Toward the improvement of safety planning for construction activities performed at high elevation by using augmented reality

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Many of the activities in construction tend to lead to accident occurrences. The major causation of the accidents in this industry is fall from height and the accidents frequently occur in building construction projects (Huang and Hinze, 2003). From preliminary survey of construction sites in Thailand, workplaces at high elevation are normally prepared unsafely. Omission in unsafe conditions may be caused from ignorance and unawareness of in-charge personnel related to hazards and risks.

To eradicate unsafe conditions and reduce a number of accidents, in-charge personnel should definitely understand and have knowledge related with requirements of safety procedures and safety facilities of construction activities performed at high elevation for planning and execution works. It is more effective to allow those personnel gain experiences and knowledge about those activities in the actual construction site. Thus, an innovative approach is needed to provide visualized information of those activities as they occur in real construction site. This study aims to develop a visualized approach for simulating the construction activities operated at high elevation using Augmented Reality and to implement this approach for investigating the improvement of construction personnel considerations in safety planning.

Augmented Reality technology is employed to develop the visualized approach for simulating construction activity performed at high elevation. This technology can supply amount of information through computer graphics and merge the virtual objects into the real world scene (Azuma, 1997). The proposed system architecture is configured and shown in Figure 1. The hardware components consist of a laptop computer, a video camera, and a head mounted display (HMD).

To develop this system, current and improvement information is required. Three databases are created in the laptop computer. The first database is virtual model of construction objects which are created into the following four modules: (1) building element module, (2) equipment module, (3) method module, and (4) worker module. The second database consists of the following three contents: (1) hazard database, (2) risk database, and (3) consequence database. The third database is safe and unsafe scenarios for performing construction activity according to the selection of equipment and method. Both safe and unsafe scenarios are classified based on safety rules, regulations, literatures, and experts’ recommendations. A computer program which generates the simulations of construction activity according to safe and unsafe scenarios is developed using Augmented Reality. The simulations are superimposed into the actual construction environment. The visualized simulations imitate real construction tasks both safe and unsafe conditions and present information regarding hazards, risks, and consequences of improper or missing safety facilities while the users perceive actual surrounding environments. The users can visualize and experience similar as they are in the real construction at high elevation situation.
The computer program will be implemented to a real construction project as a tool for investigating the improvement of construction personnel considerations. In this proposed system, the user can select construction method, safety measures, and temporary facilities that they can provide to the worker via user interface in a laptop computer. The virtual simulations which are linked with the marker are displayed for demonstrating the operation of construction activity via a HMD.

For executing experiments, staffs of a high-rise building construction project will be employed. The participants will be divided into two groups, which are control and test groups. Considerations of construction personnel will be examined by using test papers. The differences of test results between two groups will be evaluated to investigate their development. This research is in the on-going process and the prototype systems are under development.

From this proposed system, the construction personnel can gain adequate safety knowledge and have a high degree of safety awareness. They are also able to recognize the importance of safety, assign adequate resources to handle it, provide proper considerations during planning to eliminate and reduce safety problems, consider potential safety problems during preparation of method statements, avoid performing unsafe acts, avoid creating unsafe conditions, and identify unsafe acts or conditions and ask for modification. The benefit of this study is the improvement of construction personnel in safety and planning. It can enhance construction workers’ health and life quality. Furthermore, it will raise the level of safety in construction industry.

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References