**UNIVERSAL GANS**

A PROJECT REPORT

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Under the guidance of Dr. **PARTHA SARATHY BANERJEE**

Submitted in partial fulfilment of the degree

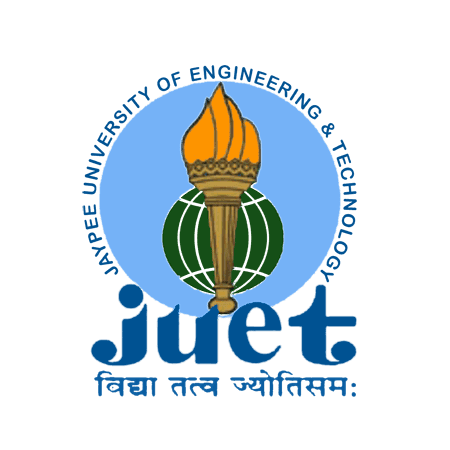
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at



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**NOVEMBER-2022**

**DECLARATION**

We hereby declare that the project entitled “**Universal Gans**” was submitted for the B.Tech. (CSE) the degree is our original work and the project has not formed the basis for the award of any other degree, diploma, fellowship, or any other similar titles.

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**Signature of the Students**

**Place: JUET GUNA**

**Date:**

**CERTIFICATE**

I certify the project entitled, “**Universal-GANs**” submitted by **VANI SETH (201B299), TANISH KHANDELWAL (201B283), and GARIMA SHUKLA (201B109)** in partial fulfilment of the Degree of Bachelor of Technology in Computer Science and Engineering at the Department of Computer Science and Engineering, Jaypee University of Engineering and Technology is a work under my supervision. To per best of my knowledge and belief, there is no infringement of copyright and intellectual property rights. Also, this work has not been submitted partially or wholly to any other Institute or University for the award of any other degree or diploma. In case of any violation concern, students will solely be responsible.

**SUPERVISOR**

Dr. PARTHA SARATHY BANERJEE

**ACKNOWLEDGEMENT**

Any endeavour cannot lead to success unless and until a proper platform is provided for the same. This is the reason why; we find ourselves very fortunate to complete our work on a minor project under supervision of **Dr. Partha Sarathy Banerjee.** Our sincere gratitude to him, for having faith in us and thus allowing us to carry out a project on technology completely new to us, for which we had to research and learn many new things, which will help us deal with advanced work in future. He helped immensely by guiding us throughout the project in any of the possible ways he could. Last but not the least, we would like to thank the Dept. Of Computer Science and Engineering who created this opportunity.

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**ABSTRACT**

Humanity has always been inspired by space travel, and owing to contemporary telescopes, it is now feasible to study celestial bodies thousands of light-years away. It is now possible to create new representations of space by using the increasing quantity of real and imagined images of space that are available on the web with current Deep Learning architectures like Generative Adversarial Networks. With the help of Lightweight GAN, a collection of photos we downloaded from the web, and the Galaxy Zoo Dataset, we created thousands of new images of galaxies and heavenly bodies for this project. Finally, by fusing these images together, we were able to create a comprehensive representation of the cosmos.

**Keywords:** Astronomy, Deep Learning, Generative Adversarial Networks.

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**CHAPTER 1**

**INTRODUCTION**

* 1. **Problem Definition**

Data scarcity is huge problem when it comes to training machine learning or deep learning models. Data Scarcity is when there is limited amount or a complete lack of labelled training data, it can also occur when is data imbalance i.e., when there is lack of data for a given label compared to the other labels. People have wondered whether it is possible to use GANs for generating training data to be used in low-data regimes. Although there has not been much success there, it is still conceivable to combine two data sources to produce more realistic and practical training data. If we have a large amount of unlabelled data and we feed it to a refiner (powered by GANs) that is trained to produce more realistic training data given some basic labelled synthetic data, it can reduce the cost of generating supervised datasets and can help in a variety of machine learning and deep learning tasks, particularly in the areas like astronomy where data is scarce and costly.

* 1. **Project Overview**

The project “Celestial GANs” mainly focuses on:

1. Scrapping images from web.
2. Making a dataset of the relevant images
3. Training a Deep Learning model to generate new images.
4. Using the generated images to create a comprehensive representation of the cosmos.

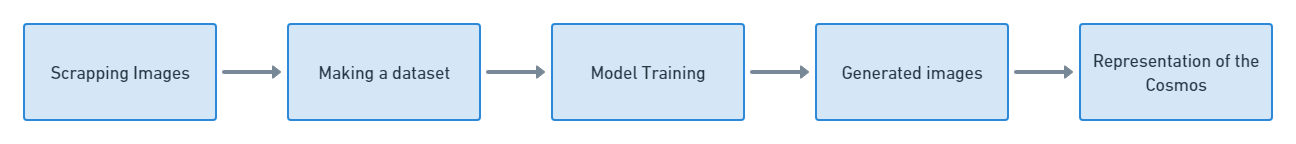


Figure 1.1 Block Diagram of General Framework

**CHAPTER-2**

**LITERARTURE SURVEY**

**2.1 RELATED WORKS**

**2.1.1 General Adversarial Networks**

General Adversarial Networks were first introduced by [1], and they were immediately very successful, regarded as one of the major breakthroughs in AI history. GANs are made up of two separate networks. The generator, network that creates fresh images in a convincing enough manner to trick the counterpart and a discriminator, which detects whether an image is fake.

With this technique, it was possible to generate new work of art [2], improve resolution of existing photos [3] and even create highly credible deepfake images and videos [4]. StyleGAN2 currently represents the state-of-the-art of these networks, with its adaptive discriminator augmentation (ADA). The Lightweight GAN [5], a further simplified version of this model capable of obtaining good results but with a lighter and shorter training phase, was used as an additional alternative for working in circumstances with minimal data. The design combines a self-supervised discriminator that has been trained as a feature-encoder with a skip-layer channel-wise excitation module to achieve this.

**2.1.2 Application of GANs in Astronomy.**

The so-called GalaxyGAN has been utilised in astronomy earlier to recover characteristics from astronomical photographs of galaxies. Deconvolution techniques are commonly employed to enhance the quality of these data, although they are quite limited. Astrophysical images are frequently disrupted by noise. With the use of GANs, missing features can be recovered, resulting in more accurate and dependable outcomes. ExoGAN, a model that can perform this task with a lower computing cost than previous ones and can distinguish molecular characteristics, atmospheric trace-gas abundances, and planetary parameters, was created using GANs in this field for atmospheric retrievals on exoplanets.

**CHAPTER-3**

**SYSTEM ANALYSIS AND DESIGN**

**3.1 SYSTEM REQUIREMENT**

The process of deciding on the requirements of a software system, which determines the responsibilities of a system, is called requirement analysis. Requirement analysis is a software engineering task that bridges the gap between system level requirements engineering and software design. Requirement reengineering activities result in the specification of software’s operational characteristics indicate the software’s interface with other system elements and establish constraints that the software must meet.

The following section presents the detailed requirement analysis of our project.

**3.1.1 HARDWARE REQUIREMENTS:**

Minimum 2.8 GHz processor Computer or latest

**3.1.2 SOFTWARE REQUIREMENT:**

Windows 8, 10 or Windows 11

Python

Google Colab

Visual Studio

**3.2 SYSTEM DESIGN**

**3.2.1 System Architecture**

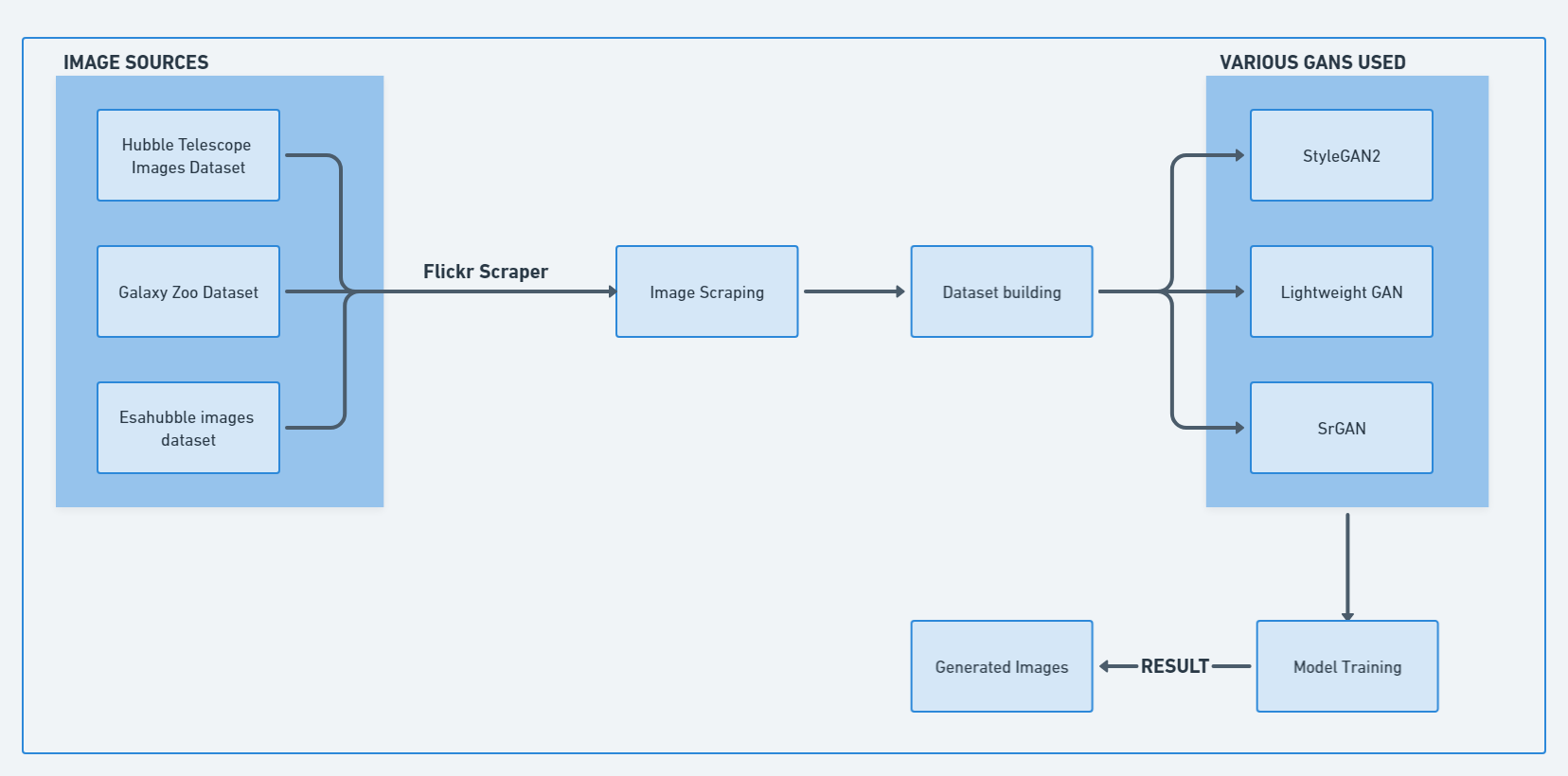
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Figure 3.1 System Architecture

**3.2.1 GANs Architecture**

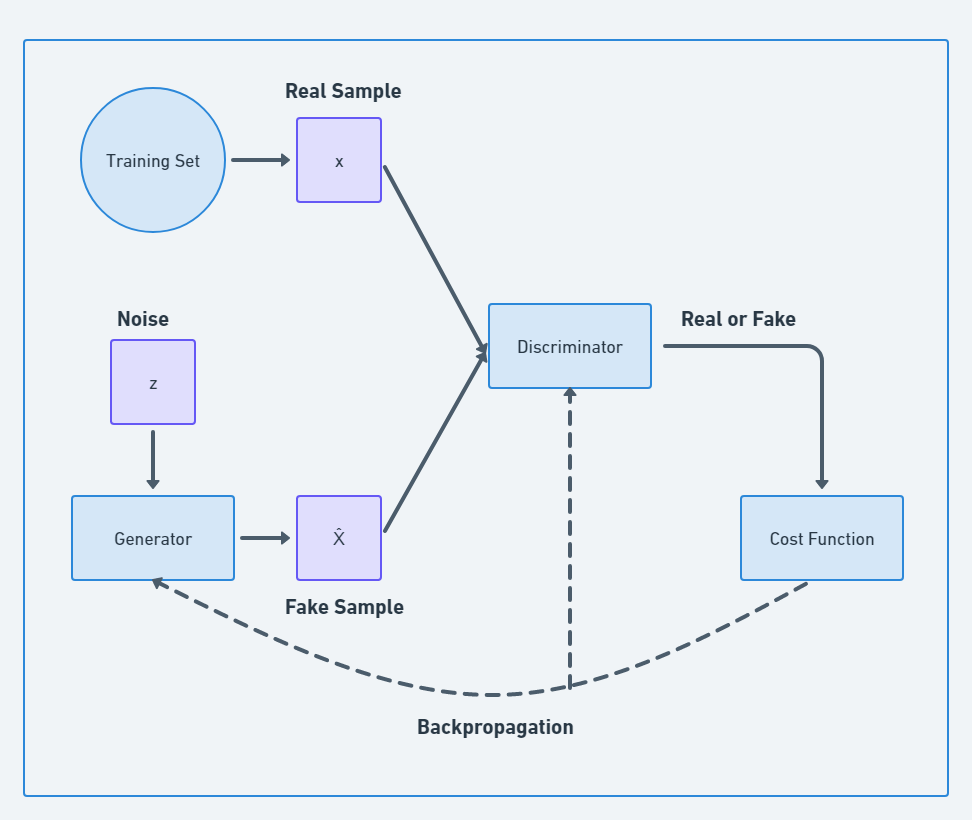


Figure 3.2 GAN Architecture

**3.3 METHODOLOGY**

To train the network to generate celestial bodies, it is necessary to create a suﬃciently large and heterogeneous dataset. To do this, we collected both real space images and artistic representations of the universe using the Flickr Scraper library, together with some handwork for manually downloading images from the web. The collected dataset was then manually revised to discard inconsistent images (e.g., the trivial ones or those having too low resolution). As the images collected online were all diﬀerent sizes, they were then cropped in a centered squared way, ensuring that the image was not deformed during the resize phase. In the end of this process, we obtained a dataset of 283 coherent, good quality, and squared images. We also exploited the Galaxy Zoo Dataset [5], a large collection with hundreds of thousands of space images collected by telescopes, to carry out further tests and obtain real galaxy images to be merged into a single wide view. The Generative Adversarial Network chosen to carry out the experiments is a Lightweight GAN [6], a version very similar to the state-of-the-art StyleGAN2 but lighter and easier to train. In fact, it has been demonstrated that this network is able to converge in a few hours, on a single GPU, with a few hundred training samples and achieving remarkable quality results. For these reasons, it is the more suitable architecture in our context.

**CHAPTER - 4**

**FEATURE EXTRACTION**

**4.1 NERURAL NETWORKS**

Neural networks are composed of simple elements operation in parallel. These elements are inspired by biological nervous systems. As in nature, the network function is determined largely by the connections between elements. We can train a neural network to perform a particular function by adjusting the values of the connections (weights) between elements.

Commonly neural networks are adjusted, or trained, so that a particular input leads to a specific target output. There, the network is adjusted, based on a comparison of the output and the target, until the network output matches the target. Typically, many such input/target pairs are used in this supervised learning to train a network.

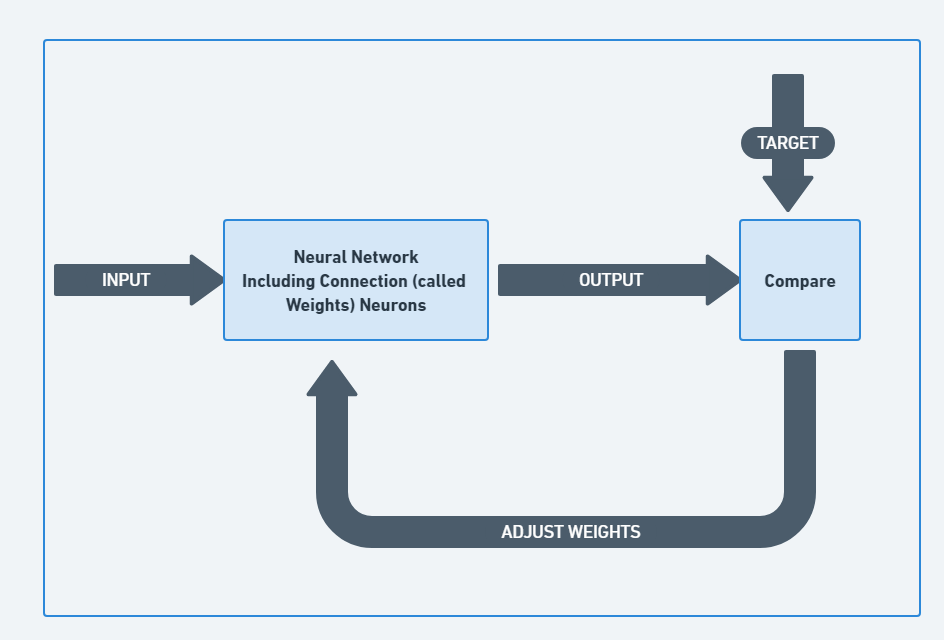


Figure 4.1.1 Neural Networks Architecture

Neural networks have been trained to perform complex functions in various fields of application including pattern recognition, identification, classification, speech, and vision and control systems. Today neural networks can be trained to solve problems that are difficult for conventional computers or human beings.

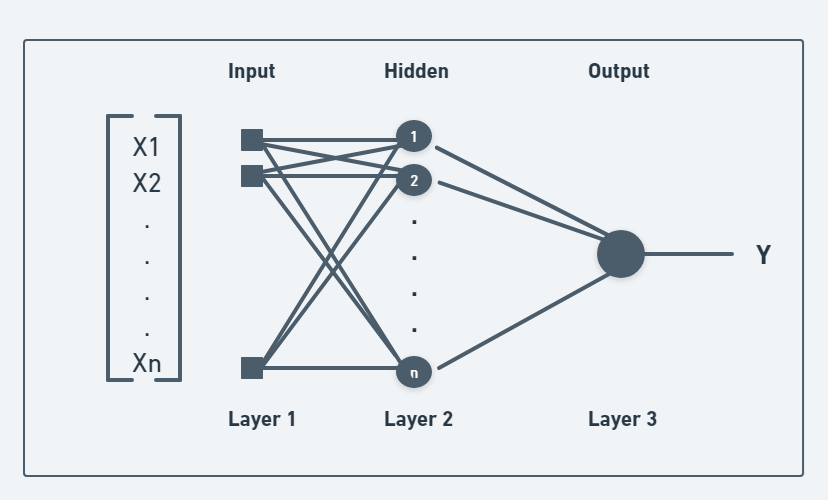


Figure 4.1.2 Neural Networks Block Diagram

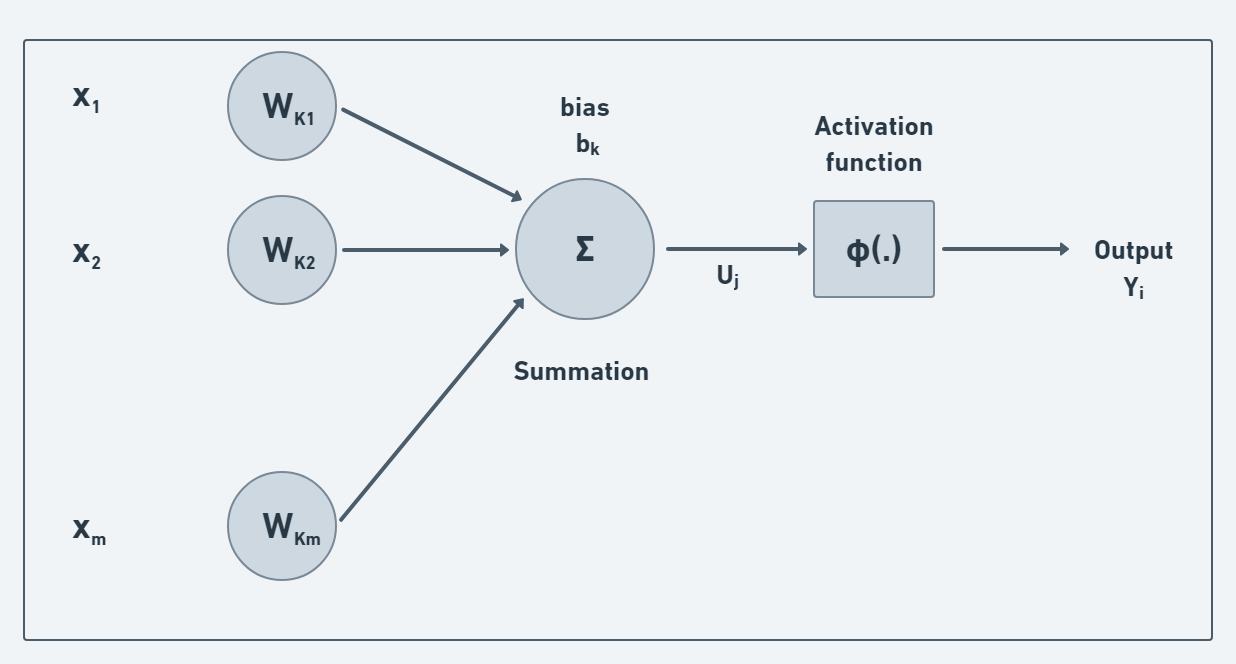


Figure 4.1.3 Structure of a Neuron

**4.2 GENERATIVE ADVERSARIAL NETWORKS**

The GAN architecture consists of two parts a Generator and a Discriminator.

**4.2.1 GENERATOR**

The generator part of a GAN learns to create fake data by incorporating feedback from the discriminator. It learns to make the discriminator classify its output as real. Generator training requires tighter integration between the generator and the discriminator than discriminator training requires.

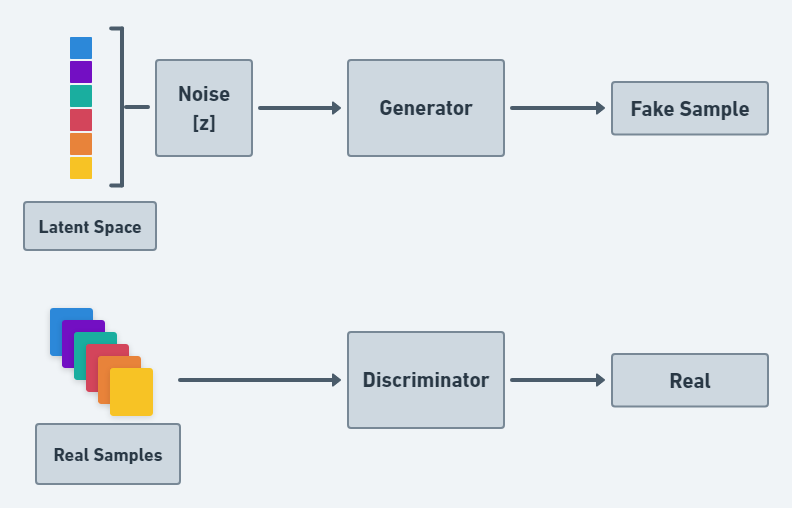


Figure 4.2.1 Generator Architecture

**4.2.2 DISCRIMINATOR**

Discriminator is the

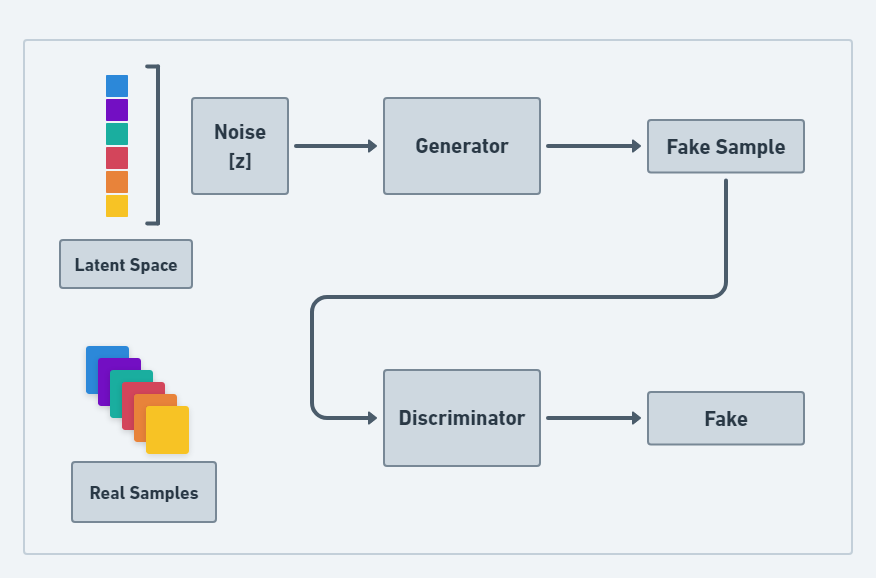


Figure 4.2.2 Discriminator Architecture

**CHAPTER- 5**

**RESULTS AND DISCUSSION**

**CHAPTER- 6**

**CONCLUSION AND FUTURE WORK**

**CHAPTER - 7**

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http://dx.doi.org/10.1093/mnras/

stt1458

**CHAPTER – 8**

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