Advanced Real-Time Volumetric Modeling of Stockpiles in Industrial Applications Using Depth Camera

K. D. Gayantha[1*], M. H. P. P. Thilakarathna[2*], W. G. C. W. Kumara[3,] , P. M. K. Alahakoon[4,] , P. R. D. S. Rudrigu[5,]

[1] *Dept. of Electrical and Telecommunications Engineering, Faculty of Engineering, South Eastern University of Sri Lanka, Oluvil, Sri Lanka, eg18063@seu.ac.lk*

[2] *Dept. of Electrical and Telecommunications Engineering, Faculty of Engineering, South Eastern University of Sri Lanka, Oluvil, Sri Lanka, eg18075@seu.ac.lk*

[3] *Dept. of Computer Science and Engineering, Faculty of Engineering, South Eastern University of Sri Lanka, Oluvil, Sri Lanka, chinthakawk@seu.ac.lk*

[4] *Dept. of Electrical and Telecommunications Engineering, Faculty of Engineering, South Eastern University of Sri Lanka, Oluvil, Sri Lanka, mahinda@seu.ac.lk*

[5]*Siam City Cement (Lanka) Ltd, Puttalam, Sri Lanka, sumith.rudrigu@siamcitycement.com*

Accurately estimating the volume of dynamically changing stockpiled materials is one of the most critical challenges in effective material management for Siam City Cement (Lanka) Limited. Traditional approaches, such as manual surveying or simple volumetric approximations, are not only laborious and time-consuming but also prone to errors, which may result in less-than-optimal outcomes with regard to resource utilization and operating costs. This paper presents a novel method based on 3D point cloud data acquired by a Kinect depth camera prototype for the estimation of stockpile volumes with increased efficiency and accuracy. The system allows accurate volumetric modeling in real-time using advanced computational algorithms, which turns out to be a striking improvement over traditional methods. It involves registration of several point cloud captures, reorientation of data by using Principal Component Analysis (PCA), noise filtering using clustering techniques, and creation of the accurate surface representation by using Delaunay triangulation. The above approach ensures the limitation brought by the Kinect's field of view and its depth resolution are effectively compensated. However, to enhance the system's robustness and scalability, the proposed design will incorporate a Light Detection and Ranging (LiDAR) sensor in its future version. The LiDAR has greater depth accuracy, the ability to acquire data faster, and consistent performance in varying environmental conditions, thus overcoming the intrinsic limitations of the Kinect sensor and enabling easy adaptation to industrial-scale applications. Such research can provide the development of a more reliable and automated volumetric estimation system that will transform material management: reduce manual effort, increase precision, and enable real-time monitoring of stockpile dynamics. This new solution aligns with modern industrial requirements by offering a practical and scalable tool for material inventory optimization and operational workflows.

Keywords: *Kinect, Real-time, Stockpile, Volume Estimation*

Paper No: IEM-02 **Industrial Engineering and Management**