Virtual and Augmented Reality Applications in Manufacturing of Precision Assembly Systems

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1. Introduction

The possibilities offered by the digitalisation of technological processes make it is an increasingly used in industrial applications. The combination of artificial intelligence, digital twins, meta-modelling, VR and AR technologies allows work to be improved at many stages of production: in design, on assembly lines or quality control. As production should be as efficient as possible while ensuring safety and generating low costs, manufacturers are attempting to implement integrated technologies, in line with the Industry 4.0 concept, describing the process of technological and organisational transformation [1].

2. Solution for support manufacturing of precision assembly systems

As part of the paper, an overview of the ADAPTSYS IT system, supporting quality control and production optimisation of precision assembly systems based on artificial intelligence (AI), augmented reality (AR) and virtual reality (VR) will be presented (Figure 1).

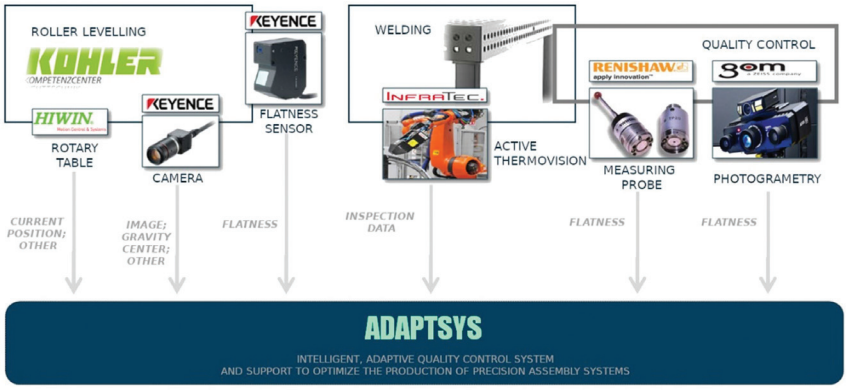

Figure 1. A set of modules included in the ADAPTSYS system.

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A key solution of the implemented system is the digital twin of roller levelling process. One of the innovations included in the digital twin, will be a module that allows fast calculations (time in seconds) to predict, among others, the strains and/or internal stresses in a band for a given levelling process parameters (Figure 2).

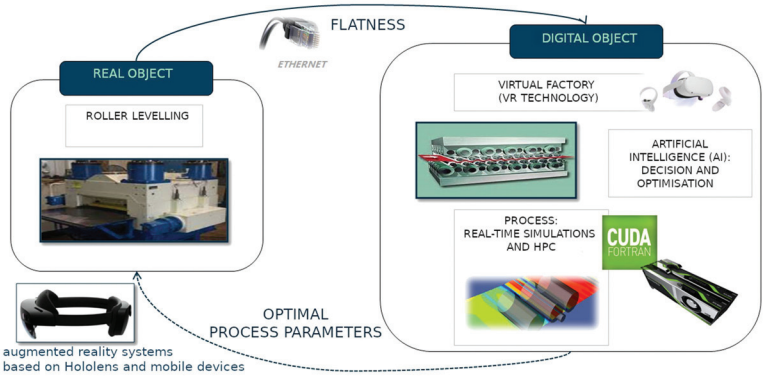

Figure 2. Data flow diagram for a digital twin model.

Coupling the computing module with an artificial intelligence (AI) module, will allow the process to be controlled according to the adopted parameters (Figure 3).

Figure 3. The digital twin of the roller levelling process in a virtual environment.

3. Augmented and Virtual Reality modules

The supporting solution will be an innovative mobile augmented reality (AR) module, enabling the monitoring and display of additional information about the real object, such as information from the laser sensors about flatness, information from the calculation module about deformation and stress values, or information about possible deviations of the semi-finished or final product from the reference model (CAD nominal) (Figure 4).

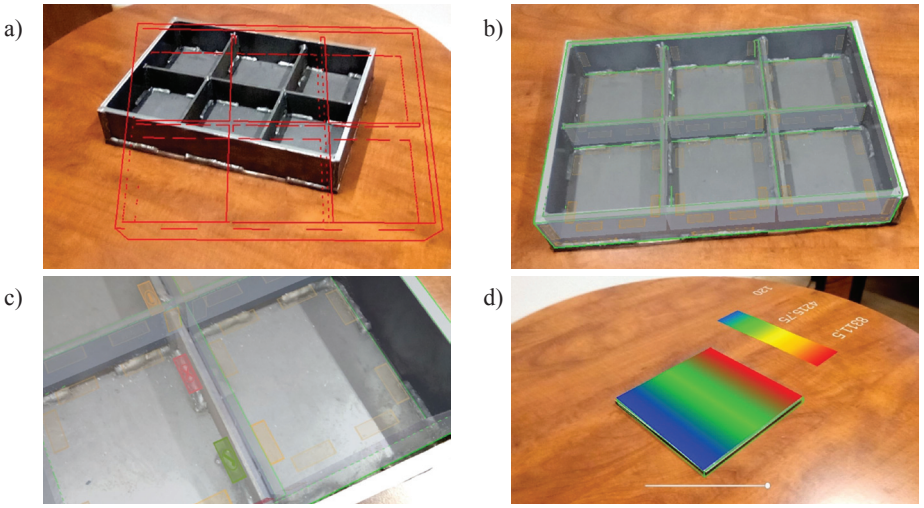

Figure 4. The use of augmented reality to monitoring a real object,
a) model and real object, b) matching the model to the object,
c) quality control, d) visualisation of sample information from the calculation module.

References

1. Eswaran M., Raju Bahubalendruni M.V.A.: *Challenges and opportunities on AR/VR technologies for manufacturing systems in the context of industry 4.0: A state of the art review*. Journal of Manufacturing Systems, 65, 2022, 260–278.

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