1D CNN for Human Activity Recognition

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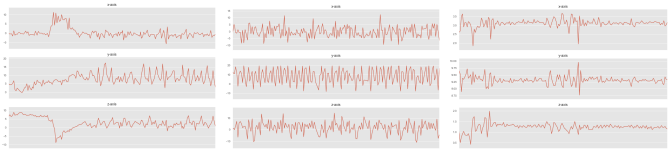
Overview

Human Activity Recognition (HAR) aims to identify the actions performed by humans using signals collected from various sensors embedded in mobile devices. Various analysis and models have been proposed, one among them is referring to 1D CNN for HAR. This project is an analysis based on this paper, where various parameters and hyperparameters have been varied to analyse the model for better results.

Keywords: *Human Activity Recognition, 1D-CNN, Hyperparameter Tuning*.

Data

Utilized data collected and published in UCI machine learning and University of Mannheim.



Downstairs *Jogging* *Sitting*

Exploratory

Projecting each data on the other data such as Walking timeline on Running, Sitting on Standing, Jogging on Walking; we see that there is some difference among the values of such.

Climbing stairs *Sitting/Standing* *Jogging/Walking*

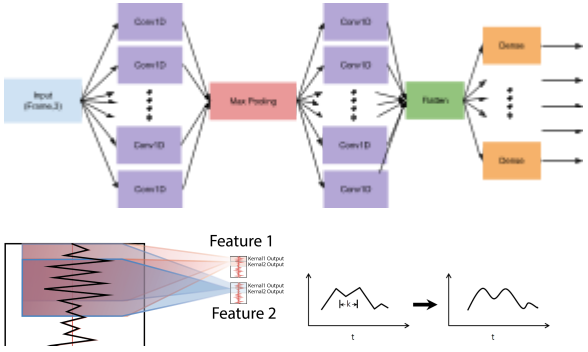
Preprocessing

1. Standardizing data
   Various data are in different range suc
2. Creating window which is acts as input to 1D CNN
   a. 80 frames
   b. 120 frames
   c. 160 frames
3. Output has multiple classes.

Neural Network

Keras provides convenient methods for creating Convolutional Neural Networks (CNNs) of 1, 2, or 3 dimensions: Conv1D, Conv2D and Conv3D.

1. The standard CNN model contains:
   a. Input Layer (frame_size,3)
   b. Convolution Layer
   c. Pooling Layer
   d. Flattening Layer
   e. Neural Network
2. As data is time series which is 1D thus using Conv 1D



Results

Grid Search for identifying best batch size and epochs

```
Best: 0.896012 using {'batch_size': 80, 'epochs': 50}
0.884512 (0.023552) with: {'batch_size': 30, 'epochs': 8}
0.892609 (0.038243) with: {'batch_size': 30, 'epochs': 20}
0.882930 (0.025027) with: {'batch_size': 30, 'epochs': 30}
0.885039 (0.022253) with: {'batch_size': 30, 'epochs': 40}
0.886187 (0.030988) with: {'batch_size': 30, 'epochs': 50}
0.881492 (0.018957) with: {'batch_size': 30, 'epochs': 50}
0.883265 (0.027367) with: {'batch_size': 30, 'epochs': 50}
0.871477 (0.029357) with: {'batch_size': 80, 'epochs': 8}
```

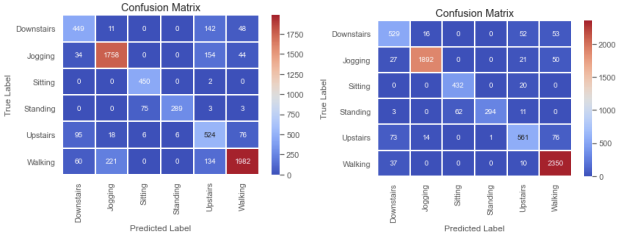
Algorithm built with 80 epochs and 50 batch size

Accuracy 0.97/0.91

Various Frame size

Frame Size	Accuracy	Macro Precision	Macro Recall
80	0.97/0.91	0.88	0.85
120	0.95/0.92	0.90	0.89
160	0.97/0.92	0.90	0.89

Multi Head Architecture



Accuracy : 0.99/0.87 to 0.98/0.92

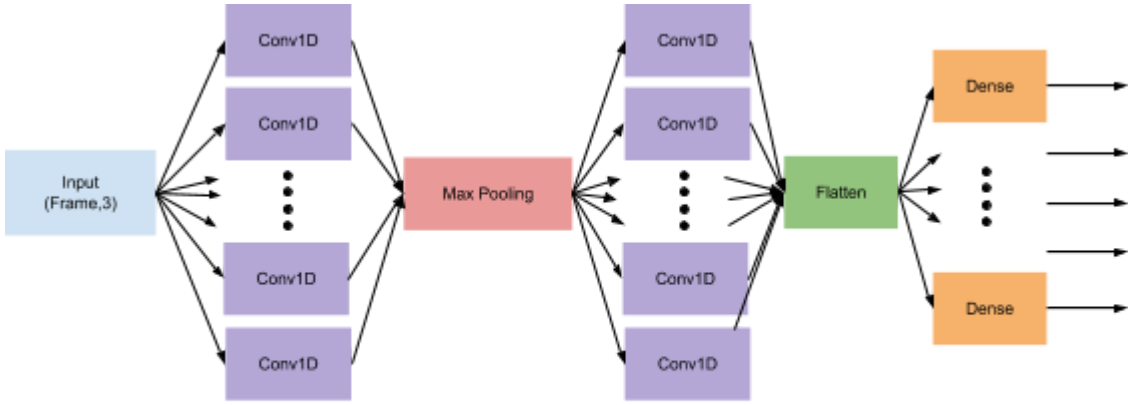


Fig: Single Headed 1D CNN

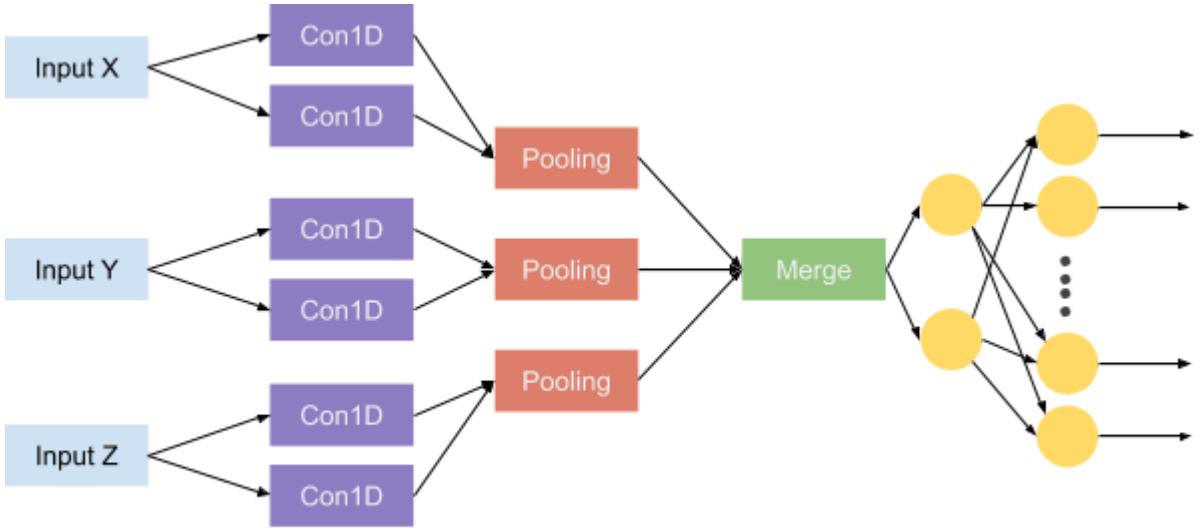


Fig: Multi Headed 1D CNN

References :

1. 1D Convolutional Neural Network Models for Human Activity Recognition
2. Human Activity Recognition with OpenCV and Deep Learning
3. Cho, H.; Yoon, S.M. Divide and Conquer-Based 1D CNN Human Activity Recognition Using Test Data Sharpening. Sensors 2018, 18, 1055.
4. Keras Document Conv1D