Integrating Virtual Reality and Building Information Model-Based Quantity Takeoffs for Supporting Construction Management

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Abstract : A construction superintendent needs to know not only the amount of quantities of cost items or materials completed to develop a daily report or calculate the daily progress (earned value) in each day, but also the amount of quantities of materials (e.g., reinforced steel and concrete) to be ordered (or moved into the jobsite) for performing the in-progress or ready-to-start construction activities (e.g., erection of reinforced steel and concrete pouring). These daily construction management tasks require great effort in extracting accurate quantities in a short time (usually must be completed right before getting off work every day). As a result, most superintendents can only provide these quantity data based on either what they see on the site (high inaccuracy) or the extraction of quantities from two-dimension (2D) construction drawings (high time consumption). Hence, the current practice of providing the amount of quantity data completed in each day needs improvement in terms of more accuracy and efficiency. Recently, a three-dimension (3D)-based building information model (BIM) technique has been widely applied to support construction quantity takeoffs (QTO) process. The capability of virtual reality (VR) allows to view a building from the first person's viewpoint. Thus, this study proposes an innovative system by integrating VR (using 'Unity') and BIM (using 'Revit') to extract quantities to support the above daily construction management tasks. The use of VR allows a system user to be present in a virtual building to more objectively assess the construction progress in the office. This VR- and BIM-based system is also facilitated by an integrated database (consisting of the information and data associated with the BIM model, QTO, and costs). In each day, a superintendent can work through a BIM-based virtual building to quickly identify (via a developed VR shooting function) the building components (or objects) that are in-progress or finished in the jobsite. And he then specifies a percentage (e.g., 20%, 50% or 100%) of completion of each identified building object based on his observation on the jobsite. Next, the system will generate the completed quantities that day by multiplying the specified percentage by the full quantities of the cost items (or materials) associated with the identified object. A building construction project located in northern Taiwan is used as a case study to test the benefits (i.e., accuracy and efficiency) of the proposed system in quantity extraction for supporting the development of daily reports and the orders of construction materials.

Keywords : building information model, construction management, quantity takeoffs, virtual reality