An Interactive Virtual Environment for Teaching Total Station Surveying

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SUMMARY

In all early stages of surveying engineering training in relevant academic and other departments, the fundamental use and implementation for a number of survey instrumentation is compulsory. Whilst traditional teaching of these instruments is on a face-to-face basis where the instructors explain the methods to students individually, the students practice with the need of a partner and/or instructor until they feel confident enough to employ the instrument in further educational tasks. Recently, however, the e-learning approach has become a dominant delivery method across universities worldwide and virtual education has become a challenge not only for the education system but for the society as a whole.

This paper describes the design, development, and initial evaluation of an interactive virtual environment whose objective is to help undergraduate students learn and review the concepts and practices of total station surveying. The virtual environment, which includes realistic measuring scenarios and a real instrument that operates and produces results comparable to the physical operation, is not meant to replace field practice completely. It will be integrated in surveying courses as a preparation, revision and assessment tool. For this work, the virtual environment was created using the 3D model of the chosen surrounding (e.g laboratory, exterior area). In the presented example, the scanning of a laboratory with the Leica Geosystems BLK360 scanner provided a mesh accurate at 0.8mm and the superposition of photographic texture enabled the photorealistic result of the 3D model. A number of different types of targets (e.g prisms, reflective, natural points of interest) were included in the 3D model to facilitate training of the students. A Trimble S6 total station was used with a quoted precision of 2 mm + 2 ppm (prism mode) and 4 mm + 2 ppm (tracking mode), with an angle reading accuracy of 3". The dedicated proprietary software TSC2 controler for the remote operation of the total station was employed and through a Remote Desktop Software, the user can make any operations on the instrument as in physical operation. The

basics steps of the e-learning platform include an initial tour of the 3D environment, correction of the total station position, recognition of targets, check of the instrument operation and finally measurement acquisition through a number of operating functions (e.g. change of fixed target, inversion, rotation, etc.). Following this procedure, and after a thorough description of functions and features of the instrument and its correct operation, the students perform measurements that refer to their exercise scenarios. Following data downloading, the students continue with carrying out calculations, completion of work, submission of work and fill of a questionnaire evaluation.

The initial findings from a formative study are also reported in the paper, with a number of undergraduate students and faculty members, on how the virtual environment is usable, engaging and useful for teaching/learning total station surveying. The results indicate that interacting with the virtual environment led to higher declarative knowledge gains but differences in procedural knowledge gains (e.g. the ability to perform the total station measurement exercises in the field) between students who used the virtual environment versus students who had practiced in the field were not significant.