Computer Vision Meets Microbiology:
Deep Learning Algorithms for Classifying Cell Treatments in Microscopy Images

PerkinElmer For the Better

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INTRODUCTION

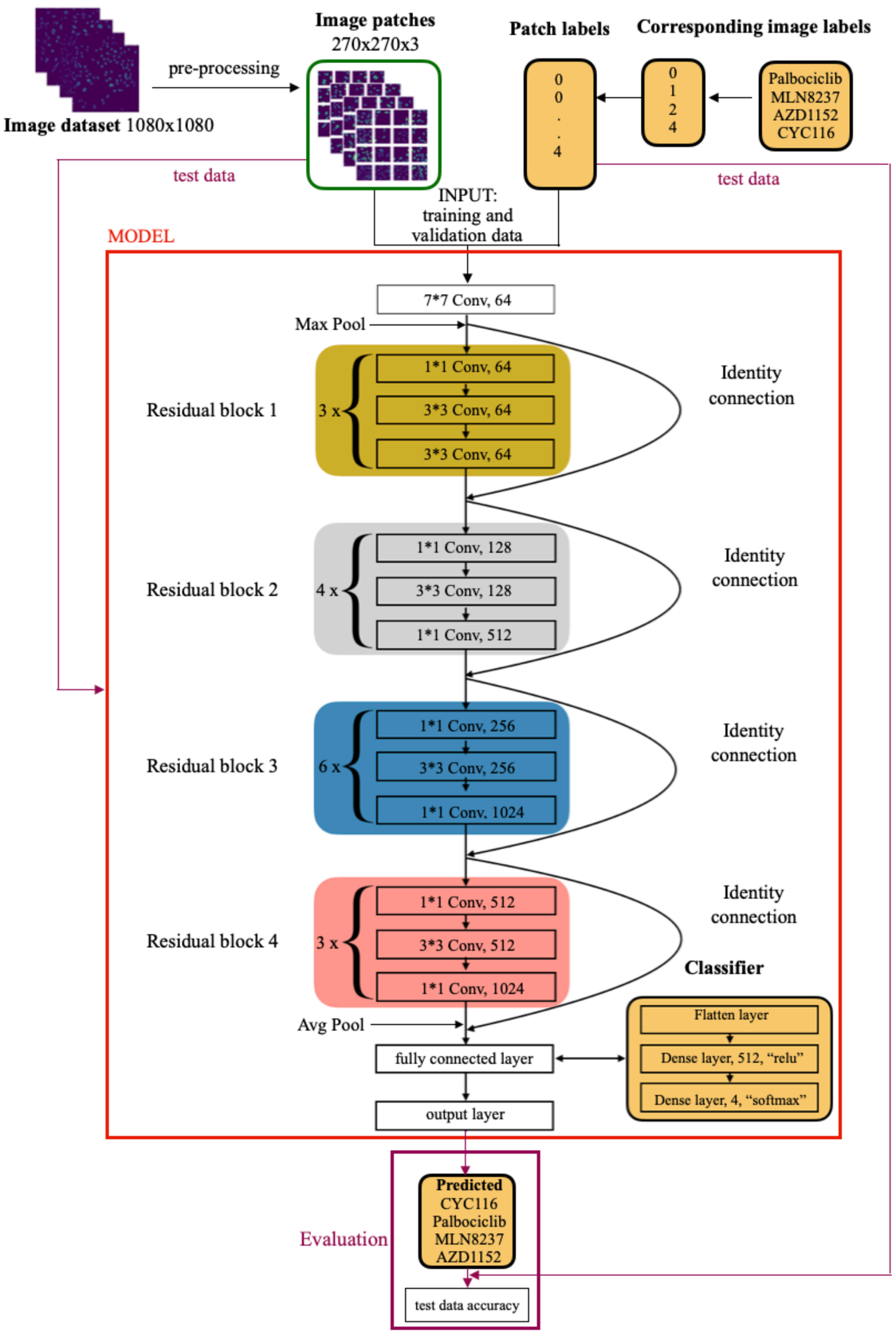
Cell classification is one of the most complex challenges in biomedical research that has significant importance to personalised medicine, cancer diagnostics and disease prevention.

AIM: explore the potential of deep learning to automate the classification of microscopy cell images into four cell treatments: Palbociclib, MLN8237, AZD1152 and CYC116.

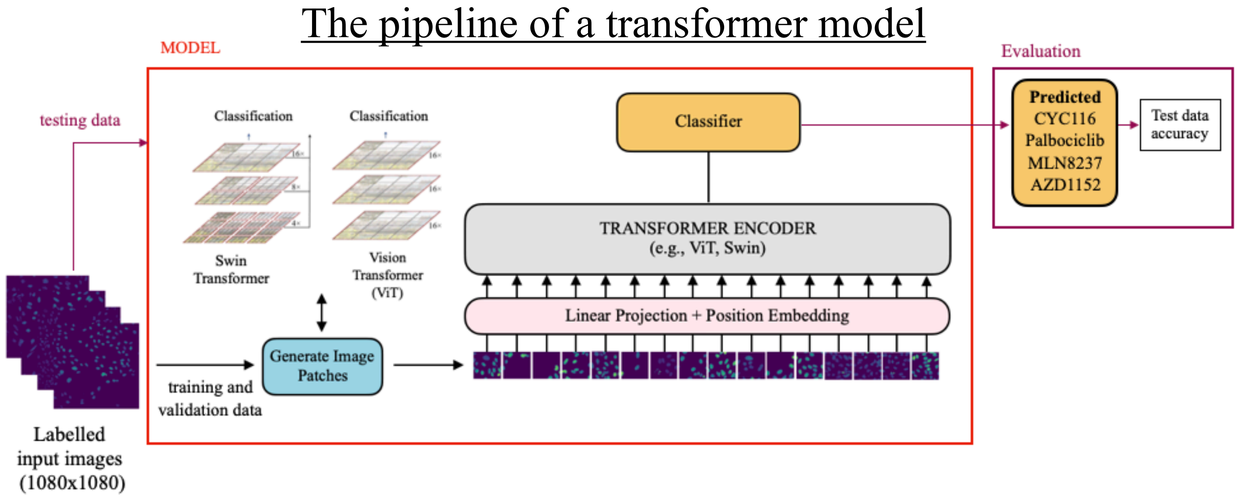
METHODS

Three pre-trained state-of-the-art deep learning models, such as ResNet50, ViT and Swin Transformer were utilised to automatically classify bright-field and fluorescent microscopy images across single and multi channels.

The pipeline of the ResNet50 model



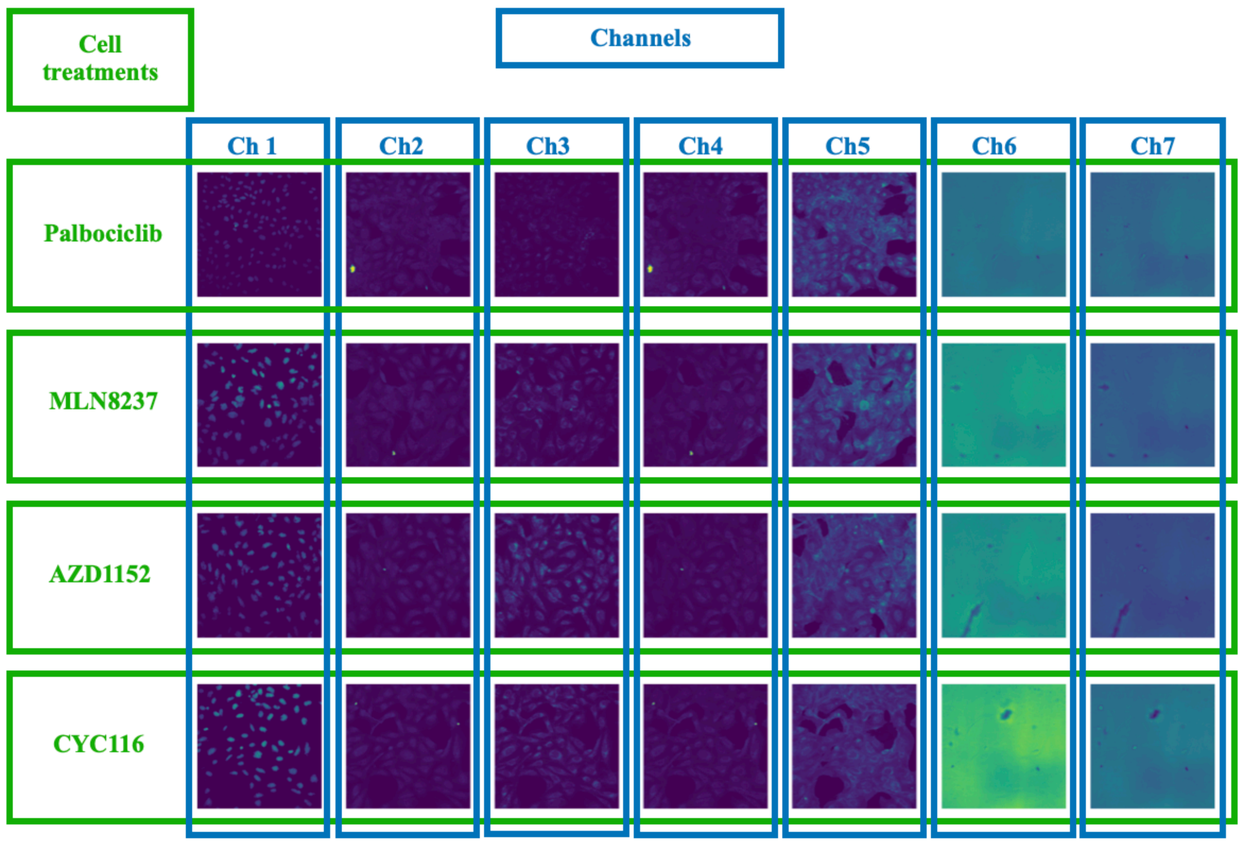
The pipeline of a transformer model



DATASET

The dataset consists of 696 images. There are 4 cell treatment classes: Palbociclib contains 192 images; MLN8237, AZD1152 and CYC116 classes contain 168 images each.

Each image of the dataset consists of 7 channels: 5 fluorescence channels and 2 bright-field channels, examples are shown below:

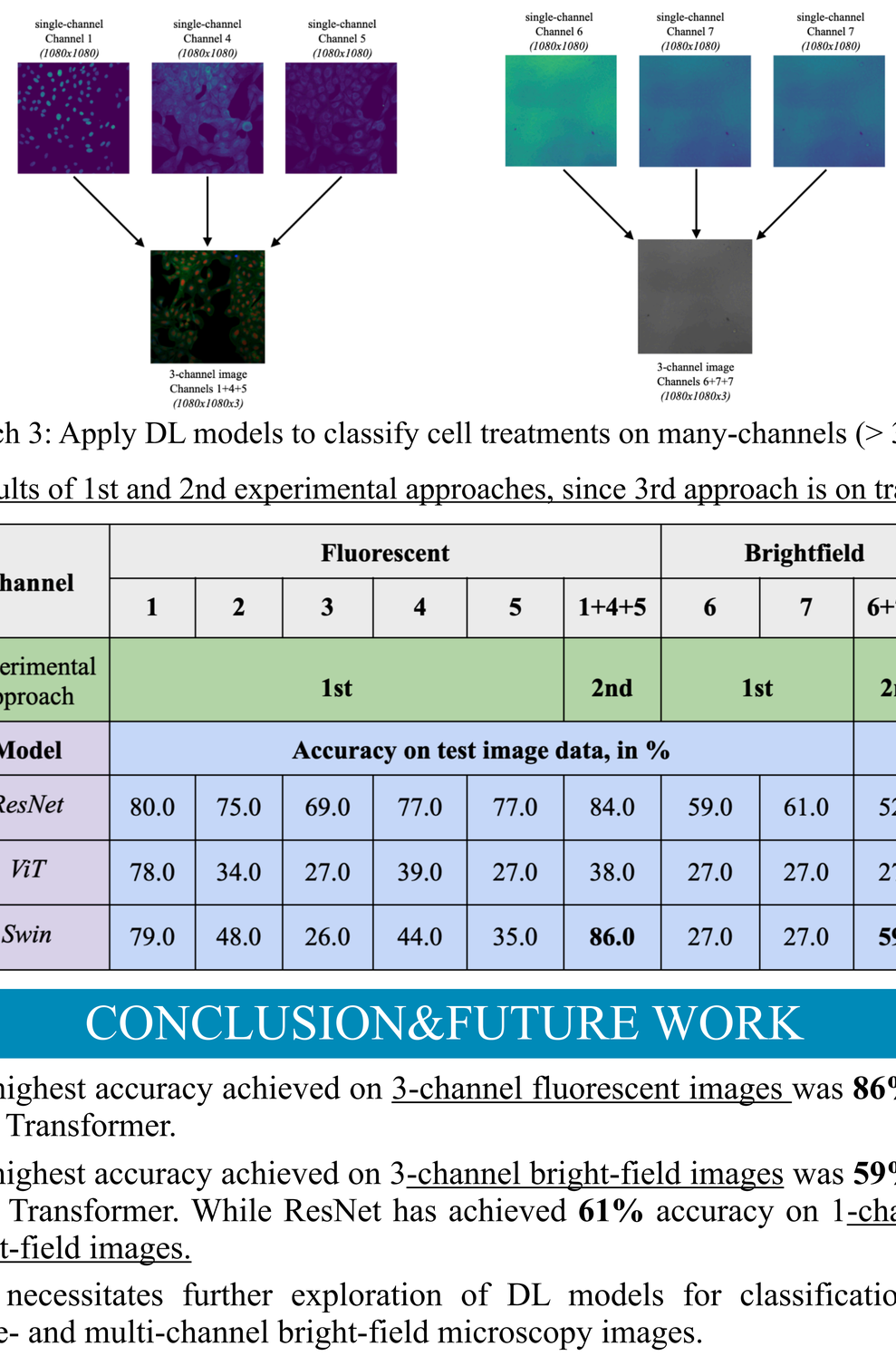


EXPERIMENTAL RESULTS

Approach 1: Apply DL models to classify cell treatments on single-channels.

Approach 2: Apply DL models to classify cell treatments on three-channels.

Process of combining three single-channels into one three-channel image



Approach 3: Apply DL models to classify cell treatments on many-channels (> 3)

The results of 1st and 2nd experimental approaches, since 3rd approach is on training

Channel	Fluorescent						Brightfield		
	1	2	3	4	5	1+4+5	6	7	6+7+7
Experimental approach	1st					2nd	1st		2nd
Model	**Accuracy on test image data, in %**								
ResNet	80.0	75.0	69.0	77.0	77.0	84.0	59.0	61.0	52.0
ViT	78.0	34.0	27.0	39.0	27.0	38.0	27.0	27.0	27.0
Swin	79.0	48.0	26.0	44.0	35.0	**86.0**	27.0	27.0	**59.0**

CONCLUSION&FUTURE WORK

- The highest accuracy achieved on 3-channel fluorescent images was **86%** by Swin Transformer.
- The highest accuracy achieved on 3-channel bright-field images was **59%** by Swin Transformer. While ResNet has achieved **61%** accuracy on 1-channel bright-field images.
- This necessitates further exploration of DL models for classification of single- and multi-channel bright-field microscopy images.