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INTERACTIVE DOCUMENTARY AND DATA VISUALIZATION
New Approaches to Telling Stories with Data

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ABSTRACT

Software development has influenced cultural products for years, and documentaries have not been an exception in this revolution. From non-linear and interactive webdocs to participatory, co-created, and transmedia projects, the documen-tary genre has given rise to diverse narrative structures. We analyze how webdocs have devel-oped different strategies when integrating data visualization into their narratives and interfaces. Multimedia content and data visualizations have been gaining prominence over film, and projects that don't use video have been considered docu-mentaries. This has given rise to what we consider the germ of a new genre and a new set of narrative structures.

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1. Introduction

Documentaries have embraced new technologies. Over the last decade, this genre has established itself as an avant-garde niche of media production (Nash, 2021), especially in terms of experimentation with new formal possibilities. From web-based and transmedia documentaries to virtual and augmented reality narratives (Ryan, 2015), the narrative structures of documentary films have been expanded, diversified, and multiplied thanks to technological advances. Furthermore, the definition of documentary has also radically evolved, particularly since the appearance of the Internet and the World Wide Web.

While initial studies on the documentary genre were focused on linear films that use an omniscient voice to present reality, today this term is used to reference a vast range of artifacts and projects (Gifreu, 2013; Gaudenzi; 2013; Alkarimeh & Boutin, 2018). These include interactive pieces known as i-docs or interactive documentaries. Contemporary definitions consider an interactive documentary to be "any project that starts with an intention to document the real (...) by using digital interactive technology" (Gaudenzi, 2013:32), regardless of the medium or platform used for its creation. Webdocs or webdocumentaries are a subtype of interactive documentary that is developed exclusively for the web (Nash, 2021) while interactive documentaries, at large, can be built on any medium, support, or platform, such as physical installations, tablets, CD-ROMs, and virtual reality environments (Gifreu, 2013; Gaudenzi; 2013; Nash, 2021; Kim, 2022). Although webdocs and interactive documentaries have been used as synonyms on some occasions, as they share many similarities, it should be noted that they do not denote exactly the same type of documentary and technology. Hereby, when we refer to webdoc, we apply the definition provided by Gifreu (2013) and Documentary Network: "a form of documentary conceived specifically for the web (...) navigable and interactive, (...) usually characterized by non-linear narrative (...) and multi-media content" (p.289).

With the great advances in the World Wide Web and its technology, the webdoc has emerged as one of the most prolific forms of interactive documentaries, attracting analysis from multiple and varied perspectives (Gifreu, 2013; Gaudenzi, 2013; Nash, 2021). Initially, it was analyzed from a purely cinematographic angle (Gifreu, 2013:280), as a natural adaptation of the documentary film to the web. However, due to its huge evolution within this new medium, it has been increasingly studied from other points of view (Gifreu, 2013; Gaudenzi; 2013; Nash, 2021; Kim, 2022). The profound influence of the new interaction possibilities on the logic and the message of the documentary; the new role of the audience as an active user — a prosumer instead of just a consumer; and the substantial array of examples that challenged the traditional definition of the documentary as a linear film, led some authors to consider it even a different genre (Gifreu, 2013; Gaudenzi; 2013).

1.1. Documentaries, Interactive Documentaries, and Webdocs

The emergence of webdocs that bear significant similarities with the traditional documentary film, but also important differences, caught the attention of many researchers, who realized that these new documentaries did not only fit into the traditional definition of the genre but implied important changes in its basic concepts. For instance, the omniscient voice of the author is absent in many webdocs, especially if we understand it as the piece of audio that guides linear documentaries, which is considered a basic characteristic of the traditional documentary film. As Gaudenzi (2013) asserts, the non-linear narration proposed by webdocs collides with this authoritative voice, since it allows different itineraries and endings for the narrative, giving the author less control over it, and more power to the user (Gifreu, 2013). In webdocs, users are asked to adopt a much more active role, beyond mere content consumption. Webdocs demand a physical response from their audience, like clicking or commenting, instead of just a cognitive reaction to the author's discourse. Plus, in some cases, users may even become co-authors of the documentary (Gifreu, 2013; Gaudenzi, 2013; Nash, 2021; Kim, 2022).

While the traditional vision of the documentary revolves around the film as a goal, contemporary scholarship tends to understand it more as a process rather than a finite product (Gaudenzi, 2013). This perspective finds its roots in the 1990s when Nichols (1991) decided to address it as a social construct, shifting the focus from the film as the core of documentary practice to the interaction between three elements: the author, the narrative, and the audience or interactor, and becoming a key perspective for current studies. As Gaudenzi (2013) defended, the aim of webdocs and interactive documentaries is not

to present an authoritative point of view on reality, as traditional documentaries do, but to define reality through negotiation and debate between the author and the audience, as suggested by Nichols (1991).

Over the last decades, users have been gaining control over the documentary at different levels and intensities (Gaudenzi, 2013; Gifreu, 2013; Nash, 2021; Kim, 2022). From simple tasks, like selecting which path to follow in a branching narrative, to the possibility of creating content and adding it to open and collaborative documentaries or even deciding on its final result. User interaction and participation possibilities have multiplied, thanks to web technology advances, and they continue to evolve. Beyond the new interaction possibilities, "webdocs also differ from film documentaries by integrating a combination of (...) multimedia assets (photos, text, audio, animation, illustrations, etc.)" (Gifreu, 2013:298), which are usually interactive and sometimes compete with the film or video content. Even though many webdocs use a linear film as their central component, there are plenty of examples that have replaced it with other multimedia content. For instance, Gifreu (2013) and Nash (2021) documented a series of webdocs that use pictures, illustrations, and 3D simulations, while Gaudenzi (2013) highlighted the idea that data visualization can serve as the main content of a webdoc, as demonstrated by Jonathan Harris's We Feel Fine (2006).

1.2. Technical Evolution

There are many different types of webdocs and narrative proposals, and the emergence of these new formats is closely related to software development. Software is the way to materialize them and, in some cases, it is even considered a co-creator of the documentary (Hight, 2017), for instance, in algorithm-based projects. But despite being in a culture where most content is mediated by software, it still has received little attention in academic fields. As Manovich (2011) had pointed out, software studies have remained largely technical for years, and more transdisciplinary literacy is needed: a statement that can be also applied to documentary scholarship. To counteract this, we have focused our study on what Manovich (2011) calls cultural software: a specific type of software that supports (among other processes) the creation of cultural artifacts and interactive cultural experiences, in which the development of new forms of documentary film is included.

Although the interactive documentary has been analyzed and categorized by various authors (Nash, 2021; Gaudenzi, 2013; Gifreu, 2013), only some of the narrative structures and features resulting from this co-evolution of technology and documentary form have been analyzed and systematized (Hight, 2017). Only popular options like "play a site as a movie (and) the default possibilities for navigating through timeline and map interfaces" (p.89) have been studied, and the same goes for the use of data visualization and narrative in webdocs. Although some authors have noticed the existing relationship between interactive documentaries and data visualization (Fallon, 2016; Takahashi, 2017; Nash, 2021; Ocak, 2021), a systematic analysis of this type of project has not yet been carried out.

New software developments had an immense impact on traditional media, and documentary film has not been an exception to this revolution:

> Even in interactive formats (...), the media players for online video have made them impermeable to the wider data richness of the web. With HTML5 this is suddenly changing. Video coded into the webpage enables a dynamic relationship to static and live web data. (...) This allows for new agility in the way that connections can be made between video and other web information sources. (Sághy, 2012, 4-9)

The possibilities opened by HTML5, a new coding standard released in 2014, coincided with the definition of "living documentary" by Gaudenzi (2013), who saw the future of interactive documentaries as "relational objects" or "a nexus of connections" between the video and different sources (p.91). A feature that software previous to HTML5 did not allow. However, despite the capabilities of the new coding languages, the first generation of interactive documentaries really "didn't push the boundaries of documentary form" (Dovey & Rose, 2012:10) and we had to wait a little longer to see what it could mean for the genre.

Over the last decade, the possibility of creating new connections between video and other multimedia content (Yáñez, 2012) has been gaining relevance. For example, to feed data visualizations with open and real-time data sources. Today we consider documentary pieces that don't even use video. Webdocs such as We Feel Fine (2006), Invisible Cities (2010), The Counted(2015), and Yesterday,

Today, Tomorrow (2021) seem to indicate that the webdocs that do not have video are precisely the ones that make the most use of data visualizations. For example, The We Feel Fine (2006) documentary soon became an iconic piece because of its use of blog metadata and data visualization (Dovey & Rose, 2012), which bears more similarities to a software project than a web adaptation of a linear documentary film: no play, pause, or rewind buttons are displayed. Their authors, Kamvar & Harris (2011), also evidenced and explained this idea in We Feel Fine and Searching the Emotional Web, a paper in which they detail the software architecture of what they call 'Experiential Data Visualization', a new class of visualization "which focuses on immersive item-level interactions with data" (p.1). This transmedia project, exhibited in several museums, consists of an interactive documentary, a book, and a traveling exhibition. It offers the user an immersive experience focused on the exploration of feelings on the internet through an innovative display of data.

Of course, not all documentaries that use data visualizations have developed this software architecture or given them the same prominence, but there is a considerable number of them that have opted for similar proposals. Nowadays, more than half of webdocs still use video as their main content but data visualization has been gaining relevance in many pieces (Bradbury & Guadagno, 2020; Ocak, 2021; Takahashi, 2017; Fallon, 2016). In some cases, data visualization became half of the project, an alternative navigation proposal, and even the main content, like the examples we have mentioned above and that we will analyze in the paper.

The adaptation of traditional journalistic genres to the World Wide Web has given rise to an enormous diversity of genres and narrative structures (MIT & MacArthur Foundation, 2015). Among them, we considered having identified the germ of a new one: a type of webdoc that uses data visualization as the central axis of the project, trying to build an interactive and participatory narrative around it. As Hight (2017) has claimed, interactive documentaries are still experimental forms since the technologies with which they are built are still unstable. But there is a series of visual, interactive, and narrative elements that are common to all of them, regardless of the coding language with which they were created. A reason why we consider that these components should be analyzed and studied as part of the new interaction grammar of the documentary genre.

Reviewing how software has allowed the documentary film to evolve is a fundamental step in the development of the genre and its scholarship can't be complete until we consider this software layer (Manovich, 2011). To understand the present of the interactive documentary it is necessary to acknowledge its hybridity, which derives from the remediation and convergence processes to which it has been subjected (Nash, 2021). The new formats and structures resulting from these processes should be understood as "a dialogue between past and future" (Uricchio, 2017 in Nash, 2021:2) and the progressive adaptation of traditional media to the digital realm.

For years, interactive documentaries have been searching and finding new ways to shape all the new elements into coherent experiences, as Dovey and Rose (2012) claimed, creating "a whole new form of visual and informational grammar" (p.18). This is why we consider it important to analyze the different interfaces that have emerged, how traditional genres have adapted, and how data visualization has become an increasingly relevant part of many interactive documentaries.

According to Nash (2021), we believe that interfaces are "the most visible dimension of database voice" (p.24). They are tailored to the content to be displayed, the story to be told, and the user experience to be created. The interface is part of the discourse in interactive documentaries, the author's proposal to experience the living documentary. And there is a new group of interfaces based on data visualization that has not yet been analyzed.

In addition to the most common user interface (UI) components (buttons, menus, lists, charts, filters, tags, etc.) present on any web page, webdocs have developed their own grammar. New resources and structures have been used to build innovative narrative proposals, provide tools for interaction and promote an aesthetic experience (Pold, 2005). Analyzing these existing interfaces will provide essential information to sustain their future (Nash, 2021), understand their history, and create tools that facilitate their construction.

The second and subsequent paragraphs in sections must have 0.5 first line indentation. Text should be single spaced, and spaces should only exist between paragraphs when using block quotes.

2. Methodology

We have inspected the MIT Docubase, IMDb, IDFA DocLab, and National Film Board of Canada repositories looking for all webdocs or web-based interactive documentaries that use data visualizations, performing the following searches:

- **MIT Docubase**. Project filtering was done using the platform's tag system. We have specifically used *Data visualization*, *Interactive Map*, and *Database storytelling* labels, resulting in 55 webdocs that use data visualizations.
- **IDFA DocLab**. We used the search engine to get all the interactive documentaries and manually reviewed the results, obtaining a total of 32 projects that use data visualizations.
- **IMDb**. We used the advanced search option, filtering by the *Documentary genre* and the *Interactive* keyword. Then we manually review the results of this search. In this case, we found 13 projects that use data visualizations, a surprisingly low figure given the size of the repository, clearly focused on linear and non-interactive formats.
- **NFB of Canada**. We used the advanced search to filter for *Interactive* > *Web experience*, manually reviewing the results again. In this case, we found 8 projects.

Taking into account that some projects appeared in several databases, we have located 83 webdocs that use data visualizations at different levels. For the analysis of these projects, we have developed a sheet based on those previously carried out by Segel and Heer (2010), Figueiras (2016), and Hook (2018), incorporating some new sections, that can be checked in the annexes of this paper.

Due to the end of web browser support for Flash in late 2020, some of the projects are no longer available. In these cases, the analysis was carried out based on the available reviews in the repositories, digital magazines and other online publications, YouTube and Vimeo videos, and the Wayback Machine (https://archive.org/). However, some projects could not be analyzed, due to not having found resources nor having been able to obtain images from their authors and the institutions responsible for them.

To analyze the software technologies, we have used the Built With service (https://builtwith.com/) to get the stack of each domain. Plus the technical files of the repositories, publications, and articles. Then we structured our project analysis into three sections:

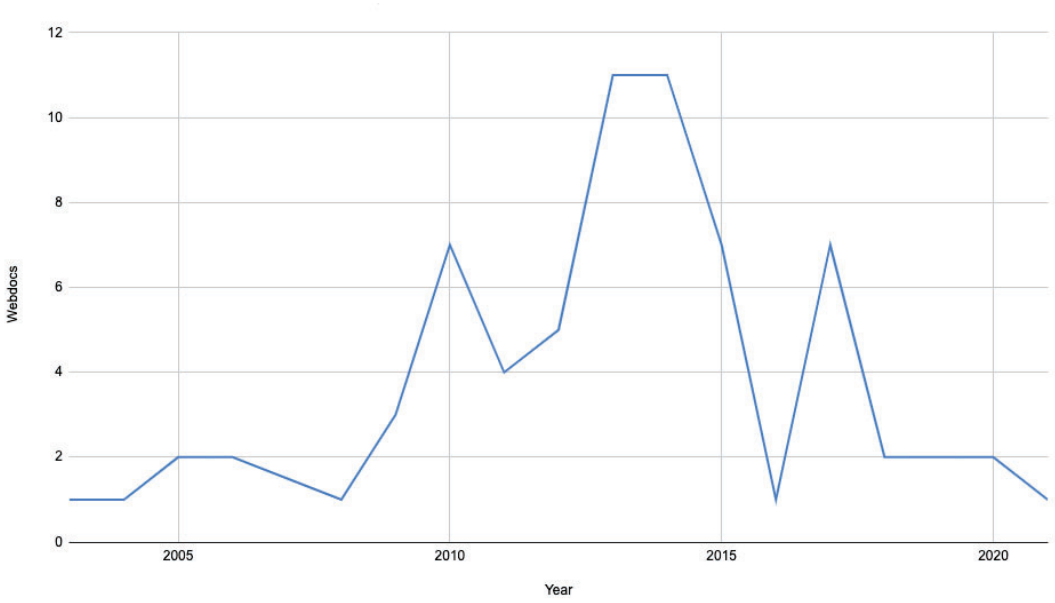
- **Evolution and technology**. We have obtained the software technologies with which the projects have been created in order to analyze their presence and evolution over the last two decades. We have focused on the transition from proprietary technologies such as Flash to open-source coding standards such as HTML5 and JavaScript.
- **Main content and interface**. We have determined the fundamental content of each webdoc, and how the interface and the rest of the content are structured based on that decision. Taking these results into account, we have established a series of categories and defined their fundamental characteristics.
- **Genres**. After analyzing the projects, we have compared our results with the genres and structures identified by Segel and Heer (2010). As a result, we have collected a series of genres that mix data visualization with multimedia content. Some of them had been already identified by them, but new ones have arisen.
- **Narrative structures.** Our analysis of narrative structures has been focused on projects whose main content is data visualization. We have evaluated the narrative structures created around them, and how the different genres are mixed within the projects to create a complete documentary piece.

Finally, we have analyzed the presence of each of the genres and narrative structures for years, to verify if the changes that occurred in the web development languages in that period are related to their appearance.

3. Evolution and Technology

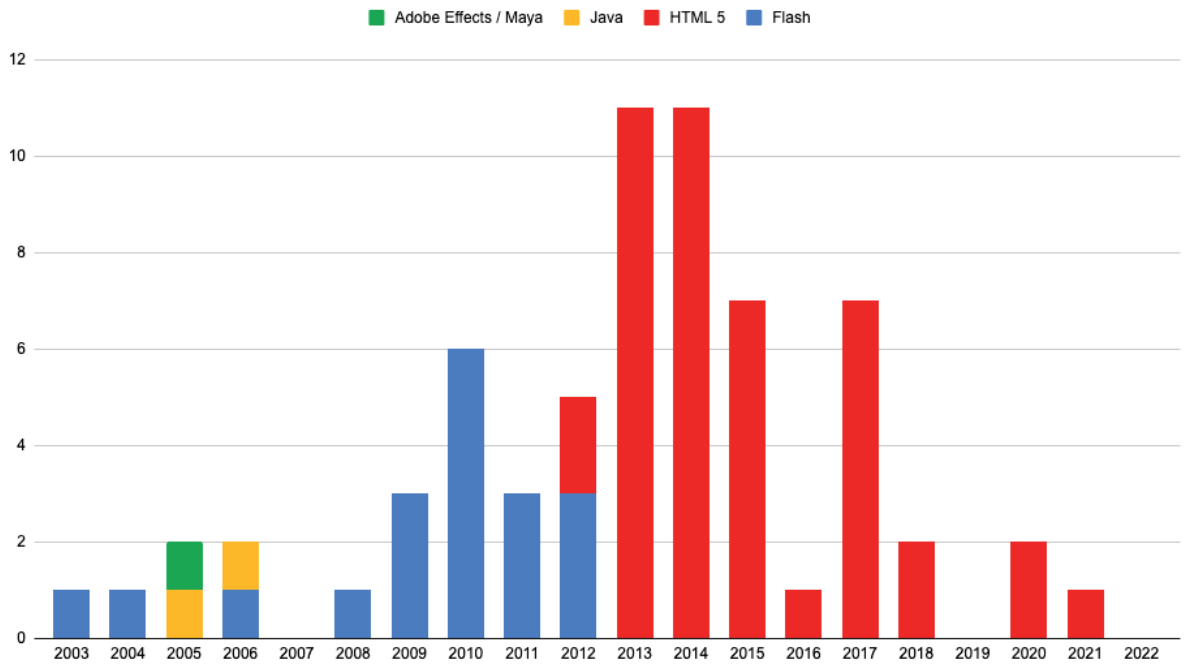
After placing the analyzed projects on a timeline, we have been able to check how the creation of webdocs that use data visualization has varied over the last two decades. 2013, 2014, and 2015 are the years in which more projects of this type have been developed.

Figure 1. Webdocs with data visualization per year.



Furthermore, we have added the basic tech stack of the projects to this graph. We can see how the emergence of the HTML5 coding standard triggered the creation of this type of project around 2014, the year of its official launch, to the detriment of the use of Flash (Bedingfield, 2019) and other proprietary technologies, like Adobe Effects and Java. We have also found some HTML5 projects before the official release, which we believe may have been updated or refactored later, anticipating the end of support for Flash and web browsers in 2020.

Figure 2. Software per year.



The peak in the creation of webdocs that use data visualization was reached during the launch of HTML5 in 2014, and it has been decreasing in the following years, although unevenly. This may be due to two reasons. First, the increasing diversity and complexity of JavaScript (Brown, 2018; Figueiras, 2016), with which data visualization and interactive components in HTML5 projects are usually built. Second, a growing trend towards the creation of virtual reality projects can be seen in the analyzed repositories in recent years, many of them financed by themselves, such as the NFB of Canada.

The huge advances in coding languages in recent years have not only opened up many more creative possibilities but have also complicated their use and the creation of software projects. Nowadays, building a project with these characteristics requires a much more advanced level of coding skills than Flash required a decade ago. Projects have become more of a team effort (MIT & MacArthur Foundation, 2015) than a task that one person can carry out autonomously. Although there may be, of course, exceptions.

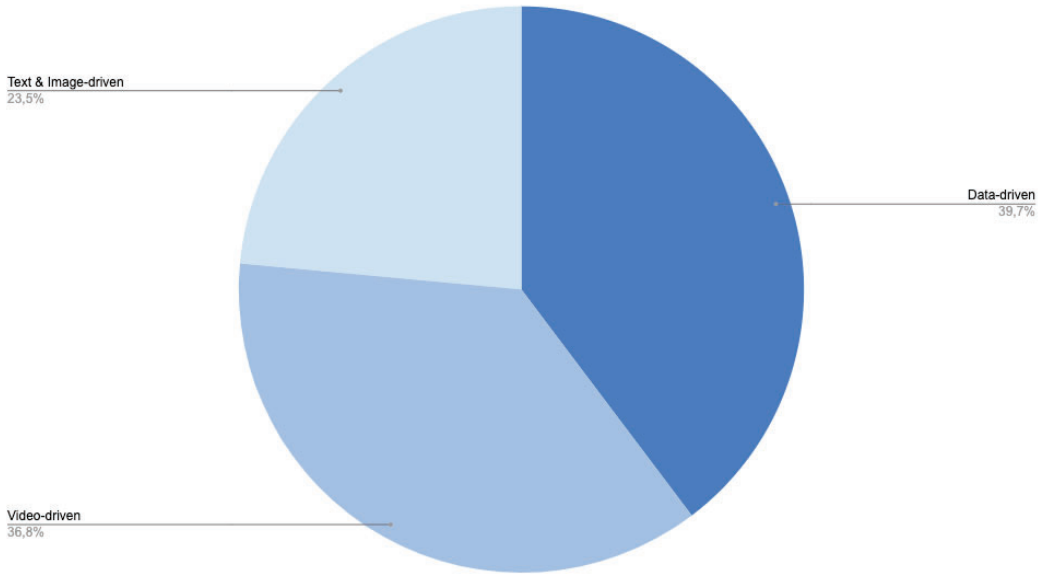
We have identified 74 different software technologies, although most of them are used occasionally in one or two projects. Among them, a wide variety of JavaScript frameworks and libraries stand out, such as Modernizr, Popcorn.js, and Angular.js, being the culminating moment of technological diversification the same year the HTML5 standard was released.

Figure 3. Most used software in webdocs with data visualization.

4. Main Content and Interface

When analyzing the interface or navigation proposal of these projects, we have found that all of them present a specific type of content as the main element of the webdoc while the rest of the project is articulated around it. This main content is usually a video, text and images, or a data visualization.

Figure 4. Type of interface in webdocs with data visualizations.

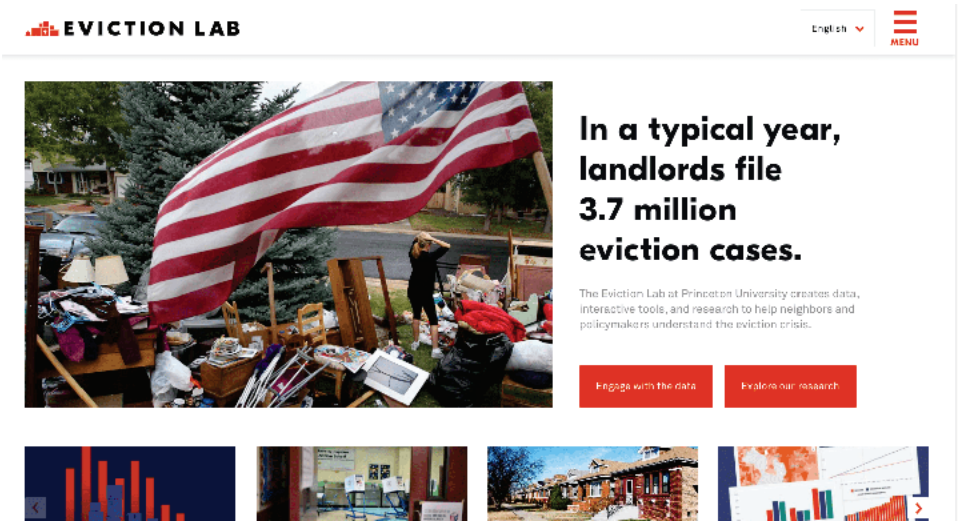


The fundamental characteristics of these three types of interfaces are the following.

4.1. Text & Image-Driven Webdocs

The main content of 23,5% of the analyzed webdocs is text and images, and the navigation proposal is structured as a written report, a hypertext narrative, or a slide show. They correspond to the Magazine Style and SlideShow genres identified by Segel & Heer (2010) respectively. Some examples are Desaparecidas (2018), The Eviction Lab (2017), Borderland (2014), NSA Files: Decoded (2013), and InfoAmazonia (2012) webdocs.

Figure 5. Webdoc with a text and image-driven interface.



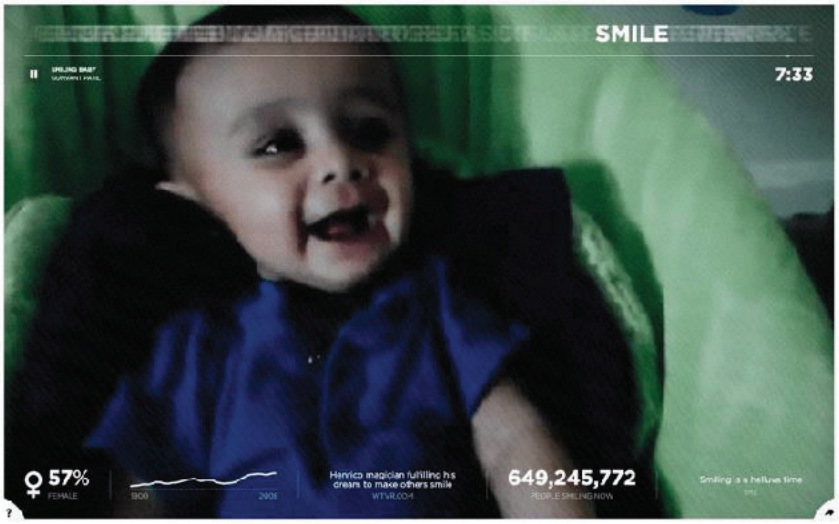
Source: The Eviction Lab at Princeton University. (2017). *Eviction Lab*. https://evictionlab.org/

4.2. Video-Driven Webdocs

In 36,8% of webdocs, the main content is a video, either a central video or a series of videos or chapters. They usually have related multimedia content (images, text, data visualizations) linked and organized in different ways. Examples of this type of webdoc are Birth in the 21st century (2020), Poppy

Interactive (2017), Do Not Track (2015), The Network Effect (2015), Last Hijack (2014), and Seven Digital Deadly Sins (2014).

Figure 6. Webdoc with a video-driven interface.

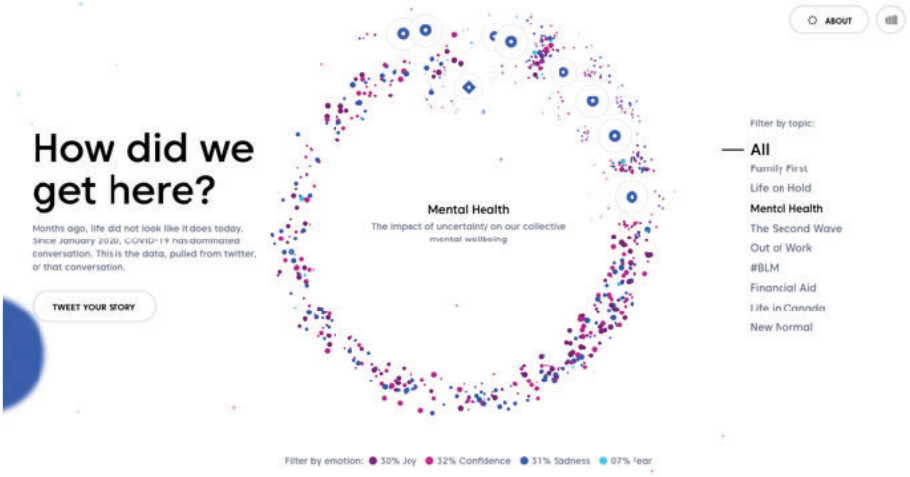


Source: Harris & Hochmuth. (2015). *The Network Effect*. http://networkeffect.io/

4.3. Data-Driven Webdocs

In 39,7% of webdocs, the main content is a data visualization that becomes the main interface of the project. It is always explorable or interactive, and the rest of the content is structured around it. Good examples of this type of webdoc are Yesterday, Today, Tomorrow (2021); Mémoires des Déportations (2017); Quipu Project (2015), The Counted (2015), and Out of Sight, Out of Mind (2013).

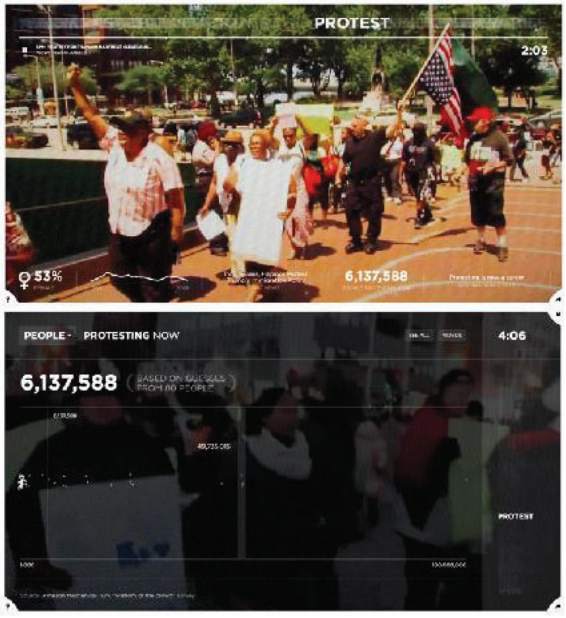
Figure 7. Webdoc with a data-driven interface



Source: Jam3 & NFB. (2021). *Yesterday, Today, Tomorrow*. https://yesterday.nfb.ca/

It is also worth noting that, in addition to data-driven webdocs, another 23,1% give data visualization practically the same prominence as the main content of the interface. Although they do not present data visualization as the core of the webdoc, these webdocs use it as an alternative navigation proposal, becoming practically half of the project. This partitioning occurs in both text & image-driven and video-driven webdocs, such as Poppy Interactive (2017); Jerusalem, We Are Here (2016); Network Effect (2015); Last Hijack (2014), and Unspeak (2013).

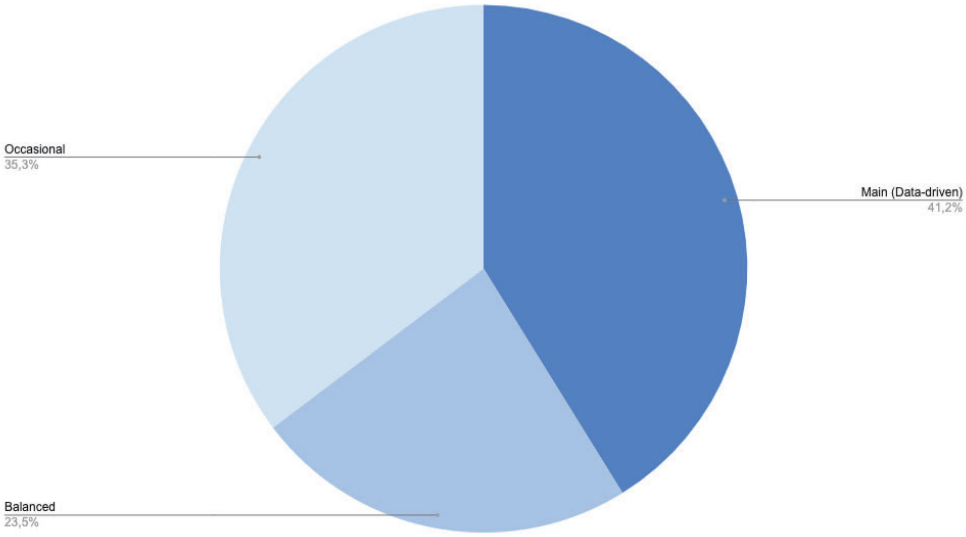
Figure 8. Webdoc with two different navigational proposals.



Source: Harris & Hochmuth. (2015). *The Network Effect*. http://networkeffect.io/

Considering all the gathered data, we can affirm that data visualization represents half or all of the projects in 64,7% of the webdocs analyzed.

Figure 9. Use of data visualizations in webdocs.



5. Genres

When comparing the sample of projects with the study by Segel and Heer (2010), we found some of the structures identified by them, but also new cases and combinations. There is a clear correspondence with the genres identified by them: *Magazine Style*, *Slide Show*, *Film/Video/Animation,* and *Annotated Chart/Map*, but we have also identified new options that offer substantially different experiences.

In the text & image-driven projects, we have identified 4 different structures. Two correspond to the *Magazine Style* and *SlideShow* genres identified by Segel and Heer (2010). Plus a third structure, which we have called *Scrolling Telling*, seems to be a combination of different features of the previous ones; and a fourth one that we have named *Street View/Panoramic Exploration*.

5.1. Magazine Style

Identified by Segel and Heer (2010), it is the most traditional structure of all of them, since it simply replicates the style of a written press report on the web. Its main content is text, static images, and graphics, although some projects also use videos. However, the text is the main content and conductive thread of the webdoc. The navigation proposal consists of vertically scrolling a page to read it. Some are divided into sections or chapters, so they have a menu that allows us to access each one. The Eviction Lab (2017), Toxic Trail (2014), NSA Files: Decoded (2013), and InfoAmazonia (2012) are examples of this type of structure.

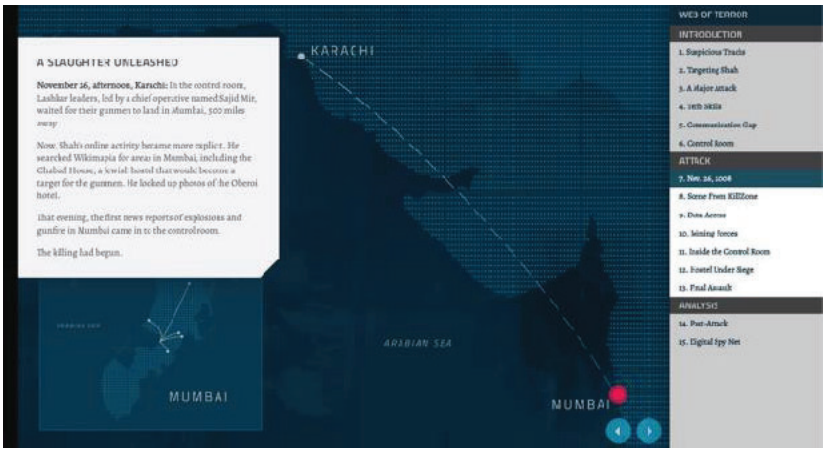
Figure 10. Magazine Style webdoc..

Source: Faleiros. (2012). *InfoAmazonia*. https://infoamazonia.org/

5.2. Slide Show

Also identified by Segel and Heer (2010), this genre consists of a slide show through which the user scrolls sideways. Its main content is text, static images, and graphics. Contrary to the previous case, the image usually has a greater prominence, occupying the entire screen, and only a paragraph of text is displayed over it. The most common navigation proposal consists of lateral navigation, using back/forward or previous/next buttons. Some stories are divided into sections or chapters too, so they usually also display a menu to access each of them. Desaparecidas (2018), Web of Terror (2014), and Borderland (2014) are examples of this type of proposal.

Figure 11. Slide Show webdoc.

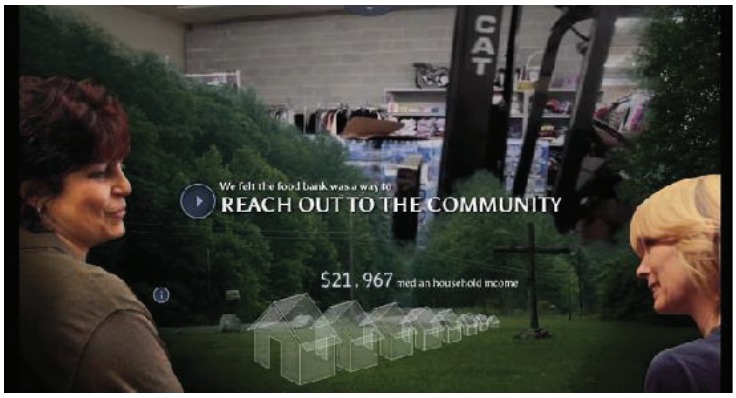


Source: PBS Frontline. (2012). *Web of Terror*. http://apps.frontline.org/web-of-terror/

5.3. Scrolling Telling/Parallax Telling

This structure is the result of the combination of the two previous ones. The image is the content with the greatest prominence and the text and data visualizations, to a lesser extent, are displayed over it. In this case, instead of laterally navigating the content, slide by slide, the webdoc is navigated by vertically scrolling and the content is dynamically displayed with different transitions and effects. Many of them use the parallax effect, a technique that makes the background move at a different speed than the content, revealing different parts of it as we scroll, and giving rise to more visual, fluid, and aesthetic transitions. Hollow (2013) and Isabel, la conquista de Granada (2014) are good examples of it.

Figure 12. Scrolling Telling/Parallax Telling webdoc.



Source: Sheldon. (2013). *Hollow*. http://hollowdocumentary.com/

5.4. Street View/Panoramic Exploration

The main content is 180º and 360º panoramic photographs, in which a series of clickable points are defined. These images exceed the width of the screen, allowing the user to move them to the left or the right with the mouse, to discover the fragments that remain outside of it. They seek to simulate the experience of being *in situ*. Some of these projects combine this navigation proposal with a map, on which they propose routes or spaces that can be explored in a more immersive way. Examples of this type of webdoc are Jerusalem, We Are Here (2016), and Prison Valley (2010).

Figure 13. Street View/Panoramic Exploration webdoc.

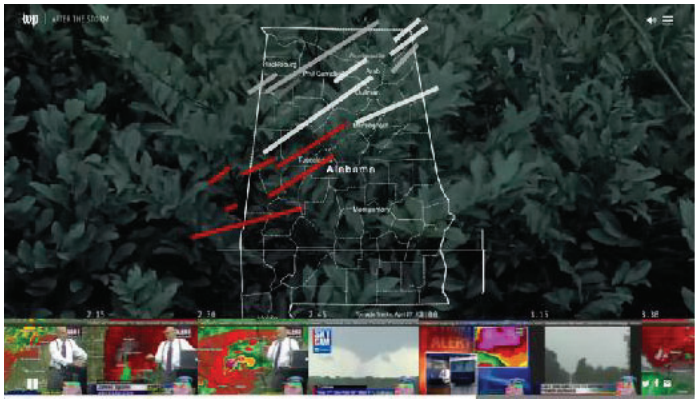
Source: Naam. (2016). *Jerusalem: We Are Here*. https://jerusalemwearehere.com/

Among the video-driven projects, we have identified 4 structures. Segel and Heer (2010) do not specify whether or not the genre they identify is a linear video, although everything seems to indicate that it is. Therefore, they only analyze data visualization within the video, such as graphics or animations inherent to the film footage, as in traditional and non-interactive documentaries. However, although data visualization is part of the video in many projects, some present the video and data visualization as separate, independent elements, developing new navigational proposals between them.

5.5. Film/Video/Animation

The most traditional video-driven genre, previously identified by Segel and Heer (2010). It consists of a non-interactive video piece in which the data visualization appears as a graph inside the film, and it is not explorable or clickable. Like those we can see on television, data visualization is a series of frames within a linear video. An example of this type of structure is the After the Storm (2015) webdoc.

Figure 14. Film/Video/Animation webdoc.



Source: Grace. (2015). *After The Storm*. https://itvs.org/films/after-the-storm

5.6. Video with Related Content

This is the most common structure in video-driven webdocs. The data visualization is an independent element, separate from the video, accessible from different points and times during playback. The function of data visualization in these projects is to support the main story: expanding the context, providing detailed data on the topics covered in the video, etc., although it has different relevance depending on the webdoc.

The level of interactivity of these data visualizations also varies: from non-interactive or illustrative infographics to graphics that allow a certain level of exploration by the user, like filtering data, displaying details when hovering over an area with the cursor, etc. Birth in the 21st century (2020),

Localore: Finding America (2017), Last Hijack (2014), First World War (2014), and Seven Digital Deadly Sins (2014) are examples of it.

Figure 15. Video with Related Content webdoc.

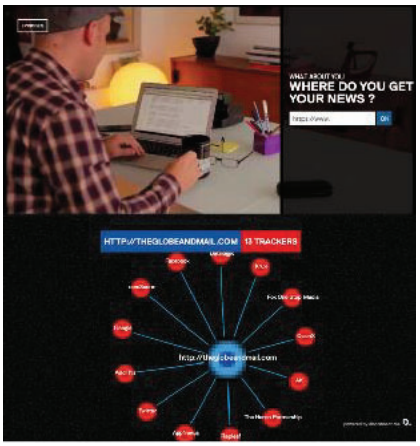
Source: Reig. (2020). *Birth in the 21st Century*. https://lab.rtve.es/webdocs/parto-respetado/en/

5.7. Interactive Film/Video/Animation

This structure is an evolution of the previous format. The data visualization is also part of a linear film but the video player pauses to allow the user to interact with it, by clicking or hovering over the visualization to see more details. Once the user finishes exploring the data visualization, the video playback resumes and continues linearly. No different paths are available for the user to navigate.

In some cases, these data visualizations are personalized, so the data displayed in the visualization is different for each one. For example, before showing it, a question will be displayed and the visualized data will vary based on the user response. A clear example of this type of project is Do Not Track (2015), in which the user is asked to link a social network profile to get metadata and personalize the data visualizations. In Limbo (2015), Hazardous Hospitals (2013), and The Test Tube With David Suzuki (2010) are other webdocs that make use of this technique.

Figure 16. Interactive Film/Video/Animation webdoc.



Source: Gaylor. (2015). *Do Not Track*. https://donottrack-doc.com/en/

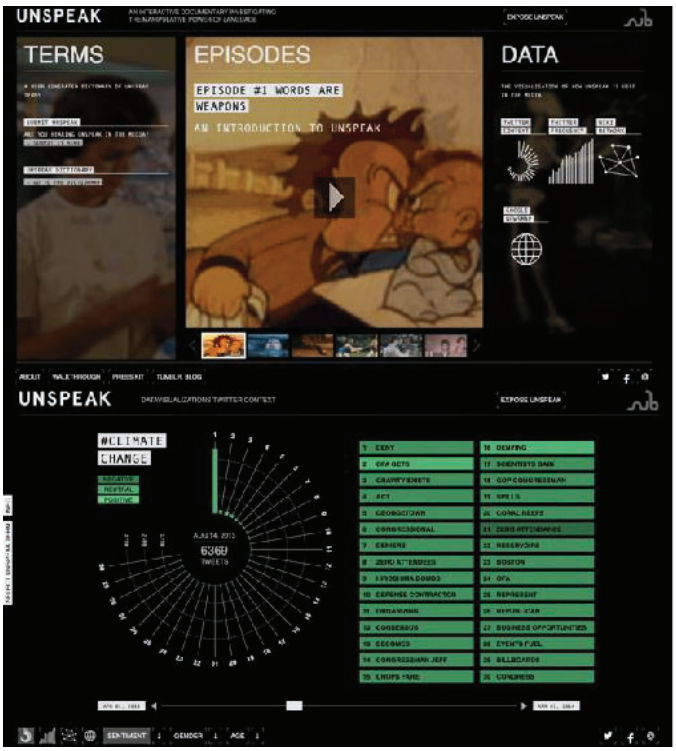
5.8. Video with Alternative Navigation

In addition to displaying quantitative data that provides context to the story, in these webdocs, the data visualization gives access to fragments of the main content. So it functions as an interface or alternative way of navigating it.

The use of data visualizations in this type of project is closely related to data-driven webdocs. The main difference is that, in Videos with Alternative Navigation, the video piece is the heart of the project, and data visualization is just an alternative navigational proposal while in data-driven webdocs data visualization is the main content of the interface. Webdocs such as Network Effect (2015), Lagos Wide

and Close Web (2014), Unspeak (2013), Immigrant Nation (2013), and Question Bridge: Black Males (2012) are some examples of this structure.

Figure 17. Video with Alternative Navigation webdoc.



Source: Submarine Channel. (2013). *Unspeak*. http://unspeak.submarinechannel.com/

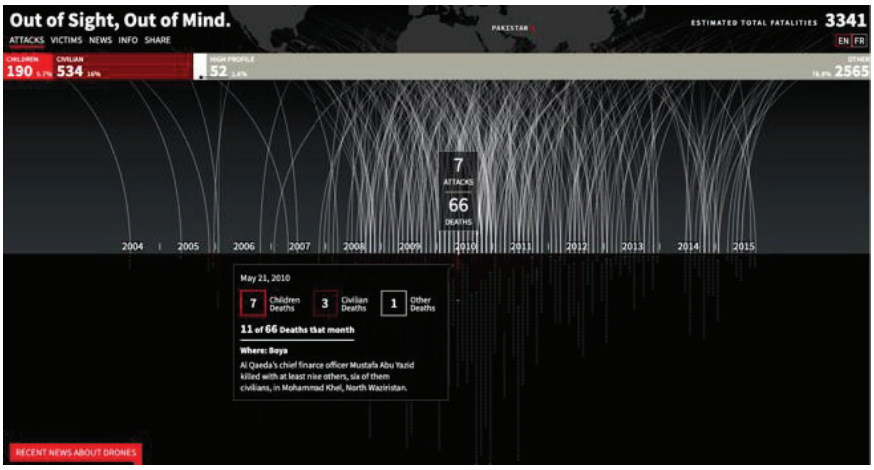
In the case of data-driven interfaces, we start from a more traditional genre or structure identified by Segel and Heer (2010) towards a series of new formats that present a considerable evolution due to technological advances.

5.9. Annotated Chart/Map

The most traditional format, identified by Segel and Heer (2010). It consists of a graph that offers a low level of interactivity since it simply offers the possibility of exploring the data visualization by hovering it to see more details, or to visualize the same data in different ways.

The graph and its data are not clickable, so it doesn't work as an interface, but as an infographic on which we can see detailed data by hovering the mouse over some areas or elements. It is the simplest and most common format in digital newspapers and magazines, accompanying texts, although there are projects in which they are dispensed with, giving full relevance to the data visualization. A good example of this type of project is the Out of Sight, Out of Mind (2013) webdoc.

Figure 18. Annotated Chart/Map webdoc.



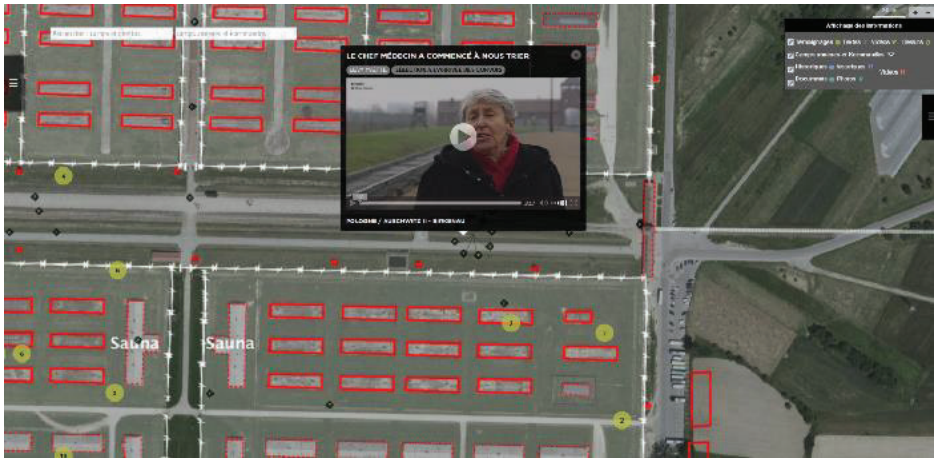
Source: Pitch Interactive, Inc. (2013). *Out of Sight, Out of Mind*. https://drones.pitchinteractive.com/

5.10. Explorable Chart/Map

This genre bears similarities to the previous one but, unlike it, the data visualization is clickable and allows the user to access related content. This means that, in addition to allowing us to visualize the data, the graph gives access to other multimedia content, becoming part of the navigation interface, like videos with related content do.

Its operation and features are similar to those found in the Video with Alternative Navigation genre but the data visualization is the center of the project and not just a form of alternative navigation. They present different levels of exploration and interactivity (zoom, filters, search engines, labels, etc.) and some examples of this type of webdoc are Mémoires des déportations (2017), A Father's Lullaby (2017), Invisible Cities (2010), The Iron Curtain Diaries (2009), and Yellow Arrow (2004).

Figure 19. Explorable Chart/Map webdoc**.**



Source: Fondation Shoah. (2017). *Mémoires des déportations*. https://bit.ly/3TNb9Xo

5.11. Data Dashboard

These projects present the data as a control panel, on which we can run different actions. They allow the user to have an overview of the data they present and filter it to explore the information with a greater level of detail. Some display related multimedia content such as photographs, texts, or videos with personal stories, while others form an observatory of a real context or situation. This category could be included in what Nash (2021) calls categorical databases, a form of content organization in which exploration far prevails over narrativization. We have found this type of structure in projects such as The Counted (2015) and Tidmarsh Farms: Living Observatory (2012), respectively.

Figure 20. Data Dashboard webdoc.

Source: Davenport, G. (2012). *Tidmarsh Farms: Living Observatory*. https://bit.ly/3tGXsyJ

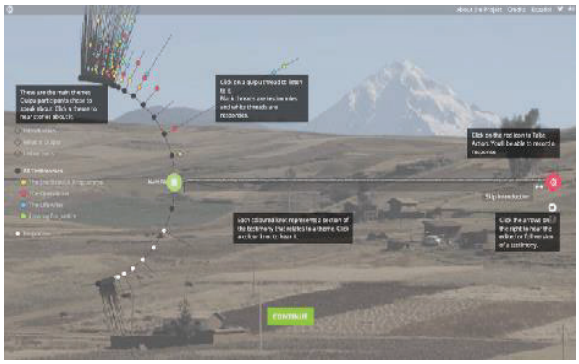
5.12. Artistic Representation/Experiential Data Visualization

The last genre we have identified consists of a series of data visualizations that do not correspond to traditional charts. Although they share identical or, at least, very similar characteristics with the previous ones (zoom, filter options, access to related content, etc.), this type of data visualization does not give as much importance to the exact figures as to the perception of percentages, volumes, and categories.

Even though there is an aesthetic-artistic intention, these data visualizations present a more creative or artistic nature (Cairo, 2012). They seek to display it understandably and to transmit a message by themselves, to create a more emotional and subjective user experience (Kennedy & Hill, 2018). In this group we have also included projects such as We Feel Fine (2006), Here at Home (2012), Quipu Project (2015), and Yesterday, Today, Tomorrow (2021). From the authors of We Feel Fine (2006), Kamvar and Harris (2011), we have taken the term "Experiential Data Visualization" (p.1), a new class of visualization whose interface aims to be "both an artwork and a scientific tool" (p.2).

Another example of this double function and intentionality is the Quipu Project (2015), a data-driven webdoc whose data visualization presents semiotic (self)awareness qualities. It doesn't correspond to any traditional type of chart but mimetically represents a quipu, a traditional indigenous accounting system, defending with that visual metaphor the memory of the victims of the massive sterilization process of the Fujimori government.

Figure 21. Artistic Representation/Experiential Data Visualization webdoc.



Source: Court & Lerner. (2015). *Quipu Project*. https://interactive.quipu-project.com/

6. Narrative Structures

When analyzing the narrative structure of the projects, we have found numerous examples and variants of the *Martini Glass Structure*, *Interactive Slideshow,* and *Drill-Down Story* structures identified by Segel and Heer (2010), although considerably diversified and evolved.

The vast majority of them incorporate new features in addition to using the genres of the previous section in innovative ways. In many cases, the genres function as modules within the same project, presented in different orders and combined in different ways, generating a great diversity of structures. Following the study by Segel and Heer (2010), we have analyzed the narrative structures of data-driven projects, finding the following patterns.

6.1. Martini Glass Structure

The most traditional format and previously identified by Segel and Heer (2010). This type of structure divides the project into two parts: one guided by the author, which works as an introduction to the visualization, and then the data visualization itself. Once the introduction finishes, in any format (video, text, slides, etc.), the data visualization is shown to be freely explored by the user. This is the most common structure in the data-driven webdocs. However, as noted in their study, the degree of authoring and readership vary depending on the project, giving rise to notably different structures, such as the ones we will see below.

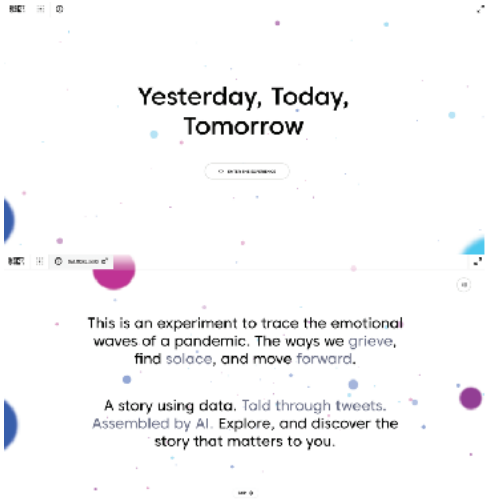
For example, in the *Martini Glass Structure with Short Stem*, the introduction to the project is concise since it consists of a single screen or presentation slide. It presents the project concisely, trying to redirect the user to the explorable data visualization as soon as possible. This first slide works simply as a cover of the project, which usually tries to be as least author-driven as possible, avoiding predisposing the user to the data displayed, as Farewell Comrades (2011) do.

Figure 22. Martini Glass Structure webdoc, with Short Stem.

Source: Thiele. (2011). *Farewell Comrades*. http://www.farewellcomrades.com/en/

In the *Martini Glass Structure with Long Stem*, the introduction of the project consists of a video, animation, or series of slides that provide more information about the data presented to the user. They usually provide context information, guidelines to navigate the data visualization, and work as a trailer or teaser for the project. And the result is usually a more author-driven narrative structure. Yesterday, Today, Tomorrow (2021), Quipu Project (2015), and Out of Sight, Out of Mind (2013) are some of the webdocs that present this narrative structure.

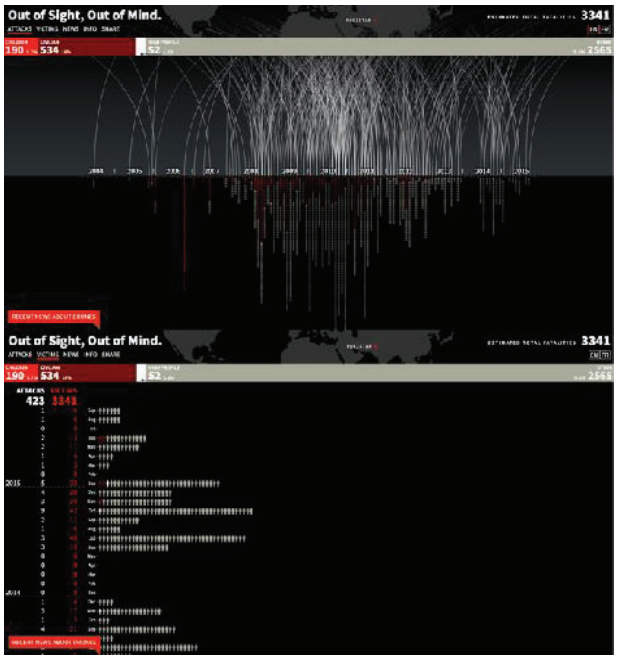
Figure 23. Martini Glass Structure webdoc, with Long Stem.



Source: NFB & Jam3. (2021). *Yesterday, Today, Tomorrow*. https://yesterday.nfb.ca/

The *Martini Glass Structure with Multi-View Data Visualization* allows the same data to be visualized in different ways. Once the introduction to the project is finished (whether short or long), different data visualizations are displayed. One of those data visualizations is shown by default after the introduction, but the user can access other data visualizations or even visualize the same data in different ways. A good example of this type of structure is the Out of Sight, Out of Mind (2013) project, in which we can consult and display the data organized by attacks or by victims.

Figure 24. Martini Glass Structure webdoc, with Multi-View Data Visualization.



Source: Pitch Interactive, Inc. (2013). *Out of Sight, Out of Mind*. https://drones.pitchinteractive.com/

In *Open or Participatory* webdocs, the projects allow the user to add data or stories to the project, or they are obtained automatically from external sources such as social networks, metadata, etc. This way, the project continues to grow and evolve, thanks to the continuous updating of data. Although because of this they are often considered more exploratory than narrative. Yesterday, Today, Tomorrow (2021), A Father's Lullaby (2017), and Quipu Project (2015) are examples of it.

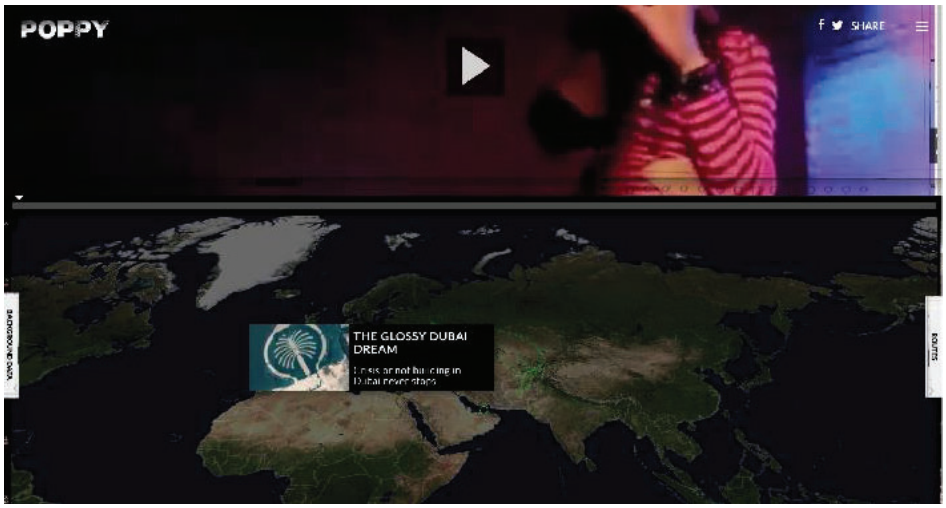
Figure 25. Open or Participatory Martini Glass Structure webdoc.

Source: NFB & Jam3. (2021). *Yesterday, Today, Tomorrow*. https://yesterday.nfb.ca/

6.2. Interactive Slideshow

We have not found any data-driven project with this type of structure, identified by Segel and Heer (2010). However, it is a common structure in video-driven projects in which data visualization is half of the project, like Do Not Track (2015) and Poppy Interactive (2017). As the authors indicate, although it follows a slideshow format, this narrative structure incorporates 'interaction mid-narrative within the confines of each slide' (p.8) or, in this case, within the confines of each video chapter. For example, Poppy Interactive (2017) allows the user to explore a route map, extra data, and background information parallel to each chapter of the video.

Figure 26. Interactive Slideshow webdoc.



Source: De Jong & Kanoth. (2017). *Poppy Interactive*. https://poppy.submarinechannel.com/

We consider that not having found this genre in the data-driven webdocs may be because, in general, they work with a lower number of data visualizations per project. Most webdocs present a single visualization to interact with but not a series of them, as is necessary to develop this format.

6.3. Drill-Down Story

Previously identified by Segel and Heer (2010), these narrative structures present a theme on a single screen or display, allowing the user to discover and access "additional details and backstories" (p.8) by clicking on concrete areas of it.

The data visualization is the first element that appears in the project, without a previous introduction, playing the role of the interface to access all the related content. It presents a theme on single data visualization, allowing the user to click on specific elements to display additional stories and content. For example, The Iron Curtain Diaries (2009) allows the user to explore videos, photographs, sound recordings, and drawings linked to virtual locations, by clicking along an interactive Iron Curtain that brings up stories connected with them.

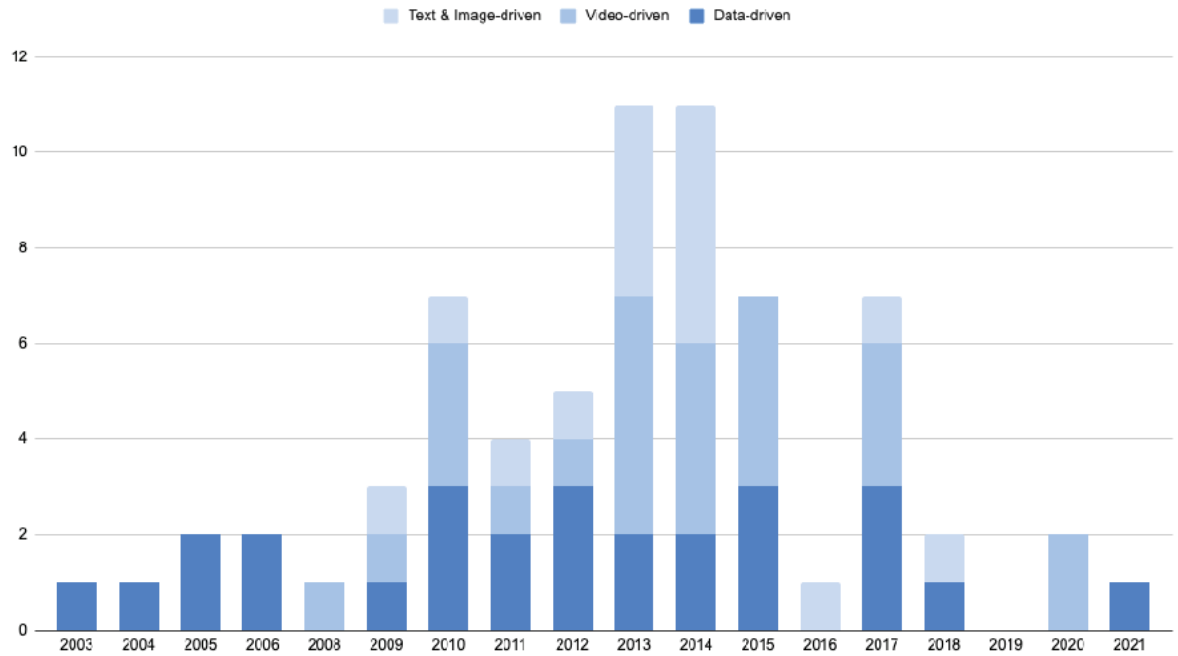
Figure 27. Drill-Down Story webdoc.

Source: Scanni, Miotto, Pellecchia & Ostanel. (2009). *The Iron Curtain Diaries*. https://bit.ly/3jtiZFA

7. Evolution and Use

When chronologically analyzing the main content and interfaces of the webdocs, we can verify that data-driven webdocs have existed since the early 2000s.

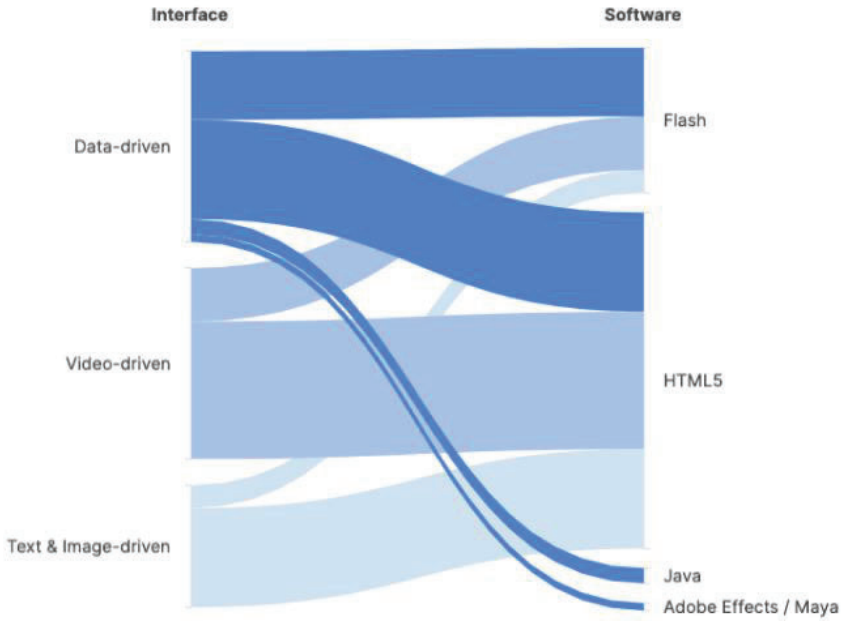
Figure 28. Type of interface by year.



However, data visualization wasn't included in video-driven and text & image-driven projects until almost a decade later, reaching its peak with the appearance of the HTML5 standard. We can consider that data visualizations and other multimedia content (video, text, images, etc.) didn't begin to mix in

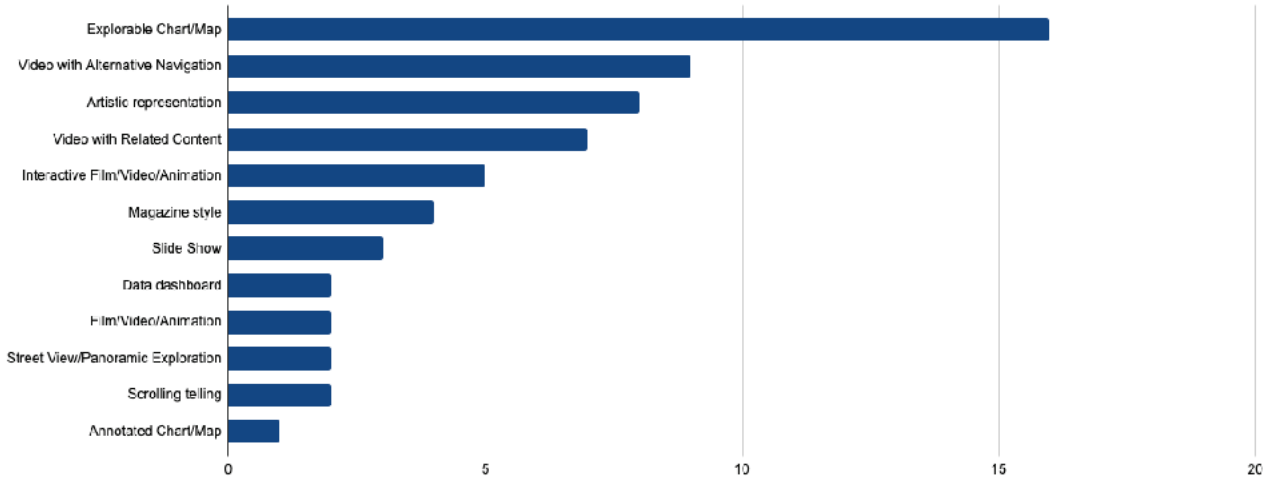
webdocs until this technological change occurred. Most webdocs that use data visualizations have been created using HTML5, especially those that combine video and visualizations.

Figure 29. Type of interface by software.



After placing the proposed genres on the timeline, we can check that the appearance of most of these structures occurs at the same time that HTML5 begins to appear. Some genres are maintained over time and regardless of software technology, such as *Artistic Representation* and *Videos with Alternative Navigation*, as seen in the supplementary material. This suggests an interest maintained over time and regardless of technology. When ordering the genres by the level of use, these two are actually among the most used, being only surpassed by the use of *Explorable Charts/Maps*.

Figure 30. Ranking of webdoc genres.



24% of the projects are *Explorable Charts/Maps*, a less narrative genre but easier to create since it doesn't present a high level of integration between narrative and data visualization. The following positions in the ranking are for *Videos with Alternative Navigation* (another 13%), *Artistic Representations* (12%), *Videos with Related Content* (10%), and *Interactive Videos/Films/Animations* (7%). From this, we can extract that explorable data visualizations are the most used feature, either with purely informative or artistic intention, along with its use as alternative navigation. The next ones in the ranking are the webdocs that use video as the main content but with a significant presence of interactive

data visualizations. The genres based on static images and text occupy the last positions, followed by the less interactive charts.

When placing the narrative structures of the data-driven webdocs in a timeline, we have checked that there is no temporal correlation, at least roughly. The *Martini Glass* structure is the most popular option, appearing throughout the two decades analyzed. Plus the *Multi-view* option, although not as often. However, due to the end of support for Flash and despite the existence of other resources, we have not been able to assess whether some of them were *Short-Stem* or *Long-Stem Martini Glass* structures. The information gap around the projects created with this technology has made it difficult to check this particular feature. However, we have verified that the *Open and Participatory* webdocs have emerged with the appearance of the HTML5 standard.

As Yáñez (2012) and Gaudenzi (2013) have affirmed, one of the main contributions of this technological change was the possibility of connecting video and other graphic elements (like data visualizations) with content from external and open data sources, so that they could be constantly updated. It is a fundamental characteristic of these webdocs, especially the data-driven ones since it allows visualizations to take and show data in real-time, as occurs in projects such as Do Not Track (2015) and Yesterday, Today, Tomorrow (2021).

8. Conclusions

The relationship between interactive documentary and data visualization is still a little explored area, although there are many examples of symbiosis between both disciplines. For this reason, we have started to review and draw the influence of web and software development on the webdoc genre, especially those that use data visualizations.

As a first step, we have extracted the webdocs that use data visualization from four well-known documentary repositories: MIT Docubase, IDFA, NFB of Canada and IMDb, finding examples mostly in the MIT Docubase and IDFA DocLab databases. We have verified how the HTML5 standard had a huge impact on their development by analyzing the coding languages used to create them. The creation of this type of format increased especially around its launch. We have also reviewed how the main content of each project — video, data visualization, or text and static images — tends to condition their interface and narrative structure, and extracted a series of genres that appear recurrently in them.

Our results have been compared with previous studies, checking that the genres identified by Segel and Heer (2010) are still valid, although they have also evolved considerably in the last decade, giving rise to new hybrids and formats, of which different examples have been provided. Then, we have focused our analysis on the narrative structures of the projects whose main content is data visualization, which we refer to as data-driven webdocs, and which we consider to have sufficiently distinctive characteristics to be a new genre.

After analyzing the identified genres over time, we have discovered that some have existed independently of the available software, such as the data-driven webdocs. This research has also allowed us to verify that the greatest diversification of genres and mixture of multimedia content coincides with the appearance of HTML5. Explorable data visualizations are also the most used feature, both with informative and artistic or expressive intentions.

The *Martini Glass* structure has turned out to be the most used narrative structure in data-driven webdocs. However, its use in some of the older projects could not be checked, due to the end of support for Flash and despite the existence of other resources. Otherwise, we have verified that the appearance of open and participatory webdocs occurs with the launch of the HTML5 standard.

Due to space limitations, in this article, we have not been able to analyze in detail the characteristics inherent to data-driven webdocs and the different techniques and features used to integrate narrative and data visualization, which we will address in future research.

We consider this paper as a first step and contribution to the study of the use of data visualization in webdocs and interactive documentaries in general. Plus the germ of a new genre that we believe is useful and necessary to build stories from large data sets: data-driven webdocs.

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