08
2022

MADE SMARTER
INNOVATION

USE CASE

GTR

Through-life Engineering Services: Maintenance 4.0

Augmented Reality for Routine Maintenance

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INTRODUCTION

The rail industry in the UK services and maintains vast fleets of rolling stock, both in the field and across a large network of depots. Whilst digital systems are now the backbone of rail MRO, once the engineer grabs their tools and heads for the train, they're on their own....

For the majority of the rail industry, service and maintenance is a manual and skilled operation with significant potential for errors and inefficiencies. This is largely because once the engineer leaves their desk, they typically lose access to the digital systems and the data they need to complete their task.

Govia Thameslink Railways (GTR), a train operating company in England that runs Southern Railway, Thameslink, Great Northern and Gatwick Express services, were looking for a way to make this process more efficient. Working with GTR, the HVM Catapult developed an augmented reality Digital Work Instructions (DWI) system for use in the depot, utilising iPads, digital geometries, servicing checklists and an AR engine. The system utilised 3D CAD data, animations, 2D diagrams and text, combined within two dedicated applications: a desktop editor and a GUI for the iPads. DWIs could be created on the desktop editor, hosted on Amazon Web Services, and downloaded from the cloud to the iPads as needed.

This system gives the engineer real-time access to data and instructions, allowing them to follow these step-by-step,

from selecting PPE before beginning maintenance, all the way through to completion of the maintenance, with the ability to record and sign off operations at the point of action.

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THE WORLD OF MAINTENANCE & AUGMENTED REALITY.

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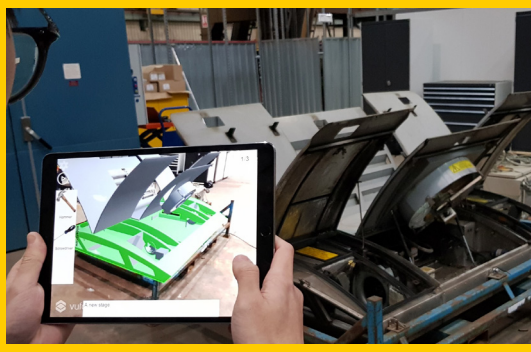

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THE CHALLENGE

Govia Thameslink Railway (GTR) wanted to improve their maintenance instructions and procedures.

Quick and easy to understand instructions are important for accurate and efficient maintenance processes. Traditional maintenance instructions are often lengthy paper directions with 2D images and diagrams, which can at times be difficult to understand, or slow to follow. This project focused on understanding the needs of both the maintenance operators and asset owners to improve productivity. In order to improve task performance and reduce errors it is imperative that information can be provided when and where users require it. The challenge was to create a system that would allow all these issues to be addressed.

Traditional Maintenance

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THE SOLUTION

The solution provided GTR with an intuitive application for the generation and deployment of augmented reality (AR) work instructions.

The Advanced Manufacturing Research Centre (AMRC), Warwick Manufacturing Group (WMG) and Advanced Forming Research Centre (AFRC) worked together to build an application based on the needs discussed with rail experts from Govia Thameslink Railway (GTR) and Bombardier.

The solution included two applications: a desktop-based app for the creation and publishing of digital work instructions and a point-of-use iPad application for the delivery of AR work instructions. These digital AR work instructions allow maintenance staff to select the relevant procedure, which would first provide a list of tools and PPE required for the job, then give step-by-step instructions. Staff can log data and report relevant information, such as confirming safety requirements, as they follow the procedure. The AR component creates a digital overlay of the relevant parts for each step of the procedure, allowing detailed visual directions alongside written instructions.

Augmented Reality Work Instructions

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THE TECHNICAL STUFF

The solution developed by AMRC, WMG and AFRC used Unity game engine software as the development platform, with the Vuforia augmented reality software development kit (SDK),

Vuforia will work with native Android and Apple AR SDKs, meaning that the solution developed was not dependent on device brand/manufacturer/ operating system. We also found that Vuforia was very good at recognising an object and snapping a matching digital model on top.

A desktop editor and graphical user interface (GUI) was produced (using Unity) to enable the creation of the work instructions in a digital format for display through the AR device, combining 3D CAD data, animations, 2D diagrams and text where most appropriate. In some instances, the CAD models were optimised in Blender where, for example, rotation axes were needed for subsequent animations. The digital work instructions (DWI) were uploaded to/hosted on an Amazon Web Services (AWS) cloud-based server, for download to the AR device as and when needed.

Finally, a runtime was created to enable the deployment of the DWIs developed in the editor, on to the AR device via the Vuforia application, and the solution was tested and optimised both in the workshop at AMRC, and at GTR's Selhurst depot in South London.

Object recognition

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THE IMPACT

The proof-of-concept application integrated digital work instructions with an unprecedented level of tractability. Further work in this direction could enable fault finding and real time data updates to be integrated into this software.

The rail network hopes to continue development of this software to realise its potential for time saving, productivity, and safer work environments.

Further work in this direction could enable/integrate real-time fault finding (as opposed to pre-designated tasks) and data updates, to be integrated into the software. Govia Thameslink Railways are carrying out further internal trials with the solution developed, and we hope to be able to assist them with the optimisation of the solution, and advise on the roll-out of the system across multiple business functions and depots.

Final Product

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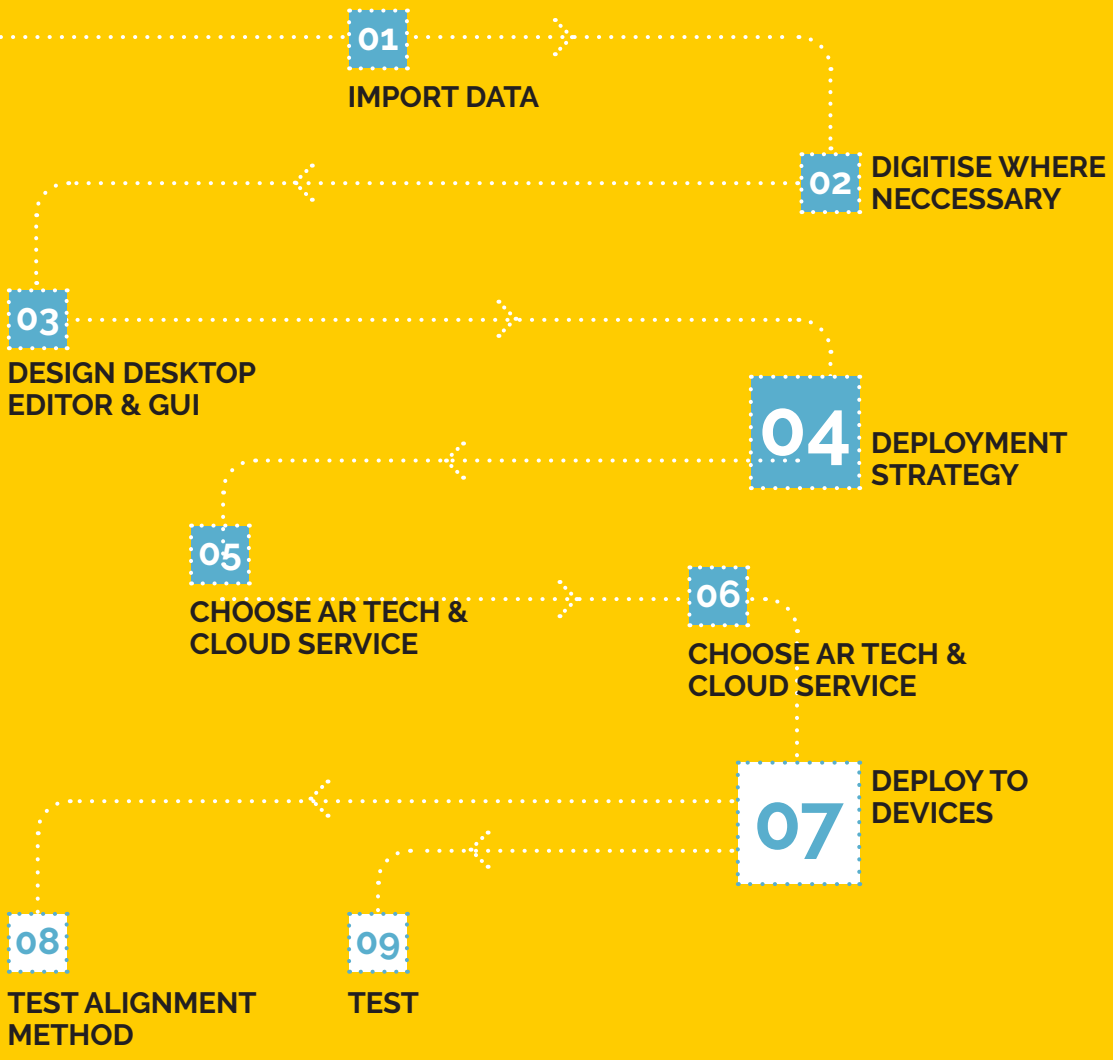
THE PROCESS



01 Identify and compile all relevant data for the overall solution (PPE, equipment, work instructions, 3D models etc.)

02 Where the data needed is not in a suitable digital format (e.g. paper-based task instructions), it must be converted/digitised

03 To enable the organisation to upload/modify the digital content, a desktop editor and user interface were created in Unity to make the system easy to use and flexible.

04 We chose to use an iPad as our AR device as (1) we didn't feel AR headsets were right for the depot environment, and (2) staff are already issued with iPads so are familiar with the tech and used to using them

05 Apple and Android systems have their own alignment SDKs, it was decided to use a 3rd party SDK called Vuforia, which is operating system agnostic and adds image recognition to aid with the alignment process. In order to take the system from desktop editor to AR device, firstly, the content must be hosted in the cloud – we chose AWS.

06 Secondly a runtime must be developed to deploy the task onto the AR device, via the AR SDK.

07 Deploy

08 We trialled the alignment method to ensure that the AR app snapped successfully to the component or system in question – we found that Vuforia worked well in this respect

09 For this last stage of the project, we worked closely with staff from the GTR depot to develop a simple and intuitive interface that enabled them to create/modify digital content

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CATAPULT High Value Manufacturing

WMG THE UNIVERSITY OF WARWICK