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Women and men in technology: an alternative historical proposal for equals



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DOI: 10.34626 / 2184-9978_2021_1_007 Abstract. Pioneers in programming from the 19th to the 20th century, women were also responsible for the creation of ARPANET (Advanced Research Projects Agency Network), one of the projects that gave rise to the Web. However, their role is usually absent from STEM official narrative, either in educational or media context. This work aims to reveal hidden aspects of women in technology at two crucial moments: the 60s (return of men to the labor market) and the 80s (influence of advertising and behavior shaped by capitalist consumption). More specifically, it intends to identify specific key aspects that were pivotal in the construction of today's invisibility of women's role in tech from the majority of persons. Based on ethnographic work with the online communities of women in technology, this study, while also resourcing to Alternative History, explores how a better historical knowledge of female IT accomplishements and communities could have determined present-day equal pay and professional opportunities in the area. Through counterfactual/factual historical discussion, we conclude that if they had not been emptied socially, politically, historically and economically in the 80s within IT and STEM context as pioneers, the fourth wave of feminism and women's rights would faced an altogether more positive scenario at present.

Keywords: Technology; Feminism; History; Communication; Alternative History; Storytelling.

1. Introduction

The 80s was the woman decade according to UN, which developed many events and projects to empower women at work and study [1]. Many female NGOs emerged to enable women with technical, political and health formation, works and group discussions, such as AnitaB.org1, Women in Technology International (WITI)2 and Linux-Chix³ (a community for women who like Linux, free software and to support inclusion in computing). These initiatives started decreasing or disappearing due to patriarchy efforts, according to published research, especially in technology, such as Women's Wire (the first online community and tech company for women), as a consequence of women becoming apart from tech; in fact, 1984 is considered the year women began to be forced out of programming. One-decade earlier, boys and men started to become closer to tech education and devices such as game consoles [2]. However, if women in tech communities had continuously growing, it is a reasonable hypothesis they could have become an outstanding empowerment place to include women in STEM (Science, Technology, Engineering, Mathematics), to engage entrepreneurship initiatives and raise awareness about IT from the hidden historical role models, for instance.

To understand why there is a need for female technological communities since the launch of the Web as a fundamental milestone, it is necessary to understand the origins and past of the History of Technology. Patriarchy has deliberately promoted, over the past few decades, an effort to erase women who have done more than contribute to scien-

1 https://anitab.org

2 https://witi.com

3 https://www.linuxchix.org/content/about-linuxchix

tific advances, but who have changed the direction of humanity from their discoveries. School education, in turn, did not incorporate this knowledge to several generations of the past. Currently, there is an effort, led mainly by these communities, to rescue and assimilate these leaders historically.

It is not possible to define in time a specific point on the Web where these communication systems of women activists in Technology groups emerged all over the world. The leaders and volunteers could be geographically dispersed but shared same interests. The leaders are formed by women who have completed a degree in a STEM career (Science, Technology, Engineering and Mathematics) or in courses offered by technological female groups, companies and institutions for a career transition in IT. These leaders, young and adult, also shared relevant professional experiences and managed to occupy prominent positions in companies, not necessarily translated into the most important positions. These women leaders are usually common people who made relevant tech contributions at work and researching IT [3]. They also tend to be female representatives in teams and, for these and other reasons, they feel the need to help themselves and women who, like them, suffered prejudices, resistance and difficulties to start and stay in studies and professional careers. The leaders are, in general, group founders, women who established rules for coexistence and entry of volunteers and new members, as well as the internal and external communication system of communication and what type of information should be produced, according to the collective profile and objectives [4].

The female technological collective volunteers are, in general, women who participated in a series of face-to-face and online events of these groups, benefited by their actions (from academic and professional updating, to scholarships, net-

working to make projects and business, for example) and were aligned by community work to the point of offering their professional workforce. According to Manuel Castells, the greater awareness and struggle of women for equal rights to men, for the control of their bodies and lives, is an inexorable process due to:

- 1 The transformation of the economy and the labor market related to opportunities for women in the field of education;
- 2 The collapse of patriarchalism due to economic and technological changes;
- 3 The extraordinary increase in the number of grassroots organizations, mostly created and run by women, in the metropolitan areas of developing countries, impacting policies and institutions, but also in the emergence of a new collective identity, in the form of empowered women;
- 4 Self-construction of identity is not the expression of an essence, but an affirmation of power by which women are mobilized to change how they are to how they want to be. To claim an identity is to build power [5].

NGOs and women tend to express themselves more openly, in digital networks, because they feel more protected in electronic media [5]. The sum of these virtual expressions would represent a great opportunity for reversing traditional power games in communication processes.

This study aims to present and deepen aspects raised in an oral presentation at the 2nd International Meeting of 'What if? ...' World History, organized by the Casa Comum of the Rectorate of the University of Porto in November 2020. It departs with a review regarding the History that illuminates and helps to understand technological development, especially regarding the emergence of the Web and the whole computational revolu-

tion, namely of the creation of new technological devices, while also presenting the new expressed online collective relations and activism, for example. However, to understand its methodological approach, it is important to contextualize the development of this work, as well as relevance. The work is part of the doctoral research study under development in a doctoral consortium at the University of Aveiro and University of Porto since 2018 [6]. Within that context, we accepted the challenge proposed at the 2nd International Meeting of 'What if? ... 'World History event and in this article to further deepen the historical perspective when talking about the achievements and characteristics of the emergence of women dedicated to studies and work in Information Technology. More specifically, we intend to identify key aspects that, if taken an historical divergence turn, would have changed the perception of women role in technology and tech development.

For this, it was necessary to address the chronological context since the first IT role models, such as Ada Lovelace, which emerged in the 19th century, and other female exponents in IT, which were fundamental to the economic, political, social, behavioral and cultural evolution that occurred since the 20th century [7]. This deepening of doctoral research to historical facts and characters adds to another challenge in this study: pointing out which of them, especially in the 60s and 80s, were fundamental for the empowerment of women in IT and, from an Alternative History perspective, to probe whether if there had not been the extinction and weakening of female communities (mainly linked to technology), women could not have been dominated by patriarchy, alienated from this job market and this scientific domain. This work aims to resource to Alternative History (AH), namely by indicating the key divergent moments in the 60s, and especially the 80s, and/or events that could allow for constructing divergent

historical timelines where present-day female IT communities could have equal pay and professional opportunities in this field.

2. Materials and Methods

The abovementioned doctoral research intends to develop a theoretical communicational model that allows the framing and understanding of the communicational phenomenon of Portuguese and Brazilian feminist technological activism (FT), mediated by communities on digital platforms. The main question the research aims to answer is this: How does the human-computer study, related to female technology communities and the impact of transmedia storytelling, contribute to the collective activism?

Though this work is part of the interpretive paradigm and qualitative naturereserach, it nevertheless but incorporates quantitative data. The Methodology chosen for this investigation was Projetual, which will follow the precepts of Grounded Theory and Etnography. In particular, the Research Methods and techniques developed within those precepts are: Observer Participation in more than 50 tech an community events, such as WebSummit; Case Studies analysis from women in tech Brazilian and Portuguese communities; focus group,; and data from more than 20 interviews.

To analyze contexts of formation and development, as well as classify the different types of groups or women in technology, it is part of this investigation to consider historical facts without which it would be impossible to understand the intentions, resolutions and paths used by individuals and collectives. There is an association of this historical perspective parallel to the study of feminist movements, something that can be taken a step further with AH [8-11].

Moreover, this study, as well as the doctoral research in which it is enrolled, analyzes and relates social, economic, historical and technological aspects of technological feminism, whose object of organizational, interactional and communicational analysis are women in technology and female communities in Brazilian and Portuguese IT context. For this work, it can be briefly mentioned that the Luso-Brazilian women's technology groups were chosen not only because they share the same language, but because they emerged and developed with greater emphasis in the same period, in the last twelve years, with communicational and similar organizational (such as the coverage in terms of members), so the preliminary results of the investigation point out.

The investigation intends to map the Portuguese and Brazilian female technological collective activism, from the communicational and interactional study of digital platforms used by leaders, volunteers and target audiences. In the bibliographical survey, it was verified the presence of Brazilian research which analyze feminism in IT with an emphasis on the maker and hacker culture and free software [12, 13], theoretical relationship on cyberfeminism with feminist practices of empowerment, education and technological inclusion in the labor market, in communities and in the Academy [14-18].

For the specific purpose of this work, AH [11] is one of the methods of investigation, as it can be used with the objective of specificy and illuminating the details related to the exclusion of historical feminine moments and characters in technology. In fact, AH can be defined by "narratives that articulate imaginative variations, which function as representations of a historical experience or memory constructions". Furthemore, resourcing to AH, this work can address which were the situations and events occurring in the new counterfactual narratives, in a fictional tone, versus the historical events, that might have impeded this patriarchal rule. To achieve this objective, two tables were constructed, the first

displaying the main historical events related to the broad theme of women in technology, namely the most notable role models and the impact of their work in STEM. The second table approaches, as an intelectual exercise, a series of divergent historical events versus the factual counterparts, and how this alterantive historical possibilities could contribute to present-day female inclusion in technology and tech environments. Discussion regarding the factual and counterfactual data ensued in order to explore and determine these past contexts of formation and development.

3. Women in Tech – History timeline and the Alternative Historical Perspective

3.1 Reviewing the Past: Women as IT role models

When we try to conceptualize what a woman in technology is, it is fundamental to contextualize what it is to be a woman in each historical period. The world's first programmer of a computer-equivalent system and machinery in the world was a woman [19]. In the 19th century Ada Lovelace invented an algorithm for an analytical number-calculating machine considered the first operation similar to a computer program. Her life story is very amazing and uncommon for a lady at that time. Daughter of the poet Lord Byron and an elite family mother who was a huge fan of Mathematic studies, Ada grew up learning the quintessence of the world of numbers and words.

"As a young mathematician in Victorian England, she met Charles Babbage, the inventor who was trying to create an Analytical Engine. The Engine was a steampunk precursor to the modern computer: Though designed to be made of metal gears, it could execute loops and store data in memory. More even than Babbage, Lovelace grasped the enormous potential of computers. She understood that because they could modify

their own instructions and memory, they could be far more than rote calculators. To prove it, Lovelace wrote what is often regarded as the first computer program in history, an algorithm that the Analytical Engine could use to calculate the Bernoulli sequence of numbers" [20].

Unfortunately, Ada Lovelace died at 36 without the recognition of her genius, as evidenced in the letters that she left which described her vision of Babbage's invention, the full potential of operations and calculations which could become valuable information for humanity.

Feminist causes that emerged after the Industrial Revolution were specially linked to social causes (civil, labor and voting rights) until the middle of the 20th century [21, 22]. The democratization of the Internet and the emergence of a networked society, from the end of the 20th century onwards, provoked an unprecedented technological and communicational revolution. They profoundly marked the evolution of feminism, the presence women in universities and in the labor market, in addition to the close relationship established with digital platforms and Information Technologies (IT).

The most favorable historical context for women to enter technology was World War II [23]. At the time when men were summoned to the front, there was a shortage of qualified labor to assist in the development of calculations for ballistic projections by land and air, as well as territorial advances by squadrons. New technological devices with computational functions were emerging and there were not enough people to operate them and train people to do so. The abundance of job opportunities in technology brought character to the less prestigious professional segment during the war. There was a mix of demand for intelligence in programming and calculation, associated with mechanical operations carried out in this machinery. Accustomed to not finding job openings in all economic sectors, women

saw IT as a chance to experience what it means to earn their own wages, to have an academic and professional career without social, cultural and behavioral resistance. To the surprise of men and women, they exceed expectations. Thanks to the female role in World War II and the victory of the Allies, they become the first coders in the 50's.

The first programmable digital computer in the US, the ENIAC (The Electronic Numerical Integrator and Computer) was a more than 30-ton behemoth made of 20,000 vacuum tubes and 70,000 resistors. As such, programming it, i.e., figuring out how to issue instructions to the machine, seemed menial, even secretarial. Since women had long been involved in the scut work of doing calculations [24], when ENIAC came around, the men in charge considered that its programming seemed to be similar enough to menial punch-card work, and therefore they happily hired women to be the ENIAC's first programmers. Indeed, the first ENIAC programmer team was all-female: Kathleen McNulty, Betty Jennings, Elizabeth Snyder, Marlyn Wescoff, Frances Bilas, and Ruth Lichterman, known later as the "ENIAC Girls. Coding had quickly become a rare white-collar professional field in which women could thrive". Another amazing woman as a tech role model of that period is Grace Murray Hopper. She was the third person and the first woman to program Harvard Mark I, an IBM computer used during war. She obtained a doctorate in mathematics and even joined the Navy [25, 26]. During the World War II, Grace Hopper was a Navy reservist sent to MIT to write programs for Mark I, the first electromechanical computer, which solved ballistic issues, and later on, due to this work, she started a computer scientist career developing programs for other computers. Grace Hopper worked in the first commercial computer project, UNIVAC (UNIVersal Automatic Computer), and developed COBOL (Common Business Oriented Language) programming language. However, her greatest innovation occurred in 1952, when she released her most know invent, the Compiler, which transformed a language into binary code. Computing and programming are still based in binary code.

Hobsbawm [27] attributed the entry of mass married women into the labor market and universities as one of the fundamental chicks for the emergence of several feminist movements from the 1960s onwards. Women had already won civil rights in several countries, such as voting, and began to claim for other causes, such as the right to abortion, the prevention of pregnancy, a broader and unrestricted exercise of femininity. In fact, in 1967, Cosmopolitan magazine published an article called "The Computer Girls" [28]. According to Thompson, the issue mentioned women "were doing 'a whole new kind of work for women 'in the age of big, dazzling computers, teaching the miracle machines what to do and how to do it". Computer programming was a real professional path to female workforce. However, the number of women working as IT developers had started decreasing [29].

The next culture of IT developers was called the "hackers", people who called themselves ethical vigilantes in favor of a culture of the code, less attached to the scientific universe, and paradoxically born by students of artificial intelligence laboratory at MIT (USA) [30]. At the same time, the programmer's career was being consolidated as promising in managerial terms since, as computers became more popular, they began to be adopted in companies to fulfill tasks of greater internal and external complexity. Men held these leadership positions in corporate technology, as IT wages had also become attractive, positions that would naturally have been reserved for women in previous decades. Despite the hostile environment, Margaret Hamilton became one of the most important IT role models (not merely

a female role model), so much so that the designation 'Software Engineering' was created by her [31]. She led the MIT team in the development of Apollo Guidance Computer, used by astronauts in the command module and also in the lunar module, to navigate and control the ship.

According to Wajcman, one of the most important tech feminism researchers in the world, technologies have a masculine image because they incorporate symbols, metaphors and values that have masculine connotations [32]. As a science, the language itself gives technology, its symbolism, and masculinity. It is not just a matter of acquiring skills, because those skills are incorporated into a culture of masculinity that is largely contrary to the culture of technology. Therefore, to enter this world, to learn its language, women must first abandon their femininity [32]. Almost in parallel to these development of hacker culture, the United Nations (UN) chose 1975 as the International Women Year [33]. The objectives established for the first event were to define a society in which women can fully participate in the economic, social and political aspects of their countries. To mark the International Women Year, a World Conference was held in Mexico, where a World Action Plan was assigned to implement two objectives of the International Women Year, proposed as a central question during the 80 s, the Women Decade according to UN. In 1985 the closing conference of Women Decade was in Nairóbi. This conference demanded two specific tasks: to review the progress achieved in the obstacles encountered during the Decade and to adopt a coherent set of Prospective Strategies for the advancement of women at the year 2000 [33]. Various feminists and feminist non-governmental organizations participated in the event.

The 80 s were marked by the consumerist expansion of capitalism. Acquiring some expensive services, such as technological ones, guarantees

the consumer a status in a way that they will relate and be professionally gratified. Publicity expanded immensely during this decade and has been extensively explored by large technology companies, such as Apple and Microsoft, as it reinforces this and another stereotype: acquisition of personal computers as professional rise [34, 35]. Personal computers were an ocean that teenagers found easy to navigate. The computer companies very much encouraged it. Indeed, most of those early '80s computers arrived with a manual explaining, step-by-step, how to write BASIC programs. The computers also had a decent ability to display graphics and play musical notes, which made them particularly suited for crafting simple computer games, which led that, for the first time, programmers were emerging in living rooms, as teenagers, propelled by the culture of making, acquiring, and sharing software. But given that the video-game scene was primarily one of boys, it began to make coding culture ever more male. A reference work on technological feminism, Jane Abbate, reinforces the last four decades gender and technology have been shaped and modified [36]. According to the researcher, engaged as technical specialists since the beginning of digital computing, women are inventing careers and professional identities, at the same time as the field itself took shape, i.e., their stories illustrate power. Notwithstanding, by the 80s, women as historical actors were widely neglected in the history of science and technology, and one of the main projects of academic feminism was to restore women's contributions.

In particular, one of the greatest historical injustices is that patriarchy has deliberately made efforts to erase female participation in a project that is considered the mother of the Web. The ARPANET (Advanced Research Projects Agency Network) was funded by USA Department of Defense's Advanced Research Projects

Agency [37, 38]. To understand the importance of this project, in a simple manner, before the ARPANET data transfer from one computer to another was done by punched cards or a roll of magnetic tape and, in fact, the ARPANET was a military computer network which is considered the precursor of the World Wide Web, since it was similar to a search engine like Google (powered by algorithms).

"The ARPANET's earliest users were its builders: mathematicians, computer scientists, and engineers at places like MIT; Carnegie Mellon; UCLA; Northern California, Berkeley, Stanford, and the Stanford Research Institute in Menlo Park. These people all contributed to designing the early Internet, suggesting new protocols, fixing bugs, and adding features as they went. Because the military and the highest degrees of academic computer science were so male dominated, it stands to reason that all these people, the first users of the Internet, were college-educated men. Except, of course, they weren't. They were women" [39].

Among them, Elizabeth Feinler impacted the IT field as she shared information, resources, directories to other developers by phone and mail. Furthermore, another woman, Radia Perlmand worked in three protocol enabling modern networking and the Internet launching. She was in charge of more than 100 tech patents. Radia designed the spanning tree algorithm that transformed Ethernet from the original limited-scalability, single-wire CSMA/CD, into a protocol that can handle large clouds. Later, she brushed it up by designing TRILL (Transparent Interconnection of Lots of Links), which allows Ethernet to make optimal use of bandwidth.

This brief review of the many female role models in the IT field that are not a household name, and probably should be, cannot be complete without mentioning Stacy Horn, the percursor of web social media. She used to meet and connect people, communities and forums by The WELL (The Whole Earth Lectronic Link, an internet network based in California). In 1990, she decided to create a new network in her apartment at New York called Echo (East Coast Hang-Out), where people talked about movies, culture, events.

In Table 1, the summary of the most important aspects and historical moments of these women, for the purposes of this work, are displayed.

Table 1. Women in tech timeline - disruptive innovations in History

Date/Women	Innovation	Social, IT and/or STEM consequences
1833 /ADA LOVELACE	First programmer in the world.	Brought new perspectives for scientific and work domains for men and women.
1943 – 1946/ ENIAC AND THE SIX WOMEN PROGRAMMERS IN WORLD WAR II	The ENIAC was programmed due to these women efforts: Jean Bartik, Marlyn Meltzer, Ruth Lichterman Teitelbaum, Kay Antonelli, Frances Spence, France Holberton.	Press media credited its success to a male colleague and it was the beginning of vanishing women in tech from History.

Date/Women	Innovation	Social, IT and/or STEM consequences
1952 GRACE HOPPER	In 1952 she released her most known invention, the Compiler, which transformed a language into binary code.	Computing and programming are still based in binary code.
1956 - 1962 - EVELYN GRANVILLE AND THE AEROSPACIAL EXPLORATION	She worked at NASA and IBM on spacial missions such as Apollo and Mercury projects.	Her work was an inspiration for new spacial missions.
1958 - MARY KELLER - PhD in COMPUTER SCIENCE AND BASIC INVENTOR	Sister Mary Keller was the first woman to earn a computer science PhD and also BASIC (Beginner's All- purpose Symbolic Instruction Code) programming language inventor.	BASIC was very important to make programming popular and accessible.
1972 - ELIZABETH FEINLER AND THE ARPANET (INTERNET BEGGINING)	She was one of the scientists responsible for ARPANET.	The ARPANET is considered the precursor of the World Wide Web. She shared information, resources, directories to other developers by phone and mail.
1985 - RADIA PERLMAN - MOTHER OF THE INTERNET	She wrote an algorithm that enabled more devices to connect to each other working (among other pre-steps for the development of the Internet).	This online network was very similar to the World Wide Web, released for everybody in the world one decade later.
1990 - STACY HORN AND ECHO (SOCIAL MEDIA PRECURSOR)	In 1990, created a new network called Echo (East Coast Hang-Out), where people talked about movies, culture, events.	It is considered similar to social media such as Twitter and Facebook.

3.2 Women and IT: Identifying the key aspects for an Alternative History Chronology

After having surveyed the key moments in the IT field where women had a fundamental, and at present erased, role, we now explore how the contemporary estrangement between women, IT and STEM could have been avoided. To do so, we cross-reference historical events, an alternative historical divergence and proposal, and the social effects that such divergence could have . The summary of this transversal approach is displayed in Table 2.

As it can be seen above, we consider that there are three key moments that could have altered

the present day of vanished female role in the History of the IT and Tech field development, the Industrial revolution, World War II, and the 80's. If there had been an incorporation of the emergence of programming in the sufragist movement, it is likely that women could have had more job opportunities in the industrial technology field in the transition between the 19th and 20th centuries. As Ada Lovelace was a social figure of some relevance, due to being the daughter of already acclaimed poet Lord Byron, it could have fostered that acceptance. Women already were socially accepted as fit for secretarial work and if the emerging technology was perceived as such, the transition could have ensued.

Table 2. Women in tech and feminism History: Reality and an Alternative History proposal

Period	Historical Events	Alternative Historical Divergence	Social effects impact
XIX - XX transition (Industrial Revolution)	Emergence of Programming (Ada Lovelace and Charles Babbage) and Feminist movement (suffragist).	Technology could be incorporated to the feminist causes by the suffragists.	Technology was an elite scientific domain. If it was part of the suffragist movement, women could have more job opportunities in the beginning of the XX century.
World War II	Women entrance in Technology due to men being in war fields: many tech female role models came up. The started learning and operating by themselves computer machines used during war such as Marc I and ENIAC. Women participation was fundamental for the Allies victory. After the war women in tech goals were vanished by patriarchy (men need to occupy new jobs when returned home).	Women in tech communities beginning with this female role models in Academia and work. They could share among themselves all knowledge accumulated during war and educate new generations of women. However, feminist causes were not interested about tech, but to sexual liberation and other social and work freedom.	If women in tech communities emerged in the end of World War II, women could be not rapidly vanished from History, society and work in computing and programming. Tech could be a possibility of female empowerment and independence in the next decades.
The 80 's: the Women Decade according to United Nations	This conference demanded two specific tasks: to review the progress achieved in the obstacles encountered during the Decade and to adopt a coherent set of Prospective Strategies for the advancement of women at the year 2000. Various feminists and feminist non-governmental organizations participated in the event.	If these communities could bring together tech female role models in their social causes perhaps they could stop patriarchy occupation in computing, games and programming jobs and studies.	Tech discoveries - such as ARPANET and Radia Perlman 's spanning tree algorithm - which revolutionize society, economy, culture, politics in the next decades (due to the fact were the principle of the World Wide Web project) could be widely communicated and inspire new female generations in education and work.

Another distinct historical moment was the female entrance in technology during World War II, something caused by the men being in the battlefields. Their role in learning and operating computer machines, such as Marc I and ENIAC, proved fundamental for the Allies victory. If they could have had a follow up in pursuing these interests, if not at factories and the general working encironment, at least at academic level in a systematic manner, they could have developed tech communities. These communities could have departed from admiration of the female role models during the WWII. They could share among themselves all knowledge accumulated during war and educate new generations of women. However, feminist causes were not interested about tech, but with sexual liberation and other social and work freedoms. Therefore, the adoption of the tech emergence as a feminist cause could have impeded the vanishment of female pioneering programmers from History textbooks and social awareness during the fifties and the sixties.

Finally, another historical aspect that could have allowed to fight the vanishment of the female role in IT and tech development would be the extensive acknowledgment, during the eighties, of the importance and reach of the tech discoveries and developments made by women, such as in the case of the ARPANET. If the United Nations conference and consequent strategies and initiatives had focused tech female role models in their social causes perhaps they could stop patriarchy occupation in computing, games and programming jobs and studies. Furthermore, Radia Perlman's spanning tree algorithm - which revolutionize society, economy, culture, politics in the next decades (due to the fact were the principle of the World Wide Web project) could be widely communicated and inspire new female generations in education and work.

4. How to induce present day 'historical' divergence in IT context?

The Web emergence and expansion has given voice to other groups of women that the traditional feminist movement has not been able to represent, such as women from peripheral countries. The Internet has redefined notions, tools and strategies for resistance and female activism. Online feminism has made women's discourse more visible, public and representative through digital media. Information Technologies (IT) expanded the possibilities of communication between women and transformed gender relations [40].

Cyberfeminism is the result of the fourth feminist wave, marked by the emergence and expansion of the Web, the network society, the creation and democratization of access to new devices and computer programs, online communities and digital platforms for interaction and communication between people all over the world [41-44]. It is an aspect of technological feminism marked by optimism in the theoretical perspective about the technology impact to empower women and transform gender relations.

Emerging techno-feminism envisions a mutually shaping relationship between gender and technology, in which technology is both the source and consequence of gender relations. In other words, we can imagine that gender relations materialize in technology, and that in turn masculinity and femininity acquire their meaning and character through their integration into working machines. Such an approach shares a conception of technology as a sociotechnical network, and recognizes the need to integrate the material, discursive and social elements of techno-scientific practice. The relationship between social analysis and social transformation projects is what makes the fundamental difference between conventional technoscience studies and techno-feminism [45, 46].

5. Conclusions

Comprised between the 1960s and 1980s, the Second Feminist Wave corresponded to the intellectual movement of liberal humanism and is concerned with the emancipation of women from patriarchal structures, against the oppression of women. It includes liberal feminism, radical feminism and black feminism among others. It fought the exploitation of women for their sex and reproductive functions, reproductive rights and the free expression of sexuality and criticism of capitalist society. Feminism would be part of an emancipatory project against gender injustices linked to struggles against racism, imperialism, homophobia and class domination. The aim was not only to vastly expand the number of activists, but also to transform common sense views on family, work and dignity. The Second Feminist Wave is also marked by the rise of radical feminists and the theory of patriarchy [47].

The first feminist theories around technology were found in radical feminism with a libertarian tendency, the core of the problem for libertarians was the oppression of women in relation to men that resides in biological issues, considering the liberating potential of technologies for women, of their reproductive and domestic responsibilities, theorize about home automation and reproductive technology, conceived as neutral, exploring the sex-gender relationship. In the wake of scientific and historical developments, feminists of technology emerged who framed it within a liberal feminist tradition. Liberal feminists considered the problem of the underrepresentation of women in technologies in the unequal access to education and technological employment, in addition to the invisibility of the role of women in its development and, therefore, in the consequent masculinized image of technology.

The Third Feminist Wave appeared between the late 1980s and early 1990s, with a focus on valuing multiplicity and difference in sex, gender, sexuality, politics, ethics, language, bodies. It contests the definitions of femininity from the previous wave, based on the experiences of intellectualized white women. The concept of intersectional feminism arises, which considers the difference of gender, race and social class. One of the main concepts of technological feminism emerged in the same decade. Donna Haraway releases "Manifest for Cyborgs" in 1985 [48], a work that becomes a turning point for the emergence and evolution of a post-feminist period of technology. The cyborg is a cybernetic organism, resulting hybrid of machine and organism, a creature of social reality and fiction, implies the collapse of pre-established binary relations (nature / culture; human / machine; subject / object; man / woman) and, therefore, it produces a releasing effect.

Haraway believes that technology is central to everyday life: that is why the idea of conceiving ourselves as cyborgs and using this conceptualization to transform power relations is useful, especially when it comes to science and technology. Cyborg images can help to reject an unscientific metaphysics, a demonology of technology. This was one of the first positive and optimistic perspectives on the relationship of women in technology to emerge from technological feminism. The cyborg metaphor has still been widely adopted in technology studies, cultural studies and gender studies and was a major influence in the emergence of cyberfeminism in the 1990s.

The Fourth Feminist Wave is known as online feminism, or cyberactivism, in the context of this investigation this is the most relevant feminist movement, as it is the origin of the main trend of feminism to be addressed in the analysis of women's collectives in technology. It is characterized by the use of digital platforms to organize, articulate and spread the idea that gender equality is still an illusion. Information and communication technologies started to be used to challenge misogyny, sexism, LGBT phobia, inequalities and gender violence.

As demonstrated in this work, from the exposure of some of the most important facts and events in the History of Technology related to actions made by women, it was found that: the female presence in IT occurred sparsely until the mid-40s, with World War II, because of the need for manpower to operate computers that emerged, as well as to train programmers to reinforce combat. Until then, technology was considered an area of knowledge and work compared to the work of a secretary, mechanic, and without having aroused male interest. With the end of the war, the economy of the winning and losing countries needed to be heated up. It was necessary to absorb the male manpower of the war.

Parallel to this, there were promising discoveries in technology, such as the space race and its tests from the 50s. In the 60s, technology was predominantly male, and this presence was mirrored, for example, in the Cultural Industry in products such as the series of Star Treck. Feminist movements, since the first wave of suffrage, have elected causes considered emergency in the historical contexts in which they developed: from the right to vote and better working conditions, to the right to abortion and reproduction, civil rights such as divorce, greater access to education and university. As feminist achievements were consolidated, new fronts of struggle emerged. The most emblematic, from the 1980s onwards with greater emphasis from the 20th to the 21st century transition, was cyberfeminism. The emergence of the Web provided, through the advent of digital platforms and unlimited connections as referred to in this work. the experience of the use of technology by women, especially computers, smartphones.

However, the Alternative History to the official one proposed in this work, suggests that if the articulation in communities had taken place since the first feminist wave in an increasingly orderly manner, it could have dynamized and anticipated the struggle for more spaces in technology; it would not have been necessary to wait for the transition to another century in order to consolidate the presence of women in professional positions in IT. World War II was a time when female role models emerged with greater emphasis (in number. including black women) on technology, as mentioned earlier. It was proposed that these women, who achieved important achievements in the same historical period and country (United States), could have collectively articulated actions. This fictional initiative could find resonance with feminists, who did not consider technology a relevant domain in terms of the struggle for representation.

Another proposed moment that could change the direction of official history would be in the 80s, the Women's decade according to the UN, at the Nairobi conference where several women's collectives participated in the closing of activities and proposed actions for the next ten years, they could have embraced technology with greater emphasis on female empowerment in society and work.

This alternative and fictional proposal gains weight and coherence if we confront the real effectiveness of the results of the emergence and growth of women's communities in technology, starting in the United States in the late 1980s, with greater emphasis on the emergence of the Web for reasons and contexts exposed in this work. If Technology were a cause to be embraced in the Second or Third Feminist Wave, as other struggles were won and consolidated by the articulators of these movements, most likely today there would be no effort in the Academy, by journalists and in social media rescue content of female role models in IT, as well as the inclusion, empowerment and education of women in technology advocated and catalyzed by communities.

6. Round Table Insight

As mentioned before, this study was presented in a 2nd International Meeting of 'What if? ...' World History Oral Presentation Round Table. The other researcher who presented her work, Cristina Garrido (UNED Spain), "The World without Punk Women", discussed some of the most important punk feminism concepts and role models, such as Patti Smith. We would like to point out one aspect that has a direct relation to the already mentioned PhD research: cyberpunk and cyberfeminism. Both started been studied in the transition of last century mostly due to the Web launch. Cyberpunk feminism [49] shares the same optimism of cyberfeminists with technology since the 90 s and agreed about the end of the boundaries between body and machine, engaging a larger relationship with gender and sexuality. Technology had become not only a scientific and professional path for women but also a medium to express a new and empowered self.

Between the end of the 90s and the first decade of the 21st century, users' cybernetic behaviors were simple and more restricted, expressed on a few digital platforms and technologies created or supported, in many cases, by information producers (gatekeepers), validated as authorities' content by society. Information sharing followed the flow space in a redundant way and occurred, in the great majority, between the same digital platforms of origin (the producer) and propagation (target audiences).

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