



Tribhuvan University

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A Project Proposal On:

Fourier Transform Drawing

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FOURIER TRANSFORM DRAWING

Introduction

Fourier Transform Drawing is drawing anything or any shape outline with the help of fourier series. In this program, we can draw anything on a canvas and the same thing will be drawn with the help of fourier transform. We will be able to take any shape from an input image and draw the given shape with a fourier transform.

Objectives

The main objectives of this project are to

1. To understand the basics about the fourier series.
2. To understand the importance of Discrete Fourier Transform and Discrete-time Fourier Transform.
3. To learn the scope of fourier series and why it is one of the most significant algorithms in history.

Proposed System

Description

Fourier series is an expansion of a periodic function in terms of an infinite sum of sines and cosines. Fourier series make use of the orthogonality relationships of the sine and cosine functions. With appropriate weights, one cycle or period of the summation can be made to approximate an arbitrary function in that interval. The discrete-time Fourier transform is an example of a Fourier series.

$$s_n(x) = \frac{a_0}{2} + \sum_{n=1}^N \left(a_n \cos\left(\frac{2\pi}{P}nx\right) + b_n \sin\left(\frac{2\pi}{P}nx\right) \right)$$

$$a_n = \frac{2}{P} \int_P s(x) \cdot \cos\left(\frac{2\pi}{P}nx\right) dx$$

$$b_n = \frac{2}{P} \int_P s(x) \cdot \sin\left(\frac{2\pi}{P}nx\right) dx$$

In mathematics, the discrete-time Fourier transform (DTFT) is a form of Fourier analysis that is applicable to the sequence of values. The DTFT is often used to analyze samples of a continuous function. The term discrete-time refers to the fact that the transform operates on discrete data, often samples whose interval has units of time.

In this program, we are going to use discrete Fourier transform in order to generate the Fourier series of the given discrete coordinate data.

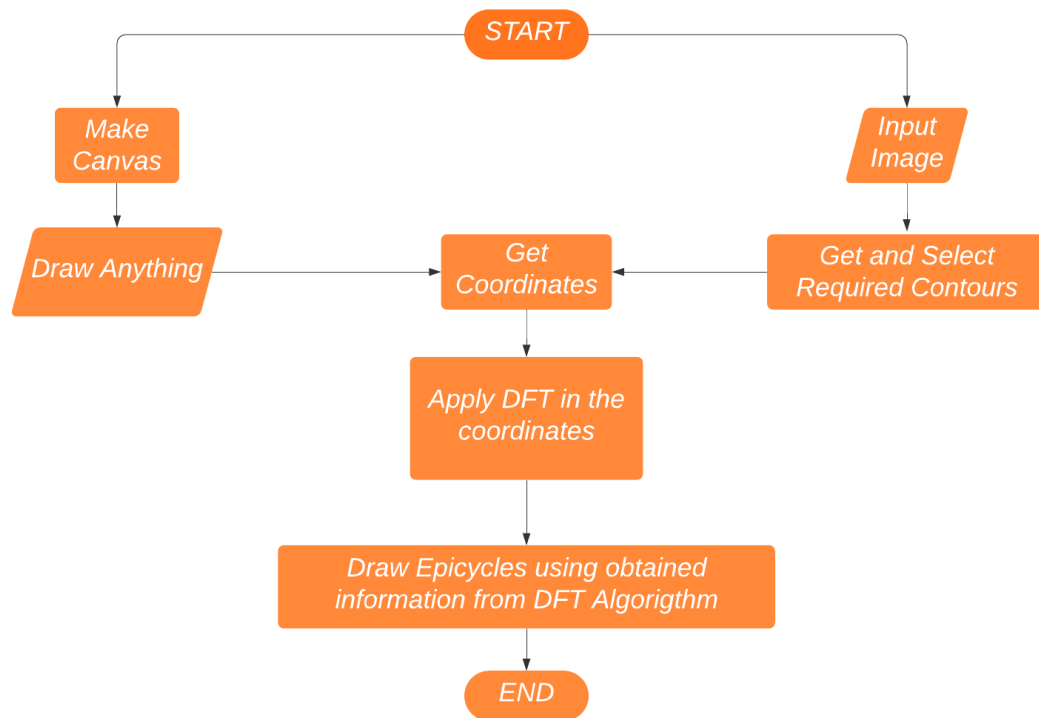
In mathematics, the discrete Fourier Transform (DFT) converts a finite sequence of equally-spaced samples of function into a same-length sequence of equal-spaced samples of the discrete-time Fourier transform (DTFT), which is a complex valued function of frequency.

The discrete Fourier transform transforms a sequence of N complex numbers $\{\mathbf{X}_n\} := x_0, x_1, \dots, x_{N-1}$ into another sequence of complex numbers, $\{\mathbf{X}_k\} := X_0, X_1, \dots, X_{N-1}$, which is defined by

$$X_k = \sum_{n=0}^{N-1} x_n \cdot e^{-\frac{i2\pi}{N}kn}$$

$$X_k = \sum_{n=0}^{N-1} x_n \cdot \left[\cos\left(\frac{2\pi}{N}kn\right) - i \cdot \sin\left(\frac{2\pi}{N}kn\right) \right]$$

Block Diagram



Block Diagram of Fourier Transform Drawing

Methodology

We will be using an object oriented approach to build this project. C++ (g++ version 9.3.0) programming language along with the SFML library and Python-3.8.10 and OpenCV Python (version 4.5.2) for image processing will be used in order to build this project.

We will first try to make a canvas and draw in canvas whose drawing will be prepared by this program and then we will move onto image processing in order to draw the shapes that are present in the given image.

Project Scope

The Fourier Transform Program is built with the objective of understanding the basics of the Fourier series and to understand the Discrete Fourier Transform. This program helps to know the detail of the fast fourier transform as well as fourier series. We know Fourier transform algorithms are considered as one of the best algorithms in history since it has wide applicability in physics as well as mathematics. Hence, Using this program to teach students about Fourier series and Fourier transforms could help a lot in order to visualize the Fourier series and understand Fourier transforms.

Project Schedule

The project schedule for developing this program is as follows:

SN	Topic	Days Required
1	Study on Fourier Series and Fourier Transform	3
2	Developing pseudocode	2
3	Study on Data Structure and relation	2
4	Design the system of flow of program	2
5	Executing, Testing, Debugging	4
6	Program Documentation	3

This schedule might get altered according to the circumstances encountered.