FRACTAL GENERATION USING MANDELBROT AND CHAOSBROT SETS IN C PROGRAMMING

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ABSTRACT :-

This paper presents the construction and analysis of fractals generated in the complex plane using C programming. The study focuses on the Mandelbrot Set and extended Chaosbrot family iterations based on the recursive relation

$$Z_{n+1} = |Z_n|^2 + c.$$

The project implements complex arithmetic, divergence testing, and ASCII-based visualization. The results demonstrate fractal boundary complexity, sensitivity to initial conditions, and applications in chaos theory. The program successfully generates fractal structures using iterative numerical methods.

Keywords :- Fractals, Mandelbrot Set, Chaosbrot, Complex Numbers, C Programming, Iterations.

INTRODUCTION :-

Fractals are mathematical sets that exhibit self-similarity and infinite complexity. The Mandelbrot Set is one of the most well-known fractals generated using iterative complex functions. This paper explores the generation of such fractals using C programming, leveraging the complex.h library to handle complex number operations. The objective is to visualize fractals and understand iterative divergence behavior.

METHODOLOGY :-

❖ **Technique:-**

The project uses complex arithmetic implemented through the C 'complex.h' library. Iteration formulas rely on recursion-like evaluation but implemented via loops. Since infinity cannot be represented in computing, thresholds are applied to determine whether a point diverges.

❖ **Goals :-**

• Construct and display the Mandelbrot set
• Display output in ASCII or graphical window

• Extend program to generate Chaosbrot and related fractals
• Build a reusable fractal generator in C

❖ *Mathematical Formulation:-*

The base formula for the Mandelbrot Set is:
   $Z_{n+1} = Z^2 + c$
For Chaosbrot, the formula is modified as:
   $Z_{n+1} = |Z|^2 + c$
A point c belongs to the set if |Zn| remains bounded after many iterations.

❖ **Algorithm Steps :-**

• Select a complex coordinate range
• Initialize $Z = 0$
• Apply iteration $Z_{n+1} = Z*Z + c$ or $|Z|^2 + c$
• If |Z| exceeds threshold (usually 2), mark divergence
• Count escape iterations and assign characters

❖ **Librariy Used :-**
   I. Complex.h

RESULTS AND DISCUSSION :-

The program successfully produces the characteristic shape of the Mandelbrot Set. Points inside the set appear as solid regions, while points outside show gradient-like ASCII patterns based on escape iterations. The results validate the correctness of the iteration logic and the divergence threshold.

CONCLUSION :-

This work demonstrates the generation of fractal structures using simple iterative complex equations in C programming. The Mandelbrot and Chaosbrot sets highlight the emergence of complex shapes from simple formulas. Future enhancements include color graphics, zoom capabilities, and GPU-accelerated fractal rendering.

ACKNOWLEDGMENT :-

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