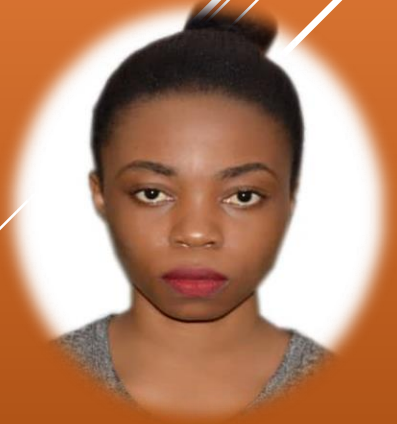
The Detection Of Malaria Parasite And Its Severity Level

At the level of a medical laboratory scientist, using Neural Networks

Justice Chukwuka
@chuka19952



Augusta Chioma
Med. Lab Scientist,
OAU Teaching Hospital

FACTS

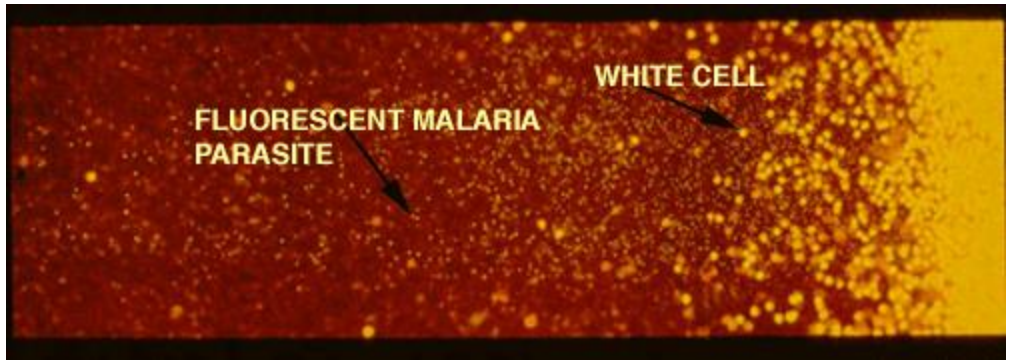
- According to the WHO data, 445,000 deaths are caused by malaria in Africa.
- Nigeria, the continent's most populous country, accounted for 27% of malaria deaths globally in 2016 and kept the lead in 2017 and 2018.
- Nigeria has only few of the world's qualified and practicing doctors especially in rural areas.
- Hence, the need for intelligent solutions that are accessible, affordable and efficient.

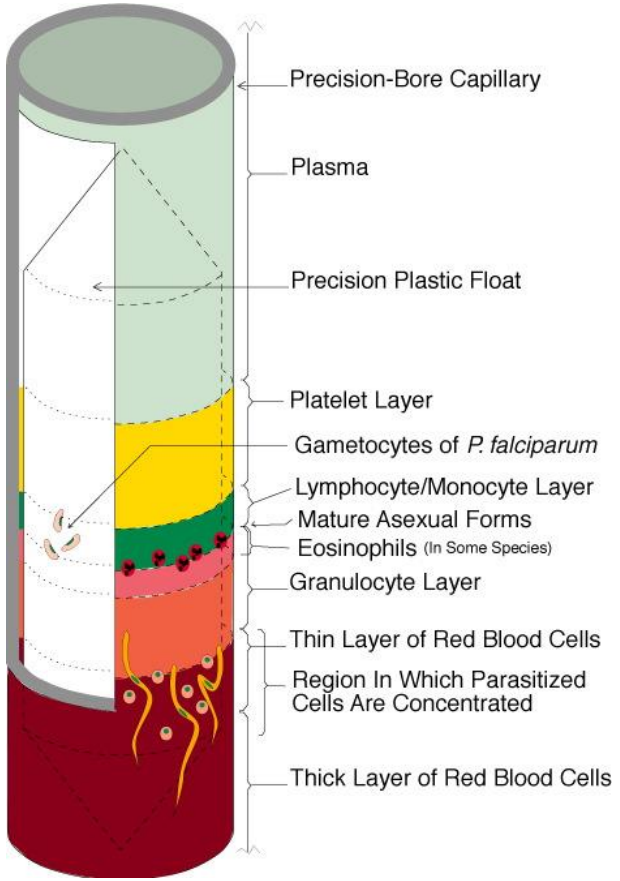
GOOD NEWS

- Survival Rate for malaria is 98% if detected early and treated appropriately
- By 2020 there would be approximately 6.1 billion smartphones in circulation globally.
- No more therapeutic delays resulting from time spent in reading blood smears.
- Medical students/researchers can use this model as an atlas for the diagnosis of malaria.

HOW IS MALARIA DIAGNOSED?

1. QBC test



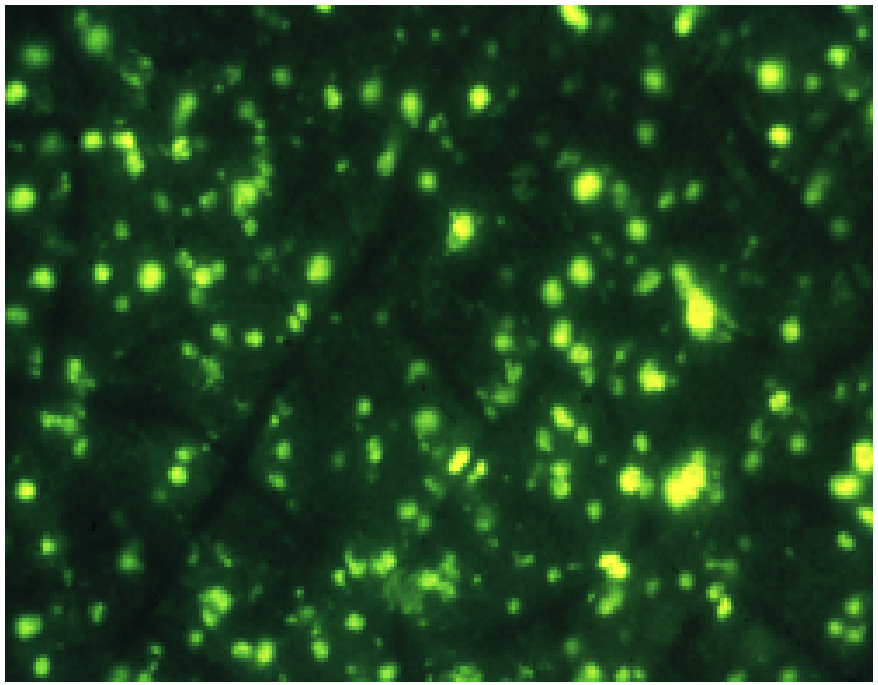


2.

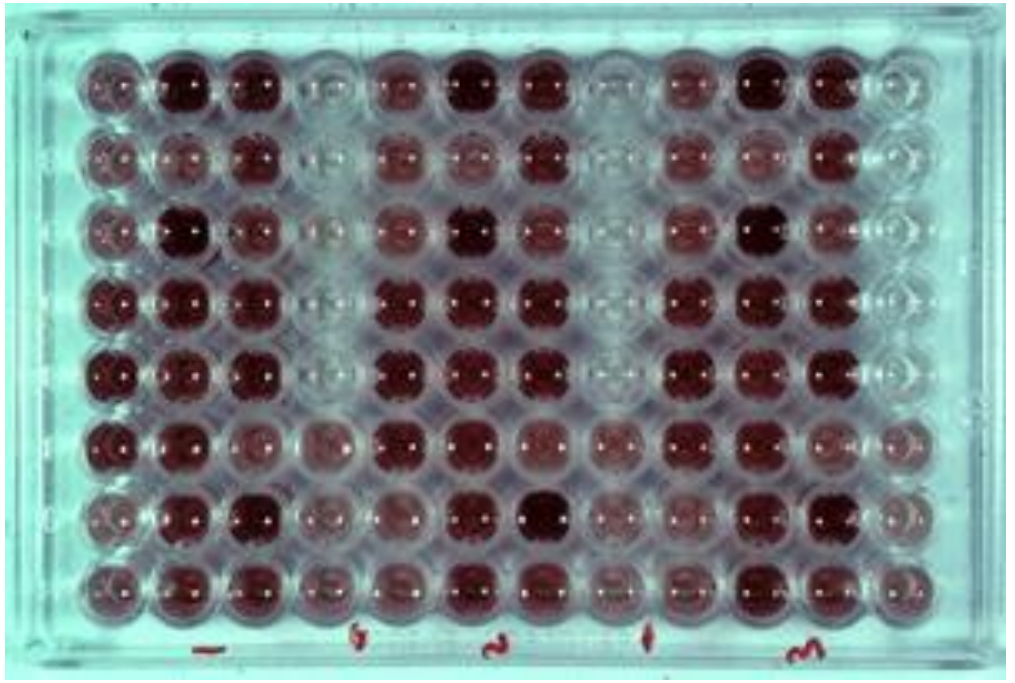
(a) Indirect fluorescent antibody test (IFAT)

(b) Enzyme- linked immunosorbent assay (ELISA)

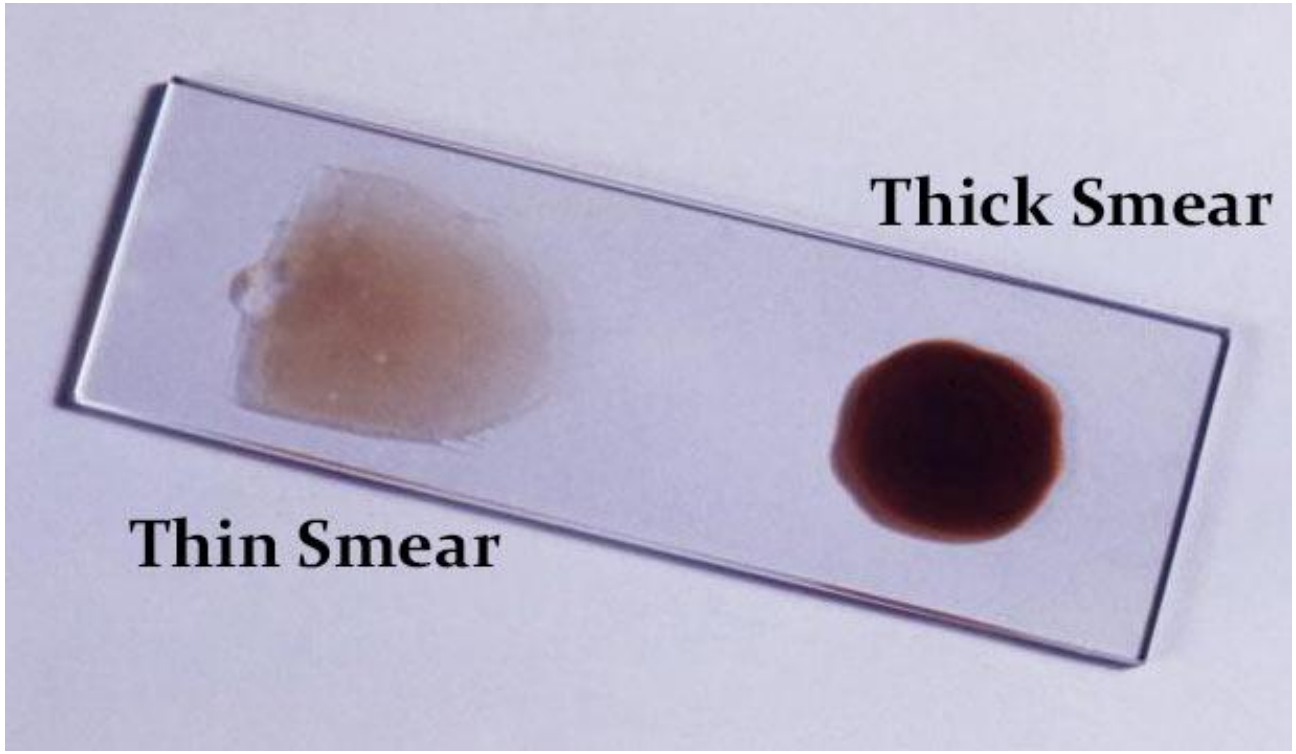
(a)



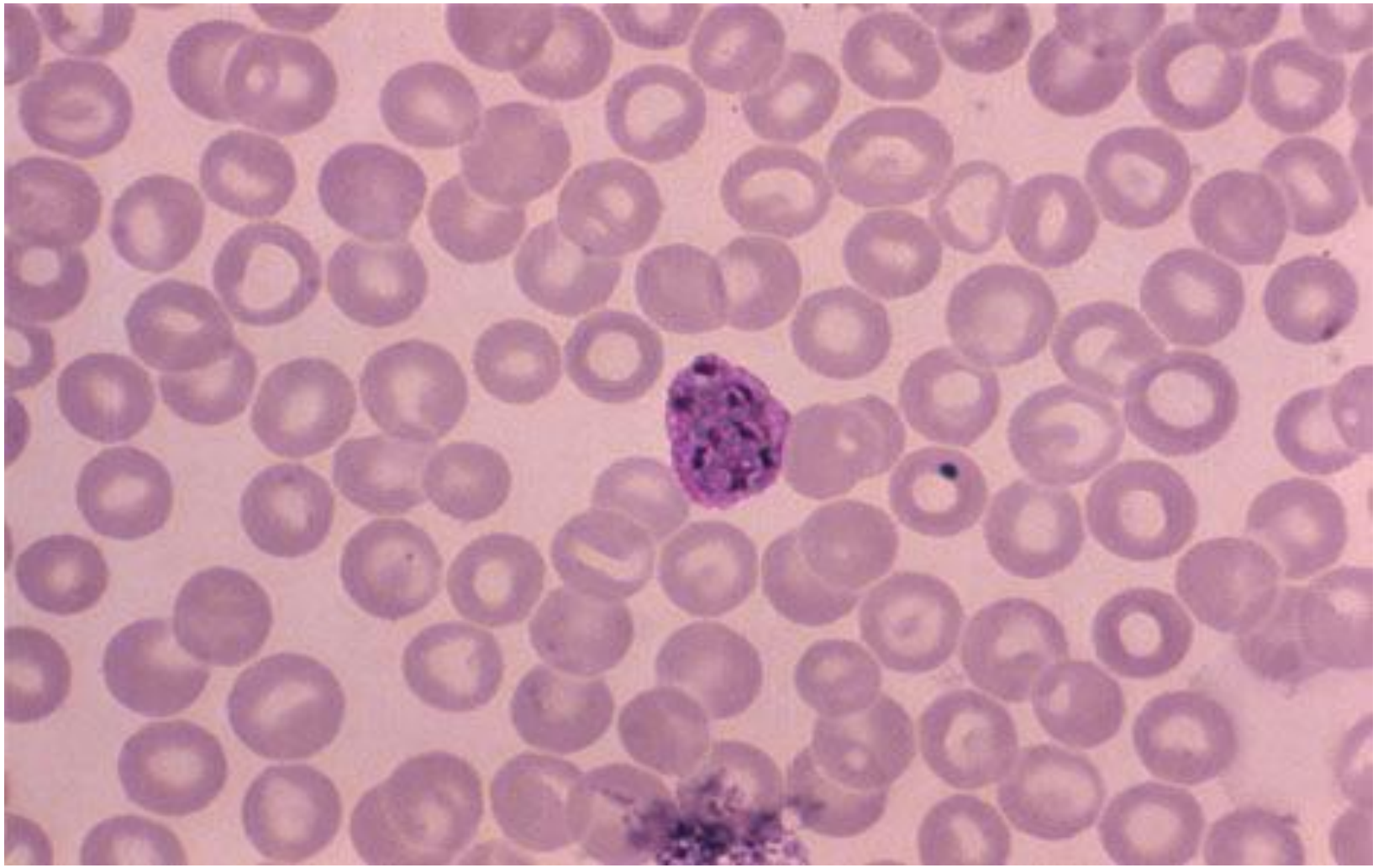
(b)



3. Microscopy Method (Gold Standard)



A FIELD OF RED BLOOD CELLS(RBCs) CAPTURED BY A MICROSCOPE



National Institutes of Health

Turning Discovery Into Health

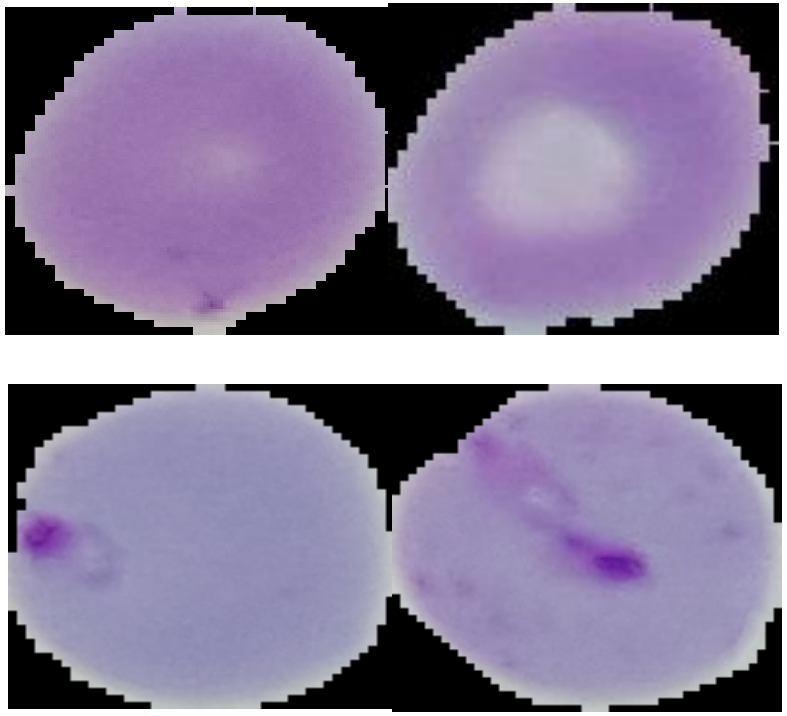
DATASET

- Dataset contained 27,558 images
- Half were infected while half were uninfected
- Contained different Shapes and Species of malaria parasites
- All were RBCs from thin smear procedures.

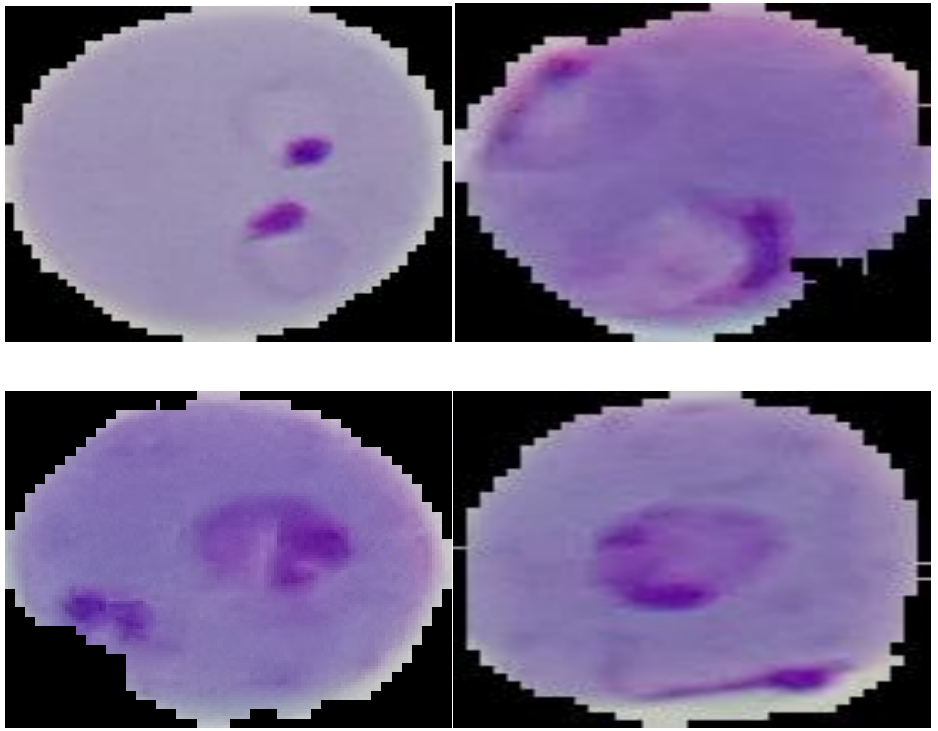
DATA PRE-PROCESSING
(MEDICAL LABORATORY SCIENTIST'S FUNCTION)

4 CLASSES, 20,174 IMAGES

HEALTHY CELLS & 1 PARASITE COUNT

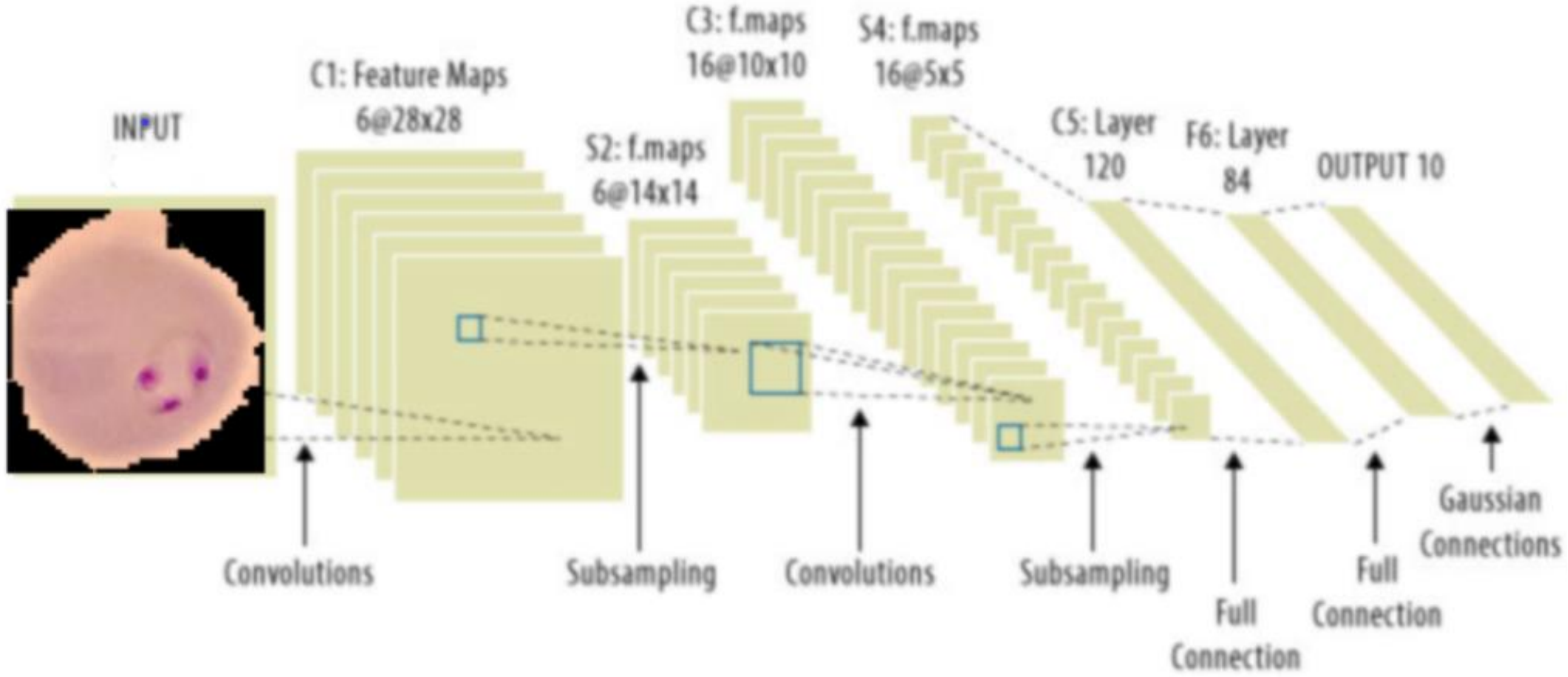


2 & 3 PARASITE COUNT



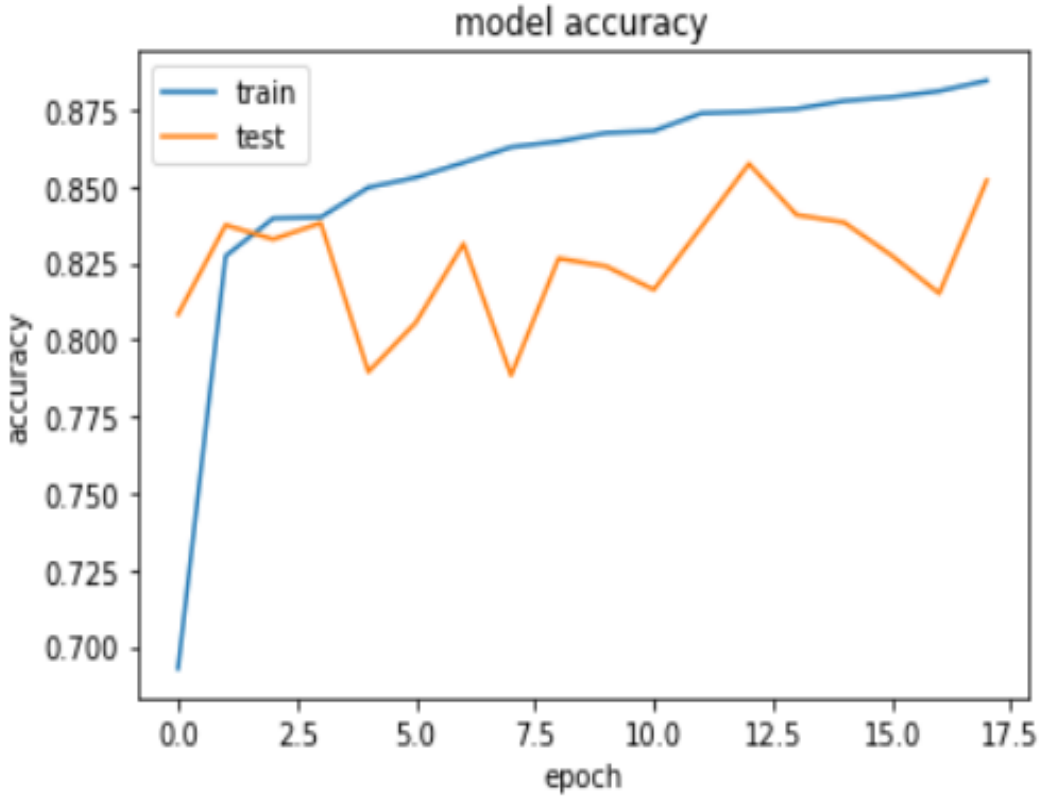
CONVOLUTIONAL NEURAL NETWORK : LeNet-9

- 4 convolutional layers
- 4 sub sampling (pooling) layers and 1 fully connected layer

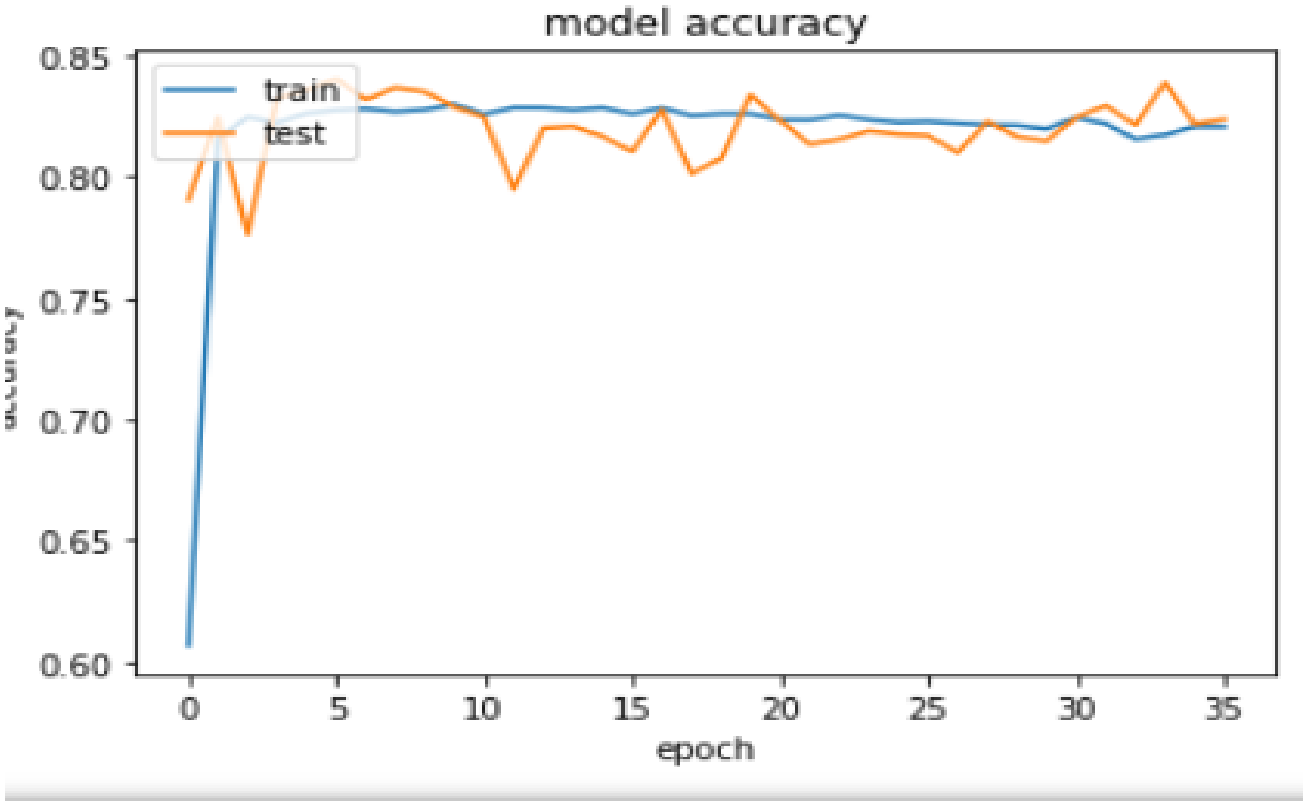


EVALUATION

82%--------18 Epochs



83%--------36 Epochs



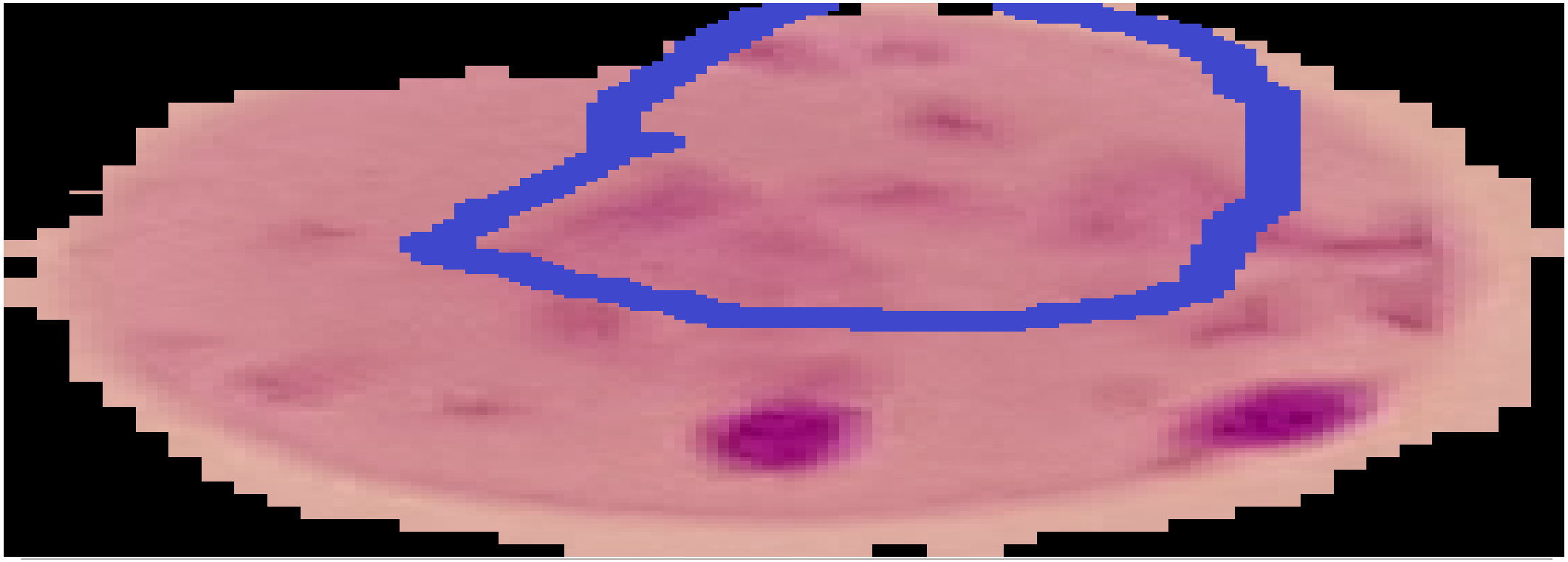
EVALUATION

METRICS = “ACCURACY”

- Accuracy hovered between 82-85% on 18 and 36 epochs
- TP = 1731
- TN = 1520
- FN = 714
- Total Samples = 3569

$$\text{ACCURACY} = \frac{TP+TN}{TOTAL\ SAMPLES} = \frac{3251}{3569}$$

LIMITATIONS



- MODELS BUSY LEARNING WRONGLY BY MISTAKING ARTIFACTS FOR MALARIA PARASITES.
- ONE OF THE MAJOR CHALLENGES OF THE RESEARCH IS THAT THE CURRENT IMAGE DATASET IS STILL TOO SMALL (20,174) AND MAY CONTRIBUTE TO OVERFITTING.

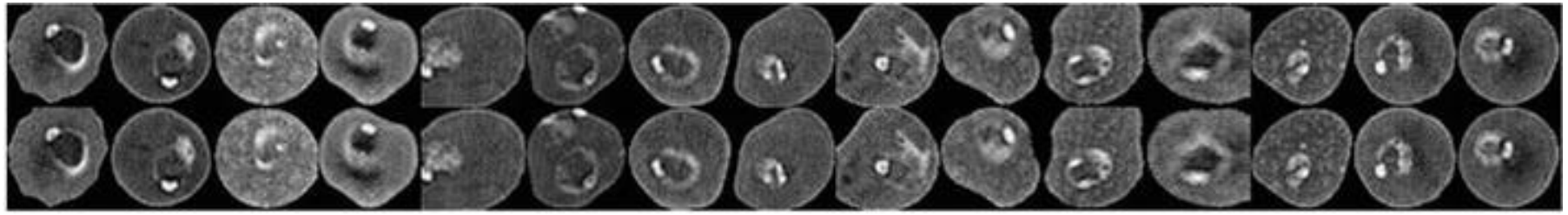
FURTHER RESEARCH/UPGRADES

- Training the model to be able to detect and count malaria parasites according to their different forms(trophozoites, schizonts, gametocytes).
- Denoise the images of unnecessary and model confusing artifacts.
- Use object recognition method in computer vision to develop a solution.
- Test models on field images and observe their performance.
- Deploy to production stage(Android or PC app).

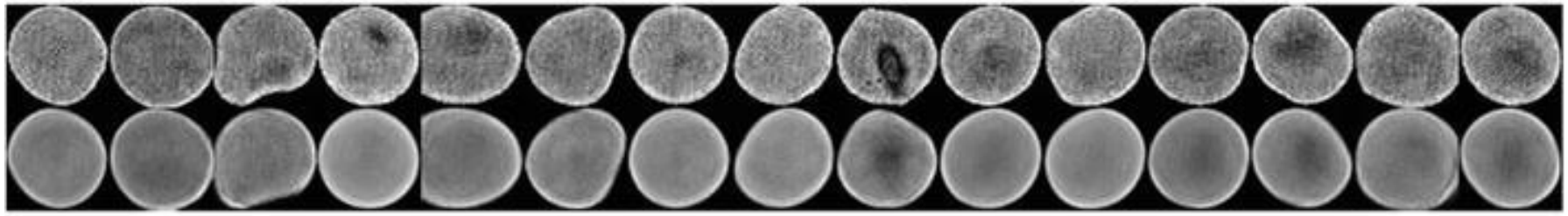
THANK YOU

EXTRA/ADDITIONAL SLIDES

EDGE AND SHAPE DETECTIONS

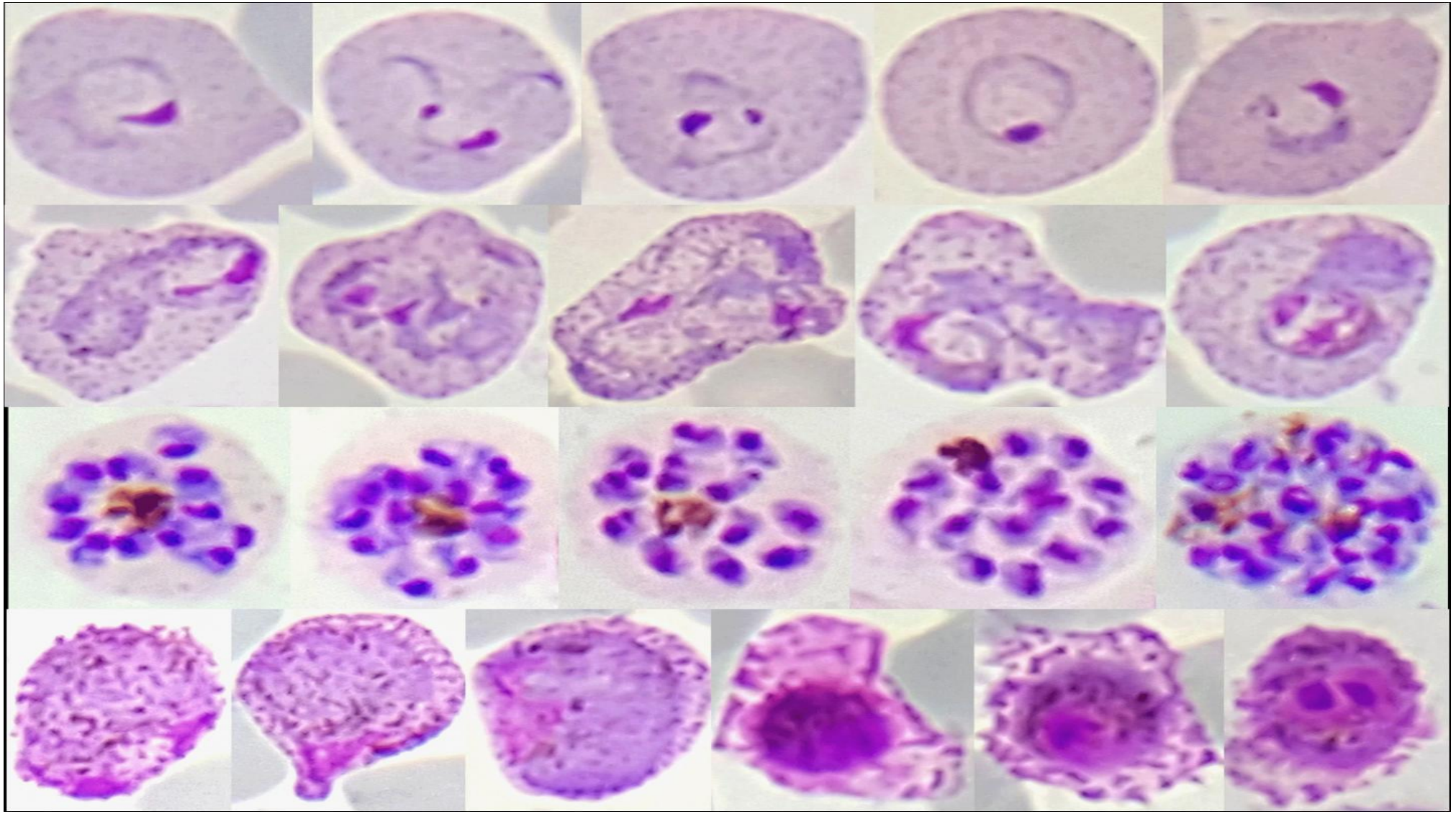


(a)



(b)

MALARIA PARASITE FORMS/MOROHOLOGY



LOSS FUNCTION BEHAVIOURS OVER THE 18 AND 36 EPOCH TRAINING SESSIONS WITHOUT BN