Field of Leaves

An Interactive Installation Sprouting Leaves Out of Public Money

PEDRO SILVA, University of Coimbra, CISUC, DEI, Portugal
DANIEL LOPES, University of Coimbra, CISUC, DEI, Portugal
PEDRO MARTINS, University of Coimbra, CISUC, DEI, Portugal
PENOUSAL MACHADO, University of Coimbra, CISUC, DEI, Portugal

Field of Leaves is an interactive installation that depicts public contracts held in Portugal and their distribution over its five regions and two autonomous regions. The installation presents information about the public contracts available at the online portal of public procurements called Portal Basegov. The installation attempts to advocate the importance and advantages of aesthetics in first-time audience engagement, and how user interaction and hedonic qualities can heighten the user's curiosity and promote more lasting explorations with a visualization.

CCS Concepts: • **Human-centered computing** → Visualization; Visualization application domains; Information visualization; Interaction design; • **Applied computing** → Arts and humanities; Media arts.

Additional Key Words and Phrases: Casual Visualization, Aesthetics, Embodied Interaction, Portugal Public Contracts

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1 INTRODUCTION

In the last few decades, the field of Information Visualization has grown as a result of increased dissemination and software availability and power, allowing practitioners from a variety of backgrounds and non-scientific fields to participate in a more democratized and integrated field than ever before in our society. Danziger [Danziger, 2008] tries to recast and characterize the Information Visualization field as a public activity in modern times, addressing the design change from "by experts, for experts" to "for the people." As Danziger described it, "Information visualization for the people" is a user-centered Information Visualization created so that the typical user may undertake useful research while also enjoying the experience of engaging with data. By creating visualizations that rely heavily on aesthetic and/or artistic motivations to produce data-driven visual communications, these new practitioners, including artists, have broadened the Information Visualization fundamentals with new paradigms such as Information Aesthetics [Lau and Moere, 2007], Artistic Visualization [Viégas and Wattenberg, 2007] and Casual Visualization [Pousman et

Authors' addresses: Pedro Silva, University of Coimbra, CISUC, DEI, Portugal, pedros@dei.uc.pt; Daniel Lopes, University of Coimbra, CISUC, DEI, Portugal, dfl@dei.uc.pt; Pedro Martins, University of Coimbra, CISUC, DEI, Portugal, pjmm@dei.uc.pt; Penousal Machado, University of Coimbra, CISUC, DEI, Portugal, machado@dei.uc.pt.

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al., 2007]. As a result, the general public has become more aware and interested in understanding the data that surrounds it.

Ong [Ong, 2019] notes that there seems to be an observable emerging relationship between embodied sensory systems and the visualization of data through the myriad of ubiquitous digital devices at our disposal nowadays. He addresses how this recent symbiosis is a pivotal strategy for improving the way we deal with our era of data saturation, by creating better and more suitable guidelines to conduct research and experimentation. Hereupon, we must embrace the human factor in the visualizations, placing the users as an element of the visualization itself and bringing them closer than ever to the data with more engaging, embodied connections for successfully communicating or instigating reactiveness to given themes.

Accessing, filtering and tampering data have become common practices, resulting in an increased responsibility embedded in visualization design, since the way in which the data is used will serve as proof to attest a given hypothesis, message or statement. This decision is up to the one who creates the visualization and the underlying intentions for the data used which may not always have an analytical main purpose. Today's visualization works are not necessarily only utilitarian, they can also explore an aesthetic concern. Here, we enter into the delicate subject of how aesthetics can improve visualizations, which has been taken into consideration for a couple of decades now [Chen, 2005]. The design choices play an important role in the efficient and accurate communication of information, and therefore in achieving both a pleasant and informative visualization. In other words, they dictate largely the functionality and success of a visualization, which could be corroborated by the famous Norman motto stating that "attractive things work better" [Norman, 2004].

We believe that the aesthetic component can be a decisive factor in the user engagement with the visualization artifact, responsible for catching their attention while also promoting more lasting and satisfying experiences, leading to the fulfillment of the visualization purpose.

User interaction is another key aspect that is increasingly present in media art works and plays an important role in their success. Works in which body movement is used as a trigger for visualization interaction and manipulation, can be a powerful way of involving audiences for both educational and commercial purposes [Richardson, 2017].

Another aspect that received growing interest in recent years was the notion of a hedonic quality of interactive products [Diefenbach et al., 2014]. Hassenzahl et al. [Hassenzahl et al., 2000] introduced the hedonic as an *"expanded concept of usability that incorporates key factors for designing appealing, enjoyable software interfaces and systems "*. This hedonic quality, which promotes an increased pleasure of exploration and discovery, can be brought into the field of information visualization to make the experience of knowledge acquisition more compelling to the user. Some assertiveness or visual clarity can be sacrificed for something not so common visually without neglecting the information broadcast. Van der Heijden [Van der Heijden, 2004] complements by saying that the hedonic nature of an information system *is "an important condition to the validity of the model and its main design objective is to encourage prolonged usages",* which is precisely the proposition we want to explore.

Installations can have different purposes, from scenarios in which the visitor is invited to participate in the installation's constant evolution [Heijdens, 2017; TeamLab, 2018] to others that foster reflection beyond properly showing data [Quintas and Sandoval, 2019], or lure visitors to a certain type of activity or some specific place [Martins et al., 2013; Sandoval, 2019]. *Field of Leaves* combines these purposes by using disregarded data to foster reflections about the data subject, while simultaneously raising awareness of an online platform that shares such information.

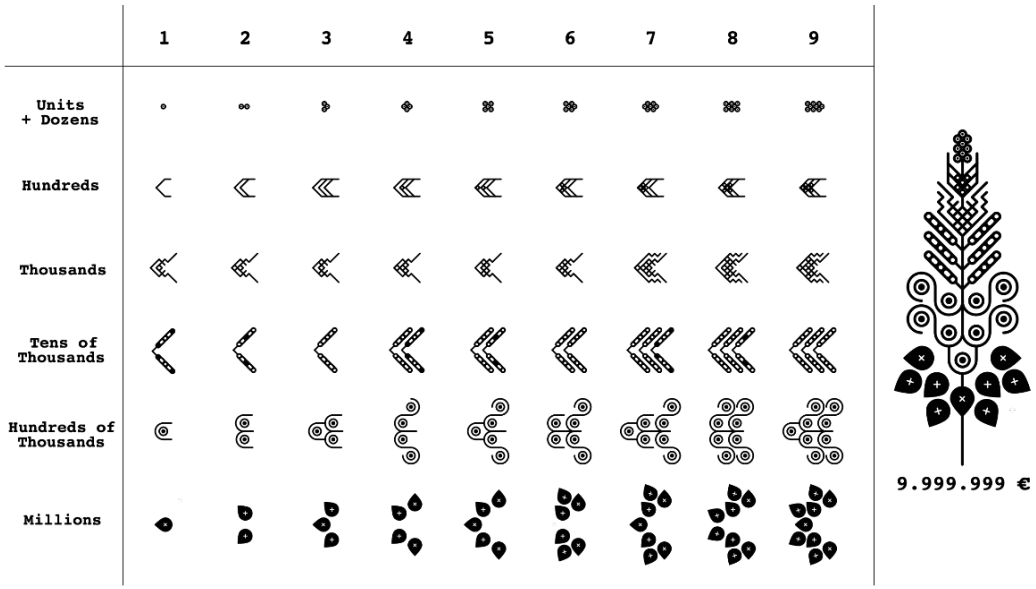

Fig. 1. All leaf elements variations (top). Example of leaf representing the amount of 9.999.999€ (bottom). Adapted image from (©Silva, Martins & Machado, 2020).

2 ENVISIONING *FIELD OF LEAVES*

Field of Leaves is an interactive installation that follows our previous work [Silva et al., 2020]. Our installation further explores the composition of similar visual elements (*leaves,* as we called them) and adds a new medium of information acquisition through users' interaction. With this new layer, we intend to advocate the importance and advantages of aesthetics in an audience's-first engagement and how an embodied interaction [Dourish, 2004] mechanism can increase the user's curiosity and promote more lasting explorations.

The installation presents information about the public contracts available at the public procurement online portal called Portal Base[1]. Similarly to [Silva et al., 2020], we wanted to reveal the monetary dimension invested in Portugal as well, but with each visualization module representing a region of Portugal, namely its five continental regions (Norte, Centro, Lisboa, Alentejo, Algarve) and its two autonomous regions (Madeira, Açores). Furthermore, with the added dimension of interaction, this information can be further presented to the user in a textual, detailed form, where extra statistics about the given region are provided.

Since we are still representing amounts of money, we also adopted the metaphorical approach to represent this value through its physical object, the money bills, through the raw materials that compose them, namely cotton and linen. We also embraced the natural process of growth and branching of its leaves, as a metaphor to represent the increase of the money invested.

The *leaves* created in our work try to expand this visual metaphor created in [Silva et al., 2020] by including additional properties. The total amount number is translated into the *leaves* in the same way as in [Silva et al., 2020], where each digit position of the amount number is represented with a combination of distinct elements as can be seen in Figure 1.

We also employed the same twelve sectors of activity: Health, Food, Business, Communication, Industry, Transports, Culture, Construction, Technology, Education, Consultancy and Society

[1]More information can be consulted at http://www.base.gov.pt/

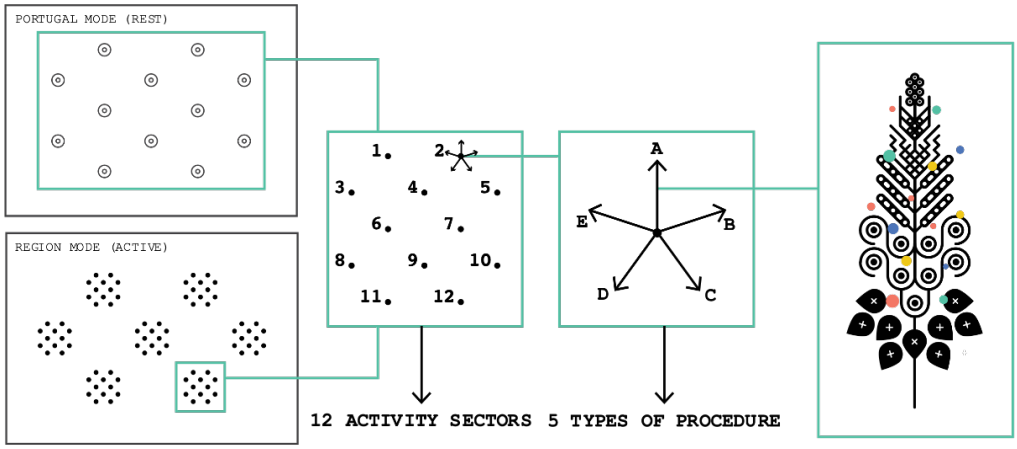

Fig. 2. Visualization structure for both rest and active modes (Left). The activity sectors (1-12) and types of procedures (A-E) disposition within each visualization module (Centre). Leaf composition (Right). (Image ©Lopes, Machado, Martins, Silva)

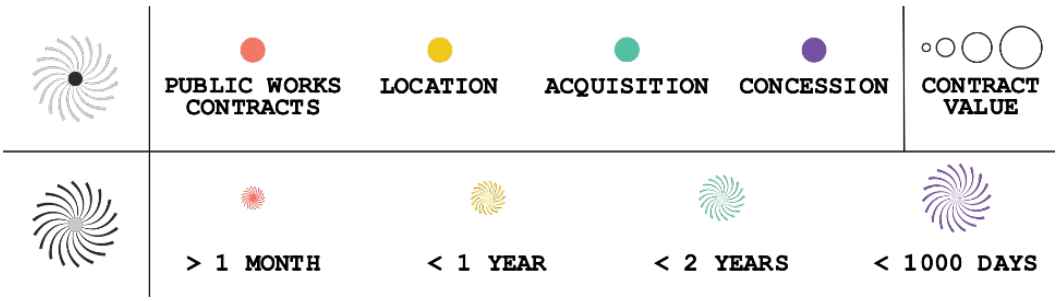

Fig. 3. Berry composition. The color of the central circle represents the type of contract and the size its value. The size of the spiral surrounding the circles represents the duration of the contract in which its color changes upon reaching the indicated time interval. (Image ©Lopes, Machado, Martins, Silva)

(1 – 12) and the different types of contract procedure: Public Tender, Direct Adjustment, Prior Consultation, Limited Tender, Framework Agreement (A – E) to place the *leaves*. The general composition of our visualization, such as the regions' disposition for both states and the *leaves* arrangement, can be consulted in Figure 2.

Our design expansion applied the metaphor of berries, represented by a composition of small circles as the number of contracts present in a given leaf, symbolizing the sprouting fruit resulting from the investments made (Figure 3). The colors of the berries central circle correspond to the type of contract carried out: orange for public works contracts, yellow for locations, green for acquisitions and purple for concessions. The size of the central circle represents the contract value. The duration of contracts is represented by additional circles arranged on Fibonacci spirals to generate petal-like shapes. The color of the spiral changes when the contract duration surpasses a given interval. Additionally, the leaf's stem uses the same colors on a full stacked bar chart approach, representing the percentage of its different types of contracts to emphasize its variability.

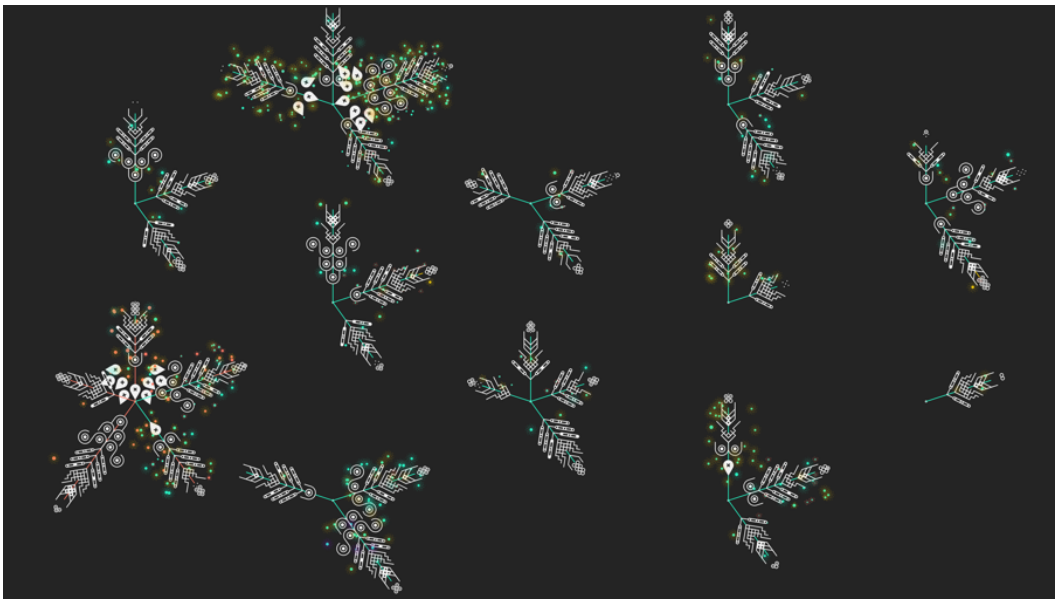

Fig. 4. Screenshot of the visualization in Portugal Mode. *Leaves* distributed by the 12 sectors of activity. (Image ©Lopes, Machado, Martins, Silva)

Our work tries to present the data in a simple and attractive manner, asserting it as a piece primarily driven by aesthetic considerations. To create an experience that can be enjoyed by a wider range of audiences, inciting both aesthetic and analytical analysis, we designed a projection of 4 meters long by 2 meters tall on a white wall, facilitating the analysis of the *leaves*' details. The resulting visualization was designed for an active engagement of the audience, prompting both reflections on the data portrait, as well as on the visualization piece itself, as a piece of artistic communication that may be capable of instilling subjective and emotional responses in the users. The installation has two states: a rest mode and an active mode, one when there are no participants interacting with the visualization, and another when one or more participants are interacting with the visualization, respectively. When in rest mode, the visualization shows the contracts for the entire country, aggregated by sector of activity, in one single module (Figure 4), following a similar approach to [Silva et al., 2020], with a small horizontal expanse, to take full advantage of the total projection space and avoid some leaves' overlapping.

The transition from rest mode to active mode takes place when at least one participant approaches the installation (See Figure 4, activation distance line), perceived by the artifact as a manifestation of interest for a detailed reading. When this happens, the visualization is updated, presenting the same contracts aggregated in rest mode, but now distributed across the regions of Portugal where they were held. Initially, the mapping was thought based on the spatial geography of the regions of Portugal, as was done in [Silva et al., 2020]. However, for physical reasons, a more horizontal approach was taken to make better use of the projection: by allowing a more comfortable exploration of the entire projection area by multiple people simultaneously, the interaction and understanding of the entire visualization could be more adequate.

Following Shneiderman's mantra of overview first, zoom and filter, then details-on-demand [Shneiderman, 2003], while in rest mode, the participants can observe the distribution of public money by sectors of activity, allowing an overview of all the money invested in a more condensed

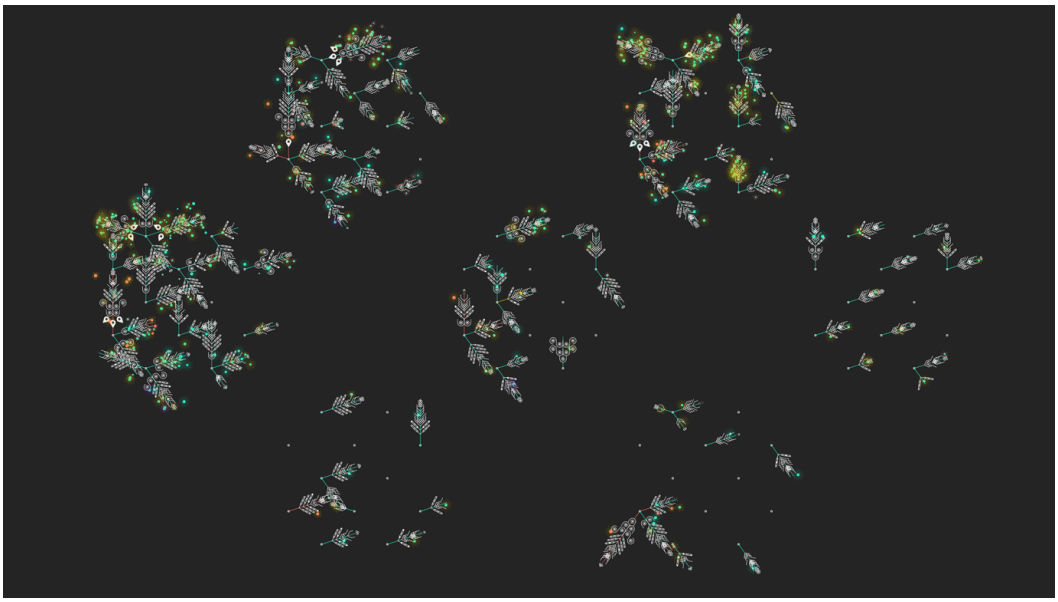

Fig. 5. Screenshot of the visualization in Region Mode. *Leaves* distributed by the 7 regions. (Image ©Lopes, Machado, Martins, Silva)

way. When they engage with the visualization, this visualization partition allows the participants to zoom in geographically and perceive the distribution of public funds across the country, and consult the details if they intended, potentiating the discovery of imbalances and patterns that were previously hidden (Figure 5).

Similar to the participant's approach used to trigger the installation's active mode, all other visualization manipulations are performed resorting to the human presence. In this way, participants experience full control of their exploration as active, driving agents of the installation itself, which may contribute to the feeling of immersiveness. A second stage of information disclosure happens when the user is engaged with the visualization: following the same principle of approximation by interest, participants can get even closer to the projection so that the contracts' details made in a given region are revealed to them in textual form. These details are presented in the form of a pop-up that condenses the following information about the region: (i) the total number of contracts; (ii) the number of contracts and money invested by sectors of activity; (iii) the number of contracts and money invested by type of contract procedure; and (iv) small captions describing the leaves' composition. Given the regions arrangement, pop-ups can appear in two possible ways: (i) in a single pop-up window for sensors responsible for two regions; or (ii) in two pop-up windows divided between the upper and lower part of the region for sensors responsible for one single region. These two pop-up styles were designed for their position not to collide with the corresponding *leaves*, enabling a simultaneous reading that joins both types of information. An example of both pop-up styles can be seen in Figure 6.

2.1 Plan(n/t)ing the *Field of Leaves*

The visualization was designed for online access, using JavaScript and the P5.js library, making it accessible and adaptive to multiple display formats and sizes.

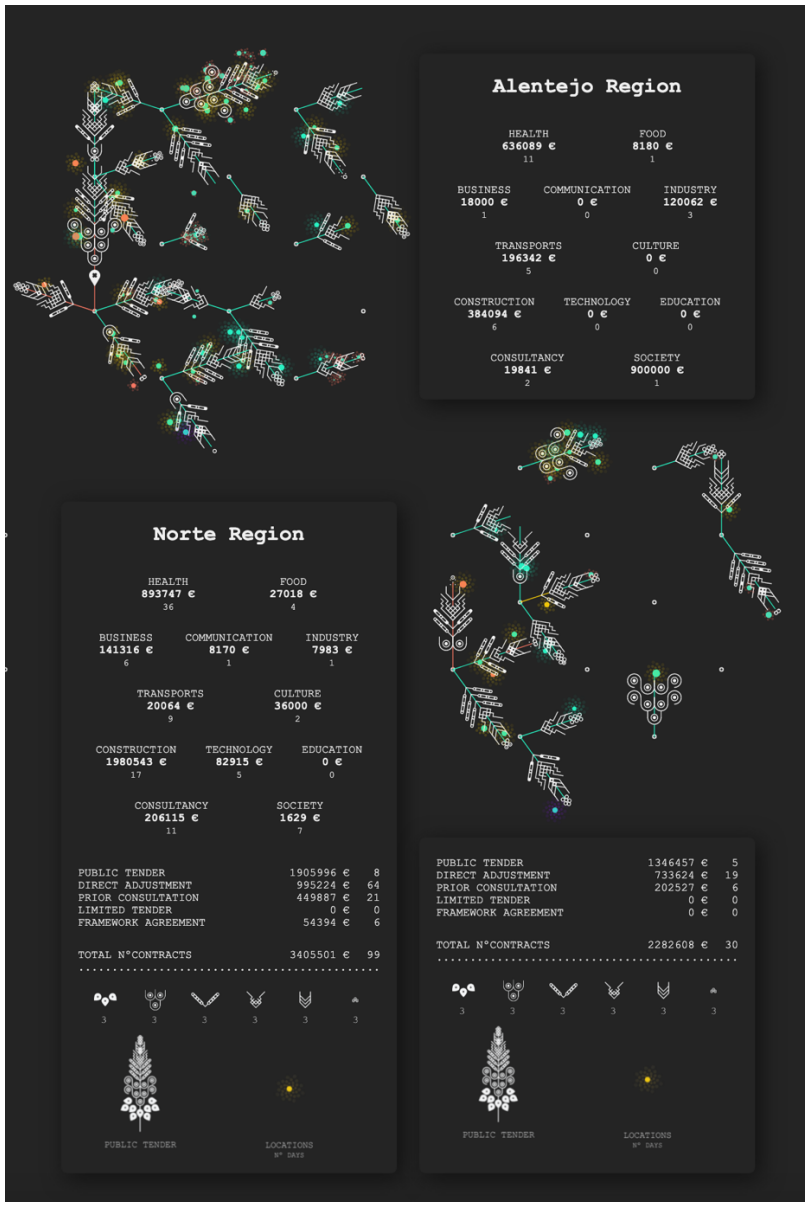

Fig. 6. The two possible Region Details pop-ups. One single pop-up window for sensors responsible for two regions (left) and two pop-up windows for sensors responsible for one region (right). (Image ©Lopes, Machado, Martins, Silva)

At the bottom of Figure 7, we can see the mentioned activation distance line responsible for the transition between rest and active mode. Furthermore, the seven trigger areas in the floor, responsible for revealing the details of the respective region are labeled from 1 to 7. These areas and the activation distance line are not signalized in the installation site, in order to promote a more hedonic and initially challenging exploration process of finding the correct position to obtain the

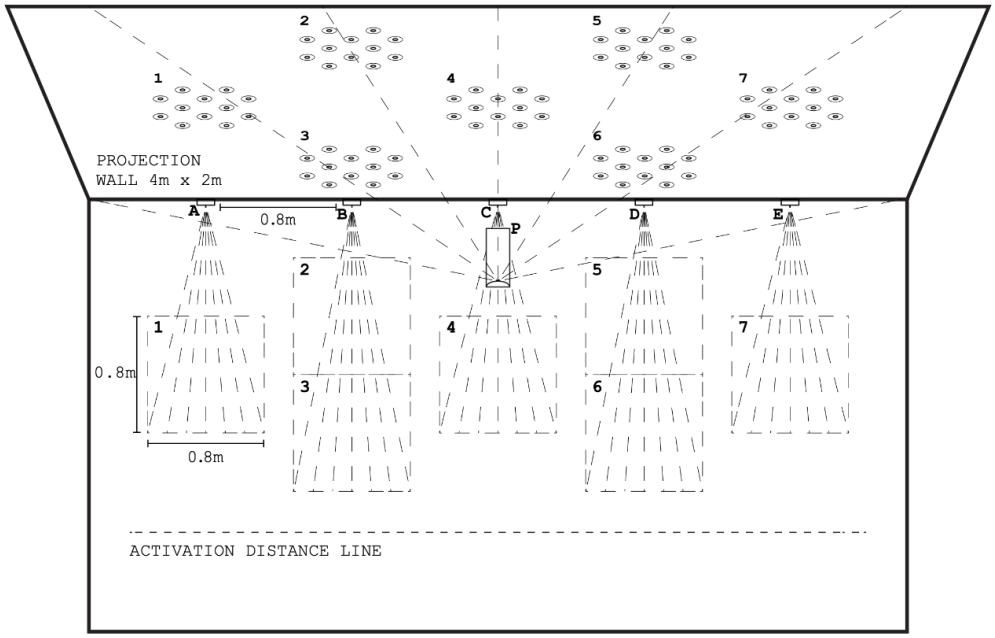

Fig. 7. Installation setup. Projection using an ultra-short throw projector (P) wall with 4x2m dimension depicting the active mode containing regions of Portugal (top, 1 – 7). Signalization of the activation distance line and the activation zones for the different regions (bottom, 1 – 7) detected by the ultrasonic sensors (A – E). (Image ©Lopes, Machado, Martins, Silva)

desired information. To reveal the details of the desired region, participants must place themselves within the distance range limited by the corresponding area. When successful, a pop-up with details appears in front of the remaining regions of the same line of action, hiding the other *leaves* and presenting statistical data, switching the aesthetics for the analytics.

The participants' distance to the projection is obtained through five ultrasonic distance sensors placed on the projection wall (Figure 7, A – E) and connected to an Arduino which communicates with a web application. Despite the installation was designed for interactions of several participants simultaneously, its use is currently limited to five people, one for each sensor's line of action.

2.2 Through the *Field of Leaves*

The installation was trialed out for a week at our university, in our research lab, accessible to the entire research group community (Figure 8). Starting in the first day of 2022, the web application was programmed to automatically collect the new public contracts inserted in the BaseGov portal every day and update the visualization with the corresponding *leaves*. With this daily update, the installation acquired a dynamism with the goal of generating an increased curiosity in its participants, making them want to consult the visualization day after day to see the differences, that is, the additional money invested in the country and its different regions.

Despite not having been applied in a real context, nor having made formal inquiries to the participants, they provided some positive feedback. After giving them a brief context and briefing about the data displayed, the participants mentioned that the installation was a very interesting way to consult such information, that otherwise they would never go to the site to do such consultation

Fig. 8. Installation photo of the visualization when in rest mode. (Image ©Lopes, Machado, Martins, Silva)

and analysis of the same data. This reflects the welcomed awareness and accessibility that rise from portraying such type of datasets in an interactive, metaphorical setting. Such scenario shows the power we, as artists, have to communicate or inform people, and the underlying responsibility to do so in the most transparent way regardless of the intended goal. Whether it is a more objective, closed-ended goal for data disclosure, or an artistically-driven, open-ended portrayal for interpretation and reflections, both encapsulate the role of the artist as a social communicator. We place our proposal as an installation that seeks to explore characteristics of both these extremes, raising awareness of such an online portal, data and, above all, information on the subject in an interactive way. Multiple distributions of public money, equally or unequally distributed across the country, are then displayed to be explored through a metaphorical representation, which in turn may incite a reflective attitude upon such governance.

Furthermore, the intentional and increased initial interaction with the installation was noticeable, namely with the sensors, where the participants tried to learn the interaction mechanisms and to take control of the visualization and only then they conducted more prolonged and detailed analysis of the *leaves'* compositions and their corresponding data. One participant can be seen browsing the installation in Figure 9. All these observations suggest that alternative visualization and interaction approaches have a growing potential for new exploratory paths of data analysis.

Despite the good reception, we are aware that the feedback collected was obtained by a limited audience, which prove to be insufficient to validate the success of the installation and its assumptions when in contact with the target audience. As such, a new iteration of the installation is being developed, this time in a public center exhibition, aiming to gather critical and diversified feedback from a general audience.

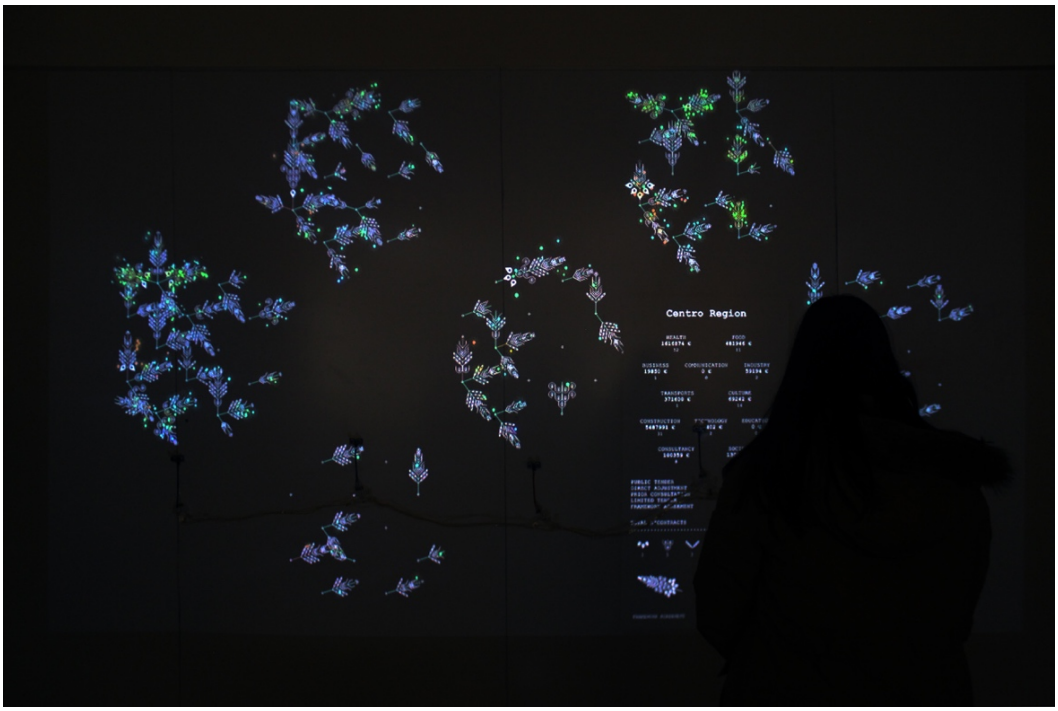

Fig. 9. Installation photo of participant interacting with the visualization. (Image ©Lopes, Machado, Martins, Silva)

3 CONCLUSION

The interactive installation *Field of Leaves* is a case study that intends to demonstrate how the aesthetics of the data can generate curiosity and lead to an increased engagement with the system, when combined with embodied interaction. The scenarios expanded by the latter can originate data explorations and analysis potentially more pleasant given its hedonic component, which in turn can be responsible for more frequent and lasting interactions, dictating the success of the visualization.

The installation presents the funds involved in public contracts carried out in Portugal, in its five continental regions and two autonomous regions. Participants appear to be drawn by the installation and invited to interact with it in order to interpret the information encoded in the *leaves*, while having a large hedonic component in mind that relies on the participants' curiosity to get them closer and thus better understand the data. However, the limited audience and consequent reduced feedback is to be solved in a near future, with a new iteration of the installation in a public space, accessible to a much larger and more diverse audience.

As future work, we also intend to further explore the possibilities given to user interactions as mechanisms for visualization manipulation by making a better usage of the participant's body gestures. Create and add more levels of data refinement or other types of data aggregation, for example, by sector of activity, amount of money involved, or contract duration could also be useful to gather other kinds of knowledge.

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