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ReSolve Research Engineering: Bespoke Technologies for Research and Innovation

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Abstract

Impactful empirical research is underpinned by high-quality data, and therefore, robust experimental equipment. However, unfortunately, researchers often lack the technical support they require to implement the specialist tools that their investigations demand. This can lead to severe time and cost inefficiencies and sub-optimal outcomes. These issues call for a more objective approach to implementing specialist experimental equipment. With a proven record of accomplishment working across various sectors in academic and industrial research, ReSolve Research Engineering help to transform the research process through the provision of bespoke technologies that integrate hardware, software and measurement systems.

Introduction

Implementing suitable scientific experimental equipment is a non-trivial endeavour. The novel nature of research often renders commercially available systems unfit-for-purpose, leaving researchers with the only option of sourcing novel solutions that are tailored to their specific needs. This raises the question of what options are available to researchers for implementing bespoke technologies? Realising highly effective solutions requires an excellent understanding of the research process, together with expert technical knowledge, techniques and capabilities. Arguably, bridging this gap is a key driving factor of high-impact research.

ReSolve Research Engineering specialises in the development of bespoke technologies for research and innovation. Our mission is to empower researchers and innovators with robust and flexible tools that enable them to speed discovery, streamline innovation, and drive change. Working across various academic and industrial research sectors, we have developed a wealth of expertise in bespoke software, hardware, measurement, and mechatronic systems.

At ReSolve, we strive to enable high-impact research through robust, intuitive, flexible, and scalable technologies. This proven approach empowers our clients with reliable, easy-to-use systems that capture the full scope of their testing requirements, with the possibility of increasing functionality as their research objectives evolve.

Case study: Test and measurement

We recently worked with the Institute of Functional Surfaces at The University of Leeds to automate heritage Tribology testing equipment for investigating the effects of surface-surface interactions during reciprocating, sliding and engine piston-cylinder contact conditions [1,2]. The previous systems required a significant amount of manual input, human monitoring, and post-processing of results. We developed a bespoke software platform and instrumentation system to integrate speed, temperature, and pressure control (see Figure 1). Using our intuitive user interface, the operator is able to configure comprehensive experimental procedures. The software then automatically runs the experiment with the specified parameters. Data are acquired, processed, and stored in an easy-to-read format. The flexible software architecture enables integration into any one of the Tribology testing systems with minimal configuration. This allows for a consistent user interface across all testing equipment (therefore reducing training times and promoting collaboration within the group) with minimal modifications to the existing platform.

Case study: Robotics and control

The Surgical Technologies group at The University of Leeds required a novel system that enabled the investigation of the relative effects of augmented visual and haptic (touch) feedback

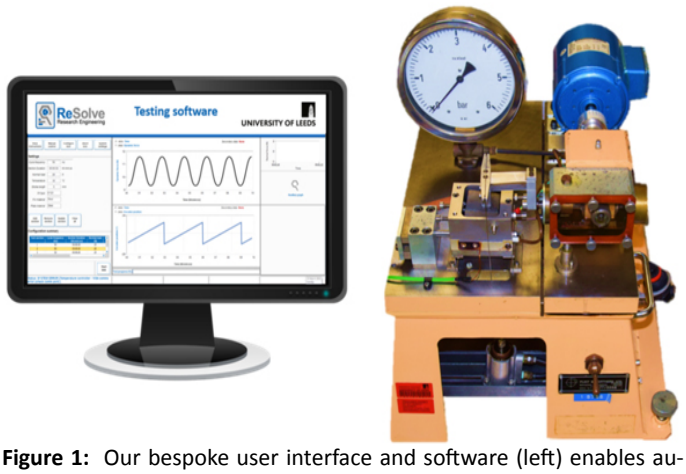

Figure 1: Our bespoke user interface and software (left) enables autonomous control of a reciprocating tribometer (right)

during the manual assessment of an object's stiffness [3]. We developedVIRI (the Visuohaptic Illusions Robotic Interface), a master-slave robotic system that mimics hand movements by relaying the position of a master haptic device end-effector to a slave robot (see Figure 2). The slave robot's movements and indented sample are recorded using a webcam and displayed on-screen. Force feedback, or haptic feedback, is generated in real-time through the haptic device using modelled data. The VIRI system is currently being used to carry out investigations to inform future robotic surgical systems.

Figure 2: VIRI uses three Denso robotic arms to control **1)** sample selection, **2)** sample indentation and **3)** feedback camera positioning

Case study: Interactive software

Working with the Bradford Institute for Health Research, we were tasked with creating an accurate, portable, and automated tool to objectively assess the manual dexterity and cognitive abilities of 13,500 school children. The Kinelab software platform, created in collaboration with Dr Peter Culmer, Associate Professor at the School of Mechanical Engineering, University of Leeds, UK, was the winner of the National Instruments 2016 Engineering Impact Award for Innovative Research. Kinelab is a tablet-based software platform that presents interactive visual stimuli and analyses hand movement data (see Figure 3). Headed by the UK National Health Service (NHS), the Kinelab project is forming a key part of the Born in Bradford (BiB) study in helping to identify children with motor-cognitive difficulties [4,5].

Figure 3: Kinelab is currently being used to measure the manual dexterity abilities of school children in Bradford, UK

Through our experience working across a variety of industry and academic sectors, ReSolve has gained valuable insights into some of the obstacles that researchers and innovators consistently face in the process of obtaining high-quality data. One obstacle we have identified is the lack of a robust and flexible platform that facilitates autonomous identification and extraction of valuable information from large datasets. Aimed at the Big Data and Internet of Things (IoT) markets, ReSolve is in the early stages of developing an intelligent data analysis software toolkit that can be used to autonomously carry out complex feature identification and process monitoring. Our constant exposure to the research ecosystem has enabled us to build a unique bank of knowledge that will inform the design and development of new products that will benefit the wider scientific and research community.

Conclusions

A key driver for high-impact research is the successful implementation of robust, intuitive, flexible, and scalable experimental equipment. With a vision to streamline the research process, ReSolve Research Engineering bridges the gap between research questions and high-quality data, by providing bespoke technologies that enable researchers to maximise the efficacy of their work. Our experience working across a wide variety of sectors in academic and industrial research gives us the unique opportunity to collaborate with experts, as well as to cross-fertilise ideas and technologies. In this way, we are able to implement innovative and disruptive engineering solutions to help revolutionise the research process.

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