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Virtual Variation of Earth Seasons: The 3D Java Solution

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Abstract: The graphic representation of 3D objects in a 2D space (e.g. sheet of paper, blackboard) is often a tedious task particularly when the used forms are complex. If in addition, such objects move or become deformed under the action of any phenomenon, it becomes difficult to give an accurate representation of the subject. In this "Interactive Experience" we investigate this problem and propose a digital solution implemented in Java to explain what causes Earth's seasons.

Keywords: digital solution, Java, Java solution, e-learning.

1 Introduction - problem of the 3D representation

When a 3D object/system (cube, sphere or 3D trajectory etc) is represented graphically in a 2D space (sheet of paper, blackboard), there is an evident loss of one dimension-representation. Pedagogically, this "dimensional deficiency" may be the cause of a limited perception of the subject. The problem becomes more acute again if the object in question varies with one or more parameters (e.g. variation of form, volume or position with time for example). In order to overcome the pedagogic difficulty inherent in this problem, it is suggested in this paper to implement a digital solution susceptible to manage the complexity of the 3D representation in a two-dimensional space.

2 Model of digital solution and technologic choices

I have recently presented a model (Boutiche, 2002) in which solutions for e-learning physics are implemented with the help of Java technology. Such an e-learning solution is in fact a combination of 3 fundamental elements:

- Pedagogic content
- Software solution for processing the pedagogic data
- System/Network (CD-ROM, Internet, …) for the solution delivery.

Independently of the pedagogic element, the choice of the software solution must be adapted to the mode of solution-delivery. If the Internet is used for such a delivery, it is suggested to choose Java for processing the pedagogic data. The choice of this technology is motivated by the fact that Java is an object oriented programming language for which it is possible to obtain an interactive graphical interface (Java applet), accessible by most Internet browsers (Java is portable). In addition, the recent development of new products such as Java 2 and the 3D API of Java, gives the Java language a prominent position as a solution for various pedagogic and scientific problems.

3 An interactive experience: Virtual variation of earth seasons

Our interactive experience consists of a presentation of a Java application (see HTML page: "Virtual_Seasons.htm"), used to show in a "digital and interactive way" how the seasons vary.

3.1 System requirements

To run the applet, some Java software is necessary. It is possible to freely download such utilities from Sun Microsystems as explained in the Virtual_Seasons page.

3.2 The Java applet for earth seasons

When the earth motion is started, the check boxes are automatically activated to check the needed parameters. By checking the position vector box, the applet draws the sunray perpendicular to the earth's surface; the relative position of any geographical position with respect to this ray determines the season of the position in question. When the sun ray falls on the tropic of Cancer (cyan coloured latitude), the season is summer in the northern hemisphere (summer solstice with theta = 3.14; indeed, the sun is nearly in the zenith in summer when it is observed from the northern hemisphere). Note that one can observe for this position that the North Pole is entirely illuminated and the South Pole is entirely dark. This explains why the duration of the day is longer in summer than winter (in the northern hemisphere). One can deduce the same explanation when the sun's ray falls on the tropic of Capricorn (magenta coloured latitude): the season is summer in the southern hemisphere and winter in the northern hemisphere for theta = 0.

4 Conclusion

With the technical performance of Java, we have obtained a reliable description of our subject. Such a high graphical output yields necessarily a good pedagogic output. If we add to these pedagogic advantages the economic dimension of the problem/solution such as cost of production and consumption (very low in comparison with the conventional pedagogic support); it is easy to deduce that Java is a promising tool for education.

References

Boutiche, S. (2002), Digital devices for e-learning/e-teaching physics, The Java applet solution – ICL-Workshop 2002, Villach-Austria. *Download paper from:* *http://www3.cti.ac.at/icl/archive/presentation/boutiche.pdf*