**CANDIDATE’S DECLARATION**

It is hereby certified that the work which is being presented in the **B. Tech Major Project** Report entitled **"FACIAL SKETCH SYNTHESIS"** in partial fulfilment of the requirements for the award of the degree of **Bachelor of Technology** and submitted in the **Department of Computer Science & Engineering** of **Dr. Akhilesh Das Gupta Institute of Professional Studies, New Delhi (Affiliated to Guru Gobind Singh Indraprastha University, Delhi)** is an authentic record of our own work carried out under the guidance of **Ms. Seema Jain, Assistant Professor, CSE.**

The matter presented in the **B. Tech Major Project Report** has not been submitted by me for the award of any other degree of this or any other Institute.

**Vikram Kumar Pushkar Kumar**

**(00115607221) (00315607221)**

This is to certify that the above statement made by the candidate is correct to the best of my knowledge. They are permitted to appear in the **External Major Project Examination**

**Ms. Seema Jain Dr. Saurabh Gupta**

**Assistant Professor, CSE Head, CSE**

The B. Tech Major Project Viva-Voce Examination of **Vikram Kumar (00115607221),** has been held on **……………………………….**

**Dr. Rakesh Kumar Arora** **(Signature of External Examiner)**

**Project Coordinator**

**ABSTRACT**

Facial sketch synthesis is an emerging area in computer vision that aims to predict realistic face images from hand-drawn sketches. This project report presents a comprehensive study and implementation of facial sketch synthesis using a pix2pix conditional Generative Adversarial Network (GAN). Leveraging the CUHK Face Sketch Database, the project employs Python for all stages of development, including data loading, pre-processing, model definition, training, and evaluation.

The pix2pix framework, known for its efficacy in image-to-image translation tasks, serves as the backbone of our approach. The generator model is designed to translate sketch inputs into photorealistic face images, while the discriminator model distinguishes between real and synthesized images, ensuring the generation of high-quality outputs. Pre-processing steps include normalization and augmentation of the dataset to improve the robustness and generalization of the model.

Extensive experimentation and tuning of the GAN architecture have been conducted to optimize the synthesis process. The results demonstrate that the pix2pix conditional GAN can effectively learn the mapping from sketches to face images, producing visually convincing results that hold promise for applications in law enforcement, digital entertainment, and beyond. This report details the methodology, implementation, and findings of the project, highlighting the potential and limitations of current facial sketch synthesis techniques.

**Keywords-** Facial sketch, pix2pix, GAN, Python.

**ACKNOWLEDGEMENT**

We express our deep gratitude to **Ms. Seema Jain**, Assistant Professor, Department of Computer Science & Engineering for his valuable guidance and suggestion throughout my project work. We are thankful to **Prof. (Dr.) Rakesh Kumar Arora,** Project Coordinator for their valuable guidance.

We would like to extend my sincere thanks to **Prof. (Dr.) Saurabh Gupta, Head of Department, Department of Computer Science & Engineering** for his time to time suggestions to complete my project work. I am also thankful to **Prof. (Dr.) Niranjan Bhattacharyya, Director** for providing me the facilities to carry out my project work.

**Vikram Kumar Pushkar Kumar**

**(00115607221) (00315607221)**

**TABLE OF CONTENTS**

|  |  |
| --- | --- |
| **CANDIDATE DECLARATION** | **i** |
| **ABSTRACT** | **Ii** |
| **ACKNOWLEDGEMENT** | **iii** |
| **TABLE OF CONTENTS** | **iv** - **v** |
| **LIST OF FIGURES** | **vi** |
| **LIST OF TABLES** | **vii** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Chapter 1:** | **Introduction** | | | | **1 -4** |
|  | 1.1  1.2  1.3 |  |  | General  Objectives  Methodology | 1  1  2 |
|  |  | 1.3.1 |  | Data Loading and Preprocessing | 2 |
|  |  | 1.3.2 |  | Model Definition | 3 |
|  |  | 1.3.3 |  | Training and Evaluation | 3 |
|  |  | 1.3.4 |  | Analysis and Improvement | 4 |
|  | 1.4  1.5 |  |  | Significance and Contributions  Summary of the Report | 4  4 |
| **Chapter 2:** | **Literature Survey** | | | | **5 – 8** |
|  | 2.1 |  |  | Traditional Methods of Facial Sketch Synthesis | 5 |
|  |  | 2.1.1 |  | Early Approaches | 5 |
|  |  | 2.1.2 |  | Data-Driven Methods | 5 |
|  | 2.2 |  |  | Rise of Deep Learning in Image Synthesis | 5 |
|  |  | 2.2.1 |  | Convolutional Neural Networks (CNNs) | 5 |
|  |  | 2.2.2 |  | Deep Learning in Facial Synthesis | 5 |
|  | 2.3 |  |  | Generative Adversarial Networks (GANs) | 6 |
|  | 2.4 |  |  | Pix2Pix Framework | 6 |
|  | 2.5 |  |  | Integrating Advanced Architectures into Pix2Pix | 7 |
|  | 2.6 |  |  | Recent Advances and Future Directions | 8 |
|  | 2.7 |  |  | Challenges and Limitations | 8 |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
| **Chapter 3:** | **Implementation** | | | | **9-11** |
|  | 3.1 |  |  | Data Loading and Preprocessing | 9 |
|  |  | 3.1.1 |  | Loading the Database | 9 |
|  |  | 3.1.2 |  | Preprocessing Pipeline | 9 |
|  | 3.2 |  |  | Training Process | 10 |
|  |  | 3.2.1 |  | Hyperparameter Tuning | 10 |
|  |  | 3.2.2 |  | Training Procedure | 10 |
|  | 3.3 |  |  | Comparative Metrics | 10 |
|  | 3.4 |  |  | Challenges and Solutions | 11 |
| **Chapter 4:** | **Results and Discussion** | | | | **12-14** |
|  | 4.1 |  |  | Quantitative Evaluation | 12 |
|  |  | 4.1.1 |  | Inception Score (IS) | 12 |
|  |  | 4.1.2 |  | Fréchet Inception Distance (FID) | 12 |
|  | 4.2 |  |  | Qualitative Assessment | 13 |
|  |  | 4.2.1 |  | Visual Inspection of Generated Images | 13 |
|  |  | 4.2.2 |  | Specific Observations | 14 |
|  | 4.3 |  |  | Practical Implications and Limitations | 14 |
| **Chapter 5:** | **Conclusion and Future Work** | | | | **15-17** |
|  | 5.1 |  |  | Conclusion | 15 |
|  |  | 5.1.1 |  | Summary of Findings | 15 |
|  |  | 5.1.2 |  | Implication for Applications | 16 |
|  | 5.2 |  |  | Future Work | 16 |
|  |  | 5.2.1 |  | Dataset Expansion | 16 |
|  |  | 5.2.2 |  | Hybrid and Novel Architecture | 16 |
|  |  | 5.2.3 |  | Enhanced Training Techniques | 17 |
|  |  | 5.2.4 |  | Advanced Evaluation Metrics | 17 |
|  |  | 5.2.3 |  | Real-World Deployments | 17 |
|  | **REFERENCES** | | | | **18** |

**LIST OF FIGURES**

|  |  |
| --- | --- |
| Figure 1.1 | Working of Pix2pix GAN. |
| Figure 2.1 | Traditional sketch to face synthesis methods. |
| Figure 2.2 | Pix2pix framework and its components |
| Figure 3.1 | Implementation of CGAN with generator and discriminator. |
| Figure 4.1 | Sketch , Ground Truth vs Predicted Face. |

**LIST OF TABLES**

|  |  |
| --- | --- |
| Table 3.1 | Comparative metrics for different pix2pix models. |
| Table 4.1 | Comparison of generated results. |