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NXGEN

A EVOLUÇÃO DA IMPRENSA ALÉM DA CAMADA FÍSICA

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NXT/GEN:
THE EVOLUTION OF PRINT MEDIA BEYOND THE PHYSICAL LAYER

PROJECT REPORT FOR THE DEGREE OF MASTER
IN GRAPHIC DESIGN AND EDITORIAL PROJECTS

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DECLARATION OF AUTHORSHIP

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AUGMENTED REALITY IS GOING TO CHANGE EVERYTHING.

TIM COOK, 2017

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RESUMO

Este projeto de mestrado explora as possibilidades de integração da Realidade Aumentada (RA) no jornalismo impresso tradicional, com o objetivo de preencher a lacuna entre os meios físicos estáticos e o conteúdo digital dinâmico. À medida que a indústria da imprensa enfrenta desafios crescentes da era digital, a RA oferece uma solução híbrida promissora que preserva os pontos fortes do papel ao mesmo tempo que expande as suas possibilidades. Este estudo teve como objetivo estabelecer guias práticos e focados no design para a criação editorial com RA através do desenvolvimento e análise de protótipos funcionais.

A metodologia envolveu a criação de um catálogo físico modular que apresentou quatro casos de uso distintos de RA (Fotografia, Vídeo, Atualizações em Tempo Real e Infografias Digitais), adaptando páginas reais de jornais portugueses de renome (Diário de Notícias, Jornal de Notícias e O Jogo). Recorrendo à plataforma Scenery e ao rastreamento baseado em marcadores (QR), os protótipos foram avaliados através de testes de utilizador em ambiente real com 10 participantes, utilizando os seus próprios dispositivos.

Os resultados revelaram uma forte intenção de adesão futura entre os participantes, que valorizaram muito as capacidades da tecnologia para proporcionar valor extra e envolvimento contínuo, especialmente nos protótipos de Vídeo e Tempo Real. No entanto, o desenvolvimento e os testes expuseram dificuldades técnicas e de usabilidade críticas. A observação dos utilizadores destacou um conflito subconsciente entre os hábitos enraizados de uso de ecrãs táteis 2D e as exigências físicas da navegação espacial 3D, nomeadamente nas faixas etárias mais velhas. Adicionalmente, as falhas graves de compatibilidade com WebXR em dispositivos Android evidenciam os atuais problemas tecnológicos da RA baseada em navegadores web.

O projeto conclui que o sucesso da integração da RA na imprensa escrita depende menos da novidade técnica e mais de um design de UX meticuloso. Para garantir crescimento a longo prazo, a indústria deve adotar padrões de indicadores visuais, controlos híbridos no próprio ecrã e guias de instrução robustos para o utilizador. Em última análise, a RA não é um substituto, mas sim um complemento poderoso capaz de dar novo folgo ao futuro do jornalismo impresso.

Palavras-Chave:
Realidade Aumentada, Jornalismo Impresso, Media Híbridos, Design de Informação, Design de Realidade Aumentada.

ABSTRACT

This Master's project dives into the possibilities of Augmented Reality (AR) integration into traditional print journalism to bridge the gap between static physical media and dynamic digital content. As the print media industry faces growing challenges in the digital age, AR offers a promising hybrid solution that preserves paper's strengths while expanding its possibilities. This study aimed to establish practical and design-focused guidelines for AR editorial creation through the development and analysis of functional prototypes.

The methodology involved creating a modular physical catalogue that presented four distinct AR use cases (Photography, Video, Real-Time Updates, and Digital Infographics), adapting real newspaper pages from prominent Portuguese news publications (Diário de Notícias, Jornal de Notícias, and O Jogo). Using the Scenery application platform and marker-based (QR) tracking, the prototypes were evaluated through real-world user testing with 10 participants using their own devices.

The findings revealed strong future adoption intent among participants, who highly valued the technology's ability to provide continuous engagement and value, especially in the Video and Real-Time prototypes. However, development and testing exposed critical usability and technical impediments. User observation highlighted a subconscious conflict between users' ingrained 2D touchscreen habits and the physical demands of 3D spatial navigation, notably among older demographics. Additionally, severe WebXR compatibility failures on Android devices showcase the current technological issues with browser-based AR.

The project concludes that successful AR integration in print media relies less on technical novelty and more on meticulous UX design. To ensure long-term growth, the industry must adopt standardised visual indicators, hybrid on-screen controls, and strong user instruction guides. Ultimately, AR is not a replacement, but a powerful complement that can breathe new life into the future of print journalism.

Keywords:
Augmented Reality, Print Journalism, Hybrid Media, Information Design, AR Design.

ACKNOWLEDGEMENTS
RESUMO
ABSTRACT

01 · INTRODUCTION 014
1.1 CONTEXT & MOTIVATION 015
1.2 PROBLEM STATEMENT 015
1.3 RESEARCH QUESTIONS 016
1.4 OBJECTIVES OF THE STUDY 016
1.5 METHODOLOGY OVERVIEW 016

02 · LITERATURE REVIEW 017
2.1 AUGMENTED REALITY IN NEWS MEDIA & JOURNALISM 018
2.1.1 AUGMENTED REALITY: DEFINITION AND EVOLUTION
2.1.2 DIGITAL STORYTELLING POTENTIAL
2.1.3 LIMITATIONS IN NEWS MEDIA
2.2 CURRENT STATE OF PRINT MEDIA 022
2.2.1 CHALLENGES IN THE DIGITAL AGE
2.3 AR CASE STUDIES 024
2.3.1 EXPERIMENTAL AR PHYSICAL PIECES
2.3.2 AR IN PRINT JOURNALISM
2.4 CHALLENGES & ETHICAL CONSIDERATIONS 037
2.4.1 ACCESSIBILITY
2.4.2 POTENTIAL AR USE RISKS
2.4.3 ETHICAL CONCERNS

03 · METHODOLOGY 041
3.1 RESEARCH APPROACH 042
3.2 PROTOTYPE DEVELOPMENT 042
3.3 USER TESTING 044

04 · PROTOTYPE 045

4.1 CONCEPT & IDEATION 046

4.2 DESIGN PROCESS 048

4.2.1 GRAPHIC IDENTITY AND DESIGN SYSTEM

4.2.2 VISUAL STANDARDISATION AND LAYOUT STRUCTURE

4.2.3 AR CONTENT INDICATORS AND USER GUIDANCE

4.2.4 DIGITAL ASSET PRODUCTION

4.2.5 AR LAYER ASSEMBLY AND INTERACTIVITY

4.3 FINAL OBJECT 052

4.3.1 DEVELOPMENT CHALLENGES AND LIMITATIONS

05 · TESTING & RESULTS 062

5.1 TESTING SETUP 063

5.2 FINDINGS & INSIGHTS 064

5.3 TECHNICAL LIMITATIONS & WEBXR INCOMPATIBILITY 066

06 · DISCUSSION 068

6.1 REFLECTIONS ON THE DESIGN PROCESS 069

6.2 DESIGN RECOMMENDATIONS FOR FUTURE AR PRINT MEDIA 069

07 · CONCLUSION 070

7.1 SUMMARY OF FINDINGS 071

7.2 FINAL THOUGHTS 071

REFERENCES 073

LIST OF FIGURES

Figure 1: Visual Representation of RV Continuum

Figure 2: Morton Heilig's "Sensorama"

Figure 3: Ivan Sutherland's HMD "The Sword of Damocles"

Figure 4: Carling's "The Last Statement" T-Shirt, 2019

Figure 5: Carling's "The Last Statement" T-Shirt - Spark AR Interface, 2019

Figure 6: Nick Barclay's "Measurements" AR Book, 2019

Figure 7: Nick Barclay's "Measurements" AR Content, 2019

Figure 8: Esquire's "Augmented Reality Issue", 2009

Figure 9: Interaction with Esquire's Augmented Content, 2009

Figure 10: Metro Herald's AR Indicator, 2011

Figure 11: Metro Herald's AR News Example, 2011

Figure 12: Metro Sweden's AR Content, 2012

Figure 13 & 14: The New Yorker's AR Cover, 2016

Figures 15 & 16: Interactions with The New Yorker's AR Cover, 2016

Figure 17: Time's "Optimist" AR Issue, 2018

Figure 18 & 19: Experiences of Time's "Optimist" AR Issue, 2018

Figure 20: National Geographic's Earth Day AR Cover, 2020

Figures 21 & 22: National Geographic's Earth Day Experience with Spark AR, 2020

Figure 23: Table on AR editing guidelines of major US news outlets

Figures 24 & 25: Photo vs. AR Model Comparison of a Burger in the article, 2019

Figure 26: Diário de Notícias' Government Cover, 2024

Figure 27: O Jogo's Portugal-Sweden Match Report, 2024

Figure 28: Jornal de Notícias' Weather Section, 2024

Figure 29: Diário de Notícias' 2024 Election Statistics, 2024

Figure 30: NXT/GEN Project Logo

Figure 31: Industry Typeface, Fort Foundry

Figure 32: Dharma Gothic Typeface, Dharma Type

Figure 33: NXT/GEN AR News Content Signal

Figures 34 & 35: Scenery Prototyping Interface

Figure 36: NXT/GEN AR Layer User Exploration

Figure 37: NXT/GEN Prototype 001 Physical Page Layout

Figure 38: NXT/GEN Prototype 001 AR Component (01)

Figure 39: NXT/GEN Prototype 001 AR Component (02)

Figure 40: NXT/GEN Prototype 001 AR Component (03)

Figure 41: NXT/GEN Prototype 001 AR Component (04)

Figure 42: NXT/GEN Prototype 002 Physical Page Layout

Figure 43: NXT/GEN Prototype 002 AR Component (01)

Figure 44: NXT/GEN Prototype 002 AR Component (02)

Figure 45: NXT/GEN Prototype 002 AR Component (03)

Figure 46: NXT/GEN Prototype 002 AR Component (04)

Figure 47: NXT/GEN Prototype 003 Physical Page Layout

Figure 48: NXT/GEN Prototype 003 AR Component (01)

Figure 49: NXT/GEN Prototype 003 AR Component (02)

Figure 50: NXT/GEN Prototype 003 AR Component (03)

Figure 51: NXT/GEN Prototype 003 AR Component (04)

Figure 52: NXT/GEN Prototype 004 Physical Page Layout

Figure 53: NXT/GEN Prototype 004 AR Component (01)

Figure 54: NXT/GEN Prototype 004 AR Component (02)

Figure 55: NXT/GEN Prototype 004 AR Component (03)

Figure 56: NXT/GEN Prototype 004 AR Component (04)

Figure 57: Screenshot of the "Unsupported Feature" error message

Figure 58: Screenshot of Chrome menu showing WebXR enabled

Figure 59: Screenshot of the visually corrupted AR experience

[01]
INTRODUCTION

1.1 CONTEXT & MOTIVATION

The print news media landscape is facing a critical shift. As audiences evolve with the digital age and gravitate toward digital platforms, traditional print struggles to maintain its historical relevance and readership. However, print media still holds a unique power, credibility and tactile appeal that cannot be fully replaced by digital screens. This dynamic makes Augmented Reality (AR) a potential bridge between the two worlds. By providing digital elements and functions onto physical formats, AR could breathe new life into newspapers. It may offer an evolved hybrid medium that preserves print's tactile feel while meeting the digital demands of modern generations.

This project began from a deep fascination with emerging technologies combined with a love for editorial design. A pivotal catalyst for the idea was Serafim Mendes' "Post-Print" (2019) exhibition, which highlighted how AR could be a powerful vessel for information design. While major publications such as Esquire and Time have experimented with AR in the past, these experiences were perceived as novelties or marketing gimmicks rather than pathways for expanded storytelling. This superficial use leaves untapped potential and significant gaps in design usability, points that this project aims to explore and address.

1.2 PROBLEM STATEMENT

Print media is currently facing severe challenges in the new digital era, struggling to compete with the immediacy and interactivity of digital news consumption. Digital platforms outpace print's daily or weekly production cycles by providing real-time updates, multimedia engagement, and, most importantly, instantaneous access to supplementary information without the added expenses of physical resources, ink, and distribution.

Consequently, traditional print lacks the extra engagement users get from interactive videos, links, and digital infographics, making it increasingly less appealing, especially for younger audiences. While AR presents a viable solution to modernise the medium with these features, its past applications have not been explored in depth. Previous uses often relied on expensive technology, niche platforms, or lacked a usability-focused perspective. A new approach is needed that integrates AR to combat misinformation, expand upon printed stories, keep readers updated in real time, and enhance how they view data.

1.3 RESEARCH QUESTIONS

As a path to guide the investigation and address the challenges in the current media landscape, this study builds on the following core research questions:

- **What design principles and guidelines are required to effectively integrate AR into current print journalism design?**
- **How do users interact with and view AR-enhanced news content?**
- **What are the most effective use cases for AR to enhance the reading experience within print newspapers?**

1.4 OBJECTIVES OF THE STUDY

The main purpose of the project is to develop a functional visual AR prototype that demonstrates practical and user-friendly experiences for augmenting existing news articles in printed newspapers. Alongside this goal, it seeks to explore how AR can elevate interactivity and information delivery in traditional print media.

Furthermore, the project aims to document user reactions, engagement levels, and comprehension when individuals interact with the resulting AR prototypes. By combining insights from these explorations, it intends to establish a strong set of design recommendations and practices for future AR applications in the editorial information design industry.

1.5 METHODOLOGY OVERVIEW

To achieve these objectives, the project follows a simple but structured methodology divided into four main phases:

- **Literature Review:** An analysis of the historical and current state of AR, print media, and AR in print journalism.
- **Prototype Development:** The creation of functional AR experiences based on existing newspaper articles, prioritising a design-based perspective and functional use cases.
- **User Testing:** Usability testing and experience surveys conducted on a diverse sample of around 10 participants, ranging in age and technological knowledge, to evaluate the physical and digital interactions.
- **Analysis & Conclusion:** A critical assessment of the testing results to understand its insights and prepare future design recommendations.

[02]
LITERATURE REVIEW

2.1 AUGMENTED REALITY IN NEWS MEDIA & JOURNALISM

Every day, the boundaries between the real and digital worlds are increasingly blurred. As society becomes more reliant on digital information, the emergence of new technologies is integral in shaping how the future world functions. Among the most promising technologies for innovation stands Augmented Reality (AR), for its ability to smoothly combine digital information with the physical environment, unlocking limitless opportunities for how we experience and visualise data.

"Augmented reality is an innovation that will almost certainly turn out to be as powerful and broadly applicable as was the Internet itself." (Margaritopoulos & Georgiadou, 2023)

This potential to transform is even more evident in the media industry, where AR can redefine how media is produced and consumed. With a landscape that has already evolved dramatically with the rise of new media on digital platforms and social media, AR could be the next step in delivering news content that pushes the current boundaries of traditional formats. This chapter explores the definition and growth of Augmented Reality, its limitations in news media, and its emerging role in storytelling for the future of journalism. It will also examine the challenges faced by print media, previous AR case studies, and key concerns surrounding AR's broad adoption in journalism.

2.1.1 AUGMENTED REALITY: DEFINITION AND EVOLUTION

At its core, AR is a technology that enhances the actual world by overlaying virtual information, such as images, videos, sounds, and other sensory data, in real time. Unlike its counterpart, Virtual Reality (VR), which seeks full user immersion in a complete virtual space, AR aims to enhance the user's experience by augmenting, rather than replacing, reality through the coexistence of real and digital elements (Carmigniani & Furht, 2011). This distinction is anchored in the Reality-Virtuality Continuum (Milgram et al., 1995), a concept created to visualise the spectrum between real and fully virtual environments, positioning AR between the two extremes (Figure 1).

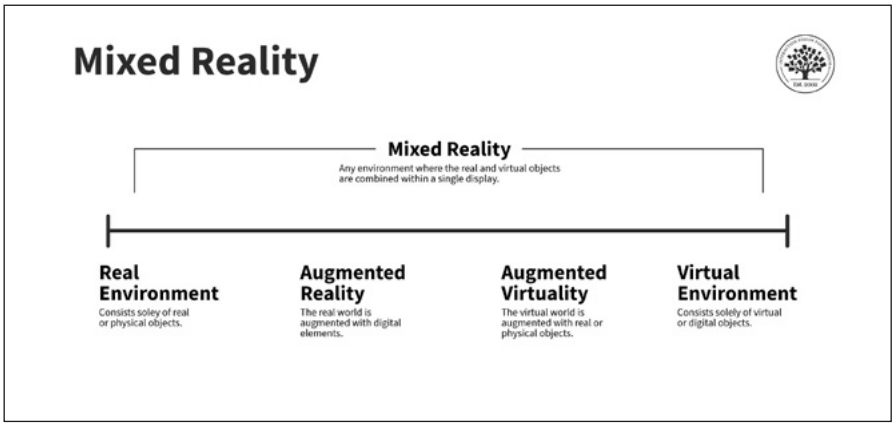


Figure 1 - Visual Representation of RV Continuum
Source: https://ixdf.org/literature/topics/virtuality-continuum

The idea of AR has significantly evolved over the decades. We can trace back in time to the 1950s to see the initial appearance of AR when cinematographer Morton Heilig created Sensorama (Carmigniani & Furht, 2011), a mechanical machine that used a stereoscopic colour display, wind fans, odour emitters, stereo sound, and a motion chair to engage all of the user's senses and draw them into the on-screen action (Figure 2).

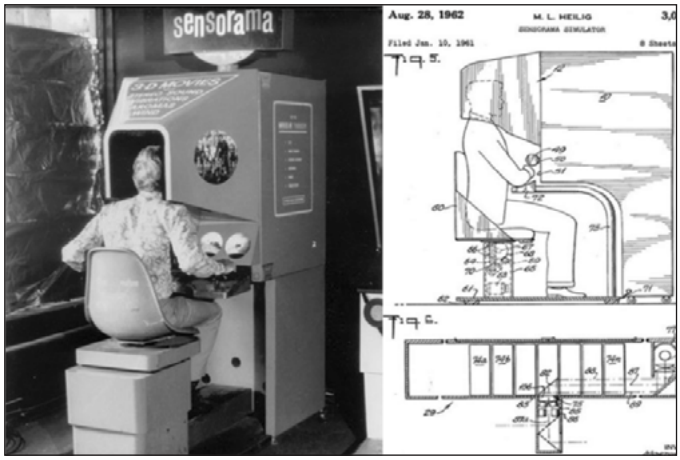


Figure 2 - Morton Heilig's "Sensorama"
Source: https://immersivearchive.org/sensorama.html

Yet, for the first use of digital computing in an AR experience, we have to advance to 1968, when Ivan Sutherland developed the first optical see-through head-mounted display (HMD) (Figure 3). The HMD was a large device comprising a tracking system and a screen in front of the user's eyes. Due to its weight, it had to be suspended from the ceiling, a characteristic that inspired its name: "The Sword of Damocles". The system used head tracking to adjust the basic wireframe graphics to the user's head movements, leading to an early form of Virtual Reality.



Figure 3 - Ivan Sutherland's HMD "The Sword of Damocles"
Source: https://immersivearchive.org/ivan-hmd.html

In 1990, the term “Augmented Reality” was established by Tom Caudell and David Mizell, who explored the technology to aid workers in aircraft assembly during their time at Boeing (Pavlik & Bridges, 2013). Years later, Ronald Azuma (1997) played a crucial role in refining the definition of AR by outlining three widely acknowledged core features: Combining Real and Virtual content, Real Time Interaction, and Registering in 3D. These early applications were largely limited to military and industrial contexts, but they laid the groundwork to expand AR into various fields, including entertainment, medicine, and journalism.

Following early developments, the late 1990s and early 2000s saw AR evolve from isolated lab experiments toward more accessible platforms. The 1999 release of ARToolKit, an open-source software library developed by Hirokazu Kato (Carmigniani & Furht, 2011), enabled developers to overlay graphics onto the real world, using video tracking. During this era, the world saw the rise of parallel technologies that would become crucial for the mass adoption of AR. The rapid expansion of the Internet provided the infrastructure for real-time data exchange, and the debut of the iPhone in 2007 revolutionised the mobile landscape with high-resolution displays, GPS, and powerful processors. This transformation turned mobile phones into universal AR platforms, bridging the gap between specialised industrial tools and consumer applications.

The last decade represented a critical phase in the evolution of AR as we now know it, largely propelled by the rapid advancement of mobile technology, combined with the widespread proliferation of smartphones and tablets equipped with increasingly more advanced cameras, sensors, and processors (Canavilhas, 2013). This made AR accessible to the general public and started the commercialisation of AR, leading to the release of mobile AR applications, such as Pokémon GO (2016), and AR content on social media platforms (Uskali et al., 2021), showcasing AR’s potential to engage users on their mobile devices.

Today, modern AR continues to develop, powered by advances in machine learning, 5G technology, and Artificial Intelligence, enabling faster, more seamless interactions.

2.1.2 DIGITAL STORYTELLING POTENTIAL

The ability of AR to reshape how we visualise complex information showcases how one of its most valuable applications lies in journalism. Taking advantage of 3D reconstructions or geographic overlays, AR transmits abstract data and narratives into spatial experiences that boost how users comprehend and empathise with news.

“We define news as a principal subset of journalism, but one that focuses on the delivery of information. AR is central to journalism in that it serves the same essential function as news — it augments the user's experience with the real-world, natural environment.” (Pavlik & Bridges, 2013)

Additionally, AR opens up many possibilities for personalised news experiences by building on the customised content consumption already common on mobile devices. As Pavlik (2001) outlined, personalisation is a crucial dimension of the era of online journalism. This adaptability enhances the relevance and engagement of stories, making it essential to present investigative reports, breaking news, and cultural topics in dynamic formats that adjust to each user's needs.

Major media organisations have experimented with AR across several media. Industry leaders such as Metro and Time (as shown in the case studies), as well as The New York Times, Wall Street Journal, and the BBC were early adopters of AR, with the BBC introducing Aurasma, one of the earliest commercial AR technologies, as early as 2011 (Pavlik & Bridges, 2013). These immersive experiences, covering topics from climate change to conflict zones, created a powerful sense of presence that traditional formats have struggled to achieve.

These innovations gave rise to a new movement in media, sometimes described as Hi-Tech Journalism, which is defined as the next step in digital journalism that integrates emerging technologies such as AR, VR, and AI (Pérez-Seijo & Vicente, 2022). Among these, AR stands out for its ability to enrich digital storytelling by merging virtual narratives into physical reality, allowing users to step into what López Hidalgo (2016) described as "journalism that will tell the future" in our increasingly digitally powered world.

As AR cements its role in journalism, it provides new and exciting creative opportunities. However, it also introduces operational challenges that require close consideration to ensure the technology delivers on its promise responsibly.

2.1.3 LIMITATIONS IN NEWS MEDIA

Despite all the possibilities in the information sector and the enormous potential of the technology, the adoption of AR across media faces several challenges and limitations. As evidenced by Tejedor-Calvo (2020), the primary barriers remain the high cost associated with the technology, even with all the advancements, users still need medium to high-end devices, excluding large audiences who cannot afford such equipment. Additionally, while more AR experiences are available on consumer devices, creating high-quality AR content requires advanced hardware and software investments, which can be cost-prohibitive for many media organisations.

Other challenges arise in user adoption and engagement, even though AR can deliver immersive storytelling experiences, it still requires specialised platforms or applications. This reliance on external factors limits its audience reach. Furthermore, this issue is compounded by the fact that several consumers still view AR as a novelty rather than a mainstream tool, leading to inconsistent usage (Pavlik & Bridges, 2013).

Technical constraints, such as limited field of view in devices, high battery usage, and the need for broadband internet connectivity (especially when interacting with real-time experiences), also impact AR implementation and limit its use in content delivery. In addition to the technical aspects, AR applications also raise several ethical and privacy issues. While AR can enhance empathy (De La Peña et al., 2010), other authors (Sánchez Laws & Utne, 2019) warn against the potential exploitation of immersive crisis recreations, which may sensationalise real suffering for engagement and cause further harm. Furthermore, augmented experiences often require extensive collection of user data, raising important questions about topics such as surveillance and data protection (Carmigniani & Furht, 2011).

2.2 CURRENT STATE OF PRINT MEDIA

"Journalism and the media have been drastically changed in large part by digital technology, the Internet, and mobile media." (Pavlik & Bridges, 2013)

The print news media industry, once the pillar of mass communication, now faces its most significant challenge across its long history: digital transformation. The digital era has not only transformed consumer behaviour but also drastically challenged how newspapers operate in the economic and technological space. Understanding the challenges that threaten the survival of traditional print journalism is essential to examining how AR can help evolve the way audiences consume the medium.

2.2.1 CHALLENGES IN THE DIGITAL AGE

Over the past two decades, the rise of digital platforms, social media, and mobile-first news consumption has eroded the traditional newspaper business model. Print circulation continues to decline, accompanied by a steep fall in revenue from a business primarily sustained by advertising and subscription fees ('Pew Research Center', 2023).

Although many news outlets have released online versions to capture growing online advertising revenue, a large share of that income remains dominated by tech giants such as Google and Meta. This imbalance leaves media companies with diminished financial returns, forcing them to downsize, reduce print operations, and, in some cases, permanently shut down (Cohan, 2020; Pavlik & Bridges, 2013).

At the same time, audiences have shifted in how they consume media. Raised in the digital era, younger audiences increasingly prefer interactive, fast-paced, and immersive content (Tkalac Verčič & Verčič, 2013), qualities that social media and multimedia platforms better meet than traditional print. As a result of these expectations, Gen Z and millennials increasingly opt for other media rather than static newspaper formats (Tejedor-Calvo, et al., 2020).

Beyond audience behaviour, print media also presents several technological limitations. Unlike digital platforms, print lacks the support for video, real-time updates, or interactive visuals, fundamental features in today's competitive information ecosystem. This lack of adaptability restricts newspapers' ability to evolve their content delivery immersively and fluidly to respond to the new reader's expectations.

At this critical point, some print media outlets have turned to emerging technologies, among which AR, in search of strategies to modernise the print experience and reconnect with predominantly digital audiences. AR has the potential to bridge the gap by offering hybrid content experiences that combine the lasting appeal of paper with the dynamic enhancements of digital.

"The mediums that adopt new approaches, enabling readers to interact with content long after issue dates fade, are the ones that will emerge victorious in digital media's new era." (Hiwaizi, 2015)

Unlike the traditional "cross-media publishing model" workflow in the modern printing sector, which only separates print and digital outputs at the publishing phase (Veglis, 2008), AR applications render this divide obsolete by blending them into a unified experience. Now, content printed on a page, a newspaper, a magazine or any other format can be enhanced with AR that gives readers access to multimedia features, such as previously mentioned videos, data visualisations, or live updates, simply through a smartphone camera. This fusion redefines the value of printed surfaces, extending their relevance well beyond their initial publication.

Above all, AR does not merely replicate digital content within a printed context. It also capitalises on print's unique enduring strengths: emotional resonance, tactile engagement, ease of navigation, and perceived credibility (Soundarapandian, 2024). As Hiwaizi (2015) argues, media that enable sustained interaction with content "long after issue date fade" will thrive. AR does this by embedding lasting digital value in physical vessels, opening them to deeper exploration. In doing so, it transforms print and digital from competitors into complementary platforms, each enhancing the other's capabilities.

However, print media must not rely solely on AR's transformative potential as a standalone solution. To remain viable, print must maintain the quality standards of its products to preserve its unique appeal. AR should augment, not replace, the value of printed content, and position itself as a hybrid medium that combines the strengths of both worlds to deliver a new communication experience.

2.3 AR CASE STUDIES

Since its emergence as a transformative communication tool, AR has been increasingly explored across various media, with organisations innovating how they deliver content. In particular, several case studies in print media showcase how media outlets have integrated AR into their platforms. These examples reveal common implementation strategies and highlight pathways for further development, offering insights into how AR could be enhanced and engaged with more effectively.

To better understand the complexity and depth of AR integration in each of these cases, Prendes (2014) proposes a four-tier classification system ranging from Level 0 to Level 3, based on the degree of immersion and application provided:

Level 0: Physical World Hyperlinking - Involves the use of Barcodes, 2D Codes (for example, QR codes), or Image Recognition. At this tier, the codes link to external content without 3D or bookmark tracking.

Level 1: Marker-Based AR - Relies on the recognition of 2D patterns or 3D objects to trigger AR content.

Level 2: Markerless AR - Uses sensors such as GPS, gyroscopes, compasses, or accelerometers in the device to determine the situation and orientation, allowing the superimposition of points of interest onto real-world environments.

Level 3: Augmented Vision - Represents the highest level of immersion, where AR content appears automatically in the user's vision without requiring interaction. This level offers limitless customisation but remains inaccessible through current technology.

2.3.1 EXPERIMENTAL AR PHYSICAL PIECES

Before diving into journalism-specific applications, it is essential to see how AR is used to enhance other static and physical products, evolving traditional everyday objects into interactive pieces.

CARLINGS - “THE LAST STATEMENT” T-SHIRT, 2019

Introduced by the innovative Scandinavian clothing brand Carlings, the “Last Statement” T-shirt is designed to be specifically altered through augmented reality. The physical shirt features a front logo that serves as a graphic marker and tracking point. Using custom AR filters in the Instagram application, users can overlay various political and social slogans onto the shirt's blank space, which dynamically tracks and moves with the fabric (Figure 4).

As an AR application, it sits at Level 1 of Prendes’ scale. The project importantly demonstrates how AR can solve physical limitations, allowing a single item to display infinite messages through a digital layer, reducing textile waste while still maximising personal expression. This use of Instagram’s Spark AR platform (Figure 5) also shows the possibility of integrating AR through widely used social media platforms, instead of relying on standalone software.



Figure 4 - Carling’s “The Last Statement” T-Shirt, 2019
Source: https://highsnobiety.com/p/carlings-the-last-statement-t-shirt/

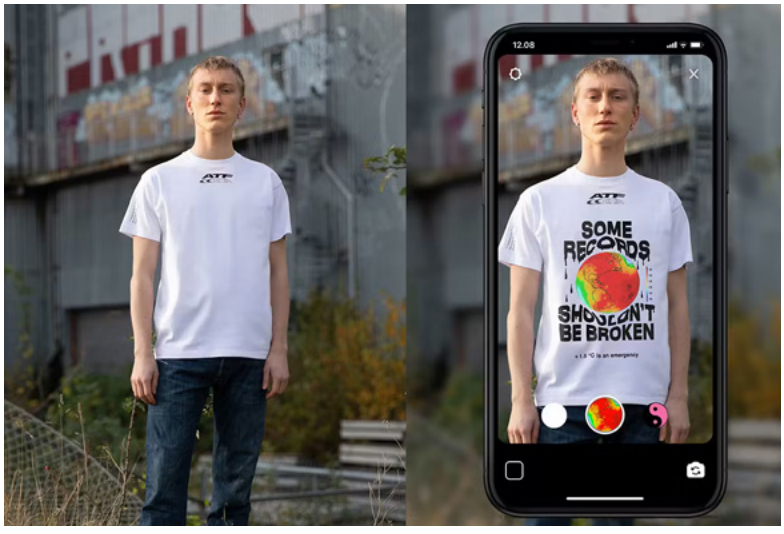


Figure 5 - Carling’s “The Last Statement” T-Shirt - Spark AR Interface, 2019
Source: https://highsnobiety.com/p/carlings-the-last-statement-t-shirt/

NICK BARCLAY - “MEASUREMENTS” AR COCKTAIL BOOK, 2019

In the scope of editorial design and publishing, designer Nick Barclay created a simple but excellent demonstration of an AR use case, integrating the technology to bring the static page recipes to life. When readers scan the book's physical pages with a smartphone, minimalist 3D animations of each cocktail and its ingredients emerge step by step from the paper (Figures 6 & 7).

This is a prime example of AR being used for data visualisation and instructional design within a traditional book format. Operating at Level 1 of the integration scale, it proves augmented layers can seamlessly complement editorial layouts and engage the reader visually, without adding extra clutter or removing the physical objects' independence.



Figure 6 - Nick Barclay’s “Measurements” AR Book, 2019
Source: https://nickbarclaydesigns.com/book

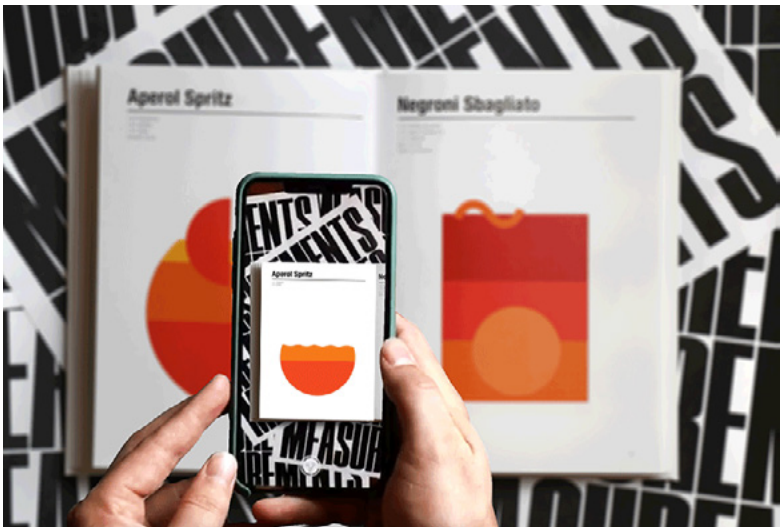


Figure 7 - Nick Barclay’s “Measurements” AR Content, 2019
Source: https://nickbarclaydesigns.com/book

2.3.2 AR IN PRINT JOURNALISM

Beyond these broader applications, several print media outlets have experimented with AR on their platforms to combat the static nature of news delivery. These examples reveal common implementation strategies and highlight ways to build on their foundations in information editorial design.

ESQUIRE, 2009

In 2009, Esquire magazine released its special “Best and Brightest” AR-enabled edition (Figure 8), marking one of the first and most notable attempts to incorporate AR into print media (Esquire | December 2009, 2009). This issue represented the first bold experiment by a mainstream publication to explore AR integration with printed content, aiming to revitalise its traditional experience through additional interactive digital components.



Figure 8 - Esquire’s “Augmented Reality Issue”, 2009
Source: https://classic.esquire.com/issue/20091201

At the heart of the issue was an interactive AR cover and internal page spread featuring actor Robert Downey Jr., inviting readers to download proprietary software and use a computer webcam to access the AR features. When the printed QR marker placed below Downey's cover photo was held up to the webcam, it activated a digital overlay. This initiated an AR sequence in which a 3D-rendered version of Downey appeared on the screen, walking, talking, and interacting with the physical magazine to promote his film Sherlock Holmes (Figure 9). As the user tilted or moved the magazine, Downey's digital counterpart responded in real time, climbing atop the physical copy or performing a short song (Ridden, 2009).

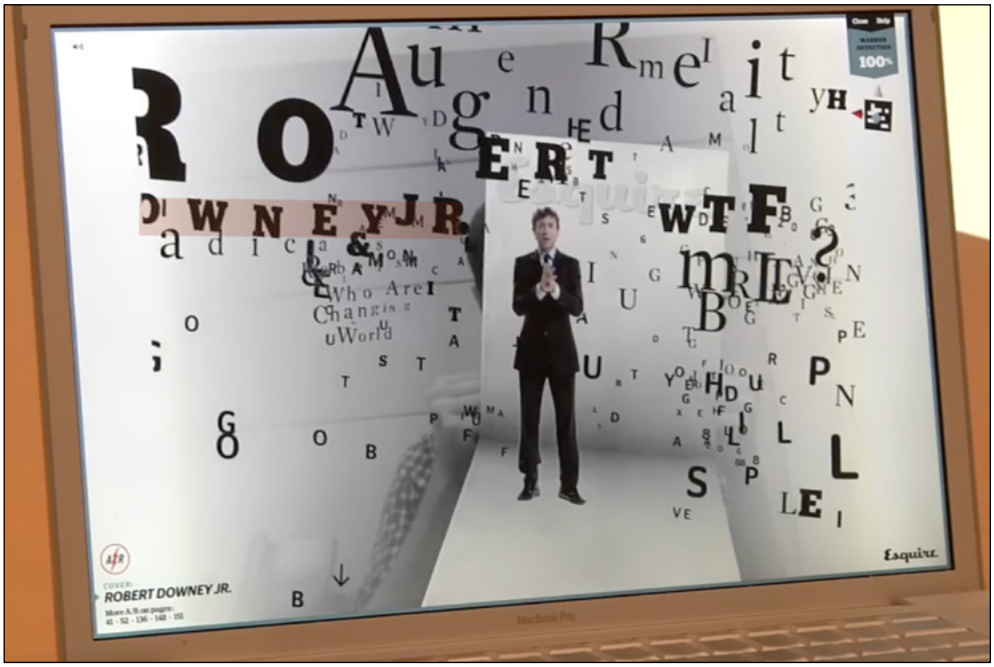


Figure 9 - Interaction with Esquire's Augmented Content, 2009
Source: https://classic.esquire.com/issue/20091201

The intent of the AR content was to cover a range of topics, including entertainment, promotional media, and access to a limited behind-the-scenes photo essay. Technologically, the experience sits at Level 0 of Prendes's AR immersion scale because it relies on QR codes to trigger digital content. However, in terms of user interaction, it reached Level 2, as readers could perform basic actions to modify the on-screen content.

Despite its relatively simple technological framework by today's standards, Esquire's 2009 issue remains influential as a foundational proof-of-concept moment in the evolution of AR in journalism. It demonstrated that printed material could become more than static content. At the same time, it highlighted many practical challenges to widespread AR adoption, from the need for dedicated hardware and software to reliance on users' willingness to engage with unfamiliar technologies. Nevertheless, the issue set a precedent for future innovation and continues to be cited as a significant leap in the merging of print with immersive media.

METRO HERALD & METRO SWEDEN, 2011-12

At the start of the decade, Ireland's Metro Herald published five editions in September 2011, advertised as the "World's first fully augmented AR newspaper" (Margaritopoulos & Georgiadou, 2023) (Figures 10 & 11). The publication used new technology developed by Blippar that could trigger digital augmentation through a smartphone application with markerless vision. By scanning the newspaper, readers could access several new interactive features, ranging from video content for advertisements to puzzles, polls, and promotional contests.



Figure 10 - Metro Herald's AR Indicator, 2011
Source: https://siliconrepublic.com/play/worlds-first-augmented-reality-newspaper-hits-presses



Figure 11 - Metro Herald's AR News Example, 2011
Source: https://facebook.com/blippar/photos/metro-herald-cover-page/251085468270008/

Following this trailblazing idea, the Swedish newspaper Metro implemented similar AR functions in 2012, allowing readers to use their smartphones to interact online with the physical newspaper's content. Using a browser created by Swedish company 13th Lab, the outlet adopted a new approach to the technology by enhancing print articles with social-media features, allowing readers to leave comments, “like”, and share content (Margaritopoulos & Georgiadou, 2023). Additionally, the AR experience supplemented the printed news stories with current information, interactive polls, video stories, music content, and an interactive art gallery (Figure 12).



Figure 12 - Metro Sweden’s AR Content, 2012
Source: https://arcticstartup.com/pointcloud-13th-labs/

Technologically, relying on markerless computer vision places both of these early newspaper experiments at Level 2 of the immersion scale. Together, they demonstrate how daily newspapers can use AR to break free from static content limitations, expanding brief news moments with dynamic, real-time interactivity and social engagement.

THE NEW YORKER, 2016

More recently, in 2016, The New Yorker launched its first AR-enhanced cover, “On the Go” (Figures 13 & 14), in collaboration with artist Christoph Niemann as part of its Innovators issue. The project marked a creative use of traditional illustration with AR, delivering an animated 3D layer for the stylised subway scene depicted on the cover when viewed through the dedicated Uncovr app on a smartphone.



Figures 13 & 14 - The New Yorker’s AR Cover, 2016
Source: https://itsnicethat.com/news/christoph-niemann-new-yorker-100516

To access the AR component, users had to download the third-party app and use their smartphone camera to scan the magazine cover. Once activated, the scene began to animate with dynamic elements within the digital environment, driven by gestures and device orientation (Figures 15 & 16). This interactivity elevated the experience by allowing readers to explore and control the bustling environment through simple actions, such as shifting their phone or changing perspective.

On the technical side, The New Yorker’s project fits Level 1 of the AR immersion scale for activation, relying on image recognition to trigger 2D animation over the physical magazine. As for user interaction, the experience aligns with Level 2, as it leverages motion tracking and device orientation to affect the displayed content, offering a limited but effective way to engage with the animation.





Figures 15 & 16 - Interactions with The New Yorker's AR Cover, 2016
https://itsnicethat.com/news/christoph-niemann-new-yorker-100516

Although relatively simple, the project was artistically ambitious and important, as it showcased how AR could enhance not only the information-storytelling side of journalism but also the visual side of news media, an integral part of The New Yorker's and many others' brand identity.

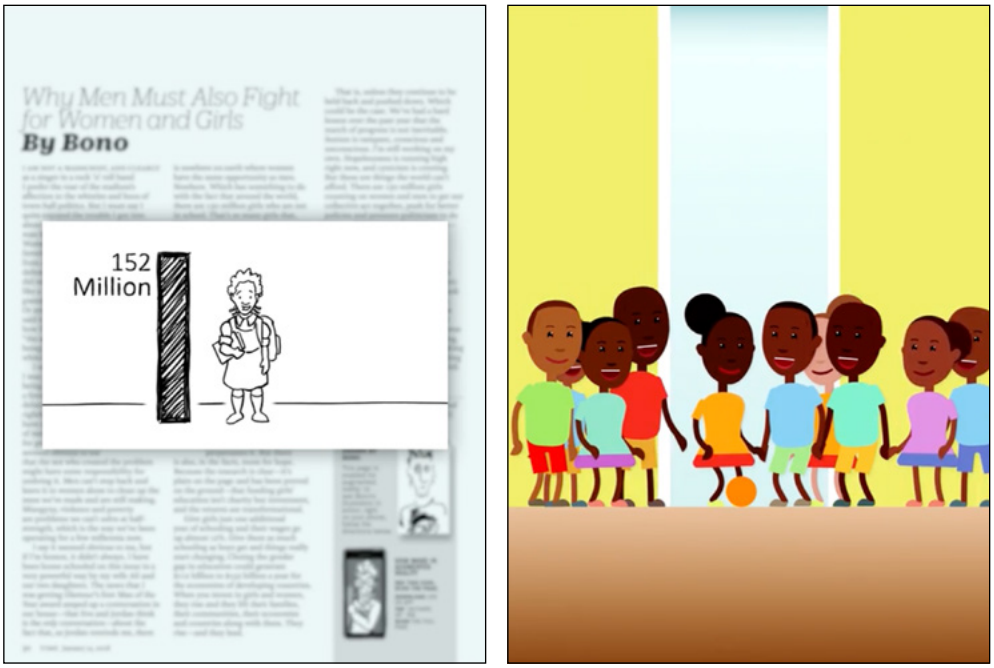
TIME MAGAZINE, 2018

In January 2018, TIME magazine released its “Optimist” Issue (Figure 17), a groundbreaking edition featuring AR. Guest-edited by Bill Gates, the issue aimed to spotlight stories of positive global change and innovation, aligning with its editorial theme of progress. The AR content was developed in collaboration with RYOT Lab and was accessed via the LIFE VR app on both smartphones and tablets.



Figure 17 - Time’s “Optimist” AR Issue, 2018
Source: https://time.com/5084021/optimism-ar/

By scanning specific pages within the magazine using the app, readers could unlock a variety of interactive experiences. These included an animated cover story narrated by Gates, telling the story of Ethiopian child Mohamad Nasir (Figure 18), as well as an infographic featuring Bono with several pieces of information on global educational gender disparities (Figure 19). Additional features allowed users to explore an interactive globe visualising the impact of global aid, access behind-the-scenes videos, and 3D models that extended the narrative beyond print.



Figures 18 & 19 - Experiences of Time's "Optimist" AR Issue, 2018
Source: https://time.com/5084021/optimism-ar/

The AR integration in this issue fits between Level 1 and Level 2 on the AR immersion scale. It used Level 1 marker-based image recognition to activate AR content and incorporated environment tracking, enabling users to reach Level 2 in content interaction through gestures and movement.

Time's initiative demonstrated AR's powerful potential as a journalistic tool, particularly for emotional storytelling and complex data visualisation. Rather than using AR merely for promotional or entertainment purposes, the magazine leveraged the technology to deepen reader understanding and empathy around serious global issues. The involvement of public figures like Gates and Bono added credibility and global resonance, signalling a forward-thinking vision for how AR could enhance the print experience while remaining rooted in serious editorial content.

NATIONAL GEOGRAPHIC, 2020

To commemorate Earth Day in April 2020, National Geographic unveiled an AR-enhanced Earth Day cover to mark the 50th anniversary of the global environmental movement, offering a view into a futuristic glimpse of our planet's climate trajectory (Figure 20). Developed with Spark AR, the experience was designed to immerse audiences in the beauty and fragility of Earth's ecosystems, aligning with the publication's longstanding mission of educating readers on the natural world.

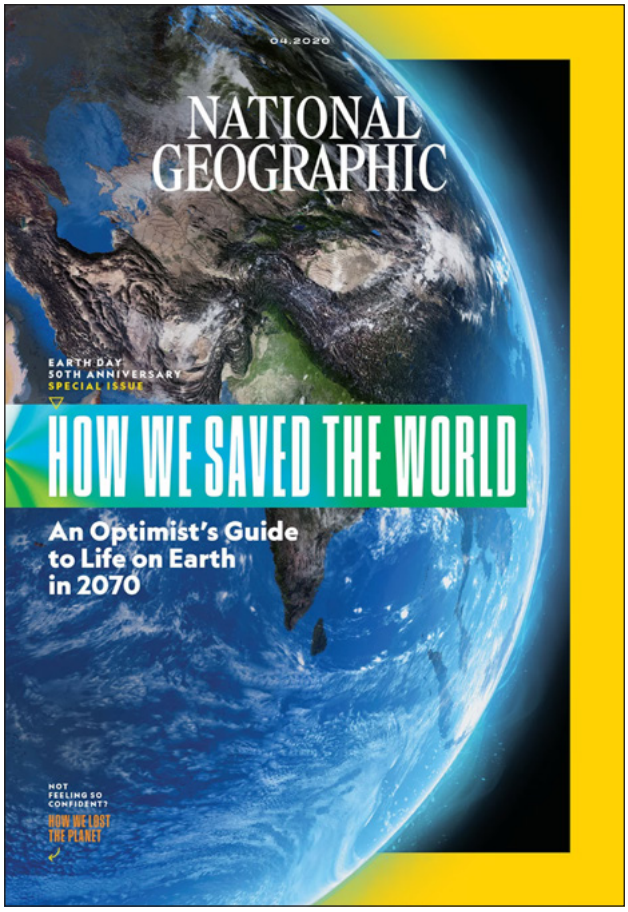
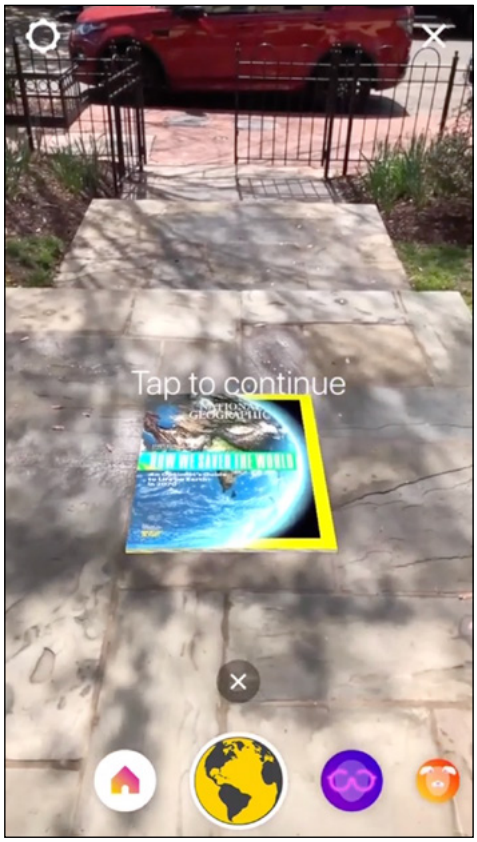


Figure 20 - National Geographic's Earth Day AR Cover, 2020
Source: https://nationalgeographic.com/pages/article/earth-day-instagram-ar-experience

By scanning the cover with the AR filter within Instagram's camera section, users could engage with a 3D animated Earth globe that responded to movement and touch. By rotating the globe or tapping sections, visuals emerged that users could use to explore key facts and data for 12 major cities, along with projected information on climate and deforestation impact (Figures 21 & 22). This made the interaction not just visually compelling, but most of all informative, offering a mini data-rich experience that directly powered the article on a platform familiar to millions of users.





Figures 21 & 22- National Geographic's Earth Day AR Experience with Spark AR, 2020
Source: https://nationalgeographic.com/pages/article/earth-day-instagram-ar-experience

On the immersion scale, the experience fits Level 1, as it used image recognition and orientation tracking via a smartphone camera, but didn't feature fully autonomous AR behaviour. In terms of interaction, it reached Level 2 by enabling real-time user manipulation of the globe and delivering layered information in response to user actions.

What sets National Geographic's Earth Day cover apart is the strategic use of a widespread platform technology. By leveraging Instagram's built-in AR filters, the experience was immediately shareable and easily accessible to platform users, taking advantage of the social media aspect and the viral potential of digital media. It demonstrated that AR could be both accessible and impactful, raising awareness of important environmental topics through immersive experiences that don't require the complexity and learning curve of third-party applications.

2.4 CHALLENGES & ETHICAL CONSIDERATIONS

While integrating AR into journalism shows promise for reinvigorating print media, it also introduces a complex range of barriers, potential risks, and ethical dilemmas. As previously outlined in section 2.1.3, AR adoption in media already faces broad obstacles, including high implementation costs, limited device accessibility, and inconsistent user engagement, issues that become even more elaborate within the domain of print journalism. Integrating immersive layers into print not only expands concerns about usability and access but also introduces new topics related to credibility, narrative focus, and editorial accountability. This section explores three key areas of AR journalism: accessibility issues, risks of misuse, and emerging ethical dilemmas.

2.4.1 ACCESSIBILITY

Despite the growing adoption of AR technology across various industries, accessibility remains a major hurdle, particularly for print journalism. Even with the increased presence of smartphones within our society, AR content often requires high-end devices equipped with powerful cameras, fast processors, and advanced sensors. This creates an inherent barrier to access for users without such devices, reinforcing the divide in lower-income communities and underdeveloped regions. As a result, AR risks worsening inequalities in information access, a critical problem for journalism's core mission of providing universal public knowledge.

Even among those with suitable devices, AR can present usability challenges. AR print applications frequently rely on QR code scanning, markers, or images to unlock digital overlays. However, these experiences can be frustrating to navigate due to unstable tracking, unintuitive interfaces, lagging connections, or the need to install third-party platforms. These hurdles disrupt the reading experience and, coupled with the medium's novelty, can lead to user frustration and engagement drop-off, limiting AR's long-term impact as a storytelling tool.

Another often overlooked barrier is technological illiteracy, a problem especially important for print journalism, whose main readership groups often consist of older generations who may not own or be savvy with newer technologies. While younger readers may be more inclined to experiment with AR features, others may struggle to learn how to interact with such content. This generational divide challenges the notion of universal access to journalism through AR.

Furthermore, exclusion may also occur on psychological levels. As noted by Sánchez Laws & Utne (2019), immersive journalism may emotionally alienate some audiences, especially when AR content places users inside traumatic or intense simulations of war or crime. This highlights how immersive formats can inadvertently distress viewers and thus require stronger safeguards.

Alongside reader limitations, incorporating AR into traditional newsrooms requires a major production transformation. Journalists, editors, and designers must adapt to collaborate closely with developers, 3D artists, and UX specialists, which introduces new logistical and financial challenges, particularly for smaller media organisations that already lack the resources to invest in such teams. Thus, while AR remains an opportunity for growth, it may also intensify existing inequalities across both readership and production capacity.

2.4.2 POTENTIAL AR USE RISKS

Beyond access and implementation concerns, AR carries several risks to journalistic storytelling. Highest among these is the potential for misinformation or manipulation, an already radically escalating concern in the digital age. The persuasive and immersive nature of AR can drive greater news impact through stimulus than traditional static news. However, if the elements are not carefully fact-checked or are not presented with sufficient context, this may lead to severe narrative distortion, exaggeration, or misrepresentation. This is a paramount concern for news reporting, where factual integrity is essential in the fight against “fake news”.

As shown by Lu et al. (2023), 3D model optimisation techniques for AR inherently alter the reality presented, potentially intensifying the risk of misinformation. For example, 3D photo-mapping techniques require removing “noise” from the original photos, a process that could be enough to misrepresent the devastation of war scenes or the scale of protests, among other effects. Unlike photo editing in articles, these changes often go unlabeled, violating standards applied to printed content, such as the New York Times' prohibition on object removal (Figure 23).

Table 1. How certain editing techniques are tolerated by two major U.S. newsrooms' editorial standard versus typical photogrammetry AR model development processes.

	New York Times photography guideline	Los Angeles Times photography guideline	A typical photogrammetry AR model
Montage	Not mentioned	Prohibited	Often required
Color adjustment	Minimally necessary	Minor adjustment allowed	Often required
Remove objects	Generally not allowed	Not allowed	Often required
Labeling practice for altered photos*	Label as “photo illustration”	Label as “photo illustration”	No labeling standard

* *Specific definition and scope vary from newsroom to newsroom.*

Figure 23 - Table on AR editing guidelines of major US news outlets
Source: (Lu et al., 2023)

These concerns are further supported by Sánchez Laws & Utne's (2019) analysis of immersive simulations, which found that visual editing in crime scene model cleanup lacked disclosure and violated established photojournalistic ethics. When augmented visuals present reconstructions of events without clear labelling, audiences may combine digital fabrication with factual reality, raising further complicated ethical implications.

Another risk presents itself in sensory overload, as AR experiences often involve multiple sensory inputs, from visual, audio, and movement cues, that, while engaging, can negatively overwhelm users in the search for immersion. In journalism, where clarity and focus are essential, excessive actions can detract from the message rather than enhance it. Critically, if the augmented content contradicts or overshadows the printed message, it can erode coherence and increase the risk of misinformation.

These risks have far-reaching implications. For example, AR content that dramatises an event or presents images without full context may unintentionally skew the facts or bias the reader. This blurs the line between factual reporting and narrative stimulation, which, while not inherently opposed, must be carefully balanced. If not used with care, AR threatens that balance, complicating the delivery of objective and accurate information.

2.4.3 ETHICAL CONCERNS

Alongside practical and technical aspects, AR in journalism raises several ethical concerns. One that is extremely relevant and pressing in our digital society is data privacy. Many AR applications rely on tracking user location, behaviour, and device activity to personalise and optimise the experience. While this personalisation can enhance interests by tailoring each experience, it raises serious concerns about surveillance and consent. Without clear disclosure and data protection policies, the transparency and public trust that anchor journalism may be compromised in the pursuit of engagement metrics.

Moreover, as the boundaries between digital storytelling and immersive media blur, it becomes clear that AR narratives require careful study to understand how augmented content may distort, sensationalise, or contradict the printed message. The previously discussed lack of labelling standards for AR content creates a significant ethical gap. While photos altered for clarity are qualified as illustrations, AR models, even those edited for performance, are rarely labelled as such. This difference is evident in the Los Angeles Times' 2019 short article featuring unlabeled AR burger models showcasing different burgers from the 21 best dinners in the city (Figure 24 & 25). This example undermines transparency and contributes to Artificial Reality, a term for immersive experiences that look realistic but are factually dishonest (Lu et al., 2023). Newsrooms must update their guidelines to ensure AR modifications are minimal and explicitly acknowledged.




Figures 24 & 25 - Photo vs. AR Model Comparison of a Burger in the article, 2019
Source: (Lu et al., 2023)

The immersive aspect of AR can provoke strong emotional responses, which, if not examined closely, may lead to unintentional misinterpretation or manipulation of information. Without extensive audience research and oversight, these risks could greatly jeopardise the future of journalism.

For AR to realise its potential as a communication tool, especially in print journalism, it is critical that these challenges are addressed proactively. Media organisations, industry leaders, and lawmakers must work together to ensure inclusive access, protect user privacy, and maintain the highest editorial integrity. Regulation and standards are needed not to stop innovation, but to guide it as a force of good in the future of journalism. Only by recognising these obstacles can AR be positioned not as a momentary gimmick, but as a lasting, powerful platform.

[03]
METHODOLOGY

To ensure the project's quality, key parameters in the research approach, prototype development, and user testing will be established for use during production. The primary goal will be to provide further insight into how AR can enhance the visual presentation of printed news content, highlighting the technology's most effective use cases from an information design perspective.

3.1 RESEARCH APPROACH

After defining the project's core intent and objectives, extensive research will be conducted to ensure a comprehensive review of the current state of the art and available resources. During this phase, the intersection of AR and print journalism will become the main focus. The main aim of the research will be to assess the current technological landscape, document historical uses of AR in print news, gather analysis of print media consumption, and expand knowledge of experimental AR design.

In order to organise the existing literature and integrate key points from reference papers, the research will be grouped into four core principles:

Technical Framework and Definition of AR: Brief introduction of the technology and how it is incorporated into the daily world.

AR Journalism Integration: Case studies and evaluation of past AR uses across the media.

Print Media Trend Analysis: Investigation into the evolution of print media in the digital era.

AR Design Creation: Breakdown of the AR process from the designer's point of view.

Importantly, a critical gap exists between current academic research and practical applications. Most existing studies are analytical and lack functional prototypes to simulate and evaluate real-world use. Moreover, there is a distinct lack of consideration for the designer's perspective. While the technical aspects of AR applications are well documented, vital visual reflections on content layout, aesthetic integration of AR triggers, and graphical content density remain largely underexplored. Therefore, this project will aim to address this discrepancy by prioritising a design-centric view over a purely technical one.

3.2 PROTOTYPE DEVELOPMENT

After an extensive and careful review to identify the core research gaps, the project will transition into the prototype development phase.

PROJECT CONCEPT

To serve as a practical and accessible tool for designers, the project will avoid a traditional newspaper format, ensuring the physical artefact aligns with the primary goal without limiting reproducibility or future expansion. Instead, to guarantee the prototype is universal, easily reproducible, and modular, a simple A4 "catalogue" format will be adopted.

CONTENT SELECTION

To properly simulate real-world AR use cases in print journalism, four existing articles from diverse genres will be sourced from popular Portuguese publications: Diário de Notícias, Jornal de Notícias, and O Jogo. Each will be specifically chosen and adapted to represent distinct AR uses in daily news consumption.

PROTOTYPE FRAMEWORK

The technical approach will prioritise ready-made prototyping tools over the development of new AR software, reinforcing the focus on the designer's perspective. To ensure a seamless visual process, the Adobe Creative Suite will be initially utilised exclusively to maintain a realistic design industry workflow:

- **Asset Production:** Adobe Illustrator, Photoshop, and After Effects will be the main tools used for editorial design, image manipulation, and motion graphic production.

- **AR Implementation:** Due to the announced discontinuation of Adobe Aero in 2025, this tool is no longer a viable option for sustainable AR development. Therefore, the project will utilise Scenery, an upcoming application that shares many of Aero's strengths, while addressing several of its weaknesses.

MARKER-BASED AR

During the design process, marker-based AR, specifically using QR codes, will be prioritised over markerless alternatives. This decision relies on several reasons identified in the case study research:

- **Performance:** Improved optical performance in smartphone cameras, enabling smoother placement and animation of AR assets.

- **Accessibility:** Wide recognition of QR codes among the general population, leading to less friction in user onboarding and a shorter learning curve for the technology's application.

DOCUMENTATION STRATEGY

Upon reaching the final prototypes, in-depth visual showcases will be prepared using both images and video. A deliberate combination of first and third-person recordings will be used to provide accurate, immersive, and deep documentation of the user experience. This strategy will be designed to establish a long-lasting record for future research, thus preventing potential risks associated with digital decay (internet rot) and software obsolescence, problems that frequently lead to the loss of interactive AR content.

3.3 USER TESTING

Upon completion of the project development, a user testing stage will be conducted to analyse the core functionalities of the prototypes in real-world use, as well as any unforeseen issues that might arise among users.

The sample will consist of 10 users, carefully selected to ensure diversity and a small but effective sample, with the following criteria:

- **News Consumption Habits:** Casual Consumers, Common Newspaper Readers, and Media Professionals.
- **Device Model:** Different iOS and Android Models.
- **Age Group:** Under 30, Between 30 and 60, and Over 60.

After the selection process, users will engage in a testing procedure, split into three main stages:

1. INTRODUCTION
A brief project explanation with no user guidelines to allow free initial exploration.

2. USER TASK
Use of the four prototypes to find and interact with augmented content.

3. SHORT POST-USE SURVEYS
Responses to key questions:
1. Was the AR component easy to use?
2. Did the AR content improve your experience reading the news?
3, Which of the four AR prototypes did you find the most useful/engaging?
4. Would you use AR in print newspapers again?
5. What did you like most about the experience and what would make it even better?

Finally, the collected data (Observation Notes, Survey Responses, and Key Takeaways) will be compiled to aid the analysis of findings and insights. Pertinent topics, such as user engagement, comprehension, usability insights, interaction patterns, user preferences, and expectations, will be considered during this stage to gather valuable information on implementing AR in print news media.

This process will also inform reflections on key points in prototype and design development for future use cases of augmented print news during the project's discussion and conclusion.

[04]
PROTOTYPE

4.1 CONCEPT & IDEATION

After completing the theoretical research and identifying appropriate case studies to support the project, four distinct AR use cases were converted into practical applications. The goal was to show how the technology could address the limitations of traditional print media, such as space constraints, static data, and limited multimedia engagement.

For these prototypes, existing articles were selected from major newspapers in the Portuguese media landscape: **Diário de Notícias (DN), Jornal de Notícias (JN), and O Jogo**. Each publication provided a familiar context area to test specific AR interactions:

- **Photographic Expansion [Prototype 001]:** Print layout design often needs to prioritise valuable page real estate over extra visual assets. Using the main front-page article covering the 2024 government election results, an AR layer was introduced to display portrait photographs of all newly appointed officials, complementing the physical component that displayed only their name and title. This lets readers associate faces with names, adding visual context without cluttering the physical layout or increasing printing costs.

- **Video Content Expansion [Prototype 002]:** Most sports journalism relies heavily on dynamic content, which print media unfortunately cannot capture. The football match report was selected because of its relevance to the country's sports industry and its potential to integrate video capabilities. At the start of the experience, the reader's smartphone displays a 3D video gallery over the physical article, with clickable buttons for videos of each goal. This allows readers to bridge the gap between reading the tactical analysis and viewing the previously digital-exclusive match highlights.

- **Real-Time Data Updates [Prototype 003]:** One of the main disadvantages of printed newspapers is the immediate obsolescence of certain news and time-sensitive data. To address this, the weather forecast and culture page was chosen. The AR layer provides readers with an intro section divided into two parts: one that allows access to updated live weather and a 24-hour forecast, and another that provides the results of the riddles, usually only shared in the next paper's edition. This demonstrates AR's value in transforming static graphics into a dynamic, real-time data feed that remains accurate long after the pages are printed.

- **Interactive Digital Infographics [Prototype 004]:** Complex data can be overwhelming to condense and confine to static printed pages. Using an article about the national election results data, an expanded AR infographic layer was designed. This way, readers could engage with the digital layer to visually explore the polls' voting totals, compare party seat counts with previous elections, and view the full elected officials map with all their information. This use case highlighted the technology's ability to turn passive reading into an appealing data visualisation experience.


Fundado em 1864, o seu Arquivo é Tesouro Nacional

Diário de Notícias

OS 17 ESCOLHIDOS

UM GOVERNO POLÍTICO FEITO COM A PRATA DA CASA

MINISTRO DE ESTADO E DE NEGÓCIOS ESTRANGEIROS PAULO RANGEL MINISTRO DO ESTADO E DAS FINANÇAS JOAQUIM MIRANDA SARMENTO MINISTRO DA PRESIDÊNCIA ANTÓNIO LEITÃO AMARO MINISTRO ADJUNTO E DE COESÃO TERRITORIAL MANUEL CASTRO ALMEIDA MINISTRO DOS ASSUNTOS PARLAMENTARES PEDRO DUARTE MINISTRO DA DEFESA NACIONAL NUNO MELO MINISTRA DA JUSTIÇA RITA JÚDICE MINISTRA DA ADMINISTRAÇÃO INTERNA MARGARIDA BLASCO MINISTRO DA EDUCAÇÃO, CIÊNCIA E INOVAÇÃO FERNANDO ALEXANDRE MINISTRA DA SAÚDE ANA PAULA MARTINS MINISTRO DAS INFRAESTRUTURAS E HABITAÇÃO MIGUEL PINTO LUZ MINISTRO DA ECONOMIA PEDRO REIS MINISTRA DO TRABALHO, SOLIDARIEDADE E SEGURANÇA SOCIAL MARIA DO ROSÁRIO PALMA RAMALHO MINISTRA DO AMBIENTE E ENERGIA MARIA DA GRAÇA CARVALHO MINISTRA DA JUVENTUDE E MODERNIZAÇÃO MARGARIDA BALSEIRO LOPES MINISTRO DA AGRICULTURA E PESCA JOSÉ MANUEL FERNANDES MINISTRA DA CULTURA DALILA RODRIGUES

SAÚDE
Milhares de doentes à espera de um atestado multiúsos

HABITAÇÃO
Gaia e Setúbal escolhidas para projetos-piloto de rendas acessíveis

RECOMENDAÇÃO
Junta de Arroios não volta atrás na emissão de atestados a imigrantes

GUERRA
Putin diz que não ataca países da NATO, mas bases com F-16 de Kiev serão um alvo

HOJE GRÁTIS
EVASÕES
SANTA MARIA

Figure 26 - Diário de Notícias' Government Cover, 2024
Source: https://pressreader.com/diario-de-noticias/20240329/


PORTUGAL-SUÉCIA 5-2

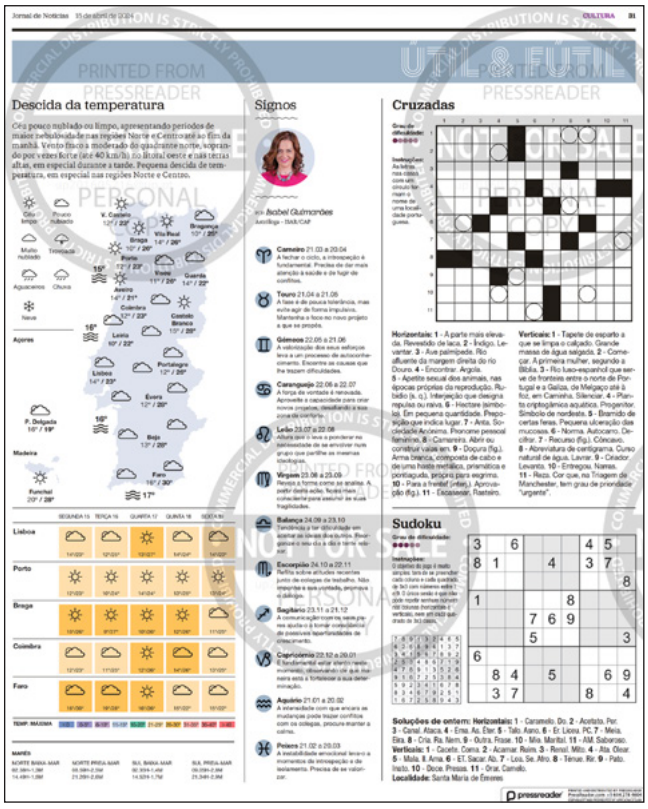
SELEÇÃO

MOMENTO

33'

FILME DO JOGO

Figure 27 - O Jogo's Portugal-Sweden Match Report, 2024
Source: https://pressreader.com/o-jogo/20240322/

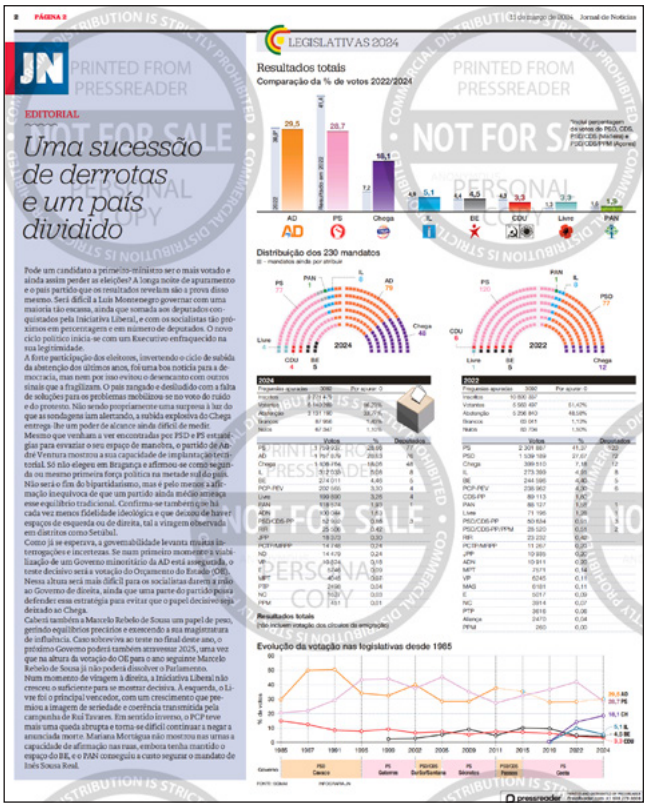

Descida da temperatura

Sígnos

Cruzadas

Sudoku

Figure 28 - Jornal de Notícias' Weather Section, 2024
Source: https://pressreader.com/jornal-de-noticias/20240415/


JN

EDITORIAL

Uma sucessão de derrotas e um país dividido

LEGISLATIVAS 2024

Resultados totais

Comparação da % de votos 2022/2024

Distribuição dos 230 mandatos

Evolução da votação nas legislativas desde 1985

Figure 29 - Diário de Notícias' 2024 Election Statistics, 2024
Source: https://pressreader.com/jornal-de-noticias/20240311/

4.2 DESIGN PROCESS

4.2.1 GRAPHIC IDENTITY AND DESIGN SYSTEM

To ensure a cohesive user experience across all AR prototypes, a simple, unified visual identity was established to bridge the gap between traditional newspaper design and the digital space. The overall theme is anchored by the NXT/GEN logo (Figure 30), which visually communicates the project's forward-looking nature. The logo was constructed using a modular typeface Fit, selected for its visual uniqueness and sharp angles that reinforce a technological aesthetic. Furthermore, a 3D vector shadow was included in the logo design, serving as a conceptual subtle nod to the multi-layered nature of combining physical print with digital augmentation.



Figure 30 - NXT/GEN Project Logo

A deliberate colour palette was implemented next, anchored by teal blue. In a design context, blue carries a strong association with technology, being universally linked to digital interfaces, hyperlinks, and software systems. When layered over the traditional black-and-white look of newspapers, this vibrant blue acts as a natural visual signal. It created an intuitive contrast that guides the reader's eye directly toward the augmented, interactive zones of the page.

The typographic system was constructed to reflect the project's hybrid aspect:

- **Body Text:** The angular sans-serif typeface Industry (Figure 31) was chosen for the primary reading material and secondary digital information. The selection hinges on the aesthetic of early mobile phone typography, swapping curvature for smooth angles and lines to link the modern AR experience to portable technology.

- **Titles and Interactive Elements:** To establish a clear hierarchy, Dharma Gothic (Figure 32) was selected for all headlines and large interactive content. This strong, bold font creates a strong contrast with the thin body text, allowing key information to stand out prominently.

The typeface pairing serves a dual purpose: ensuring maximum legibility across physical and digital components, while showing the user where digital interaction begins without overwhelming the core editorial content.

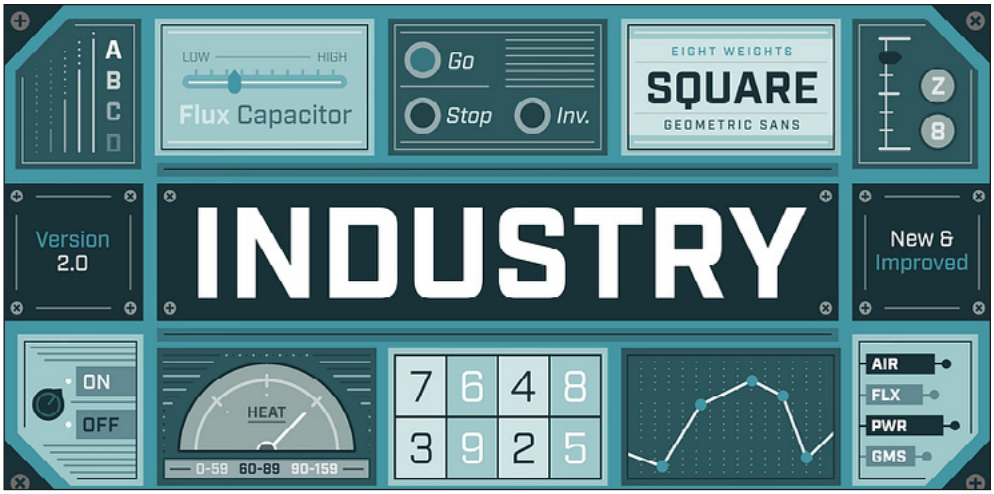


Figure 31 - Industry Typeface, Fort Foundry
Source: https://fonts.adobe.com/fonts/industry



Figure 32 - Dharma Gothic Typeface, Dharma Type
Source: https://fonts.adobe.com/fonts/dharma-gothic

4.2.2 VISUAL STANDARDISATION AND LAYOUT STRUCTURE

Building upon the established graphic identity, the next important step was standardising the visual structure across the prototypes. Because the sourced articles originated from publications with highly distinct styles, their original layouts were completely adapted to fit the new NXT/GEN design system to minimise visual distraction and maintain cohesion.

To accommodate both static text and digital overlays, the layout was restructured by organising the news content into distinct modular visual frames. Expanding the 3D idea introduced in the project's logo, frames containing an augmented layer included a simulated drop shadow. This design choice was not purely aesthetic, serving as a visual reinforcement of the idea of overlapping layers and a physical representation of the digital augmentation that would later appear "above" the printed page.

4.2.3 AR CONTENT INDICATORS AND USER GUIDANCE

A distinct visual hierarchy was established to guide the user and clearly indicate which news contained interactive content. A primary accent colour (Blue) was used to outline the specific news boxes that featured an AR layer, distinguishing them from standard, non-interactive news.

A dedicated graphic overlay was also designed and positioned in the top corner of these interactive news. The overlay included a clear label, “Conteúdo Aumentado” (Augmented Content), alongside the QR code, which served as the physical trigger for the experience (Figure 32). This consistent visual signal ensured that readers could easily identify where and how to access the augmented content, minimising friction with first-time users.



Figure 33 - NXT/GEN AR News Content Signal

4.2.4 DIGITAL ASSET PRODUCTION

The interactive layers were developed using complementary digital assets, including additional photographs and videos collected from various online news repositories, to expand on the original printed articles. The digital interface and graphical elements for each AR experience were first designed and vectorised in Adobe Illustrator. Adobe Photoshop and After Effects were then used to edit the photos, format the video content, animate the AR graphics, and create smooth motion transitions between digital elements.

4.2.5 AR LAYER ASSEMBLY AND INTERACTIVITY

Once all the visual elements were exported, the graphical content was uploaded to Scenery's user database. Within the editing platform, the mapping of each AR experience was carefully laid out, and the assets were all positioned within their respective scenes. A crucial step in this phase involved adjusting the objects along a 3D axis to establish a functional hierarchy and prevent any overlapping or clipping of digital assets in the user experience. Ultimately, interactivity was implemented by linking specific actions with transition events. This logic, which required no programming thanks to Scenery's engine, allowed users to explore through the augmented content by pressing designated zones, such as action boxes, arrows, and buttons, creating deeper engagement and a deeper flow of information.



Figures 34 & 35 - Scenery Prototyping Interface

4.3 FINAL OBJECT

The design phase resulted in a cohesive catalogue of four functional AR prototypes, each effectively demonstrating unique ways to integrate digital layers within print journalism. The development process was a long, non-linear journey that required strong professor guidance and documentation of the several challenges that arose during the project, among which included software limitations and concept challenges.

The final physical artefact was assembled as a modular A4-printed piece. This format proved to be the best option because it preserved the portability and tactile feel of traditional print media while still accommodating the scale needed to preview the technology in a real-world scenario. A instruction flyer was also introduced to support user onboarding, outlining the steps required to activate the AR experiences through the Scenery application.

When viewing the objects through a smartphone lens, the static layout evolves and begins overlaying the digital layer to create of sense of depth and connection to the physical pieces (Figure 35). The visual documentation below captures specific AR interaction moments within the each of the four prototypes: the supplementary photography expansion for text pieces, the video integration within sports coverage, the real-time updates overlay for data, and the interactive digital infographics possibilities.

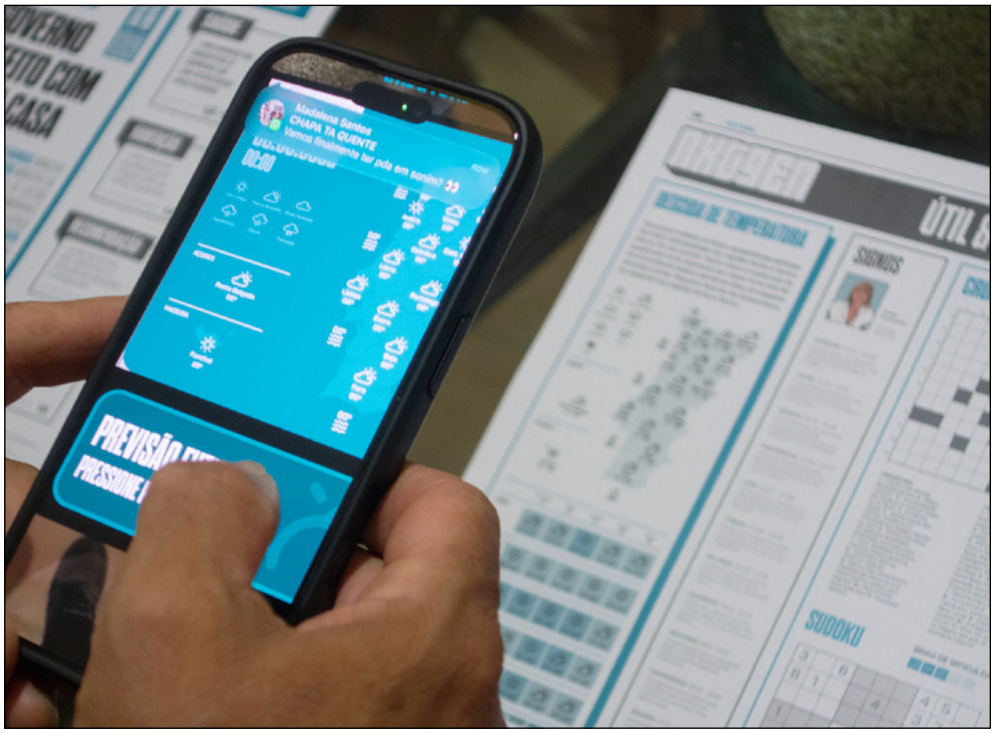


Figure 36 - NXT/GEN AR Layer User Exploration

NOTE:
All prototypes presented in this section are fully functional. Readers can experience the interactive digital layers by scanning the respective AR content triggers with a smartphone.

PROTOTYPE 001 — PHOTOGRAPHIC EXPANSION



Figure 37 - NXT/GEN Prototype 001 Physical Page Layout



Figure 38 - NXT/GEN Prototype 001 AR Component (01)



Figure 39 - NXT/GEN Prototype 001 AR Component (02)



Figure 40 - NXT/GEN Prototype 001 AR Component (03)



Figure 41 - NXT/GEN Prototype 001 AR Component (04)

PROTOTYPE 002 — VIDEO CONTENT EXPANSION



Figure 42 - NXT/GEN Prototype 002 Physical Page Layout



Figure 43 - NXT/GEN Prototype 002 AR Component (01)



Figure 44 - NXT/GEN Prototype 002 AR Component (02)



Figure 45 - NXT/GEN Prototype 002 AR Component (03)

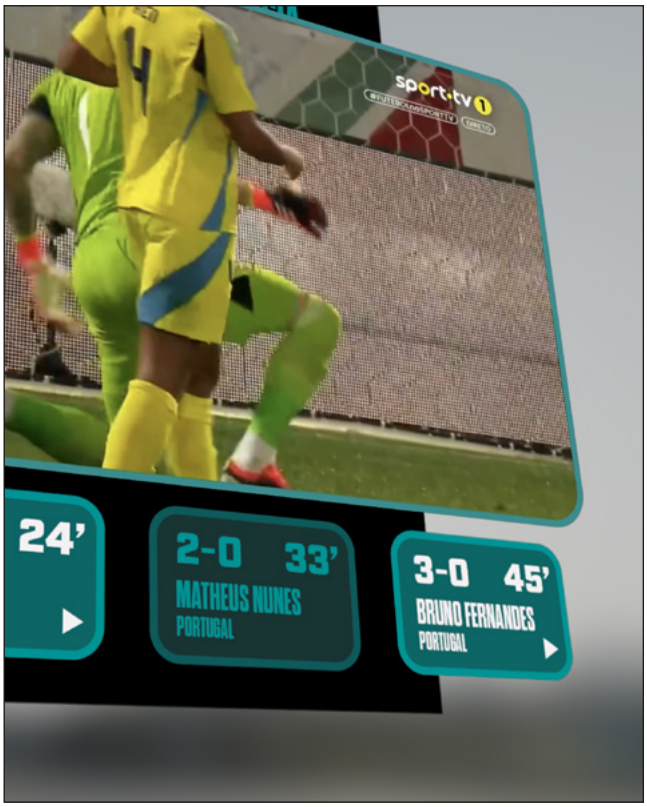


Figure 46 - NXT/GEN Prototype 002 AR Component (04)

PROTOTYPE 003 — REAL-TIME DATA UPDATES

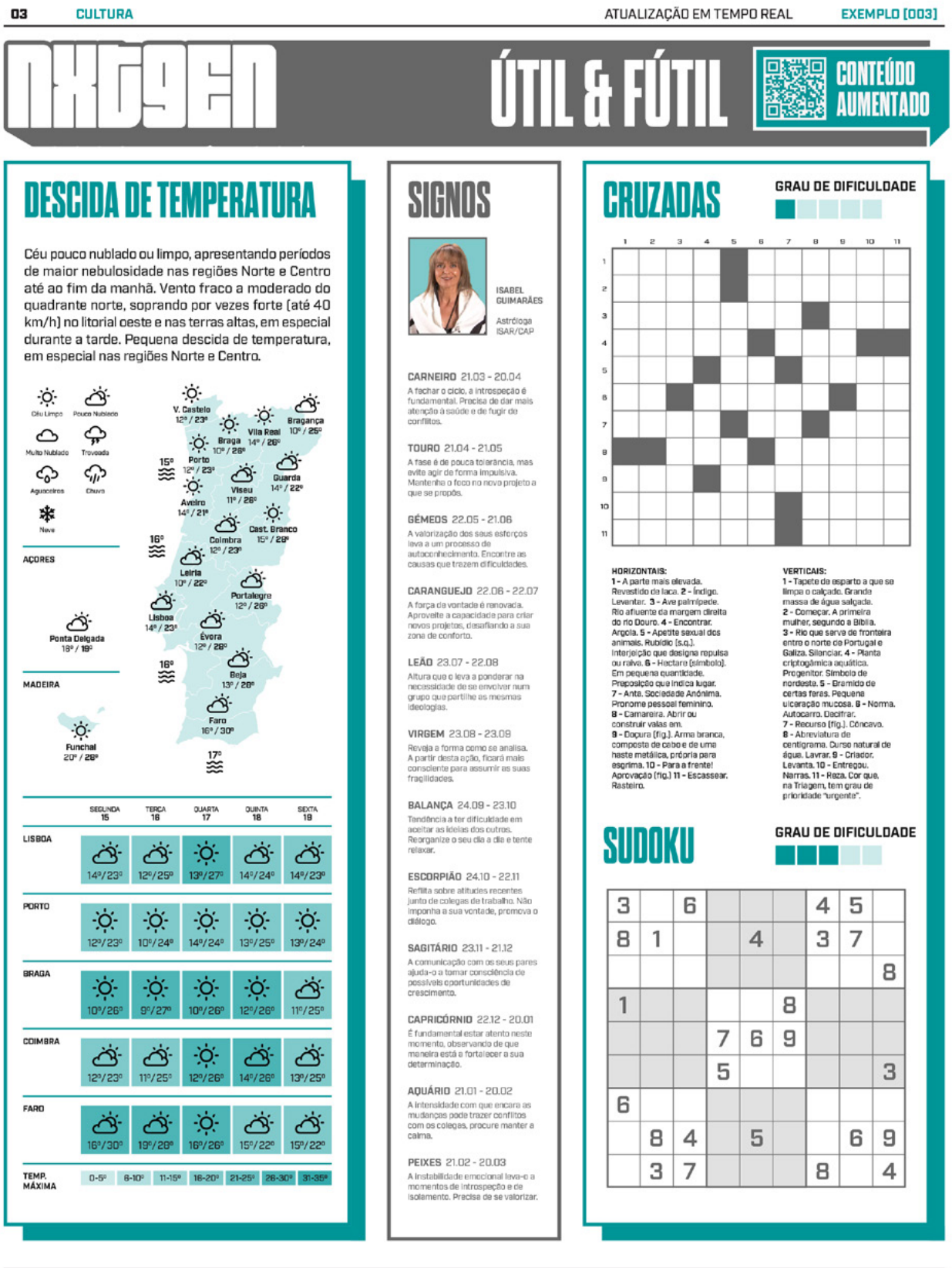


Figure 47 - NXT/GEN Prototype 003 Physical Page Layout



Figure 48 - NXT/GEN Prototype 003 AR Component (01)



Figure 49 - NXT/GEN Prototype 003 AR Component (02)

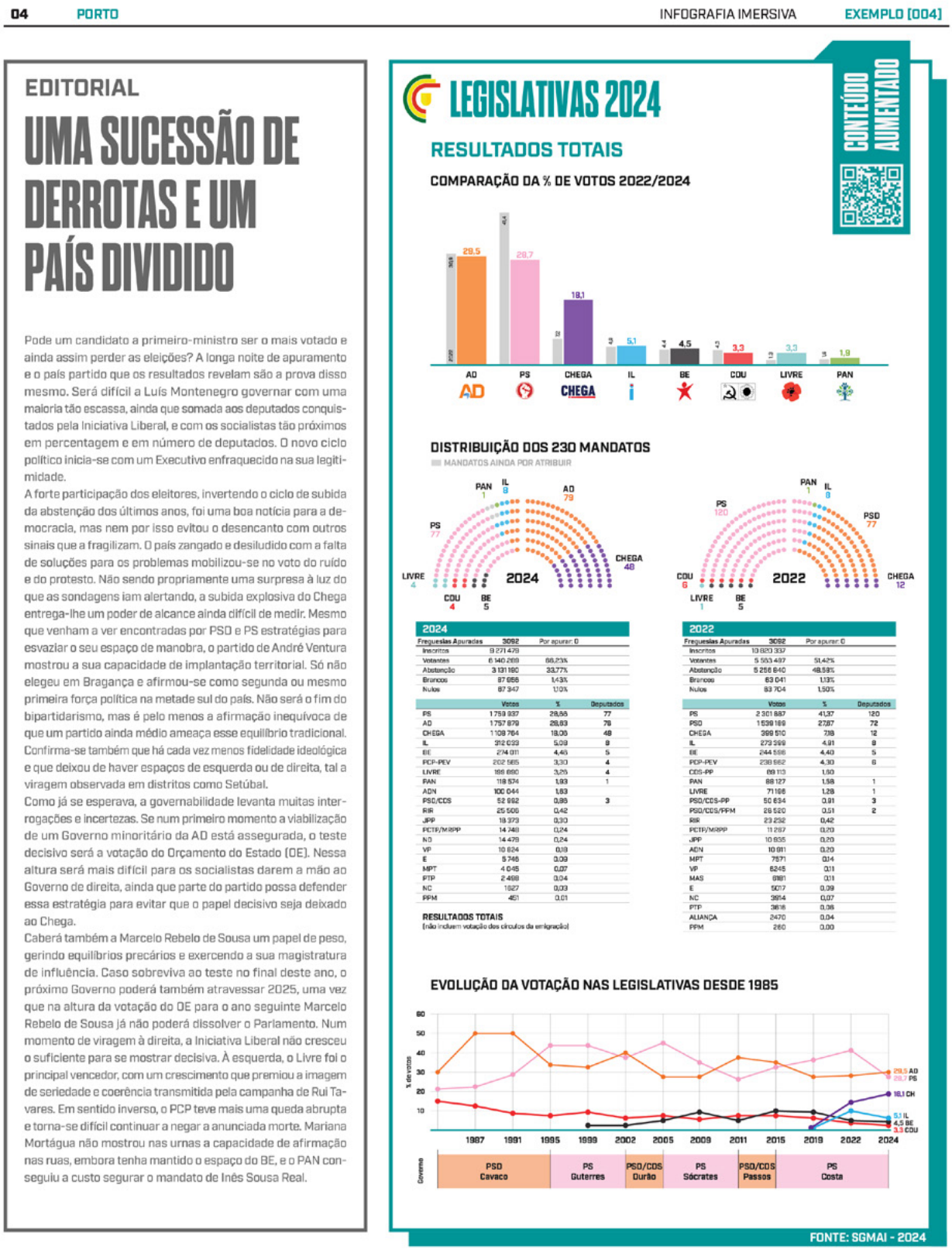


Figure 50 - NXT/GEN Prototype 003 AR Component (03)



Figure 51 - NXT/GEN Prototype 003 AR Component (04)

PROTOTYPE 004 — INTERACTIVE DIGITAL INFOGRAPHICS



04 PORTO INFOGRAFIA IMERSIVA EXEMPLO [004]

EDITORIAL

UMA SUCESSÃO DE DERROTAS E UM PAÍS DIVIDIDO

Pode um candidato a primeiro-ministro ser o mais votado e ainda assim perder as eleições? A longa noite de apuramento e o país partido que os resultados revelam são a prova disso mesmo. Será difícil a Luís Montenegro governar com uma maioria tão escassa, ainda que somada aos deputados conquistados pela Iniciativa Liberal, e com os socialistas tão próximos em percentagem e em número de deputados. O novo ciclo político inicia-se com um Executivo enfraquecido na sua legitimidade.

A forte participação dos eleitores, invertendo o ciclo de subida da abstenção dos últimos anos, foi uma boa notícia para a democracia, mas nem por isso evitou o desencanto com outros sinais que a fragilizam. O país zangado e desiludido com a falta de soluções para os problemas mobilizou-se no voto do ruído e do protesto. Não sendo propriamente uma surpresa à luz do que as sondagens iam alertando, a subida explosiva do Chega entrega-lhe um poder de alcance ainda difícil de medir. Mesmo que venham a ver encontradas por PSD e PS estratégias para esvaziar o seu espaço de manobra, o partido de André Ventura mostrou a sua capacidade de implantação territorial. Só não elegeu em Bragança e afirmou-se como segunda ou mesmo primeira força política na metade sul do país. Não será o fim do bipartidarismo, mas é pelo menos a afirmação inequívoca de que um partido ainda médio ameaça esse equilíbrio tradicional. Confirma-se também que há cada vez menos fidelidade ideológica e que deixou de haver espaços de esquerda ou de direita, tal a viragem observada em distritos como Setúbal.

Como já se esperava, a governabilidade levanta muitas interrogações e incertezas. Se num primeiro momento a viabilização de um Governo minoritário da AD está assegurada, o teste decisivo será a votação do Orçamento do Estado (OE). Nessa altura será mais difícil para os socialistas darem a mão ao Governo de direita, ainda que parte do partido possa defender essa estratégia para evitar que o papel decisivo seja deixado ao Chega.

Caberá também a Marcelo Rebelo de Sousa um papel de peso, gerindo equilíbrios precários e exercendo a sua magistratura de influência. Caso sobreviva ao teste no final deste ano, o próximo Governo poderá também atravessar 2025, uma vez que na altura da votação do OE para o ano seguinte Marcelo Rebelo de Sousa já não poderá dissolver o Parlamento. Num momento de viragem à direita, a Iniciativa Liberal não cresceu o suficiente para se mostrar decisiva. À esquerda, o Livre foi o principal vencedor, com um crescimento que premiou a imagem de seriedade e coerência transmitida pela campanha de Rui Tavares. Em sentido inverso, o PCP teve mais uma queda abrupta e torna-se difícil continuar a negar a anunciada morte. Mariana Mortágua não mostrou nas urnas a capacidade de afirmação nas ruas, embora tenha mantido o espaço do BE, e o PAN conseguiu a custo segurar o mandato de Inês Sousa Real.

LEGISLATIVAS 2024

CONTEÚDO AUMENTADO

RESULTADOS TOTAIS

COMPARAÇÃO DA % DE VOTOS 2022/2024

DISTRIBUIÇÃO DOS 230 MANDATOS

MANDATOS AINDA POR ATRIBUIR

2024

Freguesias Apuradas	3092	Por apurar: 0	
Inscritos	9 271 479		
Votantes	6 140 269	66,23%	
Abstenção	3 131 160	33,77%	
Brancos	87 656	1,43%	
Nulos	87 347	1,10%	
	Votos	%	Deputados
PS	1 759 937	28,66	77
AD	1 757 879	28,63	79
CHEGA	1 108 764	18,06	48
IL	312 039	5,08	9
BE	274 011	4,46	5
PCP-PEV	202 585	3,30	4
LIVRE	199 690	3,25	4
PAN	118 574	1,93	1
ADN	100 044	1,63	
PSD/CDS	52 662	0,86	3
RIR	25 500	0,42	
JPP	18 373	0,30	
PCTP/MRPP	14 748	0,24	
ND	14 479	0,24	
VP	10 824	0,18	
E	5 746	0,09	
MPT	4 045	0,07	
PTP	2 498	0,04	
NC	1827	0,03	
PPM	451	0,01	

RESULTADOS TOTAIS
(não incluem votação dos círculos da emigração)

2022

Freguesias Apuradas	3092	Por apurar: 0	
Inscritos	10 823 337		
Votantes	5 553 497	51,42%	
Abstenção	5 256 840	48,58%	
Brancos	63 041	1,13%	
Nulos	83 704	1,50%	
	Votos	%	Deputados
PS	2 301 887	41,37	120
PSD	1 539 189	27,67	72
CHEGA	399 510	7,18	12
IL	273 399	4,91	8
BE	244 598	4,40	5
PCP-PEV	238 982	4,30	6
CDS-PP	88 113	1,60	
PAN	88 127	1,58	1
LIVRE	71 166	1,28	1
PSD/CDS-PP	50 694	0,91	3
PSD/CDS/PPM	28 520	0,51	2
RIR	23 232	0,42	
PCTP/MRPP	11 287	0,20	
JPP	10 935	0,20	
ADN	10 911	0,20	
MPT	7571	0,14	
VP	6245	0,11	
MAS	6181	0,11	
E	5017	0,09	
NC	3854	0,07	
PTP	3616	0,06	
ALIANÇA	2470	0,04	
PPM	260	0,00	

EVOLUÇÃO DA VOTAÇÃO NAS LEGISLATIVAS DESDE 1985

FONTE: SGMAI - 2024

Figure 52 - NXT/GEN Prototype 004 Physical Page Layout



Figure 53 - NXT/GEN Prototype 004 AR Component (01)

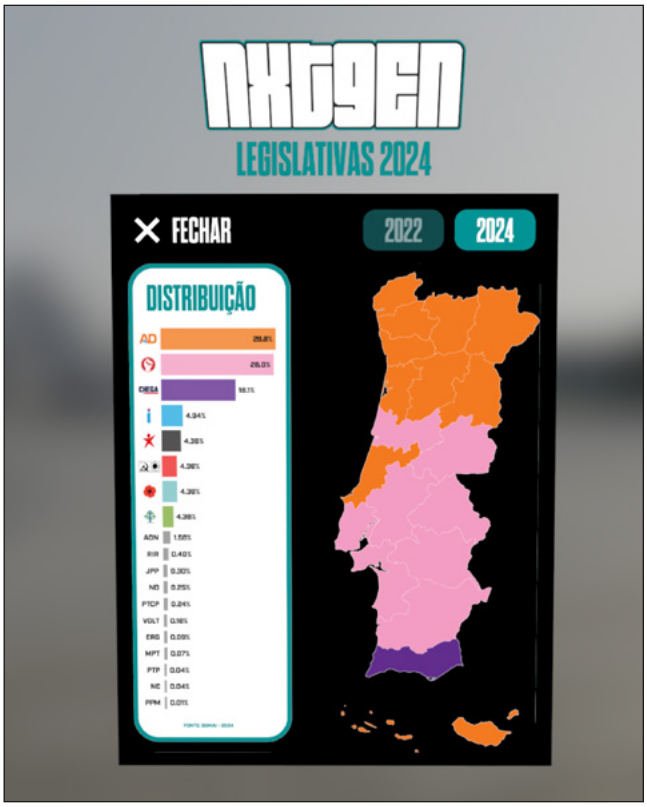


Figure 54 - NXT/GEN Prototype 004 AR Component (02)

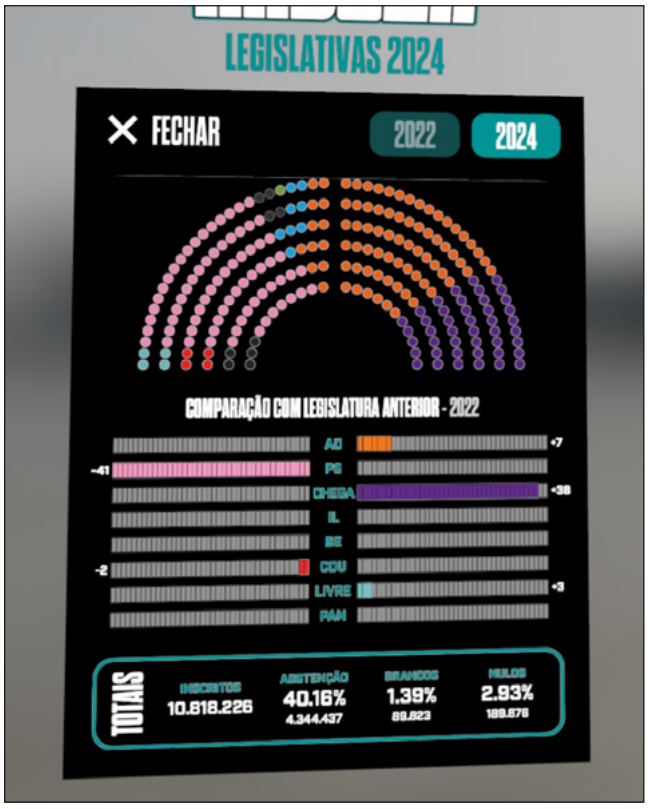


Figure 55 - NXT/GEN Prototype 004 AR Component (03)

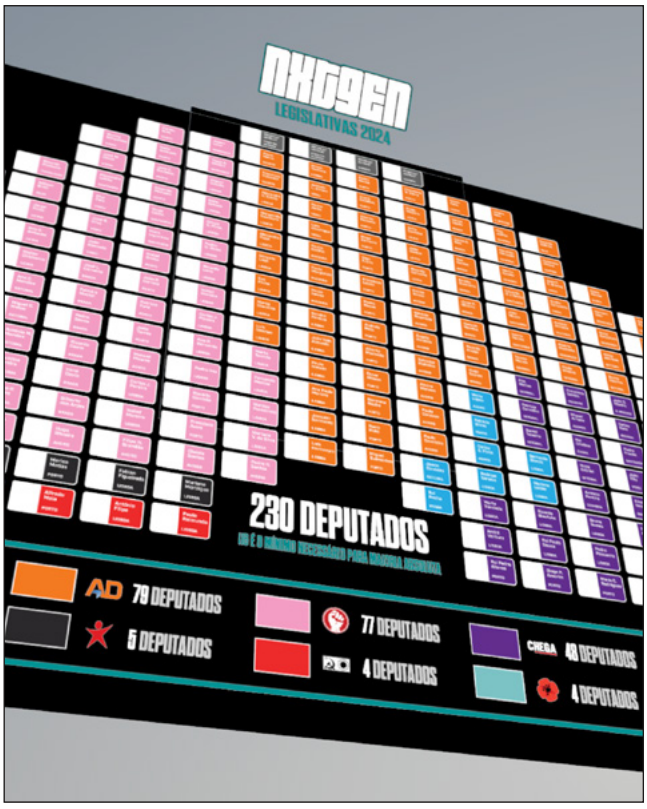


Figure 56 - NXT/GEN Prototype 004 AR Component (04)

4.3.1 DEVELOPMENT CHALLENGES AND LIMITATIONS

While the final project overall met initial design objectives, achieving the result required overcoming several setbacks inherent to emerging technology:

- **Software Obsolescence and Migration:** The most disruptive challenge to the project was the Adobe Aero discontinuation announcement in 2025. Several initial concepts and prototypes had already been fully developed in the platform within the Adobe ecosystem. Due to the proprietary nature of AR platforms, there was no way to export the scenes or interaction connections.As a result of this, the decision was to migrate to Scenery, which required abandoning all the initial progress and learning a new software to be able to rebuild the entire project from scratch, highlighting a major vulnerability in the current AR design workflows: Software Obsolescence.

- **Ecosystem Friction and Technical Adaptation:** While Scenery proved to be the most robust and cost-effective application, it introduced a steep learning curve, heightened by its separation from the Adobe ecosystem and its standardised workflows. Processes that were previously seamless in Aero, such as directly importing content from Photoshop and Illustrator, were no longer available. This required a complete workflow adaptation to understand issues that arose during digital experience construction and to resolve transparency malfunctions, incompatible video and image formats, and resolution-related performance throttling.

- **Navigating Emerging Software UI/UX:** Although Adobe Aero benefited from abundant online tutorials and user guides due to its free accessibility, Scenery's early-stage development and smaller user community presented a significant lack of online documentation. As a rapidly evolving application, many of its controls and workflows felt counter-intuitive to a designer trained in traditional software, a friction worsened by the lack of basic common features such as keyboard shortcuts for camera movement or object creation. As a result of these issues, direct contact was made with the application's development team, who provided continuous troubleshooting and guidance through the software's digital community server, making this step essential to problem-solving and achieving the final result.

- **The Benchmark Problem and Feature Creep:** On a more theoretical level, working with emerging technology presented a personal psychological challenge. Because AR in editorial design is still a highly conceptual field, there was a severe lack of historical benchmarks or references to define what constituted a successful or "perfect" project. The ambition to create a foundational reference led to occasional overcomplication of prototypes or workflows. In the pursuit of a flawless result, something that is inherently impossible due to the technology restraints, there could be an oversight of the most important aspect: the core user experience. Accepting that vital lesson ultimately led to a more grounded, user-centric approach, where clear communication and ease of use were prioritised over complex but unnecessary technical features.

[05]
TESTING & RESULTS

5.1 TESTING SETUP

TESTING ENVIRONMENT AND APPROACH

Due to the short prototype timeframe and the objective of simulating realistic newspaper reading conditions, the testing sessions were not confined to a single controlled technical environment. Instead, a natural observation approach was followed. Sessions were conducted across various everyday settings, from homes to cafés, to accommodate participants' schedules. This multi-environment approach provided secondary insights into the impact of lighting conditions, surface reflections, and background colour on the overall user experience. Any disruptions or difficulties were documented in the observation notes for future reference.

DEVICE STRATEGY AND COMPATIBILITY TESTING

To evaluate the cross-platform capabilities of the Scenery app, participants were instructed to use their personal smartphones to scan the physical prototypes. This allowed additional research into valuable technical data regarding software performance across different operating systems (iOS and Android) to test the reliability of Android's WebXR implementation compared to the application's native iOS platform. To prevent data loss in case of unforeseen technical issues or severe device incompatibility, a pre-configured iPhone was kept on standby as a fallback testing device, ensuring all participants could complete the experience.

PROCEDURES AND DATA COLLECTION

Each testing session was timed to last between 10 and 15 minutes to prevent user fatigue and emulate a quick news-reading interaction. The process was divided into three phases:

1. INTRODUCTION (1-2 MINUTES):
A brief explanation of the physical catalogue and application was provided, deliberately omitting specific usage instructions to observe the user's intuitive interactions with the layout and AR signifiers.

2. USER TASK (6-8 MINUTES):
Participants were given free rein to explore the four augmented articles. During this phase, observation notes were taken to track deep usability issues, interaction patterns, and moments of hesitation.

3. SHORT POST-USE SURVEYS (3-5 MINUTES):
To maximise feedback quality within the tight timeframe, the post-use survey was conducted verbally as a short, structured interview. Participants' responses to the five key questions were recorded, allowing for immediate follow-up questions to extract deeper insights regarding preferences and frustrations.

5.2 FINDINGS & INSIGHTS

The user testing stage provided robust data regarding how readers interacted with the AR prototypes. The sample of 10 participants provided a diverse cross-section of ages, from 19 to 62 years old, allowing for the observation of differences in technological fluency between generations.

QUANTITIVE OVERVIEW

Participants rated the ease of use and the degree to which AR improved their news experience on a scale of 1 to 5. Afterwards, they were asked to identify their preferred prototype and state whether they would use AR in print newspapers in the future.

METRIC	RESULT	BREAKDOWN
EASE OF USE (MEAN SCORE)	**4.2** / 5.0	High Overall Usability (80% Rated 4 or 5)
ENHANCEMENT (MEAN SCORE)	**3.9** / 5.0	Positive Enhancement of the News. (60% Rated 4 or 5)
FUTURE ADOPTION INTENT	**100%**	All 10 Participants stated they would use AR in Print News again
PROTOTYPE PREFERENCE	**1ST — 002** VIDEO CONTENT EXPANSION	Prefered by 5 Participants (50%)
	2ND — 003 REAL-TIME UPDATES	Prefered by 4 Participants (40%)
	3RD — 004 INTERACTIVE INFOGRAPHICS	Prefered by 1 Participant (10%)
	4TH — 001 PHOTOGRAPHIC EXPANSION	Not Selected by any Participant (0%)

USER ENGAGEMENT AND PREFERENCES

The unanimous agreement among all participants to use AR in future print newspapers strongly validates the core premise of this project. Qualitative feedback showed that users highly valued expanding traditional media rather than replacing it. Prototype 002 (Video Content Expansion) was the most favoured, with users noting that it made subjects like sports feel “more complete” and “dynamic”. Prototype 003 (Real-Time Updates) was a close second, as users appreciated the efficiency of accessing updated information without needing to actively search for it on a separate digital platform, with one user noting it felt like an “innovative point of evolution” for the medium. Finally, one user praised Prototype 004 (Digital Infographics) for its data-observation benefits, though they highlighted readability issues on smaller screens.

THE 2D VS 3D MENTAL CONFLICT

The most significant finding from the testing phase appeared from a combination of observation notes and direct user feedback. Six out of the ten participants explicitly requested a “Zoom” feature or a way to move content on the screen. Observational data explains this phenomenon: upon launching the AR component, most participants' immediate instinct was to touch, swipe, or pinch the smartphone screen to interact with the content, rather than physically moving the device around the printed page. As users applied traditional 2D movement habits to a 3D spatial experience, it led to occasional immersion breaks.

GENERATIONAL FRICTION AND ACCESSIBILITY

The observer notes highlighted that age played a significant role in usability. Older participants (aged 50 and above) struggled noticeably more with adjusting to the tridimensional perception of AR assets. Furthermore, these older users sometimes failed to spot digital buttons or interaction points within the experience, which led to momentary frustration and slowed down their process. Consequently, multiple users recommended including on-screen instruction guides to aid navigation during the initial exploration stages.

VISUAL DOCUMENTATION CONSTRAINT

It should be recognised that photographic and video documentation of the testing sessions was intentionally limited. Given the hasty timeframe of each session and the necessity to act as an active observer and technical facilitator, priority was given to real-time data collection. Maintaining continuous intermediation with the test subjects and documenting high-quality feedback during the interviews took priority over capturing visual media, which could have distracted users and disrupted the natural flow of the experience.

5.3 TECHNICAL LIMITATIONS & WEBXR INCOMPATIBILITY

While qualitative feedback from testing was positive, having each user use their own smartphone exposed a critical technological hurdle. During testing, all Android devices experienced a severe compatibility failure when attempting to access the Scenery prototypes via WebXR.

Upon scanning the QR codes, Android users were initially blocked by an “Unsupported Feature” warning, stating that the required “Image Tracking” was not available in their browser (Figure 56). The interface provided automatic troubleshooting steps, directing users to manually enable experimental developer features in browser settings (Figure 57).

However, even after enabling these flags and restarting the browser, the WebXR implementations failed to render the AR assets correctly. The resulting experiences were visually broken, displaying severely corrupted textures, fragmented text, and heavily glitched content that made interaction impossible (Figure 58). As a consequence, the planned cross-platform evaluation had to be abandoned, with all affected participants being forced to complete the user tasks using the fallback iOS device, where the experience ran natively and without visual errors.

This core failure highlights a severe constraint in the current landscape of AR journalism. While WebXR promises a strong app-less platform (a crucial benefit for newspaper readers), the technology remains too unstable and fragmented across Android ecosystems to deploy reliably. These hardware and software issues validate the concerns raised during the developmental stage about relying on proprietary or early-stage AR platforms.

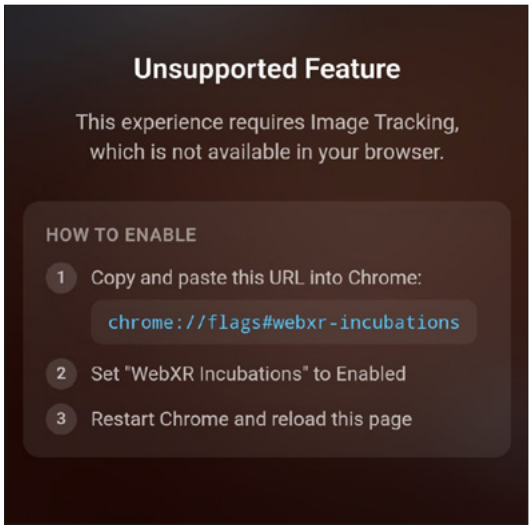


Figure 57 - Screenshot of the “Unsupported Feature” error message

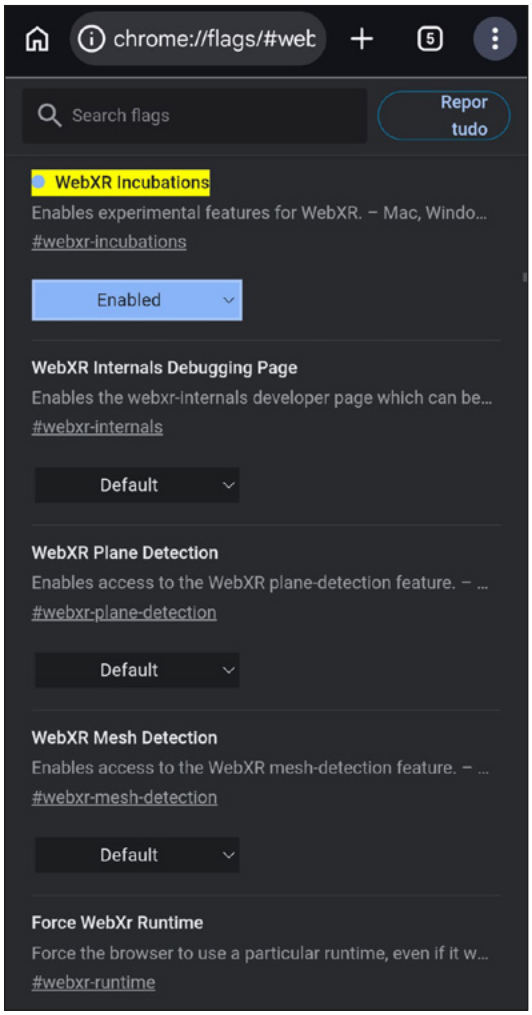


Figure 58 - Screenshot of Chrome menu showing WebXR enabled

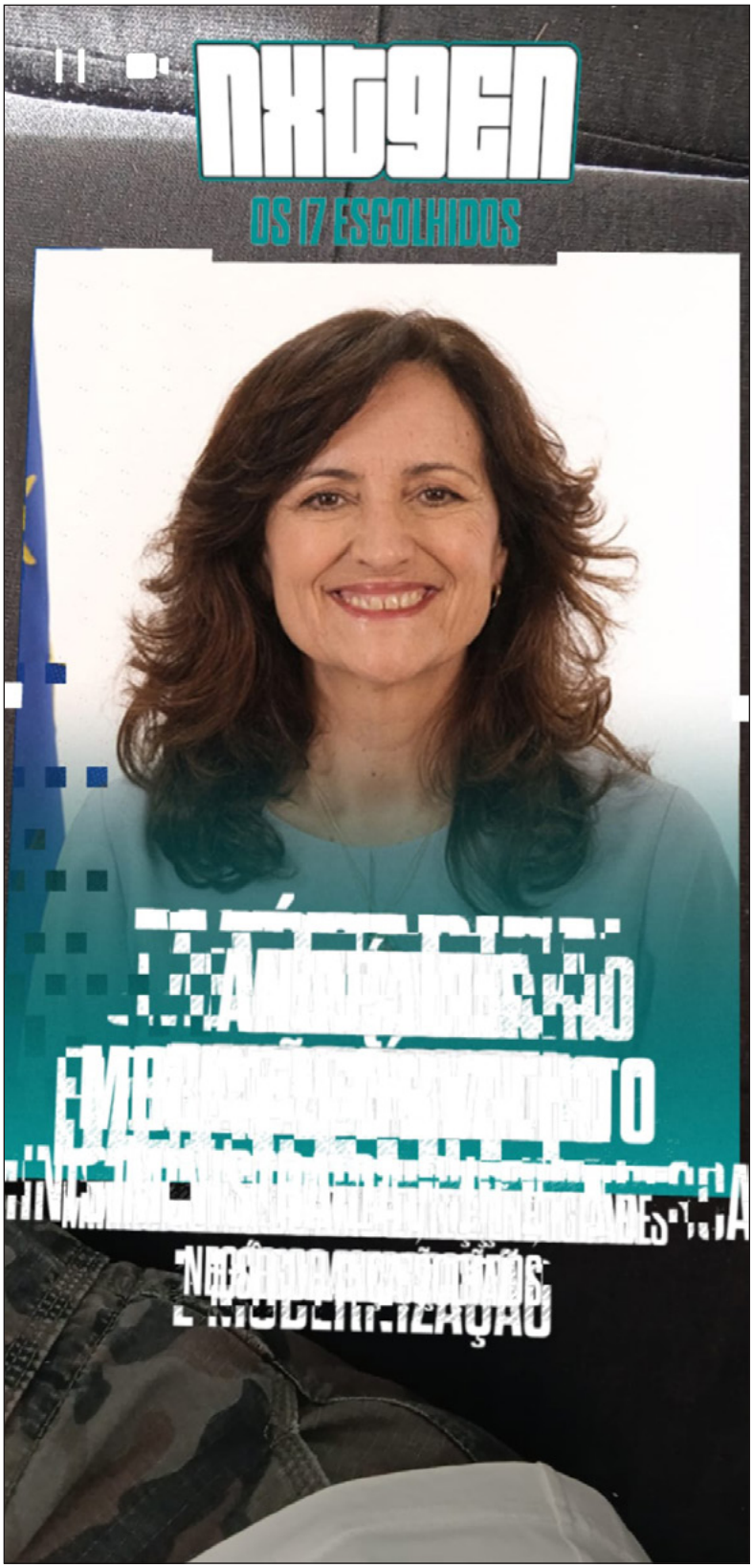


Figure 59 - Screenshot of the visually corrupted AR experience

[06]
DISCUSSION

6.1 REFLECTIONS ON THE DESIGN PROCESS

Developing the four AR prototypes provided significant insights into the intersection of editorial design and emerging technologies. Even before the external user feedback, the design process revealed that adapting print media for AR requires a fundamental shift in layout conceptualisation. Traditional print is static and bounded, while AR is dynamic and boundless. The contrast initially led to the aforementioned “perfectionism trap” during the prototyping phase.

The user testing data fundamentally validated the need for simplicity. Participants did not demand complex spatial content, instead requesting faster load times, clearer text readability, and intuitive controls. The forced migration to the Scenery platform during the project also highlighted a critical vulnerability in current AR workflows: software obsolescence. This reinforced the need for designers to maintain highly versatile, non-platformed digital assets that prioritise basic functionality over gimmicks.

6.2 DESIGN RECOMMENDATIONS FOR FUTURE AR PRINT MEDIA

Based on the research conducted, the practical hurdles overcome during prototype development, and the feedback data gathered from user testing, the following foundational guidelines are proposed for designers integrating AR into traditional news media:

- **Standardised and High-Contrast Visual Indicators:** Print layouts should feature universal UI indicators to signal AR capabilities, such as the blue border and flag used in this project.

- **Bridging the 2D/3D Gap with On-Screen Controls:** Because most users instinctively rely on traditional touchscreen habits (swiping, zooming and scrolling), AR interfaces should not rely only on physical movement in the tridimensional space. Designers should integrate hybrid UI controls that let users scale and manipulate augmented assets directly on their screen without breaking image tracking.

- **Onboarding and Instructional Guides:** To reduce the learning curve and ease the transition into the digital side, AR news experiences must include brief, on-screen instructional overlays during an initial loading phase.

- **Value-Driven Augmentation:** AR should never just replicate printed content. As shown by user preference for the Video Expansion and Real-Time Updates prototypes, AR should be used to expand narratives to clearly justify the effort of using devices to scan and interact with the content.

- **Robust Fallback Protocols:** Given the instability of WebXR found on Android devices, designers cannot rely only on browser-based AR. Future AR efforts must incorporate clear fallback mechanisms, such as directing incompatible devices to dedicated native applications or providing a link to view the digital content in a traditional 2D format, ensuring no reader is locked out of the expanded narrative.

[07]
CONCLUSION

7.1 SUMMARY OF FINDINGS

This project set out to explore the intersection of traditional print journalism and AR, aiming to develop functional experiences that demonstrate practical AR use cases for print news media. The project successfully proved that AR can indeed enhance the informational value of print media without destroying its strong tactile appeal. Throughout the development of the four distinct prototypes, in areas of photographic addition, video expansion, real-time updates and interactive data visualisation, the study confirmed that physical paper and digital layers can coexist to evolve into a cohesive hybrid medium.

While the process exposed critical vulnerabilities in the technology's landscape, such as software obsolescence and steep learning curves, the user testing phase provided vital validation. Observations and user feedback revealed a universal sense of future adoption among participants, with video and real-time updates proving to be the most engaging use cases. However, the tests also uncovered significant UX struggles, most notably the conflict between users' 2D phone interaction habits and the demands of 3D navigation. Ultimately, these findings emphasise that successful AR integration relies on meticulous UX design, clear and simple visual communication, and accessible on-screen guidance, rather than technical novelty alone.

7.2 FINAL THOUGHTS

By addressing the core points established at the start of the project, the results advance the current knowledge of Information Design within AR Journalism. It clearly defines functional use cases and shows that when AR is used to address specific print limitations of static data or space constraints, it drastically increases user engagement and reader satisfaction with the content.

Additionally, the research establishes that for AR to grow from a marketing gimmick to a standardised editorial tool, the industry must adopt strict user-centred design guidelines. Implementing universal visual indicators, hybrid digital controls, and frictionless onboarding is mandatory to ensure readers, especially older demographics, do not abandon the experience or the technology.

In conclusion, AR is not, nor should it be, seen as a replacement for traditional newspapers, but instead as a powerful complement. When executed with deep care for user accessibility and editorial integrity, AR has immense potential to support the future of print journalism, transforming reading into an engaging, multi-dimensional experience adapted for the digital age.

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