HOPS & HATHA

IST-718 Big Data Analytics

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AUGUST MOON BREWERY

Creator of Hops & Hatha

Microbrewery with notable social media presence offers “Hops & Hatha” beer yoga sessions with highly popular instructors

Resumed “Hops & Hatha” at the brewery with live streaming to accommodate social distancing and market to new customers and demographics

Looking to expand website and mobile app to drive class attendance and increase customer loyalty with rewards towards beverage purchases and yoga participation

New functionalities leveraging machine learning & computer vision:

- Yoga pose identification
- Beer recognition model

Goal is to maintain strong presence in the beer and yoga community

OBSERVATION

Yoga is inclusive ...

Yoga Dataset

10 yoga poses: Child's, Downward Dog, Mountain, Plank, Seated Forward Bend, Tree, Triangle, Warrior 1, Warrior 2, Wheel

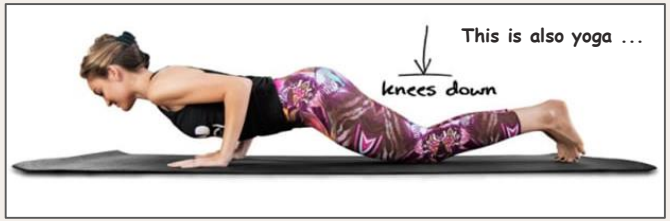
Training/validation datasets: 687 images (90%/10%)

Test dataset: 108 images

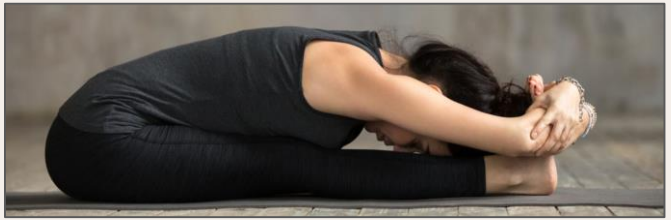
Challenge dataset: images with form variations and different angles

Images sourced from internet

Modification & Variation



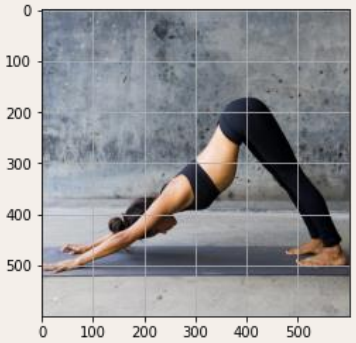
Similarity

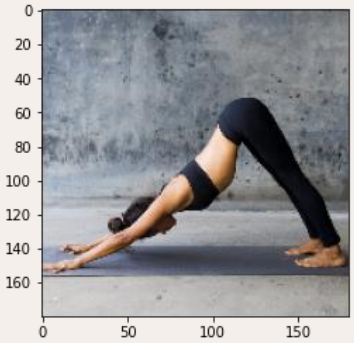


ANALYSIS

Data Preprocessing with tf.Keras

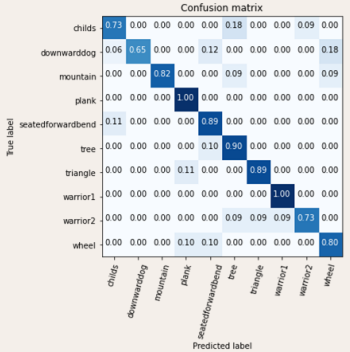
- Load images into TensorFlow datasets (training, validation, testing, challenge)
- Resize images to 180 x 180
- Rescale data between 0 and 1
- Visualize the data
- Evaluate if data augmentation is appropriate (flip, zoom, rotation, crop, etc.)





ANALYSIS

Convolutional Neural Networks



Final CNN Model Confusion Matrix & Prediction Examples

Baseline Model

- 2 x Convolution layers (32, 64)
- 2 x MaxPooling
- 2 x Dropout (0.2)
- optimizer = 'adam'
- Epochs = 20

Test Set Accuracy = **75%**

Final Model

- Data Augmentation layer (horizontal flip, 10% zoom, 10% crop)
- 3 x Convolution layers (32, 64, 64)
- 3 x MaxPooling
- 3 x Dropout (0.1, 0.1, 0.2)
- optimizer = 'adam'
- Epochs = 25

Test Set Accuracy = **82%**

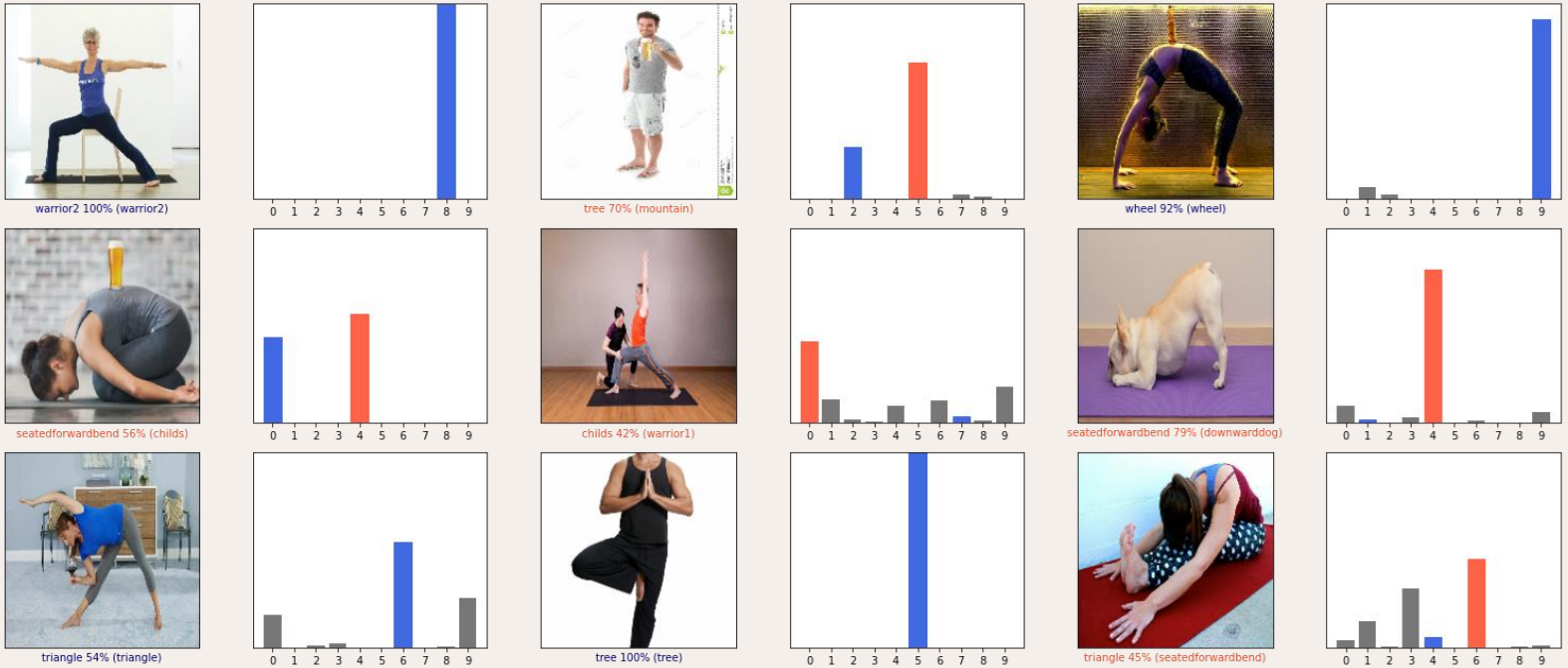
Classes: 0 - Child's, 1 - Downward Dog, 2- Mountain, 3- Plank, 4- Seated Forward Bend, 5 - Tree, 6 - Triangle, 7- Warrior 1, 8 - Warrior 2, 9 - Wheel

YOGA CHALLENGE

Model is exclusive ...

Challenge Prediction Findings

- Props in light color may not interfere
- Similar poses can be challenging
- Cropping in data augmentation works
- Single player only and not ready for dog yoga
- Beer and wine are both welcome



Classes: 0 - Child's, 1 - Downward Dog, 2- Mountain, 3- Plank, 4- Seated Forward Bend, 5 - Tree, 6 - Triangle, 7- Warrior 1, 8 - Warrior 2, 9 - Wheel

OBSERVATION

To can or not to can?

Beer Dataset

3 beer categories: Glass, Bottle, or Can

Training/test datasets: 888 / 100 (90% / 10%)

Challenge dataset: Images with variations, different lighting and non-hop based drinks

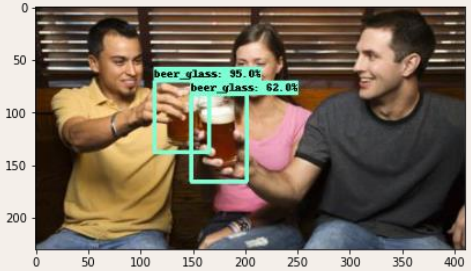
Images sourced from Open Images Dataset V6 + the internet

OpenCV + ImageAI

A combination of OpenCV + ImageAI's Yolov3 pre-trained model were considered as a low-code solution - initial results were promising

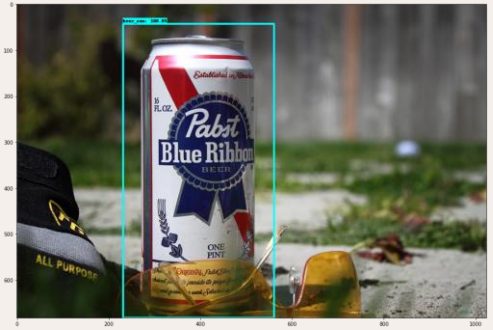
When put to the test, the required time to compute and frequent inaccuracy (example provided on the right) led us to consider a custom model instead.

TensorFlow



An application of the object detection API within Tensorflow 2 was considered to leverage transfer learning on pre-trained models.

Initial configuration and subsequent implementation is time-consuming. However, there is significant opportunity for fine tuning parameters to improve model behavior.



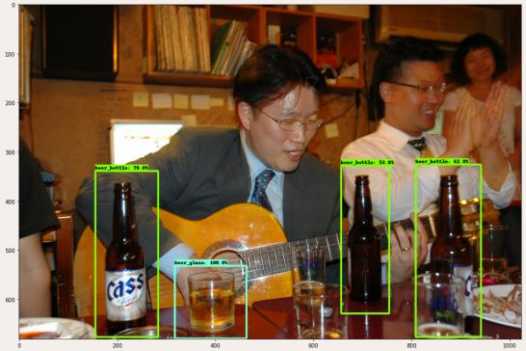
ANALYSIS All Flows lead to Tensors
Object Detection through Transfer Learning

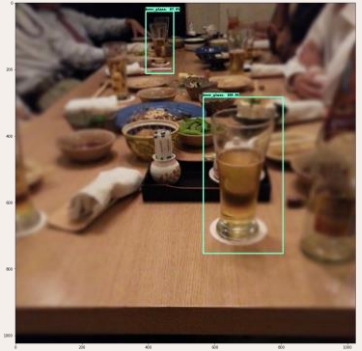
Base Model

- Pre-Trained Model: ssd_resnet50_v1_fpn_640x640
- Adam Optimizer
- # Beer Classes: 3
- Batch Size = 12
- Steps = 100000
- min loss = 0.096
- Time = 19.4 Hrs

Train Set mAP = **99.2% at IoU of 0.50**

Test Set mAP = **79.3% at IoU of 0.50**



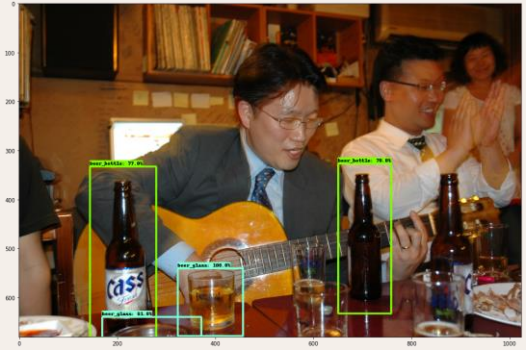


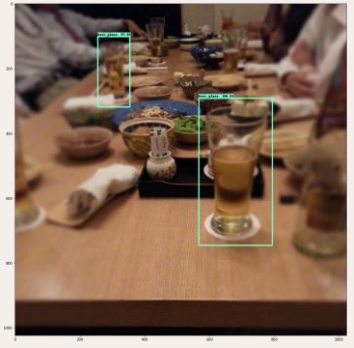
Final Model

- Pre-Trained Model: ssd_resnet50_v1_fpn_640x640
- Momentum Optimizer
- # Beer Classes: 3
- Batch Size = 8
- Steps = 25000
- min loss = 0.199
- Total Time = 4 hrs

Train Set mAP = **99.0% at IoU of 0.50**

Test Set mAP = **72.9% at IoU of 0.50**



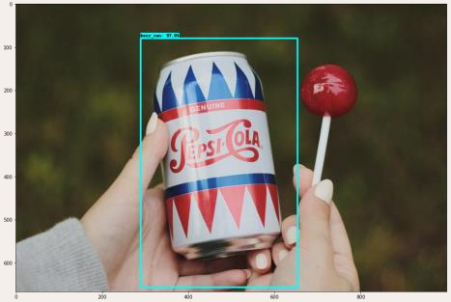


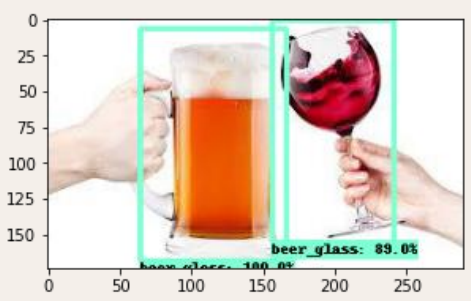
BEER CHALLENGE

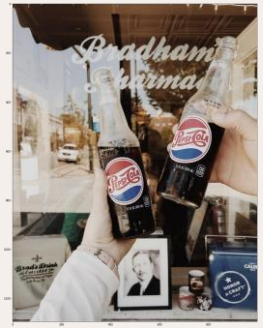
When your only tool is a hammer ...

Challenge Prediction Findings

Challenge set reveals the model considers all cans to be beer cans. Lighting on wine glasses can influence a misclassification as glass of beer. Cups of soda and mixed drinks can also be detected as glasses of beer.







SUMMARY OF FINDINGS

	Model / Method	Training Size	Training Time	Test Accuracy
Yoga Pose Classification	CNN (Keras + TensorFlow)	687 yoga images 10 classes	1 min	82%
Beer Object Recognition	OpenCV + ImageAI	180 3 classes	1.6 hrs	34%
	Deep Residual Learning (ResNet50 TensorFlow)	888 3 classes	4 hrs	73%

Note: Sklearn models accuracy were no higher than 17% in the test set.

While the models performed well independently, combining the beer detection and yoga pose classification metrics reduced the overall accuracy. That is to say both models did not necessarily produce a correct prediction on the same image. The challenge for effective yoga classification is adequate data collection and the necessity for subject matter expertise during training. The art of recognizing beer proved to be dependent on varying contexts such as angles, lighting and environment where detection was intended. A model trained with images from bars isn't going to perform well outdoors or in yoga studios.

Best Case

Beer: Glass 76%
Yoga: Triangle 24%

Only 1 is Correct

Beer: Incorrect prediction
Yoga: Downward Dog 25%

Neither is Correct

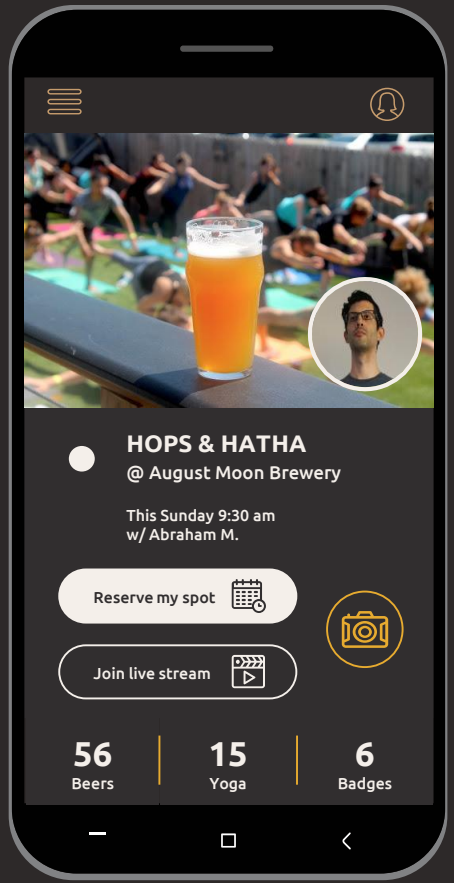
Beer: Incorrect prediction
Yoga: Downward Dog 15%

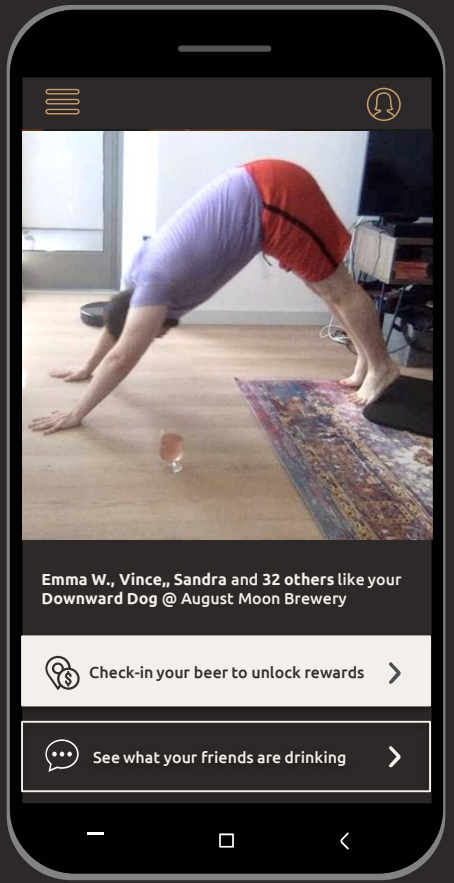
RECOMMENDATIONS

Feature Identification and Object Recognition are close cousins, but not siblings. Tuning models beyond baseline accuracy becomes a true mix of art and science. A specialized approach is therefore recommended.

Effective model training can be achieved through online image sourcing, however alternate approaches such as pose estimation (identifying joints and body parts) may also be considered.

Technologies like AR, Google Lens etc. are backed by powerful engines and skilled engineers - deploying this feature in an app may incur significant costs.






Cheers &
Namaste ...