



# BHARATIYA ANTARIKSH HACKATHON

2025

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Team Name : noisynebula

Team Leader Name : Bharat Bhusan Biswal

Problem Statement : Chase the Cloud: Leveraging Diffusion Models for Cloud Motion Prediction using INSAT-3DR/3DS Imagery [ PS -5 ]

# Team Members

## Team Leader:

Name: Bharat Bhusan Biswal  
College: Silicon University

## Team Member-1:

Name: Saurav Mohanty  
College: Silicon University

## Team Member-2:

Name: Sobhan Sahoo  
College: Silicon University

## Team Member-3:

Name: JaggaNath Patra  
College: Silicon University

## Brief about the Idea:

- To address the problem of short-term satellite-based cloud motion prediction, we propose building a **conditional latent diffusion model**. Our model will take a sequence of preceding satellite frames as input and generate the next 2–3 frames, effectively forecasting near-future cloud dynamics.
- For effective image compression with local features preserved, we will be using **patched discriminator** to train the autoencoder adversarially along with the usual losses.
- Conditioning the model on past frames enables it to learn temporal dependencies and spatiotemporal evolution patterns of cloud movements. The decoder then reconstructs the predicted future frames from the generated latent representations.
- Once the model is trained, we plan to deploy it via **Runpod.io** or **AWS**, depending on performance and hosting constraints.

Opportunity should be able to explain the following:

- Although diffusion models are compute-intensive, operating in the latent space helps make high-resolution data more manageable and computationally more efficient, resulting in faster inferencing
- This workflow ensures that we have a good model irrespective of the huge dimensions
- Using external weather dataset we will train our model to identify the evolution patterns that is associated with bad weather hence can be used as **alert based system**
- In the future, we plan to add **latent space interpolation** to generate intermediate frames and **improve the 30-minute temporal resolution of satellite data.**

## List of features offered by the solution



### SCALABILITY

S3 cloud database is used to provide scalable solutions to store the files uploaded by the user(past frames)



### INTERACTIVE VISUALIZATION

The model will inference your files and create output which will fully controllable and customizable by the user



### CLOUD ALERTS

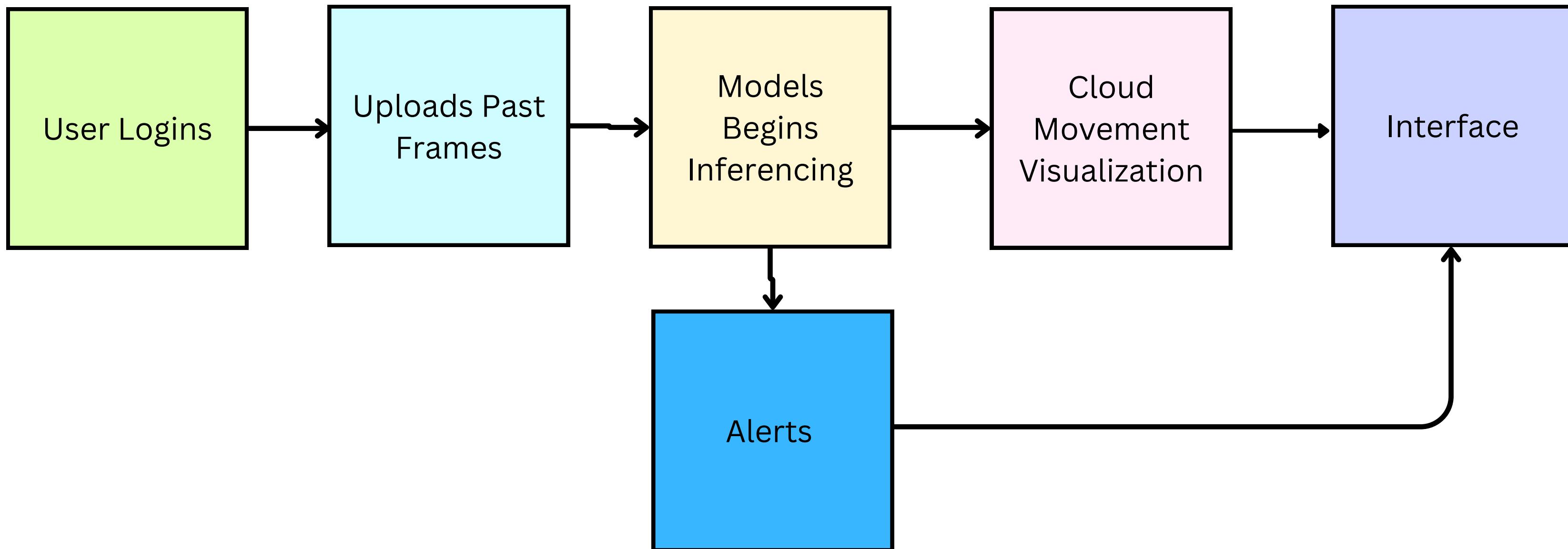
Model predicts the evolving cloud patterns from given past frames. It can also be trained using supervised loss to recognise any strong evolving patterns and send necessary alerts.



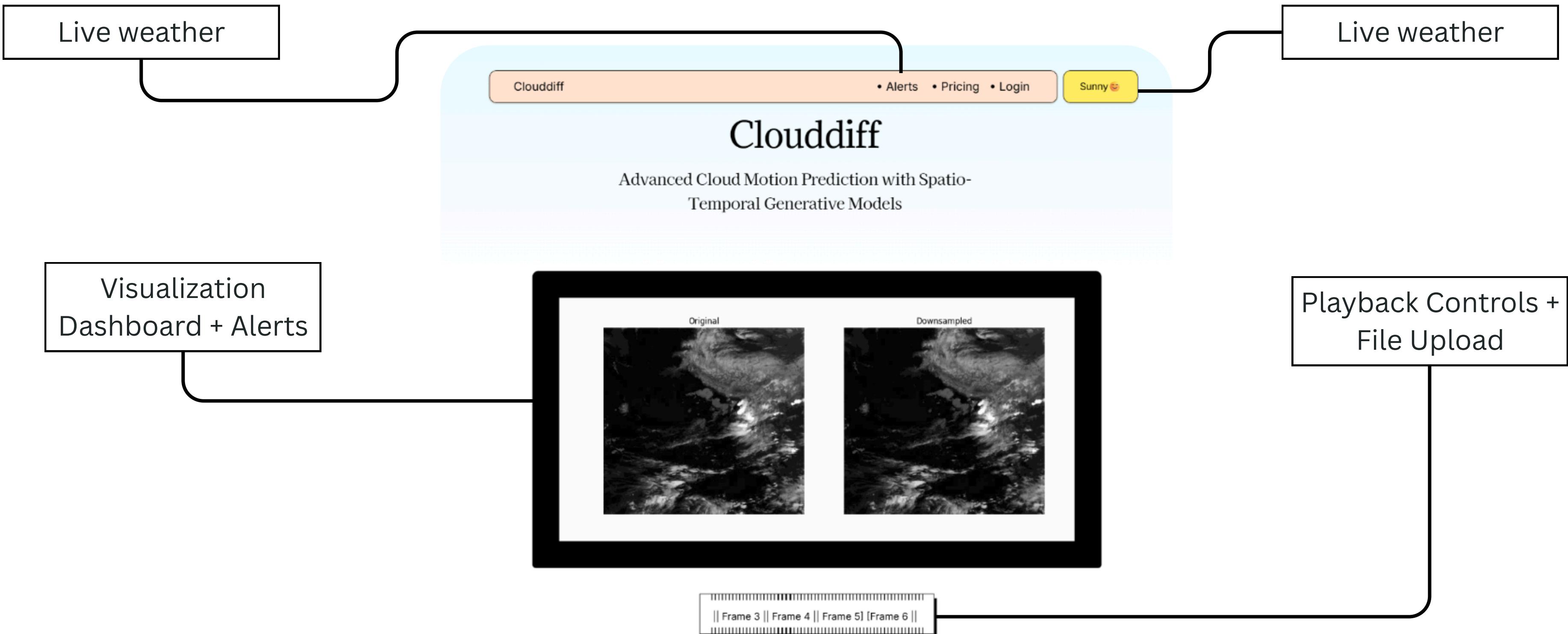
### H5 SUPPORT

We are also extending the support for inclusion of h5 data, which are natural in this domain. This will streamline the entire workflow without worrying about converting to some other type.

## Process flow diagram or Use-case diagram

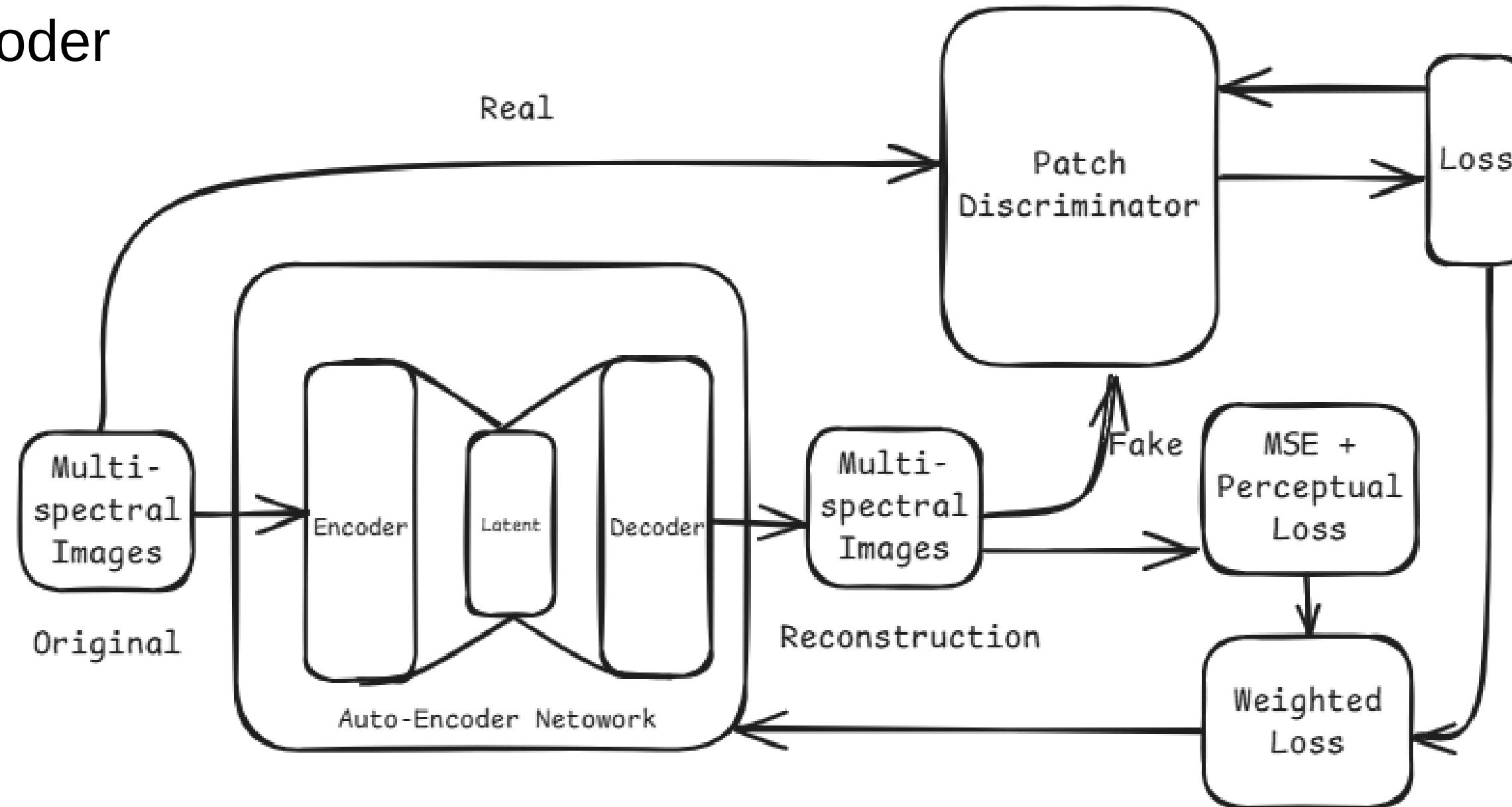


## Wireframes/Mock diagrams of the proposed solution (optional)



## Architecture diagram of the proposed solution

- Autoencoder

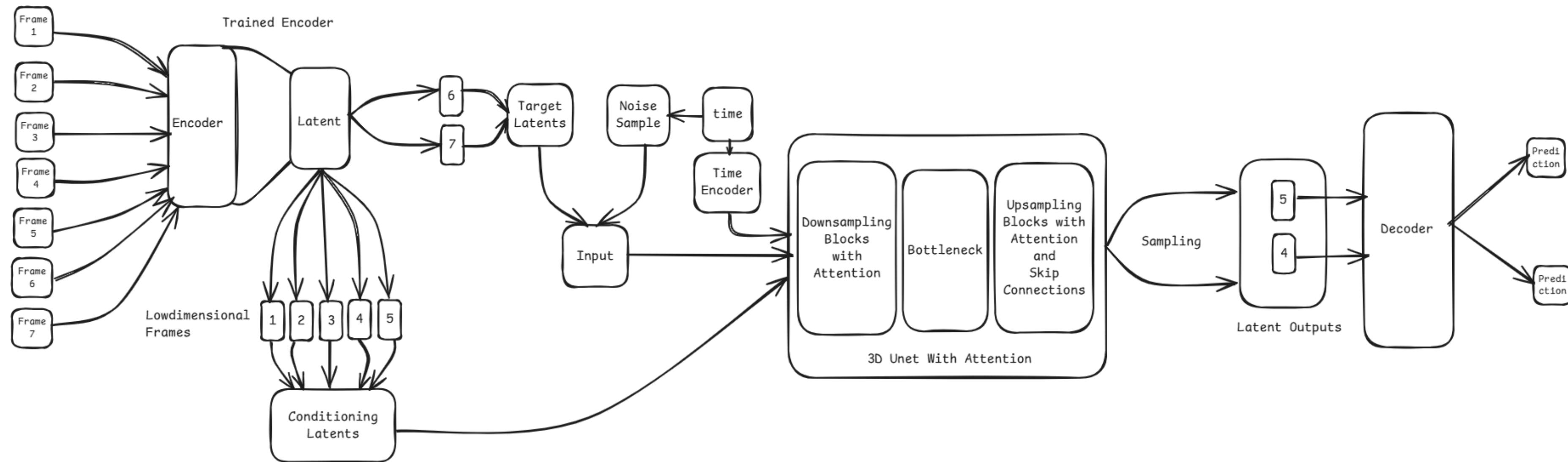


**01 / 02**

**AUTOREADER TRAINING**

# Latent Diffusion Model

High Dimensional Frames

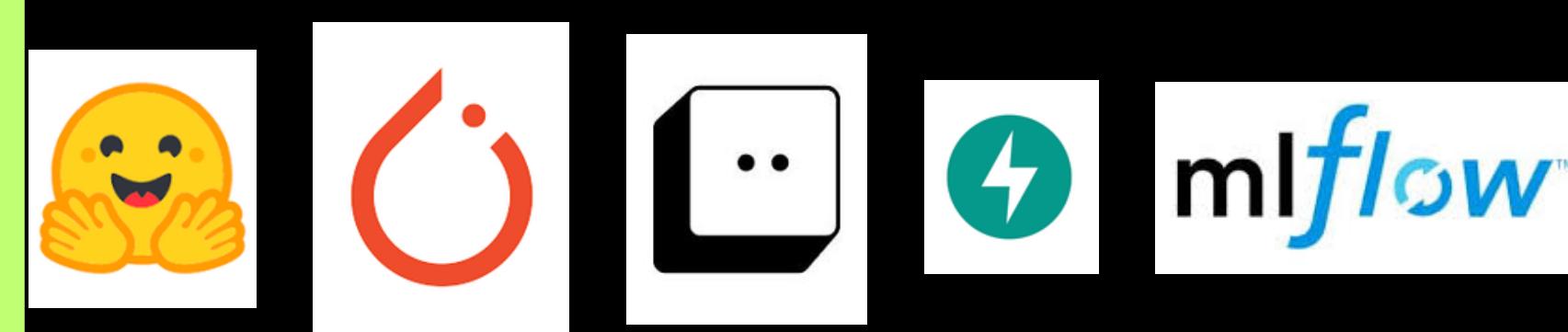


Latent Diffusion Model

02 / 02

## Technologies to be used in the solution:

Model Building  
And Deploying

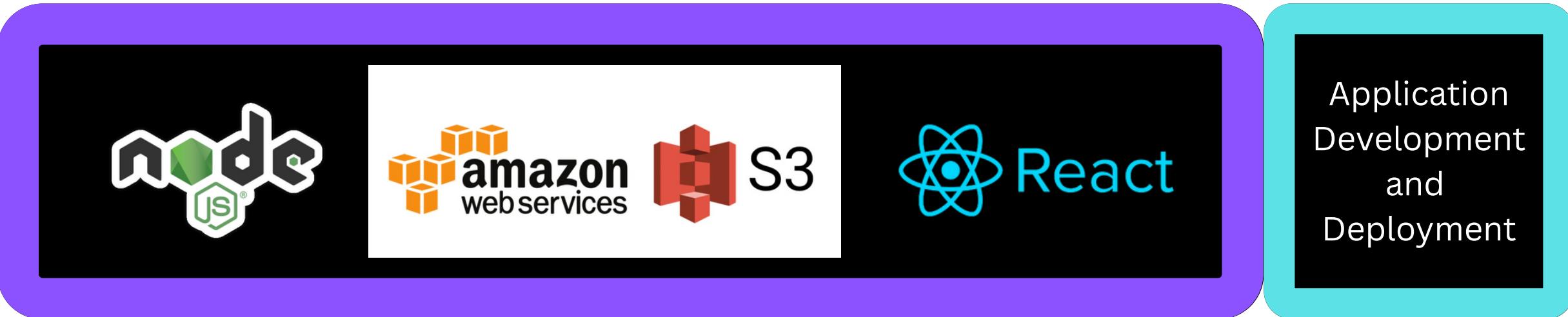


### ML STACK

- **Hugging Face** - Diffusers Library and Hugging Face Spaces
- **PyTorch** - Model building and test ready
- **mlflow** - Version Control
- **Bento ML** - Packaging and deployment
- **FastAPI** - Connect other python scripts with frontend

### Web Stack

- **React**: UI, state, API calls
- **Node.js**: APIs for model interaction
- **AWS S3**: Temporary storage for uploaded .h5 files and predicted outputs
- **Auth**: JWT, Helmet, CORS



## Estimated implementation cost:

Component	Estimated Cost	Notes
<b>Frontend (React)</b>	₹0	Vercel / Netlify free tier
<b>Backend (Node.js)</b>	₹0	Railway / Render free tier
<b>Storage (AWS S3)</b>	₹0	AWS free tier
<b>ML Model (LDM)</b>	₹0 – ₹1,000	Google Colab (free) or Colab Pro (₹1,000/month)
<b>ML Deployment</b>	₹80 - ₹100 / hr	Runpod.io
<b>Dev Tools &amp; APIs</b>	₹0	All open-source or
<b>Domain (optional)</b>	₹0 – ₹200	Use .vercel.app subdomain



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# THANK YOU

