

Enhancing Fingerprint Image Resolution Using Auto Encoder and Interpolation Techniques

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Abstract

This study introduces an efficient super-resolution (SR) method for enhancing low-resolution fingerprint images using an autoencoder combined with spline and bicubic interpolation techniques. The approach upscales images from 129×97 to 258×194 while preserving fine details and minimizing artifacts. Trained on the FVC 2004 dataset and tested on both FVC 2004 and FVC 2002, the model achieves strong performance with SSIM of 0.968, PSNR of 35.14, and MSE of 0.007. It also attains 100% identification accuracy using the SIFT algorithm, demonstrating its effectiveness for biometric and forensic applications.

Key Words: Super-Resolution, Fingerprint, Autoencoder, Spline, Bicubic, PSNR, SSIM, SIFT, Biometrics..

1.INTRODUCTION

Fingerprint image enhancement is vital for accurate biometric authentication. Low-resolution images often lack crucial details. This study proposes a super-resolution method using an autoencoder with spline and bicubic interpolation to improve image quality while preserving fine features and reducing artifacts.

2. Body of Paper

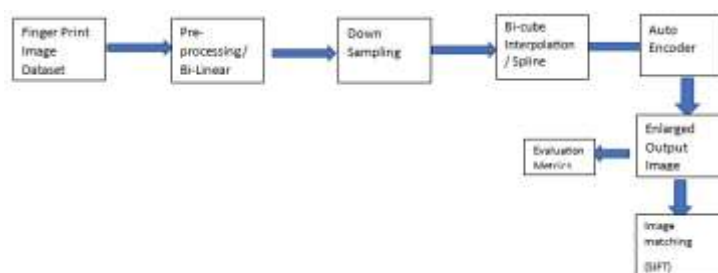
The proposed method enhances low-resolution fingerprint images using an autoencoder combined with spline and bicubic interpolation. It upscales images from 129×97 to 258×194 while preserving critical details. Trained on the FVC 2004 dataset and tested on FVC 2002 and 2004, the model achieves high SSIM, PSNR, and SIFT-based accuracy, proving its effectiveness in biometric applications..

Abstract:

Table -1:

Author / Year	Algorithm	Method	Remarks
P.P. Lisha, V.K. Jayasree / 2024	SIFT (Scale-Invariant Feature Transform) Algorithm	Auto-encoder with spline and bi-cubic interpolation for fingerprint image resolution enhancement	Achieved 100% identification accuracy on FVC 2004 & FVC 2002 datasets.
Vonderfecht & Liu / 2022	Super-Resolution Networks	ConvNext-based classification for fingerprinting SISR models	More recognizable fingerprints with high-upscaling/adversarial training.
Tapia et al. / 2022	Efficient Super-Resolution (SR)	Selfie-based biometrics for periocular verification	Achieved 8.89% EER for FaceNet, 12.14% for VGG Face.
Lee et al. / 2022	OSRCycleGAN	Ocular super-resolution for better recognition	Achieved 322% higher processing speed than CycleGAN.
Muhammad et al. / 2021	Multi-Path Deep CNN with Residual Inception Network	ResNet, Inception, and deconvolution layers for image upscaling	62% fewer parameters than DRCN with 1.88 dB PSNR improvement.

Existing Block Diagram



Proposed Block Diagram

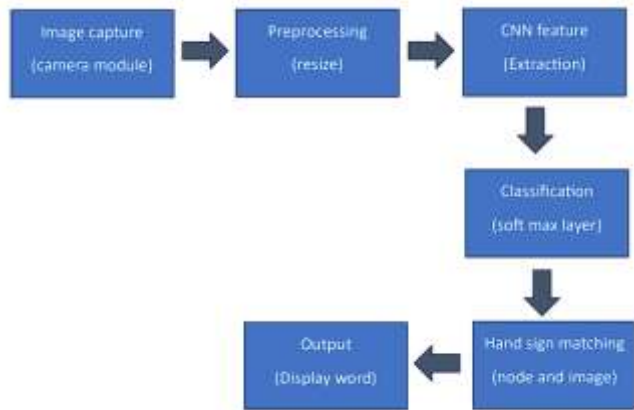


Fig -1: Figure

IMPLEMENTATION:

method 1

use the library

```
import fingerprint_enhancer # Load the library
```

```
import cv2
```

```
img = cv2.imread('image_path', 0) # read input image
```

```
out = fingerprint_enhancer.enhance_fingerprint(img) #  
enhance the fingerprint image
```

```
cv2.imshow('enhanced_image', out); # display the  
result
```

```
cv2.waitKey(0) # hold the display window
```

- Alternatively, the script "example.py" can be used to run the example for this library.



method 2

use the source codes

1) go into the src folder

- if on "develop" branch, run the file "example.py"

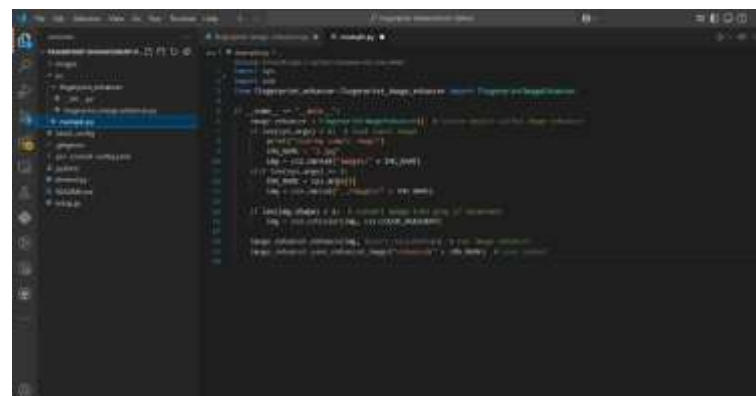
- if on "master" branch, run the file file "main_enhancement.py"

2) The sample images are stored in the "images" folder

3) The enhanced image will be stored in the "enhanced" folder

Linter check:

run the command `python devtool.py run` to run linter checks.



Original



Enhanced



Summary

The increasing demand for enhanced image quality and finer details has underscored the importance of super resolution techniques across various sectors, including scientific, medical, industrial, and entertainment domains. This study focuses on enhancing the resolution of fingerprint images by doubling their original size using an auto-encoder network combined with spline and bi-cubic interpolation techniques. The process involves the parallel application of spline and bi-cubic interpolation on down-sampled input images to extract all relevant features while preserving prominent characteristics.

References

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BIOGRAPHIES



Munipally Chakravarthy studying 3rd year department of Electronics And Communication Engineering at Institute Of Aeronautical Engineering ,Dundigal .He Published a Research Paper Recently At IJSREM as a part of academics He has a interest in image processing,web development



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