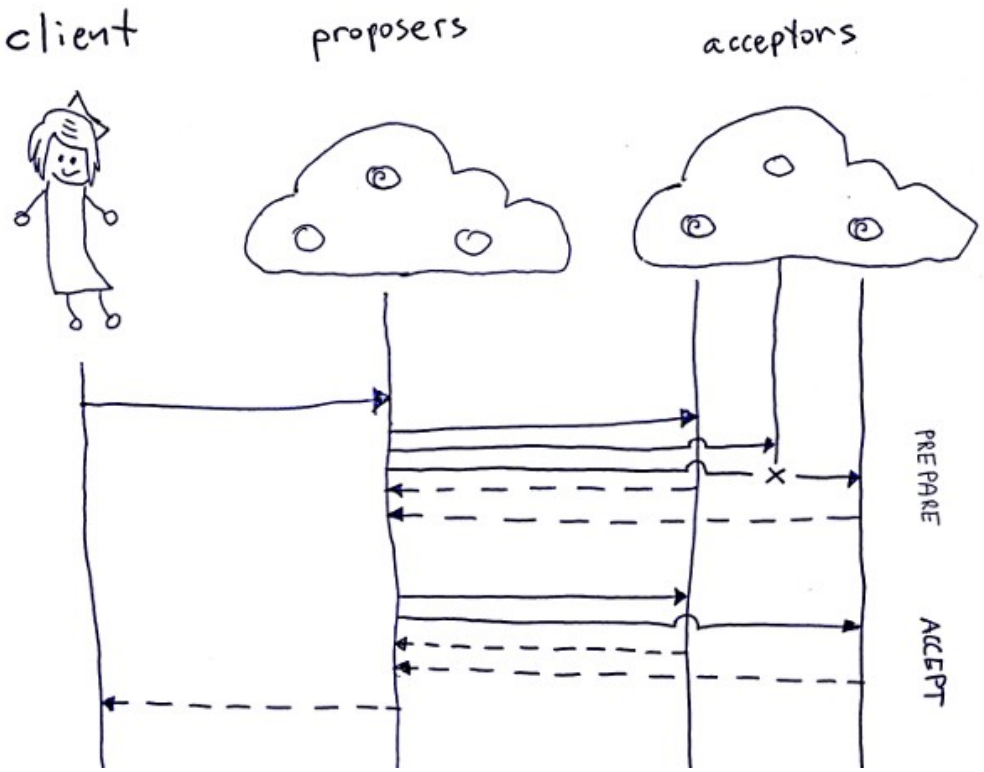

Figure 7 Rystsov, Denis. "How Paxos Works." How Paxos works. Accessed December 18, 2020. http://rystsov.info/2015/09/16/how-paxos-works.html.

PAXOS has many variations but for simplicity we will look at the basic version. It consists of four roles:

- Acceptor
- Learner
- Proposer
- Leader

Instead of using a time out as in Raft, it is very inspired by it, in the way it works and therefore share some similarities. PAXOS works with a version number and a majority poll, from different combinations of acceptors called Quorums. Every proposer tries to get elected as a leader and if successful, it then would need to confirm its recently acquired role and if nothing fails, it would then confirm the value that the proposer announced and the state will be replicated by the learners. This is a very simplified version of the protocol and

there are many logistic variations plus the fault handling. The reason why Raft came to the world was as denote in the Raft paper, the readability and comprehensiveness of the algorithm. The story of the PAXOS paper explained by Lamport on his personal website[35] is that for almost a decade, it was never understood and took as mediocre paper, so only after years it was ever implemented.

6. Voting Systems

Another definition of algorithm is “a set of rules to follow in a fixed order for solving a problem“.[36] Holding on that definition I will include in this section some of the more interesting consensus algorithms that we used historically in terms of taking an ultimate decision.

6.1 Plurality Voting

The actual voting system most used overall western democratic countries is the Plurality Voting, which allows to have a winner by just comparing the number of votes, this leads voters to only being able to choose one option without showing the secondary preferences.

6.2 The Condorcet’s Method

The Condorcet’s Method, consists as a ranking list where voters would be voting instead of only one option, for one list of the many options which would be generated from all the possible combinations of order.

Suppose there are three options a, b and c, from these options the next lists would be generated, from which voters should commit to one in order to find the Condorcet Winner.[37]

In the Condorcet Method one voter would have to choose a preferred list of the shown below, either the 1st, 2nd or 3rd.

1 2 3
a b c
b c a
c a b

6.3 The Borda Count

The Borda Count is similar to the Condorcet's Method but in this case the lists are generated by each voter with a vertical preference, meaning that the highest is the most preferred and the lowest the least, with this system each of the lists translates into a punctuation system from which the highest would get the number of points corresponding to the number of rows in the lists, as shown in the figure.[38]

		Candidate A	Candidate B	Candidate C
3 points	1st place votes	10	20	40
2 points	2nd place votes	20	40	10
1 point	3rd place votes	40	10	20

Figure 8: Study.com. "Flashcards - Mathematical Methods for Elections Flashcards." Accessed October 28, 2020. https://study.com/academy/flashcards/mathematical-methods-for-elections-flashcards.html.

6.4 The Hare System

The Hare System consists also of ranking lists,[39] to which the less voted top alternative of the lists is removed from the choosing step by step. By removing them the last one left is considered the winner. Besides that if any head of a list has more than half of the options it is also considered the winner but only more than half, if it is exactly half, the process keep going as usual.

	Number of Voters (9 total)						
Rank	3	1	1	1	1	1	1
1st	A	A	B	B	C	C	
2nd		B	C	C	B		C
3rd	B	C		A		B	B
4th	C		A		A	A	A

Figure 9: "Voting Methods Examples of Voting Methods (Other than Majority Rules) –Plurality –Borda Count –Hare System –Sequential Pairwise –Approval Voting. - Ppt Download." Accessed October 28, 2020. https://slideplayer.com/slide/8917238/.

6.5 Approval Voting

Different from the previous methods, Approval voting consists in giving as many votes to any of the possible options to vote for, then the one with most votes wins.[40]

Figure 10: David Pakman Show. Approval Voting: Better Than Ranked Choice?, 2019. https://www.youtube.com/watch?v=-8kHXorCxz4.

6.6 Quadratic Voting

As the last voting system, quadratic voting is one of the latest developments in voting systems, it has been very controversial for its innovative and perhaps rapid assimilation by very repercussive characters from different worlds, such as the already named Vitalik Buterin considering a perfect integration to implement in the Ethereum blockchain. [41]

Quadratic voting consists in a similar way to approval voting but this time there are limited amount of votes for each person, instead of as many votes as options. In this case there are given an equal delimited amount of "voice credits",[42] this type of credits works more like a currency, they can be accumulated but also all spent at once, this type of credits would be used to purchase votes in certain polls where the interest of the individual with credits can be spent. The name quadratic, comes from the formula to which the price of each vote is quadratic(squared) in proposition to the quantity of votes, this aims to achieve *"an optimal intermediate point between the extremes of dictatorship and majority rule"*[43]

Vote pricing example

Number of votes	"Vote credit" cost
1	1
2	4
3	9
4	16
5	25

Figure 11: "*Quadratic Voting*." *In Wikipedia, October 28, 2020.* https://en.wikipedia.org/w/index.php?title=Quadratic_voting&oldid=985864225.

7. Opinion making

To have a complete insight of the realm of what are some of the actual consensus procedures that are out there working and activating consensus every day here are presented some of the applications and projects that bring programming code into the shape of applications to be used as a bridge to inform, collaborate and cooperate to create collective knowledge, materials and actions.

Consensus as a process depends very much in generating the necessary exchange of information, so all the parts, even if at the beginning they don't share the same opinions, can at the end understand others perspectives. Normally this in the physical world is easier, due to very instinctive expressions, specially gestures. As we normally see in politicians ritually moving their hands according to what they are saying, this increase the reception of the message. The problem in regards to telecommunication, as the study *The Effect of Gesture on Speech Production and Comprehension* suggests without conclusion, is that there is no definitive answer in this field: "Given the importance of gesture to communication, it is surprising that there is little consensus on the role of gesture in telecommunications"[44]

> Postponing the debate of gesture influence on communication, the accountant tools that we can use to communicate nowadays include gestures, like video calls, but in terms of documenting them, it is hard to express gestures within fully logical and rational text. As McLuhan suggests:
>
> *"In speech we tend to react to each situation that occurs, reacting in tone and gesture even to our own act of speaking. But writing tends to be a kind of separate or specialist action in which there is little opportunity or call for reaction."*[45]

The best method perhaps, is to merge both video and text in the shape of recordings and transcriptions and soon enough this will become commonplace, thanks to the advances in speech-to-text recognition tools, computer vision and artificial intelligence. But currently this is not a reality yet, not at least yet established. Documenting the process is of vital importance, especially in terms of politics, as is the basis for transparency and transparency is so important because as Arthur P. J. Mol explains, in the context of environmental politics:

"transparency relates directly to power as it aims to democratize information and empower the powerless by providing them with one of the most powerful resources in current times: access to and control over information and knowledge."[46]

Here some of the most common open-source alternative tools are revisited and used to document opinion making processes in the daily life of collectives and groups. Perhaps these are not the most popular ones and there are alternatives, for example in normal communication tools to repurpose the medium, such as in assemblies made in messaging applications such as Telegram.[47] The fact that they are not listed here, is because they are not formalized as opinion/decision making tool, they are more spontaneous usage of the communication tools rather than explicitly design for that purpose.

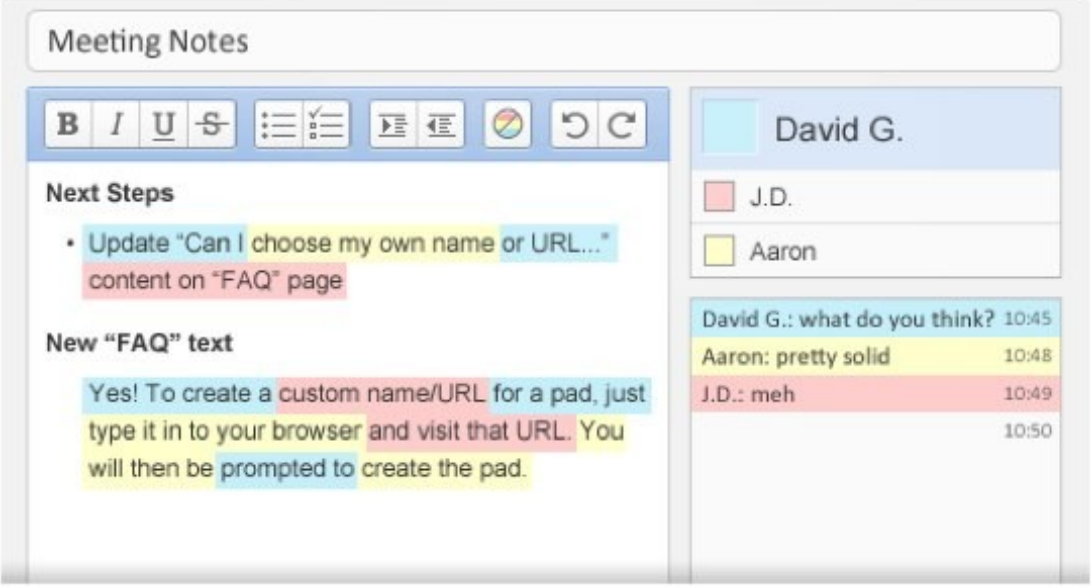

Figure 12: TechCrunch. "EtherPad Gets A Makeover And Becomes Even More Of A Threat To Google Docs (Invites)." Accessed October 31, 2020. https://social.techcrunch.com/2009/07/23/etherpad-gets-a-makeover-and-becomes-even-more-of-a-threat-to-google-docs/.

7.1 Etherpad

Etherpad is a real time collaborative text editor that born from the idea of creating texts with other people in a way that changes and editors are visible to the other readers or participators.

It works with a set of tools as the most obvious one a text editor, but also includes several other functionalities like version control, history of saved revisions, merging protocols and even an application programming interface (API) to which commands can be send to edit and manage the pads programmatically.

Figure 13: Usage prototype from Loomio application. “Introduction.” Accessed December 29, 2020. https://loomio.coop/.

7.2 Loomio

Perhaps the most unique software dedicated only to the purpose of making easier to agree within collectives. Loomio is a platform to which organizations can use in order to improve the decisions that need to be consulted between groups. It works as forum where the people can discuss and then also offers the possibility to create collaborative documents to which also revisions can be submit to different types of polls. This is perhaps the most interesting part of the application, because it offers several systems from which to choose, depending on the situation, for example, if it is time sensitive, if the decision must only be taken by *n* number of participants or to give the possibility to v*eto*

(restrict taking decision due to an opposite position. Its foundation is based on the purpose of easing social movements decision process and therefore they keep fostering self-organization and collaboration between people by offering its product as an open source (they share the code as it is).[48]

Also as part of their work, they publish in the resource section of their webpage, guides offered by the platform[49] the which make it possible to learn about different strategies online and offline about collaborating in groups. For example, as shown in the figure, *Integrative Consent*, is the recommended iteration to take decisions in groups. In this iterative process, there are also roles, for example the one that writes, it is recommended using text, a proposal takes the role of *proposer*, to which the questions are directed to and who will guide the process forward along all the steps. To help the proposer, there is the *facilitator* an assistant type like to help the proposer explaining and organizing questions and comments.

Figure 14: "Consent Decision Making | Loomio Help." Accessed December 29, 2020. https://help.loomio.org/en/guides/consent_process/.

Figure 15 The logo displayed after the two-year anniversary of the ban, with the message "2 yıldır özlüyoruz" (English: "missing you for two years"). “Wikipedia.” In *Wikipedia*, September 29, 2020. https://en.wikipedia.org/w/index.php?title=Wikipedia&oldid=980930874.

7.3 Wikipedia

Part of the Wikimedia foundation, which focuses on promoting free educational content, Wikipedia offer the services of a free encyclopedia where everybody can create, edit and reclaim articles about the documentation of any imaginable thing. It is included in this section here, because it operates as currently the most powerful consensus tool to which everybody can contribute and create common

knowledge.[50] It has a peer revision system in which when an article is created, edited or ask to be erased, there is a peer review system and moderation from the foundation in order to guarantee that the diversity of opinions remains,[51] having consensus as its primary method for publishing.

It has been a very controversial tool, due to the lack of editorial curatorship and the disagreement and refusal to make corrections asked by governments. For example, it suffered bans in countries such as Turkey, in which it is not possible to access, due to the polemic editing of several articles linking Turkey with terrorism.[52] In spite of its polemic collaborative editions, it has still achieved a free-speech goal of creating a universal free tool for knowledge and research in any topic imaginable.

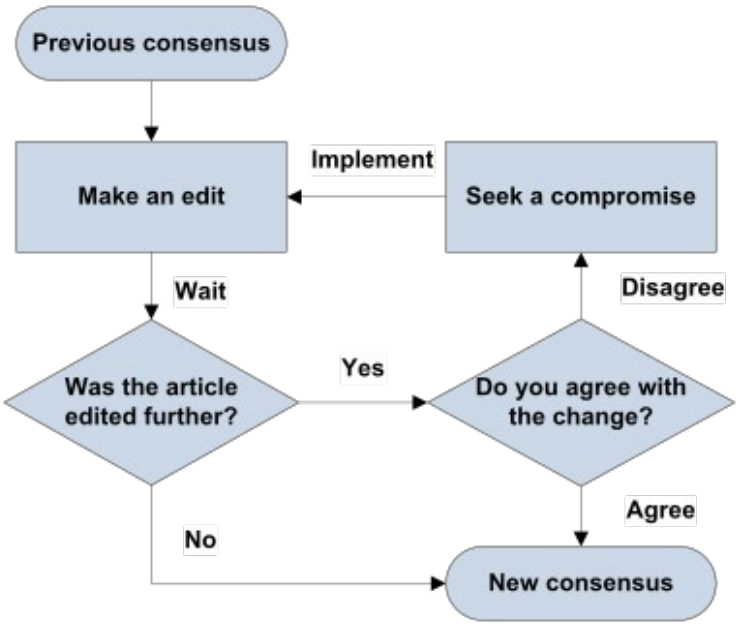

Figure 16 Publication diagram of the process to propose, edit and publish an article in Wikipedia. *"Wikipedia:Consensus." In Wikipedia, November 17, 2020.* https://en.wikipedia.org/w/index.php?title=Wikipedia:Consensus&oldid=989131833.

Another interesting point, is the usage of Wikipedia datasets in AI model training. Wikimedia foundation offers different sizes of datasets to be fed into the neural networks to learn a general overview of topics or have knowledge base about particular one.

8. Instruction based art

> *"An artwork is an artistic statement as articulated in an artistic medium realized in a vehicle"*[53]
>
> *"Instruction-based art highlights the route between thing, command, and action. It usually starts off with the material stuff which holds the instruction; a page in a book, a paper nailed to a gallery wall, or a card stuck in your wallet. The material's agency to do something—to perform—suggests that we have a thing rather than a passive object at hand. But the agency of the instruction, irrespective of its material form, is of course dependent on the command itself—what the instruction asks us to do. And there is furthermore a massive difference between receiving an instruction and acting upon it"*[54]

Through the history of art, there has been a shift from the traditional formalism of art subjects only, to a more artist-focussed vision, leaving the viewer as mere passive observers of the final artwork, as Allan Kaprow, pioneer in establishing the theory of performance as visual-participative art and creator of the Happening movement, writes in the book *Essays on the Blurring of Art and Life* (1993). McLuhan also points to the art revolution after the invention and assimilation of photography and consecutive technologies towards a more participative and collaborative art:

"art moved from outer matching to inner making. Instead of depicting a world that matched the world we already knew, the artists turned to presenting the creative process for public participation. He has given to us now the means of becoming involved in the making-process. Each development of the electric age attracts, and demands, a high degree of producer-orientation."[55]

Coming also from the performance world, who seek to include their spectators, we see different trends that follow a more social and political collaborative art. Such trends start to have different names like Art as Social Action (ASA)[56] socially engaged art, community-based art, experimental communities, dialogic art, littoral art, interventionist art, participatory art, collaborative art, contextual art also social practice.[57] These trends go more into the pedagogical capacity of art practice, mixing art with other disciplines such as sociology, architecture, law, science, economy. Also *The One and the Many: Contemporary Collaborative Art in a Global Context* by critic Grant Kester evelops the theory of a relational/dialogical art and its consolidation, through studying and writing about it, this is the direction this chapter seek after. But in contrast to Niklas Luhman, well known by its complex systems analysis, he also analyses literally how art "functions", by comparing its different capacities to each of its different stages.[58] The art strategies are not analysed here as a logical input-output system, as Luhman did already, but exploring the most common formats used to engage a group into a decision-making discussion and valuable outcome.

Referring to the quality of art regarding consensus, Kant wrote:

> *"Kant already located the function of art (of the presentation of aesthetic ideas) in its capacity to stimulate thinking in ways that exceed verbal or conceptual comprehension. The art system concedes to the perceiving consciousness its own unique adventure in observing artworks --and yet it makes available as communication the formal selection that triggered the adventure. Unlike verbal communication, which all too quickly moves toward a yes/no bifurcation, communication guided by perception relaxes the structural coupling of consciousness and communication (without destroying it, of course).*

The freedom of movement entailed in the world of perception is recovered in language and against the narrow focus of language. And the encapsulation of perception within the psyche prevents one from subjecting one's perceptions to a test for consensus. Consensus becomes an issue only in verbal communication, in commentary, where it is raised in an entirely inadequate manner."[59]

This chapter is classified by the time span the art formats target, starting from the shortest term, the happenings address a performative time box, such as seconds, minutes, hours or several days. After, a brief look at different engaging interactive installations which can last for as much as an exhibition lasts, ranging from 1 day to months, as a medium size time term. And lastly workshops, which also starting from one day, can last up until years if consider inside them are lectures, as for example university lectures or programs in the same way Beuys conceived his last art practice as social sculpture.[60]

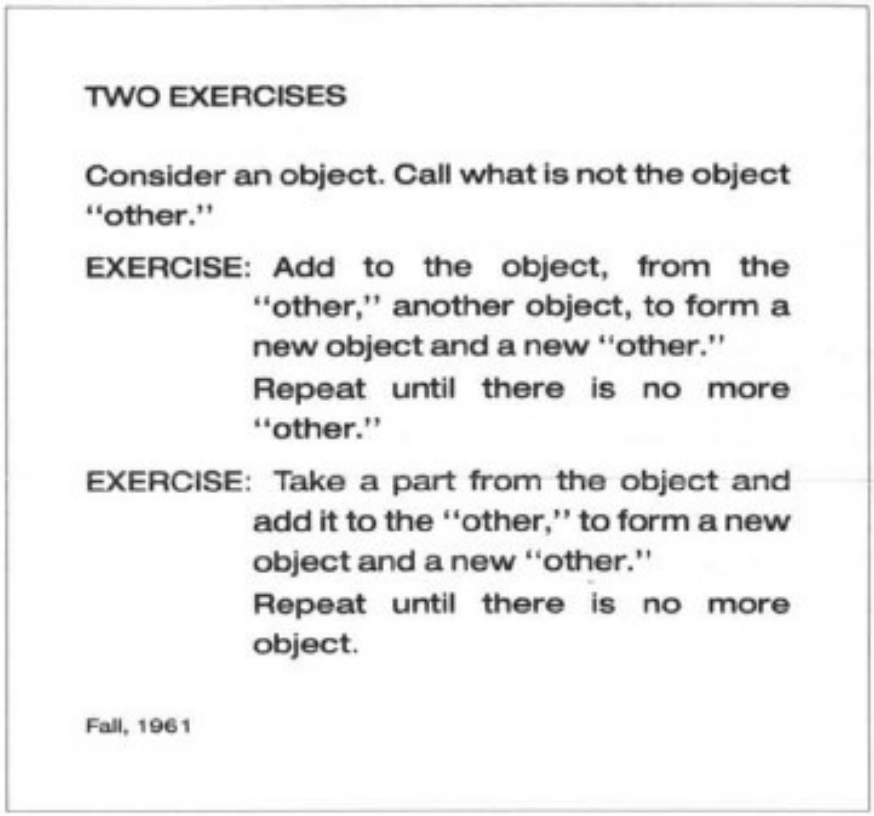

Figure 17: An example of a happening put by Kaprow referencing George Brecht. (Kaprow & Kelley, 1993, p. 172)

8.1 Happening

Happenings seems to be a starting point within media art theory, from which spectators are considered part of the art process. Perhaps there are previous participative art movements, but in terms of theorizing a conscious inclusive strategy, Happenings are the best example.

Happenings started as similar to theatre plays but began to expand the formats of presentation method, by breaking the border between audience and actors, between stage and gallery. It is first time for Art to consider context out of the frame (theatre, museums, etc). And bring the performance to a dedicated environment, conceived by the piece.

Formulaic by nature, Happenings aim to give a set of instructions, and by being followed in action, the score can only be considered the root of the artwork,[61] in

this way, *"a Happening cannot be reproduced"*.[62] Some of the Fluxus artists, such as Yoko Ono, in Space Transformers began to inappropriate mixed media installation with performance, developing what artist and theoretician Dick Higgins coined as "Intermedia", targeting the capabilities of art in regards towards interdisciplinarity[63]. Creatively, this can be seen as a paradigmatically significant breaking point, from which art no longer needed to be attached only to one discipline, vehicle or medium.

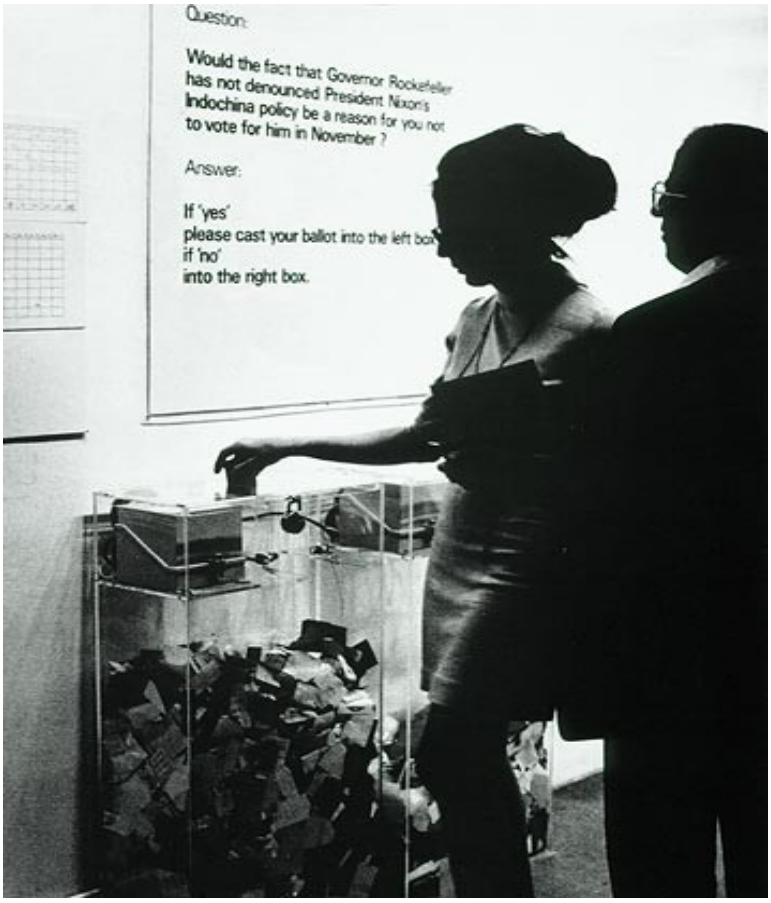

Figure 18: www.wikiart.org. "MoMA Poll, 1970 - Hans Haacke - WikiArt.Org." Accessed December 12, 2020. https://www.wikiart.org/en/hans-haacke/moma-poll-1970.

8.2 Interactive Installations

Another format of participation in Art, based on instructions, are interactive installations, which also, by using a set of steps to be able to activate the artwork, allow spectators to participate and involve themselves into them. There are many early examples of interactive installations within the history of modern art, for example Alexander Calder's Mobiles.[64] Here we will have an overview of some relevant examples of the interactive installations that deal with group decision-making, even though there is little available literature on them. The chosen examples were selected because of their potential in order to activate the dialog and empathy between participants.

One of the most acclaimed critical socio-political artists, Hans Haacke made the work MoMA Poll in 1970, a critique of of the Nixon presidency, in the US at the time, when several controversial armed conflicts were happening. The work consists of a very basic setup, but perhaps is the first of its type to be presented in such an institution as the Museum of Modern Art.[65] It presents to the spectator/participant, two plexiglass boxes for the yes or no voting options, along with paper ballots containing a question regarding Nixon's policy on how he managed the Indochina conflict, the permanence of troops, the aftermath and the fact a very influential person and board member of the museum didn't denounce those policies. The question reads as follow: "*Would the fact that Governor Rockefeller has not denounced President Nixon's Indochina Policy be a reason for your not voting for him in November?*"[66]

This was rather controversial act was most likely possible, due to Haacke's strategy to reveal the specific question just previous to the opening the exhibition, preventing perhaps, a possible censorship from the museum. With this work, Haacke not only brought current politic affairs and criticism to the art museum but throughout his career, he contribute to create a trend called "institutional critique", the type of practice we can appreciate in this artwork questioning the role of certain institutions in public matters.[67]

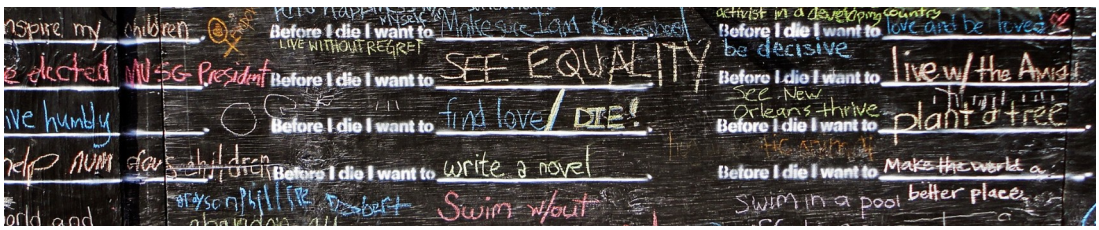

Figure 19: Threadless. "Before I Die | Featuring Custom T-Shirts, Prints, and More." Accessed December 10, 2020. https://beforeidie.threadless.com/.

Another example of an interactive installation dealing with participation is Before I die by Candy Chang,[68] this works perhaps being the most suitable to explain what can be called a universally successful interactive installation. The work is very simple, it consists of a blackboard to which a sentence is repeated leaving a gap to be fulfilled, "Before I die I want to _____,"[69]. This is presented

together with some chalk attached to the surface of the blackboard, triggering intermediately the invitation to participate. As time passes by and the installation is being activated, participants can get a hint of what is important for others. In this way every wall, as described by Candy Chang: "offers a snapshot of our shared anxieties and hopes, our collective joys and struggles".[70] The power behind this project is the gap left after a universal sentence to which anybody can fill the void. This is the starting point of a lot of works concerning public opinion, to give the opportunity to the participants to express, and the simplest way to do it is verbalizing, in this case, in the shape of text.

Individual texts then become part of a group of texts, which in this case is written on a backboard and documents in photographs. As this piece was repeated multiple times, the "dataset" of what people want to do before they die is filled, and if this data would be processed, we could extract a notion of what is commonly either feared, loved or willing to fulfil a group of people.

Figure 20: Tanni, Valentina. "Il video di Superinternet.space, una performance memetica collettiva." *Artribune* (blog), January 10, 2019. https://www.artribune.com/television/2019/01/video-superinternet-space-memepropaganda-clusterduck/.

Another kind of blackboard that serves as an example to expressing each individual opinion but in this case together with a collaborative ingredient is #MEMEPROPAGANDA.[71] A cube-like digital "blackboard" to which everybody on the virtual room can paint the walls adding or removing to what others drew previously on the time span of an event hosted by Green Cube Gallery and curated by the artist collective Clusterduck,[72] in the early stages of the project. This cube functions currently as a collaborative Meme collection and visualization tool to which participants can watch and download other participants Meme's and also upload new ones to the collective archive. The more interesting side of this project for this research, was the first experiment called *Superinternet.space,*[73] because it enables this format of collaborative creation the resulting pictures on the walls of the cube, in some sense symbolise what the people agreed to remain unchanged and evolve together. This project shows another simple strategy to create collaborative experiences in which everybody is easily integrated in the participation and build on top of others expressions.

The last example included here is that of Loren Carpenter and Stadtwerkstatt in his work "Audience Participation"[74] in the context of the opening for Ars Electronica 1994. In this project Carpenter engaged approximately 4000 people gathered in the Linz main square,[75] presenting a pong game to which they had to show either side of a pole with a ray-cast red or green coloured square. A computer would read how many people were showing either colour and by this method, the pong platform goes up or down, making it possible to play. To choose which direction the platform should head, indirectly the people have to agree to win. In this example the decision is not taken in relation to a dialogical experience but aiming to the common sense of the participants. This project involved a lot of infrastructure and technology, though the interaction is very simple and successful in terms of the participants understanding their role in the decision-making process.

Figure 21: *Ars Electronica 1994 - Opening with Loren Carpenter and Stadtwerkstatt*. Accessed December 10, 2020. https://vimeo.com/7723467.

As we saw in the previous examples, interactive installations that target people's collaboration share the main characteristic of making an experience valuable, in as much as the participation occurs, giving the participants a seductive invitation to which they would or not feel identified, and therefore grow on them the need to participate.

In terms of consensus, these examples were chosen because they show different sides of what collective decision-making involves, collaboration and understanding.

8.3 Workshop

Workshops are a very popular medium that is used in socially engaged art. It is most notable that when the artists are interested in the spectator opinion, a workshop is realised, to which spectators have the opportunity to be part of the artwork process. Unluckily there are very few if any theoreticians that are focused on the workshop as art practice.

For example, Participatory Decision-Making in Diverse Groups, by Sol Aramendi, in the book Art as Social Action: an introduction to the principles and practices of teaching social practice art by Gregory Sholette and Chloë Bass, Social Practice Queens. In this chapter, which seems to have a perfectly fitting title for this section of this research, we find an introduction to the workshop practice itself and the series of steps into which the participants are conducted in order to gain empathy, to their peers, the space and the time. Like this example, there are many published workshops formulas in relation to art practice, but very few offer a significant analysis of the specific characteristics to workshops that are bespoke for socially engaged art and participation. It works in every way possible targeting the participants processes in order to get a custom output in most of the cases, which then conforms the artwork.

As a study case, we could look at an artwork created by the same author as the workshop score described before, Sol Aramendi, who engaged the community of undocumented workers in Queens, New York, in conversations about the problems they have as they suffered from "wage theft", when there are irregularities in the payment after the day of work. In this work, guiding the participants through a series of steps to raise awareness of the context, question it, and decide on topics to act upon,[76] the artist sees herself as a "pollinizer" and explains that she see conceives her artwork as "social sculpture", quoting Joseph Beuys to do so[77]. Interestingly, the app Jornaler@s was developed from

an idea coming from one of the workers that attended one of the artist workshops.[78]

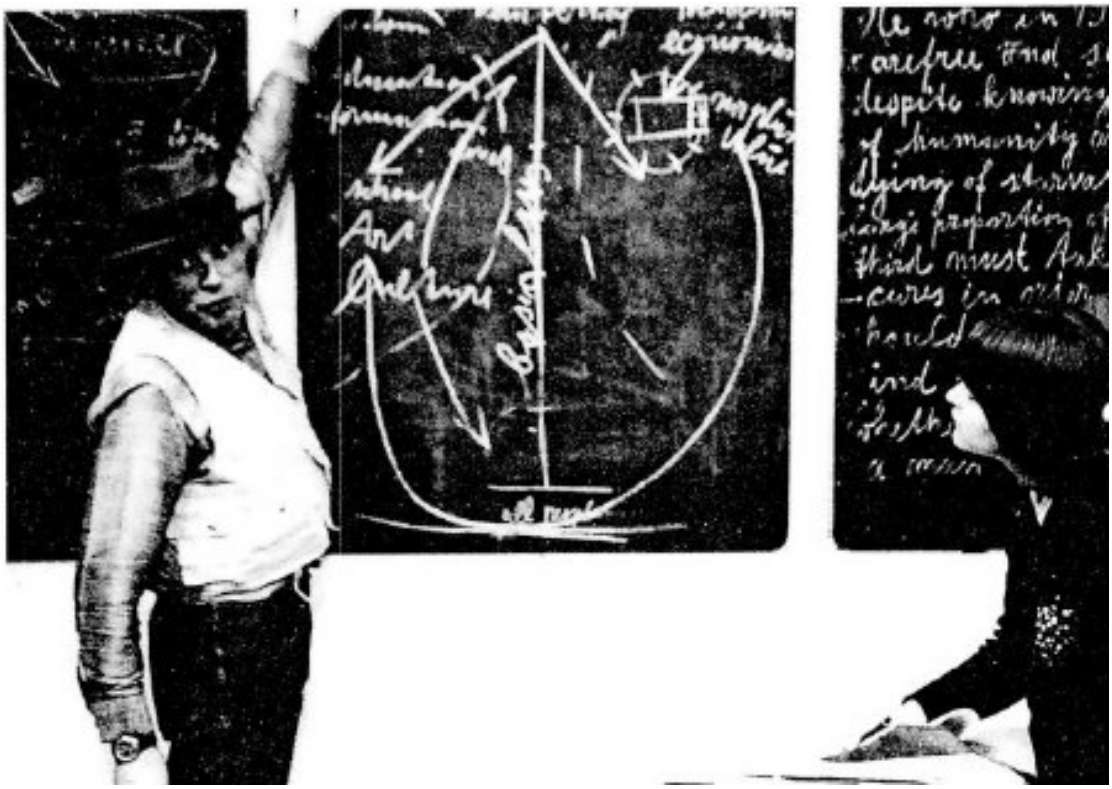

Figure 22: Joseph Beuys's Action Piece 26 February 1972. © Tate Archive Photographic Collection Photo: Simon Wilson. © DACS, 2005. ("Joseph Beuys," 2005, p. 4)

8.4 Lecture as art practice

As Beuys stated "to be a teacher is my greatest work of art".[79] It can be argued that lectures, are an integral part of art practice and as such, they can be part considered as the oldest form of participative artwork.

For example, "useful art" was coined by Tania Bruguera, an artist and lecturer created the program Cátedra Arte de Conducta. In this program is a series of experiences in which the "members" (students) would receive advice from the different "guests" (lecturers, lawyers, journalists, artists and more). Lectures

were irregular in time and space, trying to make every experience a piece of public art, as Bruguera explains to Tom Finkelpearl in an interview.[80] on his book *What we made: Conversations on Art and Social Cooperation*. With these lectures, Bruguera tries to target collectivity, not only between the students but also within the public context, and in this direction, "useful art" is targeting society, making artworks out of its problems and searching for the solution by collaborating together.

Of the other artists that define their art practice through teaching others, perhaps the best example is Joseph Beuys at the Dusseldorf Kunstakademie. Where just by themselves, the blackboards he used to teach are considered works of art and described as "a blend of art, politics, personal charisma, paradox and Utopian proposition".[81]

9. Proof I: Reference projects

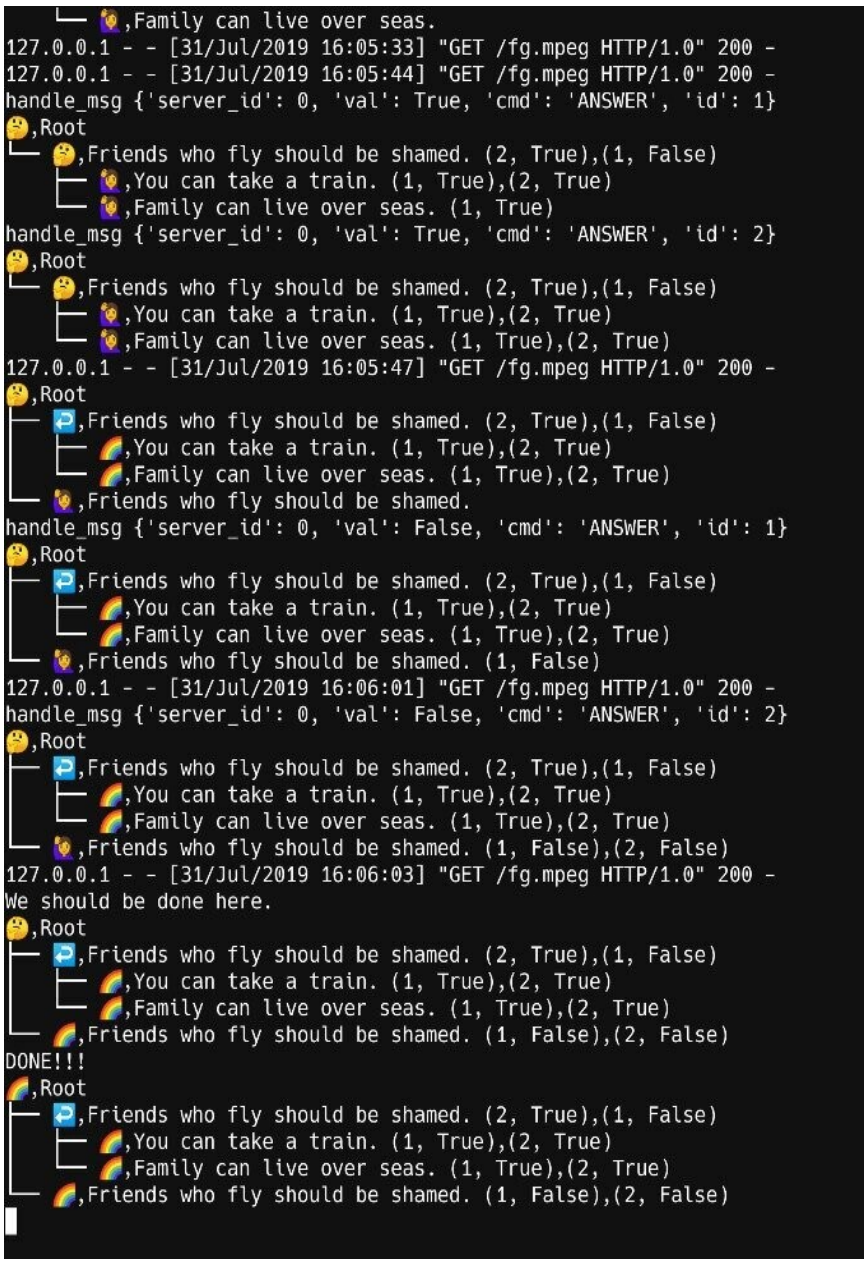

Figure 23: “WIN WIN.” Accessed November 20, 2020. https://winwin.zone/.

9.1 WINWIN

Nienke Huitenga and James Bryan Graves, inspired by a residency program, created WINWIN in order to find common grounds between people in online .[82]

Nienke Huitenga, designer and new media artist, focused in an immersive design, which we can see in this project, at the expansion of the digital interface in its performative version.[83]

James Bryan Graves, a computer scientist involved in many community projects, is part of this artistic team, working more on the technical side, evolving the idea of the PAXOS algorithm and together with Huitenga transforming it into a new human consensus interface for project.[84]

The project is still in development and currently has been only realised as first prototypes, which have been already presented. The last version presented was at the Impakt festival,[85] where some local authorities and politicians were invited to try the project and give their opinions on different topics, through their participation in the WINWIN performance.

Figure 24 "WIN WIN." Accessed November 20, 2020. https://winwin.zone/.

The project has currently two versions, including a performative version, where participants are invited to wear a conical face shields to cover their vision, and then sit together, while using the mobile application. In this version, we perceive the more artistic conception of the project, where the conception translates the participants into another context, where everything is part of the experience, not only the digital interaction. The results are projected to a large screen so that the audience can see how the debate evolves and whether there is consensus on certain topics or not.

The online version is based only in the application only, due to the Covid-19 situation and was released to be able to try and experiment to develop the project further.

The project operates based on the PAXOS algorithm. But, *"it's more of a simple breadth-first tree descent traversal algorithm where "leaves" represent moments of consensus"*.[86] By answering at first, to different statements, participants can vote to agree or disagree, and if there is disagreement, then the algorithm prompts for a reasoning for the answers for the decision made. The process continues, using the different reasons participants provide and then subject this to voting. By keeping this process going, some of the answers to other participant statements may achieve consensus, due to the fact that the participants, even if previously disagreeing, find the answers reasonable and then can adjust their choice and up vote those decisions.

In this way WINWIN makes use of a debate algorithm, from which it can extract the common grounds between different opinions shortening therefore the disagreement experience and focusing on consensus.

Figure 25 *Furtherfield. "CultureStake," March 16, 2020. https://www.furtherfield.org/culturestake-2/.*

9.2 CultureStake

CultureStake is a DECAL/Furtherfield project by Ruth Catlow, Charlotte Frost & Marc Garrett, with contributions by Sam Hart, Irene Lopez de Vallejo, Gretta Louw, Rob Myers, Stacco Troncoso, and Ann Marie Utratel, technical development by Sarah Friend & Andreas Dzialocha and the and the visual identity by Studio Hyte.[87]

CultureStake puts together some of the concepts that have been shown already in previous chapters, creating a mixture between quadratic voting and blockchain. The concept of CultureStake is to make the interests of the citizens in cultural agendas more visible, empowering them through a voting system that they can contribute to by buying tokens, in order to participate in different polls. These polls, through a playful interface, are implemented with quadratic voting, based on an Ethereum application (a blockchain that uses gas and coins to pay for the operations to keep the network working).

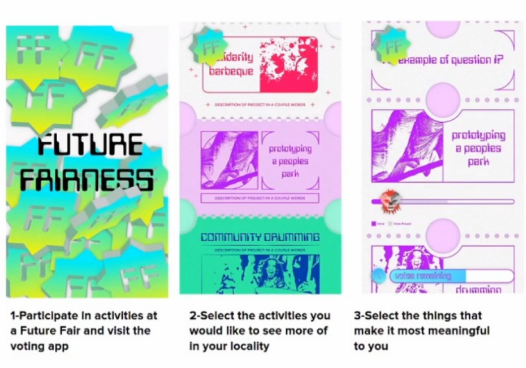

Figure 26 RadicalxChange. *Quadratic Voting in Action - Berman, Catlow, Friend, Henderson, Kuck - RxC 2020*, 2020. https://www.youtube.com/watch?v=uzFMdoGFyyA.

By proposing different activities, for example in the vacinity or in the case of the trial of the project in a festival. Participants can decide and vote on what are they preferred activities.

The voting interface is showing how quadratic voting works placing sliders to make more explicit how remaining votes run out when giving the different options values.

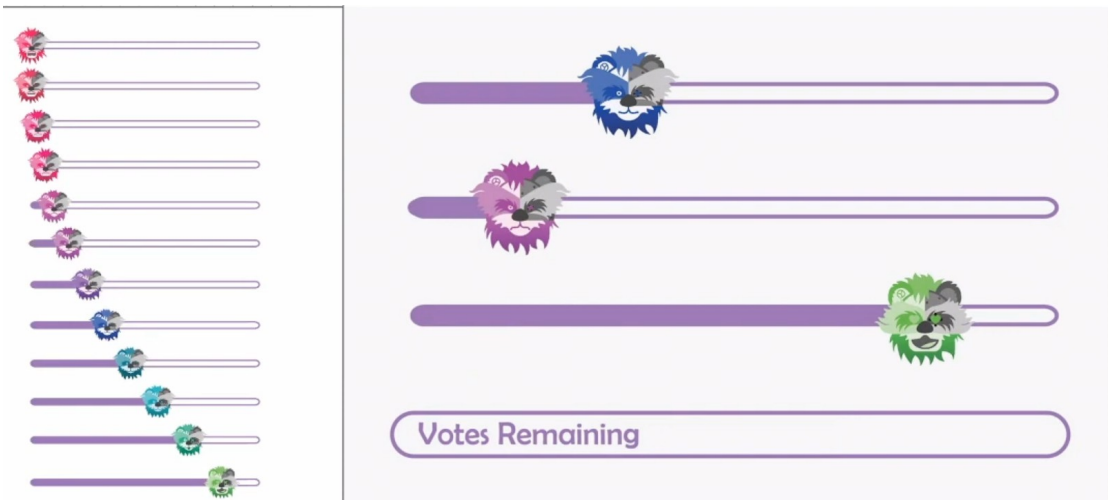

Figure 27 *Ibid.*

The target is to create data and visualise to the public institutions what is the will of the localities and promote the type of culture the citizens appreciate the most. Also shows how different technologies work in the context of democratic participation and economy wise politics.[88]

10. Proof II: Personal projects

This research is both a retrospective of my projects, workshops and experiences, along with a culmination of the research into the topics underlying all these projects, during the period of 2016 until 2020. Several previous works that were created prior to this period could also relate conceptually, as they also existed in collaboration and participation with big size groups, though the specific characteristic of this period is the digitalisation of the processes and strategies involved. Since around 2015, this research aimed to develop strategies that would ease the cooperation between participants of installations and happenings I use to prepare. Because the effort of not using technology required a lot of energy and collaborators to prepare any experience, I decided to look to technology due to appreciating its reproducibility and easiness to aim participation towards big groups.

Looking back, a pattern developed from the start this research, throughout all of the following projects, with a dedicated focus on agreement, acting together, and participating in collective processes. In this way I have been developing a series of projects and technologies exploring different ways to achieve these paradigms. Even though the technologies became developed on digital platforms, I always had in mind using them in real life, although they can also be used remotely, the purpose is to use technology to go back to the socialise and physical encounter our peers.

Making it possible for as much potential participation in these projects was always a concern, sometimes also trying to give place for small children or elders. The fact that society changes so much with each generation, in relation those that we can say that they can be considered digital natives.1 This was particularly decisive when designing the interaction of the projects, the fact that most people currently know how to use a smartphone and almost all carry one.

With around 80% penetration rate worldwide of smartphones,[89] it's interesting to realize about the speculative possibilities of usages this could have. This projects primarily explore mobile-first applications, which could lead to more realistic social usage of Internet technologies and smartphones.

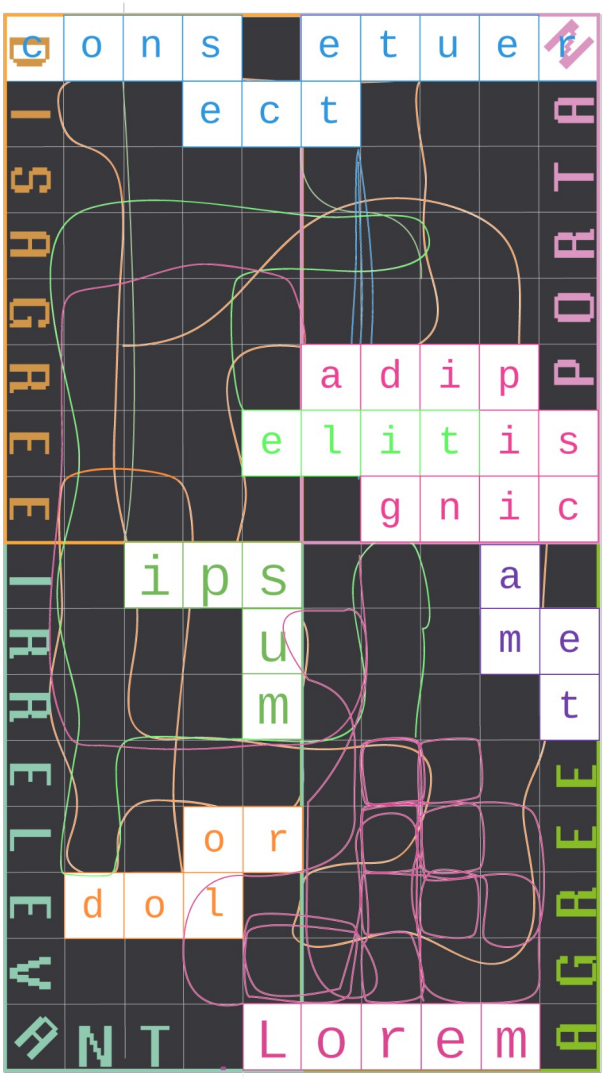

Figure 28: Expected result draft from Proof of Consensus project.

10.1 Proof of consensus

10.1.1 Abstract

Proof of consensus is a Web application to ease group decision making processes, through creating the space and time in which to rethink consensus. Within this art project, participants encounter seamlessly mixed techniques that include Peer to peer (P2P) protocols, Natural Language Processing (NLP) and

distributed computing algorithms (Scuttlebutt), in combination with data visualization (text vectorization), design thinking (reverse engineering company strategies) and social movement methodologies.
Proof of consensus is a stalker into the world of politics, technology, art and society. Following the echoes of social movements it digs into machine strategies and techniques researching new economies of human understanding.

10.1.2 Motivation

A personal aim for this project is to unbox technology from its obscurity to users and return it to a more plastic and transparent paradigm. These projects reflect on the fact that we are not aware of the tools we use, that make us more vulnerable to manipulation and exploitation, by implementing technologies and strategies used to make profit, but in these projects, to learn from the capitalistic experience in regards to what possibilities we have when controlling the protocols we use, especially regarding privacy, society and democracy.

Participating in these projects gives the possibility for participants to empower themselves playfully, to understand each other better and to resolve common decisions. Perhaps the most important factor is the conception of collectivity, as it is key that we realise that we belong together and should agree altogether in shaping our realities in a way we are all comfortable with, to do so, first we need to change percentages in many fields. The question is, what is that we have to agree on and how to achieve it?

In this project I wanted to experiment with the technologies that seem the most needed ones to ensure resiliency, transparency, privacy and shared state between nodes. Some of the most horizontal technologies, like distributed systems or peer to peer applications, experiment with natural

language processing to create a text visualization and make everything interactive and scalable.

Also at first, I didn't decide which would be the outlook of this project, rather to allow it to develop pragmatically, through different experiments and experiences. When it is exhibited and presented as a workshop, some parts of it are questioned and if times and resources allow it, then changed to shape a better design.

It is important to note, that this project is made from self-taught technologies and knowledge practices and hopefully is considered having that in mind, for many considerations, both good and bad.

10.1.3 Project Description

Proof of consensus aims to approach consensus from a computer science and an art practice perspective, from which computer logic serves in improving communication between peers and art to help getting to a point in which every participants point of view can be visualised and understood by other participants.

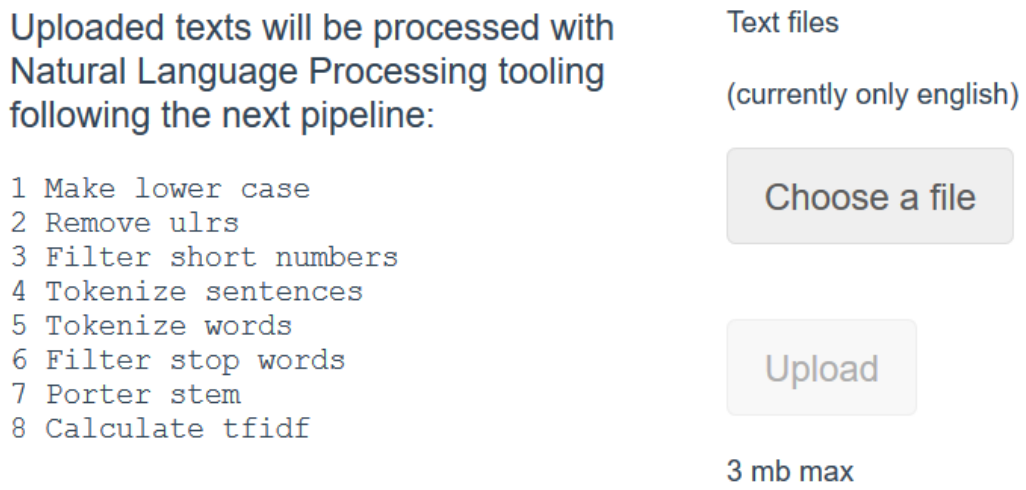

Figure 29: First prototype of the text analyzer.

This project is based on treating data logically, whereas not always rationally. Text processing and data visualizations will not always take a rational shape, but will experiment in creating new perspectives from which to look and interpret speech or text. Another concept of the project is to create a tool in which relay for better documentation, even if temporary, it produces a distributed database of what are the outcomes of the whole content produced discussing, what have been the steps towards agreement and when, where and what consensus may look like.

As said, by having some kind of data to be processed and synthesised from a group (even if it is solely real time discussion), the algorithms in Proof of Consensus create an image (literally or not) reading between the lines of the given input and interactions. The results of the project are designed by humans

for humans, concerned with cooperation and collaboration, trust and "errors" will always be a big percentage of the communication through the Proof of consensus application.

Proof of Consensus can reach any kind of agreement, even if it's just to use other tool for decision making, it will be already a goal achieved. The main purpose of this project is invigorating and reflecting on the steps we have to make to agree together.

Some of the tools used to visualize and create a playful data are information retrieval and NLP, "trustless architectures" resolving the discussion state, and the most important, humans to interpret and use the self-made geared output. Learning from the machines instead of only machine learning is a big concept present on this project. By doing so, we can better understand what is happening behind the scenes with Surveillance Capitalism, what are our systems weaknesses and how to prevent and overcome failure.

The other side of this project targets what are the acknowledgment of the networks within and around ourselves, not only the telecommunication networks but also the social connections and how powerful these can be in order to achieve a goal. This idea has been always present since the beginning of the Internet and used in the development of P2P technologies and modern business practices. This app explores how machines understand humans by analysing text and how these procedures could also enrich how we could be the models used to be "trained." It uses end to end protocols for private communication such as WebRTC to connect directly from one browser to another, consensus algorithms such as those used in Blockchain technologies like Scuttlebutt (gossip/anti-entropy/epidemic) protocols to spread information from peer to peer and resolve inconsistencies. These technologies are explored through the lenses of art considering technology part of the commons, in order

to get a more creative and sustainable way specially regarding time and space, on how to agree with each other.

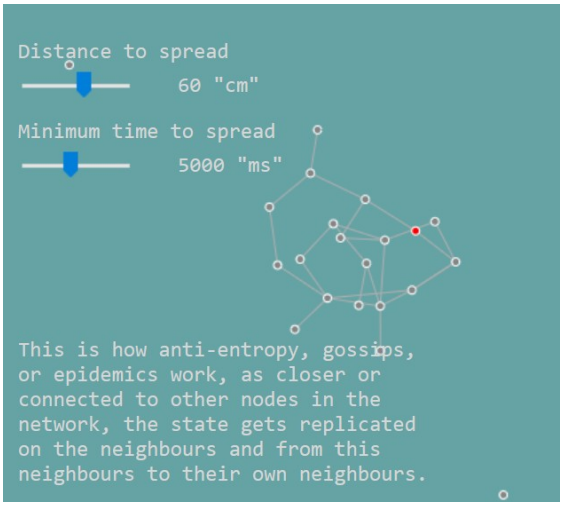

Figure 31 Prototype to explain the Scuttlebutt protocol.

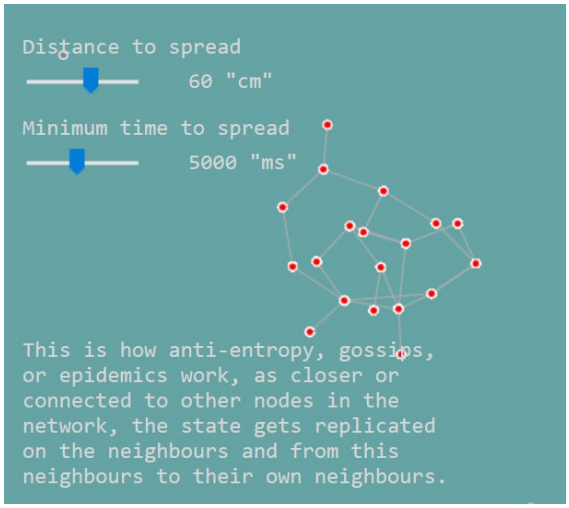

Figure 30 Different from the previous it is shown how gossip/information spread over the dots.

Not only do technologies and strategies of these projects come from the computer science world, but they also explore different, proven agreement making strategies coming from left wing movements, coaching, design-thinking, game theory, internet forums and other common practices. Transdisciplinarity plays a big role in problem solving and therefore every knowledge field is considered and sometimes

adapted in different percentages. There are two types of presentation of this project, an exhibition mode in which an installation is prepared to showcase the current state of the Web application and a poster explaining the technologies used.

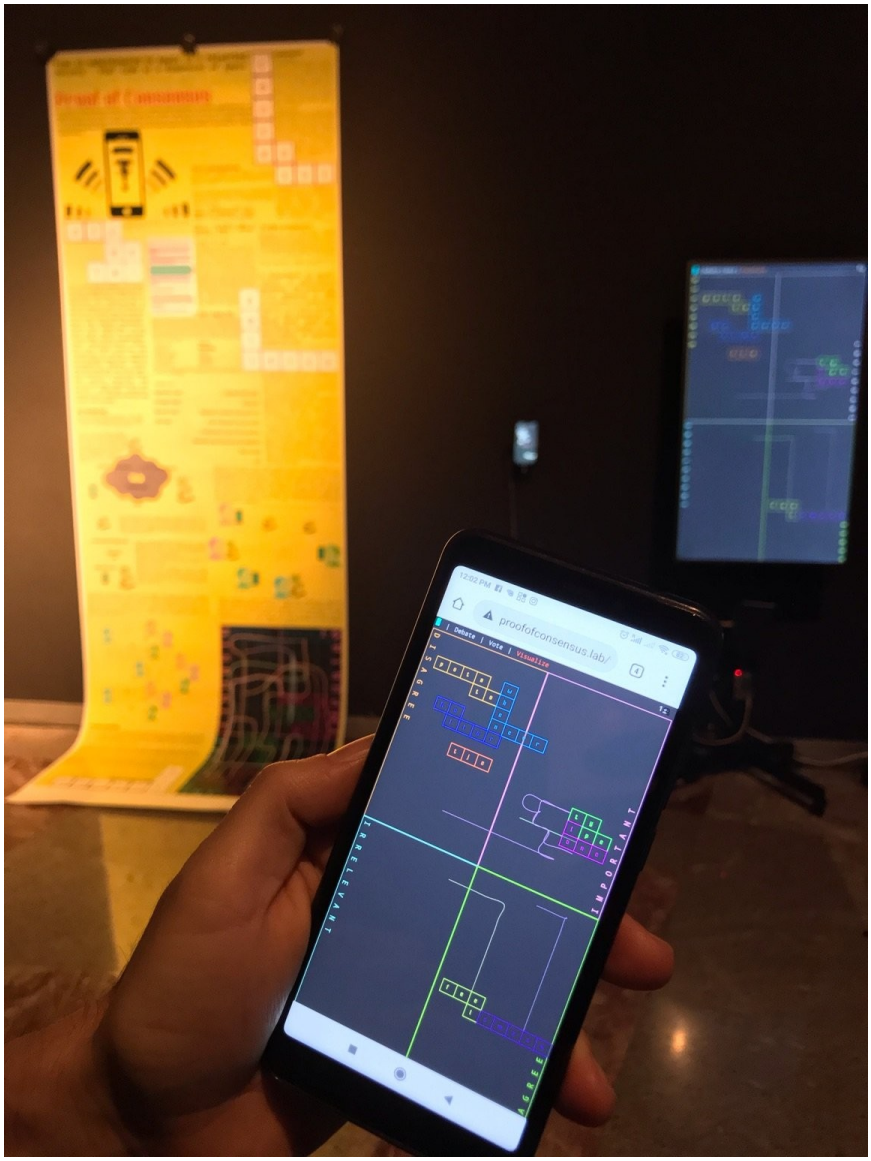

Figure 32 Project installation as shown in Speculum Artium 2020.

In the exhibition installation, a smartphone is shown with the Web browser opened in order to illustrate how people can interact with the installation and the people that are already inside the web application. Also, a screen with the visualisation page of the application open, shows the visualisation of the interactions from the extracted words from the collaborative text, which will be explained next.

The other format is a workshop organised around the technologic framework where the participants are invited to opt-in for the same concepts or adhere to their own, producing different outputs from the multiple experiences.

10.1.4 Technical aspects

As one of the targets of the project is to unbox commonly used technologies for text analysis[90], for example, TF-IDF, a weighting algorithm to show the most common uncommon words between several documents, creates awareness of how everything works "behind the scenes" and promotes fearless use those technologies ourselves. Most of Surveillance Capitalism's strength lies in its data processing capabilities, using Natural Language Processing, the mathematical and computational analysis of natural, evolved through usage and repetition in humans[91], languages considering text and speech to do so.[92] To be able to understand the output data from the text analysis, several algorithms are used to make more computational and human sense through visualizations.

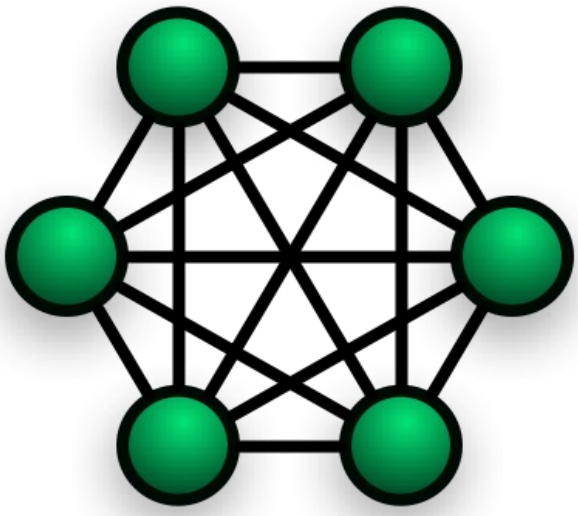

Figure 33: Aboukhadijeh, Feross. Feross/Simple-Peer. JavaScript, 2020. https://github.com/feross/simple-peer.

10.1.4.1 Communication

The project its allocated in a network, either a local network that also has access to the Internet, or simply an offline network. For the purpose of being exhibited, it will be most of the times be shown as just an offline network. This

is intended to simulate how in the case of signal jamming or connection failures, the problem could be overcome by just using either the offline version or the connection to other peers that could exchange credentials before the shutdown. This resiliency raises a challenge in keeping several communication protocols and entities on sync. For that reason, at the beginning a central server is needed for the sake of discovering other peers connected to the same network that are able to start other types of communication. This part of the communication that still works with a central server that coordinates the offer and answer to then establish a P2P connection is called Signaling.[93]

After at least two peers are connected to each other it could be possible to keep the communication and pair new nodes just by using the P2P connection and the shared state through Scuttlebutt.[94]

As more peers are connected the system becomes more resilient, and to syncing new devices gets easier on every new connection. When at least one node is still connected to the server, the application and its state will be kept alive and can always activate new nodes.

To achieve this highly resilient network, it is intended to create a full mesh topology network, which means, every node is connected to each other. WebRTC is the chosen protocol to establish the connection between nodes, it's a protocol used to stream data from browser to browser, using User Datagram Protocol(UDP), which in contrast to the more commonly used Hyper Text Transfer Protocol(HTTP), creates a media channel to listen and transfer big chunks of data at a reasonable speed.

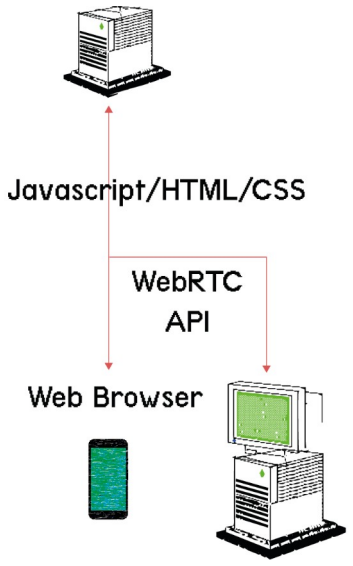

Figure 34: Common network structure with a signaling(credentials matchmaker) server and peers.

10.1.4.2 Shared state

It was important for the project that all data is both accessible and transparent to each node participating of the network. Once accessed and exchange credentials with other peer, all the transactions and data exchange get started to sync with the other peers. So after a few iterations, every node if no changes are made, share the same machine state.

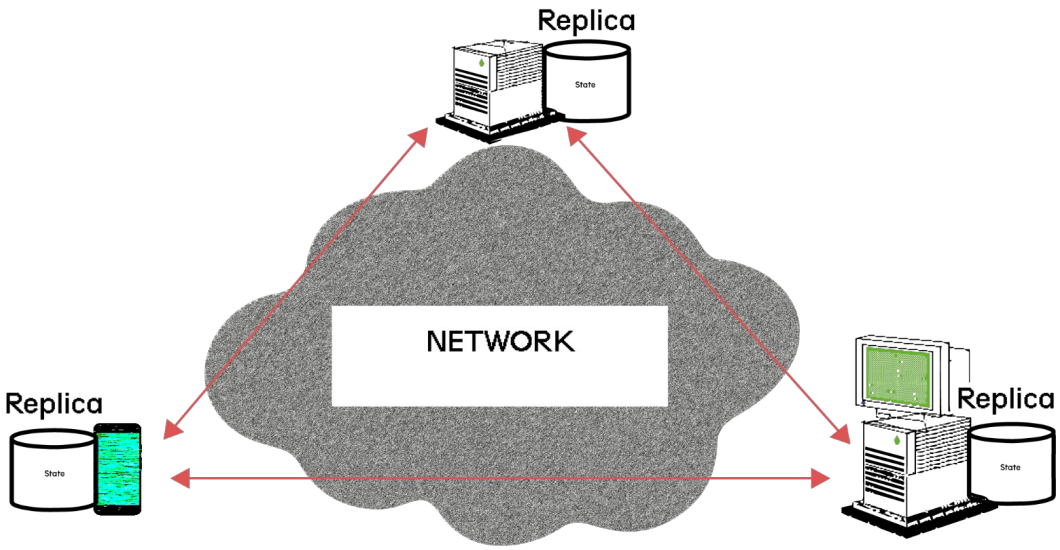

Figure 35: State is replicated along the network.

To accomplish this, the protocol used in this project is an adaptation of the commonly known Scuttlebutt protocol,[95] first published by Robbert van Renesse, Dan Dumitriuy, Valient Gough, and Chris Thomas in 2008s Efficient Reconciliation and Flow Control for Anti-Entropy Protocols. The publication later introduces the term in relation to the "gossiping effect" a mechanism referring to an analogy about a water cask where sailors would gather around and share gossip while having a drink, taking the term from the analogy to the protocol.

How Scuttlebutt works is based on events and a versioning system, to which any node in the network can share their state by a series of update requests, sharing the state that is already known and querying the information received

from other peers that still remain inconsistent. Even by requesting information the version number increases, making a log of any action, even if its self-generated. Once messages are exchanged, the version number, the identification of the source and the data that is shared gets compared in each peer. The customisable part of the algorithm is the function which evaluates if an update should be applied or not, usually the biggest(latest) version number is favoured against a series of variables, for example the time of the machine, but as said, this implementation is left to the implementation and the use case.

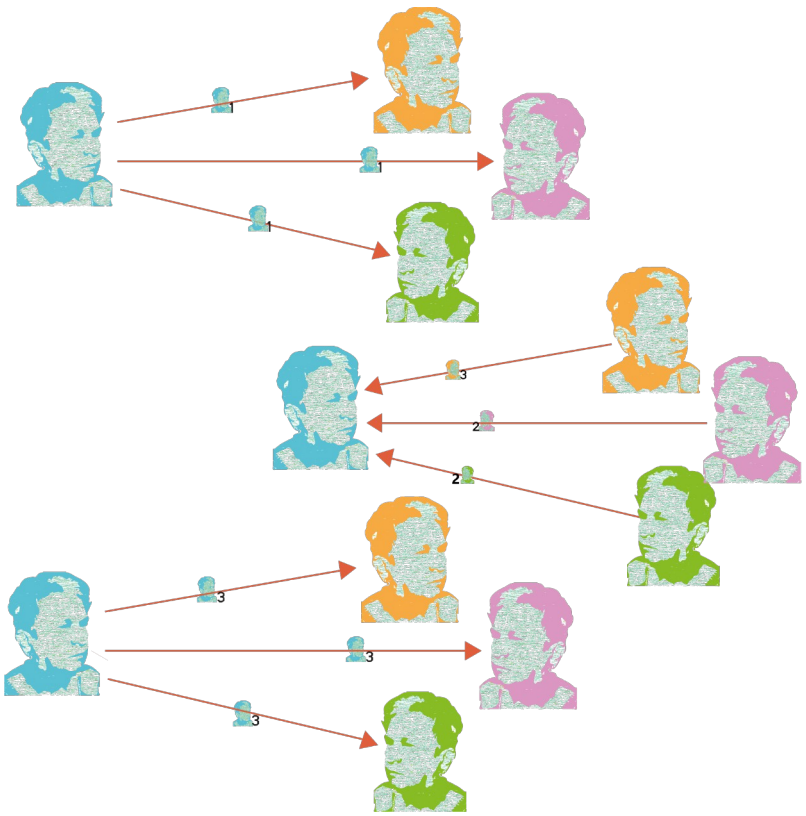

Figure 36: Part of the explanatory poster of Proof of consensus, to show how the version control works in the Scuttlebutt protocol.

it works also without having every peer connected to each other, so in case of partly failure from some nodes in the network, within the protocol is contemplated the procedure to keep updating state and then when the failure nodes are recovered, resynchronize with some conditionals, which some of will

be seen previously in the consensus algorithms. Scuttlebutt has the advantage of replicating data between peers with a versioning functionality, which then keeps track of what state is when and which peer is exchanging the information for new versions, this in a more advance application, or to better secure the communication, which can be easily used to check integrity and protect from malevolent nodes with a distorted states or trying to attack the network.

The main functionality that is interesting for this project is the so called "gossip", which is basically the messaging structure of the protocol that in this application is retransmitted within an interval to every single connected, known peer. It could potentially work better for performance optimization choosing each time a random peer or a sequential order is triggered, saving some updates by spreading the state in different orders.

By storing the history of the state of the different user actions, it can check what the steps towards the final update were, and therefore can be used as a proof. Proof is also a common term in blockchain applications which is assigned the connotation of different protocols that are used to define the admonition strategy (work, stake, etc). The name of the project, Proof of Consensus, denotes a different strategy which in this case is more likely a speculative one. It comes from the idea that being to explore the different states of the application through a visualization in which the validation turns into an aesthetic value which could be recognised by participants and appreciated by spectators of the project.

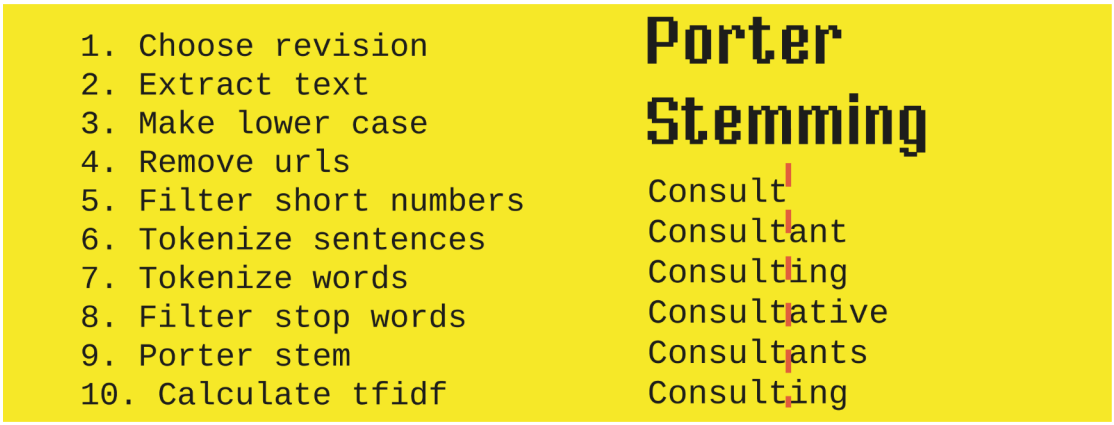

Figure 37: Text analysis pipeline sued in the project.

10.1.4.3 *Text (co)creation and analysis*

The first step of the installation process is to contribute to a text. The input for the text is an Etherpad, a real time collaborative notebook. Participants are invited to write about any topic they are interested in or to answer to previous writings. The notebook serves the purpose of discussing any topic all together in order to debate it. The text from this notebook will be analysed and then certain keywords will be calculated by using the TF-IDF (Term Frequency-inverse document frequency) algorithm. For the sake of efficiency, the text is analysed only in a randomly chosen subset of 1/4 of all the revisions and modifications of the text along time (the history of the document). The collected texts through this project are treated following the pipeline shown above in the previous figure. Mainly it is a process of "cleaning" the texts by removing "stop words,"1 making every word lower case, removing punctuation and accents etc. After this process, a brief summary of the text, no matter how long the text is, will result in a collection of ten keywords, which then can be rearranged in terms of priority/agreement.

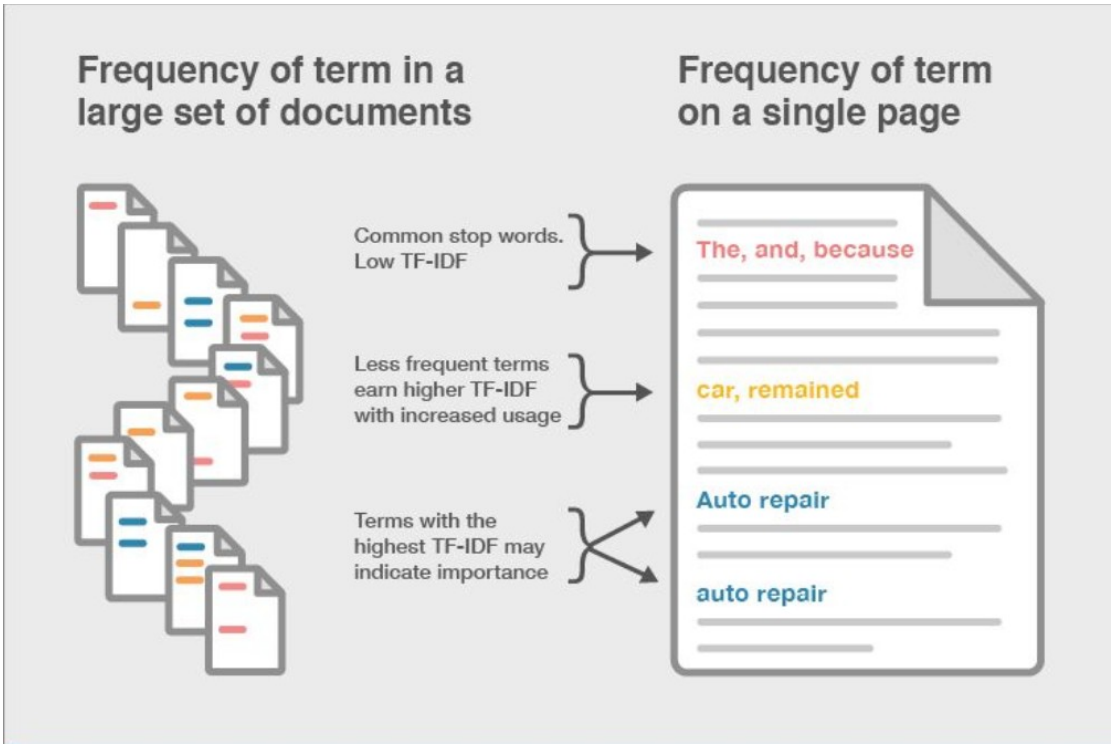

Figure 38"What Is TF-IDF and Why It's Important for SEO Case Study - TM Blast," November 6, 2018. https://www.tmblast.com/blog/seo/what-and-why-is-tf-idf-important-for-seo/.

This is a very simple but efficient strategy to get a machine generated summary of the texts exposed by participants, which bring a "bag of words" to start playing with each other and get a bit more human arrange composition of what will be the outcome keywords, concepts or just plain words.

Another level of the word arranging is a voting grid, in which the words can be moved into different spaces to denote agreement, disagreement or if the words are irrelevant or important.

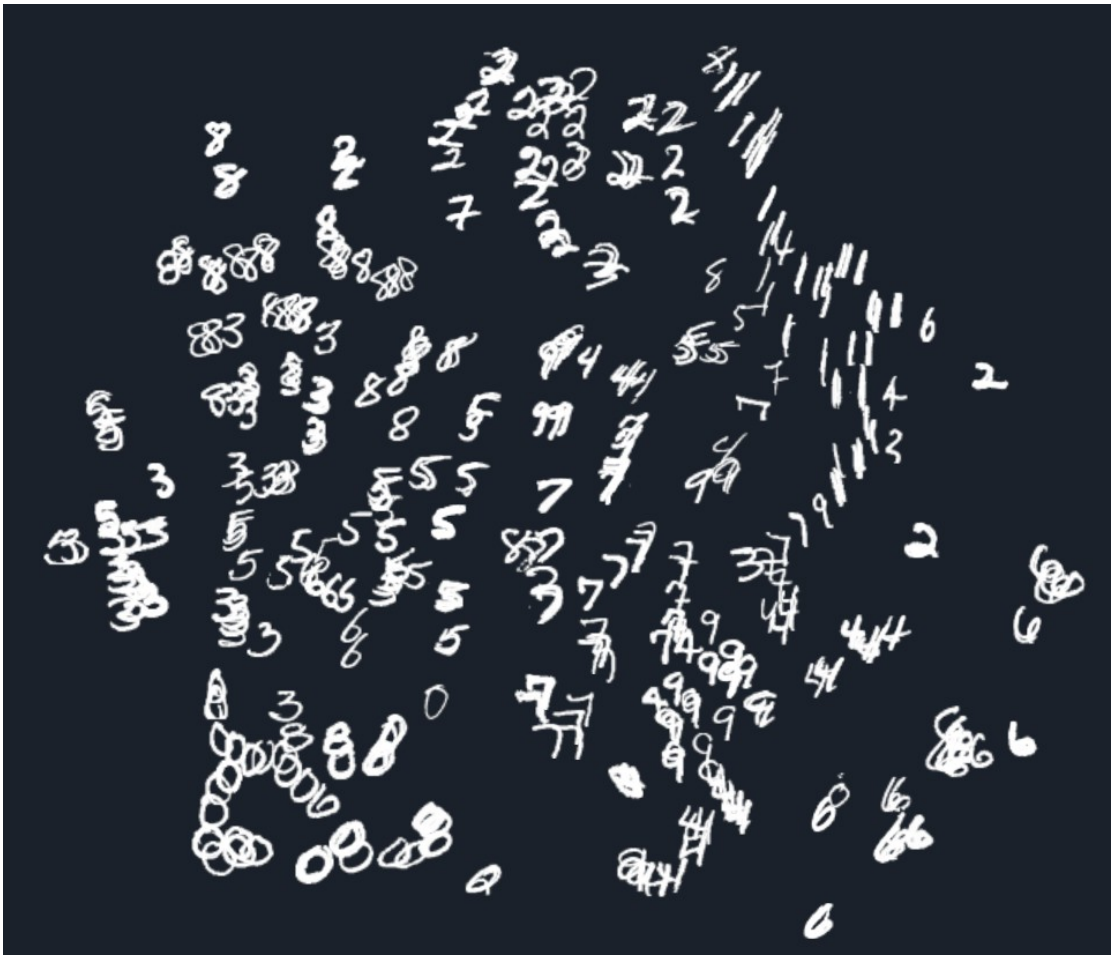

Figure 39 “T-SNE.Js.” Accessed December 30, 2020. https://scienceai.github.io/tsne-js/.

10.1.5 Visualizing

The t-distributed stochastic neighbor embedding(t-SNE) is an algorithm to reduce multiple dimensions to just three, two or even one. It is used to create clusters of information in order to visualize patterns.[96] To do so, it uses several iterations over the representations of the points in the dimensional spaces, over each iteration cluster are refined if the analytic parameters are suitable.

This technology is combined with NLP by using Word2vec, the representation of words into vectors, a list of numbers. Word2vec uses artificial intelligence models to analyze the properties of words, creating categories and values out of

those categories creating in this way a vector representing each word. To be able to analyze the output of word2vec, t-SNE is used to create visualizations that then will be used for computational and human analysis.[97] For example, how to calculate the differences and similarities of "king" and "queen" is very much used when learning about Word2vec:

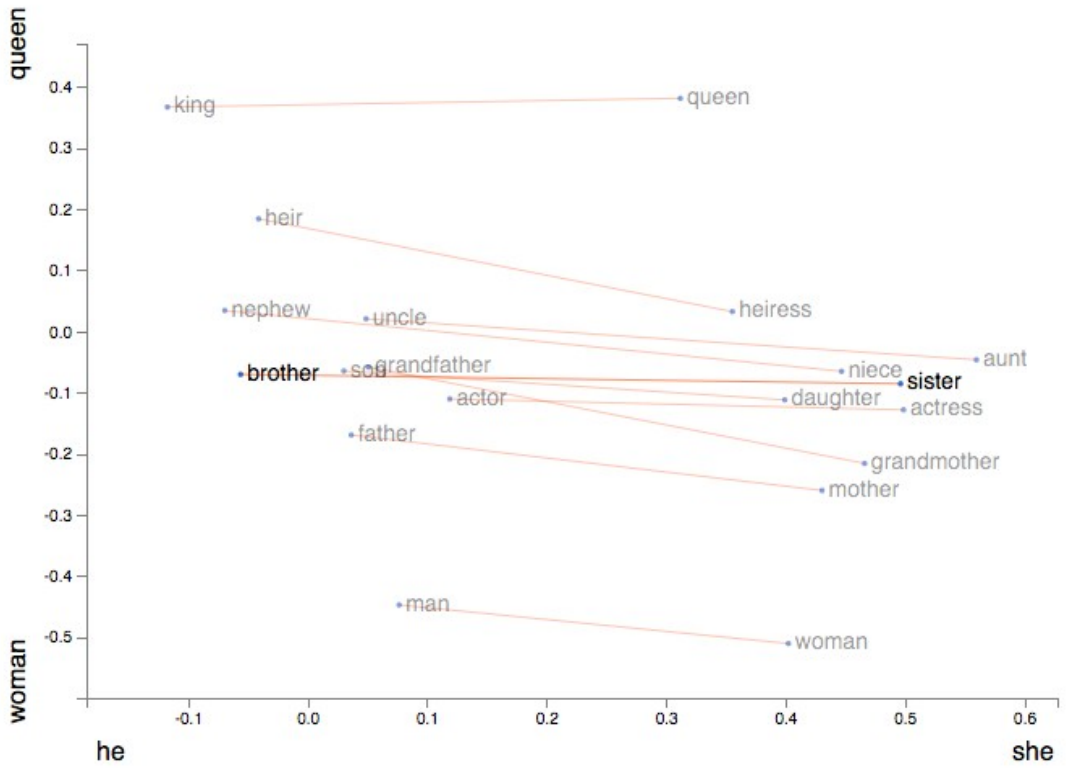

Figure 40 Piotr Migdał - blog. "King - Man + Woman Is Queen; but Why?," January 6, 2017. https://p.migdal.pl/2017/01/06/king-man-woman-queen-why.html.

What Word2vec does, is calculating average values of certain words in relation to others, and t-SNE reducing the multidimensional to a simple represenrational space.

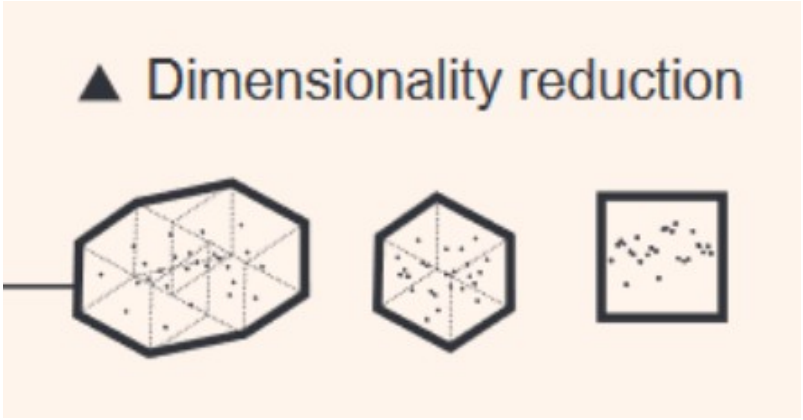

Figure 41 The Nooscope Manifested: AI as Instrument of Knowledge Extractivism. Accessed December 30, 2020. http://nooscope.ai/.

The process of dimensionality reduction over iterations where you can see how clusters are built, and the potential that Word2vec has to find out similarities inspired very much the creation of this project visualization tool.

As explained before, the proof is an artistic representation of consensus. The visualization shows what are the positionings, after writing about certain topics and the impressions from this writing, after moving the pieces into different areas of agreement, by keeping the traces. With a simple glance at the generated composition the viewer can extract a lot of information about the feelings of the participants towards certain words or make a subconscious reflection on the curious movements of the word pieces into different directions.

The movements are subject to the control of the collective, every participant can move the pieces in a way that no position is definitive unless it's not changed by other user anymore. Every movement of the pieces is registered and then translated into a path from which, besides the grid, can help further appreciate how the history of each piece moves in relation to the voting areas. When an area will be 'scratched', when users move a lot some word pieces around some area and the trace that those leave make it look , then it will most probably mean people had more that preference for each keyword.

As the culmination of the process, the visualization can be useful to get an image of how much agreement has been achieved and from where to extract valuable information.

By the words extracted from a collective generated text, we can generate a potentially valuable representation of the relations between the words itself, the people that wrote them and perhaps even between their relations to each other.

As Mark Lombardi's work suggests,[98] where he links the power relations diagrammatically in order to show who was involved in which different topics the reasons for this and the deals that take place. Visualisations can imply important connections, and such this is the role of the visualisation in this project.

10.1.6 Experiences and workshops

In the process of developing this project there have been several experiences and experiments, some of them made individually and others collaboratively in the form of feedback, co-creation, events like workshops, lectures or exhibition presentations. A summary of the extracted information and how the project evolved with it, is following in this section.

10.1.6.1 Naming collaboratively

Together for the Social Design lecture conducted by Anne Nigten, focused on collaborative projects regarding public spaces and collaborative art practices, who was guest professor in 2020 at Interfaces Cultures department at the University of Art and Design, Linz, Austria a prototype was developed, to create

a playable experiment, in order to get some input from fellow students, to propose names for an upcoming collective exhibition title to be part Ars Electronica Festival 2020 University campus.

As I was already developing this project and attending the lecture, Professor Nigten, proposed that perhaps it would be a nice idea to try out some kind of game and discuss different possibilities for the name of the exhibition.

The first idea imagined was a type of puzzle, also perhaps a crossword game, or even a labyrinth. At the end, an idea that could gather previous games logics, could be a Tetris-like game, without the row combination disappearing and with no points system.

Figure 42 "*IdeaBoardz - Annepz.*" *Accessed June 8, 2020.* https://ideaboardz.com/for/annepz/3122786.

In this regard, I started some experiments with the texts proposed by the exhibition participants as source of input to then play the game together. In analysing the texts, some keywords were extracted and transformed into randomized Tetris pieces. Once the page was loaded, the Tetris-like game activated using gravity it could be played combining the different words and

shapes in order to get either more complex words, build sentences, or create new words. After a brief experimentation with the texts and playground, the students would select some of the combinations. The selected words were transcribed to a board tool, which then was used to generate a verbal discussion, and finally a voting to which the favourite words will be taken as the results of the experience. Those were the words presented as possible exhibition names.

Because of the pressing dates schedule, there were many flaws on the interaction and some features from the application could not be implemented.

As conclusion from this experience, text analysis was a great facilitator to invite people to participate in the process, but anyway should not be restricted only to create keywords just programmatically. Text input was made by uploading text files which was not so handy in terms responsiveness, some formats were not supported, when uploading from a mobile phone it would be better to also offer a just type/paste text field to be submitted manually.

The game was initially planned as collaborative and presented on the same screen, but this would not have been possible to develop in time. This was compensated for by manually transcribing the results to the board, a very simple tool, IdeaBoardz.com[99] was discovered as a great tool to summarize the game combinations. The board was very nice to have to close the cycle with some discussion over the outcomes, being able to edit them and finally voting after some time.

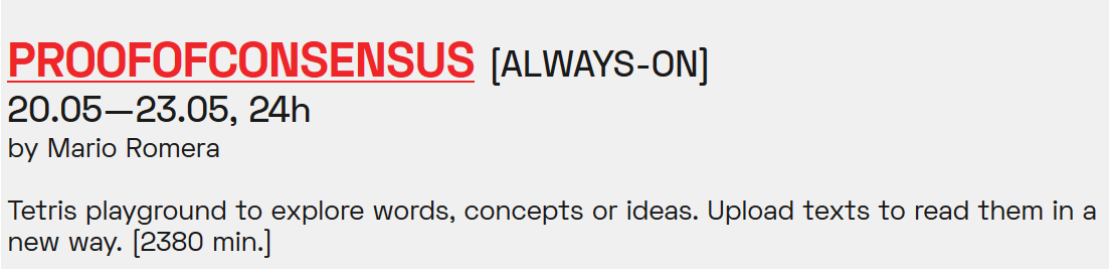

Figure 43: "AMRO20>PATIO." Accessed June 9, 2020. https://gateway.radical-openness.org/patio.html.

10.1.6.2 Enliving

Art Meet Radical Openness (AMRO) Festival 2020,[100] is a regular event that presents a critical perspective on art and technology, and this event offered a more realistic experience to show the project. It took place, not just as an interactive art piece but as an enlivening link part of the festival simulation section "Patio", where people could hang out and enjoy the different entertaining projects. This experience was interesting for the sake of testing the application in a more public environment of people accessing it and interacting with it without so much information about it, and therefore, it revealed some flaws on the design, especially concerning the accuracy of results and how the user experience was. Not only which programmatic errors occurred, but also which new words were shaped and how easy it was to understand the interaction flow. That missing information was very valuable in learning how to improve certain things for next experiences.

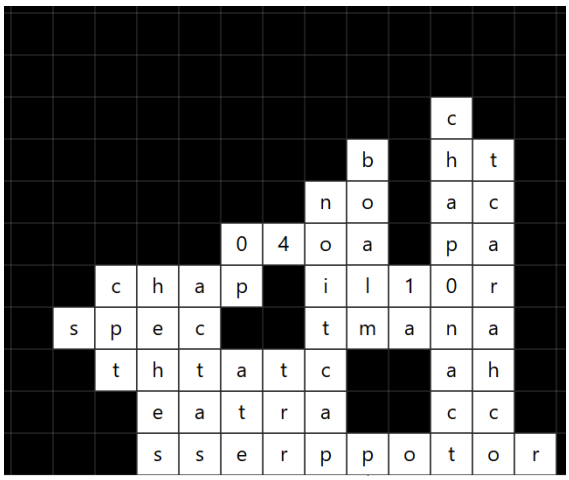

Figure 44: Second prototype of the application

10.1.6.3 Hackers & Designers Summer Academy 2020

In Hackers and Designers Summer Academy 2020, I got the opportunity to for the first time, to try the other side of the Proof of Consensus project, the workshop. By disassembling all parts of the projects into pieces, I got a set of tools each of them belonging to a different world of alternative technologies which conceptually point different ways of communicating and organizing collectives.

Even I prepared a detailed "Script", where all information about the protocols were and the instructions to get started with the concepts and code. Due to the fact that it had to be virtual, the challenge change a bit the course of the experience. To be able to meet, we used a tool called Jitsi,[101] a videocall sevice that works peer to peer and that can be customize and hosted on private servers from which the connections can be established.

It was a very nice coincidence because in the background, Jitsy is using a protocol that I was going to talk about in the workshop, WebRTC. Even if this was a good opportunity to link the workshop with everyday life use cases, the paradigm of communicating and specially documenting the workshop through Jitsy was not so successful. Suggested by the organization, we used a Jitsy server allocated in a close institution to the organization called WAAG, a cultural association using technology for social change.[102]

It was nice to get to know this institution by using their services, but the problem this time was the configuration of the privacy options that Jitsy offers. We had some difficulties for documenting and communicating, it was not possible to record the video called from the Jitsy instance and we could not kick out anybody joining, not that we did not want. After several tries with connection difficulties, some "ghosts": open sessions without anybody behind

them remained in the meetings and as I believe, were also slowing down the connection.

From the beginning we used certain tools to make the documentation and organisation accessible, for everyone to consult, edit, and share, those ones prove to be more stable and useful. The tool used for this in the end was Etherpad, already mentioned above, which even with its limitations, saved the day, allow some input from participants, and perhaps more importantly, to document it. Here is an example of some of the answers and conversations concepts we talked about:

- Eventual consistency
- Disagreement/Resistance
- Work on decisions as a group
- Direct participation

The results of the workshop can be seen in the next figure, the outcome of which fulfilled the concepts and discourses that the participants showed in the topics that came out.

Figure 45: Outcome of the workshop.

After the first introductory session during which consisted of introducing each user to each other, the interests such as the topics shown above and a brief explanation of the protocols that would be used, we started working on drafting some ideas about the topics we extracted from the discussion. Also we tried a very basic example that I proposed as a boilerplate to get an idea of the possibilities of the tools from the project framework. By the second session, we got some ideas and some very fast drafting on what we agreed could be fun to do, including a group synchronizing application in which everyone should try to imagine/count with the mind how long seconds took. From this we developed a first prototype.

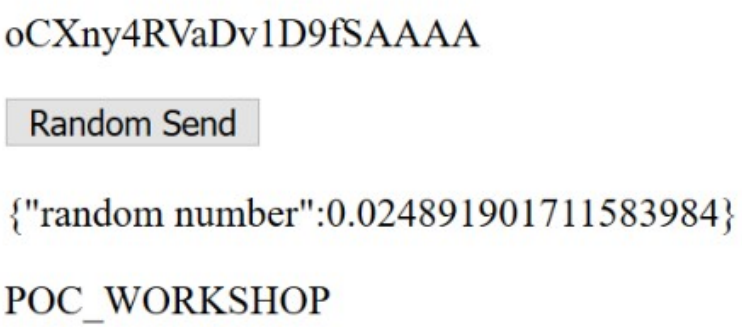

Figure 46: First prototype to get to know the protocols.

Up until this point we collaborated simply by talking to each other in the video call, writing on Etherpad, and sharing resources on it. To further increase the level of participation, I proposed to use Gitlab[103] a Web-based life cycle tool that provides a Git-repository manager and more. I created a repository hosted on Servus.at (a cultural initiative in the city of Linz, which provides several services in relation to cultural and political movements), but it was difficult to collaborate like in a normal software development (with branches and pull requests) just for some days with a very limited time. After some experimentation, we switched using CodeSandbox.io, which is an online code editor and prototyping tool that makes creating and sharing Web apps faster,[104] in which some of the participants developed the layout of the application. In the meantime, one of the participants and I focussed on developing other

functionalities, like visualizing the network of peers connected to each other, the ones that submitted a guess and how accurate the guess was.

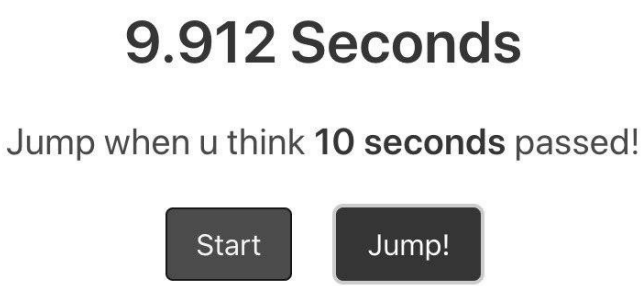

Figure 47 First prototype design by one participant.

By the end of the summer academy, we had a design and some clear functionalities developed by each of us in Hypertext Markup Language(HTML), Cascading Style Sheets(CSS) and Javascript programming language.

My role as organizer was to collect the input, efforts and participation and put this all together into an outcome, so I built another consensus interface with the ideas discussed and develop collaboratively, and the result was a rather humorous application to try to synchronize people jumping at the same time together.

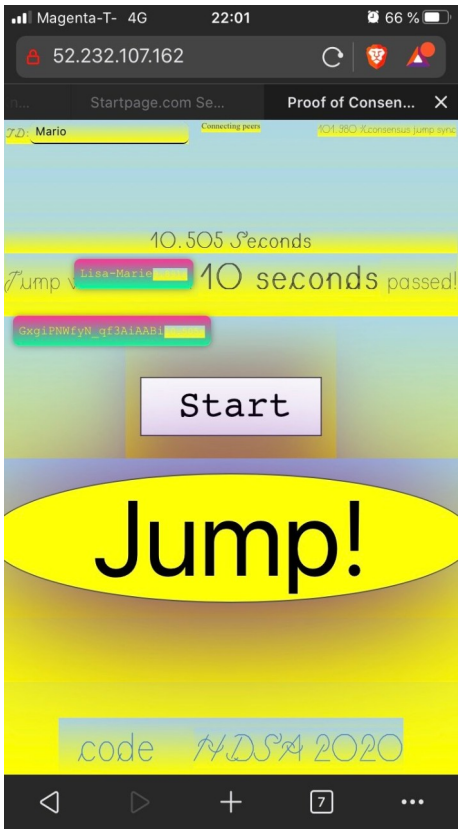

Figure 48: Final result of the workshop shown in a smartphone screen.

Figure 49: mobMess installation diagram.

10.2 mobMess

The mobMess project is a social interface dedicated to reveal the capabilities of mobile technologies for participatory art. Motivated by the increasing use of social networks, mail and communications via smart devices, such as smartphones. We are constantly and rapidly adapting to new interfaces, new languages and forms of communication and new digital realities and this project focussed on the void of reflection and understanding of these technologies and what we can use them for.

Here the concept of a pixel was used to represent an individual within a social group. With this in mind, the aim of mobMess is to create a collaborative communication tool. The interactive installation invites visitors who carry a smartphone with them to participate together in this context. While most daily interaction with mobile phones can be considered as a form of isolation in front

of a screen, this project aims to reverse this phenomenon of self-absorption and merging each participators' screen into part of a collectively merged screen that displays a combination of text and image.

Thanks to new Web protocols, users can connect through the browser to a server which then replicates to all clients in a very fast and efficient way, almost in real time. This fast synchronisation makes it possible to split up and send messages to many devices simultaneously. The messages are encoded into binary code, using black and white instead of zero and one. The server then assigns a number to each connected device and by this, the users know how to arrange the phones, in accordance to the grid to be able to synchronize and show the messages properly. In other variations, it would be possible to make aspects of this interaction more playful.

The purpose of this project is the re-identification of members which are present at the same time at the same location. Technology can make us detached from our surroundings but here it can connect us and create synergy. Through a simple interaction, you can transform your smartphone screen into one pixel and synchronize it with other participants to create a collective display, gathering to render a message, as a team effort and reflecting upon others in the same time and space, a mirror of a crowd of individuals emerges.

The aim is to have a medium interface from which a concept can transform and scale up or down in uncanny performances. Making a tool to expose the power that underlays in technology, communication and art.

The installation is a phone matrix composed by 35 phones, a minimum disposition to be able to show all alphanumeric characters, which is 5×7. The screens of the phones are synchronized to become a pixel of a grid as if it would

be LEDs blinking on and off to display a message, character by character. This message in the installation is inserted into a queue by users, that connects to the installation wirelessly to a local network to their phones.

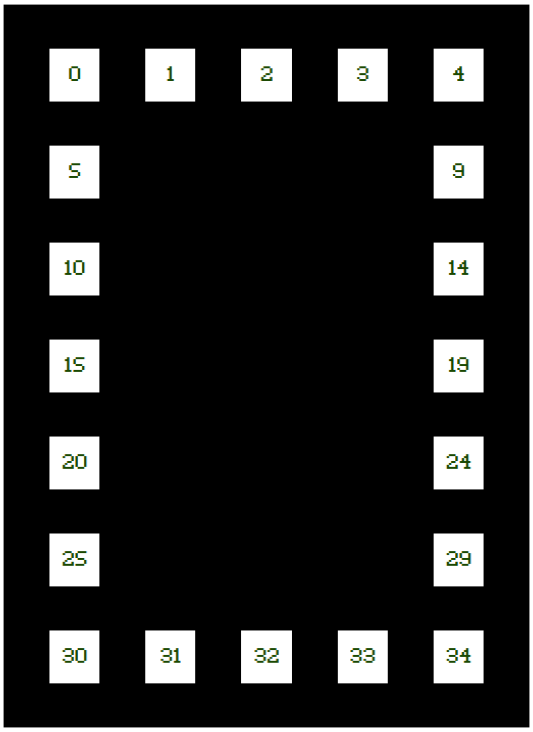

Figure 50: Example to try out how the installation worked. “MobMess.” Accessed March 22, 2020. http://marioromera.xyz/mobMess/.

Within this project I learned the basics of web technologies(WebSockets, HTML, JS, CSS), networking concepts and technologies, routers advance usage (local area networks, access point configuration, IP management), how to create a captive portal, use a Raspberry Pi as web server, etc. Which allowed me to develop further in my professional and artistic career. Also calling for help in order to collect the phones was a great experience. The project was realised thanks to the help of friends and family and their contributions old phones, some of which were broken and repairing them, was also a very educational experience.

11. Conclusion

This thesis presented an overview of very complex topics and in the process of researching, producing and presenting this research, an immense amount of new information worth studying more thoroughly was discovered, but due to the limitations and purpose inherent to this investigation, this can be considered a first step into the complexity of topics treated.

11.1 Answers

To answer the first question raised:

1. *What is this the role of technology we want?*

Information technology is compromising the sovereignty of nations and putting economies, societies and the environment at risk. In this regard, a lot of criticism has been made and there are already processes to address such topics in regards to technology, to preserve user rights and protect against the biases shown by many technological improvements. Still the organisational processes inherent in democratic states, mean that often regulations arrive later than expected, and therefore are never able to follow new risks that arise. As Floridi suggested in *The Fight for Digital Sovereignty: What It Is, and Why It Matters, Especially for the EU*,[105] the answer seems to be, no.

To answer the second question,

2.C*an we make an analogy between distributed computing and democratic processes?*

The cost of automating consensus cannot be directly translated into democratic processes, as sentient entities, we humans have not the only purpose of making the system to work. We cannot assume the same level of participation and collaboration in different times, and spaces and we cannot follow the same deterministic principle that is applied to machines, "receiving the same Inputs in the same order will arrive at the same State having generated the same Outputs"[106]

That said, it is still interesting to translate logical strategies from algorithms that are proven to work in case of failure, fault tolerance. In democracy it would mean re-evaluating how the representation and voting systems are designed. An example, is what we can learn from the CAP Theorem, its impossible to achieve the next guarantees *Consistency, Availability and Partition tolerance.* According to that, systems must be designed considering its vulnerabilities, including things such as network failure for computers or dissensus for democracy. Partition tolerance is inherent to any decentralized system such as the internet[107] or shown by Floridi, a nation states networked confederation[108]. Consistency, can be achieved for democracy and we could in fact switch to using quadratic voting instead of plurality, where citizens could vote more freely but concerned in order to make their votes more efficient. Availability could also mean increasing the usage of e-participation towards direct democracy, opening motions to be reviewed and voted on directly by a larger sum of skilled citizens[109]

Third question,

3. *Can art address the political lag with technology?*

If we were to look at the artwork *WINWIN*, which was inspired by the PAXOS algorithm, or *CultureStake* which uses quadratic voting on top of the blockchain, it is easy to imagine a new type of democracy in which a more direct participation can be implemented in the future. In my personal project Proof of Consensus, algorithms are used for information retrieval to ease the decision-making making playful the process of debating and visualizing the gestures of the participants, some of the qualities most discussed in the latest developments of democracy and its digitalization.

Even if only speculatively, the answer here is yes.

11.2 The role of technology

As in one interview with James Bryan Graves, co-creator of WINWIN, asking him myself, about what the role of the algorithms are, he told me that there are always dangers inherent to the technology it is used. In the case of WINWIN, the role of the algorithm stays behind any possible Bias, by just using logic branching of decisions, if true or if false.[110] A more delicate matter would be using artificial intelligence as mediator, or even as Bryan Graves proposes, an AI participant/s in the voting process. Regarding AI as a mediator, or a more intelligent consensus algorithm, there are a lot of exceptions, based on bias, but humans are also of course highly biased. This topic is often debated in regards to the usage of algorithms and how much bias can compromise an application,

questions will it be entirely relative to the designers and the chosen data to be used on top, or able to transcend this.

The role of technology acts differently for art and politics. In the case of politics, it seems to resist new methods proposed by technology, or perhaps it is more a matter of convenience by the establishment and economic balance, not to make improvements in the decision-making processes currently used society. The only tools presented here, are all built on open source code, mostly developed by virtual communities, associated with companies that are hybrid public (open) and private, seeking profit from donations and the community to keep the work sustainable. The fight for technical sovereignty must go in the direction of building the necessary interfaces for social purposes, including opinion and decision making.

In terms of art, and more specifically new media art. There is the problem of banality regarding innovation, the technology because of the technology. Artworks of new media art can be conceived only by its innovative technical appliance. As Luhman wrote in terms of the medium and style: "*The distinctions employed by artworks, the "against what?" of their manner, were subjected to the pressure of innovation.*"[111] Art suffers also from the technological race fostered by Big Tech companies, but at the same time, it can lead not only to technical-artistic challenges, but to realize the emptiness and banality of technology without a human and social purpose.

11.3 Personal Results

By doing this research and project production, I gathered a lot of insights into how collaboration, especially digital collaboration, can be achieved along with what are the more interesting tools to use for this and what is the best way of

documenting the process. Also, I learned a significant amount of new knowledge regarding how to overcome communication problems and experience in deploying and delivering the generated content, along with how to present and apply to different institutions that are previously unknown to me. I got a lot feedback on how to improve for next projects, how to design, adjust the format and timing of the interactions, the technical restrictions, the target audience, and the type of exhibition spaces that can be used. This research also introduced me to a lot of very interesting books, technologies, concepts and artists and I even have the luck to meet and interview some of them. The new media art world revealed itself to me, and at the end of this research, it seems more open to me and my practice. I discover that there are many interesting open calls for exhibitions, residencies, workshops, scholarships and research positions. I feel more prepared after this learning process to try to live economically from art and the different combinations that exist to do it.

In the process of learning and practicing new media art, I also gained expertise on the field of information technologies and this combined with my newly established professional practice, to allow me not have to depend on economical support, making me less anxious in the process, about showing my results, rather now I look for longer terms and I can appreciate slower times, long sighted projects and enjoy more the path.

11.3.1 Improvements

In contrast to the results, there are many things I learned that I have to improve. Some of these things were already known to me, but still could not be realised better. In relation to the projects, some examples are clean code, tests, better architecture and implementations, etc. The time dedicated to the design of the interfaces and the general aesthetics, seemed to always be lagging behind the

technical implementation. This lag was due to my technical skills limitations, which by trying to achieve the challenges of the protocols and understanding the algorithms took longer than expected. Perhaps in this sense is the lack of capturing the attention when the projects were exhibited, could be improved by adding better visuals and more seductive processes. It is hard to think about these topics having in mind that the interaction should be reflective and conscious of the algorithmic processes but still necessary.

The documentation of the work is also behind of its potential, both the media recordings of the works and the user experience documentation, due to the constraints of the technologies used. Due to the missing documentation, post produced materials where the information is very attractive and synthesised well is rather impossible to realise, or is another project on itself. This also close the doors for the project to reach more opportunities in open calls for exhibitions, residencies, festivals, etc.

In terms of the academic value of this work, I believe could have been answer better, with more examples and more elaborated theory. Some chapters are weaker than others and I can tell there are conceptual gaps, that perhaps with more references and time to process them could be better filled. Say that it is a new topic with new tech and a limited time to research but also that the speculative nature of pragmatical collaborative projects is they need time to evolve and this research may prove to be more valuable in the future.

I am sure there is room for improvement in every single step that I took by doing this research, in my art projects and my life in relation to both. I am also certain that most of the missing pieces are also related to the circumstances, and in this sense, I can only try to improve them creating better times and spaces in the future, I think I have already some ideas, and I am sure more will appear also to be improved in different ways.

11.3.2 Future projects

After the results obtained and the reflection on those, in relation to my art practice, two branches appear to me as paths to follow in my future projects. One of these is to create more serious projects that are dedicated to learn and get involved on some of the computer science and data science skills that I started with this project and the other consists of making more artistic interfaces in the shapes of mini-games or very simple interactive installations which target collaborative practices of very immediate results.

These two topics can be more explicitly projected as:

- Social interfaces to allow users to interact with new technologies and big data and learn about the political potential and raise awareness and critical thinking towards them.

- Creative interactive visualisations which explore the relation between social aesthetics and technology.

As my process in this research was trying to merge both points, I think now I would rather focus on separating them in different projects, in order to explore them with more academic rigour. Perhaps after conquering all the challenges from both, then mix them again, but in the development process, try to keep separated lines of work.

Because the most fun part of doing this project was the collaborative and pragmatic nature of the artistic production and developing such projects together with other people, I think I will also continue this collective experimentation and workshops methods.

I also would like to keep researching in some of the questions that raised in this work, either academically, perhaps a doctorate, or to be applied as an artist creating new projects and exhibit them in galleries, festivals, cultural centres and museums. I would like to keep my research about society, technology, politics and the relations in between. The formulas that exists, and discover new ones through art practice, creating concepts, artworks and events to promote art in the previous domains.

12. Table of Figures

Figure 50: Example to try out how the installation worked. “MobMess.” Accessed March 22, 2020. http://marioromera.xyz/mobMess/..... 80

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