

EXAMENSARBETE Can augmented reality supplement traditional human-machine interfaces?**STUDENTS** Gustav Lilja and Fredrik Siemund**HANDLEDARE** Günter Alce (LTH)**EXAMINATOR** Joakim Eriksson (LTH)

Can augmented reality supplement traditional human-machine interfaces?

POPULAR SCIENCE PAPER **Gustav Lilja and Fredrik Siemund**

The fourth industrial revolution, or Industry 4.0, represents the idea in which machines are augmented with wireless connectivity and sensors, creating smart and connected factories. Thanks to recent advances in areas such as communication technologies, automation and artificial intelligence, it has been possible to improve efficiency by, for example, predicting machine maintenance autonomously or react to changes in production with self-organized logistics. One emerging technology, augmented reality (AR), enhances the experience of the real world by adding digital elements to it. This makes it a useful tool in the industry, for example in use cases like expert support through remote guidance or complex assembly.

Today, operators and service technicians interact with large machines in factories using traditional human-machine interfaces (HMI). In many cases, these user interfaces are complex, making it hard for the user to find the necessary information and to perform certain tasks. Could an AR interface serve as a replacement or as a complement to the existing interfaces?

The focus of our thesis was evaluating the role AR could play as an interface in an industrial environment. To be able to do that, an AR application was developed for an Android tablet. With the AR application, a user could control a small electric elevator by moving the elevator up and down and toggle eight different lights. To control the elevator, a user has to scan a QR code placed on the elevator. Once the code has been recognized, buttons for the elevator are augmented in relation to the parts which they control. This provides the user with a context-based interface, allowing the user to see what is happening in real-time.

The AR application was evaluated in a user study by comparing it to a traditional HMI developed by the manufacturer Beijer Electronics. The user study was conducted on 20 test participants. System usability tests showed that it was easier to perform the actions through the AR application. The average time

to perform each action was lower with the AR application. However, the AR interface had a higher perceived workload. This was probably because of a slow QR scanning functionality and the test subjects having to move around and point the camera at the elevator during the test session.

In the last task of the user study, the test subjects had to find a component on the elevator which was causing an alarm to go off. In order to find this component with the AR application, a 3D object had been superimposed over the faulty component, aiding the test subjects which were not familiar with the elevator in locating the faulty component. This was considered to be the best feature of the AR application compared to the traditional HMI.

In conclusion, AR's strength is the ability to display data in a context which can be particularly useful in use cases such as error handling. However, with the current tools, it is not possible to completely replace a traditional HMI.