There and back again - A tale between photographs and bits

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Abstract
The crucial role of contemporary Computer Science teaching is to teach students to become creators and not users of the technology. In this contribution we describe an example of good practice course on how to teach Computer Science through a digital photography and use it as a motivation – an excellent example of authentic learning in Computer Science. We present learning approaches that help children understand technology and computer algorithms that are used in modern digital cameras, basic photographic principles, techniques and physics. From motivational aspect we want to inspire children by showcasing a story about travel photography. The goal is to encourage them to not only know how to use a camera as a tool but also to understand its functioning.

The course consist of two parts: the first one introduces basics of digital photography as related to physics, and the second one how to process digital photography.
Today a camera is a fully functional computer with image sensor, processor, memory and screen. In a story about travel photography we ~~can~~ explain many computer science aspects including algorithms and computational thinking. The whole story begins with traveling around New Zealand from a photographic and hiking perspective. We start by the preparation for the trip and with the explanation of core functionality and anatomy of a camera – hardware. We explain how the sensor works (Bayer sensor), what is pixel and what is a sensor size, and how the number of pixels influences the quality of photographs. We proceed by an explanation on how an image is actually represented on a computer as a data (colour channels).
In the second part of the course we further increase the student's motivation through the adventure story telling, where we introduce the meaning of composition and explain most often used photo techniques, like HDR, long exposure, time lapse, high key and low key. Of course, we explain how the techniques are applied digitally. We continue with limitations that we have to take into an account when taking photographs under different circumstances. We conclude the course by describing techniques and basic algorithms used on digital photograph in the digital darkroom, like different colour channel separations – RGB, CMYK, Lab; layers; pixel blending and photo montage, JPEG encoding, sharpening and noise reduction, image scaling.

With this approach we learned that students are more motivated and do not need to know or understand all technical details to recognize and connect complex computer processes, algorithms or computational thinking with something familiar and understandable. Fundamentally we achieved that they wanted to hear the whole story.

Keywords
Aurthentic learning, photograph, algorithms, hardware, processor, image sensor, digital darkroom, colour channels, motivation.

Biography

Jan Vesel graduated in 2011 from the University of Ljubljana, Faculty of Computer and Information Science. He is involved in fields of Web development, multimedia and User experience design. His field of research also includes study of active learning and collaborative-constructivist teaching.

Nataša Kristan graduated from University of Ljubljana, Faculty of Education in 2011 and became a teacher of Mathematics and Computer Science. She has been teaching Logic and Mathematics group in Primary school. Now she organizes CS Competitions and Summer School at Faculty of Computer and Information Science, University of Ljubljana. Her main research is CS Didactics and Computational Thinking.

Andrej Brodnik got his PhD from the University of Waterloo, Canada. Afterwards he worked as a head of research and CTO in industry and was affiliated with the University of Primorska and the University of Technology in Luleå. Andrej's prime research interest is in data structures and algorithms, and didactics of CS. Prof. Brodnik is a recipient of a national award for exceptional achievements in higher education teaching. He currently holds position with the University of Ljubljana.