An Empirical Modelling Approach for Educational tool Teaching how to serve spinning ball and hit spinning ball in Table Tennis

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Abstract

This paper primarily deals with the potential of using Empirical Modelling (EM) as a simulation tool to teaching people learn how to serve spinning ball and hit spinning ball in Table tennis(Ping Pong). The first part introduced background with EM between Table tennis. The details of model such as study, building, and concepts were presented in the paragraphs. In the final, the advantages and disadvantages of EM model were described in evaluation and conclusion

1 Introduction

This project use Empirical Modelling(EM) to approach to analyse the techniques by how to serve spinning ball and hit spinning ball in table tennis. Because EM is a suitable tool to demonstrate the procedure of serve ball and hit ball in a simple and intuition way.

Table tennis is a popular sport in Europe and Asia. The rules of table tennis are not hard to learn. One player stands in one side of table and serves the ball. Another people stand in the opposite side to hit the ball back. Points will scored by a player when he/she makes his/hers opposite player to fails to return the ball. However, a profession player or a skilled player can serve many types of spinning ball to altering ball's trajectory, and this is very lethal to the opposite player, because spinning ball can cheat opposite player and make him/her hit ball with wrong direction to lose the ball. So the techniques for serve ball and hit ball are absolutely very important for table tennis players.

The purpose of the EM model produced is two-fold. Firstly, it is to investigate the EM approach and how does model get benefits from EM. Secondly, it can be used as an education tool to teach individuals the techniques that how to hit spinning ball in an experiential way.

2 Model

Central concept of this model is to elaborate a model of phenomenon in table tennis. There are two previous model named can refer to table tennis model. The first on is "Interactive Empirical Model Design Simulation of Aircraft". The second one is "An Empirical Model Approach to Self-adjusting Environmental Vehicle Reversing Alarms".

2.1 Previous Model Study

Both of previous models are 2D simulation tool, they will be much better if they use 3D interface, but developing time is a vital element in the whole develop schedule. They use three different definitive notations such as EDEN, DoNaLD and SCOUT. EDEN is a general purpose language that supports the concept of

definitions such as scalars, strings, lists. And main functions are all in EDEN. DoNaLD is using for definition the 2-D line drawings. SCOUT is using for windows, displays, screen lay out and attributes.

In the model of aircraft, the whole plane is observable, the tail fin and wings of plane are agency. The air flows around the wings are dependency of the model. After plane take off (click the "take off" button in the screen) from land, user can try to change states of modeling ("Turn left" wing or "Turn right" wing), then the state of plane will be change (origin author of this model using air flow to show how did state changed). The information of plane is showing in the top left corner of screen to tell user the operating on plane is success or fail.

2.2 The Concept of Table Tennis Model

Concern about the rules and the phenomenon in table tennis, if this project can be use as an educational tool, it have to present different kinds of spinning ball in the model. So, the first element is that can provide the phenomenon of serve ball. The second element is can show the result of hit ball. By the different situation, the ball may have different moving trajectory. For the beginner of table tennis, maybe they don't familiar with the rules and different phenomenon, this model should provide instructions for them, to help them understand some basic knowledge and guide them identify different phenomenon in table tennis. So, in the interface of this model, it should include the Bats, table, balls, instruction box, and the buttons which will be use to control the balls.

In this case, the observables are the essential items in EM model; they are balls and the bats. Dependencies are used to express the affections for the values of observables with change of balls and bats. They are such as moving trajectory, air flow. Agencies can be considered as special observable which is able to change the current status of observables. The agencies make the objects interactive for each other. In this case, the agencies are the operations to serve balls and hit balls.

2.3 Building the Model

Concern about the modeling which had been developed in the past, the Table tennis model uses EDEN, DoNaLD and SCOUT.

In the DoNaLD, the table, the balls, the bats, instructions box and kinds of buttons were presented in the interface. EDEN can be used to check and control constraints that must be observed between table tennis table, hollow ball and racket. And the main functions are written in EDEN. SCOUT are use to provide a view port window to the whole experiment and displaying information such as ball's spinning, error message, hit direction.

2.4 The Playing Rules of the Model

In this case, the left bottom player is player one which will serve the ball. The right top player is second player which will hit the ball. The first player will serve two types of spinning ball such as right spinning ball and the left spinning ball, and after first player serve the spinning ball, the second player should hit the balls back to the opposite, depend on the different type of spinning and the different hit direction by the second player, the balls include different flying trajectory, one ball will flying out of table, another one will flying in the correct way. This will be present by the ball moving in the Model.

There is a table describing the logic of serve ball and hit ball and can help individuals to understand the relationships between the observables:

Logic relationships	**Ball with Right spinning**	**Ball with Left spinning**
Serve ball	Moving in straight way to the opposite player	Moving in straight way to the opposite player
Hit left	Moving in the left direction and will be flying out of the table	moving in straight way (correct direction, means correct hitting)
Hit right	moving in straight way(correct, direction, means correct hitting)	Moving in the right direction and will be flying out of the table
Reset	Recovery to the origin place	Recovery to the origin place

2.5 The Model in Action

Figure 1 shows the original state of EM model. It can be seen that, in this initial state, the balls are holding in the player 1 (ball serve player), the ball in the left position is right spinning ball (the arrow around the ball represent the air flow), the ball in the right position is left spinning ball (the arrow around the ball represent the air flow). The green box shows the state of the ball.

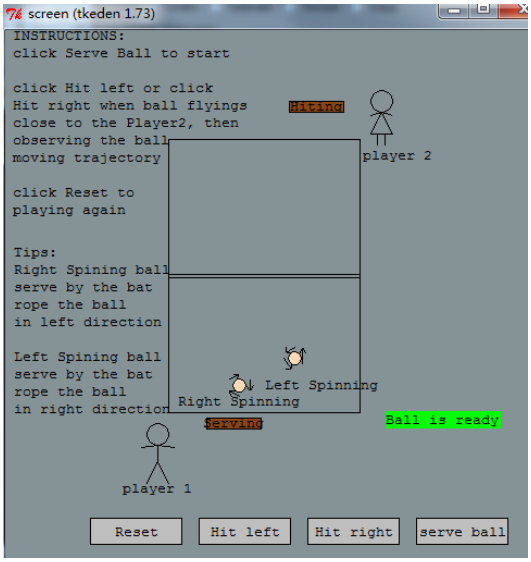

Figure 1

Figure 2 shows the state after player 1 serve the ball. When the ball get close to player 2 side, the green box will turn red and show "Hitting the ball" to remind player to click "Hit left" or "Hit right". At this time, player should hitting the ball as soon as possible, otherwise, the box will show "hitting failed" when two balls fly out of table.

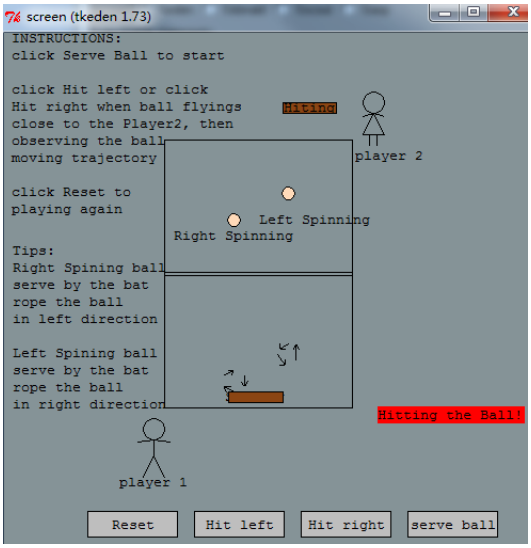

Figure 2

Figure 3 shows the ball moving trajectory of second player "hit left" after the first player serve the ball. According to the logic table

described as previous, the right spinning ball will fly out of the table, but the left spinning ball moving in the correct trajectory.

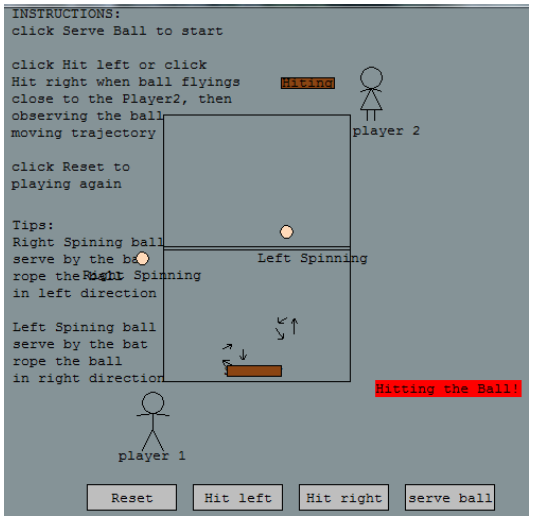

Figure 3

The figure 3 shows the trajectory of ball moving after second player "hit right" from the first player coming ball. The Left spinning will fly out of the table, the right spinning ball is moving in the correct way.

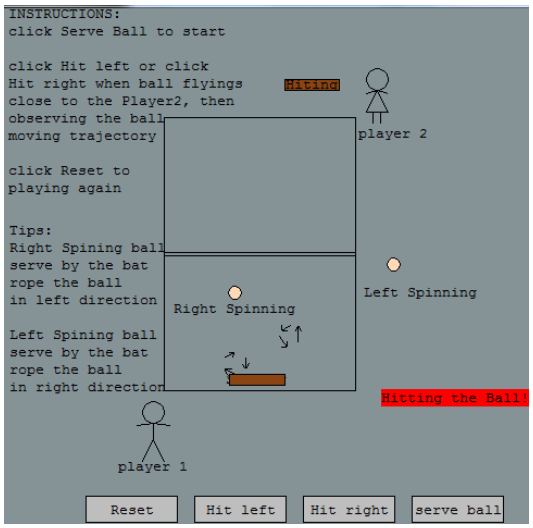

Figure 4

3 Evaluation

This section describes the evaluation of the EM model in two sides. The first is how well that EM help model to achieve the goal for education. The second is the limitations of model and possible future work.

3.1 Evaluation of EM model

In this case, the EM model provides a new way to learn about and experiment with the ball flying trajectory. With EM's help, it is very easy to achieve the goal that simulates some phenomenon, specially in some engineering project. There are lots of previous model such as bicycle chains model, helicopter rescue model, they are all pretty good example to present some situation in the real world. And EM can construct a model very quickly. That's mean this will be very convenient for some engineer which don't use programming tool very usually. Additionally, the agencies between observables could be present very well by EM, and dependency is a very powerful concept which can reduce the effort required in maintaining between observables. The traditional approaches such as object-oriented programming tool need more time on coding and maintenance.

But the negative side is some criticisms indicate the EM model oversimplifies the scenario. And compare with the object oriented programming; EM's need more modularize function, more system, and more scalability.

3.2 Limitations of Model

With expectation, with EM's help, this simulation can showing three frequent types of spinning ball: Back spinning ball, Right spinning ball and Left spinning ball. People are able to learn three types of skills for serve spinning ball and hit spinning ball. But in "tkeden", this project is a 2D interface, so it is unable to simulate the states in 3D

environments such as in the real world.

3.3 Future Work

There are a number of ways to improve this Model. First one is make this model in 3D interface, so the back spinning ball and such more types of ball could be add in the 3D environment. Second point is adding more functions for serve ball and hitting ball. Third is adding “hitting power” as a considerable element in the game. The ball might be changed with different trajectory by the different hitting power. The ball might be changed with different trajectory by the different hitting power. The third is adding “hitting power” as a considerable element in the game. The ball might be changed with different trajectory by the different hitting power.

4 Conclusion

An education tool concern about table tennis was developed successfully. Through this Model, series of investigates and experiments proved EM is a powerful tool to achieve the goal which are suitable to build a model or simulate a phenomenon in the real world. And the developing schedule is shorter than the traditional way such as object-oriented programming. The model constructions are not very complicated. This might be a suitable tool for the people who study in science and technology.

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