Software for In Vitro Diagnostics

Department of Electrical and Computer Engineering

Team 5

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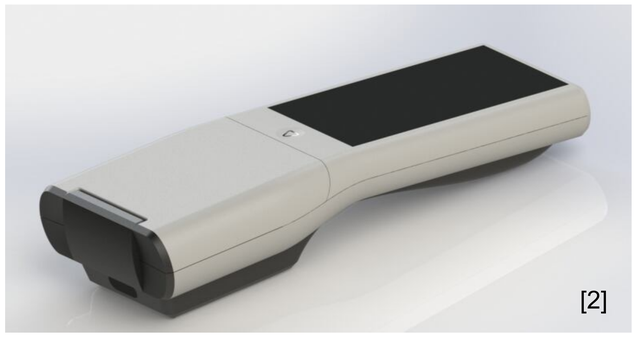
Current Device

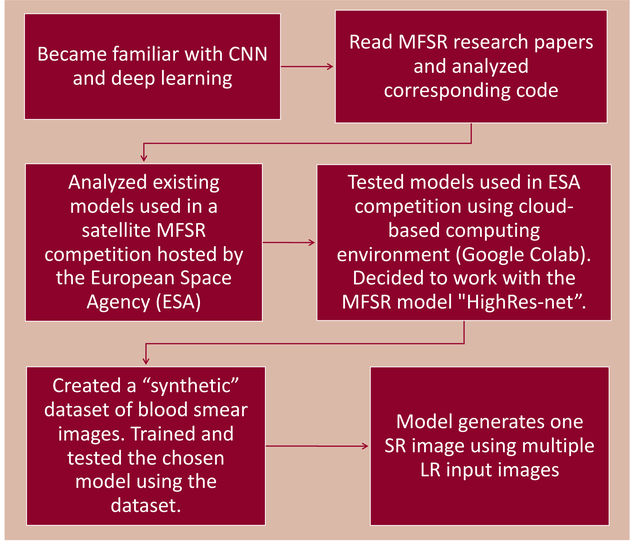
Alentic Microscience has developed a rapid blood testing device that uses lensless optical microscopy and neural networks to analyze images of blood samples and output diagnostic information.



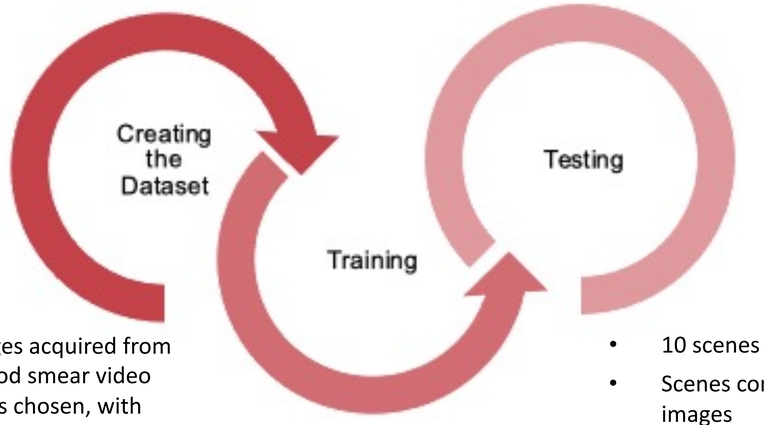
Project Scope

Team 5 is developing a Multi-Frame Super Resolution (MFSR) model utilizing deep learning to increase the resolution of blood sample images obtained from the device. This is intended to enhance the device's diagnostic accuracy. The model works by using multiple images of a scene captured in Low Resolution (LR) and passing them through a Convolution Neural Network (CNN). This effectively fuses the multiple LR images into one Super Resolution (SR) image of high resolution (HR).

Design Process



Details of Design

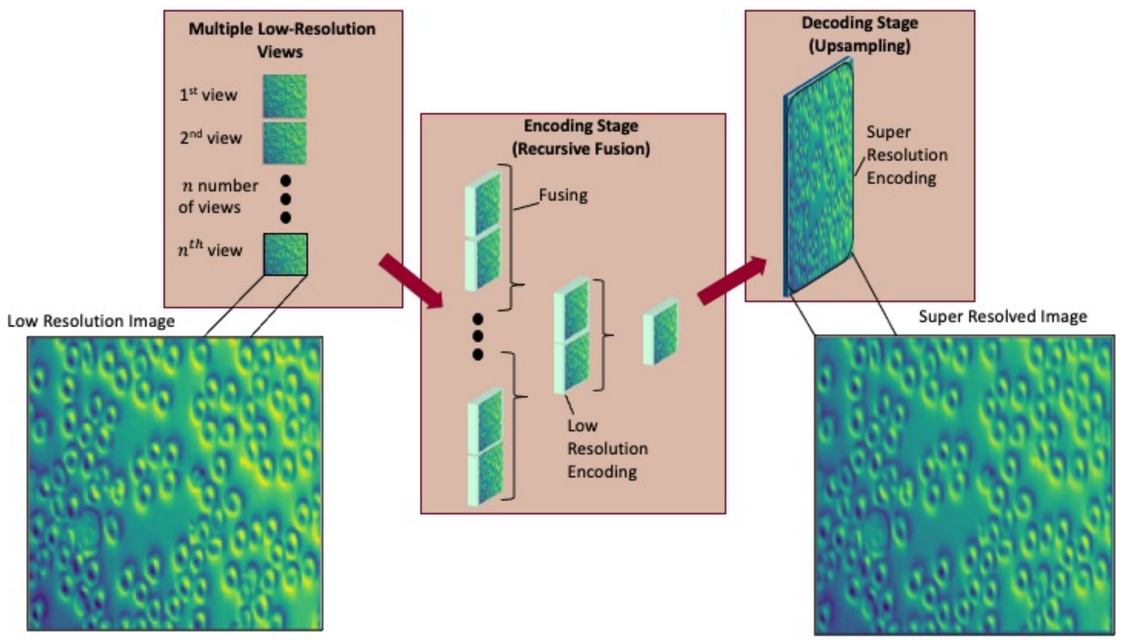


- Dataset images acquired from a human blood smear video
- 60 cell scenes chosen, with an average of 15 frames saved for each scene
- HR "ground-truth" (1080p) and LR images (144p) saved in a greyscale 16-bit PNG format
- Preliminary model trained and tested using the multi-frame dataset created by the Team

- 50 scenes
- Training takes approximately 1 hour with the synthetic dataset
- Scenes contain both LR images and a HR (reference) image

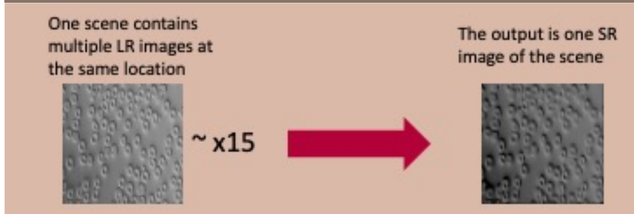
- 10 scenes
- Scenes contain only LR images
- The result is a single SR image corresponding to each of the 10 scenes

How the Model Works



Multi-Frame Super-Resolution Process (adapted from HighRes-net model [3])

Input to Output



Future Work

Winter 2021
- Tested and trained model with dataset created by the Team

Summer 2021
- Test model with blood samples acquired from device
- Ensure the model works cohesively with the hardware within the device

Fall 2021
- Validate the model
- Make continuous improvements to the model (example: image resolution and efficiency)

Conclusion

The Team trained the HighRes-Net model using the synthetic dataset comprised of LR blood smear images and obtained corresponding SR images. The synthetic dataset was small, making the training process less effective than it would be using a larger dataset. This resulted in an output SR image with only moderate improvements to resolution. The Team aims to re-train the model using a larger dataset to further enhance the output image resolution.

References

[1] Gust. "Alentic Microscience." Gust. https://gust.com/companies/alentic_microscience (accessed Mar. 29, 2021).

[2] P. Withers. "Halifax-made blood testing device heading to International Space Station." CBC. https://www.cbc.ca/news/canada/nova-scotia/halifax-blood-testing-device-international-space-station-1.5042753 (accessed Mar. 30, 2021).

[3] M. Deudon et al., "HighRes-net: Recursive Fusion for Multi-Frame Super-Resolution of Satellite Imagery," ESA MFSR Competition Entry, arXiv:2002.06460, 2020.