Vitiligo Detection Using Machine Learning

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Abstract: Vitiligo (सफेद दाग) is a disease that causes loss of skin colour in patches. The colourless areas usually get bigger in size with time. The condition is not body part specific; it can affect the skin on any part of the body, even in hair and the inside of the mouth too. There are various applications that detects the vitiligo by detecting human skin, but no one of them detects the skin tissue. Histo graphical image of tissue of vitiligous skin detects the extend of disease, a person is suffering from. By knowing the current damages in skin tissue due to vitiligo, proper and precise treatment can be given to sufferer. The present work is done in four phases. In first phase, it takes the microscopic image of a tissue. In second phase, it applies the machine learning algorithm on that image, to check for a tissue whether the image is having the characteristics that mark the tissue infected or not. In third phase, it makes a graph of different colours present in that image. In fourth phase, based upon that graph, it gives the result of whether the skin is vitiligo infected or not. The present approach is based on machine learning and annotated data increases the efficiency and reduce the false positive rate.

Keywords: Vitiligo, Machine learning, PyTorch, OpenCV, melanocyte

INTRODUCTION

Machine learning and image detection are had been a research area for several decades and emerged as a research paradigm because of the Internet, Online Platforms, social media and abundant use of digital images. Along with them, medical and health care is having a vast application of machine learning. Talking about the medical, we talk about diseases, their diagnosis, and their treatment. One of the diseases named “Vitiligo” or “White spots” is considered in this. Usually, the hair colour and the colour of skin is determined by melanin (substance is responsible for producing pigmentation in hair, eye and skin). Vitiligo occurs when cells that produces melanin stop functioning or may die. People of all skin types get affected by Vitiligo, but it may be more noticeable in people with brown or black skin. This is not a contagious or life-threatening condition. It may be stressful or make feel bad about oneself. Vitiligous skin tissues are quite different from normal skin tissue, and the difference is that the tissue of vitiligous skin is having melanocyte present in them. That is the difference this application is searching for. If these melanocytes are detected in a tissue, then it means this skin is infected, otherwise not.

To detect the extend of melanocytes in a tissue, machine learning is used. This application calculates the melanocyte patches present in the skin tissue.

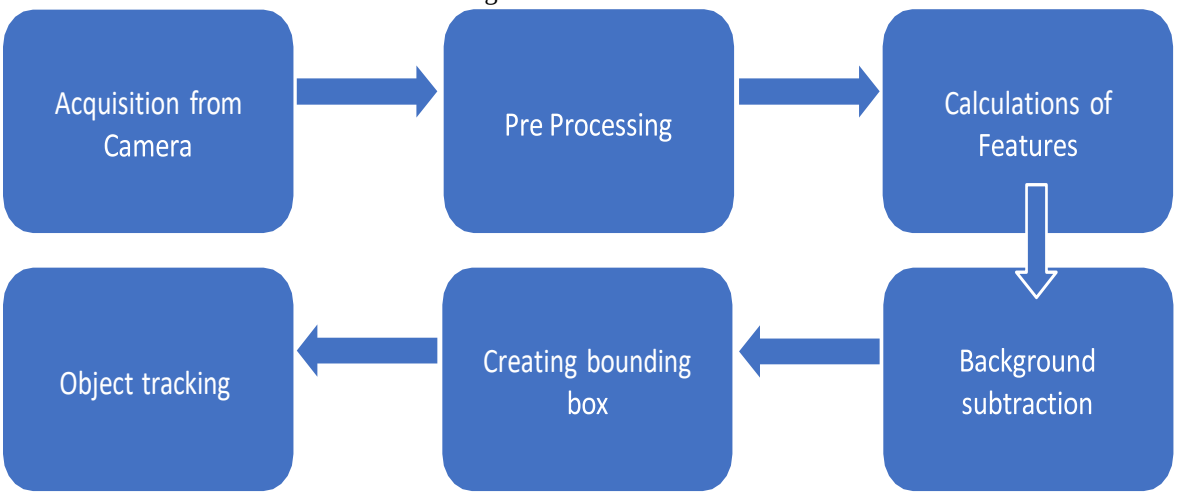


Image 1. Flow diagram of object Recognition

Problem Statement

Our project work on deep learning techniques specifically object(patch) detection to create a working model that will help the patients and doctors to interpretate the histo-image. Result interpretation takes more time in Frozen section and histo-image analysis time is crucial. So, it helps in interpretating data by using machine learning concepts.

Methodology

The general overview of this machine learning application is to given input the coloured microscopic image of skin tissue and the application will check for the melanocyte present in the tissue image.

Image 2. Circle Detection

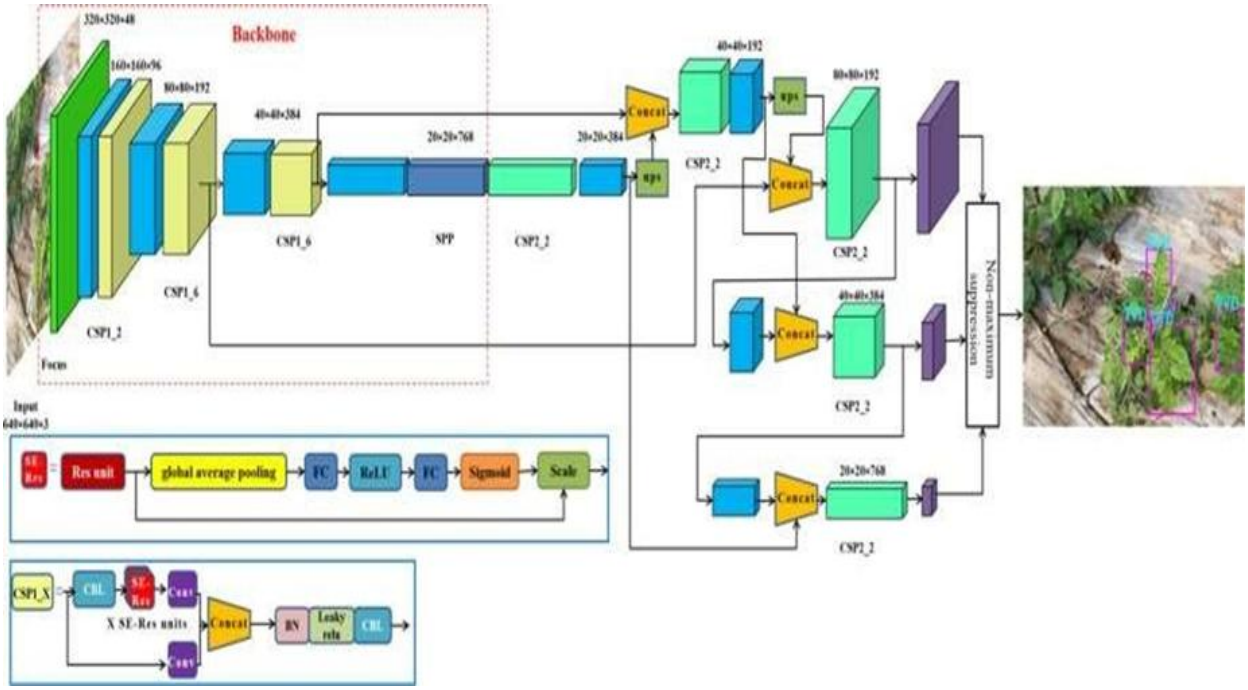


Image 3. Structure of YOLO v5

Input: The input to the present application is the microscopic tissue image. User needs to select the image for input.

The input image is then processed and the cluster are marked into the image. Clustering is done on the basis on the morphology and density of the cells. Morphology of a cell describes the shape, structure, form, and size of the cell. And density, defines the relative water content and composition of dry mass. It calculates the number of healthy melanocytes and unhealthy melanocytes.

On the basis of these number of melanocytes, the application distinguish the healthy and unhealthy melanocyte and proposed a pie graph.

Pie graph is form for 2 colours, light and dark. If the region of light is covering more than half of the graph then the skin tissue is healthy and the vitiligo report is negative, otherwise true.

Why YOLO is chosen?

YOLOv5 is a deep learning-based architecture chosen for this research due to its efficiency in object detection. It achieves state-of-the-art results while maintaining simplicity and reliability compared to other deep learning models. One of its key advantages is its lower computational requirement while delivering comparable accuracy and faster

performance. Additionally, YOLOv5 builds upon the architecture of YOLOv4, enhancing its capabilities. The selection of YOLOv5 for this study is driven by several factors, including its speed, efficiency, and robust performance in object detection tasks.

1. The potential of small size model to be used in mobile devices efficiently.
2. The network is state of the art in the field of quick object's identification.
3. This architectonic is flimsy that allow to edify this model using small computational assets and also keep it worthwhile as well.

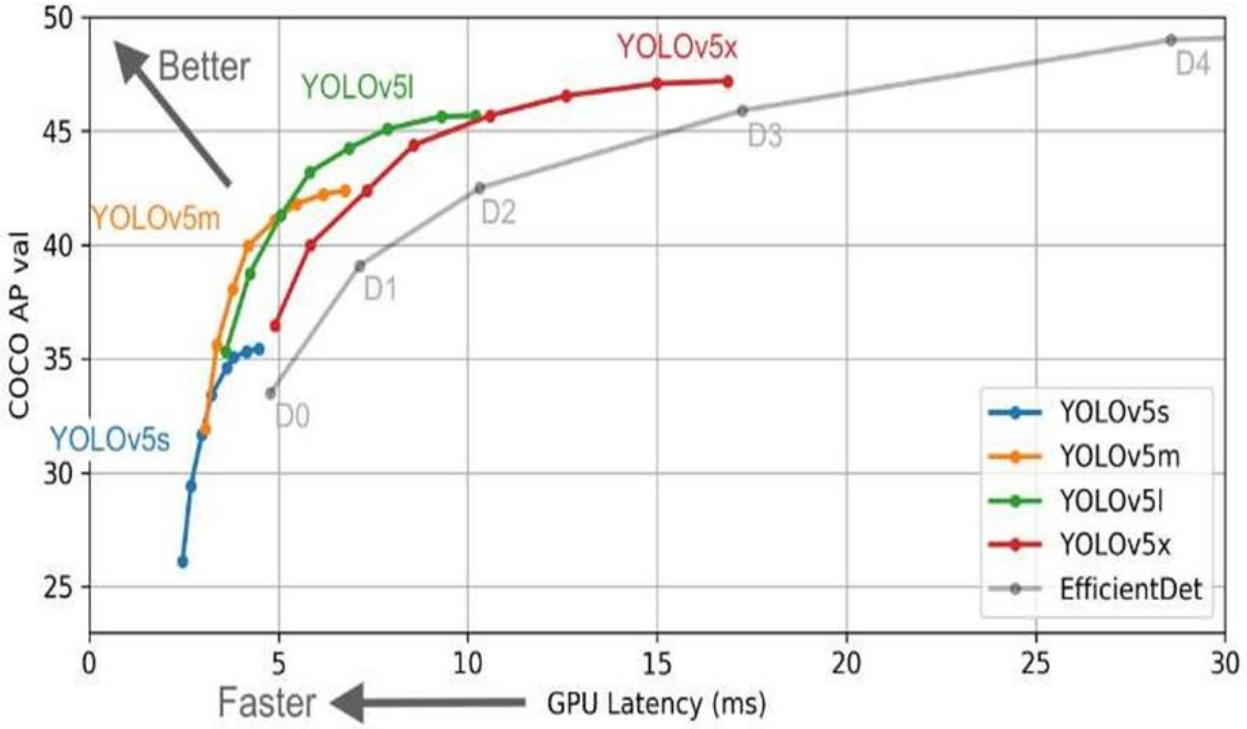
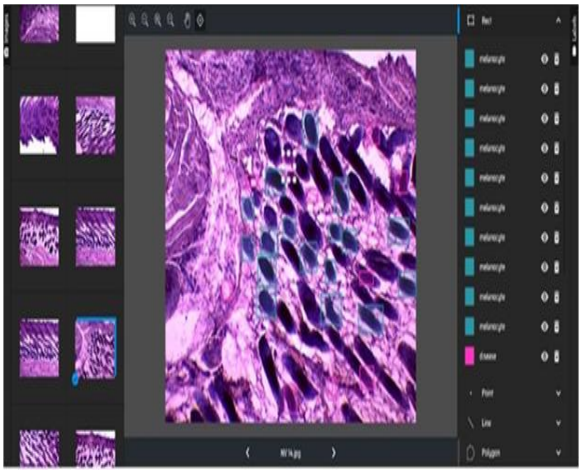


Image 4. Comparisons between Efficient Det and YOLOv5 models. Training process of this model

The initial step in the training the model involves hyper parameter tuning. To achieve this, we applied successive versions of YOLOv5's hyperparameter tuning techniques on both training and validation datasets. This approach enabled us to obtain more optimized parameters tailored to the dataset, enhancing overall performance. In 2nd step, we trained our model using the optimal hyper parameters, initiating from a previously trained YOLOv5 model checkpoints. Using an already trained model in computer vision is a familiar technique, which is known as Transfer Learning. Using transfer learning, speed of the training process is increase & it took the generalization to a higher level. During this experiment, we have observed the optimal count of epochs were 200, afterwards there were trifling changes in the model approach.



Output Screen

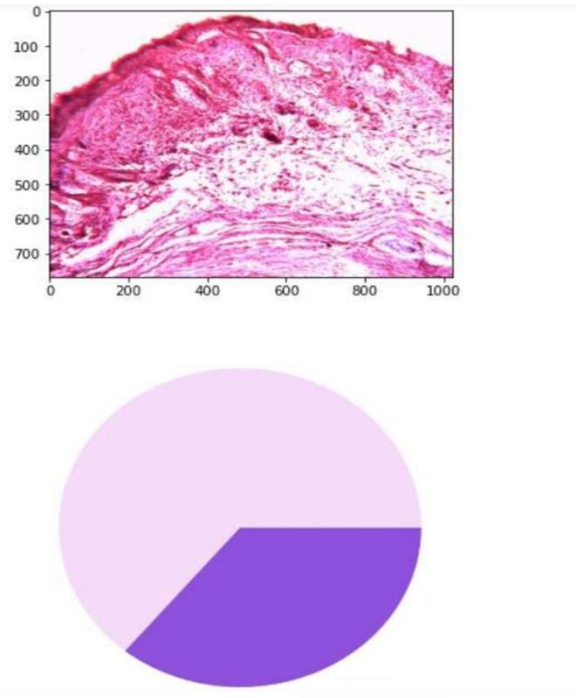


Image 6. Output screen 1

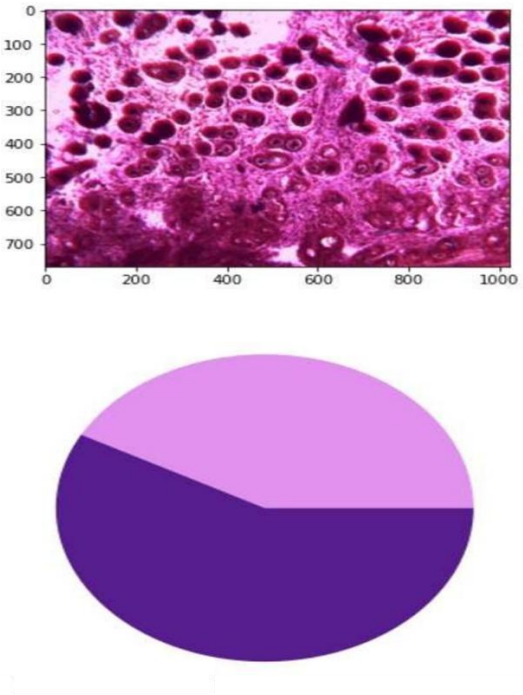


Image 7. Output screen 2

RESULTS & CONCLUSION

The preparatory results using a finite number of training data has shown an average 75% F1 score for prediction for various size of melanocytes. The result presented in this research is the average results of the annotated melanocytes in a tissue image.

Table 1. Result of the folds cross-validation process are combined.

Classes	Target(s)	Recall	Precision	F 1 score	mAP @ .5:.95	mAP @ .5
All	23	0.76	0.81	0.77	0.56	0.82
Melanocyte	13	0.76	0.82	0.75	0.58	0.84
Disease	10	0.78	0.80	0.79	0.58	0.83

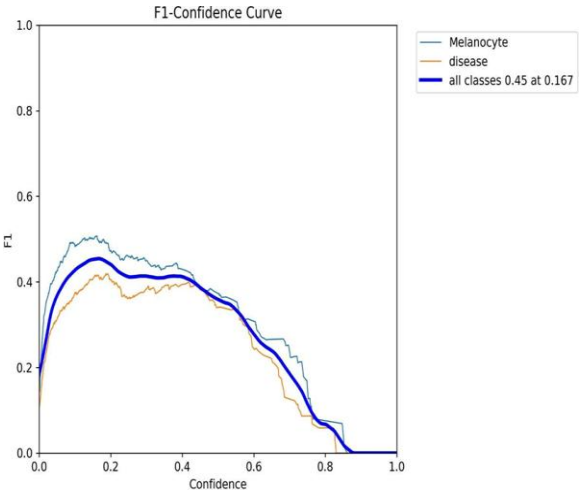


Image 8. F1 score of the prediction upon the test data.

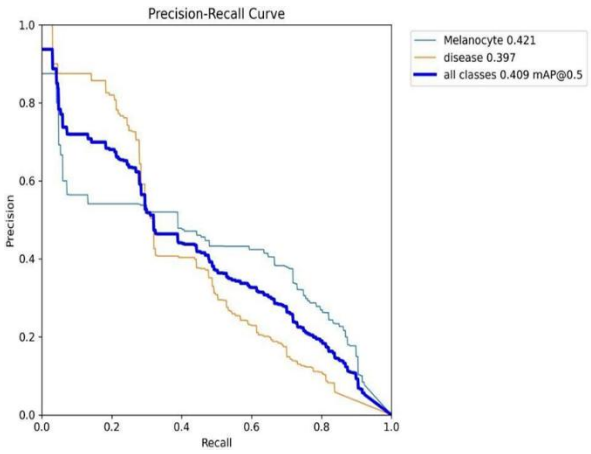


Figure 9. Precision-Recall. Values in the graph legend shows the Area under the ROC Curve (AUC) score for each image.

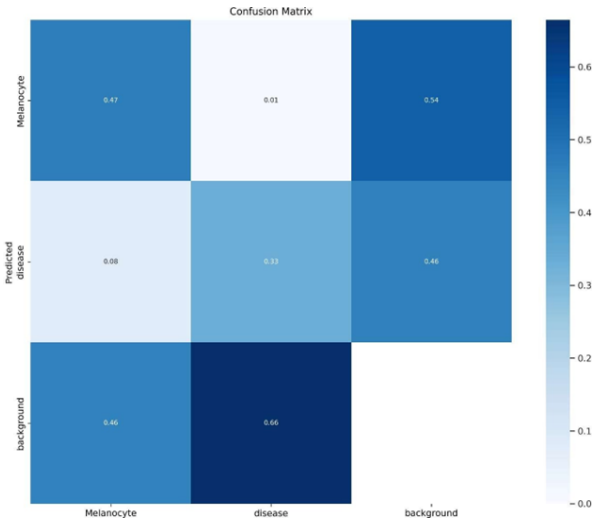


Figure 10. Matrix (Confusion matrix) for prediction on test data

We introduce YOLO and image segmentation, unified models for detail recognition. Our idea is clear to build and will be teaches on pictures. Unlike categorized-based algorithms, YOLO is trained on a reduction state which clearly directed to recognition accuracy and the whole image is trained altogether.

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