Work in Progress - IMAGERIA- A Visual Computing Festival for Girls

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Abstract – **The IMAGERIA project aims to investigate new paths in recruiting female students in engineering. The first outcome of this project was a one-day pilot workshop called** *IMAGERIA: Visual computing festival for girls* **and held in spring 2007. This workshop was based on the hypothesis that hands-on exposure to computer vision algorithms with applications to digital photography may be a significant incentive for female high-school students to enroll in Electrical and Computer Engineering or Computer Science undergraduate programs. The IMAGERIA workshop was structured as a sequence of interactive modules of image processing. As database, the participants were enabled to either use a provided image library or to acquire their own pictures using USB digital cameras. For each module of the workshop, the paper outlines the lessons that were learned and which will allow for further improvements in the structure of the workshop.**

Index Terms – Computer Vision, Female recruitment, Image Processing, Outreach.

INTRODUCTION

The IMAGERIA project aims to investigate new paths in motivating more female students to engage in engineering studies. One of its founding ideas is that interdisciplinary topics which integrate core engineering with arts or life sciences can be particularly appealing to female students, mainly because of the social content that they carry. Pfander and Williams [1] have taken a similar art-oriented approach in their outreach initiative aimed at undergraduate science/engineering students. The IMAGERIA workshop was designed for high-school students and consisted in interactive image processing activities focused on digital photography applications.

The value of image processing as a tool for teaching high-school science has been investigated in the Image Processing for Teaching Project (IPT) at the University of Arizona [2]. However, the focus in the work described in this paper is different from developing teaching tools. IMAGERIA aims at promoting a new vision for computing, a vision that is oriented towards interdisciplinary applications of computing which carry social values.

The remainder of the paper is structured as follows. The next section describes the design of each module composing the workshop, along with lessons that were learned during its first offering. The last section draws conclusions.

DESIGN AND IMPLEMENTATION OF THE IMAGERIA WORKSHOP

A one-day pilot workshop called ***IMAGERIA: Visual computing festival for girls*** was organized in spring 2007. This workshop was based on the hypothesis that hands-on exposure to computer vision algorithms with applications to digital photography may be a significant incentive for female high-school students to enroll in Electrical and Computer Engineering and in Computer Science undergraduate programs.

The IMAGERIA workshop was first offered at the University of Victoria (BC, Canada) on a Saturday as a whole-day event. There were 12 participants, all female, enrolled in school grades ranging from 8 to 12. Participants were recruited through workshop advertisements in local press and at high-schools on Vancouver Island.

The workshop started with a brief general presentation of the field of computer vision. Computer vision was presented as a branch of artificial intelligence that aims at giving computers the ability to see. Some practical applications of computer vision algorithms in health care (medical imaging) and in video surveillance were also presented.

The workshop continued with three interactive modules that implemented basic algorithms in computer vision, namely preprocessing (filtering), segmentation, and building panoramic images. Participants were assisted by graduate student volunteers (one volunteer for each two participants) throughout the experiments.

The workshop ended with each participant writing a newspaper-style article about her workshop experience. This writing exercise allowed for a post-workshop analysis of the thoughts, beliefs, and attitudes of participants related to their exposure to the computer vision field. Feedback about the workshop was also collected via anonymous post-workshop questionnaires. The modular structure of IMAGERIA is described below.

A. A brief discussion about the concept of digital image (i.e. the way a computer 'sees' an image) was meant to lead participants towards understanding a digital image as matrix (or grid) composed by elementary units (i.e. pixels).

Lessons learned.

- From the newspaper-style articles written by participants, it was found that this discussion was insufficient for a proper understanding of the concept of a digital image, mainly due to the fact that matrix algebra is not taught in

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high-school. Below is an excerpt from such an article, which clearly shows that the grid concept was not remembered.
"During this workshop we were to draw what we think a digital picture was. Most drew boxes, lines and dots. Later we learned that digital imaging has to do a lot with numbers that indicate their grey levels." (anonymous participant)
Solution. Enable the direct manipulation of the matrix concept:
- Provide all participants with an empty rectangular grid and let them create simple gray-level images.
- Ask them about finding the gray level at various locations in their image. The participants will have to perform the correct localization of the pixel in the grid.
- On a public image database, vary the grid resolution and let participants discover the relationship between resolution and level of detail in the image.

B. The first software-based module consisted in an interactive demonstration of image convolution followed by experiments on edge detectors.
Lessons learned.
- The concept of convolution was well understood by most participants. This was considered an important achievement, since 1D signal convolution is typically taught in the 2nd year of electrical engineering.
- Experiments on edge detection via convolution with various linear filters were not very engaging, mainly because most of the edge detectors obtained very similar results. It was also difficult for participants to understand why such a variety of algorithms was needed.
Solution. Expand the software so that it contains both low-pass and high-pass linear filters. Low-pass filters are useful for image smoothing, while high-pass filters are typically used for finding edges (i.e. high-frequency components). This expansion should allow for a basic understanding of classes of algorithms (smoothing versus edge detectors) and their role in image preprocessing.

C. The second module implemented image segmentation via thresholding techniques. A brief discussion introduced first the concept of segmentation as foreground-background separation. The central role of image segmentation in computer vision was explained via examples.
Lessons learned.
- The concept of intensity-based thresholding was easily understood. However, thresholding is rarely enough for obtaining a good segmentation; this is why some participants questioned its usefulness in the feedback forms.
Solution. Redesign of the image database and enhance the software with code for connected component labeling:
- Build a first database of simple images where thresholding works well in separating all objects from the background.
- Implement connected component labeling, which identifies objects in the segmented image by their label.
- Let participants try thresholding and connected component labeling on the database of simple images.
- Let participants try thresholding + connected component labeling on a second database containing more complex images (example: objects casting shadows, non-uniform illumination). Ask participants to identify and analyze the causes of imperfect segmentation.

D. The last module consisted in image 'stitching'. This interactive module allowed participants to build panoramic images by 'stitching' together two or more images with partial overlap in the viewpoint. The 'stitching' technique is based upon manual identification of feature points that are common to pairs of images to be 'stitched' together. The manual identification of these feature points was an opportunity for pointing out that more sophisticated algorithms are able to detect such features in an automatic fashion.
Lessons learned: This was by far the most interesting module, since it enabled more artistic contributions from participants. This module will remain unchanged in future workshop offerings.

E. Overall evaluation of the participants' experience. The pilot offering of IMAGERIA in 2007 involved a limited number of participants (12) which makes the quantitative evaluation of the workshop's success not relevant. However, the feedback questionnaires contain clear indications of the positive experience of each participant. For instance, all participants except one have stated that they will highly recommend this workshop to their friends. Space limit prevents from having a more details discussion on the workshop's global evaluation, as it is believed that the description of the workshop's content is more important for the audience.

CONCLUSIONS

At the best of the author's knowledge, this is the first outreach initiative based on computer vision and image processing. The IMAGERIA workshop used computer vision as an inspiring example to show that abstract mathematical concepts (for instance matrix manipulation and signal convolution) have direct contributions towards solving real-world problems. Moreover, solving a real-world problem does not involve a standard recipe for mixing algorithms and math; engineering is creative and fun.
Ongoing work focuses on the implementation of the solutions outlined in the previous section for the second offering of an improved workshop in fall 2009.

REFERENCES

[1] Pfander, J., Williams, B., "The beat of a different drum: using the arts in outreach to science/engineering students and faculty", *Issues in Science and Technology Librarianship*, available www.istl.org, 2006.

[2] Greenberg, R., Raphael, J., Keller, J., and Tobias, S. "Teaching high school science using image processing: A case study of implementation of computer technology", *Journal of Research in Science Teaching,* Vol 35, No 3, 1998, pp. 297-327.