A Proof of Concept of XR Application in the Construction of Logistics Warehouses

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Figure 1: A civil engineer visualizing the structure of a new logistics warehouse in-situ, before the land leveling process.

Abstract

This proof of concept introduced Pernambuco's industries to the new possibilities offered by XR technologies. Through the HoloLens 2, SVR 2024 attendees will be able to visualize an example of a logistics warehouse rendered in 3D within the real environment using augmented reality. The logistics company that experienced this PoC expressed interest in further exploring XR applications.

CCS Concepts

• **Human-centered computing** → **Mixed / augmented reality**;
• **Applied computing** → *Computer-aided design.*

Keywords

Extended Reality, Augmented Reality, Mixed Reality, Hololens 2, Civil Engineering, Logistics Warehouse

1 Introduction

Numerous studies highlight the growing adoption of XR in the industry[1]. Success stories of cost reduction and benefits in production processes are also found in the communication channels of companies like Microsoft[1] and PTC[2]. Beyond XR's role in industrial training[2], there is notable growth in areas like civil engineering[3].

In Brazil, we have significant initiatives like SENAI CIMATEC[3] in Bahia and Voxar Labs[4] in Pernambuco. To contribute to these efforts and support the adoption of these technologies, Instituto SENAI de Inovação para Tecnologias da Informação e Comunicação (ISI-TICs)[5] acquired equipment and formed a team of two scholarship holders, a PhD candidate, and an undergraduate. Over the past six months, they have explored XR applications in the industrial context of Pernambuco. We present here some of the results of this initiative.

[1] https://www.youtube.com/@MicrosoftHoloLens
[2] https://www.youtube.com/@vuforia
[3] https://noticias.portaldaindustria.com.br/noticias/inovacao-e-tecnologia/alem-do-universo-alunos-do-senai-cimatec-tem-primeira-aula-no-metaverso/
[4] https://voxarlabs.cin.ufpe.br/
[5] https://www.pe.senai.br/isi-tics/

2 Objective

The goal of this Proof of Concept was to demonstrate to companies in Pernambuco the potential applications of XR in industry. Our objective in presenting this work at SVR 2024 is to expand the dialogue with other research institutions and industries from different regions. We believe that others in the field may be interested in how we managed to engage key players in Pernambuco's industry with a technically simple yet strategically utilized proof of concept at the right context and timing. Additionally, we see this as an interesting opportunity for event attendees who have never experienced the HoloLens 2.

3 Material and Methods

3.1 Technical description

For this PoC, we used the Trimble XR10 with HoloLens 2[6], a mixed reality device designed for industrial environments, providing hands-free access to holographic data. Unity[7] served as the development platform, enabling the creation of interactive 3D content. The Mixed Reality Toolkit 3 (MRTK3)[8] was utilized to streamline XR app development with pre-built components and features, while Vuforia[9] was employed for its robust augmented reality capabilities, enabling precise object recognition and tracking in real-world environments.

3.2 Development process

The development of the PoC occurred between February and July 2024, following steps: planning, industrial research, hardware testing, study of XR toolkit tutorials, selection of the industrial problem, hardware and toolkits, PoC implementation, and in-situ testing. The research involved a search for examples from XR industry specialists and interviews with industrial consultants. As a result, we identified six main areas of XR industrial application: training[10], manufacturing[11], maintenance[12], energy efficiency[13], logistics[14], and civil engineering[15]. The XR hardware acquired by ISI-TICs was tested in order of market value: Trimble XR10 with HoloLens 2, RealWear Navigator 500, HP Reverb G2, and Oculus Quest 2.

The selection of the industrial problem and hardware for the PoC was made in early May, influenced by an ISI-TICs project. The Condomínio Logístico CONE Multimodal has a smart warehouse project exploring the latest Industry 4.0 trends. We chose communication difficulties between teams during warehouse construction as the problem. As a solution, we implemented an application for the HoloLens 2 to align the 3D model of a warehouse on the site where it will be built.

Initially, we attempted to use MRTK 3 for 3D model alignment with a QR code, following Joost van Schaik's tutorials[16]. However, these proved overly complex. We switched to the Vuforia toolkit, following Microsoft's tutorial[17]. We spent weeks overcoming challenges like 3D model rotation errors, an undocumented and uncommunicated error that occurs if you don't obtain the Vuforia license, even it's free version, and the fact that the system took about 15 minutes to compile and deploy to the HoloLens 2. This last one creates an extremely unhealthy and counterproductive time gap when the developer needs to repeatedly fix the code and check the results of the corrections.

4 Results and Conclusions

After completing the PoC, we took the Trimble XR10 with HoloLens 2 to the site where a new CONE Multimodal warehouse will be built. We recorded the civil engineer's reaction as he experienced the augmented reality model. He remarked, while interacting with the model on the site: "The footings and pillars coming right out of them, how cool. Fantastic, we can already see all the spaces, the foundation, the upper part, the covered structure, fantastic."

CONE Multimodal managers responded positively to the video, noting XR's applicability in visualizing different layers for management and operation beyond construction, such as maintenance, customization, energy efficiency, and fire prevention. We presented these results to the startup community, researchers, and students at the SENAI XR 2024 event: Extended Realities for Pernambuco's Industries[18].

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[7] https://unity.com/

[8] https://learn.microsoft.com/en-us/windows/mixed-reality/mrtk-unity/mrtk3-overview/

[9] https://developer.vuforia.com/

[10] Training examples: https://youtu.be/4OGw8qhnNOQ, https://youtu.be/00gPg4-sBc8, https://youtu.be/lcm33E8nT9Q

[11] Manufacturing examples: https://youtu.be/IV4EQ1Ltujs, https://youtu.be/ZM-Md1qGKbI, https://youtu.be/YdYJGwcAmFY, https://youtu.be/oxMgYks8hCQ

[12] Maintenance examples: https://youtu.be/HpFfm054EVo, https://youtu.be/0paPNZJaFVg

[13] Energy Efficiency example: https://youtu.be/e1sJ7fq6WCU

[14] Logistics examples: https://youtu.be/0PPbMQXqbhs, https://youtu.be/juFfcf6PDMA

[15] Civil Engineering examples: https://youtu.be/spA8-naOQec, https://youtu.be/MwaEsoWbiE, https://youtu.be/Wg6jN-audEM, https://youtu.be/7mTA6HTjxg0, https://youtu.be/l096Zvoj26w, https://youtu.be/sNVKJRag88I

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