A Robotic System Method and Rebar Construction with Off-the-Shelf Robots

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ABSTRACT

The construction industry has traditionally been a labor-intensive industry. Typically, labor cost takes a significant portion of the total project cost. In spite of the good pay, there was a big gap recently between demand and supply in construction trades position. A survey shows that more than 80% of construction companies in the Midwest of U.S. are facing workforce shortage and suffering in finding enough skilled trades people to hire. This workforce shortage is also nationwide or even worldwide in many places. Construction automation provides a potential solution to mitigate this problem by seeking to replace some of the demanding, repetitive, and/or dangerous construction operations with robotic automation. Currently, robots have been used in bricklaying or heavy-lifting operations in the industry, and other uses remain to be explored. In this paper, the authors proposed a feasibility breakdown structure (FBS)-based robotic system method that can be used to test the feasibility of performing target construction operations with specific robotic systems, including a top-down work breakdown structure and a bottom-up set of feasibility analysis components based on literature search and/or simulation. The proposed method was demonstrated in testing the use of a KUKA robot and a Fetch robot to perform rebar mesh construction. Results showed that the overall workflow is feasible whereas certain limitations presented in path planning. In addition, a smooth and timely information flow from the Fetch robot sensor and computer vision-based control to the two robots for a coordinated path planning and cooperation is critical for such constructability.