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A framework for an automated and integrated project monitoring and control system for steel fabrication projects

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ABSTRACT

This paper presents an automated and integrated project monitoring and control framework that facilitates decision making by enabling project managers to take corrective actions immediately after deviations occur and to mitigate potential damage to ongoing steel fabrication projects. An automated data acquisition system integrated with computer simulation provides a reliable platform for the proposed framework, as the former reduces the time required to obtain as-built data while the latter simulates different scenarios for possible corrective actions in advance. The framework employs High Level Architecture (HLA) as its infrastructure and is composed of several individual monitoring and control components which cooperate and interact with each other in real-time within a unified environment. To verify the concept and test the feasibility of this framework, a model consisting of several components, including automated data capturing, simulation, and visualization, was developed and implemented in the fabrication phase of steel construction.

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1. Introduction

For successful project delivery, a reliable monitoring and control system is essential. Actual data is collected to measure the actual values of a project's basic variables, such as the percent complete, the quality of work, and cost. Comparing this data with planned values indicates if the project is meeting the targets of the work plan. The necessary adjustments then can be made to meet the project objectives [1].

In industrialized countries, the construction industry is an important industry that contributes approximately 10% to the gross national product (GNP) [2]. Accordingly, national economies can be significantly affected by the performance of the construction industry, which highlights the importance of tracking and control in construction projects. In construction, while the average duration of activities typically falls within a range of days, the usual frequency of reporting is weekly or monthly. Therefore, in the case of deviations, traditional project control systems used in the construction industry may yield corrective actions too late. This can result in cost and schedule overruns. As well, the longer it takes to recognize deviations, the greater the potential damage [3].

Steel construction plays a significant role in the construction industry as many projects incorporate steel structures. Steel construction has a considerable impact on the total cost of such projects and it is commonly located on the critical path of the schedule. It involves designing, fabrication, shipment, and site erection of thousands of steel elements with different dimensions and complexities. To deal with such a broad area, an integrated monitoring and control system is a great tool for project managers to ensure the steel elements are fabricated and erected according to the project plan. Such a system enables real-time high-quality data to be captured, project performance indicators to be evaluated and forecasted, and timely corrective measures to be executed as needed. This helps minimize or prevent damage caused by project discrepancies.

Recent advances in automated data capturing systems and computer simulation techniques provide a reliable platform for effective project monitoring and control, as they can respectively reduce the time required to obtain as-built data and simulate different scenarios for potential corrective actions ahead of time [3]. Integrating these two techniques can significantly increase the functionality of control systems. However, the feasibility of such a concept has not yet been examined in great detail. This paper addresses this issue by proposing a framework for a new generation of project monitoring and control systems. This framework unites automated data acquisition systems and computer simulation techniques in order to create a robust decision support tool. Though the ultimate target is to develop a framework for steel construction projects, this paper specifically deals with the fabrication phase of steel projects.

2. Background and state of the art

Monitoring and control are two important issues in construction management. Many efforts have been made by researchers to improve these areas. The output of an automated monitoring system

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