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## Visualization, Engineering and Simulation

# ViSTREET: An Educational Virtual Environment for the Teaching of Road Safety Skills to School Students

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**Abstract.** Virtual reality (VR) has been prevalently used as a tool to help students learn and to simulate situations that are too hazardous to practice in real life. The present study aims to explore the capability of VR to achieve these two purposes and demonstrate a novel application of the result, using VR to help school students learn about road safety skills, which are impractical to be carried out in real-life situations. This paper describes the system design of the VR-based learning environment known as Virtual Simulated Traffics for Road Safety Education (ViSTREET) and its various features. An overview of the technical procedures for its development is also included. Ultimately, this paper highlights the potential use of VR in addressing the learning problem concerning road safety education programme in Malaysia.

**Keywords:** virtual reality, educational virtual environments, road safety education, instructional technology.

## 1 Introduction

The utilisation of computer simulations in enhancing teaching and learning has become popular in recent years largely due to technological advancements in three-dimensional (3D) graphic processing and declining costs of computer peripherals. Virtual reality (VR) is a more recent technology that is used for computer simulations. VR enables users to interact with three-dimensional data, creating a potentially powerful interface to both static and dynamic information [1]. Studies conducted by various researchers [2, 3, 4, 5] further reveal that VR offers a large number of possibilities in instructions due to its capabilities, which are absent in other tools. The key capability is that VR helps learners to experience and visualise directly some physical properties of objects and events that are unavailable or unfeasible in the real world due to distance, time, cost, or safety reasons. In light of this, VR is regarded as a potential instructional tool to provide simulated training and skills teaching in dangerous or logistically impossible circumstances such as roads with heavy traffics, house on fire or coal mine. VR is thus increasingly eminent in prevention training as well as emergency or disaster management [6].

One area of concern in which VR can provide a plausible solution is road safety education that is often confined to the use of verbal teaching and printed materials and impractical to be carried out on real roads [7]. The present work aims to explore the potential of VR in addressing these issues pertaining to the current implementation of road safety education in Malaysia. Based on the meticulous review of materials used for the teaching of road safety skills in the classroom and prior related studies, a VR-based learning environment known as Virtual Simulated Traffics for Road Safety Education (ViSTREET) is designed and developed. ViSTREET aims to complement the current road safety curriculum in Malaysian schools by providing authentic road safety practices to school students aged 12 to 14. In particular, ViSTREET teaches students on crucial pedestrian skills such as detecting dangerous situations, gap timing and safe place finding [8] by 'placing' them in life-like simulated traffic conditions within the learning environment. This paper explains the system design of the ViSTREET learning environment as well as the technical procedures for developing the learning environment.

## 2   Road Safety Education in Malaysia

Malaysia is among the countries that has consistently recorded a large number of road traffic accidents in proportion to its population annually over the last three decades [9]. A closer look at the statistics on fatalities due to road accidents in Malaysia shows that pedestrians are among the top three high-risk groups, after motorcyclists and motorists [10]. In addition to that, studies conducted by Road Safety Department of Malaysia and Malaysian Institute of Road Safety Research (MIROS) reveal that a majority of pedestrian casualties involve children and young teenagers aged 9 to 14 [9]. Therefore, under the Malaysian Road Safety Plan (2006-2010), the Road Safety Department in collaboration with Ministry of Education has initiated a road safety education programme targeting school students. The programme is being introduced into primary and secondary schools in stages, starting with Year One in 2008. It will be fully implemented in all schools by 2011 and at all school levels [11]. The programme has its emphasis on teaching pedestrian safety skills to school students by using training materials like posters, multimedia, video and pamphlets. Teachers are also told to use roads within the school compound to provide students necessary practical training.

Real-world practical training in pedestrian skills is known to be highly effective at improving the performance of children as young as 8 years of age. The ideal context for practical training would seem to be at the roadside and there is no doubt that roadside training can be highly effective [8]. When conducted at the roadside, however, this training can be time-consuming, labour intensive, dangerous and subject to disruption from poor weather and a lack of traffic situations of the types required. In addition, the teaching of pedestrian safety skills using printed materials such as pamphlets or posters (refer to Fig. 1 for an example) has its limitation in the sense that learners cannot visualise the traffic scenarios in a more concrete manner. On the other hand, the use of multimedia application in teaching road safety skills is mainly focused on factual drills without road simulations that allow active participation of the students. In general, these applications present traffic situations with the use of static