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Title:
Development and Performance Evaluation of an Augmented Reality Instructional System (Easy-AR) for Assembly Support

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Abstract:
This work develops and evaluates an Augmented Reality Instructional System for assembly support and its role in improving efficiency on manual, customized, or modular manufacturing. The prototype application is a tool designed to unite real and computer-based scenes and images to deliver a combined view of assembly with a marker-less based tracking system, the "Easy-AR". Normally, such assembly process is conducted by referring to the manual instruction, often via printed graphics which are inefficient especially for new workers. To overcome, industries need to provide series of training sessions to develop worker skills until necessary performance is obtained. This will likely contribute to an increment of direct and indirect cost towards industries. The development of the "Easy-AR" application for assembly support prototype is hypothesized to help to enhance the efficiency and reduce errors of the manual assembly process with minimum training requirement. The prototype was tested in a controlled environment to minimize unnecessary variables. Time study, efficiency, and error of assembly process was done under assistance of the prototype while assistance of a printed manual is introduced as control. Time taken to assemble each component of a prototype was recorded and analyzed to identify the difference of efficiency and assembly quality under both situations and analyzed statistically. Based on testing on 60 participants, assembly time with the prototype reported to be improved by 38.9% in comparison with control. Furthermore, a 50% reduction of errors has been recorded with the prototype. As conclusion, the problem in industry related to the manual processes in daily tasks can be overcome by the implementation of the prototype app which is scalable, and the assembling process will be more interesting, attractive, and effective, in line with the fourth industrial revolution.