Automated Blood Cell Identification and Counting

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Section Title Here

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Outline

1. Introduction

Introduction

Why this research is important	• This research addresses the challenges in analysing blood cell in traditional methods, while offering a potential breakthrough in accuracy, efficiency, and reliability of disease diagnosis. • The automation using advanced image processing and machine learning could revolutionize medical diagnostics, leading to improved patient outcomes.
What we know and what we don't know	• The limitations of manual blood cell analysis, emphasizing the need for automation. • Leverages existing methodologies and acknowledges advancements in models like YOLOv5 and YOLOX. • The specific limitations of current approaches are unaware and how the proposed solution will overcome them in areas that the project aims to explore.

Introduction (Cont’d)

Our Experiment	• This experiment develops an automated system for blood cell analysis using image processing and machine learning. • The process includes image preprocessing, feature extraction, and the implementation of machine learning models for the classification and counting of blood cells.
Our Hypothesis	• By combining solutions in image processing and machine learning, the developed system will significantly improve the accuracy and reliability of blood cell identification and counting. • It is expected to streamline the analysis process, reduce time and labor requirements, and enhance the diagnostic capabilities of healthcare professionals

Methodology

- You Only Look Once (YOLO) - Real-Time Object Detection
- YOLO Versions V1-V8
- YOLO-NAS is a next-generation object detection model that has been developed using the Neural Architecture Search (NAS) technology.
- NAS is an automated process that searches for the optimal neural network architecture for a particular task.
- It does this by exploring a vast search space of possible architectures and selecting the most efficient and high-performing one.
- The new YOLO-NAS delivers state-of-the-art (SOTA) performance with the unparalleled accuracy-speed performance

Methodology – Yolo-NAS

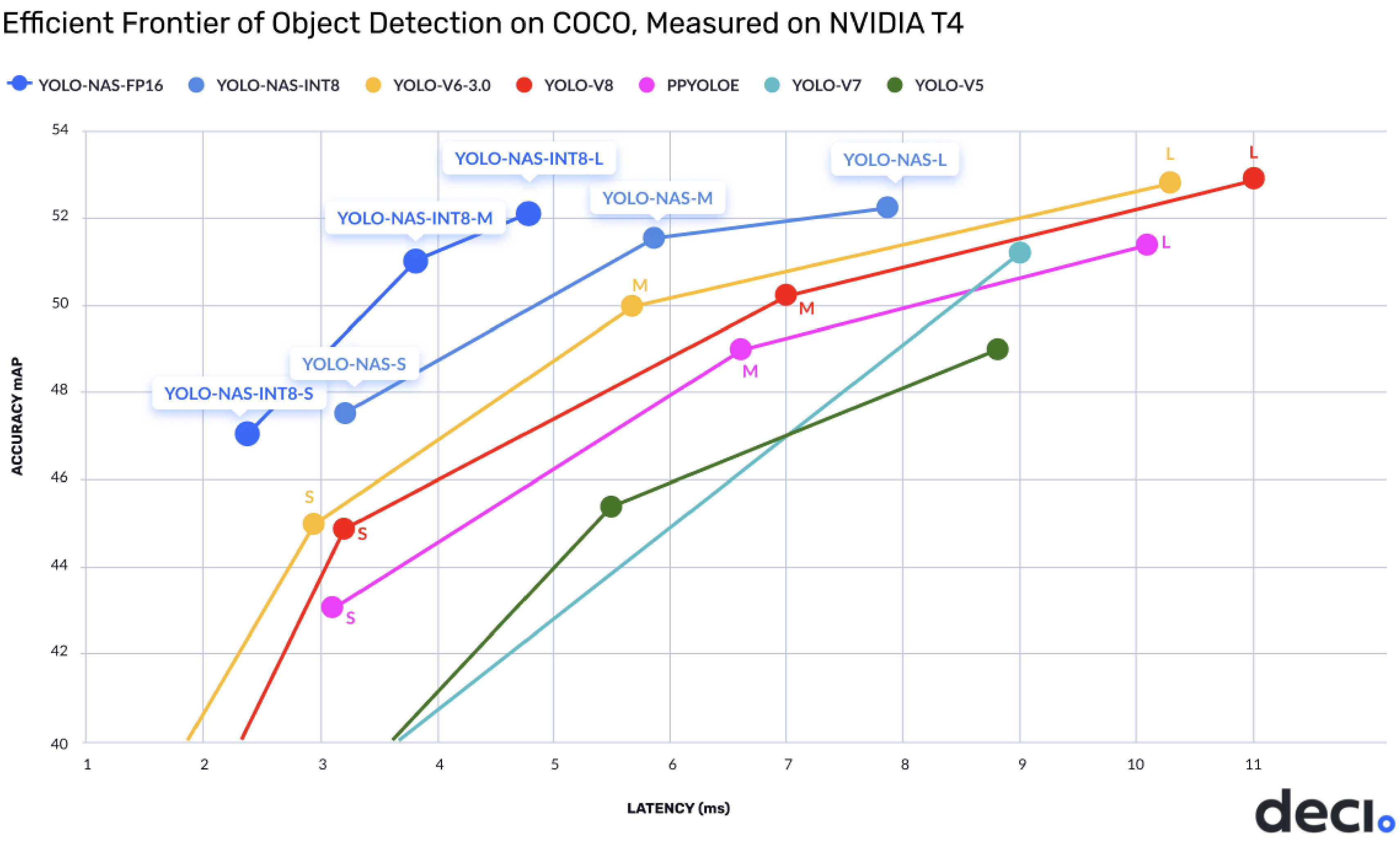
COCO – Common Object in Context

•Object segmentation

•330K images (>200K labelled)

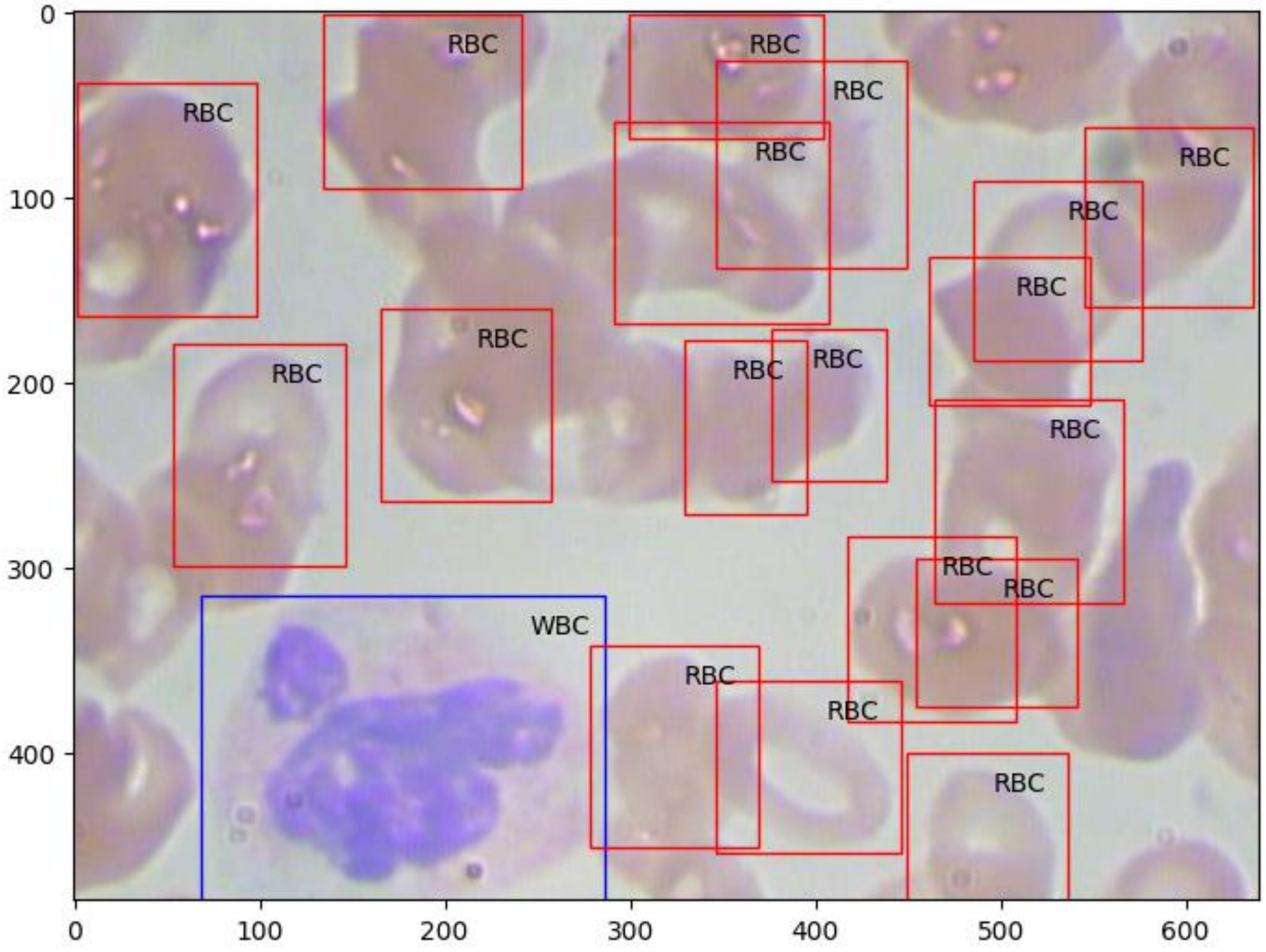
•1.5 million object instances

•80 object categories



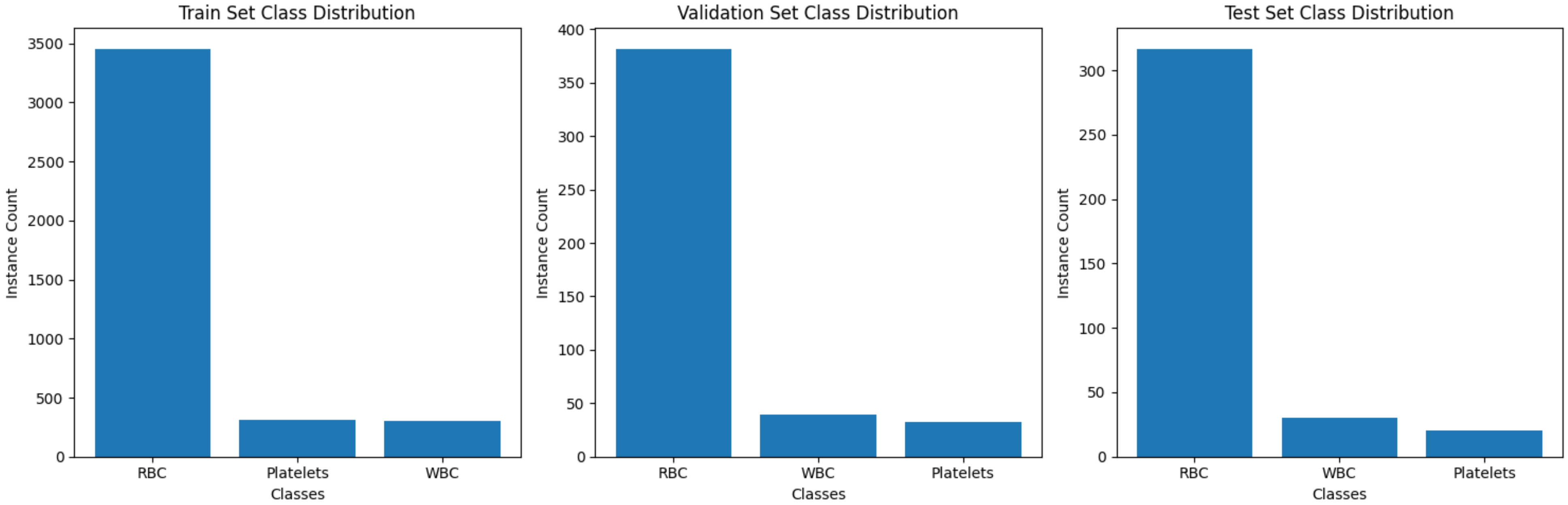
Sample Image

- Collection of sample images to train.
- Mark the rectangles as X, Y or
  width and Height from Annotations Data set.
- Identify RBC, WBC and Platelets.
- Color them in RGB Channels.



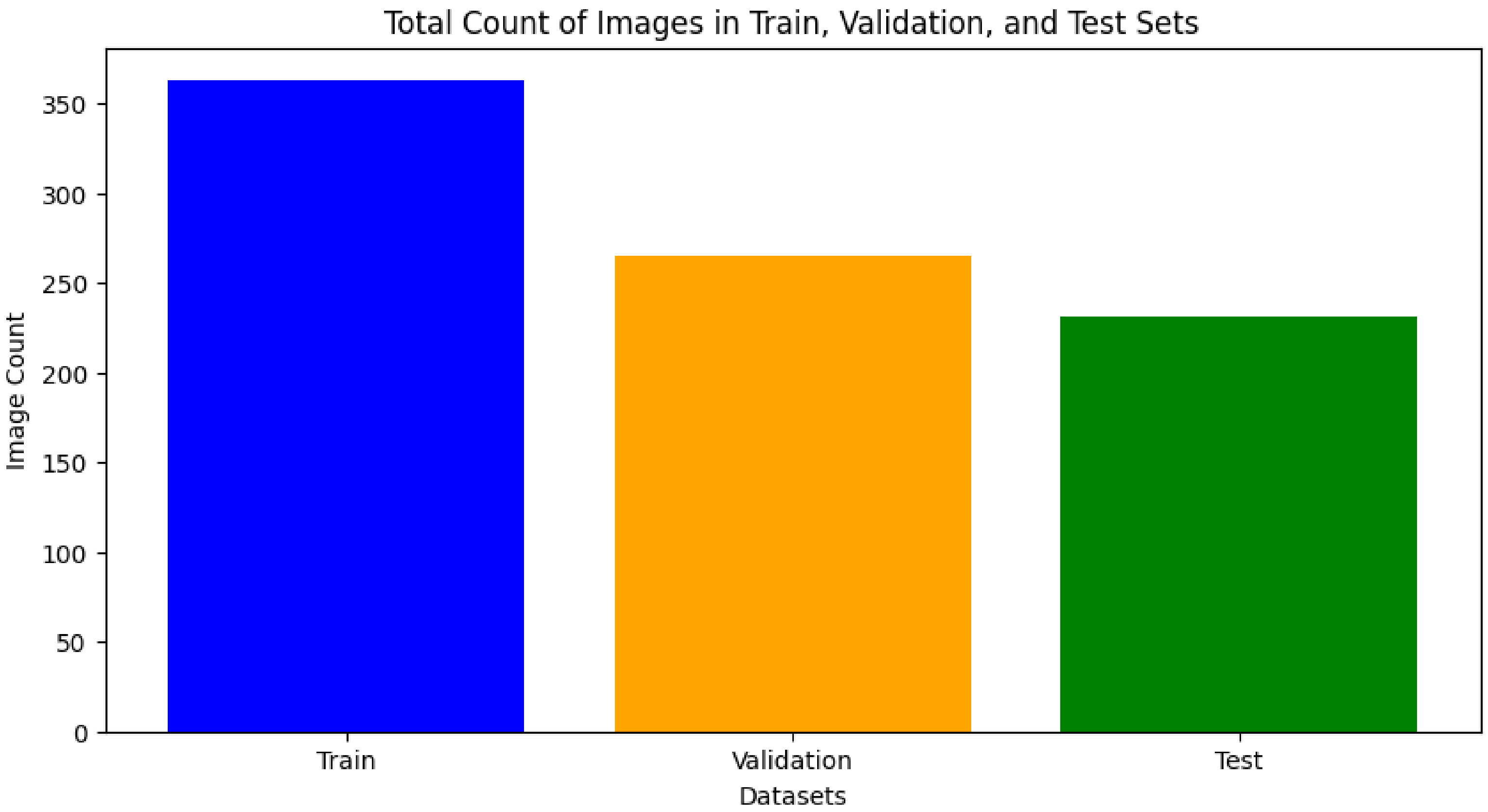
Training and Validations Data set

- Datasets are evenly distributed as Train, Validation and Test Sets
- Train – Model to be trained
- Validation – Trained model is validated
- Test – Trained models are been tested.



Training and Validations Data set

- No. of Training images 363
- No. of Training labels 363
- No. of valid images 269
- No. of valid labels 269
- No. of test images 213
- No. of test labels 213



Training and Validations Data set

- No. of Training images 363
- No. of Training labels 363
- No. of valid images 269
- No. of valid labels 269
- No. of test images 213
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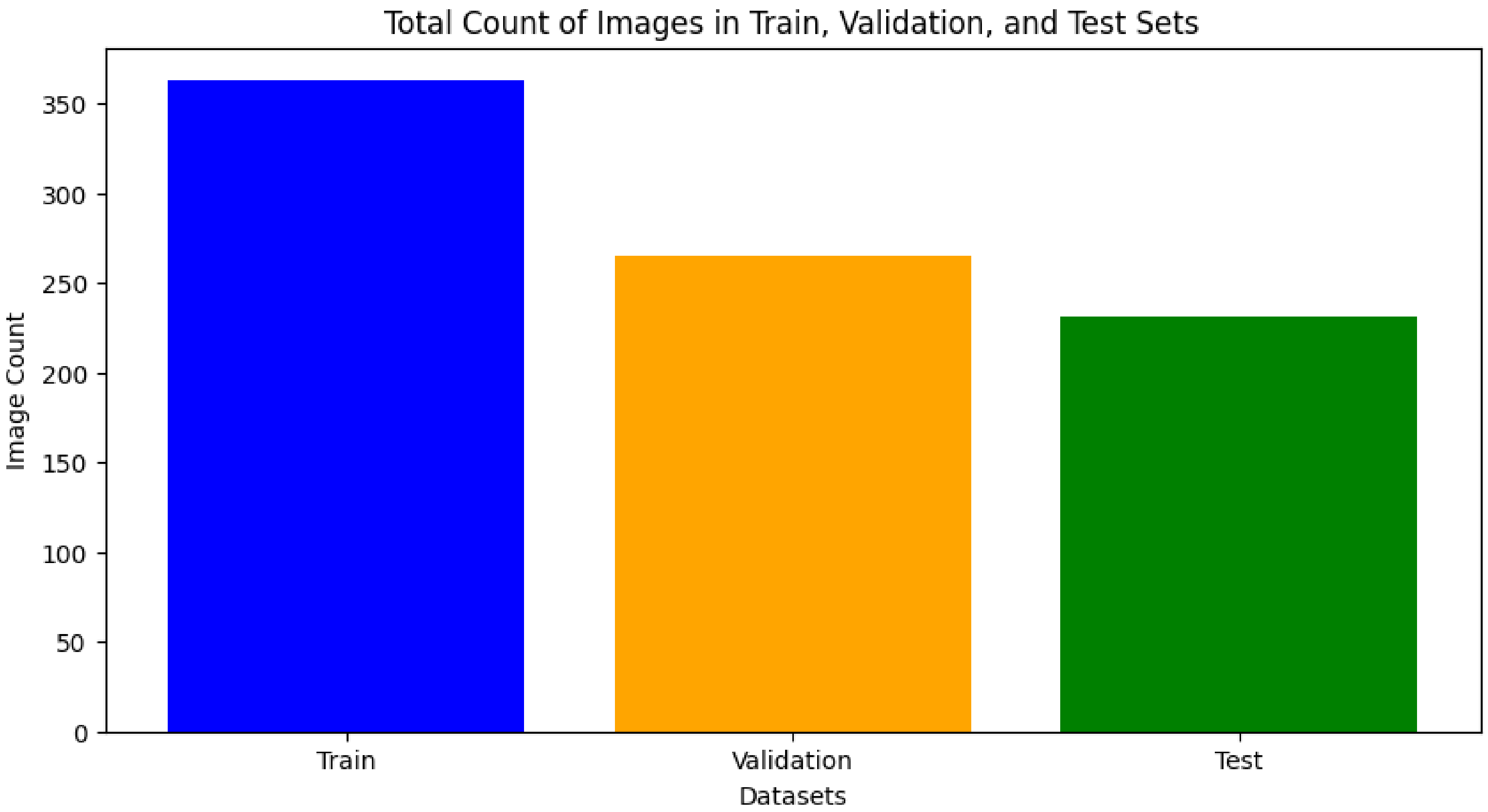


Fine Tuning

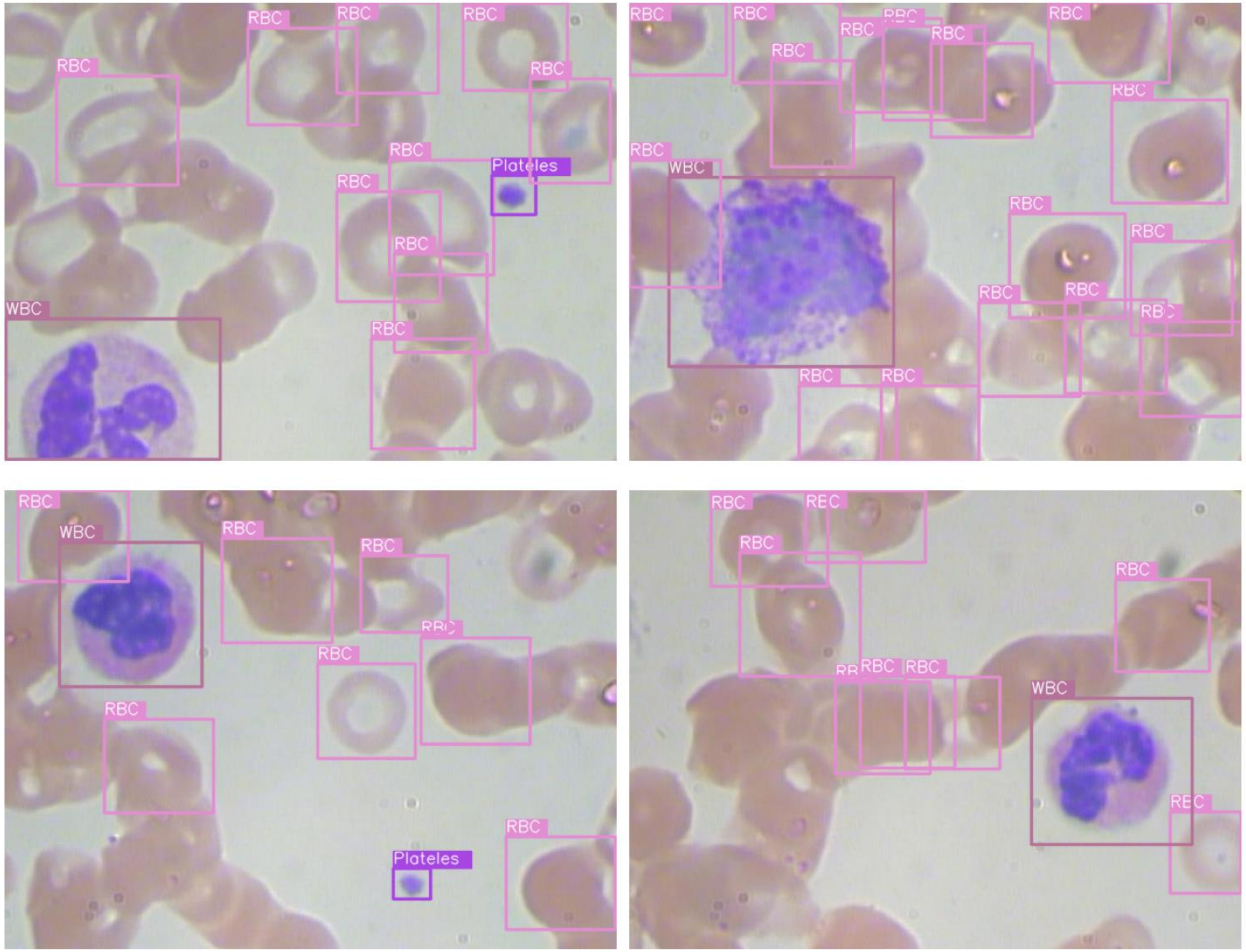
- Super Gradient is a Library used to identifying and training models with high accuracy and performance

- Easy to train the model in RGB Channels.

- The blue is trained as cars, Red as persons, Green as trees etc.

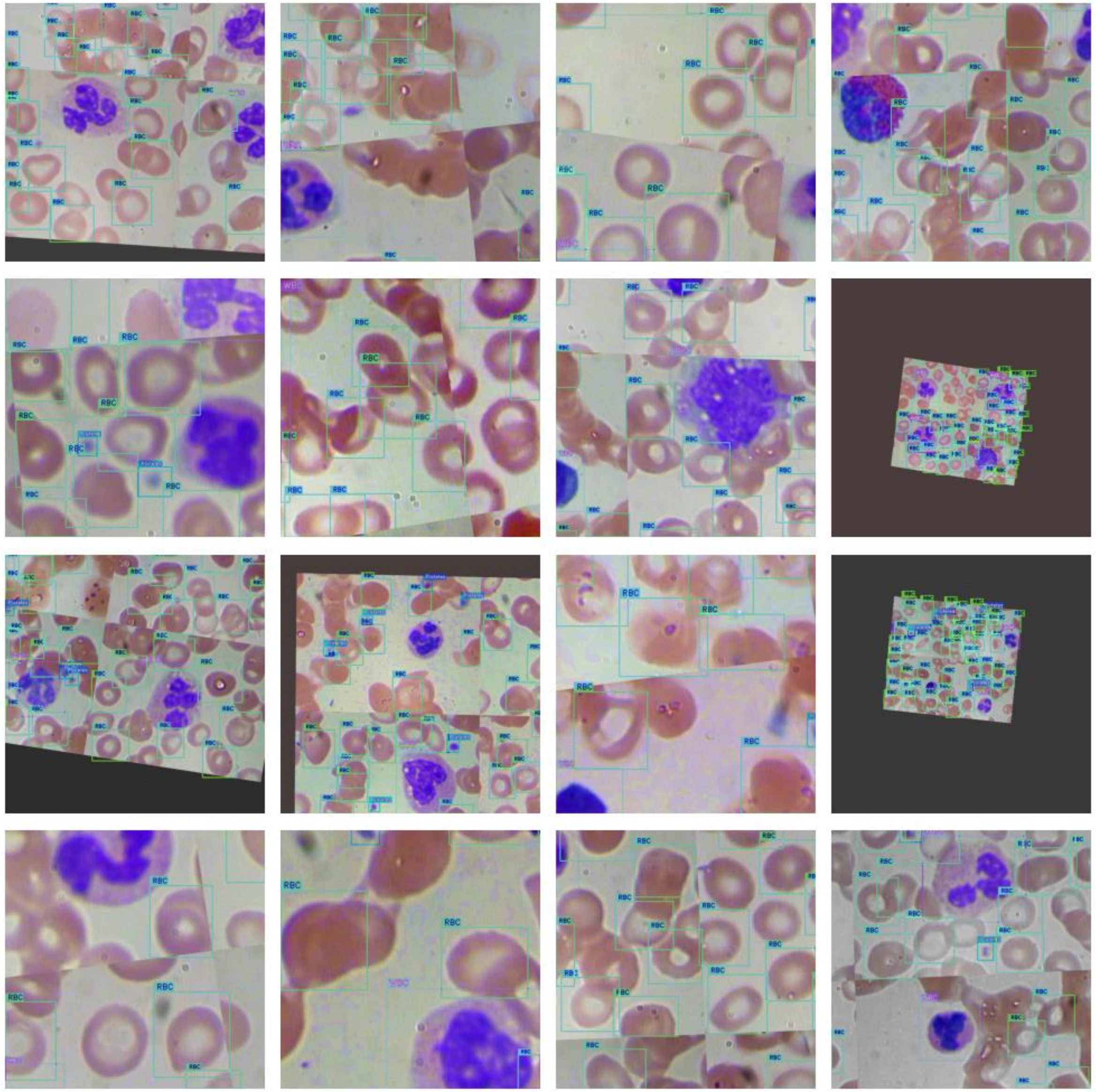
Fine Tuning

- Trained the model by passing 16 images at a time
- Machine with 8GB GPU
- The models are able to identify RBC, WBC and Platelets



Fine Tuning

- Transformed images
- Flipped Images
- Different filters of colors



Result

- The trained model has been downloaded.
- The model is tested using 3 Configurations
  YOLO_NAS_S – Small
  YOLO_NAS_M – Medium
  YOLO_NAS_L – Large
- The sizes of model determines its accuracy andefficiency
- Our model gave us high accuracy using YOLO_NAS_M

model	epochs	batch_size(-32)	learning rate	image resolution(+-32)	optimizer	map 50	precision	recall
yolo_nas_s	50	16	"warmup_initial_lr": 1e-7, "lr_warmup_epochs": 3, "initial_lr": 5e-5	width = 640 height = 480	ADAM	Map@0.50 = 0.1111 Map@0.50:0.95 = 0.0701	Precision@0.50 = 0.0345 Precision@0.50:0.95 = 0.0244	Recall@0.50 = 0.9906 Recall@0.50:0.95 = 0.68
	50	32	"warmup_initial_lr": 1e-7, "lr_warmup_epochs": 3, "initial_lr": 5e-5	width = 640 height = 480	ADAM	├── Map@0.50 = 0.1249 │ ├── Epoch N-1 = 0.1252 (↘ -0.0003) │ └── Best until now = 0.1452 (↘ -0.0202) ├── Map@0.50:0.95 = 0.0796 │ ├── Epoch N-1 = 0.0796 (↘ -0.0) │ └── Best until now = 0.0945 (↘ -0.0149)	├── Precision@0.50 = 0.0365 │ ├── Epoch N-1 = 0.0367 (↘ -0.0003) │ └── Best until now = 0.0434 (↘ -0.0069) ├── Precision@0.50:0.95 = 0.026 │ ├── Epoch N-1 = 0.0261 (↘ -0.0001) │ └── Best until now = 0.0285 (↘ -0.0025)	├── Recall@0.50 = 0.9897 │ ├── Epoch N-1 = 0.9906 (↘ -0.0009) │ └── Best until now = 0.9906 (↘ -0.0009) ├── Recall@0.50:0.95 = 0.6871 │ ├── Epoch N-1 = 0.686 (↗ 0.001) │ └── Best until now = 0.6998 (↘ -0.0128)
	50	32	"warmup_initial_lr": 1e-7, "lr_warmup_epochs": 3, "initial_lr": 5e-5	width = 672 height = 512	ADAM	├── Map@0.50 = 0.0865 │ ├── Epoch N-1 = 0.0886 (↘ -0.0021) │ └── Best until now = 0.0907 (↘ -0.0042) ├── Map@0.50:0.95 = 0.0429 │ ├── Epoch N-1 = 0.042 (↗ 0.0009) │ └── Best until now = 0.0455 (↘ -0.0027)	├── Precision@0.50 = 0.0233 │ ├── Epoch N-1 = 0.0231 (↗ 0.0003) │ └── Best until now = 0.056 (↘ -0.0327) ├── Precision@0.50:0.95 = 0.0134 │ ├── Epoch N-1 = 0.0132 (↗ 0.0002) │ └── Best until now = 0.0289 (↘ -0.0155)	├── Recall@0.50 = 0.915 │ ├── Epoch N-1 = 0.8942 (↗ 0.0208) │ └── Best until now = 0.9159 (↘ -0.0009) ├── Recall@0.50:0.95 = 0.5009 │ ├── Epoch N-1 = 0.4902 (↗ 0.0107) │ └── Best until now = 0.5178 (↘ -0.0169)
	100	32	"warmup_initial_lr": 1e-7, "lr_warmup_epochs": 3, "initial_lr": 5e-5	width = 640 height = 480	ADAM	OOM		
yolo_nas_m	50	8	"warmup_initial_lr": 1e-7, "lr_warmup_epochs": 3, "initial_lr": 5e-5	width = 640 height = 480	ADAM	├── Map@0.50 = 0.0978 │ ├── Epoch N-1 = 0.0989 (↘ -0.0011) │ └── Best until now = 0.1484 (↘ -0.0506)├── Map@0.50:0.95 = 0.0613 │ ├── Epoch N-1 = 0.0612 (↗ 0.0001) │ └── Best until now = 0.0891 (↘ -0.0278)	├── Precision@0.50 = 0.0469 │ ├── Epoch N-1 = 0.0459 (↗ 0.0009) │ └── Best until now = 0.0519 (↘ -0.005) ├── Precision@0.50:0.95 = 0.0333 │ ├── Epoch N-1 = 0.0321 (↗ 0.0012) │ └── Best until now = 0.0388 (↘ -0.0056)	├── Recall@0.50 = 0.9906 │ ├── Epoch N-1 = 0.9906 (= 0.0) │ └── Best until now = 0.9915 (↘ -0.0009) ├── Recall@0.50:0.95 = 0.6845 │ ├── Epoch N-1 = 0.6721 (↗ 0.0124) │ └── Best until now = 0.7088 (↘ -0.0243)
	50	16	"warmup_initial_lr": 1e-7, "lr_warmup_epochs": 3, "initial_lr": 5e-5	width = 640 height = 480	ADAM	├── Map@0.50 = 0.107 │ ├── Epoch N-1 = 0.1076 (↘ -0.0006) │ └── Best until now = 0.1394 (↘ -0.0324) ├── Map@0.50:0.95 = 0.0683 │ ├── Epoch N-1 = 0.0692 (↘ -0.0009) │ └── Best until now = 0.0841 (↘ -0.0157)	├── Precision@0.50 = 0.048 │ ├── Epoch N-1 = 0.049 (↘ -0.001) │ └── Best until now = 0.0523 (↘ -0.0043) ├── Precision@0.50:0.95 = 0.0351 │ ├── Epoch N-1 = 0.0363 (↘ -0.0013) │ └── Best until now = 0.0392 (↘ -0.0041)	├── Recall@0.50 = 0.9906 │ ├── Epoch N-1 = 0.9915 (↘ -0.0009) │ └── Best until now = 0.9965 (↘ -0.0059) ├── Recall@0.50:0.95 = 0.6938 │ ├── Epoch N-1 = 0.701 (↘ -0.0071) │ └── Best until now = 0.7107 (↘ -0.0168)
	50	32	"warmup_initial_lr": 1e-7, "lr_warmup_epochs": 3, "initial_lr": 5e-5	width = 640 height = 480	ADAM	OOM		
yolo_nas_l	50	8	"warmup_initial_lr": 1e-7, "lr_warmup_epochs": 3, "initial_lr": 5e-5	width = 640 height = 480	ADAM	├── Map@0.50 = 0.1042 │ ├── Epoch N-1 = 0.1029 (↗ 0.0013) │ └── Best until now = 0.1361 (↘ -0.0319) ├── Map@0.50:0.95 = 0.0696 │ ├── Epoch N-1 = 0.068 (↗ 0.0016) │ └── Best until now = 0.0865 (↘ -0.0169)	├── Precision@0.50 = 0.0542 │ ├── Epoch N-1 = 0.0521 (↗ 0.0021) │ └── Best until now = 0.0631 (↘ -0.0089) ├── Precision@0.50:0.95 = 0.0416 │ ├── Epoch N-1 = 0.0384 (↗ 0.0032) │ └── Best until now = 0.0462 (↘ -0.0046)	├── Recall@0.50 = 0.9888 │ ├── Epoch N-1 = 0.9888 (= 0.0) │ └── Best until now = 0.9915 (↘ -0.0026) ├── Recall@0.50:0.95 = 0.7082 │ ├── Epoch N-1 = 0.6989 (↗ 0.0093) │ └── Best until now = 0.7238 (↘ -0.0156)
	50	16	"warmup_initial_lr": 1e-7, "lr_warmup_epochs": 3, "initial_lr": 5e-5	width = 640 height = 480	ADAM	├── Map@0.50 = 0.0957 │ ├── Epoch N-1 = 0.0956 (↗ 0.0001) │ └── Best until now = 0.1309 (↘ -0.0352) ├── Map@0.50:0.95 = 0.0599 │ ├── Epoch N-1 = 0.0592 (↗ 0.0006) │ └── Best until now = 0.0817 (↘ -0.0219)	├── Precision@0.50 = 0.0446 │ ├── Epoch N-1 = 0.0459 (↘ -0.0013) │ └── Best until now = 0.0508 (↘ -0.0062) ├── Precision@0.50:0.95 = 0.0318 │ ├── Epoch N-1 = 0.0325 (↘ -0.0007) │ └── Best until now = 0.0358 (↘ -0.004)	├── Recall@0.50 = 0.9906 │ ├── Epoch N-1 = 0.9906 (= 0.0) │ └── Best until now = 0.9915 (↘ -0.0009) ├── Recall@0.50:0.95 = 0.6858 │ ├── Epoch N-1 = 0.6816 (↗ 0.0042) │ └── Best until now = 0.7073 (↘ -0.0216)
	100	32	"warmup_initial_lr": 1e-7, "lr_warmup_epochs": 3, "initial_lr": 5e-5	width = 640 height = 480	ADAM	OOM		

Thank You

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