A Taxonomy of Technical Animation

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Abstract

The age in which we are living nowadays is characterized by rapid innovation in the development of information and communication technologies (ICT). This innovation has a significant influence on the education process. This article deals with computer animation in technical education. Our aim is to show the taxonomy of education animation. The paper includes practical examples of animation.

Keywords: animation, taxonomy, didactic function.

Utilization of animation

The use of animation as a didactic tool is connected with the following notions: [1]

- Displaying a simulated model
- Displaying phenomena that cannot be properly processed by other didactic tools
- Equipment that cannot be demonstrated by some other model because of its size or hazardousness
- Displaying technologies which are costly in terms of money, time, etc., or which are inaccessible

However, animation can also be misused, and it is necessary to beware of potential shortcomings of animation. Some of them were summarized by Skalková. [2] The primary problems are reduced contact with reality and reduced first-hand experience of students. Young people may get the idea that they have learned everything through an animation, and that they do not need to come into contact with actual objects or phenomena. This is a fatal error that can have immense consequences. There can also be negative impacts on learners' health if they sit continuously in front of a computer screen. The utilization of these modern means can also lead to several problems affecting teachers. Firstly, the transfer of control over the learning process from the teacher to the student can lose some of the benefits that a learner can draw from the knowledge, influence and experience of a teacher. This may make learning inefficient and affect the student's orientation in the topic under discussion. In addition, the student's ability to gain information from a teacher about the relevance of a topic for other fields of study is dramatically reduced. We can also point out that teachers may be put under pressure by the need to keep up to date with innovations in education and in education technology.

Classification of computer animation — taxonomy

Computer animations designed for pedagogical purposes can be divided into a number of categories. From the didactic point of view, animation can be classified:

According to the student's activity:

- *Passive*, where a student only observes what is presented to him/her.
- *Active*, where a student participates actively in running and displaying the animation. The student can manipulate certain constituents of the animation. If the student is not active enough, the animation does not run and becomes only a static picture.

Classification of computer animations — taxonomy according to didactic function:

- *Motivational* — a motivational animation is usually applied by the teacher at the beginning of a class when giving an introduction to the topic under discussion. The goal is to get students' attention, and to engage them in the problem that is to be presented.

  An example of motivational animation:
  - Electric power generation (Figure 1)
- *Illustrative* — these animations are designed to provide an insight into the patterns of the phenomena, technologies or processes that are to be presented. They aim to explain the phenomenon, technology or process under study in great detail, with emphasis on illustration, clearness and intelligibility. The student has a passive role as an observer, and creates basic notions about the topic problem on the basis of his/her observations.
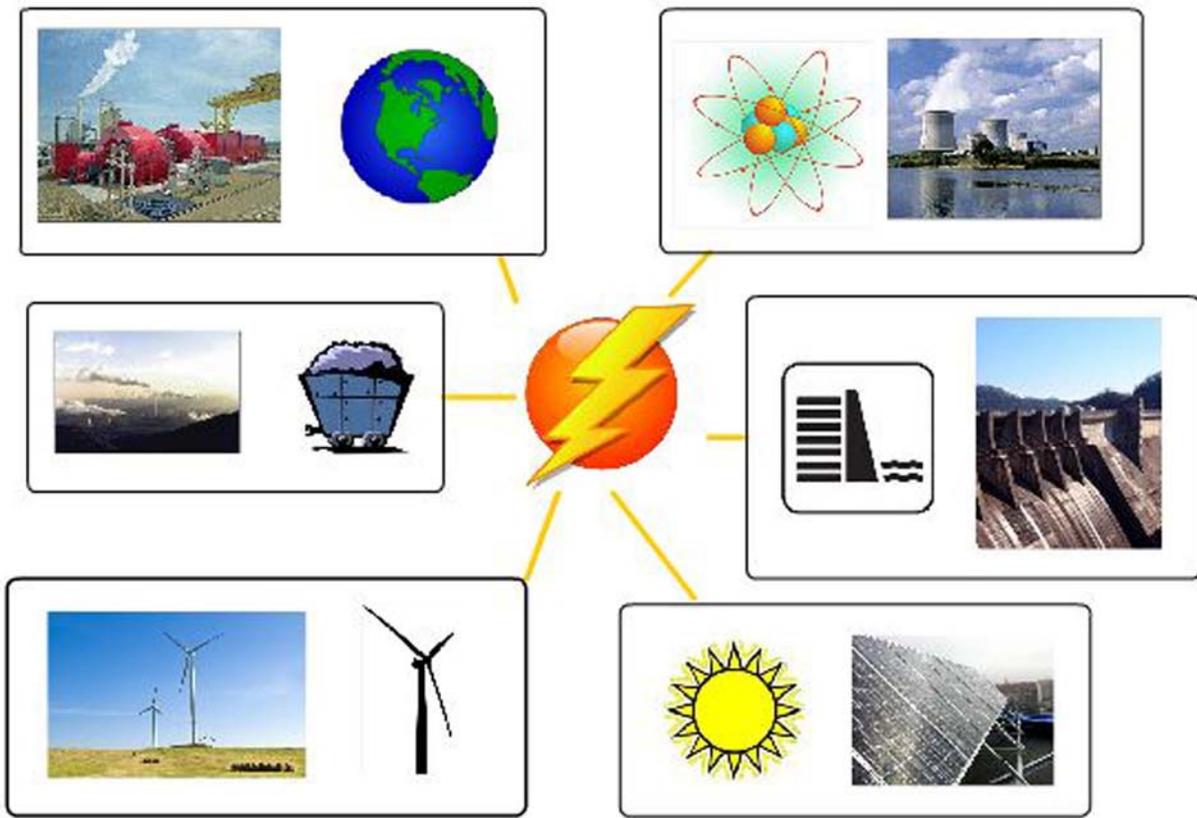
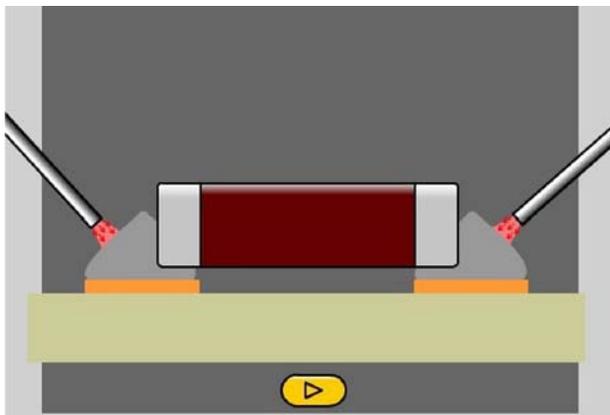Fig. 1: Electric power generation

Examples of illustrative animation:

- soldering components by the SMD remelting process (Figure 2)
- the principle of an extruder for cable production (Figure 3)
- thermal treatment (direct bainite transformation) (Figure 4)
- two-stroke and four-stroke engines (Figure 5)

Here, it is important to note that the line between motivational animation and illustrative animation is not clear-cut. We can often encounter a combination of both types. In such cases we will speak of illustrative-motivational animation.

Fig. 2: Soldering components by the SMD remelting process [3]
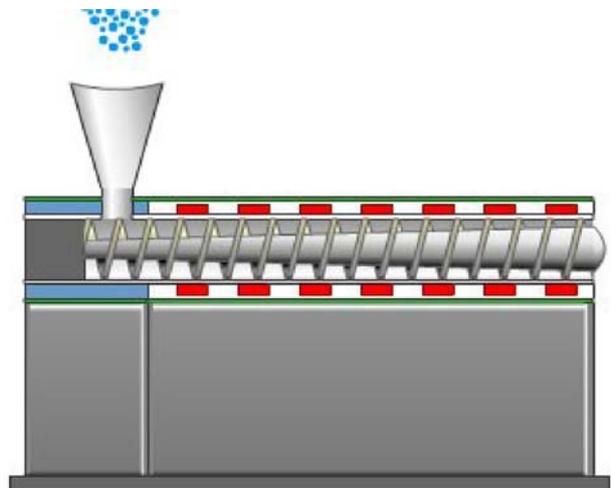

Fig. 3: The principle of an extruder for cable production [3]
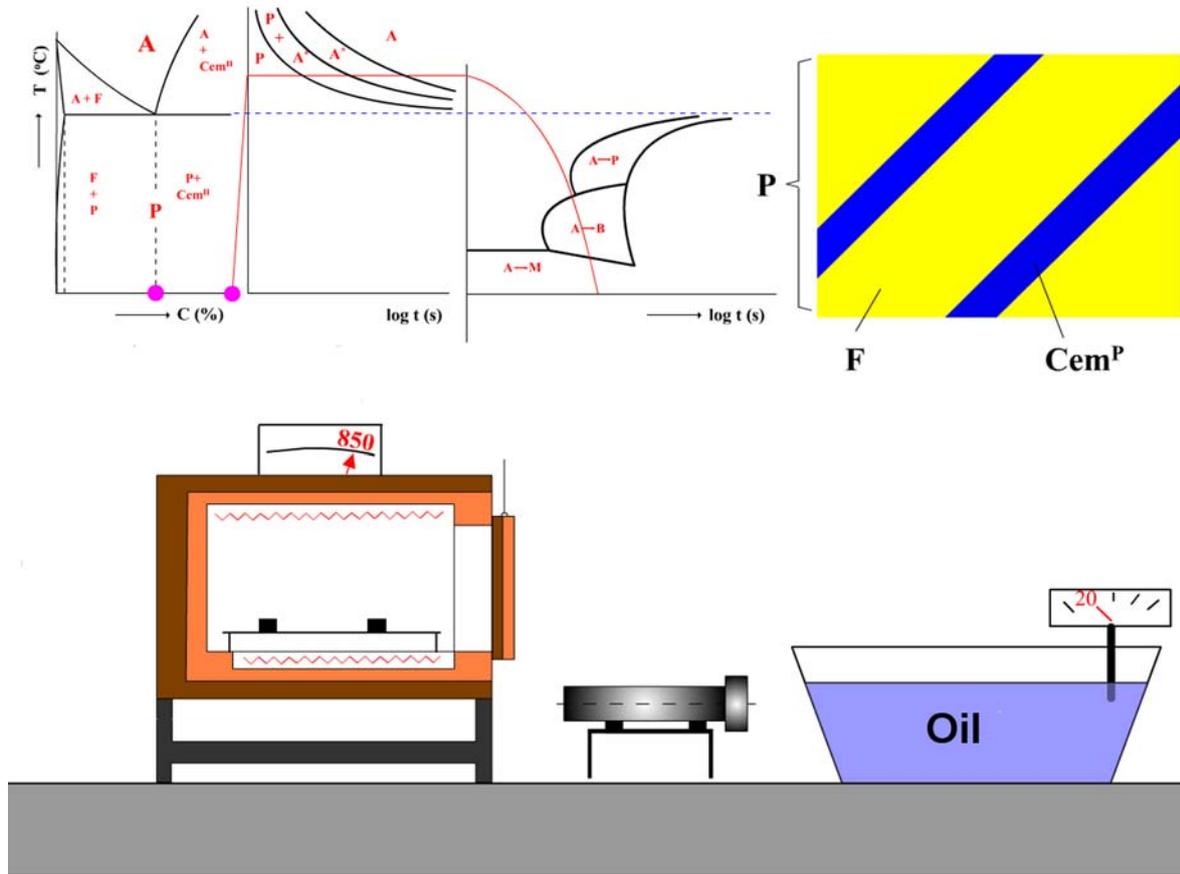
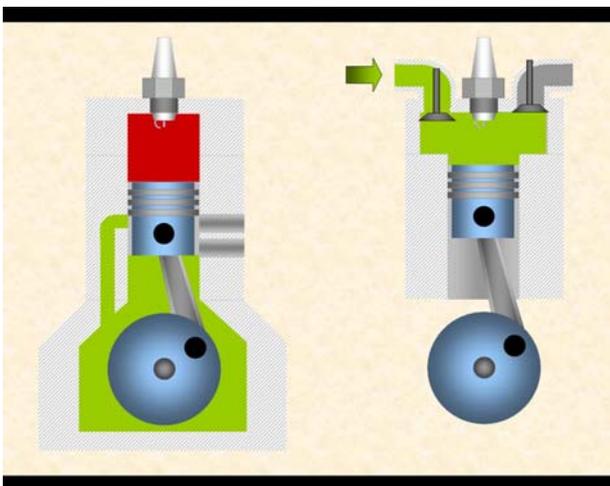Fig. 4: Thermal treatment — direct bainite transformation [4]

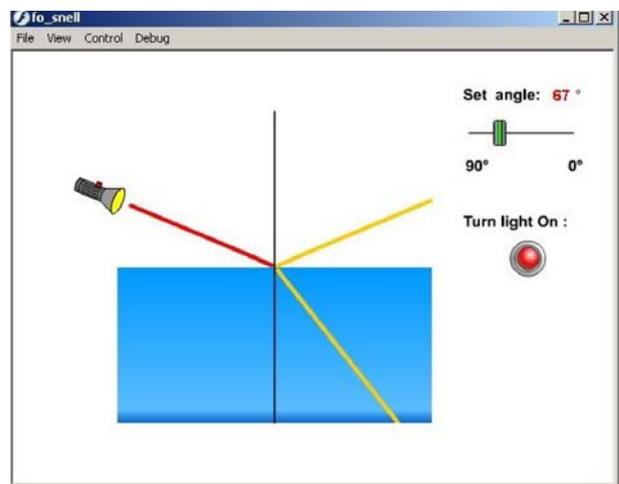Fig. 5: Two-stroke and four-stroke engines

Fig. 6: Presentation of Snell's law [3]

- *Demonstrative-interactive animation* — the student participates actively, and can affect the components of the animation (e.g. by changing the parameters of the phenomenon, technology, or process that is being presented). The animation is usually of a programmed, simplified in most cases physical model, which corresponds with the patterns of the real world.

Examples of demonstrative-interactive animation:
  - Presentation of Snell's law (Figure 6)
  - Laboratory devices for introducing impregnating processes (Figure 7)
- *Diagnostic, practicing the subject*, an examination in which the student affects the animation and tests the knowledge that has been acquired.
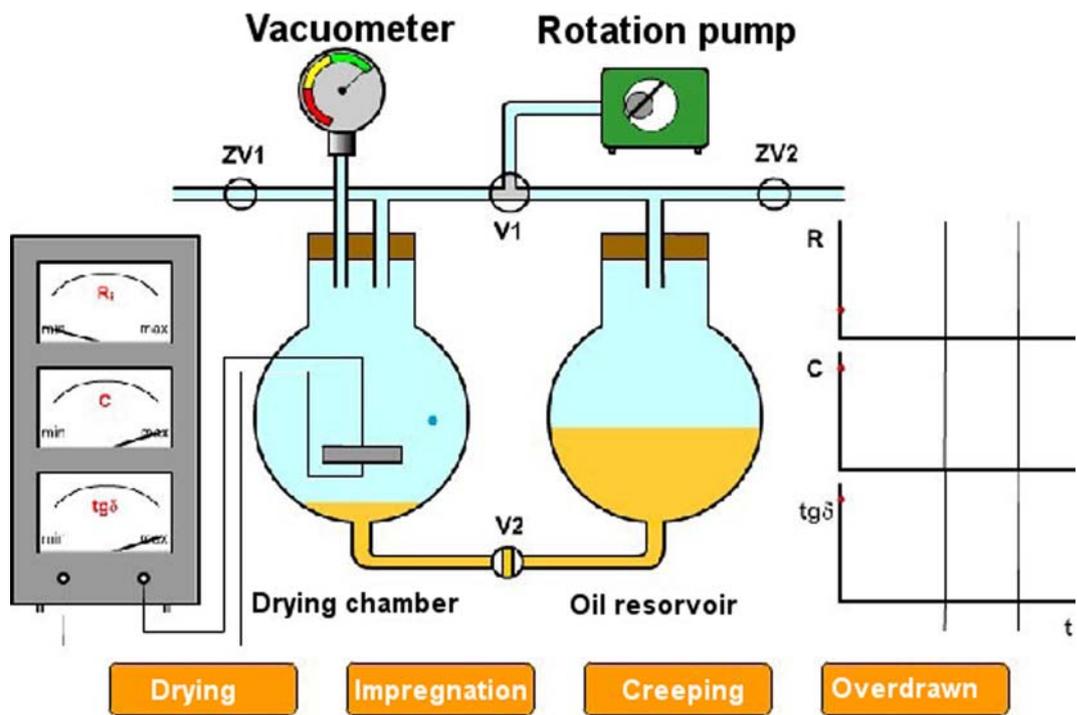
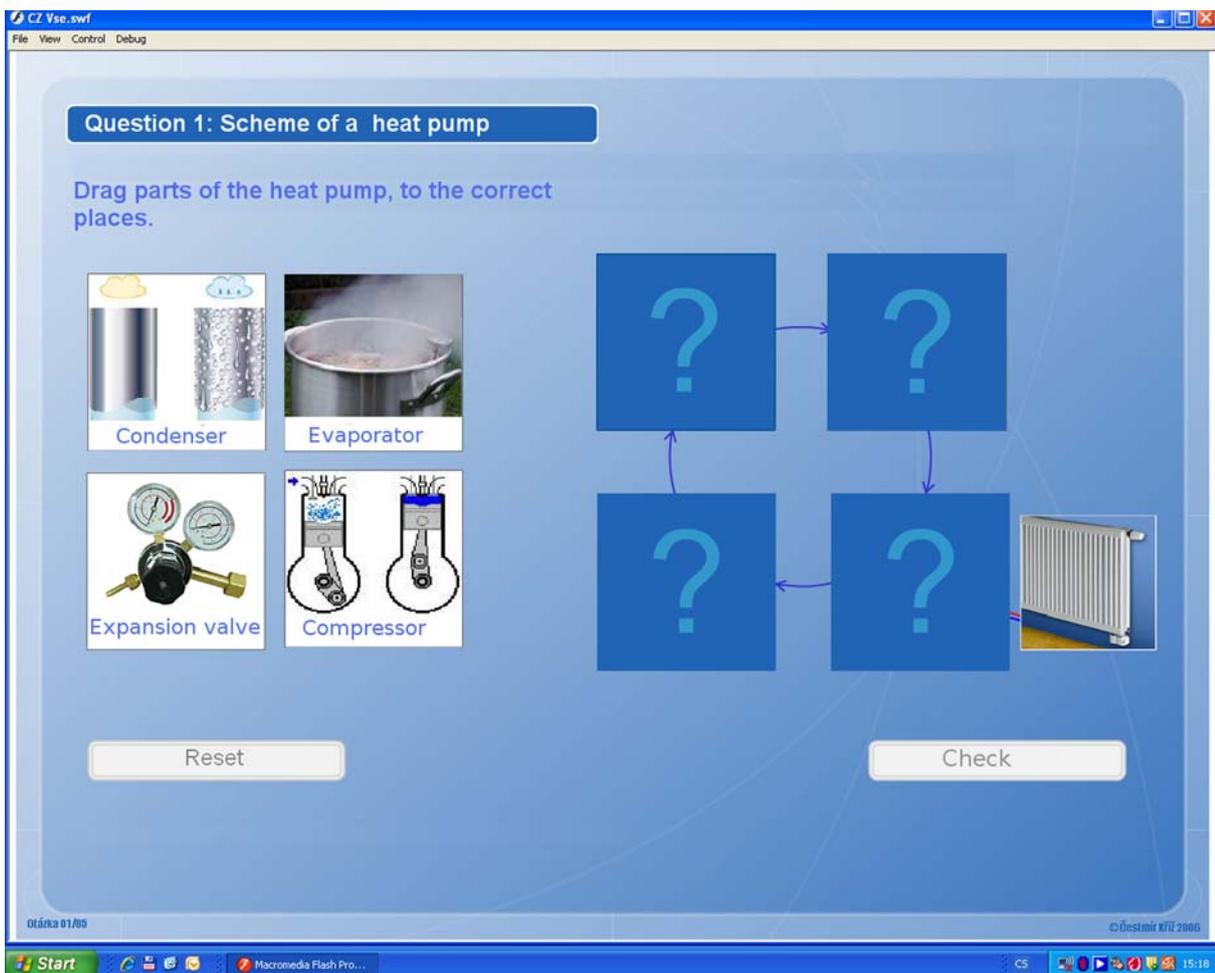Fig. 7: Animation of laboratory devices for introducing impregnating processes [3]

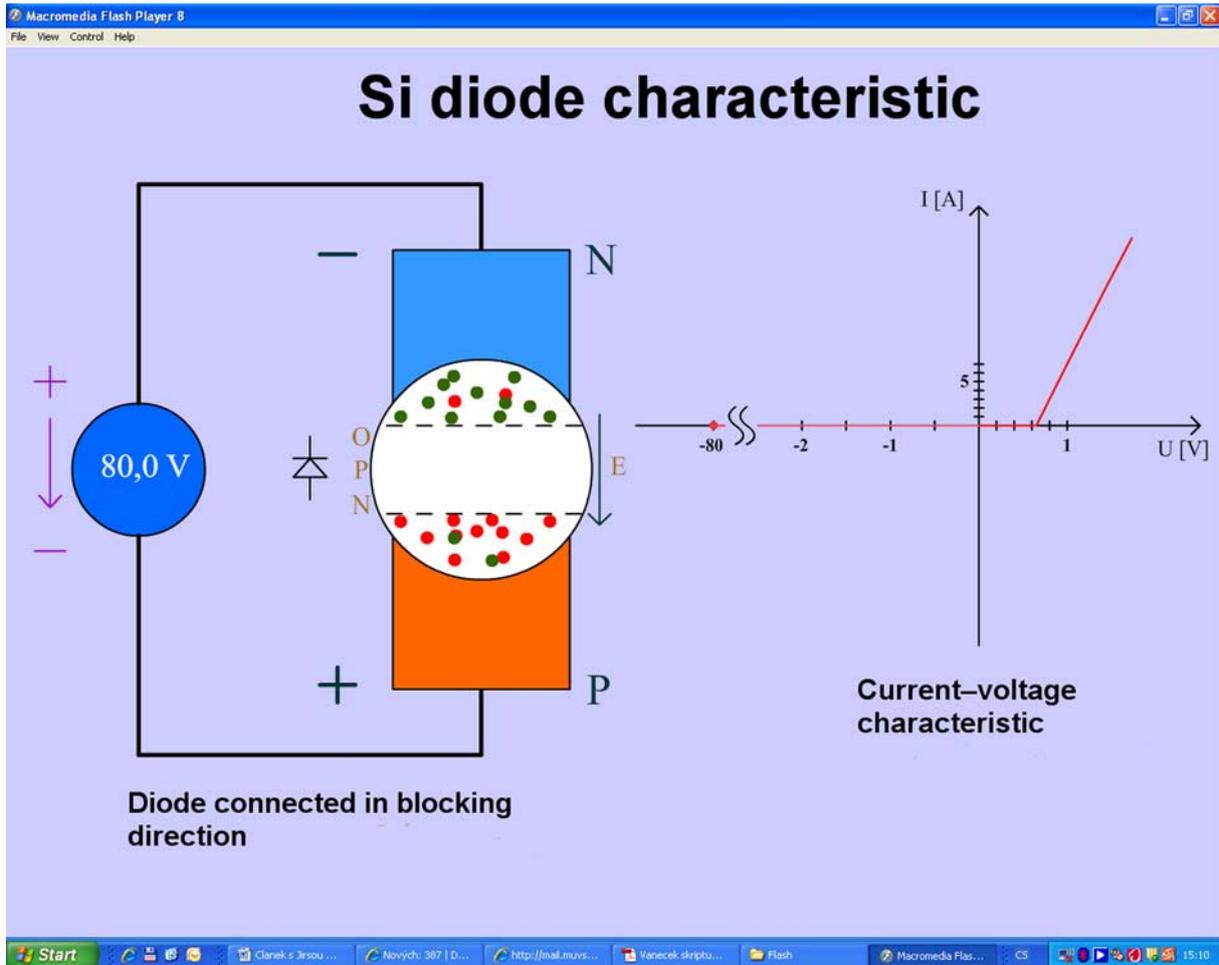Fig. 8: Creating the cycle of a heat pump [5]

Fig. 9: Characteristics of a silicon diode [6]

Here, it is necessary for some form of feed-back to be incorporated to inform the student about the correctness or incorrectness of the answer. Dividing electronic components into correct categories, creating a correct network schema, creating the cycle of a heat pump, etc., can serve as examples.

An example for gaining practice:

The principle of the heat pump — example of a practical exercise, creating the cycle of a heat pump (Figure 8)

According to the way of presenting the topic, with regard to representation in space:

- *Two-dimensional* (2D), where plane geometric figures are used to symbolize specific parts of the technology. An isometric view can also be used (so-called 2,5D) to emphasize the possible dimensional configuration of the symbols.

An example of two-dimensional (2D) animation: Characteristics of a silicon diode (Figure 9)

- *Three-dimensional* (3D) — all objects in the animation are represented by three-dimensional de-

piction and are also displayed in three dimensions on the screen. Some modeling tools are needed for creating the animation

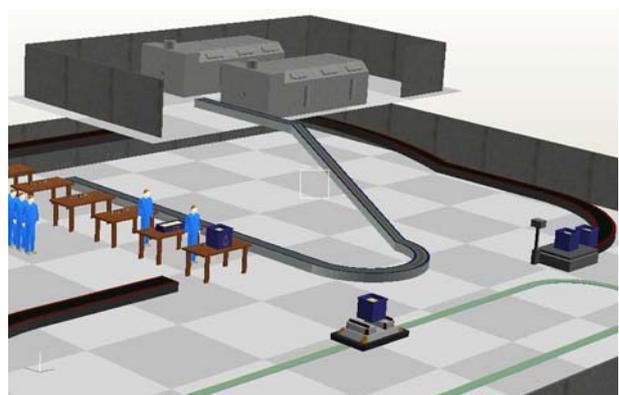An example of three-dimensional (3D) animation: Witness program — presentation of an industrial process (Figure 10)

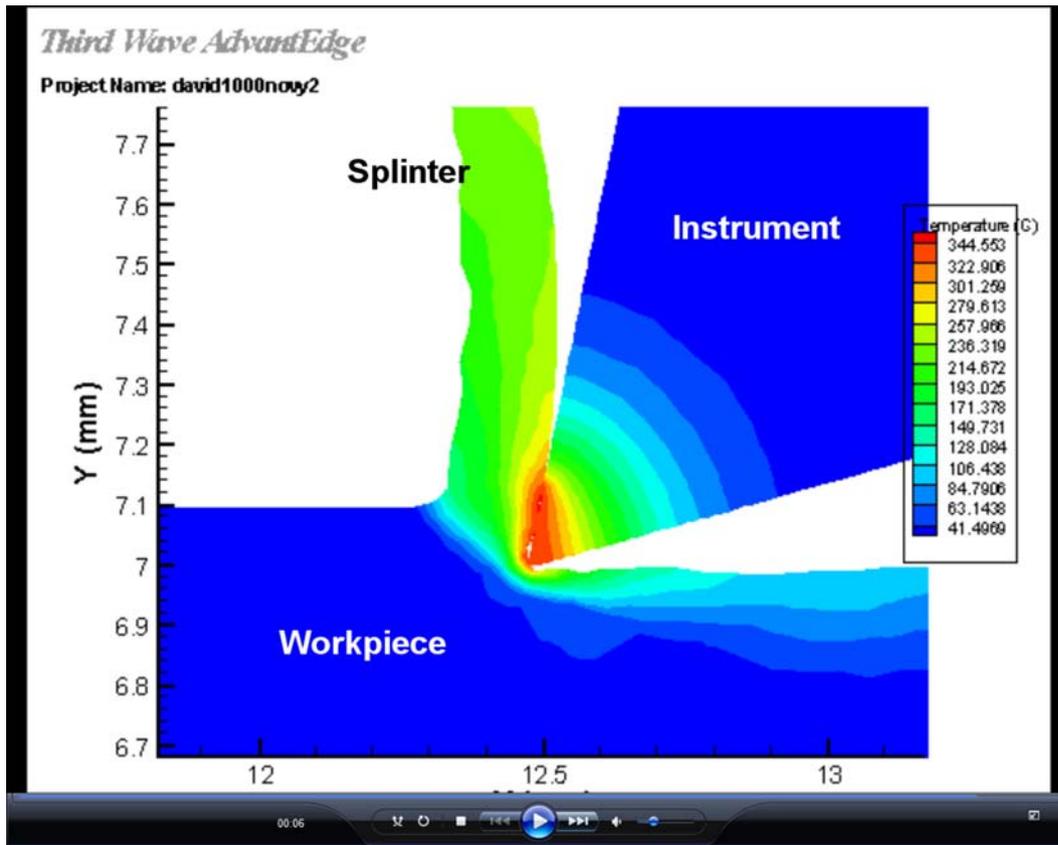Fig. 10: Witness program — presentation of an industrial process

Fig. 11: Program Third Wave AdvantEdge — thermal stratification

According to availability:
- Generally available, e.g. on the internet, commercially-available educational CD-ROMs
- Restrictively available, only within specific educational facilities

It is obvious that these basic categories can be combined with each other. The classification could be further specified, e.g. on the basis of specific specialized subjects, but that would lie beyond the framework of this paper.

A simulation can be understood as a specific case of an animation.

A simulation is a visualization of a specific mathematical model. The input parameters have to be set. The mathematical model generates output data from the parameters. The input data is usually in the form of specific physical quantities (e.g. tension, temperature, pressure, force). The difference between a simulation and an animation lies in the incorporation of random phenomena which exist in the real world and affect the final behavior of the model. An example is a simulation of an industrial process, a proposal for interior lighting, a proposal for traffic operation, etc.

Example of a simulation: Simulation of a cutting process in the AdvantEdge program — thermal stratification (Figure 11)

Conclusion

This paper has attempted to present a categorization, description and explanation of specific variants of animations for e-learning that teachers can encounter in their profession. The main emphasis has been on the teaching and learning aspects of the animations. For the sake of better understanding, the theoretical categorization was supplemented by specific practical examples. Technological aspects of creating animations are dealt with in the first and the third parts of this three-part paper.

References

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