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Implementation of interactive virtual simulation of physical systems

H Sanchez, J J Escobar, J D Gonzalez, J Beltran

Research group in didactic and pedagogical on higher education, Universidad del Magdalena, Santa Marta, Colombia.

E-mail: jedgonzalezac@unal.edu.co

Abstract. Considering the limited availability of laboratories for physics teaching and the difficulties this causes in the learning of school students in Santa Marta Colombia, we have developed software in order to generate greater student interaction with the phenomena physical and improve their understanding. Thereby, this system has been proposed in an architecture Model/View- View- Model (MVVM), sharing the benefits of MVC. Basically, this pattern consists of 3 parts: The Model, that is responsible for business logic related. The View, which is the part with which we are most familiar and the user sees. Its role is to display data to the user and allowing manipulation of the data of the application. The ViewModel, which is the middle part of the Model and the View (analogous to the Controller in the MVC pattern), as well as being responsible for implementing the behavior of the view to respond to user actions and expose data model in a way that is easy to use links to data in the view. .NET Framework 4.0 and editing package Silverlight 4 and 5 are the main requirements needed for the deployment of physical simulations that are hosted in the web application and a web browser (Internet Explorer, Mozilla Firefox or Chrome). The implementation of this innovative application in educational institutions has shown that students improved their contextualization of physical phenomena.

1. Introduction

The exponential growth of Virtual Manipulation and ownership by the students offers an advantage in the purpose to improve their learning of physics; we therefore propose the handling of a web environment that offers a friendly tool for excellent results in appropriation of physical concepts. Contemporary learning theories, such as constructivism, emphasize the importance of providing appropriate instructional supports and guidance in order to facilitate meaningful learning and maximize students' learning outcomes [1]. Many education researchers further recommend that learning environments should provide appropriate instructional scaffolding to help learners acquire knowledge [2,3]. They also reported that educational practices such as chalk and talk lessons were viewed as boring, and students preferred active participation using strategies that involved more opportunities for interaction and discussions. It is probably this perceived difficulty and the way the subject is presented which leads to boredom, disengagement and eventually to poor learning outcomes. In this way, we propose the use of laboratories with virtual environments that work as computer-based simulations.

2. Design simulation

The topics for the creation of software that include the application protocol in the form of manuals. Given the difficulties encountered in learning physics, we have developed software under Web environment that can generate more interaction with physical systems and improve their

understanding. This has been proposed in an architecture model Vista / Vista / Model (MVVM). MVVM pattern is an evolution of MVC (Model View Controller) that seeks to facilitate parallel work between someone in charge of designing the user interface and another person responsible for generating the code that will sustain. In other words, it is a design pattern to decouple application code from user interface code that is not UI. With MVVM, defines the user interface declaratively (eg, using XAML or Extensible Application Markup Language) and uses the data binding markup to link to other layers that contain data and user commands. The data link infrastructure provides a weak link that keeps synchronized the user interface and related data, and redirects all user inputs to the appropriate commands. Figure 5 shows the structure of MVVM pattern.

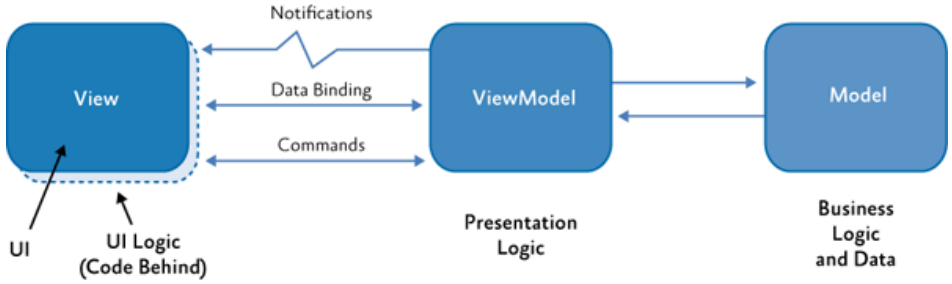

Figure. 1 Structure of the Model MVVM (Model View / View / Model). Image taken from Microsoft.

Basically, this pattern consists of 3 parts: The view or View that is expressed in XAML (UI), the View-Model or ViewModel containing the language we use to develop the presentation logic (VB.NET, C # or C + +) and Model or Model that will be in charge of data access and business logic.
. NET Framework 4.0 and editing package Silverlight 4 and 5 are the main requirements needed for the deployment of physical simulations that are hosted in the web application and a web browser (Internet Explorer, Mozilla Firefox or Chrome).

3. Description of virtual laboratory

The implementation of this innovative application in educational institutions has shown that students improved their contextualization of physical phenomena. Currently we have developed 25 virtual labs, considering different topics of physics as: optics, mechanics, electromagnetism and waves. Figure 1 and 2 show two of the mentioned labs.

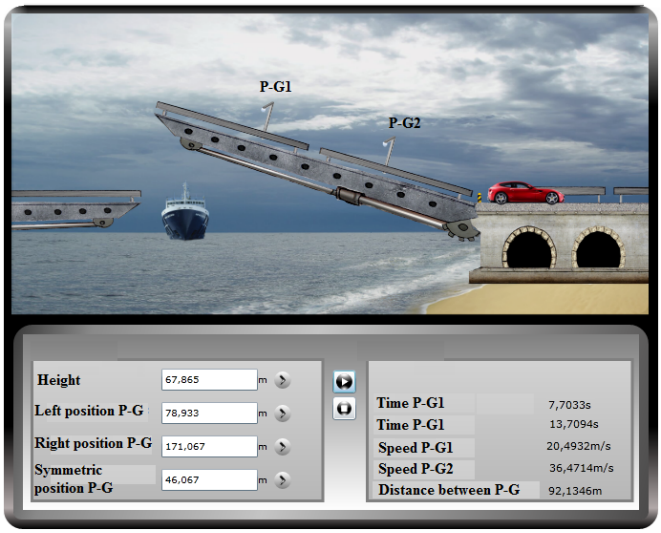

Fig 1. Interface computational simulation of energy conservation lab.

In the Figure 1. We take as input parameters in this simulation, the lifting height of the bridge rail and the distance between the Photo-Gate (P-G). To start the simulation, the times taken for the car to pass each P-G are being processed, as well as the respective speeds. The Figure 2, show simulation of Second Law of Newton, in which one we can find the same structure by using input and output parameters. The friendly environment interface with the users is one of ours objectives due to we want to obtain the attention of the student. The output information obtained for each simulation is used by the student to determine physical phenomena related to lab by obtaining the graphics and values related with the problem.

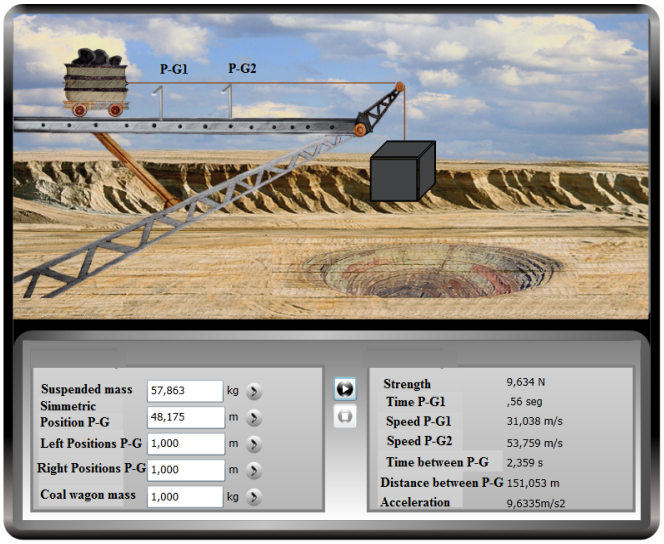

Fig 2. Interface computational simulation of Second Law of Newton lab.

4. Conclusions

It should be noted that the present proposal was considerate in the context of a normal course in physics. In which, we develop a new tool for physics teaching by using the architecture Model/View-View- Model (MVVM) to generate greater student interaction with the phenomena physical and improve their understanding. We have developed 25 new Virtual Labs in different topics of physics, whit friendly environments and a simple way to study first principles of physics and engineering.

Acknowledgement

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