Project Reports

1. Defect Detection in 3D Printing using Transformers (Yet to be published)

Institution: Thapar Institute of Engineering and Technology
Supervisor: Prof. Vinay Arora (Dean)
Duration: April 2024 – Present
Technologies Used: Deep Learning, Computer Vision, Transformers, Transfer Learning, 3D Printing.

Overview:

Here we focused on early & quick detection of defects in 3D Printing, specifically spaghetti and stringing defects. We aimed to enhance defect detection accuracy, optimize efficiency and reduce redundancy in prints. For this, we tested various models, such as transformers (Vit, Deit), transfer learning, deep learning.

Objectives:

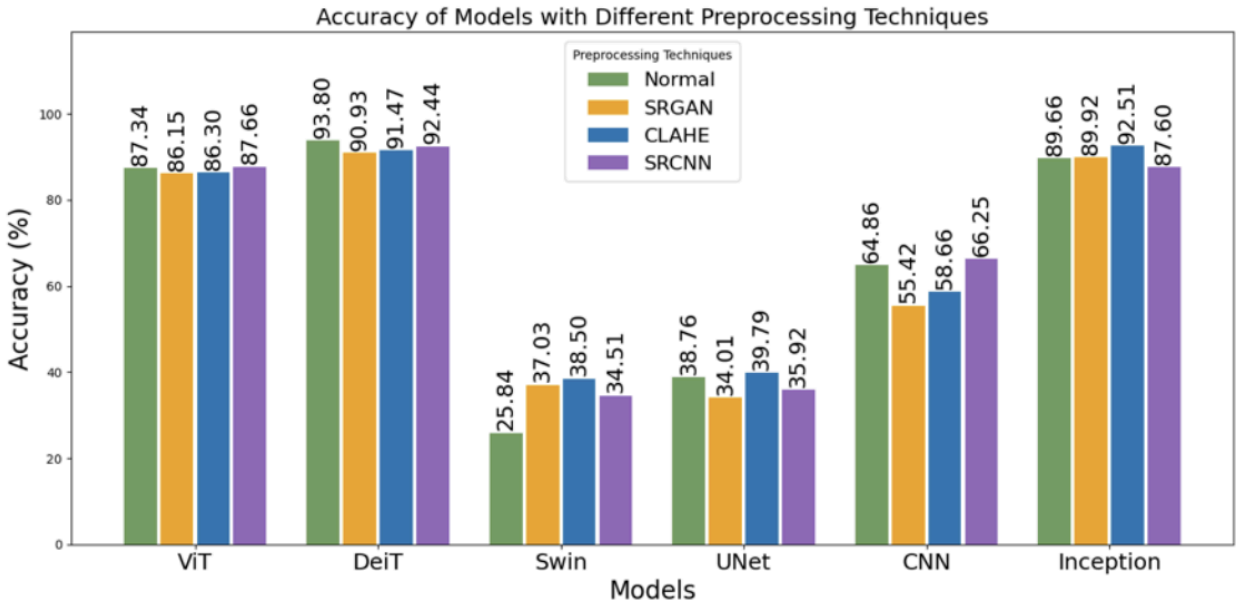
- Develop an AI based framework for real-time defect detection in 3D-printed components.
- Improve defect classification accuracy.
- Reduce detection time and lower production costs.

Methodology:

- Implemented deep learning architectures for defect classification.
- Integrated image processing techniques like Clahe, SRGAN.
- Collaborated with faculty members to refine models and validate findings.

Results & Impact:

- Improved defect detection accuracy by a significant margin.
- Potential industrial application in additive manufacturing.



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2. LLM-Enhanced Particle Swarm Optimization (PSO)
Github Link: https://github.com/Witcape/PSO

Institution: AGH University of Krakow, Poland
Supervisor: Prof. Rohit Salgotra
Duration: April 2024 – Feb 2025
Technologies Used: Python, PyTorch, Gemini's API, Flask, Particle Swarm Optimization, Large Language Models(Gemini, Llama)

Overview:

This project integrates Large Language Models (LLMs) with Particle Swarm Optimization (PSO) to enhance optimization efficiency. The goal is to examine convergence speed and accuracy in optimization tasks by integrating LLMs within the PSO itself.

Objectives:

- Enhance PSO convergence by using LLMs for updating parameters like weights.
- Reduce the number of iterations required for convergence.
- Benchmarked performance on GNBG dataset and other real world datasets.

Methodology:

- Developed an LLM assisted parameter tuning mechanism for PSO.
- Tested multiple LLMs and PSO variants to check best fit.
- Tested and validated performance on multiple optimization problems.
- Compared results with traditional PSO implementations.

Results & Impact:

- Improved convergence at the start of the training (typically first 5 ephocs).
- Reduced iterations in simpler problems, but struggles to do so in more complex real life problems.
- A combination of LLM - PSO and traditional PSO worked best.
- Works on par, if not better than traditional PSO, in almost all problems.

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3. Efficient Deep Network for COVID-19 Detection from CT Images

Link to paper: https://ieeexplore.ieee.org/document/10881424
Github link: https://github.com/Witcape/catalog-scoring-ondc

Published At: IEEE International Conference on Modelling, Simulation, and Intelligent Computing (MoSICom), Dubai (November 2024)
Institution: Thapar Institute of Engineering and Technology
Technologies Used: Deep Learning, Convolutional Neural Networks, Grey Level Co-occurrence Matrix.

Overview:

This research focuses on developing an optimized deep learning model for COVID-19 detection from CT scan images instead of MRIs. The model aims to improve accuracy while maintaining computational efficiency.

Objectives:

- Design a deep learning architecture optimized for medical image classification.
- Reduce model complexity while maintaining high accuracy.
- Use CT scan images.

Methodology:

- Developed a CNN-based architecture for CT image classification.
- Used data augmentation and preprocessing techniques for enhanced learning.
- Evaluated performance on benchmark medical imaging datasets.

Results & Impact:

- Achieved high accuracy in COVID-19 detection.
- Accepted for presentation at IEEE MoSICom 2024.

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4. Catalog Scoring Mechanism for Item Ranking

Link to Explaner video: https://www.youtube.com/watch?v=eDTuzKrIqvM

Technologies Used: Python, CLIP, Topsis, TensorFlow, Hugging Face, Flask, Zero shot Textual Classifier, Zero shot Image Classifier.

Overview:

This project focuses on improving item catalog scoring using AI based techniques, integrating CLIP, Topsis, and zero shot classifiers to enhance ranking accuracy. This was built for ONDC Hackathon

Objectives:

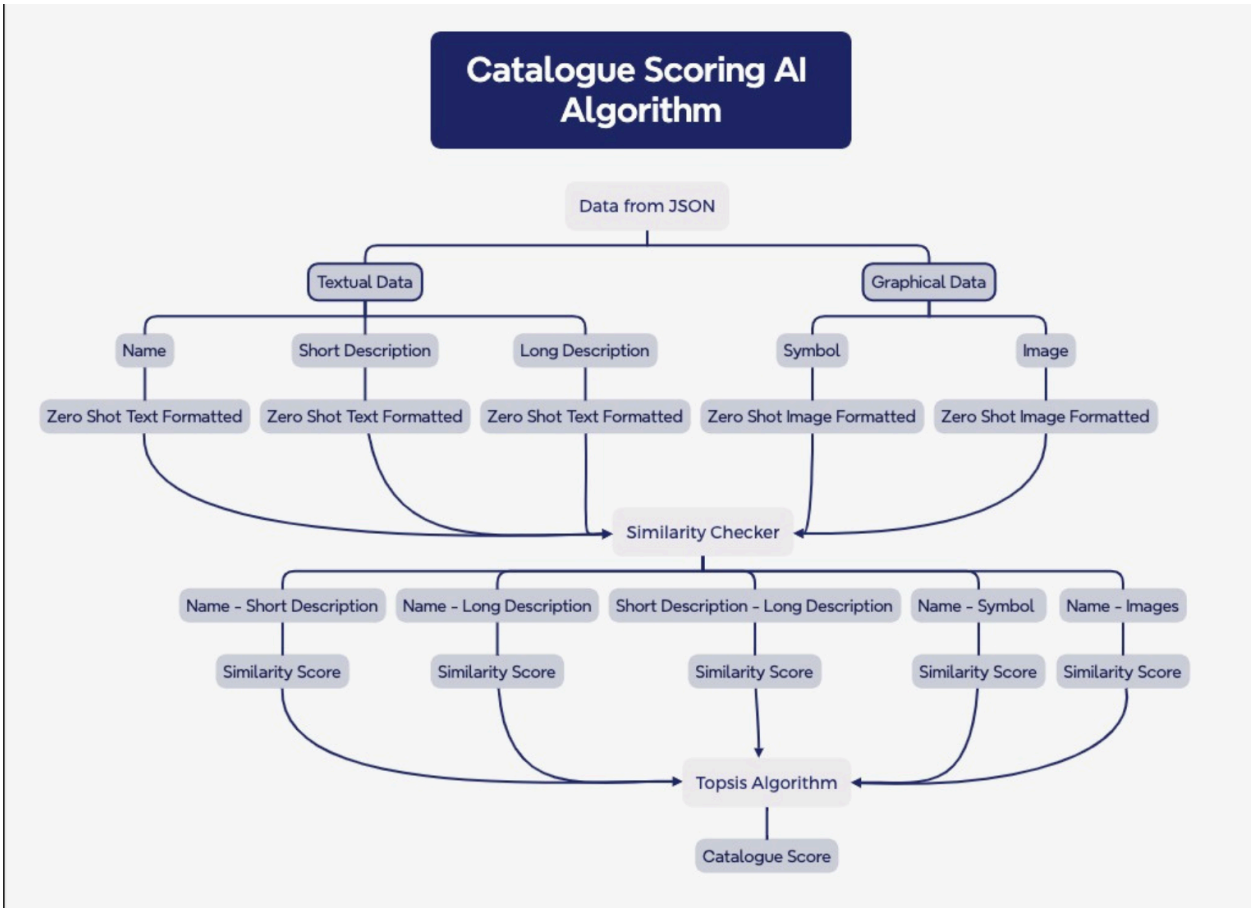
- Develop a Zero Shot mechanism to assign better scores to catalog items and make the model more diverse than typical deep learning models.
- Improve ranking accuracy through multimodal data processing.
- Increase efficiency, accuracy in automated catalog management.

Methodology:

- Used CLIP based image analysis for feature extraction and zero shot classification.
- Applied Topsis Algorithm for final ranking.
- Deployed the system using Flask for real-time accessibility.

Results & Impact:

- Incorporated textual and Graphical data for item scoring.
- Used Zero Shot classification to keep the model diverse.


Catalogue Scoring AI Algorithm
Data from JSON
Textual Data
Graphical Data
Name
Short Description
Long Description
Symbol
Image
Zero Shot Text Formatted
Zero Shot Text Formatted
Zero Shot Text Formatted
Zero Shot Image Formatted
Zero Shot Image Formatted
Similarity Checker
Name - Short Description
Name - Long Description
Short Description - Long Description
Name - Symbol
Name - Images
Similarity Score
Similarity Score
Similarity Score
Similarity Score
Similarity Score
Topsis Algorithm
Catalogue Score