Chapter 12
Enhancement of TAPS Packages Using Tangible User Interface

Manjit Singh Sidhu
Universiti Tenaga Nasional, Malaysia

Waleed Maqableh
Universiti Tenaga Nasional, Malaysia

ABSTRACT
Tangible User Interfaces (TUI) is an emerging human-machine interaction (HMI) style where significant number of new TUIs has been incorporated into the educational technology domain. This work presents the design of new user interface for technology-assisted problem solving (TAPS) packages for Engineering Mechanics subject at University Tenaga Nasional (UNITEN). In this study the TAPS packages were further enhanced by adopting TUI and compared to the previous TAPS packages. The study found additional benefits when using TUI whereby it provided human interface senses, such as haptics and tactile (touch) making it more natural to use.

INTRODUCTION
Since the existence of computing technology, we realize that traditional way of handling task in our daily lives will change rapidly aligned with the technologies offered. From analogue to digital, from atoms to bits and from physical interaction to virtual interaction; all these changes have shown us how computer has affected our daily activities. In the field of education, we see similar trends where traditional teaching and learning methods have changed, tailored towards the use of computers for example multimedia and mixed realities are being employed to enhance the learning process (Lim, 2010). Cairncross (2002) highlighted that multimedia has the potential to create high quality learning environment. The key elements of multiple media, user control over the delivery of information, and interactivity can be used to enhance the learning process through creating integrated learning environments (Cairncross, 2002; Manjit & Selvanathan 2005; Manjit 2009).
In the context of introductory courses such as Engineering Mechanics which requires the students to read and to understand the engineering structure, such interactive system can indeed facilitate and accelerate the learning curve by putting the entry-level transfer of information at the disposal of the student. The student can be provided with opportunities to control the pace of delivery, including the option to stop and re-play portions of the lecture that seem unclear.

Although, one may say that the textbook is there to serve this purpose, however, experience shows that most students are unable to do this, whether for reasons of time, motivation, ability to absorb new information from a printed medium, or others (Ramesh & Manjit, 2002). In any case, a textbook is a mono-medium that has great difficulty in presenting moving or evolving processes.

According to Cairncross (2002), the design of a multimedia system must be based on the needs and interest of the learners. Interactivity in learning applications merits more detailed investigation and the issue of how best to design learning activities that engage the learner needs to be addressed. To address these issues, an innovative approach based on the principle of computer aided learning (CAL) to design and implement integrated packages known as technology assisted problem solving (TAPS) packages was developed. Further details of TAPS packages are discussed by Manjit (2006). This chapter presents the outcomes of ongoing improvements to the existing TAPS packages. In this study we proposed the use of Tangible User Interface to improve the user interface of newer TAPS packages.

**GRAPHICAL USER INTERFACE**

Graphical User Interfaces generally consists of windows, icons, menus, pointers, alerts and warnings and dialogue boxes. The first four elements are responsible for the term WIMP in the first place. In our previous research we implemented a learning package called the technology-assisted problem solving (TAPS) using desktop virtual reality interface that brings together a 3-D model of an engineering mechanics problem in an interactive manner. TAPS package is defined as highly interactive self learning software and was found to be useful for realistic hands-on experimentation, visualization of curvilinear motion, and replacement of high cost and complicated experiments. In addition it also enhanced students’ understanding by providing a degree of reality within rich interactive learning environments. However, TAPS packages still rely on WIMP based interfaces. The reason is the lack of an interface that can fully exploit human spatiality, our innate ability to act in physical space and to interact with physical objects. Xu (2003) argued that many classic computer interactions offer very limited stimuli, little freedom to behave and low ecological validity (that is, little relevance to normal, everyday human behavior in the real world). Therefore, it is believed that TUI can give more freedom to spatiality and natural movement in order to improve interactivity enhancing learning. The next section briefly describes the concept of TUI.

**TANGIBLE USER INTERFACES (TUI)**

Recently, many CAL packages have been implemented using the TUI concept. In Augmented Reality (AR) environments, real world scenes are visually enhanced with 2D or 3D virtual objects or other data. One of the factors that made AR successful is the major usage of TUI (Xu, 2005). According to Fjeld (2002), TUI can benefit the user by offering a more direct form of interaction i.e. coming closer to the use of physical artifacts and tools. This offers users a more natural use of hand and body movements. It is commonly believed that physical action is important in learning, and tangible objects are thought to provide different kinds of opportunities for reasoning about the world (Xu, 2003). Fitzmaurice was the first to
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