IBM HACK CHALLENGE

Develop an accurate Model for Cricket Pose Estimation

Project Report

Team: Execution

Team member: Nitin Gahlawat

Number of members: 1

1 INTRODUCTION

1.1 Overview & Purpose

The use of this project is to make people aware about the pose in the cricket game so that next time when people watch cricket on the television or in the stadium they can predict the pose of the cricket accurately.

This project is very helpful in detecting the pose as well as predicting the class which it belongs to (cut,sweep,drive,fielding,bowling_action).

The pose of a player can be achieved using this project and it can also be classified into five categories:-

- Cut
- Sweep
- Drive
- Fielding
- Bowling_action

2 LITERATURE SURVEY

2.1 Proposed solution

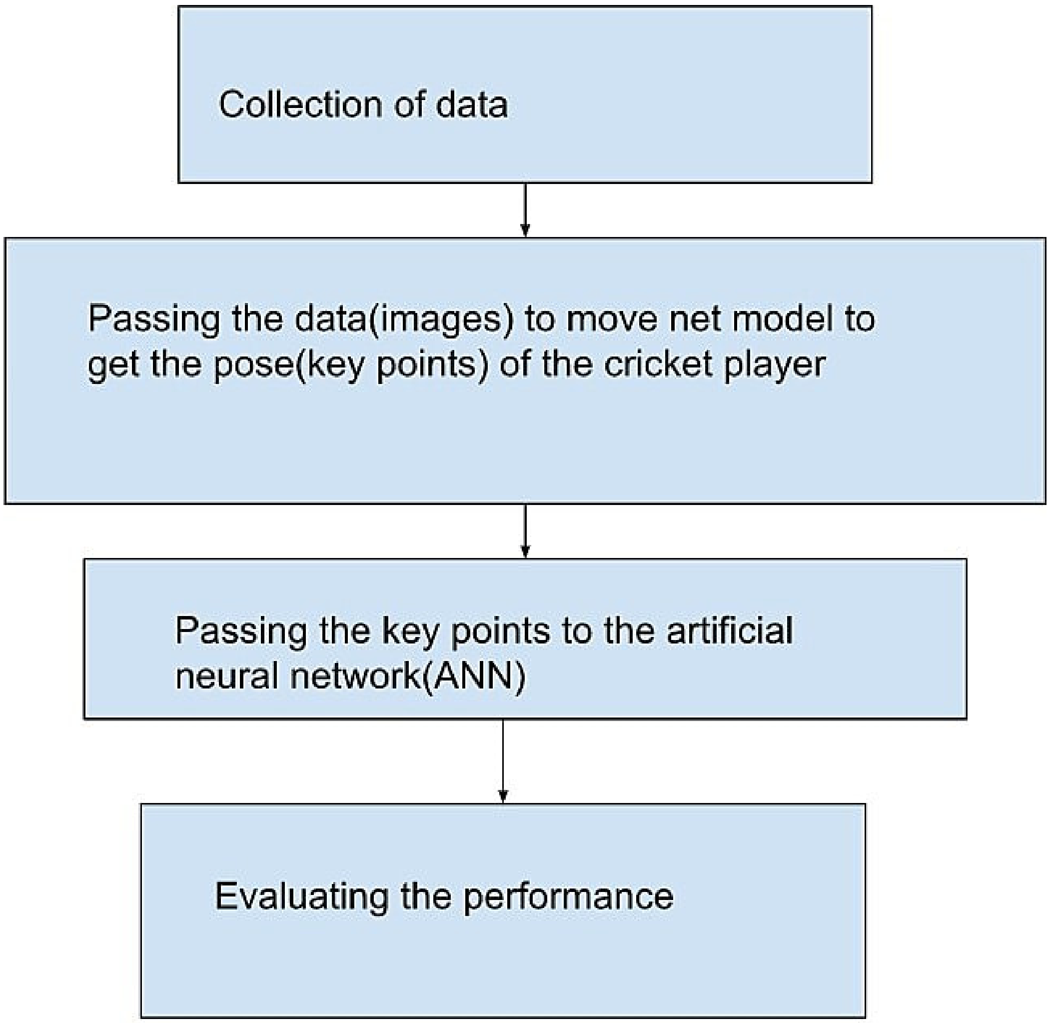
First, scrap the data from google (collection of data).

Then data needs to be processed and given to the movenet model available on tensorflow hub for pose prediction.

Finally, create your own Artificial Neural network model to classify it into classes.

3 THEORETICAL ANALYSIS

Block diagram



4 EXPERIMENTAL INVESTIGATIONS

Carefully analyze the pose first so that they can be classified within five classes(cut,sweep,drive,bowling action,fielding).

The image data set has been collected by scraping from Google to train the model.

5 RESULT

The model can predict the class of the cricketer’s pose(cut,sweep,drive,bowling action,fielding)

In the image given below, the cut is the class it belongs to.

```
In [34]: example(0) #this will take the data from the above array X
cut
```

6 ADVANTAGES & DISADVANTAGES

Advantages:

It is using the movenet model for predicting the key points (pose of the player) which can even detect the motion at a high speed of 30 frames per second.

Disadvantages:

Less data and less amount of the dense layer is used while building the model so the accuracy is affected.

7 APPLICATIONS

This model can be made available to sports club, cricket association boards to keep a check on how the players are doing and find out areas of improvement, it can be used for fair umpiring and hence revenue could be generated through the use of this model.

Provide this model to an open source platform such as github,gitlab so that this idea can lead to many more great ideas in the future.

8 CONCLUSION

The model can classify the image based on the five category such as cut,sweep,drive,fielding,bowling_action

The process of model construction is divided into four parts:

1)Scraping the data.

2)Finding the pose(or key points) using the movenet

3)Creating a Artificial neural network using the key points

4)Testing the model

9 FUTURE SCOPE

The model can be made more accurate using a large amount of data. I have trained the model on 5810 images (162 original *35),if the model is trained on more images it will lead to a higher accuracy.

This model can be armed with complex math to get higher accuracy in predicting and classifying the pose.

Use of dense layer neural networks for getting better accuracy.

10 BIBLIOGRAPHY

1. Google for scraping the image
2. IBM watson studio for training and deployment of the model

11. SOURCE CODE

```
#!/usr/bin/env python
# coding: utf-8

import os, types
import pandas as pd
from botocore.client import Config
import ibm_boto3

def __iter__(self): return 0

# @hidden_cell
# The following code accesses a file in your IBM Cloud Object Storage. It
includes your credentials.
```

```
# You might want to remove those credentials before you share the
notebook.
client_1618615d45cf46d6b2ac0ffc5768387a =
ibm_boto3.client(service_name='s3',
    ibm_api_key_id='EmBKGm4pdJCoEKaaqhzEeQq7otSWi9F6NMg_vvvZnLmo',
    ibm_auth_endpoint="https://iam.cloud.ibm.com/oidc/token",
    config=Config(signature_version='oauth'),
    endpoint_url='https://s3.private.us.cloud-object-
storage.appdomain.cloud')

streaming_body_1 =
client_1618615d45cf46d6b2ac0ffc5768387a.get_object(Bucket='cricketposeclass
ification-donotdelete-pr-x8lam4yk0mc1sp', Key='projectdata.zip')['Body']

# Your data file was loaded into a botocore.response.StreamingBody object.
# Please read the documentation of ibm_boto3 and pandas to learn more
about the possibilities to load the data.
# ibm_boto3 documentation: https://ibm.github.io/ibm-cos-sdk-python/
# pandas documentation: http://pandas.pydata.org/

ls -1



from io import  BytesIO
import zipfile
unzip=zipfile.ZipFile(BytesIO(streaming_body_1.read()),'r')
file_path=unzip.namelist()
for path in file_path:
    unzip.extract(path)
pwd
```

```
#including the libraries
import matplotlib.pyplot as plt
from matplotlib.collections import LineCollection
import matplotlib.patches as patches
get_ipython().run_line_magic('matplotlib', 'inline')
import numpy as np
import cv2
import os
import tensorflow as tf
import tensorflow_hub as hub
from tensorflow import keras
import PIL
import pathlib
from skimage.io import imread, imsave
from skimage import transform
from skimage.transform import rotate
from skimage.util import random_noise
from skimage.filters import gaussian

np.set_printoptions(suppress=True)

#this is used when we have have a zip file
# dataset_url =
"https://storage.googleapis.com/download.tensorflow.org/example_images/flowe
r_photos.tgz"
# path = tf.keras.utils.get_file('flower_photos', origin=dataset_url,
cache_dir='.', untar=True)
#makeing the size of the image default
IMAGE_SHAPE = (256, 256)
path= '/home/wsuser/work/projectdata'
```

```
#converting the path to path lib path for easy to use
data_dir = pathlib.Path(path)
data_dir

list(data_dir.glob('*/*.jpg' ))[:5] #five image in */*.jpg in cut folder
#total image to test_and_train
image_count = len(list(data_dir.glob('*/*.jpg')))
print(image_count)
#listing the first five image of cut
cut= list(data_dir.glob('cut/*'))
cut[:5]



# # plotting the image

#ploting the image
PIL.Image.open(str(cut[7]))



#making a pose dict for easiy use of the path we get using the pathlib
pose_dict = {
    'cut': list(data_dir.glob('cut/*')),
    'sweep':list(data_dir.glob('sweep/*')),
    'drive':list(data_dir.glob('drive/*')),
    'fielding': list(data_dir.glob('fielding/*')),
    'bowling_action':list(data_dir.glob('bowling_action/*'))
}

#get the target variable with the help of class
pose_labels_dict = {
```

```
    'cut': 0,
    'sweep': 1,
    'drive': 2,
    'fielding': 3,
    'bowling_action': 4
}
#to convert the predicted output to the class name
class_labels_dict = {
    0:'cut',
    1:'sweep',
    2:'drive',
    3:'fielding',
    4:'bowling_action'
}


# # ***data agmenetation working***
#data augmented for increasing the size of the data and making it more accurate
def data_append(img,pose):
    X.append(img)
    y.append(pose_labels_dict[pose_name])
def image_rotation(img,pose_name):
    #rotating the image
    rotate30 = rotate(img, angle=30)
    data_append(rotate30,pose_name)
    rotate45 = rotate(img, angle=45)
    data_append(rotate45,pose_name)
    rotate60 = rotate(img, angle=60)
    data_append(rotate60,pose_name)
    rotate90 = rotate(img, angle=90)
```

```
    data_append(rotate90,pose_name)
def data(img,pose_name):
    image_rotation(img,pose_name)

    rescaled = transform.rescale(img, 1.1) # Image rescaling with
sklearn.transform.rescale
    data_append(rescaled,pose_name)
    image_rotation(rescaled,pose_name)

    up_down = np.flipud(img) # flip up-down using np.flipud
    data_append(up_down,pose_name)
    image_rotation(up_down,pose_name)

    left_right = np.fliplr(img) # flip right and left using np.flipud
    data_append(left_right,pose_name)
    image_rotation(left_right,pose_name)

    noised = random_noise(img, var=0.1**2) # Apply Random Noise to image
using skimage.utils.random_noise
    data_append(noised,pose_name)
    image_rotation(noised,pose_name)

    highB = img + (100/255) # Increasing the brighness of the Image
    data_append(highB,pose_name)
    image_rotation(highB,pose_name)

    highC = img * 1.5 # Increasing the contrast of the Image
    data_append(highC,pose_name)
    image_rotation(highC,pose_name)
#storing the image(actual+augmented) in for of numpy array
X=[]
```

```
y=[]
for pose_name, images in pose_dict.items():
    for image in images:
        img = cv2.imread(str(image))
        resized_img = cv2.resize(img,IMAGE_SHAPE) #it is bgr form so we
have to convert it into rgb
        RGB_img = cv2.cvtColor(resized_img, cv2.COLOR_BGR2RGB)
        X.append(RGB_img)
        y.append(pose_labels_dict[pose_name])
        data(RGB_img,pose_name)



#total number of image (actual+augmented)
len(X)



# # ***using movenet for posedection***

#dictonary colour and the keypoint which is predicted by the move net
KEYPOINT_DICT = {
    'nose': 0,
    'left_eye': 1,
    'right_eye': 2,
    'left_ear': 3,
    'right_ear': 4,
    'left_shoulder': 5,
    'right_shoulder': 6,
    'left_elbow': 7,
    'right_elbow': 8,
    'left_wrist': 9,
    'right_wrist': 10,
```

```
    'left_hip': 11,
    'right_hip': 12,
    'left_knee': 13,
    'right_knee': 14,
    'left_ankle': 15,
    'right_ankle': 16
}

KEYPOINT_EDGE_INDS_TO_COLOR = {
    (0, 1): 'm',
    (0, 2): 'c',
    (1, 3): 'm',
    (2, 4): 'c',
    (0, 5): 'm',
    (0, 6): 'c',
    (5, 7): 'm',
    (7, 9): 'm',
    (6, 8): 'c',
    (8, 10): 'c',
    (5, 6): 'y',
    (5, 11): 'm',
    (6, 12): 'c',
    (11, 12): 'y',
    (11, 13): 'm',
    (13, 15): 'm',
    (12, 14): 'c',
    (14, 16): 'c'
}

#used for display the key points on the image
def
```

```
_keypoints_and_edges_for_display(keypoints_with_scores,height,width,keypoi
nt_threshold=0.11):
  keypoints_all = []
  keypoint_edges_all = []
  edge_colors = []
  num_instances, _, _, _ = keypoints_with_scores.shape
  for idx in range(num_instances):
    kpts_x = keypoints_with_scores[0, idx, :, 1]
    kpts_y = keypoints_with_scores[0, idx, :, 0]
    kpts_scores = keypoints_with_scores[0, idx, :, 2]
    kpts_absolute_xy = np.stack(
        [width * np.array(kpts_x), height * np.array(kpts_y)], axis=-1)
    kpts_above_thresh_absolute = kpts_absolute_xy[
        kpts_scores > keypoint_threshold, :]
    keypoints_all.append(kpts_above_thresh_absolute)

    for edge_pair, color in KEYPOINT_EDGE_INDS_TO_COLOR.items():
      if (kpts_scores[edge_pair[0]] > keypoint_threshold and
          kpts_scores[edge_pair[1]] > keypoint_threshold):
        x_start = kpts_absolute_xy[edge_pair[0], 0]
        y_start = kpts_absolute_xy[edge_pair[0], 1]
        x_end = kpts_absolute_xy[edge_pair[1], 0]
        y_end = kpts_absolute_xy[edge_pair[1], 1]
        line_seg = np.array([[x_start, y_start], [x_end, y_end]])
        keypoint_edges_all.append(line_seg)
        edge_colors.append(color)
  if keypoints_all:
    keypoints_xy = np.concatenate(keypoints_all, axis=0)
  else:
    keypoints_xy = np.zeros((0, 17, 2))
```

```
  if keypoint_edges_all:
    edges_xy = np.stack(keypoint_edges_all, axis=0)
  else:
    edges_xy = np.zeros((0, 2, 2))
  return keypoints_xy, edges_xy, edge_colors

#display the images
def draw_prediction_on_image(
    image, keypoints_with_scores, crop_region=None, close_figure=False,
    output_image_height=None):
  height, width, channel = image.shape
  aspect_ratio = float(width) / height
  fig, ax = plt.subplots(figsize=(12 * aspect_ratio, 12))
  # To remove the huge white borders
  fig.tight_layout(pad=0)
  ax.margins(0)
  ax.set_yticklabels([])
  ax.set_xticklabels([])
  plt.axis('off')

  im = ax.imshow(image)
  line_segments = LineCollection([], linewidths=(4), linestyle='solid')
  ax.add_collection(line_segments)
  # Turn off tick labels
  scat = ax.scatter([], [], s=60, color='#FF1493', zorder=3)

  (keypoint_locs, keypoint_edges,
   edge_colors) = _keypoints_and_edges_for_display(
       keypoints_with_scores, height, width)

  line_segments.set_segments(keypoint_edges)
```

```
  line_segments.set_color(edge_colors)
  if keypoint_edges.shape[0]:
    line_segments.set_segments(keypoint_edges)
    line_segments.set_color(edge_colors)
  if keypoint_locs.shape[0]:
    scat.set_offsets(keypoint_locs)

  if crop_region is not None:
    xmin = max(crop_region['x_min'] * width, 0.0)
    ymin = max(crop_region['y_min'] * height, 0.0)
    rec_width = min(crop_region['x_max'], 0.99) * width - xmin
    rec_height = min(crop_region['y_max'], 0.99) * height - ymin
    rect = patches.Rectangle(
        (xmin,ymin),rec_width,rec_height,
        linewidth=1,edgecolor='b',facecolor='none')
    ax.add_patch(rect)

  fig.canvas.draw()
  image_from_plot = np.frombuffer(fig.canvas.tostring_rgb(), dtype=np.uint8)
  image_from_plot = image_from_plot.reshape(
      fig.canvas.get_width_height()[::-1] + (3,))
  plt.close(fig)
  if output_image_height is not None:
    output_image_width = int(output_image_height / height * width)
    image_from_plot = cv2.resize(
        image_from_plot, dsize=(output_image_width, output_image_height),
         interpolation=cv2.INTER_CUBIC)
  return image_from_plot



#loading and using the model
```

```python
module = hub.load("https://tfhub.dev/google/movenet/singlepose/thunder/4")

#function for prediction of the pose
def movenet(input_image):
  model = module.signatures['serving_default']
  input_image = tf.cast(input_image, dtype=tf.int32)
  outputs = model(input_image)
  keypoints_with_scores = outputs['output_0'].numpy()
  return keypoints_with_scores

#predicting the pose points for all the images and storing it into output
input_size=256
output=[]
for i in range(len(X)):
  image= tf. convert_to_tensor(X[i])
  input_image = tf.expand_dims(image, axis=0)
  input_image = tf.image.resize_with_pad(input_image, input_size,
input_size)
  keypoints_with_scores = movenet(input_image)
  output.append(keypoints_with_scores)

#function for ploting the image and pose points
def img_show(image_pose_points,image_path_loc):
  if (type(image_path_loc)==str):
    '''if path is given'''
    image = tf.io.read_file(image_path_loc)
    image = tf.image.decode_jpeg(image)
  else:
    image=tf.convert_to_tensor(X[image_path_loc])
  '''if pos in x is given'''
  display_image = tf.expand_dims(image, axis=0)
```

```
  display_image = tf.cast(tf.image.resize_with_pad(display_image, 1280,
1280), dtype=tf.int32)
  output_overlay =
draw_prediction_on_image(np.squeeze(display_image.numpy(),
axis=0),image_pose_points)

  plt.figure(figsize=(5,5))
  plt.imshow(output_overlay)
  _ = plt.axis('off')

#ploting the 173 image of the X
p=0
img_show(output[p],p)



# # ***traning a nural network***

#converting the list to numpy array
output=np.array(output)
y=np.array(y)



#flatten the layer to feed it into the ANN
output1=output.reshape(len(output),17*3)

#splitinf the data into train and test
from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test =
train_test_split(output1,y,test_size=0.3,random_state=0)
```

```
#builing the model and fiting the X_train and y_train
model = keras.Sequential([
    keras.layers.Dense(75, input_shape=(51,), activation='relu'),
    keras.layers.Dense(units=256, activation='relu'),
    keras.layers.Dense(units=192, activation='relu'),
    keras.layers.Dense(units=150, activation='relu'),
    keras.layers.Dense(units=5, activation='softmax')
])

model.compile(optimizer='adam',
              loss='sparse_categorical_crossentropy',
              metrics=['accuracy'])
with tf.device('/GPU:0'):
  model.fit(X_train,y_train, epochs=100)


#evaluate the model on same X_test and y_test
model.evaluate(X_test,y_test)


model.save('model_saved.h5')


# # ***EVALUATING EXAMPLES***

def example(path):
    input_size=256
    if (type(path)==str):
        '''if path is given'''
        image = tf.io.read_file(path)
        image = tf.image.decode_jpeg(image)
```

```
    else:
        image=tf.convert_to_tensor(X[path])
    input_image = tf.expand_dims(image, axis=0)z
    input_image = tf.image.resize_with_pad(input_image, input_size,
input_size)
    # Run model inference.
    keypoints_with_scores = movenet(input_image)
    img_show(keypoints_with_scores,path)
    keypoints_with_scores=keypoints_with_scores.reshape(1,17*3)

print(class_labels_dict[np.argmax(model.predict(keypoints_with_scores))])

example(0) #this will take the data from the above array X

path=str(cut[10])
example(path) #this is the specified path
```