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Improving Video Classification Accuracy using Cloud

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Abstract: The focus of this project is on the frame level features. One of the promising algorithms that can be used for this purpose is Deep Bag of Frame pooling (DBoF). Deep bag of frame model is a convolutional neural network (CNN). The main idea is to design two layers in the convolutional part. The approach enjoys the computational benefits of CNN, while at the same time the weights on the up-projection layer can still provide a strong representation of input features on frame level. The classification is performed at the final layer of the CNN. We will use the Youtube-8M dataset for experimentation. The Youtube-8M dataset is the largest publicly available multi-label video classification dataset, with approximately 8 Million videos annotated with 3862 classes of labels. The videos within the dataset averages 3.01 labels per video, where the number of labels per video ranges from 1 to 23. As this dataset covers over 500,000 hours of video, 2.6 billion audio and visual features have been extracted and pre-processed in advance by the Google Research Team as it would be infeasible for research teams to train hundreds of Terabytes worth of video for their model.

Keywords: Video classification, convulational neural network, machine learning.

I. INTRODUCTION

There is an English idiom: “a picture is worth a thousand words”. Such theory has been standing in human society for many years, as this is the way our brain functions. With the development of neural network and deep learning, it can be applied to machine as well. In other words, we human beings are able to teach or train computer to recognize objects from pictures and even describe them in our natural language. Thanks, Google, for organizing this ‘Google Cloud & YouTube8M Video Understanding Challenge’, which gives us a wonderful opportunity to test new ideas and implement them with the Google cloud platform. Google cloud recently released the datasets and organized ‘Google Cloud & YouTube-8M Video Understanding Challenge’ on Kaggle. Competitors are challenged to develop classification algorithms that assign video-level labels using the new and improved Youtube-8M V2 dataset. Large-scale datasets have played a significant role in progress of neural network and deep learning areas. YouTube-8M is such a benchmark dataset for general multilabel video classification. It was created from over 7 million YouTube videos (450,000 hours of video) and includes video labels from a vocabulary of 4716 classes (3.4 labels/ video on average). It also comes with pre-extracted audio & visual features from every second of video (3.2 billion feature vectors total).

ImageNet is one of the large Scale of datasets which have been key enablers of recent progress in image understanding.

By supporting the learning process of deep networks with millions of parameters, such datasets have played a crucial role for the rapid progress of image understanding to near-human level accuracy.

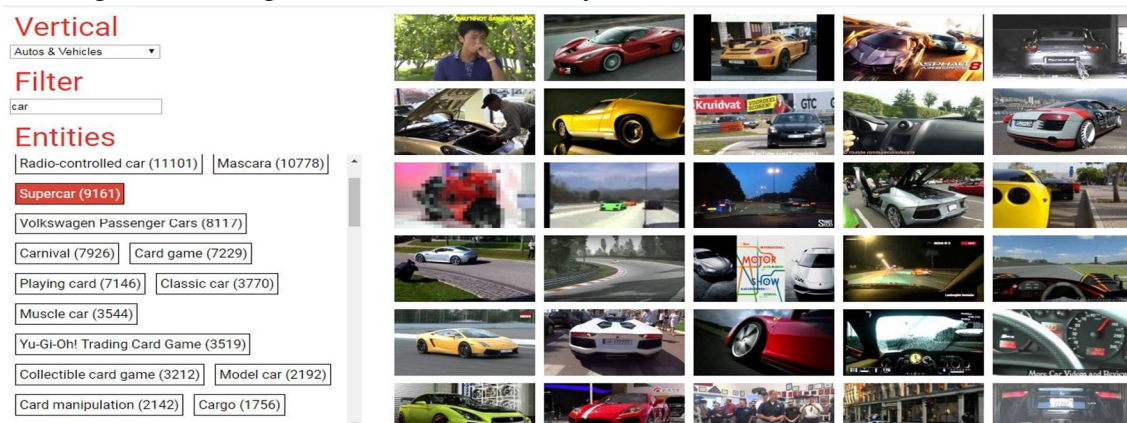


Fig 1: This screenshot of a YouTube-8M dataset (which is a large-scale benchmark for general multi-label video classification) explorer depicts a subset of videos in the dataset annotated with the entity “CAR”.

Video has become an indispensable form of media in the modern society. According to YouTube company statistics, every minute there are 300 hours of video uploaded to YouTube and every day there are nearly 5 billion videos being watched. Not only the number of videos we are dealing with is immense, but also the themes of the video has become extremely diverse. The types of videos we encounter in daily life range from entertainment use such as music videos, movies and games, educational use of lectures and experiments, to the many newly emerging technologies such as drones and autonomous cars. Under such background, an efficient method to solve large-scale video classification is desired, which could in turn be applied to content discovery and filtering. Video classification is an inherently difficult task for various reasons. The dataset for video classification is usually limited to a particular scene and separate for video and audio features. The most well studied video datasets, such as Sports-1M, Activity Net, UCF-101 are all confined to a certain theme of videos. Thus, their models are more suitable in very specific classification task in that theme than generic classification with a large number of classes. We provide several models of using both audio and visual features to classify YouTube videos. We demonstrate that the additional audio information in the training process significantly improves the model performance. The focus of this project is on the frame level features. One of the promising algorithms that can be used for this purpose is Deep Bag of Frame pooling (DBoF). Deep bag of frame model is a convolutional neural network (CNN). The main idea is to design two layers in the convolutional part. In the first layer, the up-projection layer, the weights are still applied on frames, although all selected frames share the same parameter. The second layer is pooling the previous layer into video level. The approach enjoys the computational benefits of CNN, while at the same time the weights on the up-projection layer can still provide a strong representation of input features on frame level. The classification is performed at the final layer of the CNN. We will use the Youtube-8M dataset for experimentation. The Youtube-8M dataset is the largest publicly available multi-label video classification dataset, with approximately 8 Million videos annotated with 3862 classes of labels. The videos within the dataset averages 3.01 labels per video, where the number of labels per video ranges from 1 to 23. As this dataset covers over 500,000 hours of video, 2.6 billion audio and visual features have been extracted and pre-processed in advance by the Google Research Team as it would be infeasible for research teams to train hundreds of Terabytes worth of video for their model.

II. LITERATURE SURVEY

Sl No.	Title of the Paper	Authors	Month & Year	Observations
1	Cloud Based Video Analytics using convolutional networks	Muhammad Usman Yaseen, Ashiq Anjum, Mohsen Farid, Nick Antonopoulos	August 2018	CNN, Learning Rate, SGD, stochastic gradient descent
2	Efficient video Classification Using Fewer Frames	Shweta Bharadwaj, Mukundhan Srinivasan, Mitesh M. Khapra	Feb 2019	-
3	Cloud Based Video Prepositions With Classification Of Client In Public systems	A. Arjuman Banu, A.K Reshmy		Cloud Storage, online social networks, video recommendation, media cloud and spammer detection
4	A Survey Of Research on Cloud Robotics and Automation	Be3n kehoe, Pieter Abbeel	November 2014	Cloud Automation, Cloud Robotics, Big Data, Cloudsourcing
5	A survey on Object detection and Classification methods from Video stream	Tasnia Bushra, Muhib Hassan Khan		Object detection, learning, training, classification
6	A Survey On Video Classification using action recognition	Caleb Andrew, Rex Fiona	2018	Multiple Instance learning, Conditional Random Field
7	A Review of machine learning techniques used for video classification	Seetha Parameshwaran, Dr. Shelbi Joseph	December 2017	Video classification techniques, video based approach, Deep learning
8	Video classification with Recurrent Neural Network	Bhagyashri P. Lokhande, Sanjay s. Gharde	January 2016	Video Classification, recurrent Neural Network, recurrent Multilayer Perceptron,
9	Semi Supervised and Active Learning in video Scene Classificaion from Statistical Features	Tomas Sabata, Petr Pulc, Martin Holena		Video data, scene classification, semi-supervised learning, colour statistics, feedforward neural networks
10	A survey of content aware video	Huang-Chia Shih	May 2018	Action recognition, content aware

	analysis for sports			system,content based video analysis,semantic analysis, sport video analysis.
11	A survey of the techniques for the identification and classification of human actions from visual data	Shahela saif, Samabia tehseen,Sumaira Kausar	November 2018	Computer vision, action recognition,deep learning
12	Effective news video classification based on audio content:A multiple instance learning approach	Vivek P, Kumar Rajamani,Lajish		Video classification,multiple instance learning,feature extraction,mi-Graph,mi-SVM
13	RGB-D-based human motion recognition with deep learning	Pichao wang, wanqing Li,Philip Ogunbona,Jun Wan,Sergio Escalera	May 2018	Human motion recognition,RGB-D data, Deep learning
14	Automatic Video Classification:A Survey of the Literature	Darin Brezeale and Diane J.cook	2017	Video classification, text based approaches, audio based approaches
15	Video Classification	Pravina Baraiya, Disha Sanghani	March 2018	Video classification, text based approaches, audio based approaches,visual based approach
16	Self Supervised Video Representation Learning With Odd-One-Out networks	Basura Fernando,Hakan Bilen, Efsatratios Gavves,Stephen Gould	2017	Odd-one-out learning,learning video representation with O3N
17	A Survey Paper on :Video Classification techniques	Nirav Bhatt,aspriha R. Das	2015	Audio based,T,video classification Techniques,VisualBased
18	Large scale video classification with Convolutional Neural Networks	Andrej Karpathy,George Toderici, Sanketh Shetty,Thomas Leung,Rahul Sukthankar,Li Fei-Fei		CNN,

- 1) **Problem Statement:** The objective of the research is be able to develop video level and frame level features for analyzing video contents and a framework for video classification by applying machine learning algorithm. This project focuses on widening the horizon for video classification with use of Youtube8M data set as input, and using CNN for recognizing better features. The ultimate goal is to ascertain the type of actions being performed and use video-level and frame level features to classify the videos with promising accuracy.

III. METHODOLOGY

A. Feature Extractor

A deep model, namely an Inception network, trained on ImageNet was used to preprocess the videos and extract frame-level features. An Inception Network is like a Convolutional Neural Network except it has been heavily modified to boost results and performance. The following points are the procedures and specifications of the feature extraction process of this dataset:

- 1) Each video was decoded at 1 frame-per-second up to the first 360 seconds (6 minutes). This cap was implemented for storage and computation reasons.
- 2) Decoded frames are fed into the Inception Network.
- 3) The Rectified Linear Unit (ReLU) activation function of the last hidden layer before the classification layer is fetched.
- 4) The feature vector is 2048-dimensional per second of video
- 5) Principal Component Analysis (PCA) along with whitening was applied to scale down the feature dimensions to 1024, followed by quantization (1 byte per coefficient)
- 6) PCA and Quantization down samples the size of the data by the factor of 8
- 7) The mean vector and covariance matrix for PCA was computed on all frames from the training partition
- 8) Each 32-bit float was quantized into 256 distinct values (8 bits) using optimally computed (non-uniform) quantization bin boundaries
- 9) The dataset is then broken into 3844 shares each for the training, validation, and testing partitions
- 10) The dataset is separated into the Frame-level features dataset, which is approximately 1.53 Terabytes, and the Video-level features dataset, which is approximately 31 Gigabytes

B. Multilabel Classifier

This step involves selection of the most significant features for classification. We use Knowledge Graph entities to succinctly describe the main themes of a video. Biking, not Dirt, Road, Person, Sky, and so on. Therefore, the aim of the dataset is not only to understand what is present in each frame of the video, but also to identify the few key topics that best describe what the video is about. Note that this is different than typical event or scene recognition tasks, where each item belongs to a single event or scene. This would produce thousands of labels on each video but without answering what the video is really about. The goal of this benchmark is to understand what is in the video and to summarize that into a few key topics. In the following subsections, we describe our vocabulary and video selection scheme, followed by a brief summary of dataset statistics. We followed two main tenets when designing the vocabulary for the dataset; namely 1) every label in the dataset should be distinguishable using visual information alone, and 2) each label should have sufficient number of videos for training models and for computing reliable metrics on the test set.

C. Code & Implementation

```
import os
import sys
import tarfile
import numpy
from six.moves import urllib
import tensorflow as tf
INC_TF_GRAPH = 'http://download.tensorflow.org/models/image/imagenet/inception-2015-12-05.tgz'
PCA_MAT = 'http://data.yt8m.org/yt8m_pca.tgz'
MOD_DIR = 'yt8m'
class FeatureExtractor(object):
# Extracts YouTube8M features for RGB frames.
def __init__(self, mod_dir=MOD_DIR):
# Create model directory if not created.
self._mod_dir = mod_dir
if not os.path.exists(mod_dir):
os.makedirs(mod_dir)
# Load PCA Matrix.
dw_path = self._download(PCA_MAT)
pca_mean = os.path.join(self._mod_dir, 'mean.npy')
if not os.path.exists(pca_mean):
tarfile.open(dw_path, 'r:gz').extractall(mod_dir)
self._load_pca()
# Load Inception Network
dw_path = self._download(INC_TF_GRAPH)
inc_proto_file = os.path.join(
self._mod_dir, 'classify_image_graph_def.pb')
if not os.path.exists(inc_proto_file):
tarfile.open(dw_path, 'r:gz').extractall(mod_dir)
self._load_mod(inc_proto_file)
def extract_rgb_frame_features(self, frame_rgb, apply_pca=True):
# Applies feature extraction on an RGB frame.
with self._inc_graph.as_default():
frame_features = self.session.run('pca_final_feature:0', feed_dict={'DecodeJpeg:0': frame_rgb})
return frame_features
def apply_pca(self, frame_features):
# Applies the PCA Transformation over the given frame
# Subtract mean
```

```

feats = frame_features - self.pca_mean
# Multiply by eigenvectors.
feats = feats.reshape((1, 2048)).dot(self.pca_eigenvecs).reshape((1024,))
# Whiten
feats /= numpy.sqrt(self.pca_eigenvals + 1e-4)
return feats
def _download(self, url):
    """Downloads `url` if not in `_mod_dir`."""
    filename = os.path.basename(url)
    dw_path = os.path.join(self._mod_dir, filename)
    if os.path.exists(dw_path):
        return dw_path
def _load_mod(self, proto_file):
    graph_def = tf.GraphDef.FromString(open(proto_file, 'rb').read())
    self._inc_graph = tf.Graph()
    with self._inc_graph.as_default():
        _ = tf.import_graph_def(graph_def, name='')
    self.session = tf.Session()
    Frame_Features = self.session.graph.get_tensor_by_name('pool_3/_reshape:0')
    Pca_Mean = tf.constant(value=self.pca_mean, dtype=tf.float32)
    Pca_Eigenvecs = tf.constant(value=self.pca_eigenvecs, dtype=tf.float32)
    Pca_Eigenvals = tf.constant(value=self.pca_eigenvals, dtype=tf.float32)
    Feats = Frame_Features[0] - Pca_Mean
    Feats = tf.reshape(tf.matmul(tf.reshape(Feats, [1, 2048]), Pca_Eigenvecs), [1024, ])
    tf.divide(Feats, tf.sqrt(Pca_Eigenvals + 1e-4), name='pca_final_feature')
def _load_pca(self):
    self.pca_mean = numpy.load(os.path.join(self._mod_dir, 'mean.npy'))[:, 0]
    self.pca_eigenvals = numpy.load(os.path.join(self._mod_dir, 'eigenvals.npy'))[:, 1024, 0]
    self.pca_eigenvecs = numpy.load(os.path.join(self._mod_dir, 'eigenvecs.npy')).T[:, :1024]

```

D. Structure and Data Flow Diagram

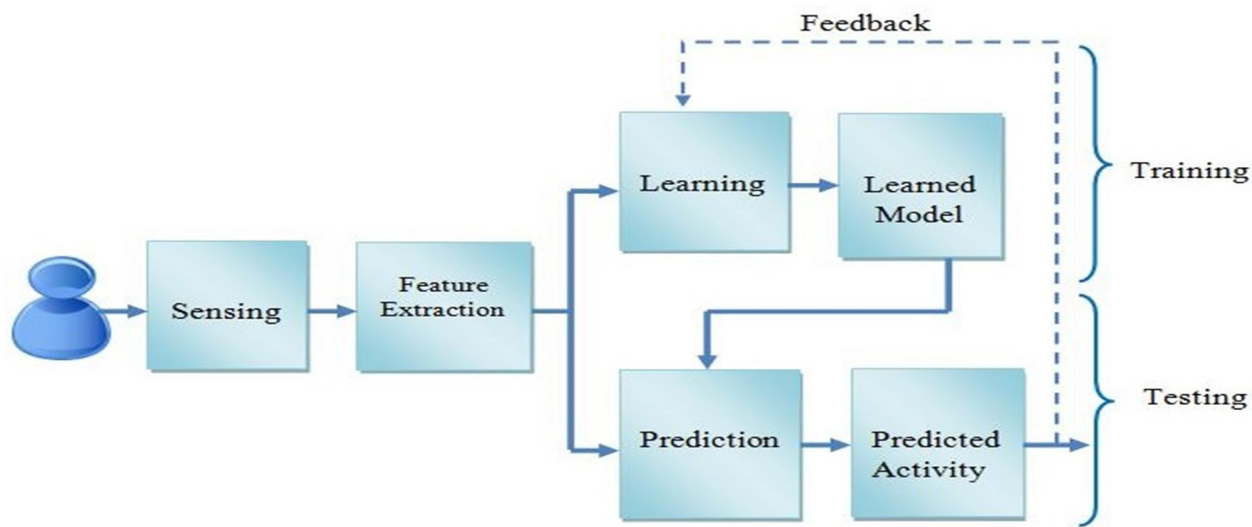


Fig 2: General Structure

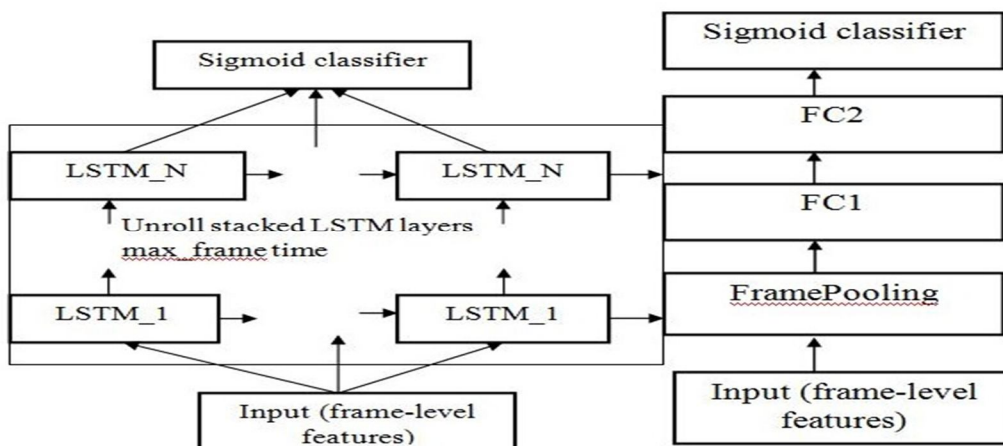


Fig 3: Data Flow Daigram

The above diagram shows us the flow of the program. The data is first collected from youtube8M data set and then the raw data is filtered and then it is segmented and then data is sent for feature extraction where the process of extraction begins. After that the Regression algorithms like LSTM, DboF and logistic regression is being applied and the classification is done with the help of machine learning algorithms.

IV. RESULT AND CONCLUSION

```
Python 3.6.1 Shell
File Edit Shell Debug Options Window Help
~1.7994473
~0.89259434
~0.6644931
~0.036850497
~1.3864683
~1.1794611
~1.2980651
0.6854687
1.4357729
~0.04229126
~0.3838031
~0.2219121
~0.18828583
0.17335947
~0.42733422
1.7577924
~2.398067
0.118692756
0.020571172
~0.55994604
0.34546173
1.3222119
0.119642325
0.79191464
0.9102284
1.0369117
0.2422019
1.0742588
0.36332908
0.2875115
~0.13650994
0.17312238
0.06666624
~0.8113318
0.06668807
0.7970724
0.2687308
~1.4245447

Extraction of features from frame is complete!
>>>
```

V. CONCLUSIONS

From survey on melanoma detection through image processing techniques results showed that the features used where able to differentiate between normal and cancerous lesions and also we are able to compare between ostus's and modifier ostus method. Modified ostus method works the best for image segmentation purpose and takes the least amount of time. Future work may include increasing the dataset size and trying this technique on a greater number of images. Different machine learning algorithm will be investigated in order to improve the accuracy.

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