# Project Name
# Pixelpals
# ITSP 2020

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# Idea behind the project

Although packaging of fruits has been automated, but the very first step of sorting the fruits into good and bad is still done manually in most of the cases when packing fruits for malls and supermarkets in large amounts.This is time consuming and costly. So we came up with an idea to automate the process of sorting fruits according to their ripeness and freshness; so that fruits which are nearly ripe or ripe can be shipped prior to those which are still unripe and not packing the overripe / bad fruits.

# Workflow

Gaining knowledge about Neural Networks

Dataset Gathering

Data Augmentation and Data Preprocessing

Training neural network models

Testing

Developing the app

# Project Details

We have created a mobile app which can predict the ripeness and freshness of mango and freshness of pear based on the outer appearance of the fruit in real time using neural network models.

The dataset was created by using online available dataset, google images and pictures clicked on our phones and sorting them based on ripeness and freshness. We implemented deep learning models and trained them using our dataset. Once we got accurate results, we deployed our models to the android app that we created.All the models were trained using  google colab and pytorch on gpu.The mobile app was created using pytorch mobile on android studio. The app size is 223 MB.

Mango Model Details: The best performance was achieved on custom model-maximum validation accuracy ~95%.

Pear Model Details: The best performance is was obtained on a custom model. It has achieved a best validation accuracy of 90% and test accuracy of 72.41%.

At present the model is good at predicting results where the input image contains single fruit and background is plain and light coloured.

# Results
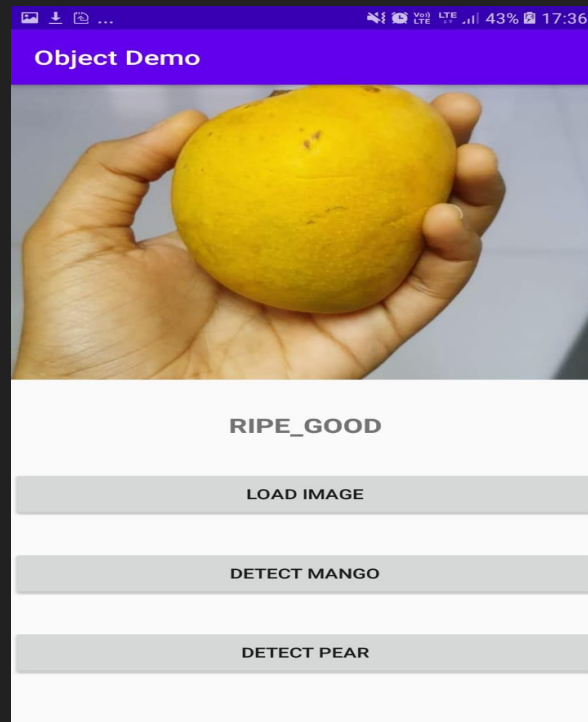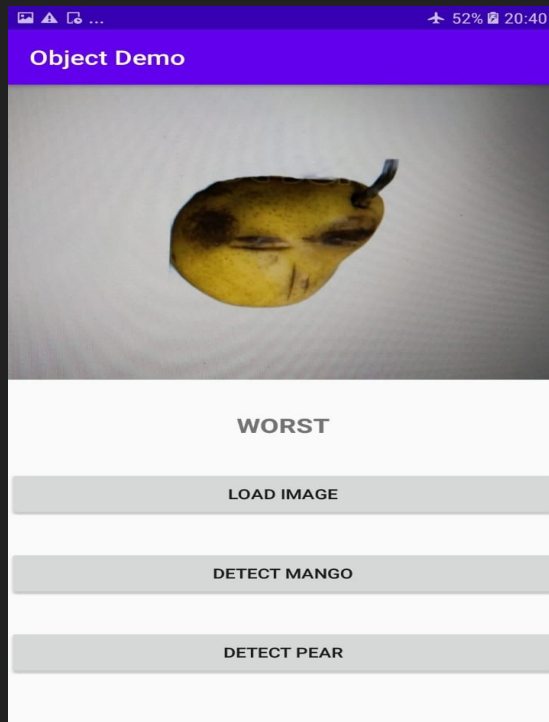
# Skills learnt

Neural Networks and Deep Learning and their applications in Computer Vision tasks such as image classification, image detection and segmentation, image captioning, GAN's. Using Google Colab, numpy and pytorch for Machine Learning tasks. Creating our own custom neural network. The practical skills of how to choose correct model, good hyperparameters,finetuning and debugging the errors.

App development using Pytorch Mobile in Android Studio.

Team work, patience and perseverance .

# Challenges faced

- Gathering the required dataset was a major challenge since the available dataset online did not meet our requirements, so we had to manually sort the data which we got online(for mango) and also manually create the dataset for pear from scratch.
- We tried classifying apples on the basis of just its appearance but even that could not give satisfactory results because some deciding features get suppressed under the same skin colour and texture. So we wanted to try hyper spectroscopy for classification since external features are sometimes deceptive or may even give incorrect results.
- However it had very minimal hardware implementation but some concrete knowledge on spectral analysis that we could not implement ourselves without someone's expertise in this topic.
- We were not able to gather dataset for artificially and naturally ripened fruits due to which we could not implement that feature.
- The app was giving wrong results when our model was integrated in the app although correct result on colab. So debugging the error took a lot of time.

# Conclusion/Future plans

- Once we are able to gather the dataset for artificially and naturally ripened fruits; we aim to build a model for classifying fruits as naturally ripened or artificially ripened.
- Expanding the model to classify images where the image contains not just one fruit but multiple fruits and predict a ripeness index for all the fruits present in the image.
- Integrate more fruits in the app.
- The performance of present model can be improved if a larger dataset is used.

*Although some of our ideas did not work either due to lack of dataset or lack of knowledge about hyper-spectroscopy; the journey which started with us wondering how can computer tell us which digit is fed as input to it to we building an app predicting fruit freshness and ripeness was a great and memorable one.*