National University of Computer & Emerging Sciences
Karachi Campus

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Machine Learning

Project Report

Title: Detection, Generation Using Stars and Image to Image Modeling

Group members:

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Abstract:

In this project our main goal was to try and make a model that can generate images on the stars' alignment and patterns. And we achieved our goal of making images on stars patterns by *making our own dataset* and then using that dataset on many different models (cGAN, KNN, Kandinsky, ControlNet, StableDiffusion).

1. Introduction

- Problem Statement: Generate Images on Stars Pattern Detection.
- Motivation: This problem helped us discover a new use case of KNN Model i.e. it can be used for image processing as we can use the N-neighbors to determine the number of lines to draw on our image.
- Scope: A real world use case of this project can be that this model can be tuned in a way that we can use it for detection of fossils in Archeology to help the scientists determine which animal is that using the structure of their remains.

2. Literature Review:

- Used the documentation of Kandinsky, cGAN, ControlNet, StableDiffusion to help us in our journey.

3. Dataset Description:

- Source: Made our own dataset by using the Images of the "Space Engine" simulation software.
- Details: We took Screenshots of the Stars one by one and got around 80 screenshots and then we used those Screenshots to generate more Images by flipping, rotating and cropping and that is how we made our dataset and we also contributed in real world by uploading this dataset on "RoboFlow".

4. Methodology:

- Approach: Tried multiple models (cGAN, Kandinsky, ControlNet, Stable-Diffusion) many times but none of them were working initially as we were unable to fine-tune it. So then we used them together (2 models at once) and finally we are able to generate images (abstract art) using Canny (ControlNet) to generate Image-Skeleton and then using Stable Diffusion for Image Generation.
- Implementation Details: Used KNN which lets user to select number of lines to join the stars with. Also the user has choice of setting the threshold, neighbors on runtime. Threshold is the brightness of stars the more the threshold the more the chances of bright stars being connected and vice versa.
  Lastly all of our work is hosted on streamlit some of it is on Google Colab as we need powerful GPUs for our model to run.
- Design Choices: Made a good looking UI on streamlit where user can input their image and then use the generated skeleton image on Google Colab because streamlit doesn't have powerful GPUs to support hugging-face models so the user has to then input the skeleton image onto Google Colab Notebook (where our code is available for image-to-image generation/abstract art generation).

5. Experiments and Results:

- Experimental Setup: Used cGAN but it failed as it required more samples for good results. Secondly we used Kandinsky but it also failed because it is not trained to generate images on connected shapes. So we used two different models at once for this task. Once was for skeleton generation the other was to use that generated skeleton and turn it into a beautiful abstract art.
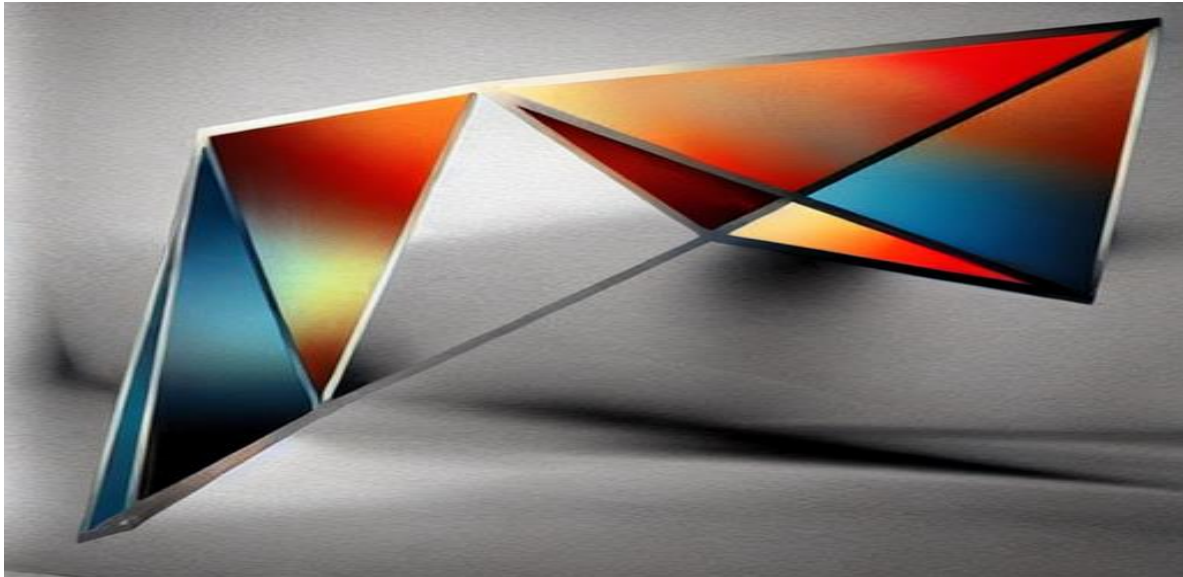
- Results:

    1. Input:

2. Stars detection and connection:
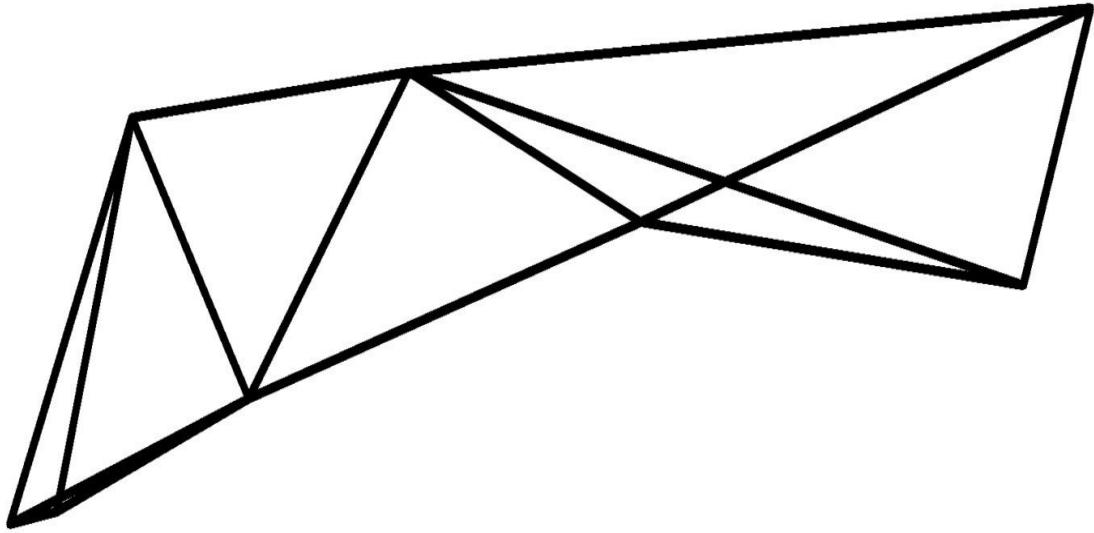
3. Art Generation:

- Analysis: As we can see our goal of generating abstract art through the images of stars is being fulfilled.

6. Discussion:

- Strengths: Used two models together output of one model (ControlNet) became the input of other model (Stable-Diffusion-v1-5).
- Limitations: Lack of dataset, only generates art, and can improve the skeleton image generation.
- Comparison: No existing work like this so no comparison.

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7. Conclusion and Future Work

- Learned a new way of using KNN.
- Improving user interface. Generating images other than art like a figure, an object or an animal using stars connection image as a base input. Also fine tuning available models for our specific use case.

References:

- Used the official documentation of the hugging face models, streamlit, research papers on cGAN and other useful image related concepts.

Appendix:

Link to project Code: https://colab.research.google.com/drive/1wP0IYf-ijvH0Y3vfrwa0OE6SRJ1oZ-tz?usp=drive_link

Link to project Video:
https://drive.google.com/file/d/1JVtt8azpXF40ARExncdeCu569XvAoLPJ/view

Link to project App: https://knn-star-points.streamlit.app/

Link to project Dataset: https://drive.google.com/drive/folders/1W-NUqvAQAnNdyUC0UDEcsQuxiTzqUNfC