Smart Driving Simulation Using Agent Approach

Nurul Azma Abdullah[a], Norlida Hassan[b], Zehan Afizah Afif @ Afip[c], Khairul Ahmad[d]

[a,b,c,d]*Faculty of Information Technology and Multimedia*
Universiti Tun Hussein Onn Malysia,86400 Parit Raja, Batu Pahat, Johor
Tel : 07-4538058, Fax : 07-4532199

[a]*E-mail : azma @uthm.edu.my*

[b]*E-mail :,norlida@uthm.edu.my*

[c]*E-mail : afizah@uthm.edu.my*

ABSTRACT

Road accidents have become a major problem in Malaysia for the last few years. This research focused on minimizing the drivers' errors by training them to be smart drivers and observe courtesy on the road. New and inexperienced driver can use smart driving system which acts as a simulation of a real driving experience. The multimedia simulation embed with agent will reward the driver with marks based on the actions taken to manage the obstacles along the drive. In conclusion, the system can be used as an alternative training module in familiarizing new drivers with real driving experience.

Keywords

Road safety, Agent, Driving Simulation.

1.0 INTRODUCTION

Malaysia always prides herself as a country with rich culture and courteous people. However, the driving attitudes of Malaysia's drivers are notorious for recklessness on the road and certainly do not reflect this perception. Malaysia is one of the countries with the highest road accident rate. Figure 1 shows the total number of road accident increased steadily from 1990 to 1996. The government revises vehicle and road safety law and initiated lots of campaign to alert Malaysia driver of the implication of their callous attitude on the road but there is no significant reduction in road accidents. According to the statistic produced by Royal Malaysian Police (PDRM) total road accident rate increased again from 265,416 in 2001 to 328,264 in 2005.

The Malaysian government has considers road safety as a prime agenda of government's social responsibilities. Therefore, various bodies have been formed within the government department, private agencies and non-profit organizations to look in depth the road safety issues. The cause of road accidents can be generalized into three categories which are road user errors, road environment faults and vehicle defects.

The purpose of this paper is to concentrate on the first cause of road accidents with the intent of minimizing driver's errors. The government has enforced a law to any new driver to attend road safety classes and training in any registered driving school or institute before sitting for the necessary examinations in order to get a valid driving license. This license beside a road tax is a permit to drive on Malaysia road legally. The purpose of this law is to teach and guide the driver to drive safe and courteous. However, although most of drivers have proper driving license and go through all necessary road safety examinations, still the accident is hard to prevent. The accident occurred also involved those with a valid driving license. A new direction for the driving school should be considered. A need to mould Malaysia driver to become a smarter and more courteous driver must be fulfilled.

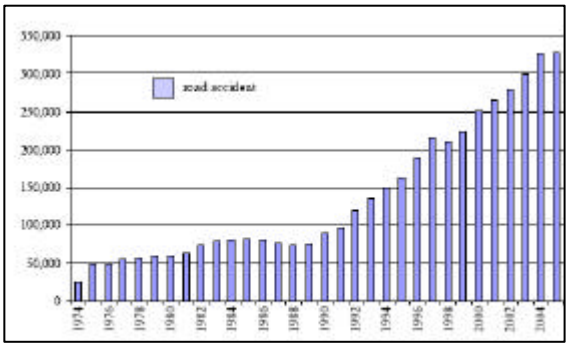

Figure 1: Statistics of Road Accident in Malaysia (2005). Source : Royal Malaysian Police (PDRM).

This paper proposed a smart driving system which can act as an agent to guide the new learner in driving lesson as an alternative approach to encourage young drivers to be smart and courteous on the road. The agent should act as a guide throughout the learning process. The agent will react to the obstacles that will randomly pop out in the scene. The trainee will control the action that should be taken with the guidance of the agent. The user of the system is the trainee in a driving school or institute.

2.0 CONCEPTS AND RELATED WORKS.

Agents have been discussed since about 30 years but are still at an early stage of development. With the rise of the Internet the interest in agents also grew, resulting in a number of environments focusing on different aspects. Agent-based systems technology is one of the AI generation has generated lots of excitement in recent years because of its advantages and opportunities for embarking new concept of conceptualizing, designing and implementing software systems (Sycara, 1998).

2.1 Agent

An agent is a computer system that is situated in some environment, and that is capable of autonomous action in this environment in order to meet its design objectives (Wooldridge and Jennings, 1995). Agent(s) are pieces of software that are designed to make computing and other tasks easier by assisting and acting on behalf of the user. The user interacts with the agent at a user interface while the agent senses and acts autonomously in a work environment such as an operating system. The agent performs a given task using information taken from its environment.

The key problem facing an agent is that of deciding which of its actions it should perform in order to best satisfy its design objectives (Wooldridge, 2002).

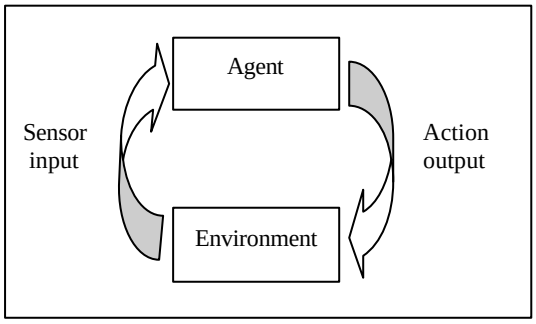

Figure 2: An agent in its environment (Wooldridge, 2002).

Figure 2 gives an abstract view of an agent. In this diagram, we can see the action output generated by the agent in order to affect its environment. The agent takes sensory input from the environment, and produces as output actions that affect it. The interaction is usually an ongoing, non-terminating one.

2.2 Related Works

Sankar Virdhagriswaran of agent technology company Crystaliz Inc. define that the term *agent* is used to represent two orthogonal concepts. The first is the agent's ability for autonomous execution. The second is the agent's ability to perform domain oriented reasoning. This definition can be expanded in certain areas. First, an agent executes; it acquires input and produces output. Agent processing is domain-oriented: An agent "knows" about certain concepts, data structures, rules, and interfaces but is not necessarily capable of interpreting information outside its field. An agent also "reasons" by encapsulating rules that allow it to transform conditions into decisions. And it operates autonomously by virtue of being persistent and capable of operating in a changing environment.

Apart from wide range application of agent-based in other domain (i.e. business, medical, network), agent application in teaching environment also had create its avenue (Jafari, 2002). Hence, agent-based technology systems are assumed to involve AI and include a degree of autonomous problem-solving and communication ability. Also state by Negroponte (1995) that agent should react as a perfect helper.

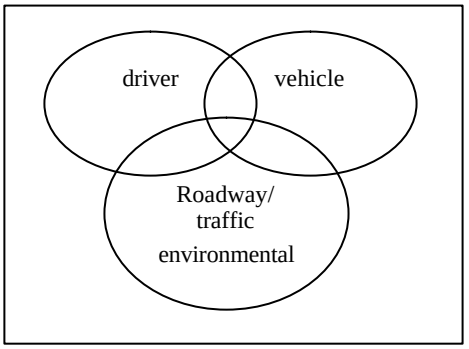

Figure 3: Components of the Highway Safety Problem (Allen, et. al, 2004)

Allen, *et. al.* (2004) has illustrated in Figure 3, the roadway, vehicle and driver interact to determine transportation system safety. Driver behavior is clearly a factor in all cases. Elements of the roadway environment include geometry of the road and surrounding environment (shoulders, foreslope, etc.), traffic control devices (signs, signals and markings), traffic, pedestrians and roadside objects.

With the existing of this simulator, it will has little opportunity for practicing these skills in real-world situations. A virtual reality training program would provide operators with the opportunity to practice these skills under realistic yet safe conditions, as well as provide basic training to novice or less experienced operators (Masciocchi, *et. al*, 2007).

3.0 THE ARCHITECTURE

The proposed system combines a multimedia environment and agent to provide a learning-based simulation of car driving. The architecture of the whole system is shown in Figure 4.

The user is the new learner of a driving school. The user interacts with the system and initiates the system to start. The multimedia simulation will ask the user to drive the car from starting point to the destination. The obstacles which are defined earlier will pop up randomly throughout the virtual journey. Every time the obstacles pop up on the scene, the agent is triggered and will react toward the current situation. The agent will guide the user about the current situation, what is happening and what action should be taken. When the user react toward the situation by entering an input, the agent will check whether the input provided is correct or not and give the appropriate marks for the current input. Then, after the simulation ended, the agent will sum the whole marks accumulated by the user. The marks will be displayed before the ending session.

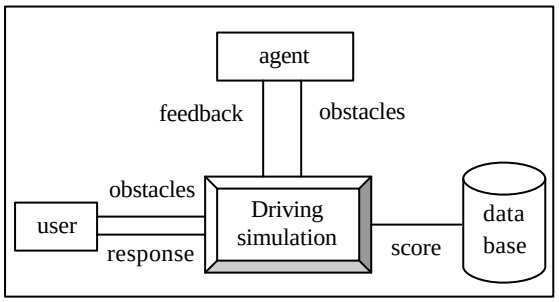

Figure 4: The Architecture of The Driving Simulation System.

4.0 THE DESIGN

This project implements modified System Development Life Cycle (SDLC). This section will discuss the design phase of the project. The design of the system combines multimedia, database and agent environment.

4.1 The Database

The database of *Driving Simulation System* is simple. Based on normalized Entity Relationship Diagram (ERD) in Figure 5, the entities involved are obstacle, user and evaluation (score).

The obstacles table contains all obstacle identified to be used in the simulation. For this project, the number of the obstacles is limited to five which are yellow light, red light, pedestrian, accident, school area. Each obstacle carries different identification (ID). This ID is assigned as primary key for table obstacle. For each obstacle, different mark is given.

The user table contains the user's identification card number which is assigned as a primary key and the name of user. Both primary key from obstacle and user table will hold as a **partial key** in the evaluation table. The evaluation table will hold the mark of user's input for each obstacle.

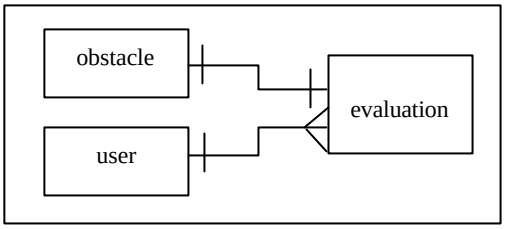

Figure 5: The Normalized ERD of Driving Simulation System.

4.2 The Agent

An agent is a computer program or software which capable responds toward controlled situation or environment. In this project, the agent is acting as an intermediate between the user and the system. It interacts with both user and system. It interacts with the user verbally.

The agent is developed using Visual Basic 6.0. It is programmed to identify the obstacle current screen. The agent will respond toward the obstacle that pop out on the screen by the system and will tell the user the type of obstacle and advise the user of precaution steps or action toward the obstacle.

4.3 The Multimedia Approach

The system is presented in multimedia presentation. The Figure 6 shows the storyboard of the simulation. For each scene same window will be displayed. This is the part where a journey of a driving simulation is embedded in the system. With this multimedia approach, the user will be accustomed to the feel of driving on the road.

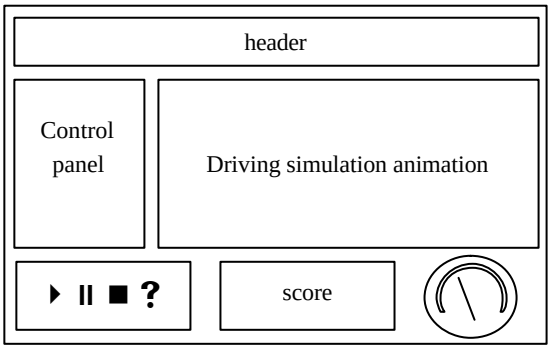

Figure 6: The Storyboard of Driving Simulation.

However, for this project, the multimedia presentation do not using real image for the scenes but more to 3D image to simulate the real waorld.

5.0 DISCUSSION AND CONCLUSION

The purpose of this paper is to propose a simulation driving system with agent as a tool in teaching drivers to be smart and courteous. An agent is embedded in the system to guide the learner throughout the simulation. An

input from the learner will be considered as part of the assessment to pass the lesson.

The system with enhancement may be considered to be a preliminary requirement for a driving school before signing up the student for real examination with Road Transport Department (JPJ). The user could learn to drive safely and be courteous on the road. However, for this paper, the obstacles are limited to five types of obstacles as mentioned earlier. Therefore, for further enhancement, more obstacles should be added to the system to provide more challenging lessons to the learner and mimic the real driving situation. The simulation itself shows a basic multimedia presentation. It does not accurately simulate a real scene on road. In order to give better view of real situation to the learner, a good simulation which simulates a real scene could be enhanced to the system.

As a conclusion, the main goal of *driving simulation system* is to produce an alternative of learning tool for driver which will stress on safety and courteous driving. The *driving simulation system* is one of the approaches to promote to the new Malaysian drivers a way to drive safely and be courteous on the road. The learner is given a preview of what can happen while driving on the road and what precautionary steps need to be taken while driving on the road.

REFERENCES

Allen, R.W., Cook, M.L., Aponso, B.L. and Rosenthal, T.J. (2004). Special issue review of a symposium on new directions in driving simulation research. *Advances in Transportation Studies an International Journal 2004 Special Issue*. Pg 5-8.

Masciocchi, C. M., Dark, V. J. and Parkhurst, D. J. (2007). Evaluation of Virtual Reality Snowplow Simulator Training. *Proceedings of the 2007 Mid-Continent Transportation Research Symposium*, Ames, Iowa, August 2007.

Negroponte, N, (1995) Being Digital, London Hodder and Stroughton, pp. 152-156.

Sycara, K.P. (1998). Multiagent Systems, AI magazine Volume 19, No.2 Intelligent Agents Summer.

Woolridge, M. and Jennings, N. R. (1995). Intelligent agents: theory and practices. *The Knowledge Engineering Review, 10(2), 115.*

Woolridge, M.. (2002). *An Introduction to MultiAgent Systems*. John Wiley & Sons, Ltd. ,Chichester.