Design and Analysis of Algorithms Project Report

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Abstract

The implementation of geometric algorithms plays a pivotal role in diverse fields such as computer graphics, computer-aided design, robotics, neural networks, and geographic information systems. This abstract provides a comprehensive overview of recent advancements in the practical application of geometric algorithms, focusing on the transition from theoretical foundations to real-world implementation.

1 Introduction

This document includes multiple different geometric algorithms for a multitude of problems, such as a Convex Hull, Concave-Convex Hulls, and Line Intersections. The algorithms are further defined and discussed in the next section.

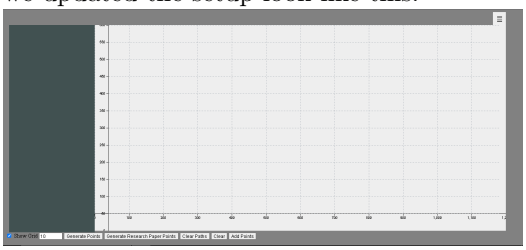
2 Programming Design

The programming language used was Javascript and the design for the program is quite simple and dynamic. We run a function called CreatePaths(GeometricAlgorithm, PathAlgorithm), which takes has 2 parameters. The first one determines which algorithm is executed and this is decided by the button the user clicked. A path algorithm is linked with the geometric algorithm used in the function. Other utilities include graphics utilities and quality of life changes like the tooltip and grid.

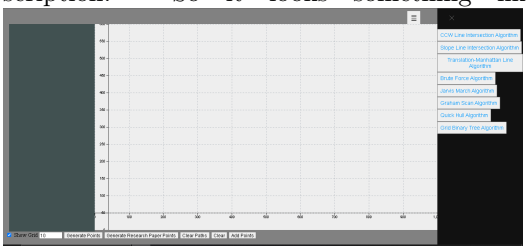
3 Experimental Setup

The main look of our setup looks something like this:

For the implementation of our chosen research paper, we required the implementation of a grid, therefore we updated the setup look like this:



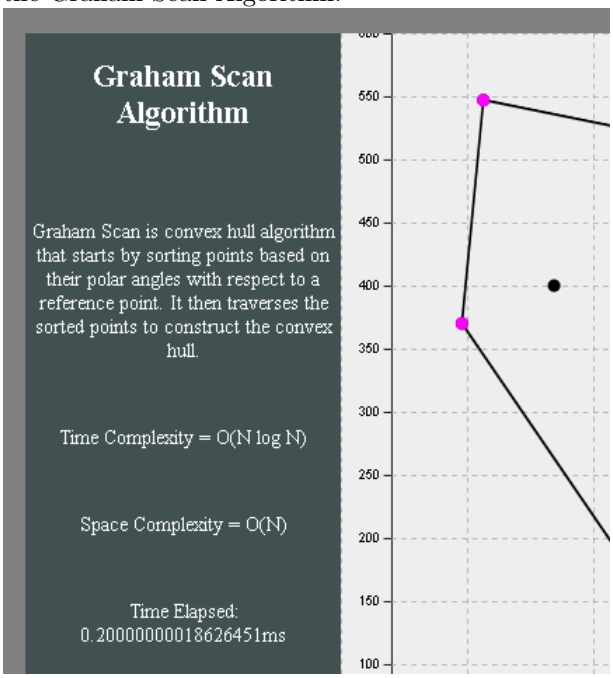
Lastly, to pick the desired algorithm to run, we can open the collapsible sidebar which contains all required algorithms as requested in the description. So it looks something like this:



4 Results and Discussion

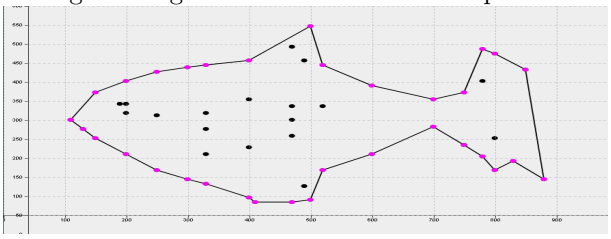
4.1 Geometric Algorithms

The results of the execution of any of the geometric algorithms can be seen in the leftmost container, were a description of said algorithm, complexities and the actual time elapsed is shown. Such is an example of the Graham Scan Algorithm:

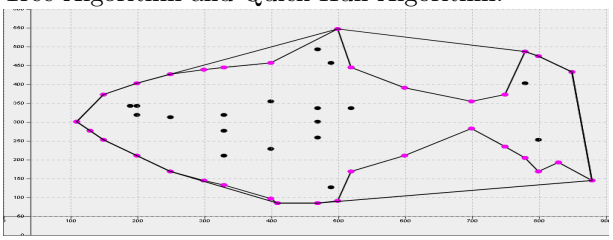


4.2 Research Implementation

The research paper that we implemented was based on an algorithm that generates a convex-concave hull. We replicated an example given in the research paper in which the points of a fish were given and the algorithm generated a fish. Here is a picture:



Here is the difference between the Grid-Binary Tree Algorithm and Quick Hull Algorithm:



5 Conclusion

In conclusion, this project has delved into the realm of geometric algorithms, specifically focusing on line intersections and convex hulls. The study not only deepens our understanding of fundamental geometric principles but also highlights the practical significance of these algorithms in computer graphics, computational geometry, and beyond. As we conclude, the insights gained highlights relevance of geometric algorithms in solving real-world problems, paving the way for continued advancements and applications in the ever-evolving landscape of computational science.

References

[1] GAO Yang, CHENG Yuhu, WANG Xuesong, "A Quick Convex Hull Building Algorithm Based on Grid and Binary Tree," Chinese Journal of Electronics, vol. 24, no. 2, pp. 317-320, 2015, link: `cje.ejournal.org.cn/en/article/doi/10.1049/cje.2015.04.015`

[2] Sharif, Muhammad Khan, Safdar Khan, Sadaf Raza, Mudassar(2009), "An algorithm to find convex hull based on binary tree," INMIC 2009 - 2009 IEEE 13th International Multitopic Conference. 1-6. 10.1109/INMIC.2009.5383163, link : `www.researchgate.net/publication/236898960_An_algorithm_to_find_convex_hull_based_on_binary_tree`

6 Appendix