**Image Generation using GAN**

A Synopsis Submitted

in Partial Fulfilment of the Requirements

for the Degree of

**BACHELOR OF TECHNOLOGY**

in

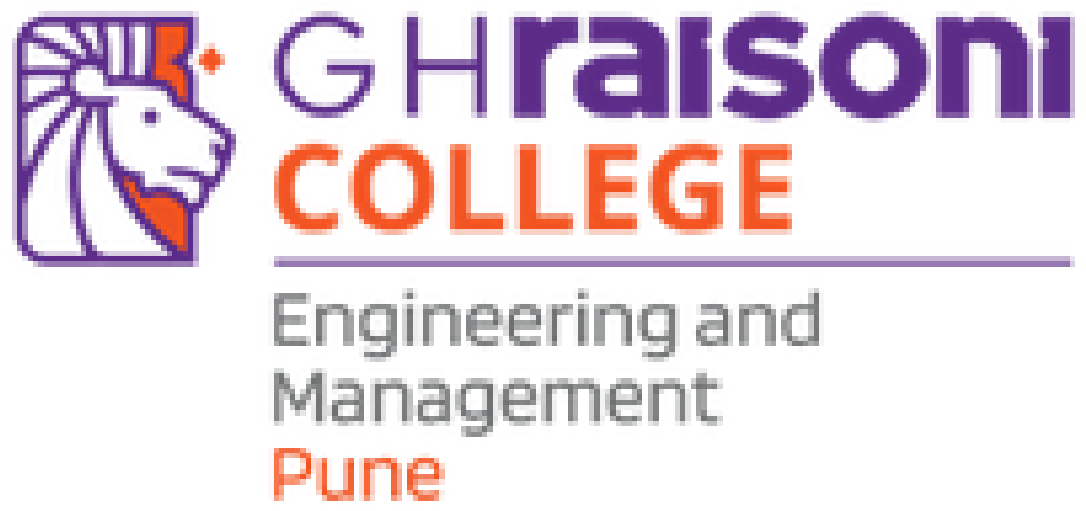
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**(An Empowered Autonomous Institute (NAAC A+ Grade) Affiliated to SPPU, Pune)**

# *Synopsis*

# 1. Introduction

**Project Title:**

## Image Generation using Generative Adversarial Networks (GANs)

**Overview of the Project:** This project aims to develop a Generative Adversarial Network (GAN) model to generate images. GANs provide a robust framework for creating images that not only look realistic but also fulfil specified requirements, making them valuable for various applications in art, design, and data generation.

**Background Information:** Generative Adversarial Networks (GANs) were introduced by Ian Goodfellow et al. in 2014 and have since transformed the landscape of image synthesis. GANs operate through a generator and a discriminator, where the generator creates images and the discriminator evaluates them. This adversarial process allows the model to improve over time, generating increasingly realistic images. GANs have been applied to various fields, including art, gaming, and healthcare, enabling the creation of high-quality synthetic images. Despite their success, GANs face challenges like mode collapse, training instability, and control over the quality of generated outputs.

**Purpose and Significance of the Project:** The purpose of this project is to leverage the capabilities of GANs to produce high-quality images from random inputs. The significance of this research lies in its potential to advance image generation techniques, making it useful in fields such as digital art, product visualization, content creation, and data augmentation for training machine learning models. By focusing on improving the quality and realism of the generated images, this project aims to push the boundaries of what is achievable in AI-driven image synthesis across various applications.

**2. Objectives :**

* + **Primary Goals of the Project:**

D**esign and implement a GAN Model for Generating Images:**The generator will take random noise to produce images, while the discriminator will assess the authenticity of these images, determining whether they are real or generated.The design phase includes selecting appropriate neural network layers, activation functions, and optimization techniques to enable effective learning during training and ensure high-quality image generation**.**

**Enhance the Quality, Diversity, and Realism of Generated Images:**The project aims to enhance the diversity of the generated images by ensuring a broader range of possible outputs. This involves creating images that not only look realistic but also represent various visual features and patterns within the training dataset.

* + W**hat the Project Intends to Achieve:**

**Develop a Functional GAN Model Capable of Generating Realistic Images from Random Inputs**:  
The goal is to create a GAN model that can produce realistic images from random noise inputs. The generator will learn to create detailed images, while the discriminator evaluates their authenticity. By training on a diverse dataset, the GAN will capture patterns that enable convincing image generation. Validation techniques will ensure consistent performance during training and testing.

**3. Literature Review:**

* + **Summary of Existing Research:**

The groundbreaking work by Goodfellow et al. (2014) introduced the concept of Generative Adversarial Networks (GANs), framing image generation as a two-player game between a generator and a discriminator. The generator creates images from random noise while the discriminator evaluates their authenticity, pushing both models to improve through competition. This novel approach revolutionized the field of generative modeling and laid the groundwork for future advancements.

* + **How Your Project Will Add to This Existing Body of Knowledge:**

**Architectural Improvements:** The research will also focus on refining the GAN architecture. By implementing novel design elements and utilizing different neural network configurations, the project aims to enhance the model's ability to generate high-quality images while maintaining stability during training. These improvements will help ensure that the generated images are realistic and exhibit diverse features and details that reflect the underlying patterns in the training data.

**Optimizing Image Quality and Diversity:** The findings from this project will provide valuable insights into optimizing the quality and diversity of GAN-generated outputs. By addressing challenges like mode collapse and poor generalization, the project aims to enhance the practical applicability of GANs in real-world scenarios. This work will contribute to the ongoing efforts to improve the effectiveness of GANs across various applications.

## 4. Methodology :

## Methods and Procedures:

* **Data Collection:** MNIST (70,000 grayscale handwritten digit images) as datasets for training the GAN. These datasets are well-labeled, ensuring effective learning.
* **Model Architecture:**

**Generator:** A neural network that takes random noise and conditioning inputs to generate images that meet specified conditions.

**Discriminator:** A neural network that assesses if generated images are real or fake, ensuring they correspond to the conditioning inputs.

**Training Process:**

* Train using Stochastic Gradient Descent (SGD) or Adam optimizers, which are known for their efficiency in deep learning.
* Utilize adversarial training, where the generator and discriminator compete against each other, iteratively refining their performance.
* Employ binary cross-entropy as the loss function for both networks to effectively guide their learning process.

## 5. Project Timeline for GAN Implementation

## Month 1: Acquired foundational knowledge on GANs, including architectures and implementations. Identified the target audience (artists/researchers) and refined project goals based on their needs.

## Month 2: Collected and preprocessed the dataset. Submitted the project synopsis and created a presentation that covered the problem, architecture, and objectives.

## Month 3: Designed and implemented the generator and discriminator networks using deep learning frameworks like TensorFlow or PyTorch, ensuring alignment with the project's objectives.

## Month 4: Trained the GAN model, fine-tuning hyperparameters like learning rate and batch size to balance generator and discriminator learning for optimal performance.

## 6. Expected Outcomes

**What Results or Products Are Expected from the Project:**

A fully trained GAN model capable of generating high-quality images that accurately reflect specific input conditions. This model will demonstrate enhanced diversity and realism, showcasing its ability to produce visually compelling outputs.

## 7. References:

1. Goodfellow, I., et al. "Generative Adversarial Nets." NIPS, 2014.
2. Radford, A., et al. "Unsupervised Representation Learning with Deep Convolutional GANs." ICLR, 2015.
3. Gulrajani, I., et al. "Improved Training of Wasserstein GANs." NIPS, 2017.

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