Exploring Pervasive Augmented Reality in the Industry Sector

Bernardo Marques[1], Rafael Maio[1], André Santos[2], Tiago Araújo[1], Carlos Ferreira[3], Pedro Ramalho[2], Duarte Almeida[2], Paulo Dias[1], Beatriz S Santos[1]

1 – Department of Electronics, Telecommunications and Informatics & IEETA-LASI, University of Aveiro.
2 – Bosch Thermotechnology S.A.
3 – Department of Economics, Management, Industrial Engineering and Tourism & IEETA-LASI, University of Aveiro.

Industry 4.0 is changing shop floors thanks to technological innovations in manufacturing processes, with significant impact in the way they are controlled, influencing circular economies, sustainability, and the production value. One of its nine pillars is Augmented Reality (AR), given its ability to support operators in faster decision-making while improving work processes, through interactive computer-generated information superimposed over the real-world environment.

This research, conducted in the scope of the Augmented Humanity Project, used Pervasive AR to understand operators' context and present digital content in a continuously manner as they move through space. This was done through a Human-Centered Design (HCD) methodology with partners from the industry sector, defining real-life use-cases, identifying stakeholders' needs, as well as requirements for development of two prototypes: 1- allowing workers to be guided during picking tasks with validation of the components selected; 2- supporting real-time data monitoring and problem detection in an assembly line. These were iteratively evaluated through user studies conducted over a three-year period, with countless hours spent at the shop floor. More than 60 stakeholders and domain experts in their respective fields participated in this process (e.g., operators, technicians, production line and logistic managers, process development engineers and ergonomics engineers, etc.).

Results suggest that Pervasive AR is robust and accurate to be applied in real setups, being easy to use and having great potential to support the operator's task, especially inexperienced operators. Also, having lower cognitive effort when compared to the alternatives being used. Furthermore, it enables visualization of synchronous data associated with each pre-defined station, as well as have a grasp of the assembly line as a whole, helping to identify issues and intervene accordingly to ensure the levels of productivity are achieved.

FIGURE 1
Example of an Industrial scenario, having an operator visualizing how to perform a picking task (1), while his actions are monitored and validated (2) through Pervasive Augmented Reality (AR) in a Head-Mounted Display (HMD).

FIGURE 2
Example of an industrial scenario, having an assembly line manager visualizing real-time data of the whole line (1), as well as detailed information for a given station (2) through Pervasive Augmented Reality (AR) in a Head-Mounted Display (HMD).