

Title: Machine learning vs non-machine learning algorithms to detect circles in images with various characteristics

Objectives:

- Differentiate the optimizations between different algorithms in image processing.
- Examine and compare the statistics of the output yielded by each algorithm.
- Find limitations of the algorithms for different image scenarios.

Abstract:

Circle detection has been an important area of interest for many years in computer science. Some of the examples of detection of circular objects in images include, help identify abnormal cells, atomic structures, informative street signs, etc. Though the general algorithm appears very elementary, the optimized algorithm for detecting circular objects is strategically very substantial. In this research we are considering Convolutional Neural Network as a machine learning approach to detect circles in comparison to the Canny detection algorithm for detecting circles. We will also look at how the machine learning approach augments the results in compared to the general approach or not, and the limitations of both methods.

Implementation and testing:

The source code provided for both algorithms is run separately for several test samples, images that are training data for the CNN algorithm, also to be tested on the Canny algorithm approach. The results will accentuate factors that represent the effectiveness of the algorithms, some of which are performance, time taken, edge detected image quality, and most importantly correct number of circles. We are also going to test the CNN algorithm against images that are not in the training data and measure the aforementioned factors. The comparison thus will give an understanding of the augmentation of the implementations over the other. Furthermore, we will analyze how the implementations can be more optimized to make it a better fit for dynamic images.

Reading Materials:

1. Ercan, M. F., Qiankun, A. L., Sakai, S. S., & Miyazaki, T. (2020). Circle detection in images: A deep learning approach. *Global Oceans 2020: Singapore – U.S. Gulf Coast*. <https://doi.org/10.1109/ieeconf38699.2020.9389048>
2. How to Detect Circles in Images. (n.d.). <https://www.codingame.com/playgrounds/38470/how-to-detect-circles-in-images>
3. Hsouri. (n.d.). *Circle-detection-CNN: A convolutional neural network model for detecting the parameters of the circle present inside of a given image under the presence of noise*. GitHub. <https://github.com/hsouri/Circle-Detection-CNN.git>
4. Yao, Z., & Yi, W. (2016). Curvature aided Hough Transform for circle detection. *Expert Systems with Applications*, 51, 26–33. <https://doi.org/10.1016/j.eswa.2015.12.019>

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- Mamun Or Rashid – ID: 201960713– Contribution: Finding resource materials for the algorithms.
- Md Golam Mahmud Chowdhury – ID: 202164141 – Contribution: Writing the research proposal and providing implementation ideas.
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