• SharpVision AI – Project Report

Project Title: Image Sharpening using Knowledge Distillation

Team Details

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Problem Statement:

Image Sharpening using Knowledge Distillation

- Many images captured by cameras in real life are **blurry or low in quality**.
- Clear images are important in fields like **security, medical imaging, and video calling**.
- Normally, we use **deep learning models** to improve image quality, but they are **heavy, slow**, and **use a lot of memory**.
- These big models can't be used easily on **mobile phones or small devices**.

Our solution:

- We used a method called **Knowledge Distillation**.
- A large model (called the **Teacher**) learns how to sharpen images well.
- A small model (called the **Student**) learns from both:
  - The real sharp image
  - The output of the Teacher model
- This helps the Student model become **lightweight, fast**, and still **very accurate**.

Goal:

To build an efficient and accurate image sharpening model that works on devices with low computing power, without losing quality.

Model Architecture

Our project is based on **two neural networks** that work together: a **Teacher Model** and a **Student Model**. The idea is to train a smaller model (Student) to learn from a larger, high-performing model (Teacher), making the system faster and lightweight.

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1. Teacher Model

- A **deep convolutional neural network** with many layers.
- Learns to convert blurry images into sharp images with high accuracy.
- This model is **large and powerful**, but too heavy for real-time or mobile use.
- Used **only during training** to guide the student model.

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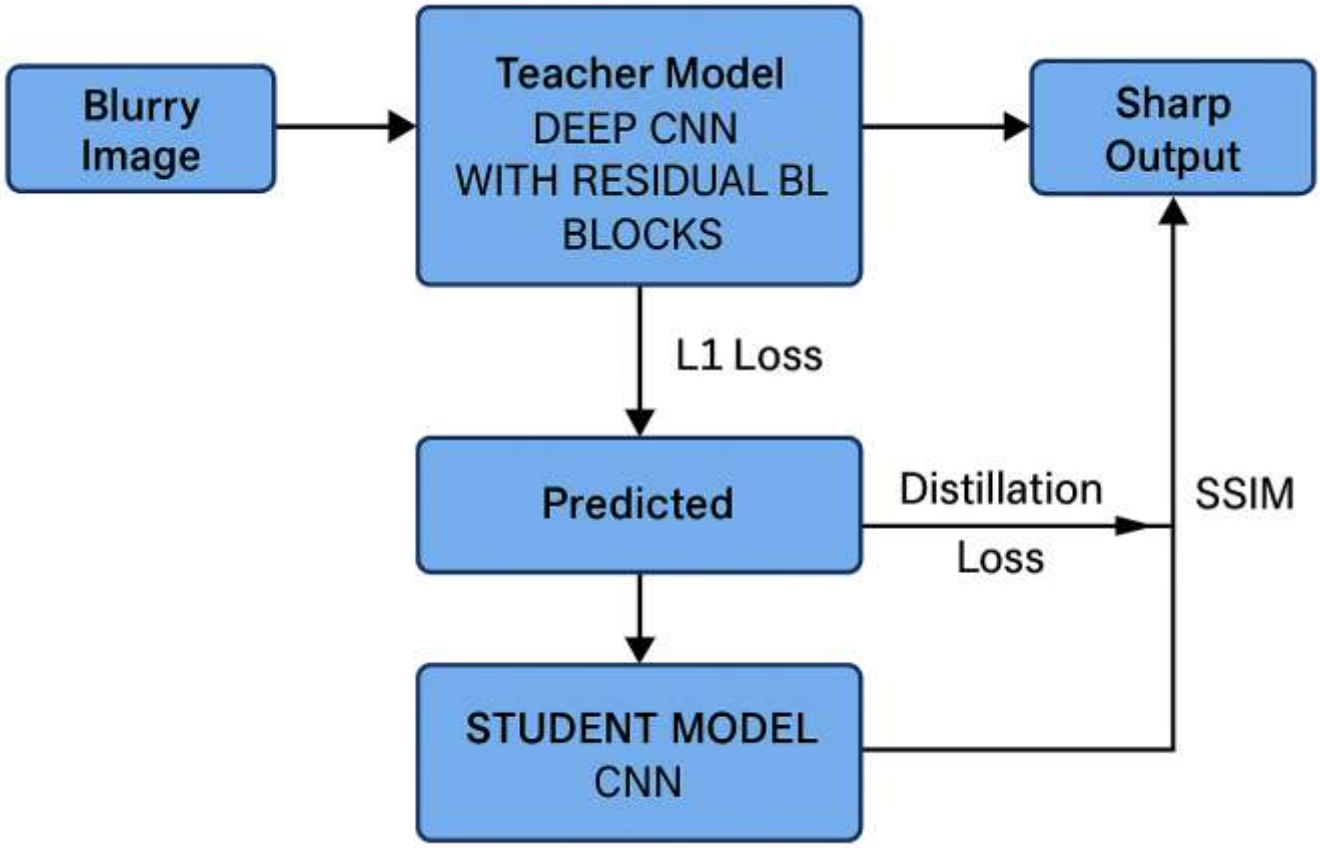
2. Student Model

- A **lightweight CNN** with fewer layers and much fewer parameters.
- Learns to produce sharp images by:
  - Comparing its output with the **ground truth** (real sharp image).
  - Also learning from the **output of the teacher model**.
- Can run on **mobile devices, IoT, and edge systems** after training.

How the Training Works

We used three key techniques during training:

- **L1 Loss** – Compares student output to the real sharp image.
- **Distillation Loss** – Helps the student learn from the teacher's output.
- **SSIM (Structural Similarity Index)** – Used to evaluate image sharpness and quality.



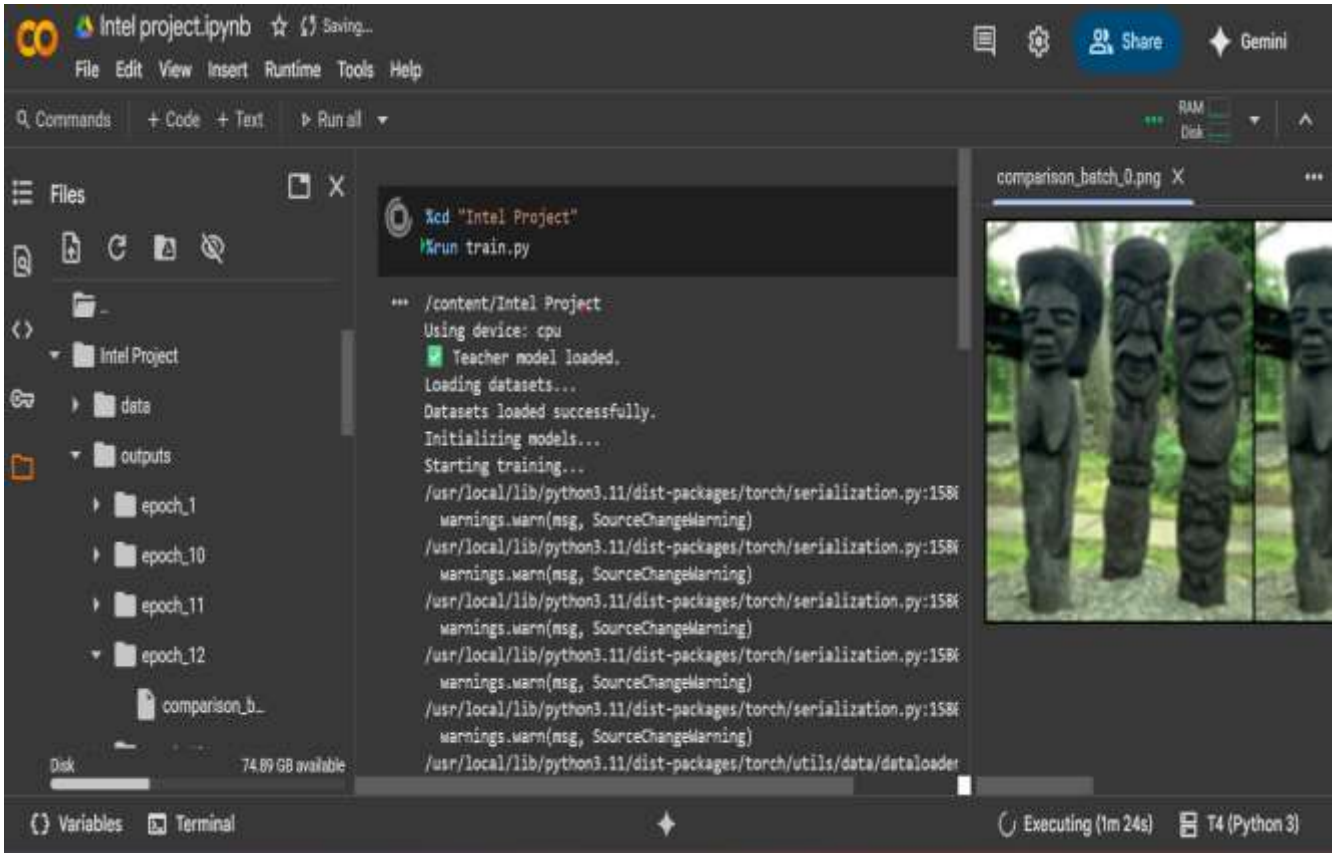
Code Analysis

- models.py – Defines Teacher and Student CNN models.
- dataset.py – Loads blurry-sharp image pairs for training.
- train.py – Trains the student model using L1 and distillation loss.
- utils.py – Calculates SSIM is 0.7124 and handles image saving.
- requirements.txt – Lists needed Python libraries.
- report.pdf – Full documentation of the project.
- results/ – Contains sample outputs (optional).

The code is clean, modular, and easy to run.

Training Summary: Project Explanation Video

- Dataset: Custom or open blurry-sharp image pairs
- Optimizer: Adam
- Epochs: 50+
- Evaluation: SSIM is 0.7124, PSNR comparison between student, teacher, and ground truth



Project Highlights

- Used **Knowledge Distillation** to build a lightweight model
- Achieved high image sharpness with minimal computation
- Created modular and scalable code with PyTorch
- Evaluated performance using **SSIM** and **visual comparisons**
- Open-source project hosted on **GitHub**
- Ready for edge deployment with reduced memory footprint

GitHub Repository Link

https://github.com/Tanujydv123/SharpVision-AI-ImageSharpening

Project Explanation Video:

https://drive.google.com/drive/folders/1HLDm_MSMY_H3YM1Oe_BoOB-x5eZd7xYq?usp=drive_link