SIGNIFICANCE OF SOLID DIGITAL RECORD IN LEARNING PROCESS BY SCHOLA LUDUS

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INTRODUCTION

Digital records that differ in one or more physical parameters can serve as an excellent base for study of complex processes /identification of system elements and their interaction, physical conditions, stages of progress, dominance of physical effects, etc./, deepening of elementary physical terms of school physics and improvement of complexity creative thinking as per educational programme by SCHOLA LUDUS. All the above is subject to suitably selected and recorded series of complex processes.

PHOTO AND VIDEORECORDS AT SCHOLA LUDUS TEACHING AND LEARNINIG

Fig. 1 shows conventional use of a pair of photos to approach a relatively slow process. The value of the above can be both informative and motivating.

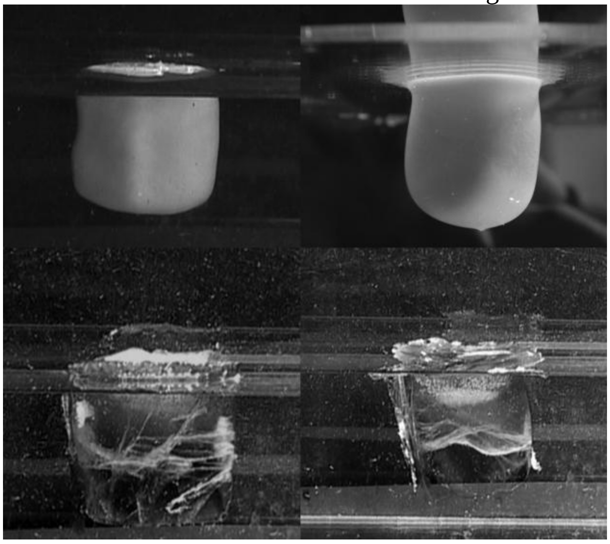

Fig. 1 Frozen oil /top/ and ice /bottom/ melting in water at t=0 and t=20 minutes. "Did you expect…?!"

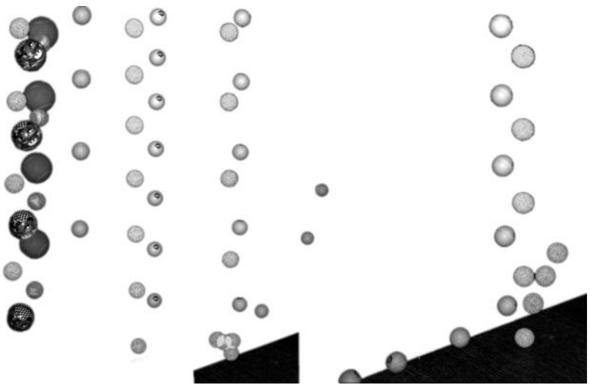

Fig. 2 Parallel falling of balls

Pictured balls (Fig. 2) represent several physical processes that can be used in very simple but sophisticated way: What can you see? What kind of physical process is recorded? Can you deduce any physical relation? Are some of these records an evidence of …? Are these processes mutually dependent or independent? What about the starting conditions? And what about the current conditions at fall and at collision/accident?

HAMMER AND CENTRE OF MASS

Fig. 3 Hammer's centre of mass

Fig. 3 illustrates centre of mass of rotating non-homogeneous object in motion; in this instance the object is a hammer. To figure such an action, it is adequate to use stroboscopic shooting or videorecording, however, if the later is used it needs to be further edited in suitable bitmap editor, e.g. The Gimp, Adobe Photoshop. The first method requires special photo equipment – stroboscopic flash or light projector. The advantage of using this method is relatively simple post-processing. Apart from post-processing of videorecording being highly time consuming, several different software are required for editing compared to the other above mentioned method. Fig. 3 can be used in learning process by tutors for better illustration and consecutive understanding of behaviour of centre of mass in motion by students. The mergence of individual pictures into one seems to be crucial for overall topic understanding as more phases of subject's motion (thrown rotating hammer in this case) can be seen in a single picture.

BOUNCING BALLOONS

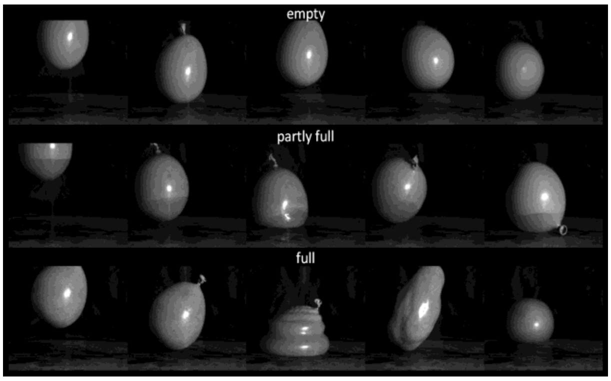

Fig. 4 Parallel visualization

Parallel method is largely adopted in Educational programmes by SCHOLA LUDUS [1 34-40p.]. As shown in Fig. 4, adequately selected snapshots are presented next to each other in such a way, that this might evoke questions similar to the following, if seen few first cases: Why isn't the empty balloon on the picture deformed? Can it be deformed at all? Are the changes after rebound so quick that they can't be recorded? Furthermore, pictures can be selected in order to answer questions like these: What was the order the pictures were shot in? (Fig. 5) Can you reconstruct the real process development?

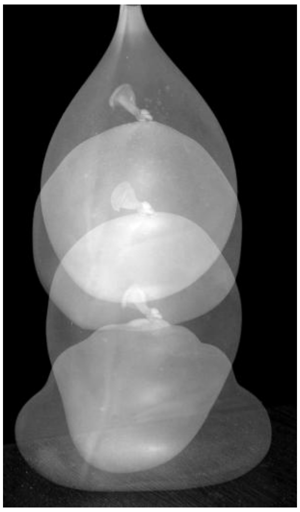

Fig. 5 Stroboscopic shooting

TIME-LAPSE IN MELTING

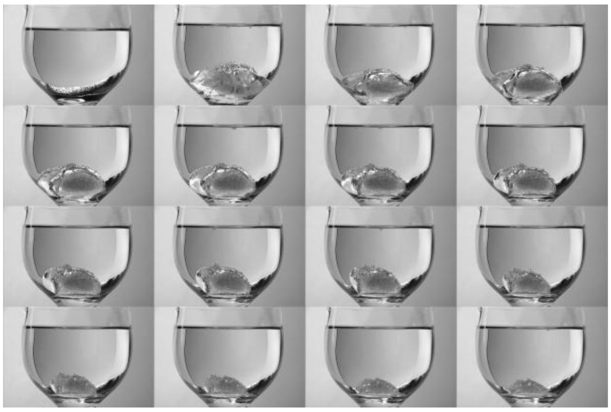

Fig. 6 Time-lapse in melting

Fig. 6 shows snapshots taken by time-lapse photography. The images taken by camera at the specific time intervals are converted to the video. This causes for observed processes to be speeded-up several times in comparison to the reality. This technique is useful when shooting slow processes such as crystallization, clouds movement, the growth of plants, etc. The final video then offers speeded up insight into observed action in return for a relatively small data space needed for high definition. Using the following formula it can be easily calculated how many times the video will be accelerated in comparison with real process.

$$AV = PVFR \cdot FI \qquad \text{(I)}$$

Acceleration Video /AV/ shows how many times is scene accelerated.
Projection Video Frame Rate /PVFR/ is in EU countries 24 or 25 s^{-1}.
Frame Interval /FI/ represents time between frames taken by photo camera.

Fig. 7 Various exposure times

Fig. 7 presents application of various exposure times to visualize intensity of fire/flame radiation. Long exposure time /the frame on left/ shows that flame is much more concentrated on the right side than in the middle of fire. Unlike on pictures taken with short exposure time /right frame/, many details are lost when using longer exposure time. To sum it up, to illustrate the direction of movement and group/object properties long exposure time is befitting. On the other hand, short exposure time captures the shape of objects in detail.

CONCLUSIONS

All the examples referred to in this article were prepared for SCHOLA LUDUS educational programmes and can be effectively used in different ways at any stage of SCHOLA LUDUS teaching and learning cycle for motivation, description, mapping, modelling, abstracting, imbedding as well as for appropriation [3].

Also, there are many non-formal possibilities how to use solid digital records to gain pupils and students for physics, e.g. by competitions – pupils capture records of attractive processes and provide their explanation [4] or cartoon physical jokes prepared on the base of records including original physical context [5].

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