University of Peradeniya

Development of an Artificial Intelligence based Image Processing System for Industrial Sorting of Big Onion

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Abstract- This study combines OpenCV and TensorFlow for automated onion sorting using a Raspberry Pi camera setup. The model developed with SSD MobileNet V2 and converted to TensorFlow Lite, achieved a mean Average Precision of 77.94% and an F1-Score of 0.82.

Introduction

- Manual sorting of onions is labour-intensive.
- Cargills supermarket chains' collection centers sort onions at a rate of 156 kg/man/hour, for Pusa Red variety.

- High-tech sorting machines are not widely used due to their expense and the availability of cheaper labor.
- Affordable technology like Raspberry Pi and Pi Camera modules for image processing can enhance sorting efficiency cost effectively.

Objectives

I. To develop an artificial intelligence based identification system of big onions for industrial sorting
II. To evaluate the built model for its performance in real time identification

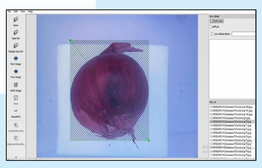
Materials & Method

Data Acquisition

- Image capturing using **Pi Camera** module integrated to **Raspberry Pi** Single Board Computer

Data Structuring

- Annotation of the images using **LabelImg** tool



Training the Model

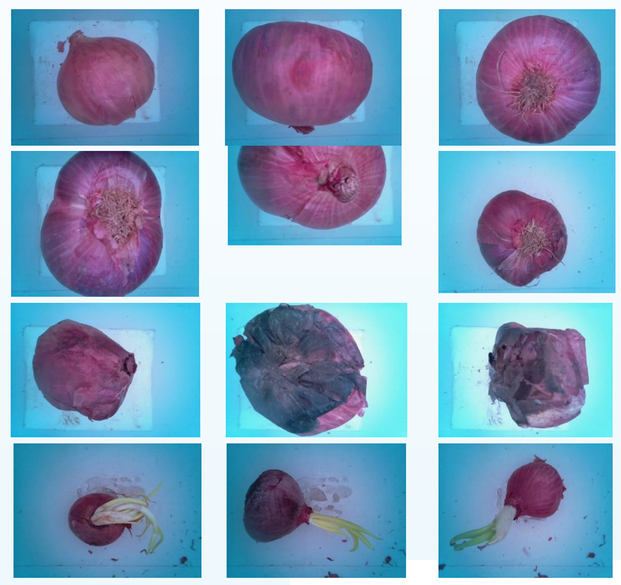
- Training a TensorFlow Lite model using **OpenCV** and **TensorFlow** Python modules

Evaluating the Model

- Evaluation of **accuracy**, **precision**, **recall, mean Average Precision** and **F1-Score**

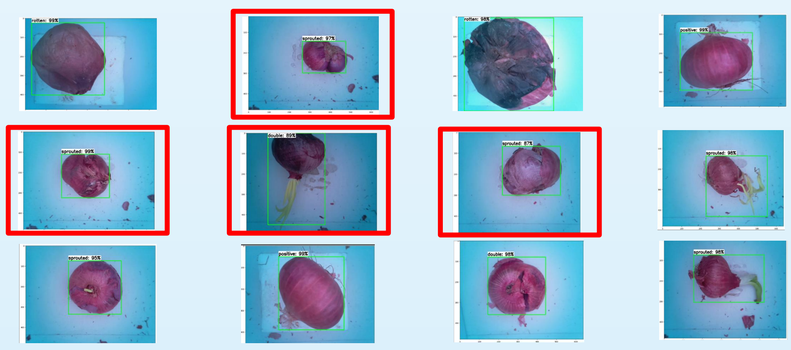
- Classification was done on 4 onion categories.

Good onions
Double onions
Rotten onions
Sprouted onions



python | Google Colaboratory | OpenCV | TensorFlow

Results & Discussion



- 4 incorrect classifications out of 20 images uploaded

$$Accuracy = \frac{TP+TN}{TP+TN+FP+FN}$$

$$Precision = \frac{TP}{TP+FP}$$

$$Recall = \frac{TP}{TP+FN}$$

$$F1-Score = \frac{2 \times Precision \times Recall}{Precision + Recall}$$

Conclusion

An AI based image processing model was built for sorting onion

- Accuracy 91.62%
- Precision 83.90%
- Recall 82.92%
- F1 – Score 0.827
- mean Average Precision 77.94%

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