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Integrating automated data acquisition technologies for progress reporting of construction projects

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ABSTRACT

Controlling construction projects necessitates controlling their time and cost in an effort to meet the planned targets. Management needs timely data that represent the status of the project to take corrective actions, if needed. This paper presents a control model that integrates different automated data acquisition technology to collect data from construction sites required for progress measurement purposes. Current automated data acquisition technologies are described, and their suitability for use in tracking and controlling construction activities is assessed. This includes bar coding, Radio Frequency Identification (RFID) 3D laser scanning, photogrammetry, multimedia, and pen-based computers. The user can move with a tablet PC in the construction site and record, take snapshots and also hand written comments about activities on site. The proposed cost/schedule control model integrates with the automated data acquisition technologies, a planning and scheduling software system, a relational database, and AutoCAD to generate progress reports that can assist project management teams in decision making.

1. Introduction

The earned value technique is widely used for periodic monitoring of actual expenditures and physical scope accomplishment and, accordingly, for generating period-by-period progress reports. These reports are commonly developed by essentially comparing the collected actual data pertinent to work performed on site to that planned. The reliability of these progress reports depends primarily on the accuracy, and timeliness collection of actual data that depicts work progress on site. This paper presents a control model that integrates different automated data acquisition technologies including bar coding, Radio Frequency Identification (RFID) 3D laser scanning, photogrammetry, multimedia, and pen-based computers to collect actual data from construction sites to generate progress reports. To do so, the characteristics of different automated data acquisition technologies were studied and analyzed. This includes their capabilities and limitations and their respective suitability to track various construction operations. Experiments were conducted to study the applications of different automated data acquisition technologies and explore the most suitable IT platform for integrating them in one tracking and control system. Each automated technology, is used for a certain construction task on site. For example, 3D scanner or LADAR (laser distance and ranging) was integrated together with photogrammetry to rapidly track changes of quantities of work accomplished such as excavation works. Integrating these two technologies alleviates limitations associated with each of them individually such as the number of scans required and the time needed for each scan to produce acceptable results during the 3D modeling process. It also overcomes limitations associated with photogrammetry when modeling 3D images of objects with unclear geometrical properties as in the case of earthmoving operations where modeling 3D images from digital photo images becomes difficult and the presence of a scanned image can be helpful. Bar coding and RFID are utilized for material and labor tracking. In the reporting stage, more photo images would be more desirable. A pen-based or tablet computer is utilized as the main interface tool with the user [1].

2. Proposed control model

A project control system establishes guidelines for effective cost and schedule control. As mentioned earlier, data collection is a crucial step in the tracking control process. Considerable work has been carried out to utilize various automated data acquisition technologies for the purpose of data collection [2–6]. For example in Abudayyeh's model [7], the barcode technology was used in acquiring construction data from site. In some other cases, these technologies were used for the purpose of inventory, maintenance, or inspection [1,26]. The

Abbreviations: RFID, Radio Frequency Identification; 3D, 3 dimensional; LADAR, Laser Distance And Ranging; BIM, Building Information Modeling; PM+, Project Management Plus; GPS, Global Positioning System; JMSB, John Molson School of Business (Concordia University in Montreal); BRI, Basic Reader Interface.

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