Augmented Reality assistance for R&D assembly in Aeronautics

Martin PRUVOST

Arts et Métiers Paristech, France
martin.pruvost@ensam.eu

Pierre MIALOCQ

Safran Helicopter Engines, France
pierre.mialocq@saf-rangroup.com

Fakhreddine ABABSA

Arts et Métiers Paristech, France
fakhreddine.ababsa@en-sam.eu

Keywords: aeronautics, augmented reality, factory of the future, assembly.

1. Introduction

Augmented reality (AR) allows integration of digital information in the real world through the use a device. As a brick of the Factory of the Future, it begins its deployment throughout the industry and especially in aeronautics industry where several implementations are being tested.

This paper presents an AR system architecture for assisting complex assembly work by adding visual information superimposed on the physical assembly parts. The traditional approach for complex assembly assistance is to use assembly drawings and instruction manuals to describe the content of each work task.

This approach is not adapted to the complexity and the small series of R&D assembly. The main objectives in this paper are to expose the benefits of AR for complex assembly and to offer an application for the instrumentation of aeronautics parts. The organization of this paper is as follows. First we present a brief overview of related work on AR assistance for assembly operations. Our use case is explained next. Then we will expose our demonstrator, explaining both its hardware and software, and then the conclusions of the work so far.

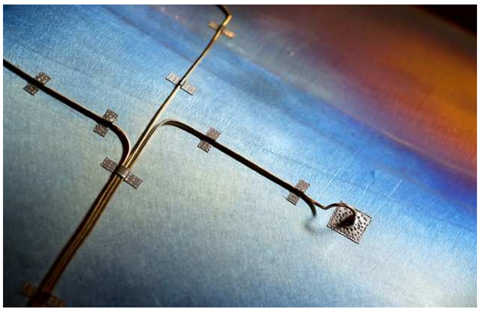
2. Related Work

AR can be used in several ways to assist complex assembly. [Gonzalez-Franco & al.] showed that an assembly training using an immersive Augmented Reality setup with see-through headset can give the same level of knowledge than a conventional face-to-face training. [Suarez-Warden & al.] lead an experiment using a monitor-based system for the assembly of an aircraft structure. They found the mean time for AR assisted assembly to be shorter than the time using traditional instructions. It has to be noted that none of the subjects had any prior knowledge about assembly. French start-up Diota provides an AR software and hardware solution for the manufacturing industry. A system based on projection was deployed to help the assembly of large fuselage parts, and it reduced the error rates by 90% as well as the cycle time by 35%.

3. Use case

Safran Helicopter Engines is a French manufacturer of gas turbine turboshaft engines for helicopters. When developing a new engine or an evolution of an existing one, they have to perform several kind of engine tests on test benches. In order to determine the performances of the engine, a large number of sensors (strain gauges, thermocouples, pressure strobes,…) are disposed on critical parts. This instrumentation is made by specialized workers who read blueprints, defer the position asked by the R&D development and then set the sensors to the requested position. When instrumenting complex-shaped parts such as centrifugal impeller, it becomes difficult to defer the dimensions.

A centrifugal impeller

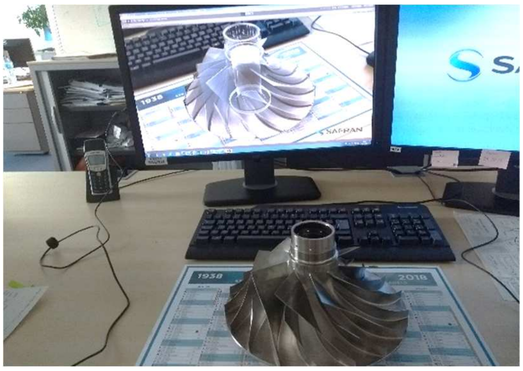


Thermocouples and their wires and guards

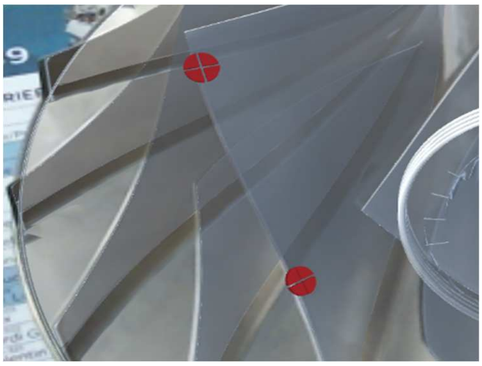
This project's aim is to use an Augmented Reality system displaying in real time a sight standing for the requested position while positioning a sensor.
The device shall use a remote monitor and a mobile camera in order to be hands-free. The instrumentist will align the sensor on the part while looking at the screen instead of his hands. The target accuracy is 1/10 mm and the parts shall not be altered by any means. In a second time, it could be useful to add the pattern of the wire's pathway and to include a measurement function that measure the offset and create position reports after the positioning.

4. Demonstrator

The demonstrator has been made using a 720p webcam, Unity, Vuforia and its Model Target feature. It focuses on the laying of strain gauges on a centrifugal impeller. After creating the Model Target file, the digital mock-up of the part is superimposed on the real part and a sight represents the requested position of the gauge.



The work station of the demonstrator



Sights that are used to position the gauges

Despite the relatively good tracking especially in motion, the precision is inadequate. The overlay's mismatch can reach up to 4mm, as it can be seen on the edge in the right figure above. This mismatch is too important to carry a real experiment and gather significant data to conclude. However, it seems that Diota could reach the target precision of 1/10 mm in a similar project, using its software and a higher resolution camera.

References

Gonzalez-Franco, M. 2016. Immersive Augmented Reality Training for Complex Manufacturing Scenarios

Suárez-Warden, F., &al. 2015. Assembly Operations Aided by AR: An Endeavour toward a Comparative Analysis. International Conference on Virtual and Augmented Reality in Education.

DIOTA. 2016. Aircraft sub-system Assembly. http://www.diota.com/diota-case-assembly.pdf [seen 07/18/18]