IDENTIFICATION OF THE MOTION OF AN OBJECT FROM A VIDEO CAPTURE WITH NO REFERENCE FRAME, USING A MOBILE PHONE

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Abstract. This paper presents the creation of an educational resource using a camera of a mobile phone, a video of a daily context and a video analysis software. It shows a way to introduce Information and Communication Technologies (ICT) and Digital Educational Resources (DER) as interactive tools to teach and disseminate physics in schools. Through the contextualization of students' daily situations, ICT encourage students to increase their interest and increase the understanding of science topics based on their own realities, which becomes an important and available educational tool for teachers.

1 Introduction

The use of technological resources is becoming more and more current in the classroom, and in the daily life of citizens in many of their different activities. Among these resources are mobile phones and smartphones, for which the number of applications - Apps - is increasing for countless tasks. Such software, more and more accessible from both economic and usability perspectives, are currently effective tools to arouse interest and facilitate citizens' understanding of kinematics phenomena, therefore contributing to their scientific literacy.
Perrenoud [1] pointed out the 10 basic skills that should be taught in the 21st century, and the eighth of these is "to use the new technologies". According to Santos & Rodrigues [2], Information and Communication Technologies (ICT) and Digital Educational Resources (DER) are the preferred incomes by students, for obtaining better results in their global learning and raising the level of interaction between teachers and students. The use of mobile devices to capture images by the students themselves favours the meaning of the contents, in line with Vygotsky's Sociocultural Theory.
In this work, we describe the creation of a curricular resource using a mobile device, accessible to everyone, that starts at an episodic moment of opportunity when a video of a large airplane's take-off was recorded. The work shows how a daily context can be very useful for teachers to take good ideas and propose a research on Physics to their students, supported by video analysis software available nowadays.

2. Experimental

The location of the video capture is a frequent scene for travellers: waiting inside a commercial plane in one of the airport runways, awaiting to departure. From the airplane window, it is usual to watch other planes taking off and landing at the airport.
The software chosen for video analysis has a large database of videos organized by topics of Physics. Its video analysis tool allows the students to track the motion of an object and obtain the values of physical quantities with the corresponding uncertainties, such as distance (d), average speed (v_m), instantaneous speed (v_i) and average acceleration (a_m). Graphs can also be

generated and mathematical operations performed. This leads to a great understanding of the phenomena by the students, namely from physical quantities such as the average acceleration, serving to confirm or refute interpretations that can be made by the students after the first contact with the video, such as: "The plane seems to accelerate very slowly when taking off". The calibration of the video images, without known reference objects, needs a true investigation by the students on the lists of planes taking-off in that day.
The plots obtained allow discussing about the relation between mathematical curves and the classification of the motions in Physics.

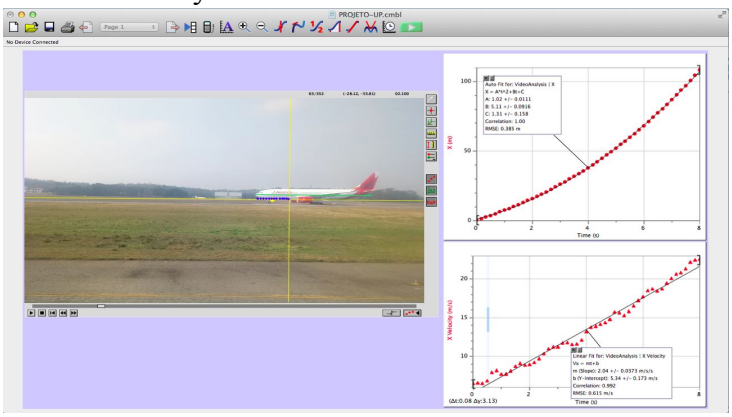

Figure 1: Image of the graphs x(t) and v(t) obtained from the marked positions of the aircraft. The two graphs have curves that physically identify a uniformly accelerated motion.

The value obtained for the acceleration was 2.04 +/- 0.02 (m/s^2). We can use comparisons with well-known everyday numbers to interpret whether such quantity represents a small or high value, and discuss if the interpretation of motions by students does not result from the observation of an optical effect, because the plane is very far from the observer. Comparing with the fastest train that runs in Portugal and reaches a cruising speed of 300 km/h, the plane moves with an acceleration that is three times greater than that of this high-speed train! With such a comparison within the reach of a common citizen, one can explain why an airplane passenger feels pressured against his seat when the plane takes off.

4. Conclusions

The teaching strategy explained in this work goes beyond filming a pre-determined situation for later analysis as a laboratory "scene", but rather capturing real situations, which allow to contextualize the contents studied in the school. At a time where the vast majority of citizens, and especially young people, are constantly using a smartphone, it is more than appropriate for schools and teachers to take advantage of this reality and to allow the use of this device as an educational tool at schools and in the classroom, with the same educational potential as a sheet of paper, a pencil or a calculator.

6. References

[1] Perrenoud, P. 2000. *Dez novas competências para ensinar*. (translation by Ramos, P. C.). Porto Alegre: Artes Médicas Sul, Brazil.

[2] Santos, L. R., Rodrigues, 2017. *O uso das TIC no ensino de ciências sob a perspectiva de alunos do 9o. ano de uma escola de São Paulo: Procurando fatores para delimitar a formação continuada de professores de ciências*. EDUCERE – XIII National Congresso n Education, IV International Seminar of Social Representations, Subjectivity and Education, Curitiba, Brazil. Available at http://educere.bruc.com.br/arquivo/pdf2017/24718_13721.pdf . Accessed in December 5, 2017.