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TEXAS A&M UNIVERSITY
Research Experience for Teachers

Computer Vision: Helping Computers See
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Abstract

To build effective autonomous robots, algorithms must be developed that allow computer systems to interpret visual interpretations of their environment providing computer vision.

Complete Computer Vision algorithms would be much too complex for the average high school student. However, it is possible to examine some of the underlying principles of image processing to prepare students to learn the more in depth algorithms involved in feature detection and full scale computer vision.

Through this course of lessons, students will be guided through some of the basic concepts of computer vision and how they apply to real world problems. Students will then explore developing techniques for image rectification and other basic image processing algorithms.

Research Objectives

This study will determine which underlying concepts and algorithms related to computer vision could be readily presented to students in middle and high school.

Additionally a tool is being developed to assist and enhance the student's ability to experiment and explore the algorithms involved with image rectification and image processing.

The tool itself will have minimal functionality including only a rudimentary Graphical User Interface and a menu selection that is tied to internal function calls. It will be the exercise of the students to implement the appropriate algorithms in the functions.

The algorithms to be implemented are: flatten, convert to grayscale, adjust brightness, adjust contrast, and inversion. The tool includes an implementation for edge detection as guidance. A second menu of convolution algorithms is included for extension of the exercise.

Methodology

Research in SLAM (Simultaneous localization and mapping) as well as agricultural visual studies was analyzed for common algorithms, concepts and processes. These elements were then compared to current state educational standards.

From this research a selection of image processing algorithms was selected to be examined by the students and a tool that provides a graphical user interface for the students to use to explore these algorithms was developed.
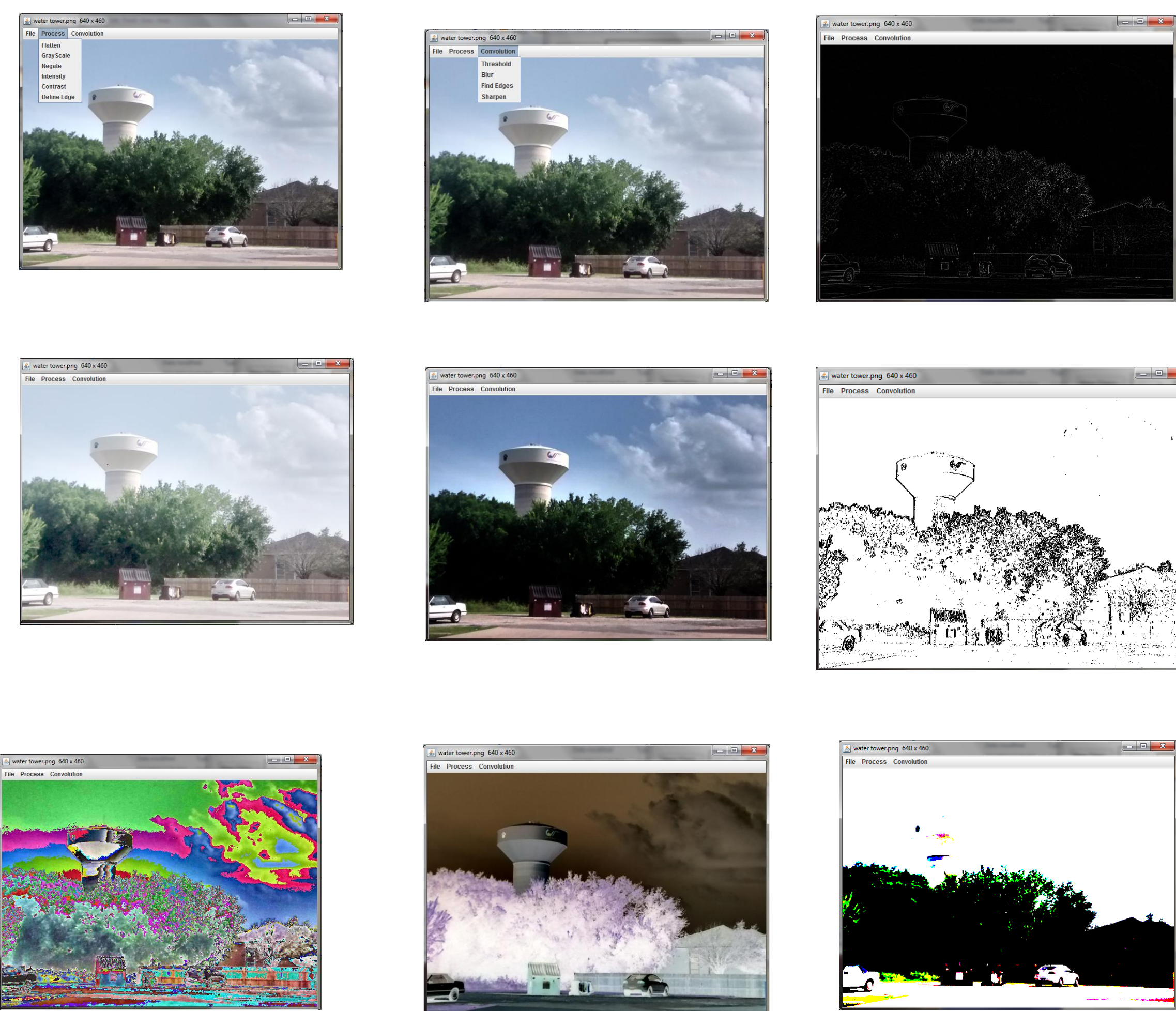
Figures from left to right, top to bottom: 1. Demonstrating basic process menu, 2. Demonstrating Convolution Menu for extension exercise, 3. Convolution Edge Detection, 4. Image Brightness, 5. Image Sharpening, 6. Linear Edge Detection, 7. Contrast, 8. Image Inversion, 9. Convolution Thresholding

Results and Conclusions

The research examined had several underlying commonalities, but one topic, Image Processing, provided itself to be highly suitable for study in a high school Computer Science class. The elements of Image Processing that were well aligned to study were; homogenous point processing, convolutions, edge detection and feature point extraction. For the sake of time, only the first three elements will be considered for lessons.

Image processing is an accessible topic for high school students to experience graduate level research in the field of Computer Vision and is well suited to fulfilling state educational requirements.

A tool was developed and tested with some former high school students and they seemed to interact with the interface in a meaningful way. The students were able to quickly implement the suggested algorithms and suggested that it was a sufficient tool for introducing the concepts.

Further testing will be conducted in a classroom environment with feedback from the participating students providing further insights into the quality of this research project.

References

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