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INCREASE

CiAUD Centro de Investigação em Arquitetura, Urbanismo e Design

FCT Fundação para a Ciência e a Tecnologia
MINISTÉRIO DA EDUCAÇÃO E CIÊNCIA

Interactive Print Media Design and Autonomous Systems

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External Researchers

Keywords
Interaction Design; Print Media; Autonomous Systems

Partner Institutions

Expected Future Partner Institutions
NOVA.ID.FCT (NOVA School of Science and Technology), ICNOVA (NOVA School of Social Sciences and Humanities)

OBJECTIVES

This research will deepen recent interactive concerns to print media, proposing to achieve the following goals:

G1: Study and identify the challenges of interactive print media when regarding dynamic ML and AI scenarios.

G2: Understand how interaction design is being affected by autonomous systems, which generate content difficult to predict.

G3: Realize how print media can become interactive and integrated into a physical/digital ecosystem.

G4: Design print prototypes that relate to autonomous systems through technological augmentation. Undertake experimental transformation of print media into an interaction system that allows different ways of requesting and returning information.

G5: To know and formulate new possibilities of interaction allowed by complex systems and their application in print media. Generate design guidelines for research that seeks to improve and streamline the production of print media and their user experience.

BIBLIOGRAPHIC REFERENCES

[1] Zimmerman, J, Forlizzi, J & Evenson, S (2007). Research through Design as a Method for Interaction Design Research. *HCI '07: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, ACM, NY: 493-502

[2] Höök, K & Löwgren, J (2021). Characterizing Interaction Design by Its Ideals: A Discipline in Transition, *She Ji: The Journal of Design, Economics, and Innovation*, 7(1): 24-40

[3] Wiberg, M (2018). *The Materiality of Interaction: Notes on the Materials of Interaction Design*. MIT Press, Cambridge, MA

[4] Ballatore, A & Natal, S (2015). E-readers and the death of the book: Or, new media and the myth of the disappearing medium. *New Media & Society* 18, 2379–2394

[5] Neves, M (2019). A Practice-Based Research Model for Interaction in Print Design. in D Raposo, J Neves, J Silva (eds.), *Perspectives on Design: Research and Practice in communication design, fashion design, interior design, product design and intersection areas*. Design and Innovation, vol.1, Springer, 175-187

ABSTRACT + IMAGES

'INCREASE' is an exploratory study of interaction design, given its current context influenced by autonomous systems based on artificial intelligence (AI) and machine learning (ML), and how it can be applied to print media. The main purpose is to improve the relationship between print media and digital production, by collecting helpful information for several user groups.

We intend to establish a connection between interaction design, as the shaping of physical/digital, updatable systems, with print media – understood as communication and knowledge materials, subject to creative action.

Our driving question is: How can print media be designed as interactive artefacts when influenced or benefited by autonomous systems?

For this we propose an exploratory approach with 4 complementary methods: a) case study of autonomous systems and their interactive presence; b) cognitive mapping; c) research through design (RtD) [1] for the development of interactive prototypes; d) design guidelines.

Interaction design, which started out to benefit computer systems, is dealing with developments allowed by new technology, expanding its boundaries. A discipline that has gone from graphical interfaces to ubiquitous systems and from programming to AI.

Höök and Löwgren [2] suggest interaction design should recognize its material object is no longer software accessible on a screen, but rather a physical and digital hybrid.

Changing from screens to a set of diversified objects, based on ubiquity, technological qualification of surfaces and information networks, leads us to study interaction in different contexts. When changing the focus of interaction, from representations to tangibility, ideas are needed on how to adapt and design for interaction [3].

One context in which this study is required is in the design of print media. Interaction in print media stems from these concerns and has found form in experimental projects such as *Bitbook* (fig. 1), *Elektrobiblioteka* (fig. 2), or *Papertab* (fig. 3).

Print media occupy a great importance in our information needs. They actively contribute to knowledge acquisition, daily tasks, content distribution and mobility. Still, we are witnessing a progressive decrease in the use, purchase and circulation of print media. One cause for this are consequences brought by digital media, which Ballatore and Natal [4] baptized as the 'myth of disappearing media', i.e., intense digitization of information and cultural transformations as result of digital conversion of products and services.

Digital alternatives bring convenience, speed and often, lower costs, presenting us opportunities for participation and personalized content. But also, a marked influence on cognition, literacy and development of younger generations. Although recommendations in film, music, shows, news and books can be appreciated, it also raises concerns about self-segregation, misinformation and biases. In an era of information overload and post-truth, it is ever more important for print media to contribute to critical thinking. For it is only through well-informed citizens that democracies can thrive.

A possible way for print and digital media coexistence is to review print media or a symbiosis that will include interactive content.

However, print media has been mainly characterized by its graphic elements and it lacks an approach to behavior and dynamic information. Research so far has focused on print media to maintain its material presence [5] as based on digital performance. Except, digital media are not stable and are conditioning the possibilities for interaction between people and artefacts [2].

Anticipation has been a key factor in allowing designers to predict what users will see and do. Autonomous systems based on AI and ML introduce dynamic and growing information which may contradict such predictability. Best known examples are in social media, product recommendations, self-driving cars or virtual personal assistants. They are evolving systems and difficult to anticipate. They record uses, predict needs, and make suggestions based on patterns of behavior. This is what happens today with Netflix, Youtube or Amazon.

This research will help to understand how these systems will work with books, posters, signage, textbooks or newspapers. Collected information will also contribute to better understanding what interference autonomous systems have in a design project.

Team members gather knowledge of print media and interaction design, collaborating in the scope of the <DIV> Design, Interaction and Visualization research group. This leads us to want to identify and implement interaction in print media, adapting them to a context of digital transformation, where interaction appears as an enhancer of user participation and collaboration in defining the final shape of objects.

Interaction has the potential to associate multisensory, behaviors and storytelling with print media, helping them to preserve their importance in a daily life dominated by digital media and thus contribute in an innovative way.

Fig. 1 ***Bitbook***. Interacting with a children book connected to a wireless device (accessed at bitbook.ink).

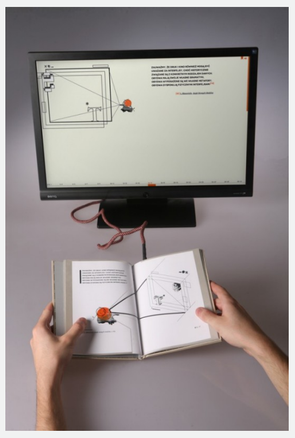
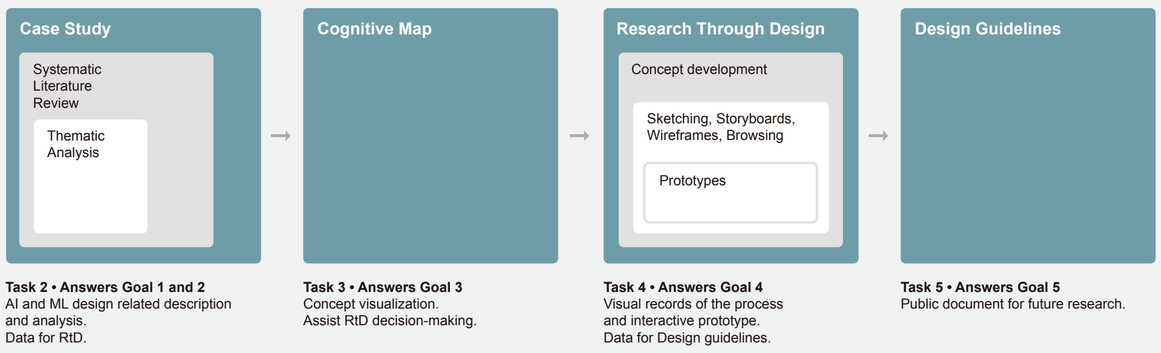


Fig. 2 ***Elektrobiblioteka***. Book connected via USB (accessed at ebookfriendly.com).

Fig. 3 ***Papertab***. Flexible e-ink touchscreen display (accessed at extremetech.com).

Research Plan Diagram



Project Timeline

Task Nº	Task Denomination	Participants involved in task	Months 1	2	3	4	5	6	7	8	9	10	11	12
1	**Project management**	MN, JL, JGS, CPS	■	■	■	■	■	■	■	■	■	■	■	■
1.1	Coordinating team members		■	■	■	■	■	■	■	■	■	■	■	■
1.2	Scheduling meetings		■	■	■	■	■	■	■	■	■	■	■	■
1.3	Evaluating project progress		■	■	■	■	■	■	■	■	■	■	■	■
1.4	Identifying main project risks		■	■	■	■	■	■	■	■	■	■	■	■
1.5	Monitoring activities		■	■	■	■	■	■	■	■	■	■	■	■
1.6	Supervising project dissemination				■	■	■	■	■	■	■	■	■	■
1.7	Submitting a final report													■
2	**Case sudy**	MN, JL, CB	■	■	■	■								
2.1	Desk research, observation and analysis		■	■	■									
2.2	identification, comparison and synthesis				■	■								
3	**Cognitive map**	MN, JL, JS, BC					■							
3.1	Identify and select topics						■							
3.2	Create a cognitive map						■							
4	**Research through design**	MN, JS, CPS, S#1						■	■	■	■	■	■	
4.1	Concept development, sketches, storyboards, wireframes and browsing structure							■	■					
4.2	Low and medium-fidelity prototypes									■	■			
4.3	Semi-functional interactive print prototype										■	■	■	
5	**Design Guidelines**	MN, CPS, SE, S#1											■	■
5.1	Compiled data												■	
5.2	Design principles													■
	Outreach activities	All members			■	■	■	■	■	■	■	■	■	■
	Project website				■	■	■	■	■	■	■	■	■	■

Final Report

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SCIENTIFIC RELEVANCE FOR THE DISCIPLINE

Interaction design is in redefinition. Most well-known approaches focused on shaping screen-based media, but there is a growing awareness of tangible, hybrid and mixed-media systems.

Concepts like 'embodied', 'materiality', 'shape-changing' are altering interaction design towards an extended material and augmented practice, not only concerned with efficiency, but with cultural and social factors, as observed from the designer's view.

Print media have been excluded from this understanding, but are able to generate opportunities for interaction and for different relationships with people. By including interaction features and changing the way they are developed we may help print media preserve their meaning.

On the other hand, AI and ML-based systems are clearly present today in several design related situations. Whether we understand and support them or not, we need to find greater understanding of how they affect and contribute positively to interaction design in its physical/digital practice.

EXPECTED ECONOMIC AND SOCIAL IMPACT

The proposal relates with two UN goals for Sustainable Development: SDG 4 Quality Education and SDG 8 Decent Work and Economic Growth.

Covid-19 has enhanced digital exclusion. Scarcity of equipment and lack of internet reception are barriers to distance learning, to which at least 500 million students worldwide do not have access. In Portugal, 25% of the population above 16 years old do not have internet access. Reading on paper is still more effective and textbooks are essential to support learning. The print industry had a profound decline. Between 2014 and 2019, there was a drop of 65 million copies of newspapers sold in Portugal, book sales dropped 30% between Jan. - Jun. 2020. Print media is one of the main channels of research journalism. News outlets made commitments to erase disinformation, created sections to counter fake news. Print-related products are relevant, promote inclusion and may benefit from innovative processes and technology, adding value to users and expanding markets.

RESEARCH PLAN AND TASKS

Our research plan derives from the nature of the study areas and listed goals.

The Interaction Design process leads us to research, by identifying situations; defining requirements for interactive approaches; the need to develop interactive prototypes; and heuristics for future development.

As for autonomous systems, they work similarly to the human mind, through reception, interpretation and learning. They are supposed to identify reception signals in objects that allow the system to interpret and learn.

Recent interaction design practice emphasizes artifacts that fit into a 'digital ecology' rather than unique products and their interfaces. We intend to use exploratory and design methods to discover which interactions can be established for print media, transformed by technological augmentation and their integration in this dynamic environment. Such methods are directed to understand and generate design requirements for interactive print media.

The work plan consists of 5 tasks, 3 of which are exploratory and will run for 12 months.

Collected information may indicate which products or services can benefit from such media and what are the advantages in future research.

Task 1: Project management 12 months

Objectives: To ensure all goals are achieved as planned. It will run throughout the project, along with tasks 2 to 5, for coordination between team members.

Team members will meet regularly at the beginning and at the middle of each task, to assure workflow. This task will include the following activities: **1.1** Coordinating interactions among team members; **1.2** Scheduling meetings to provide input at specific time points; **1.3** Evaluating project progress; **1.4** Identifying main project risks and proposing contingency plans to mitigate them; **1.5** Monitoring activities from scientific, technical and financial points of view; **1.6** Supervising project dissemination actions, outreach activities and expected indicators; **1.7** Submitting a final report.

Expected results: 1) Project performance management within pre-defined timelines; **2)** Detailed plans at the beginning of each task; **3)** Good communication between all team members; **4)** Connect and relate results between tasks; **5)** Compliance with the project's communication plan.

Connections with other tasks: Task 1 is linked to all other tasks, as it is the one that will monitor and control all project tasks.

Resources: No costs in this task. All team members are expected to provide information on tasks in which they are involved, share decision-making and contribute to the overall project progress.

Members: MN, JL, JGS, CPS

Task 2: Case study 4 months, G1 and G2

Selection of cases through a systematic literature review of ML-based autonomous systems related to design. Codification of cases through a thematic analysis using MAXQDA software.

Objectives: Identify and select main relevant cases; map their characteristics, processes, and tools that may be transferable to an interaction design project.

This task aims to answer the following questions: **1.** Which methodologies were more successfully applied? **2.** What is the knowledge gap? **3.** What transformations are possible in the main print media through AI and ML? **4.** Are these transformations likely to be integrated into the creation of print media, lending them usefulness, benefit and viability?

We propose a descriptive and explanatory study based on: **2.1** desk research, observation on information management and multimodality and function analysis; **2.2** identification, comparison and synthesis of input signals possible to include or combine with print media that enable interaction at a technical level (sensors, conductive paint, cameras) and at a functional level (click, drag, fold material).

Expected results: 1) Case study report with identification of ML-based interactive features; **2)** Data for development of RtD and interactive prototypes;

Connections with other tasks: Task 2 provides data for task 3 and 4.

Members: MN, JL, CB

Task 3: Cognitive map 1 month, G3

Objectives: Visualize a network of ideas and concepts associated with research; assist the decision-making process of RtD and future research activities.

This task aims to answer the following questions: **1.** What are the main concepts related to interactive print media and autonomous systems? **2.** What are the existing connections and correlations?

Activities: 3.1 Identify and select the most relevant topics originated from task 2. **3.2** Create a cognitive map including all topics and their correlations.

Expected results: A visual representation of the most relevant concepts regarding the relationships between ML and print media.

Connections with other tasks: Task 3 is informed by task 2 and provides data for task 4 and 5.

Members: MN, JL, JGS, BC

Task 4: Research through Design 6 months, G4

Task 4 will use information collected in tasks 2 and 3, by crossing more detailed knowledge of autonomous systems and which interactive techniques and functions should be tested in print media.

Objectives: To develop a semi-functional interactive print media prototype; record and communicate the process; to demonstrate how it is possible to deal with unpredictable factors in developing an interaction design project.

This task aims to answer the following questions: **1.** What are the exploratory interactions that can be implemented in main print media? **2.** How can these interactions be implemented? **3.** What material and technological conditions must be met?

Task 4 will include the following activities: **4.1** Concept development, generation of ideas, sketches, storyboards, wireframes and browsing structure. **4.2** Development of low and medium-fidelity prototypes and work with materials to rapidly test generated ideas in 4.1. **4.3** Semi-functional interactive print prototype.

Expected results: Low and medium-fidelity prototypes, semi-functional wireframes and 3D mockups that will enable manipulation by the team. Semi-functional prototype to test haptic interaction and provide insights for future improvements.

Connections with other tasks: Task 4 is informed by task 2 and 3 and provides information for task 5.

Resources: 1 scholarship for 6 months. Technical equipment for prototype development. All costs are justified in the Budget section.

Members: MN, JGS, CPS, S#1

Task 5: Design guidelines 2 months, G5

Objectives: Develop a descriptive set of proposals based on results from tasks 2, 3 and 4; provide a basis for future interactive print media projects, making use of information visualization to allow explicit knowledge transfer to other studies and contexts.

This task aims to answer the following questions: **1.** What are the main achievements and limitations that should be addressed in future research? **2.** How to communicate indications for future projects in these areas?

Design guidelines will be produced through a process of synthesis that will gather: **5.1** Compiled data from previous tasks; **5.2** Design principles observed and extracted from prototypes.

Expected results: Working document made available for future research as a set of actionable design advice.

Connections with other tasks: Task 5 is informed by task 3 and 4.

Members: MN, CPS, SE, S#1

EXPECTED SCIENTIFIC RESULTS

1. Set of approaches to implement interaction in print media. Autonomous systems imply decisions about the type of information to be worked on. Tasks 2 and 3 will allow decision on more concrete research to be developed about ML systems and print media for new products or services.

2. Visual records of research data as result of creative production procedures on how to deal with interaction features in print media.

3. Interactive prototypes and consequent conceptual, technical and production data as physical evidence of interaction in print media for future products and services.

4. Design guidelines for future inclusion of interaction in print media made publicly available as lasting dissemination output.

As part of outreach activities, we also expect the following output indicators: 2 papers in international journals; 3 communications in international meetings; 1 final report; 1 master thesis; 1 prototype. A project website will be available, showcasing research activities and information and kept online to support further research.

BUDGET: € 6.675,22

1 scholarship for 6 months: 5675,22€

1 master's student will be involved for 6 months. This student will provide aid to tasks 4 and 5. Will be included in RtD and development of interactive prototypes. Final dissertation should fit the topic of interactive print through practice based research. These tasks will provide knowledge of processes, methods and tools in interaction design, aided by practical skills with materials, so the student can benefit from close contact with more experienced researchers. The student will also contribute to outreach activities.

Technical equipment: 1000,00€

Estimated 20% amortization/write off value for acquisition of several technological augmentation material. For task 4 a set of materials will be necessary to create prototypes with conditions for interaction: conductive inks, soft and capacitive sensors and Arduino boards/kits. We present an estimated value, considering the need to develop multiple prototypes.