

In [1]: `# Import Data`

In [2]:

```
import itertools
import os
# plt.style.use('ggplot')
from warnings import filterwarnings

import matplotlib.pyplot as plt
import numpy as np
import pandas as pd
import pywt
# from keras.callbacks import ModelCheckpoint, CSVLogger
# from keras.layers import Dense, Dropout, LSTM, Input
# from keras.models import Model
# from keras.utils import to_categorical
from tensorflow.keras.callbacks import ModelCheckpoint, CSVLogger
from tensorflow.keras.layers import Dense, Dropout, LSTM, Input
from tensorflow.keras.models import Model
from tensorflow.keras.utils import to_categorical
from mlxtend.plotting import plot_confusion_matrix
from scipy.signal import find_peaks
from sklearn.metrics import confusion_matrix, accuracy_score, classification_re

# from keras.models import Sequential
# from keras.layers import Dense, Dropout, LSTM, Activation
# from keras.callbacks import EarlyStopping

filterwarnings('ignore')
# %matplotlib
# inline
```

```
D:\DocumentsDDrive\Installed_Files\Anaconda3\envs\tf-gpu\lib\site-packages\tensorflow\python\framework\dtypes.py:523: FutureWarning: Passing (type, 1) or '1type' as a synonym of type is deprecated; in a future version of numpy, it will be understood as (type, (1,)) / '(1,)type'.
    _np_qint8 = np.dtype([("qint8", np.int8, 1)])
D:\DocumentsDDrive\Installed_Files\Anaconda3\envs\tf-gpu\lib\site-packages\tensorflow\python\framework\dtypes.py:524: FutureWarning: Passing (type, 1) or '1type' as a synonym of type is deprecated; in a future version of numpy, it will be understood as (type, (1,)) / '(1,)type'.
    _np_quint8 = np.dtype([("quint8", np.uint8, 1)])
D:\DocumentsDDrive\Installed_Files\Anaconda3\envs\tf-gpu\lib\site-packages\tensorflow\python\framework\dtypes.py:525: FutureWarning: Passing (type, 1) or '1type' as a synonym of type is deprecated; in a future version of numpy, it will be understood as (type, (1,)) / '(1,)type'.
    _np_qint16 = np.dtype([("qint16", np.int16, 1)])
D:\DocumentsDDrive\Installed_Files\Anaconda3\envs\tf-gpu\lib\site-packages\tensorflow\python\framework\dtypes.py:526: FutureWarning: Passing (type, 1) or '1type' as a synonym of type is deprecated; in a future version of numpy, it will be understood as (type, (1,)) / '(1,)type'.
    _np_quint16 = np.dtype([("quint16", np.uint16, 1)])
D:\DocumentsDDrive\Installed_Files\Anaconda3\envs\tf-gpu\lib\site-packages\tensorflow\python\framework\dtypes.py:527: FutureWarning: Passing (type, 1) or '1type' as a synonym of type is deprecated; in a future version of numpy, it will be understood as (type, (1,)) / '(1,)type'.
    _np_qint32 = np.dtype([("qint32", np.int32, 1)])
D:\DocumentsDDrive\Installed_Files\Anaconda3\envs\tf-gpu\lib\site-packages\tensorflow\python\framework\dtypes.py:532: FutureWarning: Passing (type, 1) or
```

```
'1type' as a synonym of type is deprecated; in a future version of numpy, it
will be understood as (type, (1,)) / '(1,)type'.
```

```
np_resource = np.dtype([("resource", np.ubyte, 1)])
```

In [3]:

```
# set data folder path
DATA_FOLDER = r'./MAREA_dataset'
ACTIVITY_FOLDER = os.path.join(DATA_FOLDER, 'Activity Timings')
SUBJECT_FOLDER = os.path.join(DATA_FOLDER, 'Subject Data_txt format')
PROCESSED_FOLDER = os.path.join(DATA_FOLDER, 'Processed_data')

# define activity timing labels
label_indoor = ['tread_flat_walk_start',
                 'tread_flat_walk_end',
                 'tread_flat_run_end',
                 'tread_slope_walk_start',
                 'tread_slope_walk_end',
                 'indoor_flat_walk_start',
                 'indoor_flat_walk_end',
                 'indoor_flat_run_end']

label_outdoor = ['outdoor_walk_start',
                  'outdoor_walk_end',
                  'outdoor_run_end']

# prepare timing index for different activities
df_indoor_time = pd.read_csv(os.path.join(ACTIVITY_FOLDER, 'Indoor Experiment 1'),
                             names=label_indoor)

df_outdoor_time = pd.read_csv(os.path.join(ACTIVITY_FOLDER, 'Outdoor Experiment 1'),
                             names=label_outdoor)

df_indoor_time["subject"] = ["Sub" + str(i) for i in range(1, 12)]
df_outdoor_time["subject"] = ["Sub" + str(j) for j in range(12, 21)]
```

In [4]:

```
# set up activity column names
axis_list = ['accX', 'accY', 'accZ']
pos_list = ['LF', 'RF', 'Waist', 'Wrist']
sub_list = ['Sub' + str(i) for i in range(1, 21)]
column_names = [f"{{y}}_{x}" for x, y in itertools.product(pos_list, axis_list)]

# TODO: purposely exclude subject 4 first as missing data -- dont know how to do this
sub_list.remove('Sub4')
```

In [5]: column\_names

Out[5]: ['accX\_LF',  
 'accY\_LF',  
 'accZ\_LF',  
 'accX\_RF',  
 'accY\_RF',  
 'accZ\_RF',  
 'accX\_Waist',  
 'accY\_Waist',  
 'accZ\_Waist',  
 'accX\_Wrist',  
 'accY\_Wrist',  
 'accZ\_Wrist']

In [6]:

```
# create master dataframe
const_master_df = pd.DataFrame()
for sub in sub_list:
    df_lf = pd.read_csv(os.path.join(SUBJECT_FOLDER, sub + '_' + 'LF.txt'))
    df_rf = pd.read_csv(os.path.join(SUBJECT_FOLDER, sub + '_' + 'RF.txt'))
    df_waist = pd.read_csv(os.path.join(SUBJECT_FOLDER, sub + '_' + 'Waist.txt'))
    df_wrist = pd.read_csv(os.path.join(SUBJECT_FOLDER, sub + '_' + 'Wrist.txt'))
    df_sub = pd.concat([df_lf, df_rf, df_waist, df_wrist], axis=1)
    df_sub.columns = column_names

    df_sub = df_sub.copy()
    n = int(sub[3:])
    if n > 11:
        sub_row = df_outdoor_time[df_outdoor_time['subject'] == sub]
        tmp = sub_row.iloc[0]
        df_sub.loc[0:tmp['outdoor_walk_end'], 'label'] = 'outdoor_walk'
        df_sub.loc[tmp['outdoor_walk_end']: tmp['outdoor_run_end'], 'label'] =
    else:
        sub_row = df_indoor_time[df_indoor_time['subject'] == sub]
        tmp = sub_row.iloc[0]
        df_sub.loc[0:tmp['tread_flat_walk_end'], 'label'] = 'tread_flat_walk'
        df_sub.loc[tmp['tread_flat_walk_end']: tmp['tread_flat_run_end'], 'label']
        df_sub.loc[tmp['tread_flat_run_end']: tmp['tread_slope_walk_start'], 'label']
        df_sub.loc[tmp['tread_slope_walk_start']: tmp['tread_slope_walk_end'], 'label']
        df_sub.loc[tmp['tread_slope_walk_end']: tmp['indoor_flat_walk_start'], 'label']
        df_sub.loc[tmp['indoor_flat_walk_start']: tmp['indoor_flat_walk_end'], 'label']
        df_sub.loc[tmp['indoor_flat_walk_end']: tmp['indoor_flat_run_end'], 'label']

    df_sub['subject'] = sub
    const_master_df = const_master_df.append(df_sub)
# print(df.shape)
```

In [7]:

```
const_master_df.head(5)
```

Out[7]:

	accX_LF	accY_LF	accZ_LF	accX_RF	accY_RF	accZ_RF	accX_Waist	accY_Waist	accZ_Waist
0	-2.196	-11.765	-1.569	4.078	-6.902	2.196	-0.157	-8.157	0.784
1	-2.510	-10.353	-2.039	4.392	-8.000	1.255	-0.157	-8.000	1.256
2	-2.353	-10.824	-2.510	4.863	-8.314	0.941	-0.157	-7.843	1.256
3	-1.882	-10.667	-2.667	4.549	-9.412	-0.157	-0.157	-8.000	1.412
4	-1.412	-10.353	-2.824	3.451	-10.353	-0.784	-0.627	-7.529	1.882



```
In [8]: def PreprocessingSignal(df, label, subject, feature, window,
                                wavelet_args={"type": "Y",
                                              "threshold": 2,
                                              "wavedec_options": {"wavelet": "db4", "level": 1},
                                              "waverec_options": {"wavelet": "db4"}, },
                                window_args={"type": "no_overlap"}):
    df = df.loc[(df['label'] == label) & (df['subject'] == subject)]

    ### Do wavelet transform or NOT ####
    if wavelet_args["type"] == "Y":
        # wavelet_args = {"threshold":2, "options": {"wavelet": "db4", "Level": 0}}
        # Do wavelet transform
        signal_orig = df[feature].values
        args1 = wavelet_args["wavedec_options"]
        coeffs_orig = pywt.wavedec(signal_orig, **args1)
        coeffs_filter = coeffs_orig.copy()
        threshold = wavelet_args["threshold"]
        for i in range(1, len(coeffs_orig)):
            coeffs_filter[i] = pywt.threshold(coeffs_orig[i], threshold * max(coeffs_orig))
        args2 = wavelet_args["waverec_options"]
        signal_denoised = pywt.waverec(coeffs_filter, **args2)
        to_process_df = pd.DataFrame(signal_denoised)
    else:
        tmp_df = df[feature].reset_index()
        to_process_df = tmp_df.drop(columns=["index"])
        to_process_df.columns = [0]
    ### Do wavelet transform or NOT ####

    min_index = min(to_process_df.index)
    max_index = max(to_process_df.index)

    ### Define Method to cut signal into windows ####
    if window_args["type"] == "no_overlap":
        # window_args = {"type": "no_overlap"}
        index_list = range(min_index, max_index + 1, int(window))
    elif window_args["type"] == "with_overlap":
        # window_args = {"type": "with_overlap", "overlap_perc": 0.5}
        overlap_perc = window_args["overlap_perc"]
        step = int(window / (1 / overlap_perc))
        index_list = range(min_index, max_index + 1, step)
    elif window_args["type"] == "by_peaks":
        index_list = window_args["peaks_index"]
    ### Define Method to cut signal into windows ####

    ### Cut signal into windows ####
    windowed_selected_chunk_array = []
    for index in index_list:
        windowed_selected_chunk = to_process_df[0].iloc[index:index + window]
        if windowed_selected_chunk.shape[0] == window:
            windowed_selected_chunk_array.append(windowed_selected_chunk.values)
    output_np_arr = np.array(windowed_selected_chunk_array)
    ### Cut signal into windows ####

    output_np_label = np.asarray([label] * output_np_arr.shape[0])
```

```
    return output_np_arr, output_np_label
```

```
In [9]: # feature_list = column_names TODO: is this line still needed?
```

```
    # Create
    const_indoor_activity = ['rest',
                             'tread_flat_walk',
                             'tread_flat_run',
                             'tread_slope_walk',
                             'indoor_flat_walk',
                             'indoor_flat_run']
    const_outdoor_activity = ['outdoor_walk', 'outdoor_run']

    const_indoor_sub = ['Sub' + str(i) for i in range(1, 12)]
    const_outdoor_sub = ['Sub' + str(i) for i in range(12, 21)]
    const_indoor_sub.remove('Sub4')
```

```
In [10]: def PrepareFeature(df, feature, feature_col, split_method, window, wavelet_args):
    X_train = pd.DataFrame()
    X_test = pd.DataFrame()
    y_train = pd.DataFrame()
    y_test = pd.DataFrame()

    # TODO: find_peaks from a given column
    # NOTE: code will break when using -> window_args = {"type": "by_peaks", "pe"

    # method 1: split within each subject
    if split_method == 'TrainTestSplitWithinSubject':
        # indoor activity
        for sub in const_indoor_sub:
            for activity in const_indoor_activity:
                if window_args["type"] == "by_peaks":
                    data_df = df.loc[(df['label'] == activity) & (df['subject'] == sub)]
                    args = window_args["find_peaks_options"]
                    peak_col = feature_col
                    peaks_index_list = list(find_peaks(data_df[peak_col], **args))
                    window_args["peaks_index"] = peaks_index_list

                    output_np_arr, output_label = PreprocessingSignal(df, activity, window, window_args)

                    output_train_len = int(train_size * len(output_np_arr))
                    tr_x = output_np_arr[:output_train_len, :]
                    ts_x = output_np_arr[output_train_len:len(output_np_arr), :]

                    label_train_len = int(train_size * len(output_label))
                    tr_y = output_label[:label_train_len]
                    ts_y = output_label[label_train_len:len(output_label)]

                    X_train = X_train.append(pd.DataFrame(tr_x))
                    X_test = X_test.append(pd.DataFrame(ts_x))
                    y_train = y_train.append(pd.DataFrame(tr_y))
                    y_test = y_test.append(pd.DataFrame(ts_y))

                    # outdoor activity
                    for sub in const_outdoor_sub:
                        for activity in const_outdoor_activity:
                            if window_args["type"] == "by_peaks":
                                data_df = df.loc[(df['label'] == activity) & (df['subject'] == sub)]
                                args = window_args["find_peaks_options"]
                                peak_col = feature_col
                                peaks_index_list = list(find_peaks(data_df[peak_col], **args))
                                window_args["peaks_index"] = peaks_index_list

                                output_np_arr, output_label = PreprocessingSignal(df, activity, window, window_args)

                                output_train_len = int(train_size * len(output_np_arr))
                                tr_x = output_np_arr[:output_train_len, :]
                                ts_x = output_np_arr[output_train_len:len(output_np_arr), :]

                                label_train_len = int(train_size * len(output_label))
                                tr_y = output_label[:label_train_len]
```

```

ts_y = output_label[label_train_len:len(output_label)]

X_train = X_train.append(pd.DataFrame(tr_x))
X_test = X_test.append(pd.DataFrame(ts_x))
y_train = y_train.append(pd.DataFrame(tr_y))
y_test = y_test.append(pd.DataFrame(ts_y))

# method 2: split all samples randomly
if split_method == 'Random':
    #           output = np.asarray(list())
    #           label = np.asarray(list())
    output = np.empty((0, window), float)
    label = np.empty((0,), float)

# indoor activity
for sub in const_indoor_sub:
    for activity in const_indoor_activity:
        if window_args["type"] == "by_peaks":
            data_df = df.loc[(df['label'] == activity) & (df['subject'] == sub)]
            args = window_args["find_peaks_options"]
            peak_col = feature_col
            peaks_index_list = list(find_peaks(data_df[peak_col], **args))
            window_args["peaks_index"] = peaks_index_list
            output_np_arr, output_label = PreprocessingSignal(df, activity, sub, window_args)
            output = np.append(output, output_np_arr, axis=0)
            label = np.append(label, output_label, axis=0)

# outdoor activity:
for sub in const_outdoor_sub:
    for activity in const_outdoor_activity:
        if window_args["type"] == "by_peaks":
            data_df = df.loc[(df['label'] == activity) & (df['subject'] == sub)]
            args = window_args["find_peaks_options"]
            peak_col = feature_col
            peaks_index_list = list(find_peaks(data_df[peak_col], **args))
            window_args["peaks_index"] = peaks_index_list
            output_np_arr, output_label = PreprocessingSignal(df, activity, sub, window_args)
            output = np.append(output, output_np_arr, axis=0)
            label = np.append(label, output_label, axis=0)

shuffle_index = np.arange(len(label))
np.random.RandomState(42).shuffle(shuffle_index)

output_train_len = int(train_size * len(output))
tr_x = output[shuffle_index][:output_train_len, :]
ts_x = output[shuffle_index][output_train_len:len(output), :]

label_train_len = int(train_size * len(label))
tr_y = label[shuffle_index][:label_train_len]
ts_y = label[shuffle_index][label_train_len:len(label)]

X_train = X_train.append(pd.DataFrame(tr_x))
X_test = X_test.append(pd.DataFrame(ts_x))
y_train = y_train.append(pd.DataFrame(tr_y))

```

```

y_test = y_test.append(pd.DataFrame(ts_y))

# method 3: only keep several subjects in the train,
# put other subjects in the test
if split_method == 'DifferentSubjectsInTrainTest':
    train_sub = np.empty((0, window), float)
    train_label_sub = np.empty((0,), float)
    test_sub = np.empty((0, window), float)
    test_label_sub = np.empty((0,), float)

# indoor activity
indoor_sub_train_len = int(train_size * len(const_indoor_sub))
indoor_sub_train = const_indoor_sub[:indoor_sub_train_len]
indoor_sub_test = const_indoor_sub[indoor_sub_train_len:len(const_indoor_sub)]

for sub in indoor_sub_train:
    for activity in const_indoor_activity:
        if window_args["type"] == "by_peaks":
            data_df = df.loc[(df['label'] == activity) & (df['subject'] == sub)]
            args = window_args["find_peaks_options"]
            peak_col = feature_col
            peaks_index_list = list(find_peaks(data_df[peak_col], **args))
            # print("THIS", activity, peaks_index_list)
            window_args["peaks_index"] = peaks_index_list
            output_np_arr, output_label = PreprocessingSignal(df, activity, sub, window_args)
            train_sub = np.append(train_sub, output_np_arr, axis=0)
            train_label_sub = np.append(train_label_sub, output_label, axis=0)

for sub in indoor_sub_test:
    for activity in const_indoor_activity:
        if window_args["type"] == "by_peaks":
            data_df = df.loc[(df['label'] == activity) & (df['subject'] == sub)]
            args = window_args["find_peaks_options"]
            peak_col = feature_col
            peaks_index_list = list(find_peaks(data_df[peak_col], **args))
            window_args["peaks_index"] = peaks_index_list
            output_np_arr, output_label = PreprocessingSignal(df, activity, sub, window_args)
            test_sub = np.append(test_sub, output_np_arr, axis=0)
            test_label_sub = np.append(test_label_sub, output_label, axis=0)

# outdoor activity
outdoor_sub_train_len = int(train_size * len(const_outdoor_sub))
outdoor_sub_train = const_outdoor_sub[:outdoor_sub_train_len]
outdoor_sub_test = const_outdoor_sub[outdoor_sub_train_len:len(const_outdoor_sub)]

for sub in outdoor_sub_train:
    for activity in const_outdoor_activity:
        if window_args["type"] == "by_peaks":
            data_df = df.loc[(df['label'] == activity) & (df['subject'] == sub)]
            args = window_args["find_peaks_options"]
            peak_col = feature_col
            peaks_index_list = list(find_peaks(data_df[peak_col], **args))
            window_args["peaks_index"] = peaks_index_list
            output_np_arr, output_label = PreprocessingSignal(df, activity, sub, window_args)
            train_sub = np.append(train_sub, output_np_arr, axis=0)
            train_label_sub = np.append(train_label_sub, output_label, axis=0)

for sub in outdoor_sub_test:
    for activity in const_outdoor_activity:
        if window_args["type"] == "by_peaks":
            data_df = df.loc[(df['label'] == activity) & (df['subject'] == sub)]
            args = window_args["find_peaks_options"]
            peak_col = feature_col
            peaks_index_list = list(find_peaks(data_df[peak_col], **args))
            window_args["peaks_index"] = peaks_index_list
            output_np_arr, output_label = PreprocessingSignal(df, activity, sub, window_args)
            test_sub = np.append(test_sub, output_np_arr, axis=0)
            test_label_sub = np.append(test_label_sub, output_label, axis=0)

```

```
train_sub = np.append(train_sub, output_np_arr, axis=0)
train_label_sub = np.append(train_label_sub, output_label, axis=0)

for sub in outdoor_sub_test:
    for activity in const_outdoor_activity:
        if window_args["type"] == "by_peaks":
            data_df = df.loc[(df['label'] == activity) & (df['subject'] == sub)]
            args = window_args["find_peaks_options"]
            peak_col = feature_col
            peaks_index_list = list(find_peaks(data_df[peak_col], **args))
            window_args["peaks_index"] = peaks_index_list
            output_np_arr, output_label = PreprocessingSignal(df, activity, sub, window_args)
            test_sub = np.append(test_sub, output_np_arr, axis=0)
            test_label_sub = np.append(test_label_sub, output_label, axis=0)

X_train = pd.DataFrame(train_sub)
y_train = pd.DataFrame(train_label_sub)
X_test = pd.DataFrame(test_sub)
y_test = pd.DataFrame(test_label_sub)

return X_train, X_test, y_train, y_test
```

```
In [11]: # SAMPLE #

def prepare_single_feature_to_csv(feature='accY_LF', feature_col='accY_LF', mod
window=512, wavelet_args={"type": "N"}, window_args={"type": "by_peaks", "find_peaks_
"find_peaks_options": {"prominer
# feature = 'accY_LF'
# feature_list = column_names
# for feature in column_names:
# (example) feature = accX_LF (which is stored in the column_names)

X_train, X_test, y_train, y_test = PrepareFeature(const_master_df, feature,
window_args)

X_train_filename = "_".join(
    ['X_train', feature, "Window" + str(window), "Wavelet" + wavelet_args['
split_method]) + '.txt'
X_test_filename = "_".join(
    ['X_test', feature, "Window" + str(window), "Wavelet" + wavelet_args["t
split_method]) + '.txt'
y_train_filename = "_".join(
    ['y_train', feature, "Window" + str(window), "Wavelet" + wavelet_args['
split_method]) + '.txt'
y_test_filename = "_".join(
    ['y_test', feature, "Window" + str(window), "Wavelet" + wavelet_args["t
split_method]) + '.txt'

WORK_FOLDER = r'./Models'
MODEL_FOLDER = os.path.join(WORK_FOLDER, model_name)
if not os.path.exists(MODEL_FOLDER):
    os.makedirs(MODEL_FOLDER)

X_train.to_csv(os.path.join(MODEL_FOLDER, X_train_filename), header=None, i
X_test.to_csv(os.path.join(MODEL_FOLDER, X_test_filename), header=None, inc

pd.DataFrame(y_train).to_csv(os.path.join(MODEL_FOLDER,y_train_filename), h
pd.DataFrame(y_test).to_csv(os.path.join(MODEL_FOLDER,y_test_filename), hea

print("Saved X_train to %s" % (X_train_filename))
print("Saved X_test to %s" % (X_test_filename))
print("Saved X_train to %s" % (y_train_filename))
print("Saved X_test to %s" % (y_test_filename))
```

```
In [12]: def load_file(model_folder, filename):

    filepath = os.path.join(model_folder, filename)

    dataframe = pd.read_csv(filepath, header=None, delim_whitespace=True)
    return dataframe.values
```

```
In [13]: def load_group(model_folder, filenames):
    loaded = list()
    for name in filenames:
        data = load_file(model_folder, name)
        loaded.append(data)

    loaded = np.dstack(loaded)
    return loaded
```

```
In [14]: def load_dataset(model_name, feature_list, window, wavelet_args, window_args, split_method):
    WORK_FOLDER = r'./Models'
    MODEL_FOLDER = os.path.join(WORK_FOLDER, model_name)

    X_train_filenames = []
    X_test_filenames = []

    for feature in feature_list:
        X_train_filenames.append("_".join(
            ['X_train', feature, "Window" + str(window), "Wavelet" + wavelet_args["split_method"]]) + '.txt')

    X_test_filenames.append("_".join(
        ['X_test', feature, "Window" + str(window), "Wavelet" + wavelet_args["split_method"]]) + '.txt')

    # X_train_filenames = ['X_train_accY_LF_Window512_WaveletN_by_peaks_TrainTest']
    # y_train_filename = 'y_train_accY_LF_Window512_WaveletN_by_peaks_TrainTest'

    y_train_filename = "_".join(
        ['y_train', feature, "Window" + str(window), "Wavelet" + wavelet_args["split_method"]]) + '.txt'

    y_test_filename = "_".join(
        ['y_test', feature, "Window" + str(window), "Wavelet" + wavelet_args["split_method"]]) + '.txt'

    X_train = load_group(MODEL_FOLDER, X_train_filenames)
    y_train = load_file(MODEL_FOLDER, y_train_filename)

    # X_test_filenames = ['X_test_accY_LF_Window512_WaveletN_by_peaks_TrainTest']
    # y_test_filename = 'y_test_accY_LF_Window512_WaveletN_by_peaks_TrainTestSp'
    X_test = load_group(MODEL_FOLDER, X_test_filenames)
    y_test = load_file(MODEL_FOLDER, y_test_filename)

    activity_to_num_mapping = {
        "rest": 0,
        # indoor
        "tread_flat_walk": 1,
        "tread_flat_run": 2,
        "tread_slope_walk": 3,
        "indoor_flat_walk": 4,
        "indoor_flat_run": 5,
        # outdoor
        "outdoor_walk": 6,
        "outdoor_run": 7
    }

    y_train = np.vectorize(activity_to_num_mapping.get)(y_train)
    y_test = np.vectorize(activity_to_num_mapping.get)(y_test)

    # convert to binary class matrix
    y_train = to_categorical(y_train)
    y_test = to_categorical(y_test)
```

```
    return X_train, y_train, X_test, y_test
```

In [15]:

```
# create LSTM Model
def createLSTMModel(n_timesteps, n_features, n_outputs):
    ipt = Input(shape=(n_timesteps, n_features))
    x = LSTM(100)(ipt)
    x = Dropout(0.5)(x)
    x = Dense(100, activation='relu')(x)
    x = Dense(n_outputs, activation='softmax')(x)

    model = Model(inputs=ipt, outputs=x)

# Sequential API
# model = Sequential()
# model.add(LSTM(100, input_shape=(n_timesteps, n_features)))
# model.add(Dropout(0.5))
# model.add(Dense(100, activation='relu'))
# model.add(Dense(n_outputs, activation='softmax'))

model.compile(optimizer='adam', loss='categorical_crossentropy', metrics=['accuracy'])
return model
```

```
In [16]: def train_predict_plot(X_train, y_train, X_test, y_test, model_name='v1', verbose=1):
    model = createLSTMModel(n_timesteps=X_train.shape[1], n_features=X_train.shape[2])
    model.summary()

    filepath = os.path.join(model_name + ".hdf5")
    checkpoint = ModelCheckpoint(filepath,
                                  monitor='val_acc',
                                  verbose=1,
                                  save_best_only=True,
                                  mode='max')

    # Log the epoch detail into csv
    csv_logger = CSVLogger(os.path.join(model_name + '.csv'))
    callbacks_list = [checkpoint, csv_logger]

    history = model.fit(X_train, y_train,
                         validation_data=(X_test, y_test),
                         epochs=epochs, batch_size=batch_size,
                         verbose=verbose, callbacks=callbacks_list)

    y_pred = model.predict(X_test)
    y_pred = np.argmax(y_pred, axis=1)
    y_test = np.argmax(y_test, axis=1)

    # plot model accuracy
    plt.plot(history.history['acc'])
    plt.plot(history.history['val_acc'])
    plt.title('model accuracy')
    plt.ylabel('accuracy')
    plt.xlabel('epoch')
    plt.legend(['train', 'val'], loc='upper left')
    plt.savefig(model_name + '_model_acc', dpi=300)
    plt.show()

    plt.plot(history.history['loss'])
    plt.plot(history.history['val_loss'])
    plt.title('model loss')
    plt.ylabel('loss')
    plt.xlabel('epoch')
    plt.legend(['train', 'val'], loc='upper right')
    plt.savefig(model_name + '_model_loss', dpi=300)
    plt.show()

    class_label = np.concatenate((const_indoor_activity, const_outdoor_activity))

    cnf_matrix = confusion_matrix(y_test, y_pred)

    print("Best accuracy (on validation dataset): %.2f%%" % (accuracy_score(y_test, y_pred) * 100))
    print(cnf_matrix)

    plt.figure()
    fig, ax = plot_confusion_matrix(conf_mat=cnf_matrix,
                                    show_absolute=True,
                                    show_normed=True,
                                    colorbar=True,
                                    class_names=class_label,
```

```
figsize=(10, 10))
plt.savefig(model_name + '_confusion_matrix', dpi=300)
plt.show()

# display report
report_display = classification_report(y_test, y_pred, target_names=class_1
print("Classification Report:")
print(report_display)

# create report and store in csv
report = classification_report(y_test, y_pred, output_dict=True)
df_report = pd.DataFrame(report).transpose()
df_report.to_csv(model_name + '_classification_report')
```

In [17]:

```

# # Permutation starts here:
# axis_list = ['accX', 'accY', 'accZ']
# pos_list = ['LF', 'RF', 'Waist', 'Wrist']

# seed      = 29
# np.random.seed(seed)

# split_method_list = ['TrainTestSplitWithinSubject',
#                       'Random',
#                       'DifferentSubjectsInTrainTest'
#                     ]
# window_list = [512,
#                256
#              ]

# wavelet_args_list = [
#   {
#     "type": "Y",
#     "threshold": 2,
#     "wavelet_options": {"wavelet": "db4", "Level": 2},
#     "waverec_options": {"wavelet": "db4"}
#   },
#   {"type": "N"}
# ]

# window_args_list = [{"type": "by_peaks", "find_peaks_options": {"prominence": 0.5, "type": "with_overlap", "overlap_perc": 0.5}, "type": "no_overlap"}]

# feature_list_list = [
#   ['accX_LF', 'accY_LF',
#    'accZ_LF', 'accX_RF', 'accY_RF', 'accZ_RF',
#    'accX_Waist', 'accY_Waist', 'accZ_Waist', 'accX_Wrist', 'accY_Wrist', 'accZ_Wrist']
# ]

# count = 0
# for split_method in split_method_list:
#   for window in window_list:
#     for wavelet_args in wavelet_args_list:
#       for window_args in window_args_list:
#         for feature_list in feature_list_list:
#           count = count + 1
#           model_name = 'model_v' + str(count)

#           feature_col = feature_list[0]

#           for feature in feature_list:
#             prepare_single_feature_to_csv(feature, feature_col, n=1000, wavelet_args=wavelet_args, window_args=window_args)

#             X_train, y_train, X_test, y_test = load_dataset(model_name)

#             print(X_train.shape)

```

```
#             print(y_train.shape)
#             print(X_test.shape)
#             print(y_test.shape)
#             print(X_train.shape[1])
#             print(X_train.shape[2])
#             print(y_train.shape[1])

#
#             train_predict_plot(X_train, y_train, X_test, y_test, mode
#                                batch_size=300)
```

In [18]:

```

# Permutation starts here:
# axis_list = ['accX', 'accY', 'accZ']
# pos_list = ['LF', 'RF', 'Waist', 'Wrist']

# seed      = 29
# np.random.seed(seed)

# split_method_list = ['TrainTestSplitWithinSubject',
#                       'Random',
#                       'DifferentSubjectsInTrainTest'
#                     ]
# window_list = [512,
#                256
#              ]

# wavelet_args_list = [
#   {
#     "type": "Y",
#     "threshold": 2,
#     "wavelet_options": {"wavelet": "db4", "Level": 2},
#     "waverec_options": {"wavelet": "db4"}
#   },
#   {"type": "N"}
# ]

# window_args_list = [{"type": "by_peaks", "find_peaks_options": {"prominence": 0.5, "type": "with_overlap", "overlap_perc": 0.5}, "type": "no_overlap"}]

# feature_list_list = [
#   ['accX_LF', 'accY_LF',
#    'accZ_LF', 'accX_RF', 'accY_RF', 'accZ_RF',
#    'accX_Waist', 'accY_Waist', 'accZ_Waist', 'accX_Wrist', 'accY_Wrist'],
# ]
# count = 0
# for split_method in split_method_list:
#   for window in window_list:
#     for wavelet_args in wavelet_args_list:
#       for window_args in window_args_list:
#         for feature_list in feature_list_list:
#           count = count + 1
#           model_name = 'model_v' + str(count)

#           feature_col = feature_list[0]

#           for feature in feature_list:
#             prepare_single_feature_to_csv(feature, feature_col, n=1000, wavelet_args=wavelet_args, window_args=window_args)

#           X_train, y_train, X_test, y_test = load_dataset(model_name)

#           print(X_train.shape)

```

```
#             print(y_train.shape)
#             print(X_test.shape)
#             print(y_test.shape)
#             print(X_train.shape[1])
#             print(X_train.shape[2])
#             print(y_train.shape[1])

#
#             train_predict_plot(X_train, y_train, X_test, y_test, mode
#                                batch_size=300)
```

```
In [19]: axis_list = ['accX', 'accY', 'accZ']
pos_list = ['LF', 'RF', 'Waist', 'Wrist']

seed      = 29
np.random.seed(seed)

split_method = 'Random'

window = 256

wavelet_args = {"type": "Y",
                 "threshold": 2,
                 "wavedec_options": {"wavelet": "db4", "level": 2},
                 "waverec_options": {"wavelet": "db4"}}

window_args = {"type": "with_overlap", "overlap_perc": 0.5}

feature_list_list = [
    ['accX_LF', 'accY_LF', 'accZ_LF',
     'accX_RF', 'accY_RF', 'accZ_RF',
     'accX_Waist', 'accY_Waist', 'accZ_Waist',
     'accX_Wrist', 'accY_Wrist', 'accZ_Wrist'],
    ['accX_Wrist', 'accY_Wrist', 'accZ_Wrist'],
    ['accX_LF', 'accY_LF', 'accZ_LF'],
    ['accX_LF', 'accY_LF'],
    ['accX_LF', 'accZ_LF'],
    ['accY_LF', 'accZ_LF'],
    ['accX_LF', 'accY_LF', 'accZ_LF', 'accX_RF', 'accY_RF', 'accZ_RF'],
    ['accX_LF', 'accY_LF'],
    ['accX_LF', 'accZ_LF'],
    ['accX_LF', 'accX_RF'],
    ['accX_LF', 'accY_RF'],
    ['accX_LF', 'accZ_RF'],
    ['accY_LF', 'accZ_LF'],
    ['accY_LF', 'accX_RF'],
    ['accY_LF', 'accY_RF'],
    ['accY_LF', 'accZ_RF'],
    ['accZ_LF', 'accX_RF'],
    ['accZ_LF', 'accY_RF'],
    ['accZ_LF', 'accZ_RF'],
    ['accX_RF', 'accY_RF'],
    ['accX_RF', 'accZ_RF'],
    ['accY_RF', 'accZ_RF'],
    ['accX_LF', 'accY_LF', 'accZ_LF', 'accX_Wrist', 'accY_Wrist', 'accZ_Wrist'],
    ['accX_LF', 'accY_LF'],
    ['accX_LF', 'accZ_LF'],
    ['accX_LF', 'accX_Wrist'],
    ['accX_LF', 'accY_Wrist'],
    ['accX_LF', 'accZ_Wrist'],
    ['accY_LF', 'accZ_LF'],
    ['accY_LF', 'accX_Wrist'],
    ['accY_LF', 'accY_Wrist'],
    ['accY_LF', 'accZ_Wrist'],
    ['accZ_LF', 'accX_Wrist'],
    ['accZ_LF', 'accY_Wrist'],
    ['accZ_LF', 'accZ_Wrist'],
    ['accZ_LF', 'accZ_Wrist'],
```

```

['accX_Wrist', 'accY_Wrist'],
['accX_Wrist', 'accZ_Wrist'],
['accY_Wrist', 'accZ_Wrist'],
['accX_LF', 'accY_LF', 'accZ_LF', 'accX_Waist', 'accY_Waist', 'accZ_Waist'],
['accX_LF', 'accY_LF'],
['accX_LF', 'accZ_LF'],
['accX_LF', 'accX_Wrist'],
['accX_LF', 'accY_Wrist'],
['accX_LF', 'accZ_Wrist'],
['accY_LF', 'accZ_LF'],
['accY_LF', 'accX_Wrist'],
['accY_LF', 'accY_Wrist'],
['accY_LF', 'accZ_Wrist'],
['accZ_LF', 'accX_Wrist'],
['accZ_LF', 'accY_Wrist'],
['accZ_LF', 'accZ_Wrist'],
['accX_Wrist', 'accY_Wrist'],
['accX_Wrist', 'accZ_Wrist'],
['accY_Wrist', 'accZ_Wrist']
]

# feature_list = ['accX_LF', 'accY_LF', 'accZ_LF']

for feature_list in feature_list_list:
    model_name = 'model_v5'
    X_train, y_train, X_test, y_test = load_dataset(model_name, feature_list, v
                                                    split_method)

    print("Trying for these features %s" %(feature_list))
    print(X_train.shape)
    print(y_train.shape)
    print(X_test.shape)
    print(y_test.shape)
    print(X_train.shape[1])
    print(X_train.shape[2])
    print(y_train.shape[1])

    seed = 29
    np.random.seed(seed)
    train_predict_plot(X_train, y_train, X_test, y_test, model_name=model_name
                        batch_size=300)

```

```

Trying for these features ['accX_LF', 'accY_LF', 'accZ_LF', 'accX_RF', 'accY_
RF', 'accZ_RF', 'accX_Waist', 'accY_Waist', 'accZ_Waist', 'accX_Wrist', 'accY_
_Wrist', 'accZ_Wrist']
(19084, 256, 12)
(19084, 8)
(4772, 256, 12)
(4772, 8)
256
12
8

```

Layer (type)	Output Shape	Param #
<hr/>		
input_1 (InputLayer)	(None, 256, 12)	0
lstm (LSTM)	(None, 100)	45200
dropout (Dropout)	(None, 100)	0
dense (Dense)	(None, 100)	10100
dense_1 (Dense)	(None, 8)	808
<hr/>		
Total params: 56,108		
Trainable params: 56,108		
Non-trainable params: 0		

Train on 19084 samples, validate on 4772 samples

Epoch 1/20

19084/19084 [=====] - 35s 2ms/step - loss: 1.6696 - acc: 0.3513 - val\_loss: 1.1720 - val\_acc: 0.5427

Epoch 00001: val\_acc improved from -inf to 0.54275, saving model to model\_v5accX\_LF-accY\_LF-accZ\_LF-accX\_RF-accY\_RF-accZ\_RF-accX\_Waist-accY\_Waist-accZ\_Waist-accX\_Wrist-accY\_Wrist-accZ\_Wrist.hdf5

Epoch 2/20

19084/19084 [=====] - 32s 2ms/step - loss: 1.0271 - acc: 0.6063 - val\_loss: 0.6880 - val\_acc: 0.7810

Epoch 00002: val\_acc improved from 0.54275 to 0.78101, saving model to model\_v5accX\_LF-accY\_LF-accZ\_LF-accX\_RF-accY\_RF-accZ\_RF-accX\_Waist-accY\_Waist-accZ\_Waist-accX\_Wrist-accY\_Wrist-accZ\_Wrist.hdf5

Epoch 3/20

19084/19084 [=====] - 33s 2ms/step - loss: 0.6890 - acc: 0.7529 - val\_loss: 0.4517 - val\_acc: 0.8445

Epoch 00003: val\_acc improved from 0.78101 to 0.84451, saving model to model\_v5accX\_LF-accY\_LF-accZ\_LF-accX\_RF-accY\_RF-accZ\_RF-accX\_Waist-accY\_Waist-accZ\_Waist-accX\_Wrist-accY\_Wrist-accZ\_Wrist.hdf5

Epoch 4/20

19084/19084 [=====] - 33s 2ms/step - loss: 0.5218 - acc: 0.8246 - val\_loss: 0.3514 - val\_acc: 0.8845

Epoch 00004: val\_acc improved from 0.84451 to 0.88453, saving model to model\_v5accX\_LF-accY\_LF-accZ\_LF-accX\_RF-accY\_RF-accZ\_RF-accX\_Waist-accY\_Waist-accZ\_Waist-accX\_Wrist-accY\_Wrist-accZ\_Wrist.hdf5

Epoch 5/20

19084/19084 [=====] - 34s 2ms/step - loss: 0.4299 - acc: 0.8578 - val\_loss: 0.2885 - val\_acc: 0.9019

Epoch 00005: val\_acc improved from 0.88453 to 0.90193, saving model to model\_v5accX\_LF-accY\_LF-accZ\_LF-accX\_RF-accY\_RF-accZ\_RF-accX\_Waist-accY\_Waist-accZ\_Waist-accX\_Wrist-accY\_Wrist-accZ\_Wrist.hdf5

Epoch 6/20

19084/19084 [=====] - 40s 2ms/step - loss: 0.3604 - acc: 0.8833 - val\_loss: 0.2376 - val\_acc: 0.9233

```
Epoch 00006: val_acc improved from 0.90193 to 0.92330, saving model to model_v5accX_LF-accY_LF-accZ_LF-accX_RF-accY_RF-accZ_RF-accX_Waist-accY_Waist-accZ_Waist-accX_Wrist-accY_Wrist-accZ_Wrist.hdf5
Epoch 7/20
19084/19084 [=====] - 31s 2ms/step - loss: 0.3557 - acc: 0.8854 - val_loss: 0.2255 - val_acc: 0.9306

Epoch 00007: val_acc improved from 0.92330 to 0.93064, saving model to model_v5accX_LF-accY_LF-accZ_LF-accX_RF-accY_RF-accZ_RF-accX_Waist-accY_Waist-accZ_Waist-accX_Wrist-accY_Wrist-accZ_Wrist.hdf5
Epoch 8/20
19084/19084 [=====] - 31s 2ms/step - loss: 0.3216 - acc: 0.8962 - val_loss: 0.2503 - val_acc: 0.9147

Epoch 00008: val_acc did not improve from 0.93064
Epoch 9/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.2561 - acc: 0.9191 - val_loss: 0.1545 - val_acc: 0.9570

Epoch 00009: val_acc improved from 0.93064 to 0.95704, saving model to model_v5accX_LF-accY_LF-accZ_LF-accX_RF-accY_RF-accZ_RF-accX_Waist-accY_Waist-accZ_Waist-accX_Wrist-accY_Wrist-accZ_Wrist.hdf5
Epoch 10/20
19084/19084 [=====] - 33s 2ms/step - loss: 0.2241 - acc: 0.9322 - val_loss: 0.1850 - val_acc: 0.9447

Epoch 00010: val_acc did not improve from 0.95704
Epoch 11/20
19084/19084 [=====] - 35s 2ms/step - loss: 0.2041 - acc: 0.9384 - val_loss: 0.1177 - val_acc: 0.9640

Epoch 00011: val_acc improved from 0.95704 to 0.96396, saving model to model_v5accX_LF-accY_LF-accZ_LF-accX_RF-accY_RF-accZ_RF-accX_Waist-accY_Waist-accZ_Waist-accX_Wrist-accY_Wrist-accZ_Wrist.hdf5
Epoch 12/20
19084/19084 [=====] - 37s 2ms/step - loss: 0.1759 - acc: 0.9477 - val_loss: 0.1309 - val_acc: 0.9619

Epoch 00012: val_acc did not improve from 0.96396
Epoch 13/20
19084/19084 [=====] - 32s 2ms/step - loss: 0.1515 - acc: 0.9564 - val_loss: 0.1115 - val_acc: 0.9677

Epoch 00013: val_acc improved from 0.96396 to 0.96773, saving model to model_v5accX_LF-accY_LF-accZ_LF-accX_RF-accY_RF-accZ_RF-accX_Waist-accY_Waist-accZ_Waist-accX_Wrist-accY_Wrist-accZ_Wrist.hdf5
Epoch 14/20
19084/19084 [=====] - 31s 2ms/step - loss: 0.1418 - acc: 0.9586 - val_loss: 0.0922 - val_acc: 0.9740

Epoch 00014: val_acc improved from 0.96773 to 0.97402, saving model to model_v5accX_LF-accY_LF-accZ_LF-accX_RF-accY_RF-accZ_RF-accX_Waist-accY_Waist-accZ_Waist-accX_Wrist-accY_Wrist-accZ_Wrist.hdf5
Epoch 15/20
19084/19084 [=====] - 31s 2ms/step - loss: 0.1102 - acc: 0.9681 - val_loss: 0.1069 - val_acc: 0.9648
```

```
Epoch 00015: val_acc did not improve from 0.97402
Epoch 16/20
19084/19084 [=====] - 33s 2ms/step - loss: 0.1206 -
acc: 0.9660 - val_loss: 0.1135 - val_acc: 0.9648

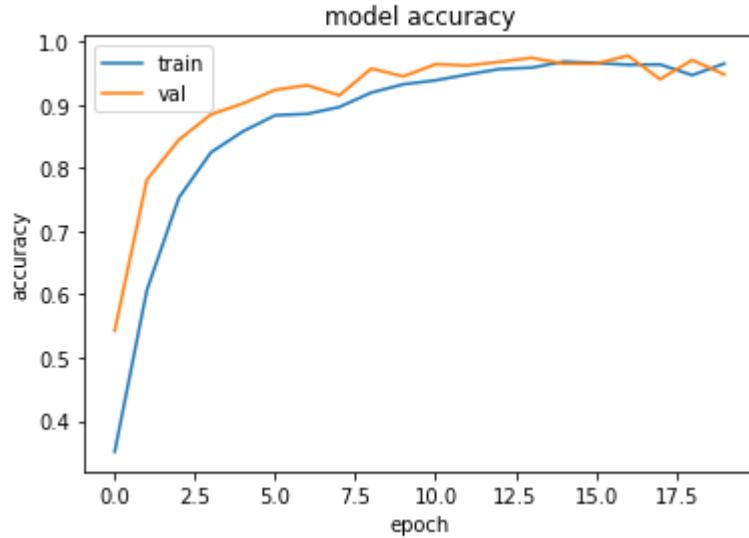
Epoch 00016: val_acc did not improve from 0.97402
Epoch 17/20
19084/19084 [=====] - 32s 2ms/step - loss: 0.1239 -
acc: 0.9631 - val_loss: 0.0805 - val_acc: 0.9776

Epoch 00017: val_acc improved from 0.97402 to 0.97758, saving model to model_
v5accX_LF-accY_LF-accZ_LF-accX_RF-accY_RF-accZ_RF-accX_Waist-accY_Waist-accZ_
Waist-accX_Wrist-accY_Wrist-accZ_Wrist.hdf5
Epoch 18/20
19084/19084 [=====] - 34s 2ms/step - loss: 0.1282 -
acc: 0.9635 - val_loss: 0.2022 - val_acc: 0.9403

Epoch 00018: val_acc did not improve from 0.97758
Epoch 19/20
19084/19084 [=====] - 33s 2ms/step - loss: 0.1798 -
acc: 0.9467 - val_loss: 0.0979 - val_acc: 0.9705

Epoch 00019: val_acc did not improve from 0.97758
Epoch 20/20
19084/19084 [=====] - 34s 2ms/step - loss: 0.1166 -
acc: 0.9649 - val_loss: 0.1572 - val_acc: 0.9478

Epoch 00020: val_acc did not improve from 0.97758
```



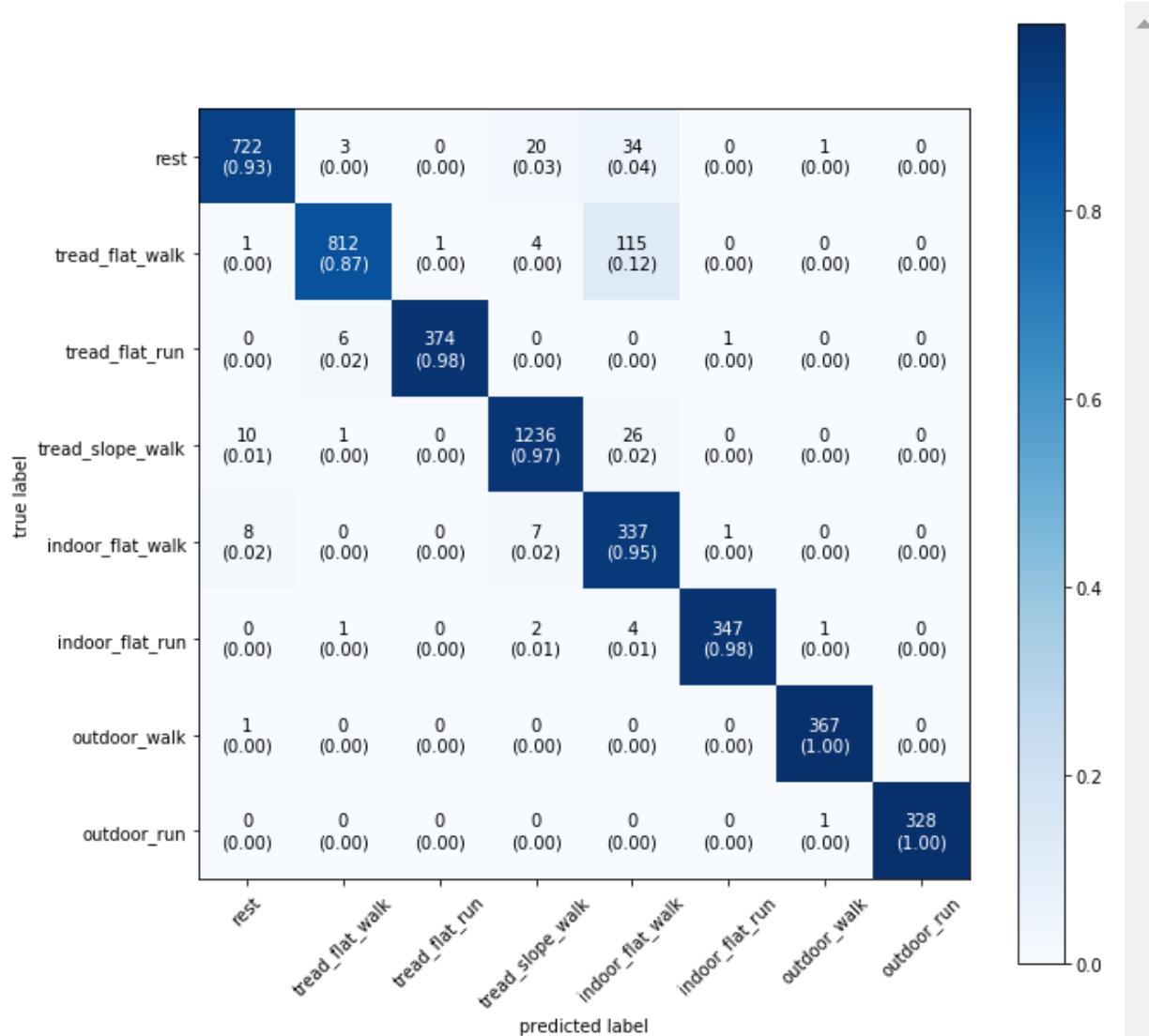
## model loss



Best accuracy (on validation dataset): 94.78%

```
[[ 722    3    0   20   34    0    1    0]
 [  1  812    1    4  115    0    0    0]
 [  0    6  374    0    0    1    0    0]
 [ 10    1    0 1236   26    0    0    0]
 [  8    0    0    7  337    1    0    0]
 [  0    1    0    2    4  347    1    0]
 [  1    0    0    0    0    0  367    0]
 [  0    0    0    0    0    0    1  328]]
```

<Figure size 432x288 with 0 Axes>



## Classification Report:

	precision	recall	f1-score	support
rest	0.9730	0.9256	0.9488	780
tread_flat_walk	0.9866	0.8703	0.9248	933
tread_flat_run	0.9973	0.9816	0.9894	381
tread_slope_walk	0.9740	0.9709	0.9725	1273
indoor_flat_walk	0.6531	0.9547	0.7756	353
indoor_flat_run	0.9943	0.9775	0.9858	355
outdoor_walk	0.9919	0.9973	0.9946	368
outdoor_run	1.0000	0.9970	0.9985	329
accuracy			0.9478	4772
macro avg	0.9463	0.9594	0.9487	4772
weighted avg	0.9591	0.9478	0.9506	4772

```
Trying for these features ['accX_Wrist', 'accY_Wrist', 'accZ_Wrist']
(19084, 256, 3)
(19084, 8)
(4772, 256, 3)
(4772, 8)
256
3
8
```

Layer (type)	Output Shape	Param #
<hr/>		
input_2 (InputLayer)	(None, 256, 3)	0
lstm_1 (LSTM)	(None, 100)	41600
dropout_1 (Dropout)	(None, 100)	0
dense_2 (Dense)	(None, 100)	10100
dense_3 (Dense)	(None, 8)	808
<hr/>		
Total params: 52,508		

Trainable params: 52,508  
Non-trainable params: 0

---

Train on 19084 samples, validate on 4772 samples

Epoch 1/20

19084/19084 [=====] - 35s 2ms/step - loss: 1.7127 -  
acc: 0.3173 - val\_loss: 1.4219 - val\_acc: 0.4082

Epoch 00001: val\_acc improved from -inf to 0.40821, saving model to model\_v5a  
ccX\_Wrist-accY\_Wrist-accZ\_Wrist.hdf5

Epoch 2/20

19084/19084 [=====] - 33s 2ms/step - loss: 1.3922 -  
acc: 0.3988 - val\_loss: 1.2608 - val\_acc: 0.4566

Epoch 00002: val\_acc improved from 0.40821 to 0.45662, saving model to model\_v5accX\_Wrist-accY\_Wrist-accZ\_Wrist.hdf5

Epoch 3/20

19084/19084 [=====] - 33s 2ms/step - loss: 1.2639 -  
acc: 0.4506 - val\_loss: 1.1933 - val\_acc: 0.4776

Epoch 00003: val\_acc improved from 0.45662 to 0.47758, saving model to model\_v5accX\_Wrist-accY\_Wrist-accZ\_Wrist.hdf5

Epoch 4/20

19084/19084 [=====] - 33s 2ms/step - loss: 1.2212 -  
acc: 0.4736 - val\_loss: 1.1460 - val\_acc: 0.5197

Epoch 00004: val\_acc improved from 0.47758 to 0.51970, saving model to model\_v5accX\_Wrist-accY\_Wrist-accZ\_Wrist.hdf5

Epoch 5/20

19084/19084 [=====] - 32s 2ms/step - loss: 1.1747 -  
acc: 0.5044 - val\_loss: 1.2083 - val\_acc: 0.5189

Epoch 00005: val\_acc did not improve from 0.51970

Epoch 6/20

19084/19084 [=====] - 33s 2ms/step - loss: 1.2303 -  
acc: 0.4775 - val\_loss: 1.1319 - val\_acc: 0.5140

Epoch 00006: val\_acc did not improve from 0.51970

Epoch 7/20

19084/19084 [=====] - 32s 2ms/step - loss: 1.1812 -  
acc: 0.4905 - val\_loss: 1.1183 - val\_acc: 0.5251

Epoch 00007: val\_acc improved from 0.51970 to 0.52515, saving model to model\_v5accX\_Wrist-accY\_Wrist-accZ\_Wrist.hdf5

Epoch 8/20

19084/19084 [=====] - 33s 2ms/step - loss: 1.1642 -  
acc: 0.5049 - val\_loss: 1.0916 - val\_acc: 0.5411

Epoch 00008: val\_acc improved from 0.52515 to 0.54107, saving model to model\_v5accX\_Wrist-accY\_Wrist-accZ\_Wrist.hdf5

Epoch 9/20

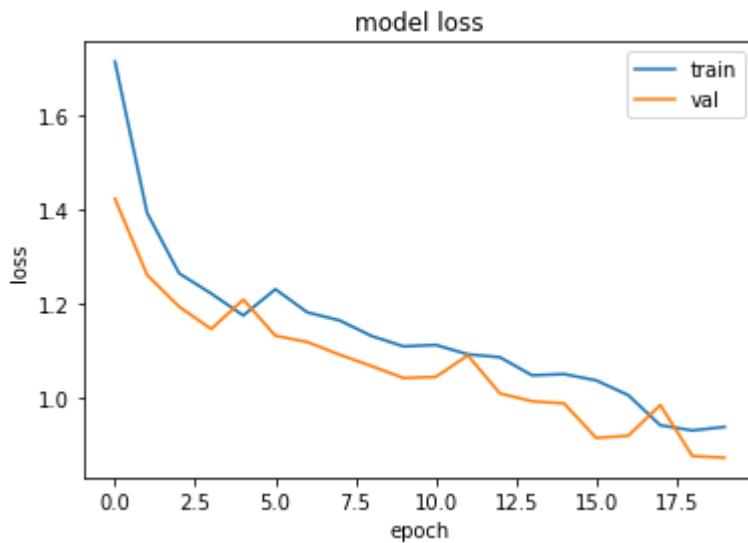
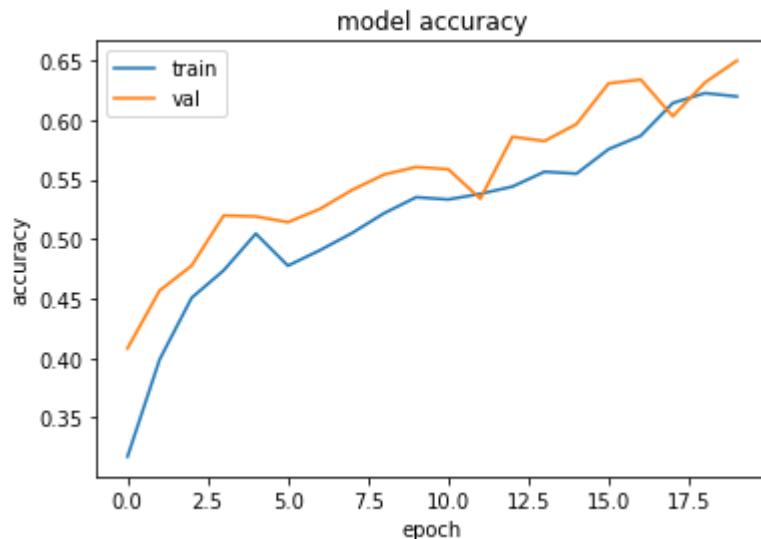
19084/19084 [=====] - 33s 2ms/step - loss: 1.1312 -  
acc: 0.5216 - val\_loss: 1.0673 - val\_acc: 0.5541

Epoch 00009: val\_acc improved from 0.54107 to 0.55407, saving model to model\_v5accX\_Wrist-accY\_Wrist-accZ\_Wrist.hdf5

Epoch 10/20

```
19084/19084 [=====] - 34s 2ms/step - loss: 1.1091 -  
acc: 0.5350 - val_loss: 1.0420 - val_acc: 0.5604  
  
Epoch 00010: val_acc improved from 0.55407 to 0.56035, saving model to model_  
v5accX_Wrist-accY_Wrist-accZ_Wrist.hdf5  
Epoch 11/20  
19084/19084 [=====] - 36s 2ms/step - loss: 1.1122 -  
acc: 0.5331 - val_loss: 1.0444 - val_acc: 0.5585  
  
Epoch 00011: val_acc did not improve from 0.56035  
Epoch 12/20  
19084/19084 [=====] - 37s 2ms/step - loss: 1.0923 -  
acc: 0.5378 - val_loss: 1.0902 - val_acc: 0.5337  
  
Epoch 00012: val_acc did not improve from 0.56035  
Epoch 13/20  
19084/19084 [=====] - 32s 2ms/step - loss: 1.0861 -  
acc: 0.5439 - val_loss: 1.0094 - val_acc: 0.5857  
  
Epoch 00013: val_acc improved from 0.56035 to 0.58571, saving model to model_  
v5accX_Wrist-accY_Wrist-accZ_Wrist.hdf5  
Epoch 14/20  
19084/19084 [=====] - 31s 2ms/step - loss: 1.0478 -  
acc: 0.5564 - val_loss: 0.9928 - val_acc: 0.5821  
  
Epoch 00014: val_acc did not improve from 0.58571  
Epoch 15/20  
19084/19084 [=====] - 33s 2ms/step - loss: 1.0504 -  
acc: 0.5548 - val_loss: 0.9883 - val_acc: 0.5964  
  
Epoch 00015: val_acc improved from 0.58571 to 0.59640, saving model to model_  
v5accX_Wrist-accY_Wrist-accZ_Wrist.hdf5  
Epoch 16/20  
19084/19084 [=====] - 38s 2ms/step - loss: 1.0371 -  
acc: 0.5754 - val_loss: 0.9150 - val_acc: 0.6306  
  
Epoch 00016: val_acc improved from 0.59640 to 0.63055, saving model to model_  
v5accX_Wrist-accY_Wrist-accZ_Wrist.hdf5  
Epoch 17/20  
19084/19084 [=====] - 33s 2ms/step - loss: 1.0058 -  
acc: 0.5865 - val_loss: 0.9197 - val_acc: 0.6337  
  
Epoch 00017: val_acc improved from 0.63055 to 0.63370, saving model to model_  
v5accX_Wrist-accY_Wrist-accZ_Wrist.hdf5  
Epoch 18/20  
19084/19084 [=====] - 35s 2ms/step - loss: 0.9419 -  
acc: 0.6140 - val_loss: 0.9848 - val_acc: 0.6029  
  
Epoch 00018: val_acc did not improve from 0.63370  
Epoch 19/20  
19084/19084 [=====] - 34s 2ms/step - loss: 0.9309 -  
acc: 0.6224 - val_loss: 0.8766 - val_acc: 0.6312  
  
Epoch 00019: val_acc did not improve from 0.63370  
Epoch 20/20  
19084/19084 [=====] - 32s 2ms/step - loss: 0.9384 -  
acc: 0.6195 - val_loss: 0.8733 - val_acc: 0.6496
```

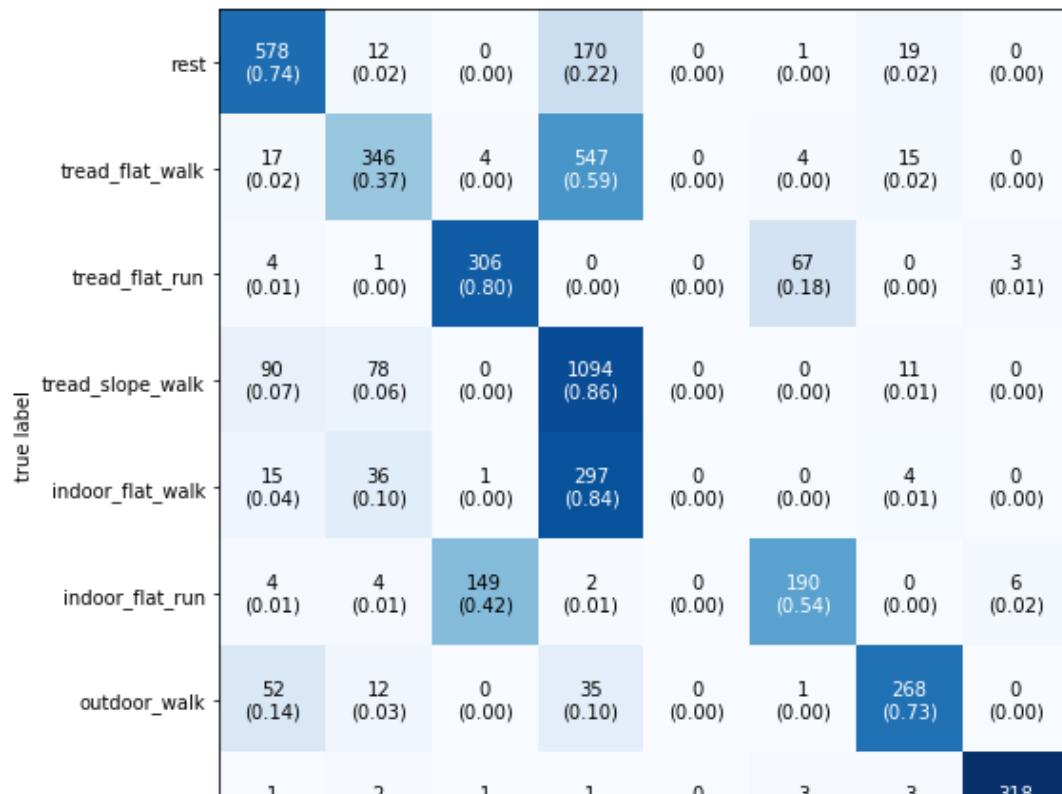
Epoch 00020: val\_acc improved from 0.63370 to 0.64962, saving model to model\_v5accX\_Wrist-accY\_Wrist-accZ\_Wrist.hdf5



Best accuracy (on validation dataset): 64.96%

```
[[ 578   12    0  170    0    1   19    0]
 [  17   346    4  547    0    4   15    0]
 [   4    1  306    0    0   67    0    3]
 [  90    78    0 1094    0    0   11    0]
 [ 15    36    1  297    0    0    4    0]
 [   4    4  149    2    0  190    0    6]
 [  52   12    0   35    0    1  268    0]
 [   1    2    1    1    0    3    3  318]]
```

<Figure size 432x288 with 0 Axes>



## Classification Report:

	precision	recall	f1-score	support
rest	0.7595	0.7410	0.7502	780
tread_flat_walk	0.7047	0.3708	0.4860	933
tread_flat_run	0.6638	0.8031	0.7268	381
tread_slope_walk	0.5098	0.8594	0.6400	1273
indoor_flat_walk	0.0000	0.0000	0.0000	353
indoor_flat_run	0.7143	0.5352	0.6119	355
outdoor_walk	0.8375	0.7283	0.7791	368
outdoor_run	0.9725	0.9666	0.9695	329
accuracy			0.6496	4772
macro avg	0.6453	0.6256	0.6204	4772
weighted avg	0.6357	0.6496	0.6188	4772

Trying for these features ['accX\_LF', 'accY\_LF', 'accZ\_LF']  
(19084, 256, 3)  
(19084, 8)  
(4772, 256, 3)  
(4772, 8)  
256  
3  
8

Layer (type)	Output Shape	Param #
<hr/>		
input_3 (InputLayer)	(None, 256, 3)	0
lstm_2 (LSTM)	(None, 100)	41600

dropout_2 (Dropout)	(None, 100)	0
dense_4 (Dense)	(None, 100)	10100
dense_5 (Dense)	(None, 8)	808
<hr/>		
Total params: 52,508		
Trainable params: 52,508		
Non-trainable params: 0		

---

Train on 19084 samples, validate on 4772 samples

Epoch 1/20

19084/19084 [=====] - 33s 2ms/step - loss: 1.7788 - acc: 0.3114 - val\_loss: 1.3273 - val\_acc: 0.4705

Epoch 00001: val\_acc improved from -inf to 0.47045, saving model to model\_v5accX\_LF-accY\_LF-accZ\_LF.hdf5

Epoch 2/20

19084/19084 [=====] - 37s 2ms/step - loss: 1.1891 - acc: 0.5259 - val\_loss: 1.0541 - val\_acc: 0.5780

Epoch 00002: val\_acc improved from 0.47045 to 0.57795, saving model to model\_v5accX\_LF-accY\_LF-accZ\_LF.hdf5

Epoch 3/20

19084/19084 [=====] - 33s 2ms/step - loss: 1.0237 - acc: 0.5886 - val\_loss: 0.9681 - val\_acc: 0.6153

Epoch 00003: val\_acc improved from 0.57795 to 0.61526, saving model to model\_v5accX\_LF-accY\_LF-accZ\_LF.hdf5

Epoch 4/20

19084/19084 [=====] - 44s 2ms/step - loss: 0.9408 - acc: 0.6292 - val\_loss: 0.9710 - val\_acc: 0.6186

Epoch 00004: val\_acc improved from 0.61526 to 0.61861, saving model to model\_v5accX\_LF-accY\_LF-accZ\_LF.hdf5

Epoch 5/20

19084/19084 [=====] - 34s 2ms/step - loss: 0.8986 - acc: 0.6456 - val\_loss: 0.8494 - val\_acc: 0.6626

Epoch 00005: val\_acc improved from 0.61861 to 0.66262, saving model to model\_v5accX\_LF-accY\_LF-accZ\_LF.hdf5

Epoch 6/20

19084/19084 [=====] - 30s 2ms/step - loss: 0.8167 - acc: 0.6800 - val\_loss: 0.7355 - val\_acc: 0.7135

Epoch 00006: val\_acc improved from 0.66262 to 0.71354, saving model to model\_v5accX\_LF-accY\_LF-accZ\_LF.hdf5

Epoch 7/20

19084/19084 [=====] - 30s 2ms/step - loss: 0.7376 - acc: 0.7144 - val\_loss: 0.6678 - val\_acc: 0.7376

Epoch 00007: val\_acc improved from 0.71354 to 0.73764, saving model to model\_v5accX\_LF-accY\_LF-accZ\_LF.hdf5

Epoch 8/20

19084/19084 [=====] - 29s 2ms/step - loss: 0.7185 - acc: 0.7206 - val\_loss: 0.6622 - val\_acc: 0.7416

```
Epoch 00008: val_acc improved from 0.73764 to 0.74162, saving model to model_v5accX_LF-accY_LF-accZ_LF.hdf5
Epoch 9/20
19084/19084 [=====] - 31s 2ms/step - loss: 0.6549 - acc: 0.7482 - val_loss: 0.5834 - val_acc: 0.7716

Epoch 00009: val_acc improved from 0.74162 to 0.77158, saving model to model_v5accX_LF-accY_LF-accZ_LF.hdf5
Epoch 10/20
19084/19084 [=====] - 34s 2ms/step - loss: 0.6335 - acc: 0.7537 - val_loss: 0.5460 - val_acc: 0.7867

Epoch 00010: val_acc improved from 0.77158 to 0.78667, saving model to model_v5accX_LF-accY_LF-accZ_LF.hdf5
Epoch 11/20
19084/19084 [=====] - 37s 2ms/step - loss: 0.5725 - acc: 0.7826 - val_loss: 0.5483 - val_acc: 0.7978

Epoch 00011: val_acc improved from 0.78667 to 0.79778, saving model to model_v5accX_LF-accY_LF-accZ_LF.hdf5
Epoch 12/20
19084/19084 [=====] - 39s 2ms/step - loss: 0.5441 - acc: 0.8001 - val_loss: 0.5238 - val_acc: 0.8068

Epoch 00012: val_acc improved from 0.79778 to 0.80679, saving model to model_v5accX_LF-accY_LF-accZ_LF.hdf5
Epoch 13/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.5255 - acc: 0.8060 - val_loss: 0.4635 - val_acc: 0.8365

Epoch 00013: val_acc improved from 0.80679 to 0.83655, saving model to model_v5accX_LF-accY_LF-accZ_LF.hdf5
Epoch 14/20
19084/19084 [=====] - 33s 2ms/step - loss: 0.4854 - acc: 0.8304 - val_loss: 0.4492 - val_acc: 0.8451

Epoch 00014: val_acc improved from 0.83655 to 0.84514, saving model to model_v5accX_LF-accY_LF-accZ_LF.hdf5
Epoch 15/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.4449 - acc: 0.8436 - val_loss: 0.3886 - val_acc: 0.8759

Epoch 00015: val_acc improved from 0.84514 to 0.87594, saving model to model_v5accX_LF-accY_LF-accZ_LF.hdf5
Epoch 16/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.4123 - acc: 0.8613 - val_loss: 0.3930 - val_acc: 0.8674

Epoch 00016: val_acc did not improve from 0.87594
Epoch 17/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.3883 - acc: 0.8767 - val_loss: 0.3599 - val_acc: 0.8835

Epoch 00017: val_acc improved from 0.87594 to 0.88349, saving model to model_v5accX_LF-accY_LF-accZ_LF.hdf5
Epoch 18/20
19084/19084 [=====] - 31s 2ms/step - loss: 0.3776 -
```

```
acc: 0.8792 - val_loss: 0.3291 - val_acc: 0.9028
```

```
Epoch 00018: val_acc improved from 0.88349 to 0.90277, saving model to model_v5accX_LF-accY_LF-accZ_LF.hdf5
```

```
Epoch 19/20
```

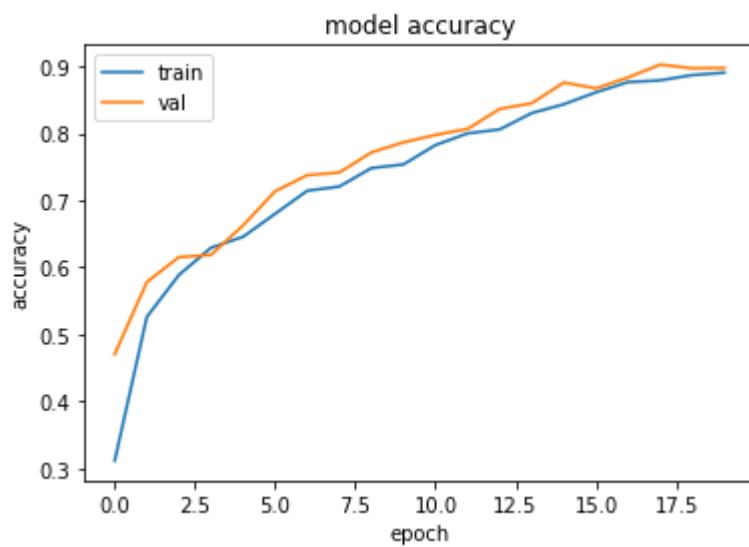
```
19084/19084 [=====] - 37s 2ms/step - loss: 0.3536 -  
acc: 0.8871 - val_loss: 0.3304 - val_acc: 0.8973
```

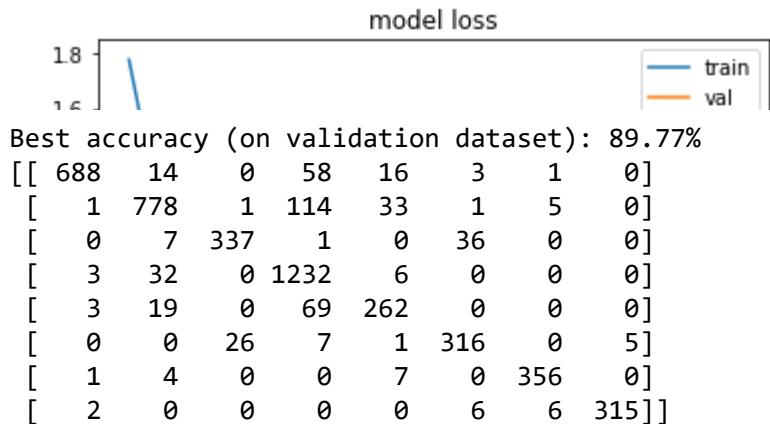
```
Epoch 00019: val_acc did not improve from 0.90277
```

```
Epoch 20/20
```

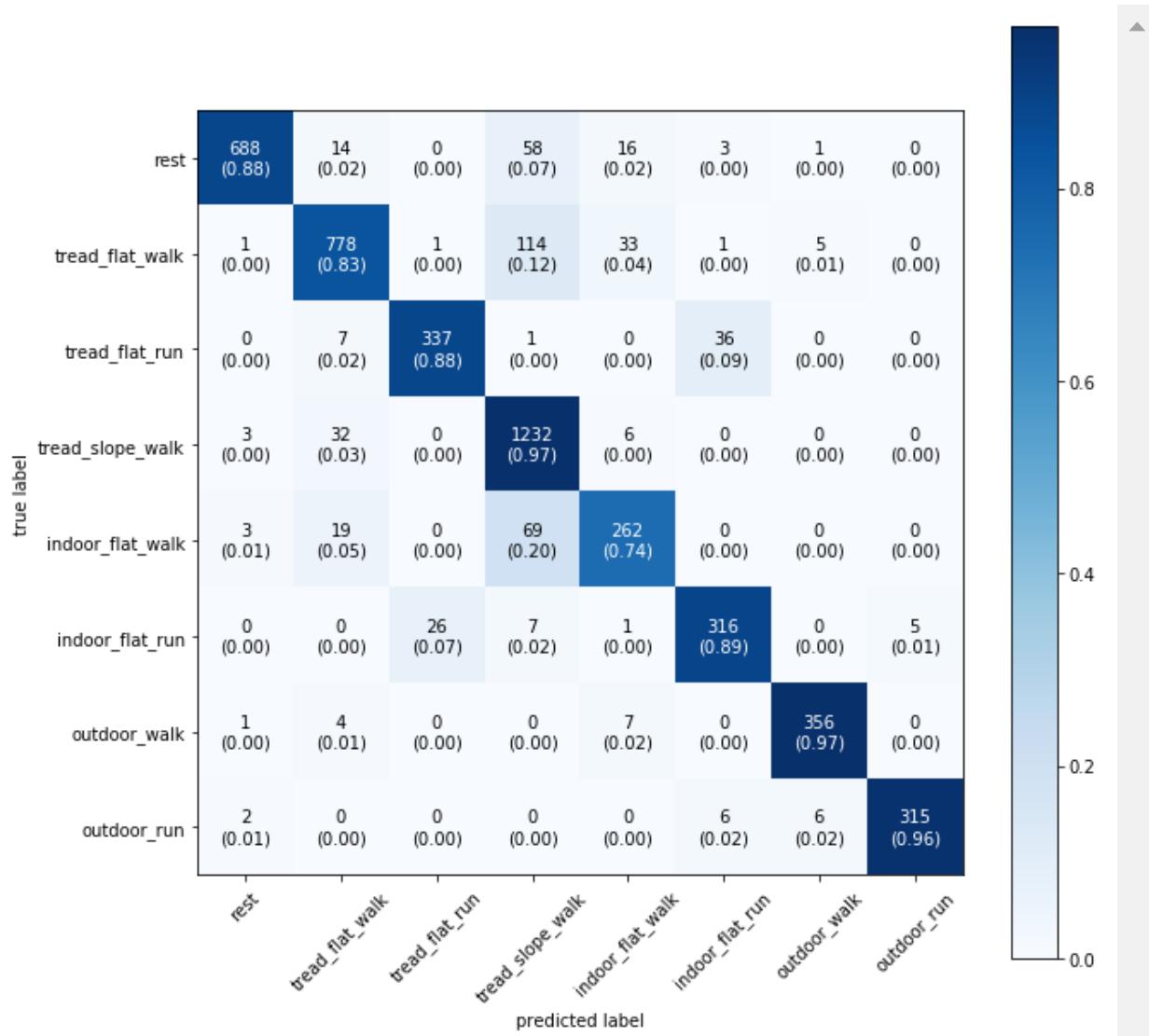
```
19084/19084 [=====] - 36s 2ms/step - loss: 0.3557 -  
acc: 0.8907 - val_loss: 0.3368 - val_acc: 0.8977
```

```
Epoch 00020: val_acc did not improve from 0.90277
```





<Figure size 432x288 with 0 Axes>



## Classification Report:

	precision	recall	f1-score	support
rest	0.9857	0.8821	0.9310	780
tread_flat_walk	0.9110	0.8339	0.8707	933
tread_flat_run	0.9258	0.8845	0.9047	381
tread_slope_walk	0.8319	0.9678	0.8947	1273
indoor_flat_walk	0.8062	0.7422	0.7729	353
indoor_flat_run	0.8729	0.8901	0.8815	355
outdoor_walk	0.9674	0.9674	0.9674	368
outdoor_run	0.9844	0.9574	0.9707	329
accuracy			0.8977	4772
macro avg	0.9107	0.8907	0.8992	4772
weighted avg	0.9021	0.8977	0.8976	4772

Trying for these features ['accX\_LF', 'accY\_LF']

(19084, 256, 2)

(19084, 8)

(4772, 256, 2)

(4772, 8)

256

2

8

Layer (type)	Output Shape	Param #
<hr/>		
input_4 (InputLayer)	(None, 256, 2)	0
lstm_3 (LSTM)	(None, 100)	41200
dropout_3 (Dropout)	(None, 100)	0
dense_6 (Dense)	(None, 100)	10100
dense_7 (Dense)	(None, 8)	808
<hr/>		
Total params:	52,108	
Trainable params:	52,108	
Non-trainable params:	0	
<hr/>		
Train on 19084 samples, validate on 4772 samples		

```
Epoch 1/20
19084/19084 [=====] - 39s 2ms/step - loss: 1.8289 - ac
c: 0.2906 - val_loss: 1.4669 - val_acc: 0.4292

Epoch 00001: val_acc improved from -inf to 0.42917, saving model to model_v5acc
X_LF-accY_LF.hdf5
Epoch 2/20
19084/19084 [=====] - 37s 2ms/step - loss: 1.2870 - ac
c: 0.4782 - val_loss: 1.1457 - val_acc: 0.5170

Epoch 00002: val_acc improved from 0.42917 to 0.51697, saving model to model_v5
accX_LF-accY_LF.hdf5
Epoch 3/20
19084/19084 [=====] - 37s 2ms/step - loss: 1.1116 - ac
c: 0.5214 - val_loss: 1.0369 - val_acc: 0.5486

Epoch 00003: val_acc improved from 0.51697 to 0.54862, saving model to model_v5
accX_LF-accY_LF.hdf5
Epoch 4/20
19084/19084 [=====] - 39s 2ms/step - loss: 1.0437 - ac
c: 0.5572 - val_loss: 1.0062 - val_acc: 0.5882

Epoch 00004: val_acc improved from 0.54862 to 0.58822, saving model to model_v5
accX_LF-accY_LF.hdf5
Epoch 5/20
19084/19084 [=====] - 35s 2ms/step - loss: 0.9757 - ac
c: 0.5910 - val_loss: 0.9094 - val_acc: 0.6350

Epoch 00005: val_acc improved from 0.58822 to 0.63495, saving model to model_v5
accX_LF-accY_LF.hdf5
Epoch 6/20
19084/19084 [=====] - 40s 2ms/step - loss: 0.9236 - ac
c: 0.6160 - val_loss: 0.8294 - val_acc: 0.6664

Epoch 00006: val_acc improved from 0.63495 to 0.66639, saving model to model_v5
accX_LF-accY_LF.hdf5
Epoch 7/20
19084/19084 [=====] - 36s 2ms/step - loss: 0.8421 - ac
c: 0.6584 - val_loss: 0.7895 - val_acc: 0.6832

Epoch 00007: val_acc improved from 0.66639 to 0.68315, saving model to model_v5
accX_LF-accY_LF.hdf5
Epoch 8/20
19084/19084 [=====] - 32s 2ms/step - loss: 0.8037 - ac
c: 0.6722 - val_loss: 0.8252 - val_acc: 0.6588

Epoch 00008: val_acc did not improve from 0.68315
Epoch 9/20
19084/19084 [=====] - 31s 2ms/step - loss: 0.7906 - ac
c: 0.6751 - val_loss: 0.6931 - val_acc: 0.7171

Epoch 00009: val_acc improved from 0.68315 to 0.71710, saving model to model_v5
accX_LF-accY_LF.hdf5
Epoch 10/20
19084/19084 [=====] - 33s 2ms/step - loss: 0.7273 - ac
c: 0.7005 - val_loss: 0.6859 - val_acc: 0.7169
```

```
Epoch 00010: val_acc did not improve from 0.71710
Epoch 11/20
19084/19084 [=====] - 40s 2ms/step - loss: 0.6972 - acc: 0.7122 - val_loss: 0.7660 - val_acc: 0.6903

Epoch 00011: val_acc did not improve from 0.71710
Epoch 12/20
19084/19084 [=====] - 34s 2ms/step - loss: 0.7154 - acc: 0.7077 - val_loss: 0.6598 - val_acc: 0.7345

Epoch 00012: val_acc improved from 0.71710 to 0.73449, saving model to model_v5
accX_LF-accY_LF.hdf5
Epoch 13/20
19084/19084 [=====] - 35s 2ms/step - loss: 0.6799 - acc: 0.7248 - val_loss: 0.6625 - val_acc: 0.7318

Epoch 00013: val_acc did not improve from 0.73449
Epoch 14/20
19084/19084 [=====] - 35s 2ms/step - loss: 0.6671 - acc: 0.7264 - val_loss: 0.6511 - val_acc: 0.7446

Epoch 00014: val_acc improved from 0.73449 to 0.74455, saving model to model_v5
accX_LF-accY_LF.hdf5
Epoch 15/20
19084/19084 [=====] - 32s 2ms/step - loss: 0.6103 - acc: 0.7528 - val_loss: 0.5825 - val_acc: 0.7737

Epoch 00015: val_acc improved from 0.74455 to 0.77368, saving model to model_v5
accX_LF-accY_LF.hdf5
Epoch 16/20
19084/19084 [=====] - 35s 2ms/step - loss: 0.5956 - acc: 0.7673 - val_loss: 0.5483 - val_acc: 0.7844

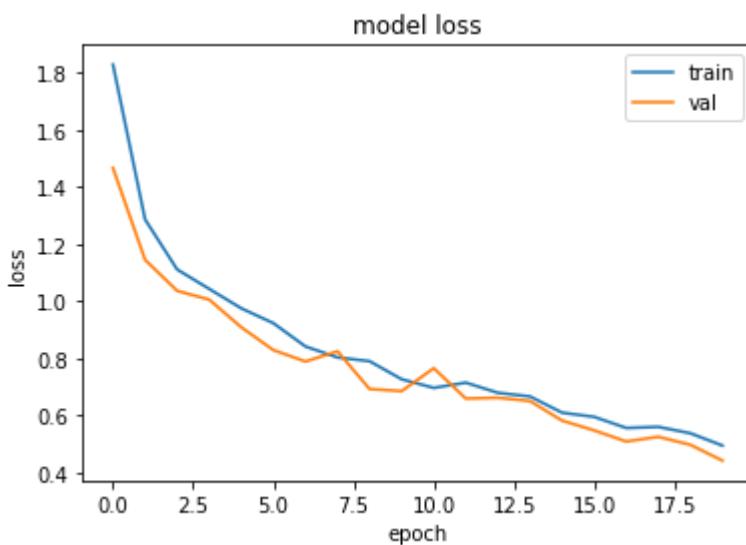
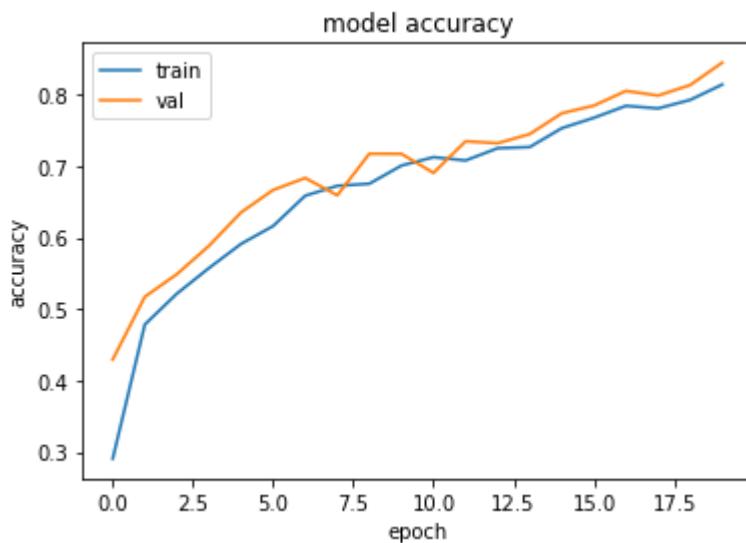
Epoch 00016: val_acc improved from 0.77368 to 0.78437, saving model to model_v5
accX_LF-accY_LF.hdf5
Epoch 17/20
19084/19084 [=====] - 34s 2ms/step - loss: 0.5568 - acc: 0.7841 - val_loss: 0.5094 - val_acc: 0.8049

Epoch 00017: val_acc improved from 0.78437 to 0.80490, saving model to model_v5
accX_LF-accY_LF.hdf5
Epoch 18/20
19084/19084 [=====] - 33s 2ms/step - loss: 0.5606 - acc: 0.7804 - val_loss: 0.5259 - val_acc: 0.7984

Epoch 00018: val_acc did not improve from 0.80490
Epoch 19/20
19084/19084 [=====] - 34s 2ms/step - loss: 0.5383 - acc: 0.7923 - val_loss: 0.4978 - val_acc: 0.8131

Epoch 00019: val_acc improved from 0.80490 to 0.81308, saving model to model_v5
accX_LF-accY_LF.hdf5
Epoch 20/20
19084/19084 [=====] - 33s 2ms/step - loss: 0.4950 - acc: 0.8138 - val_loss: 0.4424 - val_acc: 0.8445
```

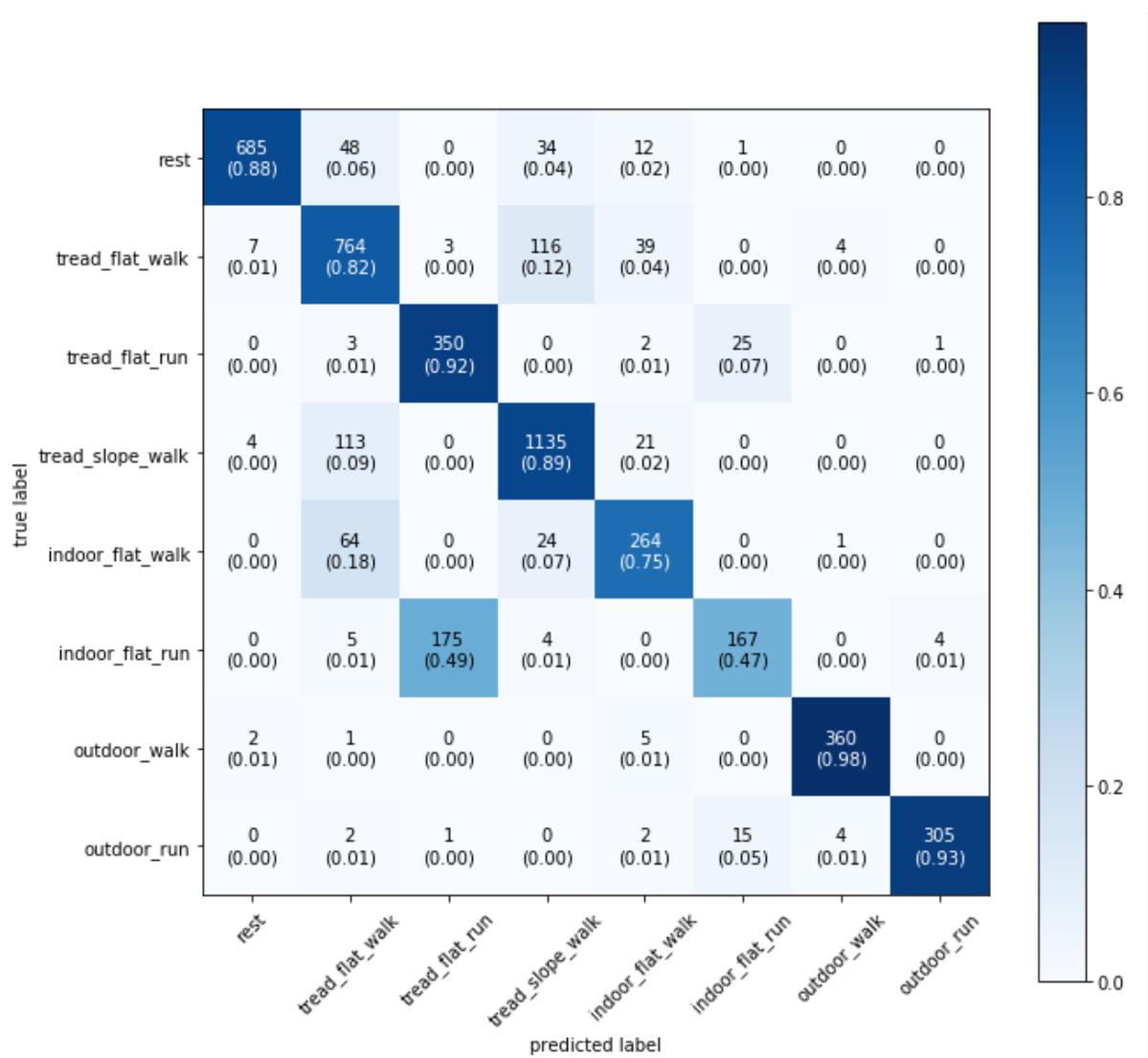
Epoch 00020: val\_acc improved from 0.81308 to 0.84451, saving model to model\_v5  
---  
---



Best accuracy (on validation dataset): 84.45%

```
[[ 685   48     0    34    12     1     0     0]
 [  7   764     3   116    39     0     4     0]
 [  0     3   350     0     2    25     0     1]
 [  4   113     0  1135    21     0     0     0]
 [  0    64     0    24   264     0     1     0]
 [  0     5   175     4     0   167     0     4]
 [  2     1     0     0     5     0   360     0]
 [  0     2     1     0     2    15     4  305]]
```

<Figure size 432x288 with 0 Axes>



## Classification Report:

	precision	recall	f1-score	support
rest	0.9814	0.8782	0.9269	780
tread_flat_walk	0.7640	0.8189	0.7905	933
tread_flat_run	0.6616	0.9186	0.7692	381
tread_slope_walk	0.8644	0.8916	0.8778	1273
indoor_flat_walk	0.7652	0.7479	0.7564	353
indoor_flat_run	0.8029	0.4704	0.5933	355
outdoor_walk	0.9756	0.9783	0.9769	368
outdoor_run	0.9839	0.9271	0.9546	329
accuracy			0.8445	4772
macro avg	0.8499	0.8289	0.8307	4772
weighted avg	0.8526	0.8445	0.8429	4772

```
Trying for these features ['accX_LF', 'accZ_LF']
(19084, 256, 2)
(19084, 8)
(4772, 256, 2)
(4772, 8)
256
2
8
```

Layer (type)	Output Shape	Param #
<hr/>		
input_5 (InputLayer)	(None, 256, 2)	0
lstm_4 (LSTM)	(None, 100)	41200
dropout_4 (Dropout)	(None, 100)	0
dense_8 (Dense)	(None, 100)	10100
dense_9 (Dense)	(None, 8)	808
<hr/>		

Total params: 52,108

Trainable params: 52,108

Non-trainable params: 0

---

Train on 19084 samples, validate on 4772 samples

Epoch 1/20

19084/19084 [=====] - 36s 2ms/step - loss: 1.8441 - acc: 0.2923 - val\_loss: 1.5470 - val\_acc: 0.3946

Epoch 00001: val\_acc improved from -inf to 0.39459, saving model to model\_v5a\_ccX\_LF-accZ\_LF.hdf5

Epoch 2/20

19084/19084 [=====] - 38s 2ms/step - loss: 1.3824 - acc: 0.4586 - val\_loss: 1.2691 - val\_acc: 0.4778

Epoch 00002: val\_acc improved from 0.39459 to 0.47779, saving model to model\_v5accX\_LF-accZ\_LF.hdf5

Epoch 3/20

19084/19084 [=====] - 39s 2ms/step - loss: 1.2274 - acc: 0.4980 - val\_loss: 1.1434 - val\_acc: 0.5166

Epoch 00003: val\_acc improved from 0.47779 to 0.51655, saving model to model\_v5accX\_LF-accZ\_LF.hdf5

Epoch 4/20

19084/19084 [=====] - 34s 2ms/step - loss: 1.1439 - acc: 0.5321 - val\_loss: 1.0926 - val\_acc: 0.5427

Epoch 00004: val\_acc improved from 0.51655 to 0.54275, saving model to model\_v5accX\_LF-accZ\_LF.hdf5

Epoch 5/20

19084/19084 [=====] - 31s 2ms/step - loss: 1.0687 - acc: 0.5674 - val\_loss: 0.9822 - val\_acc: 0.5901

Epoch 00005: val\_acc improved from 0.54275 to 0.59011, saving model to model\_v5accX\_LF-accZ\_LF.hdf5

Epoch 6/20

```
19084/19084 [=====] - 31s 2ms/step - loss: 1.0547 -  
acc: 0.5752 - val_loss: 0.9715 - val_acc: 0.6222  
  
Epoch 00006: val_acc improved from 0.59011 to 0.62217, saving model to model_  
v5accX_LF-accZ_LF.hdf5  
Epoch 7/20  
19084/19084 [=====] - 35s 2ms/step - loss: 0.9588 -  
acc: 0.6143 - val_loss: 0.9326 - val_acc: 0.6301  
  
Epoch 00007: val_acc improved from 0.62217 to 0.63013, saving model to model_  
v5accX_LF-accZ_LF.hdf5  
Epoch 8/20  
19084/19084 [=====] - 37s 2ms/step - loss: 0.9530 -  
acc: 0.6189 - val_loss: 0.8862 - val_acc: 0.6431  
  
Epoch 00008: val_acc improved from 0.63013 to 0.64313, saving model to model_  
v5accX_LF-accZ_LF.hdf5  
Epoch 9/20  
19084/19084 [=====] - 34s 2ms/step - loss: 0.9851 -  
acc: 0.6095 - val_loss: 0.9420 - val_acc: 0.6123  
  
Epoch 00009: val_acc did not improve from 0.64313  
Epoch 10/20  
19084/19084 [=====] - 32s 2ms/step - loss: 0.9489 -  
acc: 0.6158 - val_loss: 0.8941 - val_acc: 0.6299  
  
Epoch 00010: val_acc did not improve from 0.64313  
Epoch 11/20  
19084/19084 [=====] - 30s 2ms/step - loss: 0.9114 -  
acc: 0.6290 - val_loss: 0.8808 - val_acc: 0.6282  
  
Epoch 00011: val_acc did not improve from 0.64313  
Epoch 12/20  
19084/19084 [=====] - 36s 2ms/step - loss: 0.8999 -  
acc: 0.6307 - val_loss: 0.8497 - val_acc: 0.6622  
  
Epoch 00012: val_acc improved from 0.64313 to 0.66220, saving model to model_  
v5accX_LF-accZ_LF.hdf5  
Epoch 13/20  
19084/19084 [=====] - 42s 2ms/step - loss: 0.8644 -  
acc: 0.6525 - val_loss: 0.8184 - val_acc: 0.6584  
  
Epoch 00013: val_acc did not improve from 0.66220  
Epoch 14/20  
19084/19084 [=====] - 35s 2ms/step - loss: 0.8285 -  
acc: 0.6576 - val_loss: 0.8284 - val_acc: 0.6584  
  
Epoch 00014: val_acc did not improve from 0.66220  
Epoch 15/20  
19084/19084 [=====] - 35s 2ms/step - loss: 0.8291 -  
acc: 0.6612 - val_loss: 0.7787 - val_acc: 0.6896  
  
Epoch 00015: val_acc improved from 0.66220 to 0.68965, saving model to model_  
v5accX_LF-accZ_LF.hdf5  
Epoch 16/20  
19084/19084 [=====] - 30s 2ms/step - loss: 0.8028 -  
acc: 0.6706 - val_loss: 0.7821 - val_acc: 0.6932
```

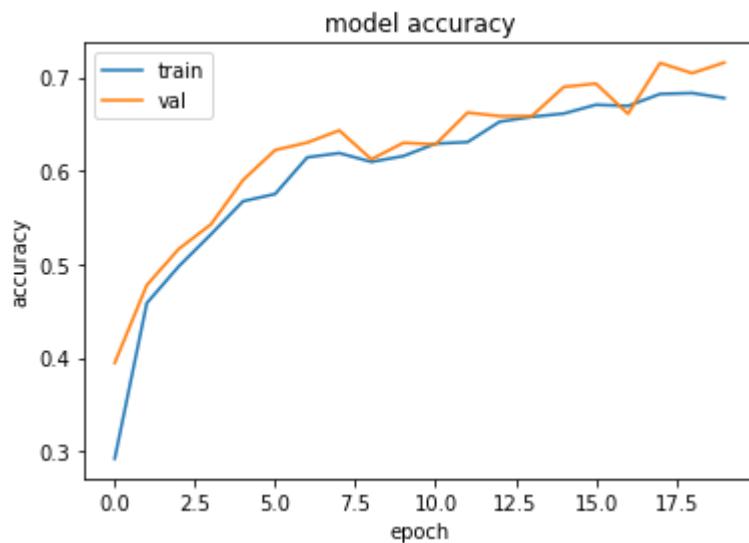
```
Epoch 00016: val_acc improved from 0.68965 to 0.69321, saving model to model_
v5accX_LF-accZ_LF.hdf5
Epoch 17/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.8305 -
acc: 0.6693 - val_loss: 0.8289 - val_acc: 0.6609

Epoch 00017: val_acc did not improve from 0.69321
Epoch 18/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.7880 -
acc: 0.6821 - val_loss: 0.7330 - val_acc: 0.7152

Epoch 00018: val_acc improved from 0.69321 to 0.71521, saving model to model_
v5accX_LF-accZ_LF.hdf5
Epoch 19/20
19084/19084 [=====] - 32s 2ms/step - loss: 0.7905 -
acc: 0.6831 - val_loss: 0.7572 - val_acc: 0.7043

Epoch 00019: val_acc did not improve from 0.71521
Epoch 20/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.8051 -
acc: 0.6777 - val_loss: 0.7217 - val_acc: 0.7156

Epoch 00020: val_acc improved from 0.71521 to 0.71563, saving model to model_
v5accX_LF-accZ_LF.hdf5
```



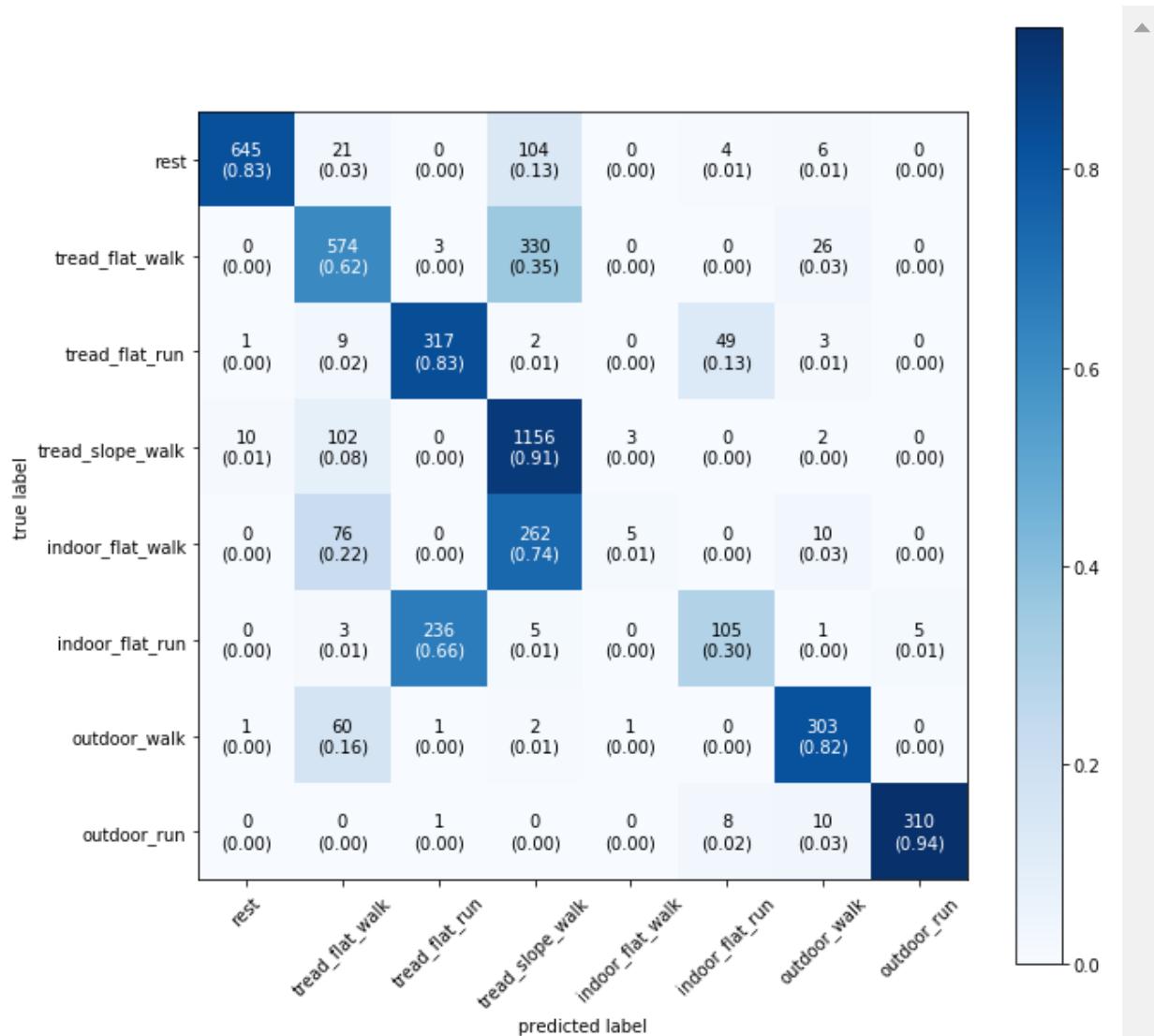
**model loss**


---

Best accuracy (on validation dataset): 71.56%

```
[[ 645   21     0   104     0     4     6     0]
 [  0   574     3   330     0     0    26     0]
 [  1     9   317     2     0    49     3     0]
 [ 10   102     0  1156     3     0     2     0]
 [  0    76     0   262     5     0    10     0]
 [  0     3   236     5     0   105     1     5]
 [  1    60     1     2     1     0   303     0]
 [  0     0     1     0     0     8    10   310]]
```

<Figure size 432x288 with 0 Axes>

**Classification Report:**

precision	recall	f1-score	support
-----------	--------	----------	---------

rest	0.9817	0.8269	0.8977	780
tread_flat_walk	0.6793	0.6152	0.6457	933
tread_flat_run	0.5681	0.8320	0.6752	381
tread_slope_walk	0.6212	0.9081	0.7377	1273
indoor_flat_walk	0.5556	0.0142	0.0276	353
indoor_flat_run	0.6325	0.2958	0.4031	355
outdoor_walk	0.8393	0.8234	0.8313	368
outdoor_run	0.9841	0.9422	0.9627	329
accuracy			0.7156	4772
macro avg	0.7327	0.6572	0.6476	4772
weighted avg	0.7251	0.7156	0.6862	4772

Trying for these features ['accY\_LF', 'accZ\_LF']

(19084, 256, 2)

(19084, 8)

(4772, 256, 2)

(4772, 8)

256

2

8

Layer (type)	Output Shape	Param #
<hr/>		
input_6 (InputLayer)	(None, 256, 2)	0
lstm_5 (LSTM)	(None, 100)	41200
dropout_5 (Dropout)	(None, 100)	0
dense_10 (Dense)	(None, 100)	10100
dense_11 (Dense)	(None, 8)	808
<hr/>		

Total params: 52,108

Trainable params: 52,108

Non-trainable params: 0

---

Train on 19084 samples, validate on 4772 samples

Epoch 1/20

19084/19084 [=====] - 40s 2ms/step - loss: 1.8345 - ac  
c: 0.3063 - val\_loss: 1.6094 - val\_acc: 0.3912

Epoch 00001: val\_acc improved from -inf to 0.39124, saving model to model\_v5acc  
Y\_LF-accZ\_LF.hdf5

Epoch 2/20

19084/19084 [=====] - 40s 2ms/step - loss: 1.4293 - ac  
c: 0.4551 - val\_loss: 1.2139 - val\_acc: 0.5119

Epoch 00002: val\_acc improved from 0.39124 to 0.51194, saving model to model\_v5  
accY\_LF-accZ\_LF.hdf5

Epoch 3/20

19084/19084 [=====] - 35s 2ms/step - loss: 1.2024 - ac  
c: 0.5090 - val\_loss: 1.1063 - val\_acc: 0.5543

Epoch 00003: val\_acc improved from 0.51194 to 0.55427, saving model to model\_v5

```
accY_LF-accZ_LF.hdf5
Epoch 4/20
19084/19084 [=====] - 31s 2ms/step - loss: 1.0734 - ac
c: 0.5692 - val_loss: 1.0296 - val_acc: 0.5863

Epoch 00004: val_acc improved from 0.55427 to 0.58634, saving model to model_v5
accY_LF-accZ_LF.hdf5
Epoch 5/20
19084/19084 [=====] - 31s 2ms/step - loss: 1.0103 - ac
c: 0.5904 - val_loss: 0.9152 - val_acc: 0.6224

Epoch 00005: val_acc improved from 0.58634 to 0.62238, saving model to model_v5
accY_LF-accZ_LF.hdf5
Epoch 6/20
19084/19084 [=====] - 31s 2ms/step - loss: 0.9019 - ac
c: 0.6369 - val_loss: 0.8457 - val_acc: 0.6653

Epoch 00006: val_acc improved from 0.62238 to 0.66534, saving model to model_v5
accY_LF-accZ_LF.hdf5
Epoch 7/20
19084/19084 [=====] - 32s 2ms/step - loss: 0.8426 - ac
c: 0.6617 - val_loss: 0.8010 - val_acc: 0.6869

Epoch 00007: val_acc improved from 0.66534 to 0.68692, saving model to model_v5
accY_LF-accZ_LF.hdf5
Epoch 8/20
19084/19084 [=====] - 31s 2ms/step - loss: 0.7991 - ac
c: 0.6809 - val_loss: 0.7209 - val_acc: 0.7075

Epoch 00008: val_acc improved from 0.68692 to 0.70746, saving model to model_v5
accY_LF-accZ_LF.hdf5
Epoch 9/20
19084/19084 [=====] - 32s 2ms/step - loss: 0.7658 - ac
c: 0.6952 - val_loss: 0.6897 - val_acc: 0.7249

Epoch 00009: val_acc improved from 0.70746 to 0.72485, saving model to model_v5
accY_LF-accZ_LF.hdf5
Epoch 10/20
19084/19084 [=====] - 32s 2ms/step - loss: 0.7144 - ac
c: 0.7166 - val_loss: 0.6287 - val_acc: 0.7437

Epoch 00010: val_acc improved from 0.72485 to 0.74371, saving model to model_v5
accY_LF-accZ_LF.hdf5
Epoch 11/20
19084/19084 [=====] - 31s 2ms/step - loss: 0.6753 - ac
c: 0.7352 - val_loss: 0.6354 - val_acc: 0.7586

Epoch 00011: val_acc improved from 0.74371 to 0.75859, saving model to model_v5
accY_LF-accZ_LF.hdf5
Epoch 12/20
19084/19084 [=====] - 31s 2ms/step - loss: 0.6251 - ac
c: 0.7595 - val_loss: 0.5350 - val_acc: 0.7940

Epoch 00012: val_acc improved from 0.75859 to 0.79401, saving model to model_v5
accY_LF-accZ_LF.hdf5
Epoch 13/20
19084/19084 [=====] - 32s 2ms/step - loss: 0.6227 - ac
```

c: 0.7623 - val\_loss: 0.5585 - val\_acc: 0.7844

Epoch 00013: val\_acc did not improve from 0.79401

Epoch 14/20

19084/19084 [=====] - 30s 2ms/step - loss: 0.5793 - ac

c: 0.7866 - val\_loss: 0.6189 - val\_acc: 0.7714

Epoch 00014: val\_acc did not improve from 0.79401

Epoch 15/20

19084/19084 [=====] - 29s 2ms/step - loss: 0.5538 - ac

c: 0.7895 - val\_loss: 0.4710 - val\_acc: 0.8256

Epoch 00015: val\_acc improved from 0.79401 to 0.82565, saving model to model\_v5  
accY\_LF-accZ\_LF.hdf5

Epoch 16/20

19084/19084 [=====] - 29s 2ms/step - loss: 0.4966 - ac

c: 0.8209 - val\_loss: 0.4221 - val\_acc: 0.8527

Epoch 00016: val\_acc improved from 0.82565 to 0.85268, saving model to model\_v5  
accY\_LF-accZ\_LF.hdf5

Epoch 17/20

19084/19084 [=====] - 29s 2ms/step - loss: 0.4681 - ac

c: 0.8296 - val\_loss: 0.4475 - val\_acc: 0.8483

Epoch 00017: val\_acc did not improve from 0.85268

Epoch 18/20

19084/19084 [=====] - 29s 2ms/step - loss: 0.4748 - ac

c: 0.8262 - val\_loss: 0.4135 - val\_acc: 0.8521

Epoch 00018: val\_acc did not improve from 0.85268

Epoch 19/20

19084/19084 [=====] - 29s 2ms/step - loss: 0.4556 - ac

c: 0.8378 - val\_loss: 0.3998 - val\_acc: 0.8638

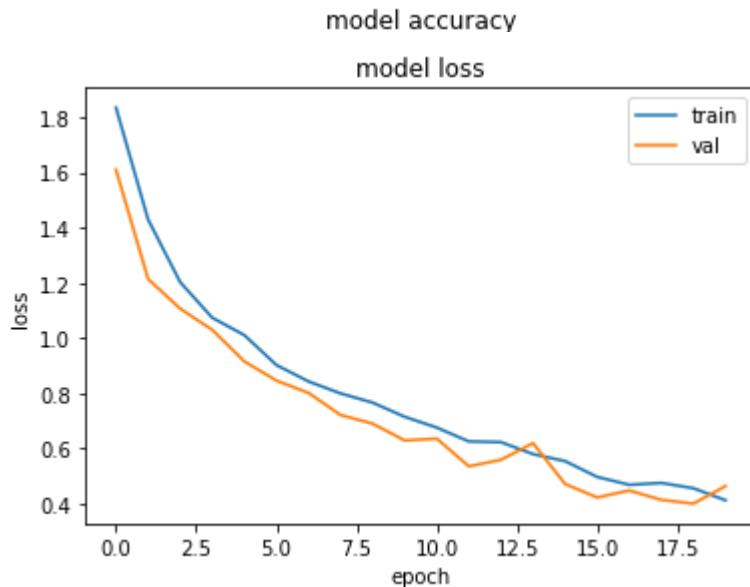
Epoch 00019: val\_acc improved from 0.85268 to 0.86379, saving model to model\_v5  
accY\_LF-accZ\_LF.hdf5

Epoch 20/20

19084/19084 [=====] - 29s 2ms/step - loss: 0.4120 - ac

c: 0.8565 - val\_loss: 0.4634 - val\_acc: 0.8395

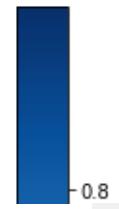
Epoch 00020: val\_acc did not improve from 0.86379



Best accuracy (on validation dataset): 83.95%

```
[[ 714     9     1    29    26     1     0     0]
 [   3   760     2    96    71     0     1     0]
 [   0     2   370     0     3     5     0     1]
 [  10    58     0  1191    14     0     0     0]
 [   5   21     0    25   302     0     0     0]
 [   0     3   153     2     4   192     0     1]
 [   2   18     0     0    34     0   313     1]
 [   0     0     3     0     0   156     6  164]]
```

<Figure size 432x288 with 0 Axes>



rest	714 (0.92)	9 (0.01)	1 (0.00)	29 (0.04)	26 (0.03)	1 (0.00)	0 (0.00)	0 (0.00)
------	---------------	-------------	-------------	--------------	--------------	-------------	-------------	-------------

## Classification Report:

	precision	recall	f1-score	support
rest	0.9728	0.9154	0.9432	780
tread_flat_walk	0.8726	0.8146	0.8426	933
tread_flat_run	0.6994	0.9711	0.8132	381
tread_slope_walk	0.8868	0.9356	0.9106	1273
indoor_flat_walk	0.6652	0.8555	0.7485	353
indoor_flat_run	0.5424	0.5408	0.5416	355
outdoor_walk	0.9781	0.8505	0.9099	368
outdoor_run	0.9820	0.4985	0.6613	329
accuracy			0.8395	4772
macro avg	0.8249	0.7978	0.7963	4772
weighted avg	0.8547	0.8395	0.8381	4772

```
Trying for these features ['accX_LF', 'accY_LF', 'accZ_LF', 'accX_RF', 'accY_RF', 'accZ_RF']
(19084, 256, 6)
(19084, 8)
(4772, 256, 6)
(4772, 8)
256
6
8
```

Layer (type)	Output Shape	Param #
<hr/>		
input_7 (InputLayer)	(None, 256, 6)	0
lstm_6 (LSTM)	(None, 100)	42800
dropout_6 (Dropout)	(None, 100)	0
dense_12 (Dense)	(None, 100)	10100
dense_13 (Dense)	(None, 8)	808
<hr/>		

Total params: 53,708

Trainable params: 53,708

Non-trainable params: 0

---

Train on 19084 samples, validate on 4772 samples

Epoch 1/20

19084/19084 [=====] - 31s 2ms/step - loss: 1.6415 - acc: 0.3634 - val\_loss: 1.0954 - val\_acc: 0.5478

Epoch 00001: val\_acc improved from -inf to 0.54778, saving model to model\_v5a\_ccX\_LF-accY\_LF-accZ\_LF-accX\_RF-accY\_RF-accZ\_RF.hdf5

Epoch 2/20

19084/19084 [=====] - 29s 2ms/step - loss: 0.9966 -

```
acc: 0.5947 - val_loss: 0.7789 - val_acc: 0.6922
```

```
Epoch 00002: val_acc improved from 0.54778 to 0.69216, saving model to model_v5accX_LF-accY_LF-accZ_LF-accX_RF-accY_RF-accZ_RF.hdf5
Epoch 3/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.7807 -
acc: 0.6898 - val_loss: 0.6408 - val_acc: 0.7601
```

```
Epoch 00003: val_acc improved from 0.69216 to 0.76006, saving model to model_v5accX_LF-accY_LF-accZ_LF-accX_RF-accY_RF-accZ_RF.hdf5
Epoch 4/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.6549 -
acc: 0.7509 - val_loss: 0.5374 - val_acc: 0.8022
```

```
Epoch 00004: val_acc improved from 0.76006 to 0.80218, saving model to model_v5accX_LF-accY_LF-accZ_LF-accX_RF-accY_RF-accZ_RF.hdf5
Epoch 5/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.5886 -
acc: 0.7818 - val_loss: 0.5274 - val_acc: 0.8028
```

```
Epoch 00005: val_acc improved from 0.80218 to 0.80281, saving model to model_v5accX_LF-accY_LF-accZ_LF-accX_RF-accY_RF-accZ_RF.hdf5
Epoch 6/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.5452 -
acc: 0.8000 - val_loss: 0.4725 - val_acc: 0.8263
```

```
Epoch 00006: val_acc improved from 0.80281 to 0.82628, saving model to model_v5accX_LF-accY_LF-accZ_LF-accX_RF-accY_RF-accZ_RF.hdf5
Epoch 7/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.4885 -
acc: 0.8241 - val_loss: 0.4899 - val_acc: 0.8221
```

```
Epoch 00007: val_acc did not improve from 0.82628
Epoch 8/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.4444 -
acc: 0.8378 - val_loss: 0.3561 - val_acc: 0.8747
```

```
Epoch 00008: val_acc improved from 0.82628 to 0.87469, saving model to model_v5accX_LF-accY_LF-accZ_LF-accX_RF-accY_RF-accZ_RF.hdf5
Epoch 9/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.4091 -
acc: 0.8570 - val_loss: 0.3857 - val_acc: 0.8619
```

```
Epoch 00009: val_acc did not improve from 0.87469
Epoch 10/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.3896 -
acc: 0.8611 - val_loss: 0.3902 - val_acc: 0.8588
```

```
Epoch 00010: val_acc did not improve from 0.87469
Epoch 11/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.3605 -
acc: 0.8762 - val_loss: 0.2823 - val_acc: 0.9086
```

```
Epoch 00011: val_acc improved from 0.87469 to 0.90863, saving model to model_v5accX_LF-accY_LF-accZ_LF-accX_RF-accY_RF-accZ_RF.hdf5
Epoch 12/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.3219 -
```

```
acc: 0.8942 - val_loss: 0.2619 - val_acc: 0.9179
```

```
Epoch 00012: val_acc improved from 0.90863 to 0.91785, saving model to model_v5accX_LF-accY_LF-accZ_LF-accX_RF-accY_RF-accZ_RF.hdf5
```

```
Epoch 13/20
```

```
19084/19084 [=====] - 30s 2ms/step - loss: 0.2864 - acc: 0.9087 - val_loss: 0.2245 - val_acc: 0.9327
```

```
Epoch 00013: val_acc improved from 0.91785 to 0.93273, saving model to model_v5accX_LF-accY_LF-accZ_LF-accX_RF-accY_RF-accZ_RF.hdf5
```

```
Epoch 14/20
```

```
19084/19084 [=====] - 29s 2ms/step - loss: 0.2865 - acc: 0.9091 - val_loss: 0.3187 - val_acc: 0.8917
```

```
Epoch 00014: val_acc did not improve from 0.93273
```

```
Epoch 15/20
```

```
19084/19084 [=====] - 29s 2ms/step - loss: 0.2996 - acc: 0.9053 - val_loss: 0.2300 - val_acc: 0.9321
```

```
Epoch 00015: val_acc did not improve from 0.93273
```

```
Epoch 16/20
```

```
19084/19084 [=====] - 29s 2ms/step - loss: 0.2634 - acc: 0.9183 - val_loss: 0.2319 - val_acc: 0.9248
```

```
Epoch 00016: val_acc did not improve from 0.93273
```

```
Epoch 17/20
```

```
19084/19084 [=====] - 29s 2ms/step - loss: 0.2248 - acc: 0.9333 - val_loss: 0.2305 - val_acc: 0.9288
```

```
Epoch 00017: val_acc did not improve from 0.93273
```

```
Epoch 18/20
```

```
19084/19084 [=====] - 29s 2ms/step - loss: 0.2103 - acc: 0.9393 - val_loss: 0.1765 - val_acc: 0.9461
```

```
Epoch 00018: val_acc improved from 0.93273 to 0.94614, saving model to model_v5accX_LF-accY_LF-accZ_LF-accX_RF-accY_RF-accZ_RF.hdf5
```

```
Epoch 19/20
```

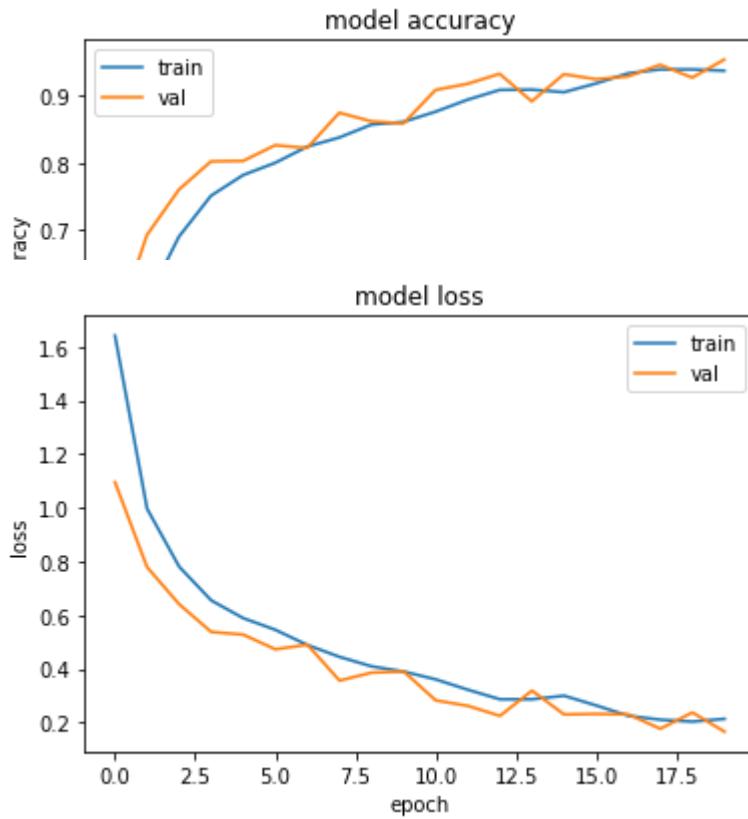
```
19084/19084 [=====] - 29s 2ms/step - loss: 0.2033 - acc: 0.9393 - val_loss: 0.2373 - val_acc: 0.9271
```

```
Epoch 00019: val_acc did not improve from 0.94614
```

```
Epoch 20/20
```

```
19084/19084 [=====] - 29s 2ms/step - loss: 0.2134 - acc: 0.9373 - val_loss: 0.1658 - val_acc: 0.9539
```

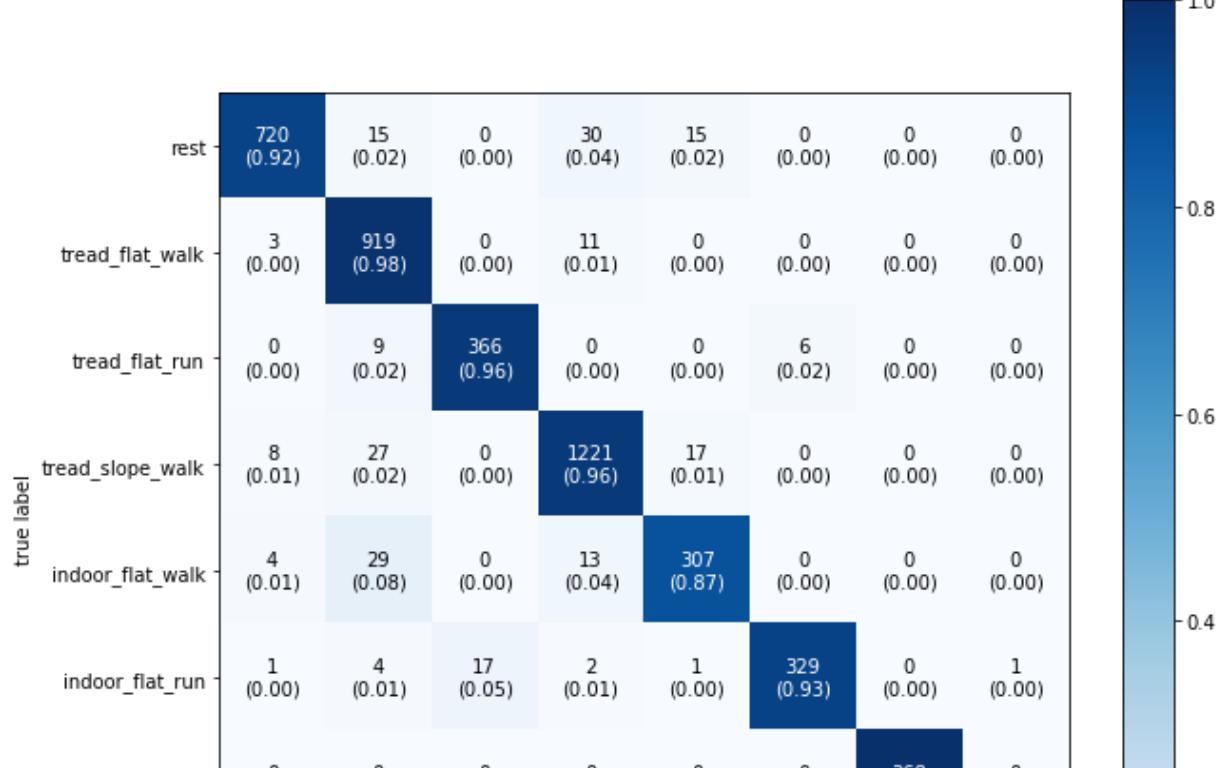
```
Epoch 00020: val_acc improved from 0.94614 to 0.95390, saving model to model_v5accX_LF-accY_LF-accZ_LF-accX_RF-accY_RF-accZ_RF.hdf5
```



Best accuracy (on validation dataset): 95.39%

```
[[ 720   15     0    30    15     0     0     0]
 [  3  919     0    11     0     0     0     0]
 [  0    9  366     0     0     6     0     0]
 [  8   27     0 1221    17     0     0     0]
 [  4   29     0    13   307     0     0     0]
 [  1    4   17     2     1   329     0     1]
 [  0    0     0     0     0     0   368     0]
 [  0    0     0     0     0     0     7  322]]
```

<Figure size 432x288 with 0 Axes>



## Classification Report:

	precision	recall	f1-score	support
rest	0.9783	0.9231	0.9499	780
tread_flat_walk	0.9163	0.9850	0.9494	933
tread_flat_run	0.9556	0.9606	0.9581	381
tread_slope_walk	0.9561	0.9592	0.9576	1273
indoor_flat_walk	0.9029	0.8697	0.8860	353
indoor_flat_run	0.9821	0.9268	0.9536	355
outdoor_walk	0.9813	1.0000	0.9906	368
outdoor_run	0.9969	0.9787	0.9877	329
accuracy			0.9539	4772
macro avg	0.9587	0.9504	0.9541	4772
weighted avg	0.9547	0.9539	0.9538	4772

Trying for these features ['accX\_LF', 'accY\_LF']

(19084, 256, 2)

(19084, 8)

(4772, 256, 2)

(4772, 8)

256

2

8

Layer (type)	Output Shape	Param #
<hr/>		
input_8 (InputLayer)	(None, 256, 2)	0
lstm_7 (LSTM)	(None, 100)	41200
dropout_7 (Dropout)	(None, 100)	0
dense_14 (Dense)	(None, 100)	10100

```
dense_15 (Dense)           (None, 8)          808
=====
Total params: 52,108
Trainable params: 52,108
Non-trainable params: 0

Train on 19084 samples, validate on 4772 samples
Epoch 1/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.7544 -
acc: 0.3285 - val_loss: 1.3595 - val_acc: 0.4501

Epoch 00001: val_acc improved from -inf to 0.45013, saving model to model_v5a
ccX_LF-accY_LF.hdf5
Epoch 2/20
19084/19084 [=====] - 29s 2ms/step - loss: 1.2647 -
acc: 0.4741 - val_loss: 1.1383 - val_acc: 0.5180

Epoch 00002: val_acc improved from 0.45013 to 0.51802, saving model to model_
v5accX_LF-accY_LF.hdf5
Epoch 3/20
19084/19084 [=====] - 29s 2ms/step - loss: 1.1219 -
acc: 0.5226 - val_loss: 1.0624 - val_acc: 0.5446

Epoch 00003: val_acc improved from 0.51802 to 0.54464, saving model to model_
v5accX_LF-accY_LF.hdf5
Epoch 4/20
19084/19084 [=====] - 29s 2ms/step - loss: 1.0907 -
acc: 0.5365 - val_loss: 1.0183 - val_acc: 0.5780

Epoch 00004: val_acc improved from 0.54464 to 0.57795, saving model to model_
v5accX_LF-accY_LF.hdf5
Epoch 5/20
19084/19084 [=====] - 29s 2ms/step - loss: 1.0373 -
acc: 0.5698 - val_loss: 0.9640 - val_acc: 0.6190

Epoch 00005: val_acc improved from 0.57795 to 0.61903, saving model to model_
v5accX_LF-accY_LF.hdf5
Epoch 6/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.9908 -
acc: 0.5883 - val_loss: 0.9112 - val_acc: 0.6442

Epoch 00006: val_acc improved from 0.61903 to 0.64417, saving model to model_
v5accX_LF-accY_LF.hdf5
Epoch 7/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.9419 -
acc: 0.6199 - val_loss: 0.8609 - val_acc: 0.6664

Epoch 00007: val_acc improved from 0.64417 to 0.66639, saving model to model_
v5accX_LF-accY_LF.hdf5
Epoch 8/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.9002 -
acc: 0.6332 - val_loss: 0.8316 - val_acc: 0.6710

Epoch 00008: val_acc improved from 0.66639 to 0.67100, saving model to model_
v5accX_LF-accY_LF.hdf5
Epoch 9/20
```

```
19084/19084 [=====] - 29s 2ms/step - loss: 0.8441 -  
acc: 0.6592 - val_loss: 0.7552 - val_acc: 0.6943  
  
Epoch 00009: val_acc improved from 0.67100 to 0.69426, saving model to model_  
v5accX_LF-accY_LF.hdf5  
Epoch 10/20  
19084/19084 [=====] - 29s 2ms/step - loss: 0.8451 -  
acc: 0.6662 - val_loss: 0.8518 - val_acc: 0.6637  
  
Epoch 00010: val_acc did not improve from 0.69426  
Epoch 11/20  
19084/19084 [=====] - 29s 2ms/step - loss: 0.8162 -  
acc: 0.6785 - val_loss: 0.7682 - val_acc: 0.6907  
  
Epoch 00011: val_acc did not improve from 0.69426  
Epoch 12/20  
19084/19084 [=====] - 29s 2ms/step - loss: 0.7549 -  
acc: 0.6994 - val_loss: 0.7225 - val_acc: 0.7108  
  
Epoch 00012: val_acc improved from 0.69426 to 0.71081, saving model to model_  
v5accX_LF-accY_LF.hdf5  
Epoch 13/20  
19084/19084 [=====] - 29s 2ms/step - loss: 0.7246 -  
acc: 0.7112 - val_loss: 0.6943 - val_acc: 0.7175  
  
Epoch 00013: val_acc improved from 0.71081 to 0.71752, saving model to model_  
v5accX_LF-accY_LF.hdf5  
Epoch 14/20  
19084/19084 [=====] - 29s 2ms/step - loss: 0.6793 -  
acc: 0.7283 - val_loss: 0.6217 - val_acc: 0.7554  
  
Epoch 00014: val_acc improved from 0.71752 to 0.75545, saving model to model_  
v5accX_LF-accY_LF.hdf5  
Epoch 15/20  
19084/19084 [=====] - 29s 2ms/step - loss: 0.6771 -  
acc: 0.7296 - val_loss: 0.6554 - val_acc: 0.7320  
  
Epoch 00015: val_acc did not improve from 0.75545  
Epoch 16/20  
19084/19084 [=====] - 29s 2ms/step - loss: 0.6625 -  
acc: 0.7357 - val_loss: 0.5797 - val_acc: 0.7735  
  
Epoch 00016: val_acc improved from 0.75545 to 0.77347, saving model to model_  
v5accX_LF-accY_LF.hdf5  
Epoch 17/20  
19084/19084 [=====] - 30s 2ms/step - loss: 0.6259 -  
acc: 0.7505 - val_loss: 0.5796 - val_acc: 0.7772  
  
Epoch 00017: val_acc improved from 0.77347 to 0.77724, saving model to model_  
v5accX_LF-accY_LF.hdf5  
Epoch 18/20  
19084/19084 [=====] - 29s 2ms/step - loss: 0.6002 -  
acc: 0.7645 - val_loss: 0.5593 - val_acc: 0.7896  
  
Epoch 00018: val_acc improved from 0.77724 to 0.78961, saving model to model_  
v5accX_LF-accY_LF.hdf5  
Epoch 19/20
```

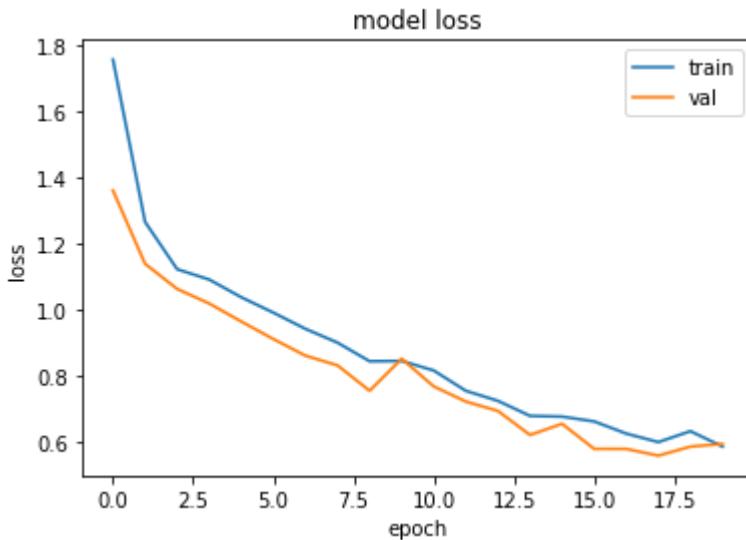
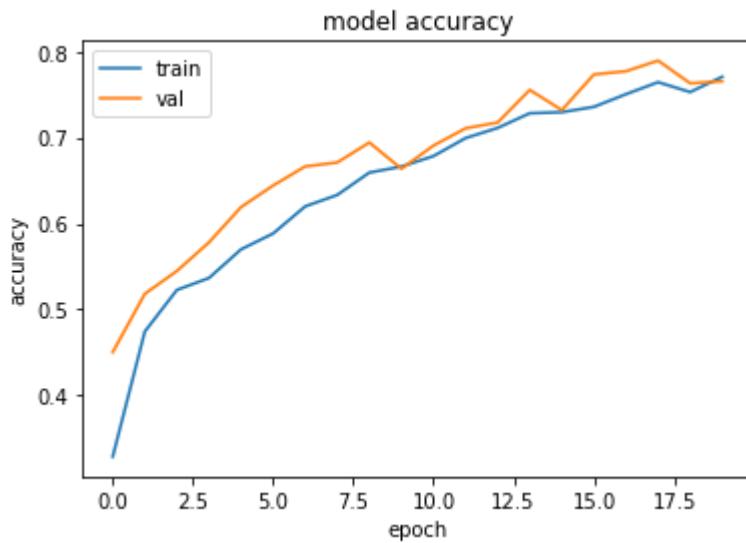
```
19084/19084 [=====] - 29s 2ms/step - loss: 0.6331 - acc: 0.7530 - val_loss: 0.5865 - val_acc: 0.7632
```

Epoch 00019: val\_acc did not improve from 0.78961

Epoch 20/20

```
19084/19084 [=====] - 29s 2ms/step - loss: 0.5868 - acc: 0.7708 - val_loss: 0.5947 - val_acc: 0.7655
```

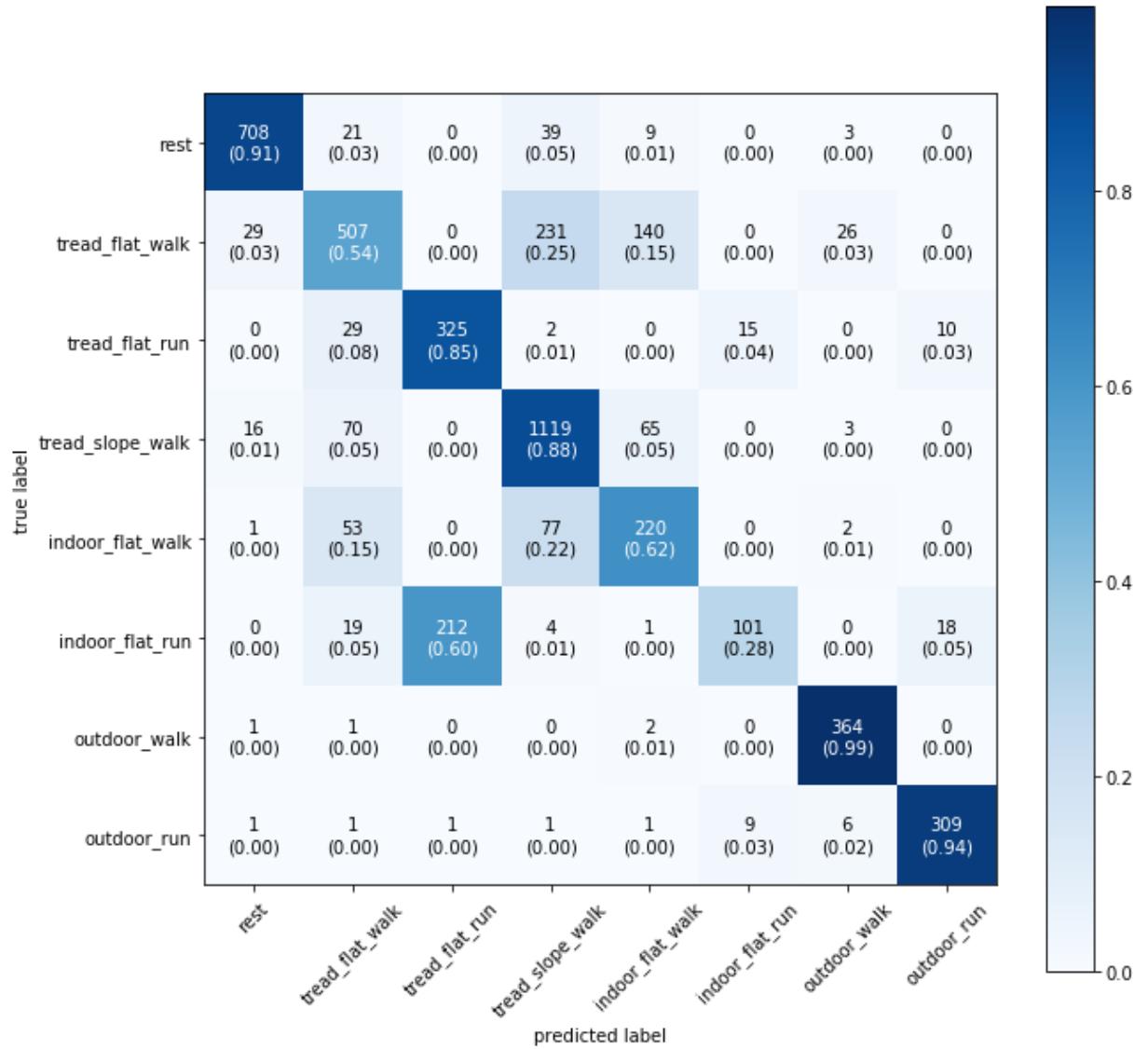
Epoch 00020: val\_acc did not improve from 0.78961



Best accuracy (on validation dataset): 76.55%

```
[[ 708   21    0   39     9    0    3    0]
 [ 29   507    0  231   140    0   26    0]
 [  0    29   325    2    0   15    0   10]
 [ 16    70    0 1119    65    0    3    0]
 [  1    53    0    77   220    0    2    0]
 [  0    19   212    4    1  101    0   18]
 [  1    1     0    0    2    0  364    0]
 [  1    1     1    1    1    9    6 309]]
```

<Figure size 432x288 with 0 Axes>



## Classification Report:

	precision	recall	f1-score	support
rest	0.9365	0.9077	0.9219	780
tread_flat_walk	0.7233	0.5434	0.6206	933
tread_flat_run	0.6041	0.8530	0.7073	381
tread_slope_walk	0.7597	0.8790	0.8150	1273

indoor_flat_walk	0.5023	0.6232	0.5563	353
indoor_flat_run	0.8080	0.2845	0.4208	355
outdoor_walk	0.9010	0.9891	0.9430	368
outdoor_run	0.9169	0.9392	0.9279	329
accuracy			0.7655	4772
macro avg	0.7690	0.7524	0.7391	4772
weighted avg	0.7753	0.7655	0.7550	4772

Trying for these features ['accX\_LF', 'accZ\_LF']

(19084, 256, 2)

(19084, 8)

(4772, 256, 2)

(4772, 8)

256

2

8

Layer (type)	Output Shape	Param #
<hr/>		
input_9 (InputLayer)	(None, 256, 2)	0
lstm_8 (LSTM)	(None, 100)	41200
dropout_8 (Dropout)	(None, 100)	0
dense_16 (Dense)	(None, 100)	10100
dense_17 (Dense)	(None, 8)	808
<hr/>		

Total params: 52,108

Trainable params: 52,108

Non-trainable params: 0

---

Train on 19084 samples, validate on 4772 samples

Epoch 1/20

19084/19084 [=====] - 31s 2ms/step - loss: 1.8352 - acc: 0.2814 - val\_loss: 1.5407 - val\_acc: 0.4034

Epoch 00001: val\_acc improved from -inf to 0.40339, saving model to model\_v5accX\_LF-accZ\_LF.hdf5

Epoch 2/20

19084/19084 [=====] - 29s 2ms/step - loss: 1.4540 - acc: 0.4195 - val\_loss: 1.3960 - val\_acc: 0.4478

Epoch 00002: val\_acc improved from 0.40339 to 0.44782, saving model to model\_v5accX\_LF-accZ\_LF.hdf5

Epoch 3/20

19084/19084 [=====] - 29s 2ms/step - loss: 1.4371 - acc: 0.4403 - val\_loss: 1.3223 - val\_acc: 0.4738

Epoch 00003: val\_acc improved from 0.44782 to 0.47381, saving model to model\_v5accX\_LF-accZ\_LF.hdf5

Epoch 4/20

19084/19084 [=====] - 29s 2ms/step - loss: 1.2621 - acc: 0.4935 - val\_loss: 1.5624 - val\_acc: 0.4457

```
Epoch 00004: val_acc did not improve from 0.47381
Epoch 5/20
19084/19084 [=====] - 29s 2ms/step - loss: 1.2117 - ac
c: 0.5195 - val_loss: 1.0715 - val_acc: 0.5627

Epoch 00005: val_acc improved from 0.47381 to 0.56266, saving model to model_v5
accX_LF-accZ_LF.hdf5
Epoch 6/20
19084/19084 [=====] - 29s 2ms/step - loss: 1.0979 - ac
c: 0.5542 - val_loss: 1.0703 - val_acc: 0.5744

Epoch 00006: val_acc improved from 0.56266 to 0.57439, saving model to model_v5
accX_LF-accZ_LF.hdf5
Epoch 7/20
19084/19084 [=====] - 29s 2ms/step - loss: 1.0536 - ac
c: 0.5723 - val_loss: 0.9917 - val_acc: 0.5943

Epoch 00007: val_acc improved from 0.57439 to 0.59430, saving model to model_v5
accX_LF-accZ_LF.hdf5
Epoch 8/20
19084/19084 [=====] - 29s 2ms/step - loss: 1.1893 - ac
c: 0.5402 - val_loss: 1.0321 - val_acc: 0.6023

Epoch 00008: val_acc improved from 0.59430 to 0.60226, saving model to model_v5
accX_LF-accZ_LF.hdf5
Epoch 9/20
19084/19084 [=====] - 29s 2ms/step - loss: 1.0211 - ac
c: 0.5892 - val_loss: 1.0037 - val_acc: 0.6127

Epoch 00009: val_acc improved from 0.60226 to 0.61274, saving model to model_v5
accX_LF-accZ_LF.hdf5
Epoch 10/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.9919 - ac
c: 0.6113 - val_loss: 0.9466 - val_acc: 0.6197

Epoch 00010: val_acc improved from 0.61274 to 0.61966, saving model to model_v5
accX_LF-accZ_LF.hdf5
Epoch 11/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.9478 - ac
c: 0.6235 - val_loss: 0.8819 - val_acc: 0.6490

Epoch 00011: val_acc improved from 0.61966 to 0.64899, saving model to model_v5
accX_LF-accZ_LF.hdf5
Epoch 12/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.9632 - ac
c: 0.6214 - val_loss: 0.9502 - val_acc: 0.6352

Epoch 00012: val_acc did not improve from 0.64899
Epoch 13/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.9558 - ac
c: 0.6288 - val_loss: 0.8916 - val_acc: 0.6511

Epoch 00013: val_acc improved from 0.64899 to 0.65109, saving model to model_v5
accX_LF-accZ_LF.hdf5
Epoch 14/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.9470 - ac
c: 0.6249 - val_loss: 1.0640 - val_acc: 0.5589
```

```
Epoch 00014: val_acc did not improve from 0.65109
Epoch 15/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.9975 - ac
c: 0.5812 - val_loss: 0.9097 - val_acc: 0.6417

Epoch 00015: val_acc did not improve from 0.65109
Epoch 16/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.9367 - ac
c: 0.6195 - val_loss: 0.8939 - val_acc: 0.6570

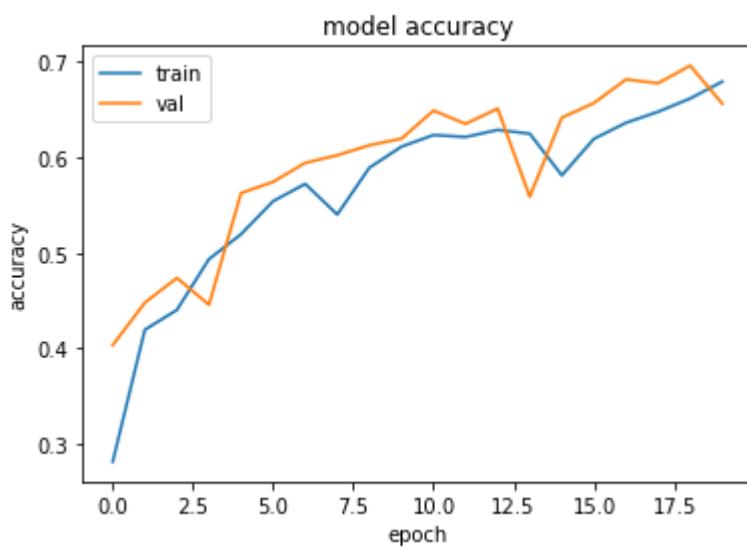
Epoch 00016: val_acc improved from 0.65109 to 0.65696, saving model to model_v5
accX_LF-accZ_LF.hdf5
Epoch 17/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.9257 - ac
c: 0.6363 - val_loss: 0.8155 - val_acc: 0.6817

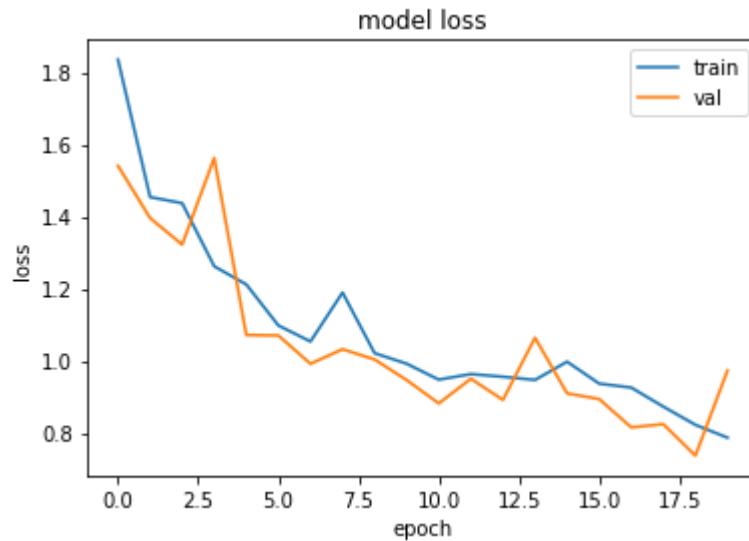
Epoch 00017: val_acc improved from 0.65696 to 0.68168, saving model to model_v5
accX_LF-accZ_LF.hdf5
Epoch 18/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.8729 - ac
c: 0.6478 - val_loss: 0.8243 - val_acc: 0.6777

Epoch 00018: val_acc did not improve from 0.68168
Epoch 19/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.8224 - ac
c: 0.6617 - val_loss: 0.7370 - val_acc: 0.6961

Epoch 00019: val_acc improved from 0.68168 to 0.69614, saving model to model_v5
accX_LF-accZ_LF.hdf5
Epoch 20/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.7869 - ac
c: 0.6794 - val_loss: 0.9731 - val_acc: 0.6563

Epoch 00020: val_acc did not improve from 0.69614
```

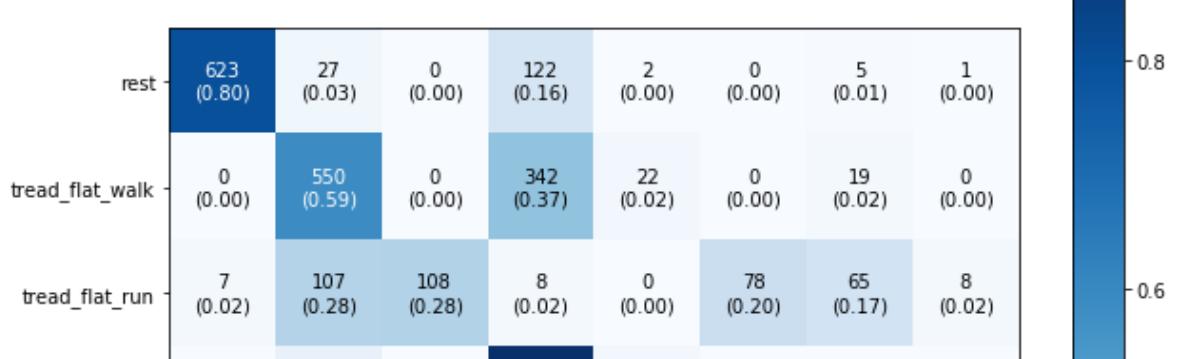




Best accuracy (on validation dataset): 65.63%

```
[[ 623   27     0   122     2     0     5     1]
 [  0   550     0   342    22     0    19     0]
 [  7   107   108     8     0    78    65     8]
 [  1    83     0  1159    30     0     0     0]
 [  0   114     0   180    59     0     0     0]
 [ 14    71    52    19     0   141    30    28]
 [  1   161     0     9     4     0   193     0]
 [  0     1     3     0     1    14    11  299]]
```

<Figure size 432x288 with 0 Axes>



## Classification Report:

	precision	recall	f1-score	support
rest	0.9644	0.7987	0.8738	780
tread_flat_walk	0.4937	0.5895	0.5374	933
tread_flat_run	0.6626	0.2835	0.3971	381
tread_slope_walk	0.6302	0.9104	0.7449	1273
indoor_flat_walk	0.5000	0.1671	0.2505	353
indoor_flat_run	0.6052	0.3972	0.4796	355
outdoor_walk	0.5975	0.5245	0.5586	368
outdoor_run	0.8899	0.9088	0.8992	329
accuracy			0.6563	4772
macro avg	0.6679	0.5725	0.5926	4772
weighted avg	0.6646	0.6563	0.6376	4772

Trying for these features ['accX\_LF', 'accX\_RF']

(19084, 256, 2)

(19084, 8)

(4772, 256, 2)

(4772, 8)

256

2

8

Layer (type)	Output Shape	Param #
<hr/>		
input_10 (InputLayer)	(None, 256, 2)	0
lstm_9 (LSTM)	(None, 100)	41200
dropout_9 (Dropout)	(None, 100)	0
dense_18 (Dense)	(None, 100)	10100
dense_19 (Dense)	(None, 8)	808
<hr/>		

Total params: 52,108

Trainable params: 52,108

Non-trainable params: 0

---

Train on 19084 samples, validate on 4772 samples

Epoch 1/20

19084/19084 [=====] - 31s 2ms/step - loss: 1.8211 - ac

```
c: 0.3054 - val_loss: 1.4038 - val_acc: 0.4696

Epoch 00001: val_acc improved from -inf to 0.46961, saving model to model_v5accX_LF-accX_RF.hdf5
Epoch 2/20
19084/19084 [=====] - 29s 2ms/step - loss: 1.3051 - acc: 0.4776 - val_loss: 1.2128 - val_acc: 0.5207

Epoch 00002: val_acc improved from 0.46961 to 0.52075, saving model to model_v5accX_LF-accX_RF.hdf5
Epoch 3/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.1929 - acc: 0.5111 - val_loss: 1.0688 - val_acc: 0.5601

Epoch 00003: val_acc improved from 0.52075 to 0.56014, saving model to model_v5accX_LF-accX_RF.hdf5
Epoch 4/20
19084/19084 [=====] - 29s 2ms/step - loss: 1.0805 - acc: 0.5499 - val_loss: 0.9999 - val_acc: 0.5987

Epoch 00004: val_acc improved from 0.56014 to 0.59870, saving model to model_v5accX_LF-accX_RF.hdf5
Epoch 5/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.9957 - acc: 0.5946 - val_loss: 0.9253 - val_acc: 0.6377

Epoch 00005: val_acc improved from 0.59870 to 0.63768, saving model to model_v5accX_LF-accX_RF.hdf5
Epoch 6/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.9610 - acc: 0.6153 - val_loss: 0.9865 - val_acc: 0.6207

Epoch 00006: val_acc did not improve from 0.63768
Epoch 7/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.9386 - acc: 0.6298 - val_loss: 0.8878 - val_acc: 0.6616

Epoch 00007: val_acc improved from 0.63768 to 0.66157, saving model to model_v5accX_LF-accX_RF.hdf5
Epoch 8/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.9050 - acc: 0.6454 - val_loss: 0.8078 - val_acc: 0.6800

Epoch 00008: val_acc improved from 0.66157 to 0.68001, saving model to model_v5accX_LF-accX_RF.hdf5
Epoch 9/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.9225 - acc: 0.6339 - val_loss: 0.8596 - val_acc: 0.6586

Epoch 00009: val_acc did not improve from 0.68001
Epoch 10/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.9121 - acc: 0.6347 - val_loss: 0.9037 - val_acc: 0.6551

Epoch 00010: val_acc did not improve from 0.68001
Epoch 11/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.8843 - acc:
```

```
c: 0.6492 - val_loss: 0.7915 - val_acc: 0.6934
```

```
Epoch 00011: val_acc improved from 0.68001 to 0.69342, saving model to model_v5  
accX_LF-accX_RF.hdf5  
Epoch 12/20  
19084/19084 [=====] - 29s 2ms/step - loss: 0.8295 - ac  
c: 0.6728 - val_loss: 0.7768 - val_acc: 0.7033
```

```
Epoch 00012: val_acc improved from 0.69342 to 0.70327, saving model to model_v5  
accX_LF-accX_RF.hdf5  
Epoch 13/20  
19084/19084 [=====] - 29s 2ms/step - loss: 0.8623 - ac  
c: 0.6596 - val_loss: 0.8021 - val_acc: 0.6859
```

```
Epoch 00013: val_acc did not improve from 0.70327  
Epoch 14/20  
19084/19084 [=====] - 29s 2ms/step - loss: 0.8008 - ac  
c: 0.6870 - val_loss: 0.7200 - val_acc: 0.7272
```

```
Epoch 00014: val_acc improved from 0.70327 to 0.72716, saving model to model_v5  
accX_LF-accX_RF.hdf5  
Epoch 15/20  
19084/19084 [=====] - 30s 2ms/step - loss: 0.7399 - ac  
c: 0.7129 - val_loss: 0.6366 - val_acc: 0.7529
```

```
Epoch 00015: val_acc improved from 0.72716 to 0.75293, saving model to model_v5  
accX_LF-accX_RF.hdf5  
Epoch 16/20  
19084/19084 [=====] - 29s 2ms/step - loss: 0.7140 - ac  
c: 0.7255 - val_loss: 0.7053 - val_acc: 0.7240
```

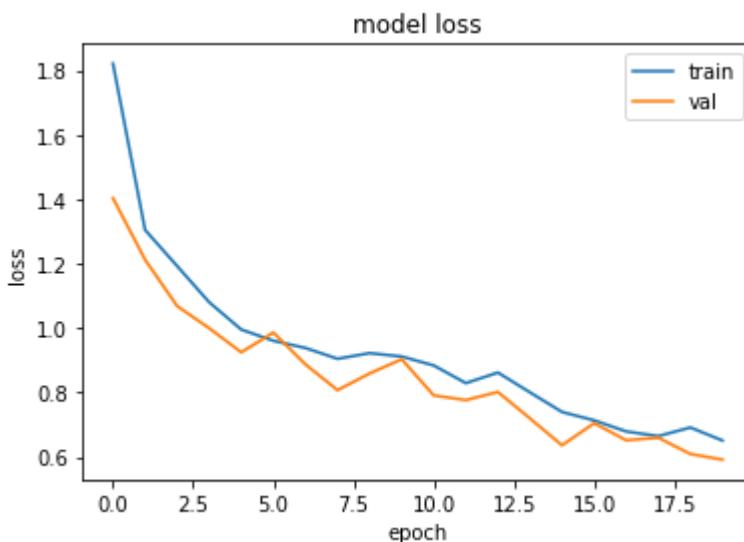
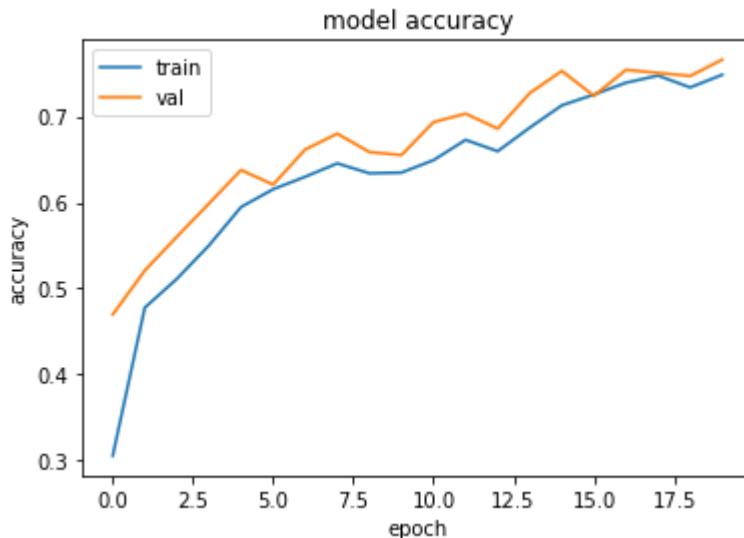
```
Epoch 00016: val_acc did not improve from 0.75293  
Epoch 17/20  
19084/19084 [=====] - 29s 2ms/step - loss: 0.6795 - ac  
c: 0.7393 - val_loss: 0.6522 - val_acc: 0.7542
```

```
Epoch 00017: val_acc improved from 0.75293 to 0.75419, saving model to model_v5  
accX_LF-accX_RF.hdf5  
Epoch 18/20  
19084/19084 [=====] - 29s 2ms/step - loss: 0.6651 - ac  
c: 0.7475 - val_loss: 0.6601 - val_acc: 0.7506
```

```
Epoch 00018: val_acc did not improve from 0.75419  
Epoch 19/20  
19084/19084 [=====] - 29s 2ms/step - loss: 0.6918 - ac  
c: 0.7338 - val_loss: 0.6096 - val_acc: 0.7471
```

```
Epoch 00019: val_acc did not improve from 0.75419  
Epoch 20/20  
19084/19084 [=====] - 29s 2ms/step - loss: 0.6514 - ac  
c: 0.7485 - val_loss: 0.5921 - val_acc: 0.7661
```

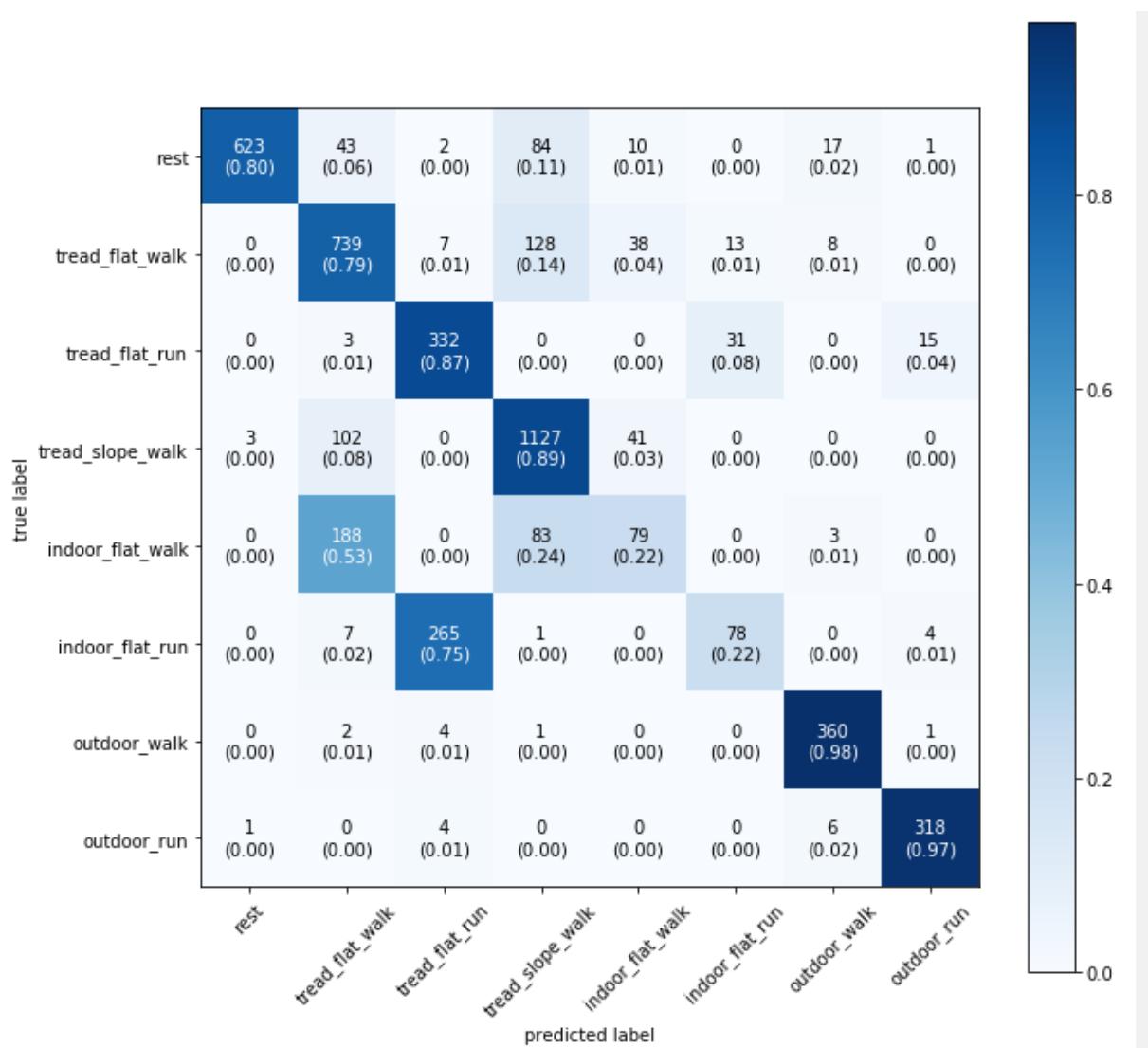
```
Epoch 00020: val_acc improved from 0.75419 to 0.76614, saving model to model_v5  
accX_LF-accX_RF.hdf5
```



Best accuracy (on validation dataset): 76.61%

```
[[ 623   43    2   84   10    0   17    1]
 [  0   739    7  128   38   13    8    0]
 [  0    3  332    0    0   31    0   15]
 [  3   102    0 1127   41    0    0    0]
 [  0   188    0   83   79    0    3    0]
 [  0     7  265    1    0   78    0    4]
 [  0     2    4    1    0    0  360    1]
 [  1     0    4    0    0    0    6 318]]
```

<Figure size 432x288 with 0 Axes>



## Classification Report:

	precision	recall	f1-score	support
rest	0.9936	0.7987	0.8856	780
tread_flat_walk	0.6817	0.7921	0.7328	933
tread_flat_run	0.5407	0.8714	0.6673	381
tread_slope_walk	0.7914	0.8853	0.8357	1273
indoor_flat_walk	0.4702	0.2238	0.3033	353
indoor_flat_run	0.6393	0.2197	0.3270	355
outdoor_walk	0.9137	0.9783	0.9449	368
outdoor_run	0.9381	0.9666	0.9521	329
accuracy			0.7661	4772
macro avg	0.7461	0.7170	0.7061	4772
weighted avg	0.7675	0.7661	0.7495	4772

```
Trying for these features ['accX_LF', 'accY_RF']
(19084, 256, 2)
(19084, 8)
(4772, 256, 2)
(4772, 8)
256
2
8
```

Layer (type)	Output Shape	Param #
<hr/>		
input_11 (InputLayer)	(None, 256, 2)	0
lstm_10 (LSTM)	(None, 100)	41200
dropout_10 (Dropout)	(None, 100)	0
dense_20 (Dense)	(None, 100)	10100
dense_21 (Dense)	(None, 8)	808
<hr/>		

Total params: 52,108

Trainable params: 52,108

Non-trainable params: 0

---

Train on 19084 samples, validate on 4772 samples

Epoch 1/20

19084/19084 [=====] - 31s 2ms/step - loss: 1.7348 - acc: 0.3315 - val\_loss: 1.3410 - val\_acc: 0.4713

Epoch 00001: val\_acc improved from -inf to 0.47129, saving model to model\_v5accX\_LF-accY\_RF.hdf5

Epoch 2/20

19084/19084 [=====] - 29s 2ms/step - loss: 1.1883 - acc: 0.5139 - val\_loss: 1.0312 - val\_acc: 0.5560

Epoch 00002: val\_acc improved from 0.47129 to 0.55595, saving model to model\_v5accX\_LF-accY\_RF.hdf5

Epoch 3/20

19084/19084 [=====] - 29s 2ms/step - loss: 1.0717 - acc: 0.5455 - val\_loss: 0.9764 - val\_acc: 0.5840

Epoch 00003: val\_acc improved from 0.55595 to 0.58403, saving model to model\_v5accX\_LF-accY\_RF.hdf5

Epoch 4/20

19084/19084 [=====] - 29s 2ms/step - loss: 0.9859 - acc: 0.5809 - val\_loss: 0.9260 - val\_acc: 0.6125

Epoch 00004: val\_acc improved from 0.58403 to 0.61253, saving model to model\_v5accX\_LF-accY\_RF.hdf5

Epoch 5/20

19084/19084 [=====] - 29s 2ms/step - loss: 0.8957 - acc: 0.6363 - val\_loss: 0.8096 - val\_acc: 0.6825

Epoch 00005: val\_acc improved from 0.61253 to 0.68252, saving model to model\_v5accX\_LF-accY\_RF.hdf5

Epoch 6/20

```
19084/19084 [=====] - 29s 2ms/step - loss: 0.8076 - ac  
c: 0.6767 - val_loss: 0.7147 - val_acc: 0.7114
```

Epoch 00006: val\_acc improved from 0.68252 to 0.71144, saving model to model\_v5  
accX\_LF-accY\_RF.hdf5

Epoch 7/20

```
19084/19084 [=====] - 29s 2ms/step - loss: 0.7343 - ac  
c: 0.7143 - val_loss: 0.6971 - val_acc: 0.7376
```

Epoch 00007: val\_acc improved from 0.71144 to 0.73764, saving model to model\_v5  
accX\_LF-accY\_RF.hdf5

Epoch 8/20

```
19084/19084 [=====] - 29s 2ms/step - loss: 0.6935 - ac  
c: 0.7325 - val_loss: 0.6742 - val_acc: 0.7456
```

Epoch 00008: val\_acc improved from 0.73764 to 0.74560, saving model to model\_v5  
accX\_LF-accY\_RF.hdf5

Epoch 9/20

```
19084/19084 [=====] - 29s 2ms/step - loss: 0.6402 - ac  
c: 0.7629 - val_loss: 0.5568 - val_acc: 0.7942
```

Epoch 00009: val\_acc improved from 0.74560 to 0.79422, saving model to model\_v5  
accX\_LF-accY\_RF.hdf5

Epoch 10/20

```
19084/19084 [=====] - 29s 2ms/step - loss: 0.5998 - ac  
c: 0.7697 - val_loss: 0.5719 - val_acc: 0.7758
```

Epoch 00010: val\_acc did not improve from 0.79422

Epoch 11/20

```
19084/19084 [=====] - 29s 2ms/step - loss: 0.5565 - ac  
c: 0.7922 - val_loss: 0.4598 - val_acc: 0.8368
```

Epoch 00011: val\_acc improved from 0.79422 to 0.83676, saving model to model\_v5  
accX\_LF-accY\_RF.hdf5

Epoch 12/20

```
19084/19084 [=====] - 29s 2ms/step - loss: 0.5302 - ac  
c: 0.8046 - val_loss: 0.4578 - val_acc: 0.8405
```

Epoch 00012: val\_acc improved from 0.83676 to 0.84053, saving model to model\_v5  
accX\_LF-accY\_RF.hdf5

Epoch 13/20

```
19084/19084 [=====] - 29s 2ms/step - loss: 0.4797 - ac  
c: 0.8312 - val_loss: 0.4429 - val_acc: 0.8518
```

Epoch 00013: val\_acc improved from 0.84053 to 0.85184, saving model to model\_v5  
accX\_LF-accY\_RF.hdf5

Epoch 14/20

```
19084/19084 [=====] - 29s 2ms/step - loss: 0.4509 - ac  
c: 0.8463 - val_loss: 0.4315 - val_acc: 0.8516
```

Epoch 00014: val\_acc did not improve from 0.85184

Epoch 15/20

```
19084/19084 [=====] - 29s 2ms/step - loss: 0.4157 - ac  
c: 0.8589 - val_loss: 0.3890 - val_acc: 0.8789
```

Epoch 00015: val\_acc improved from 0.85184 to 0.87888, saving model to model\_v5  
accX\_LF-accY\_RF.hdf5

```
Epoch 16/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.4257 - ac
c: 0.8593 - val_loss: 0.4060 - val_acc: 0.8623

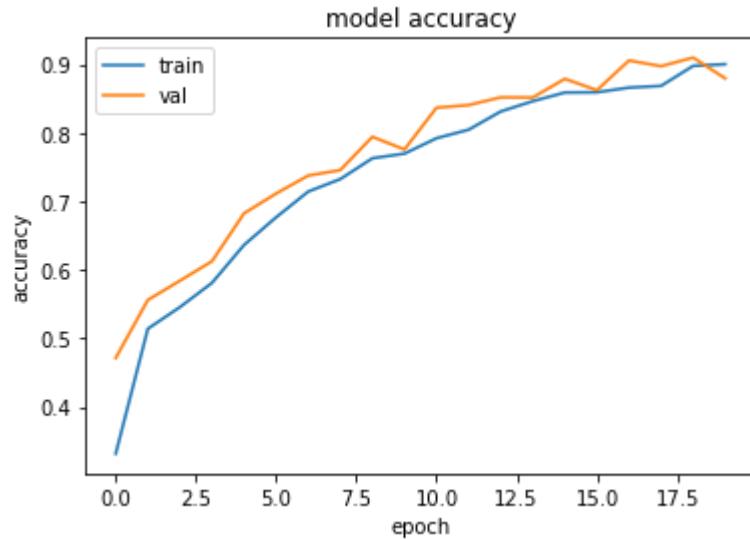
Epoch 00016: val_acc did not improve from 0.87888
Epoch 17/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.4121 - ac
c: 0.8661 - val_loss: 0.3121 - val_acc: 0.9057

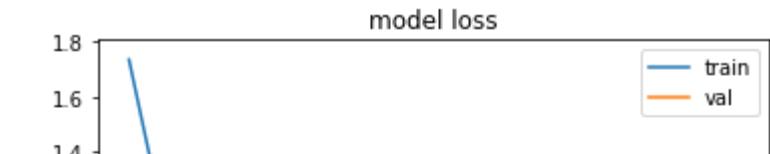
Epoch 00017: val_acc improved from 0.87888 to 0.90570, saving model to model_v5
accX_LF-accY_RF.hdf5
Epoch 18/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.4036 - ac
c: 0.8686 - val_loss: 0.3321 - val_acc: 0.8973

Epoch 00018: val_acc did not improve from 0.90570
Epoch 19/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.3371 - ac
c: 0.8978 - val_loss: 0.2919 - val_acc: 0.9099

Epoch 00019: val_acc improved from 0.90570 to 0.90989, saving model to model_v5
accX_LF-accY_RF.hdf5
Epoch 20/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.3297 - ac
c: 0.9002 - val_loss: 0.3839 - val_acc: 0.8795

Epoch 00020: val_acc did not improve from 0.90989
```

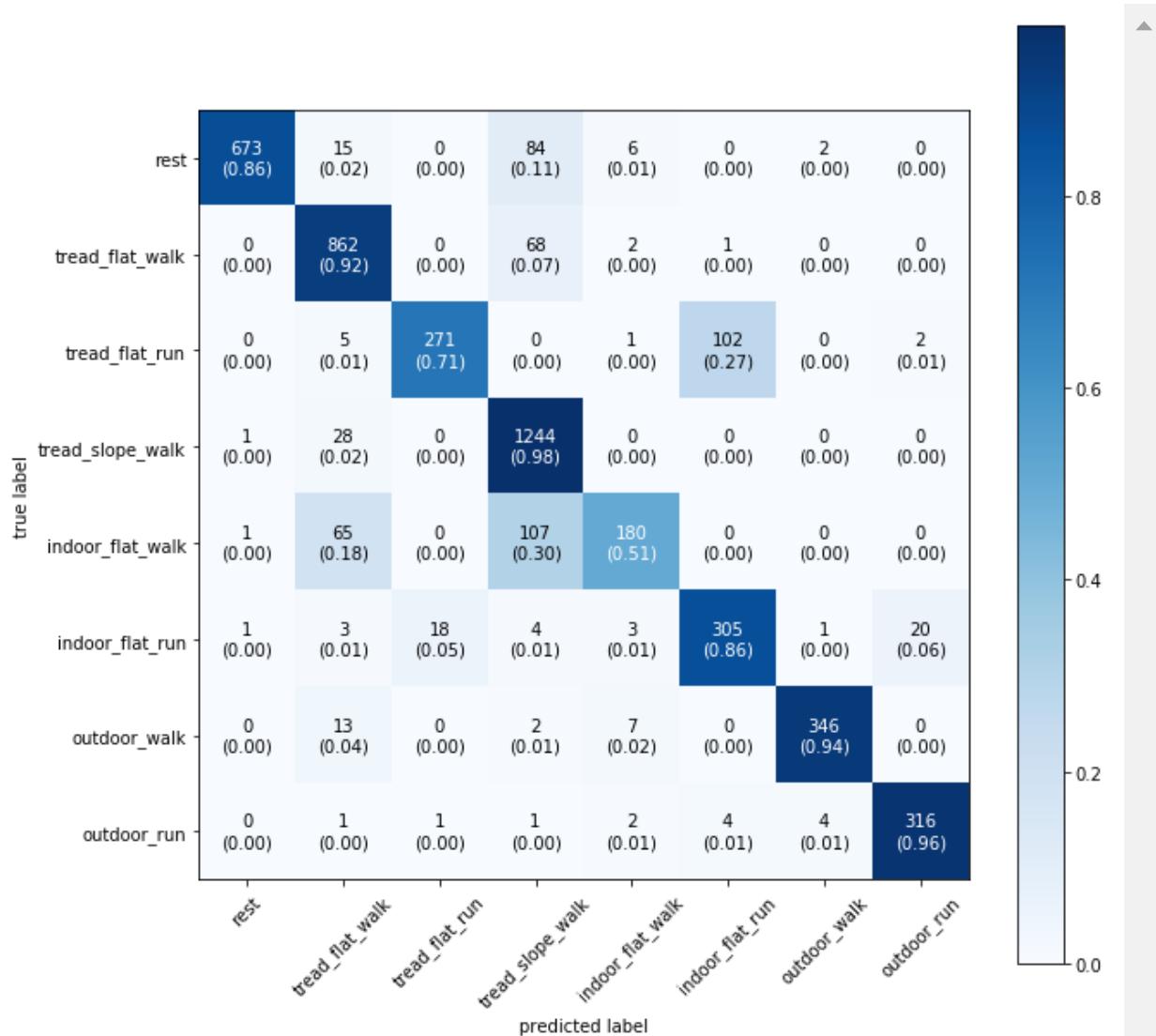




Best accuracy (on validation dataset): 87.95%

```
[[ 673   15     0    84     6     0     2     0]
 [  0   862     0    68     2     1     0     0]
 [  0     5   271     0     1   102     0     2]
 [  1    28     0  1244     0     0     0     0]
 [  1    65     0   107   180     0     0     0]
 [  1     3   18     4     3   305     1   20]
 [  0   13     0     2     7     0   346     0]
 [  0     1     1     1     2     4     4   316]]
```

<Figure size 432x288 with 0 Axes>



## Classification Report:

	precision	recall	f1-score	support
rest	0.9956	0.8628	0.9245	780
tread_flat_walk	0.8690	0.9239	0.8956	933
tread_flat_run	0.9345	0.7113	0.8077	381
tread_slope_walk	0.8238	0.9772	0.8940	1273
indoor_flat_walk	0.8955	0.5099	0.6498	353
indoor_flat_run	0.7403	0.8592	0.7953	355
outdoor_walk	0.9802	0.9402	0.9598	368
outdoor_run	0.9349	0.9605	0.9475	329
accuracy			0.8795	4772
macro avg	0.8967	0.8431	0.8593	4772
weighted avg	0.8884	0.8795	0.8758	4772

Trying for these features ['accX\_LF', 'accZ\_RF']  
(19084, 256, 2)  
(19084, 8)  
(4772, 256, 2)  
(4772, 8)  
256  
2  
8

Layer (type)	Output Shape	Param #
<hr/>		
input_12 (InputLayer)	(None, 256, 2)	0
lstm_11 (LSTM)	(None, 100)	41200
dropout_11 (Dropout)	(None, 100)	0
dense_22 (Dense)	(None, 100)	10100
dense_23 (Dense)	(None, 8)	808
<hr/>		
Total params: 52,108		
Trainable params: 52,108		
Non-trainable params: 0		

---

Train on 19084 samples, validate on 4772 samples  
Epoch 1/20  
19084/19084 [=====] - 31s 2ms/step - loss: 1.7427 - ac  
c: 0.3298 - val\_loss: 1.5214 - val\_acc: 0.3881

Epoch 00001: val\_acc improved from -inf to 0.38810, saving model to model\_v5acc  
X\_LF-accZ\_RF.hdf5  
Epoch 2/20  
19084/19084 [=====] - 29s 2ms/step - loss: 1.3319 - ac  
c: 0.4562 - val\_loss: 1.2180 - val\_acc: 0.5122

Epoch 00002: val\_acc improved from 0.38810 to 0.51215, saving model to model\_v5  
accX\_LF-accZ\_RF.hdf5  
Epoch 3/20  
19084/19084 [=====] - 29s 2ms/step - loss: 1.1924 - ac  
c: 0.5110 - val\_loss: 1.1198 - val\_acc: 0.5407

```
Epoch 00003: val_acc improved from 0.51215 to 0.54065, saving model to model_v5  
accX_LF-accZ_RF.hdf5  
Epoch 4/20  
19084/19084 [=====] - 29s 2ms/step - loss: 1.0822 - ac  
c: 0.5530 - val_loss: 1.0259 - val_acc: 0.5803  
  
Epoch 00004: val_acc improved from 0.54065 to 0.58026, saving model to model_v5  
accX_LF-accZ_RF.hdf5  
Epoch 5/20  
19084/19084 [=====] - 30s 2ms/step - loss: 1.0286 - ac  
c: 0.5687 - val_loss: 0.9637 - val_acc: 0.6058  
  
Epoch 00005: val_acc improved from 0.58026 to 0.60583, saving model to model_v5  
accX_LF-accZ_RF.hdf5  
Epoch 6/20  
19084/19084 [=====] - 30s 2ms/step - loss: 0.9877 - ac  
c: 0.5948 - val_loss: 0.8943 - val_acc: 0.6375  
  
Epoch 00006: val_acc improved from 0.60583 to 0.63747, saving model to model_v5  
accX_LF-accZ_RF.hdf5  
Epoch 7/20  
19084/19084 [=====] - 29s 2ms/step - loss: 1.0815 - ac  
c: 0.5664 - val_loss: 0.9807 - val_acc: 0.6100  
  
Epoch 00007: val_acc did not improve from 0.63747  
Epoch 8/20  
19084/19084 [=====] - 29s 2ms/step - loss: 1.0065 - ac  
c: 0.5921 - val_loss: 0.8912 - val_acc: 0.6454  
  
Epoch 00008: val_acc improved from 0.63747 to 0.64543, saving model to model_v5  
accX_LF-accZ_RF.hdf5  
Epoch 9/20  
19084/19084 [=====] - 29s 2ms/step - loss: 0.9225 - ac  
c: 0.6237 - val_loss: 0.8226 - val_acc: 0.6670  
  
Epoch 00009: val_acc improved from 0.64543 to 0.66702, saving model to model_v5  
accX_LF-accZ_RF.hdf5  
Epoch 10/20  
19084/19084 [=====] - 30s 2ms/step - loss: 0.8402 - ac  
c: 0.6556 - val_loss: 0.7867 - val_acc: 0.6804  
  
Epoch 00010: val_acc improved from 0.66702 to 0.68043, saving model to model_v5  
accX_LF-accZ_RF.hdf5  
Epoch 11/20  
19084/19084 [=====] - 29s 2ms/step - loss: 0.8055 - ac  
c: 0.6825 - val_loss: 0.7565 - val_acc: 0.7020  
  
Epoch 00011: val_acc improved from 0.68043 to 0.70201, saving model to model_v5  
accX_LF-accZ_RF.hdf5  
Epoch 12/20  
19084/19084 [=====] - 29s 2ms/step - loss: 0.8235 - ac  
c: 0.6742 - val_loss: 0.8342 - val_acc: 0.6609  
  
Epoch 00012: val_acc did not improve from 0.70201  
Epoch 13/20  
19084/19084 [=====] - 29s 2ms/step - loss: 0.7752 - ac
```

```
c: 0.6920 - val_loss: 0.7028 - val_acc: 0.7276
```

```
Epoch 00013: val_acc improved from 0.70201 to 0.72758, saving model to model_v5  
accX_LF-accZ_RF.hdf5  
Epoch 14/20  
19084/19084 [=====] - 29s 2ms/step - loss: 0.7432 - ac  
c: 0.7079 - val_loss: 0.6803 - val_acc: 0.7376
```

```
Epoch 00014: val_acc improved from 0.72758 to 0.73764, saving model to model_v5  
accX_LF-accZ_RF.hdf5  
Epoch 15/20  
19084/19084 [=====] - 29s 2ms/step - loss: 0.7998 - ac  
c: 0.6942 - val_loss: 0.7622 - val_acc: 0.6943
```

```
Epoch 00015: val_acc did not improve from 0.73764  
Epoch 16/20  
19084/19084 [=====] - 30s 2ms/step - loss: 0.7369 - ac  
c: 0.7089 - val_loss: 0.6605 - val_acc: 0.7343
```

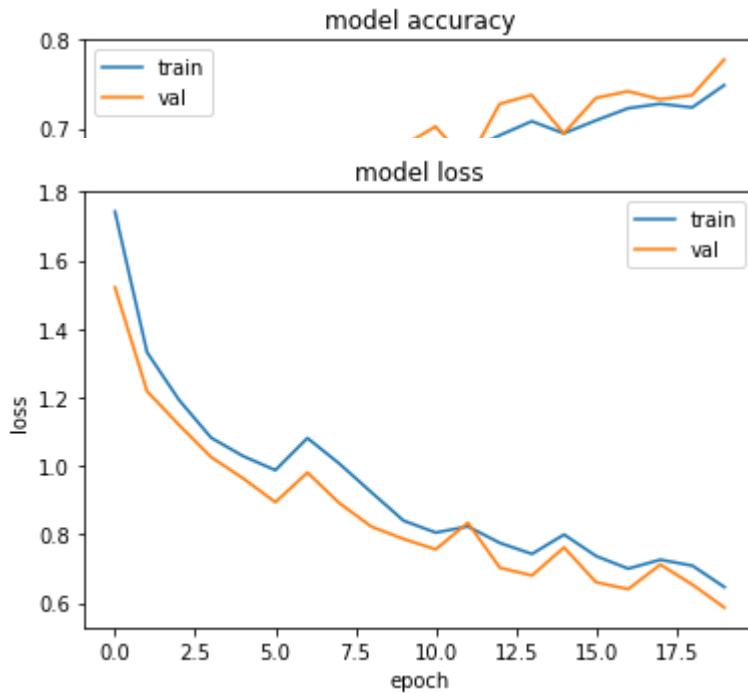
```
Epoch 00016: val_acc did not improve from 0.73764  
Epoch 17/20  
19084/19084 [=====] - 29s 2ms/step - loss: 0.7002 - ac  
c: 0.7226 - val_loss: 0.6405 - val_acc: 0.7418
```

```
Epoch 00017: val_acc improved from 0.73764 to 0.74183, saving model to model_v5  
accX_LF-accZ_RF.hdf5  
Epoch 18/20  
19084/19084 [=====] - 29s 2ms/step - loss: 0.7262 - ac  
c: 0.7277 - val_loss: 0.7121 - val_acc: 0.7328
```

```
Epoch 00018: val_acc did not improve from 0.74183  
Epoch 19/20  
19084/19084 [=====] - 29s 2ms/step - loss: 0.7089 - ac  
c: 0.7235 - val_loss: 0.6539 - val_acc: 0.7374
```

```
Epoch 00019: val_acc did not improve from 0.74183  
Epoch 20/20  
19084/19084 [=====] - 29s 2ms/step - loss: 0.6463 - ac  
c: 0.7488 - val_loss: 0.5864 - val_acc: 0.7777
```

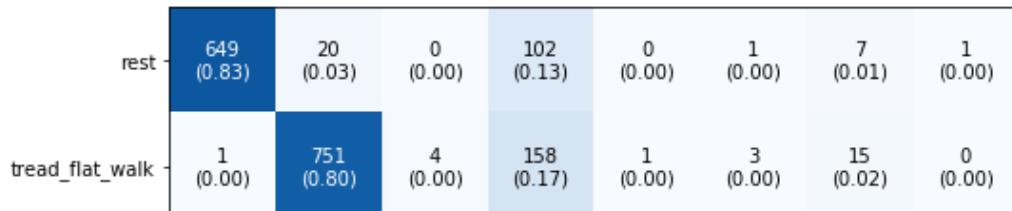
```
Epoch 00020: val_acc improved from 0.74183 to 0.77766, saving model to model_v5  
accX_LF-accZ_RF.hdf5
```



Best accuracy (on validation dataset): 77.77%

```
[[ 649   20     0   102     0     1     7     1
   [ 1   751     4   158     1     3    15     0
   [ 0     5   328     0     1    38     3     6
   [ 7    73     0  1190     0     0     3     0
   [ 0    68     0   283     1     0     1     0
   [ 0     5   220     4     0   120     0     6
   [ 1     4     0     0     2     0   360     1
   [ 0     0     4     1     0     3     9  312]]
```

<Figure size 432x288 with 0 Axes>



## Classification Report:

	precision	recall	f1-score	support
rest	0.9863	0.8321	0.9026	780
tread_flat_walk	0.8110	0.8049	0.8080	933
tread_flat_run	0.5899	0.8609	0.7001	381
tread_slope_walk	0.6847	0.9348	0.7904	1273
indoor_flat_walk	0.2000	0.0028	0.0056	353
indoor_flat_run	0.7273	0.3380	0.4615	355
outdoor_walk	0.9045	0.9783	0.9399	368
outdoor_run	0.9571	0.9483	0.9527	329
accuracy			0.7777	4772
macro avg	0.7326	0.7125	0.6951	4772
weighted avg	0.7542	0.7777	0.7452	4772

Trying for these features ['accY\_LF', 'accZ\_LF']

(19084, 256, 2)

(19084, 8)

(4772, 256, 2)

(4772, 8)

256

2

8

Layer (type)	Output Shape	Param #
<hr/>		
input_13 (InputLayer)	(None, 256, 2)	0
lstm_12 (LSTM)	(None, 100)	41200
dropout_12 (Dropout)	(None, 100)	0
dense_24 (Dense)	(None, 100)	10100
dense_25 (Dense)	(None, 8)	808
<hr/>		

Total params: 52,108

Trainable params: 52,108

Non-trainable params: 0

---

Train on 19084 samples, validate on 4772 samples

Epoch 1/20

19084/19084 [=====] - 31s 2ms/step - loss: 1.7421 - ac  
c: 0.3292 - val\_loss: 1.3532 - val\_acc: 0.4874

Epoch 00001: val\_acc improved from -inf to 0.48743, saving model to model\_v5acc  
Y\_LF-accZ\_LF.hdf5

```
Epoch 2/20
19084/19084 [=====] - 29s 2ms/step - loss: 1.1959 - ac
c: 0.5118 - val_loss: 1.0447 - val_acc: 0.5968

Epoch 00002: val_acc improved from 0.48743 to 0.59681, saving model to model_v5
accY_LF-accZ_LF.hdf5
Epoch 3/20
19084/19084 [=====] - 29s 2ms/step - loss: 1.0316 - ac
c: 0.5833 - val_loss: 0.9268 - val_acc: 0.6276

Epoch 00003: val_acc improved from 0.59681 to 0.62762, saving model to model_v5
accY_LF-accZ_LF.hdf5
Epoch 4/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.9408 - ac
c: 0.6247 - val_loss: 0.8580 - val_acc: 0.6553

Epoch 00004: val_acc improved from 0.62762 to 0.65528, saving model to model_v5
accY_LF-accZ_LF.hdf5
Epoch 5/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.8875 - ac
c: 0.6490 - val_loss: 0.8120 - val_acc: 0.6767

Epoch 00005: val_acc improved from 0.65528 to 0.67666, saving model to model_v5
accY_LF-accZ_LF.hdf5
Epoch 6/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.8334 - ac
c: 0.6732 - val_loss: 0.7709 - val_acc: 0.7028

Epoch 00006: val_acc improved from 0.67666 to 0.70285, saving model to model_v5
accY_LF-accZ_LF.hdf5
Epoch 7/20
19084/19084 [=====] - 32s 2ms/step - loss: 0.8004 - ac
c: 0.6897 - val_loss: 0.7452 - val_acc: 0.7129

Epoch 00007: val_acc improved from 0.70285 to 0.71291, saving model to model_v5
accY_LF-accZ_LF.hdf5
Epoch 8/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.7447 - ac
c: 0.7119 - val_loss: 0.6673 - val_acc: 0.7456

Epoch 00008: val_acc improved from 0.71291 to 0.74560, saving model to model_v5
accY_LF-accZ_LF.hdf5
Epoch 9/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.6928 - ac
c: 0.7330 - val_loss: 0.6614 - val_acc: 0.7492

Epoch 00009: val_acc improved from 0.74560 to 0.74916, saving model to model_v5
accY_LF-accZ_LF.hdf5
Epoch 10/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.6912 - ac
c: 0.7348 - val_loss: 0.5946 - val_acc: 0.7733

Epoch 00010: val_acc improved from 0.74916 to 0.77326, saving model to model_v5
accY_LF-accZ_LF.hdf5
Epoch 11/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.6348 - ac
c: 0.7550 - val_loss: 0.5977 - val_acc: 0.7640
```

```
Epoch 00011: val_acc did not improve from 0.77326
Epoch 12/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.5933 - ac
c: 0.7727 - val_loss: 0.5508 - val_acc: 0.7865

Epoch 00012: val_acc improved from 0.77326 to 0.78646, saving model to model_v5
accY_LF-accZ_LF.hdf5
Epoch 13/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.5805 - ac
c: 0.7804 - val_loss: 0.5774 - val_acc: 0.7850

Epoch 00013: val_acc did not improve from 0.78646
Epoch 14/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.5401 - ac
c: 0.7971 - val_loss: 0.4782 - val_acc: 0.8248

Epoch 00014: val_acc improved from 0.78646 to 0.82481, saving model to model_v5
accY_LF-accZ_LF.hdf5
Epoch 15/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.5096 - ac
c: 0.8124 - val_loss: 0.4546 - val_acc: 0.8334

Epoch 00015: val_acc improved from 0.82481 to 0.83340, saving model to model_v5
accY_LF-accZ_LF.hdf5
Epoch 16/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.4927 - ac
c: 0.8217 - val_loss: 0.4544 - val_acc: 0.8384

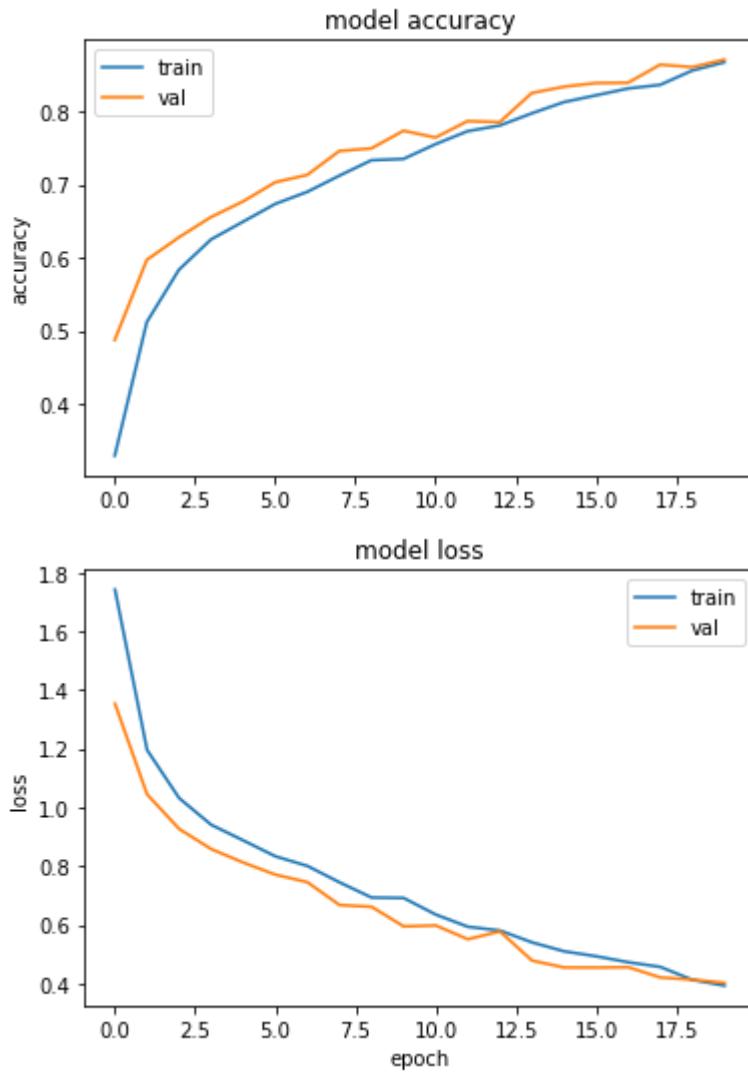
Epoch 00016: val_acc improved from 0.83340 to 0.83843, saving model to model_v5
accY_LF-accZ_LF.hdf5
Epoch 17/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.4724 - ac
c: 0.8310 - val_loss: 0.4554 - val_acc: 0.8389

Epoch 00017: val_acc improved from 0.83843 to 0.83885, saving model to model_v5
accY_LF-accZ_LF.hdf5
Epoch 18/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.4564 - ac
c: 0.8360 - val_loss: 0.4205 - val_acc: 0.8636

Epoch 00018: val_acc improved from 0.83885 to 0.86358, saving model to model_v5
accY_LF-accZ_LF.hdf5
Epoch 19/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.4124 - ac
c: 0.8555 - val_loss: 0.4129 - val_acc: 0.8602

Epoch 00019: val_acc did not improve from 0.86358
Epoch 20/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.3926 - ac
c: 0.8669 - val_loss: 0.4021 - val_acc: 0.8705

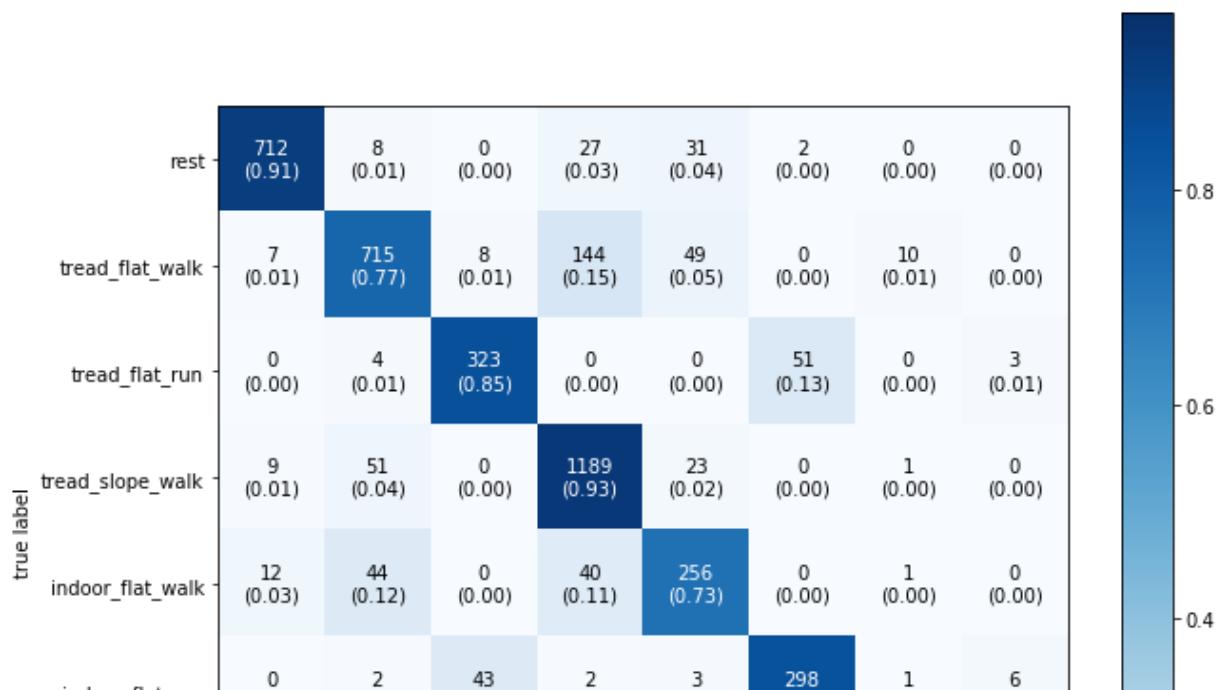
Epoch 00020: val_acc improved from 0.86358 to 0.87049, saving model to model_v5
accY_LF-accZ_LF.hdf5
```



Best accuracy (on validation dataset): 87.05%

```
[[ 712     8     0    27    31     2     0     0]
 [   7   715     8   144    49     0    10     0]
 [   0     4   323     0     0    51     0     3]
 [   9     51     0  1189    23     0     1     0]
 [  12     44     0    40   256     0     1     0]
 [   0     2   43     2     3   298     1     6]
 [   1     5     0     1     4     2   355     0]
 [   0     0     0     0     0    15     8  306]]
```

<Figure size 432x288 with 0 Axes>



## Classification Report:

	precision	recall	f1-score	support
rest	0.9609	0.9128	0.9362	780
tread_flat_walk	0.8625	0.7663	0.8116	933
tread_flat_run	0.8636	0.8478	0.8556	381
tread_slope_walk	0.8475	0.9340	0.8886	1273
indoor_flat_walk	0.6995	0.7252	0.7121	353
indoor_flat_run	0.8098	0.8394	0.8243	355
outdoor_walk	0.9441	0.9647	0.9543	368
outdoor_run	0.9714	0.9301	0.9503	329
accuracy			0.8705	4772
macro avg	0.8699	0.8650	0.8666	4772
weighted avg	0.8725	0.8705	0.8702	4772

Trying for these features ['accY\_LF', 'accX\_RF']

(19084, 256, 2)

(19084, 8)

(4772, 256, 2)

(4772, 8)

256

2

8

Layer (type)	Output Shape	Param #
<hr/>		
input_14 (InputLayer)	(None, 256, 2)	0
lstm_13 (LSTM)	(None, 100)	41200
dropout_13 (Dropout)	(None, 100)	0
dense_26 (Dense)	(None, 100)	10100
dense_27 (Dense)	(None, 8)	808

```
=====
Total params: 52,108
```

```
Trainable params: 52,108
```

```
Non-trainable params: 0
```

---

```
Train on 19084 samples, validate on 4772 samples
```

```
Epoch 1/20
```

```
19084/19084 [=====] - 31s 2ms/step - loss: 1.7724 - ac  
c: 0.3081 - val_loss: 1.4111 - val_acc: 0.4749
```

```
Epoch 00001: val_acc improved from -inf to 0.47485, saving model to model_v5acc  
Y_LF-accX_RF.hdf5
```

```
Epoch 2/20
```

```
19084/19084 [=====] - 29s 2ms/step - loss: 1.3127 - ac  
c: 0.4794 - val_loss: 1.1367 - val_acc: 0.5390
```

```
Epoch 00002: val_acc improved from 0.47485 to 0.53898, saving model to model_v5  
accY_LF-accX_RF.hdf5
```

```
Epoch 3/20
```

```
19084/19084 [=====] - 29s 2ms/step - loss: 1.1217 - ac  
c: 0.5441 - val_loss: 1.0250 - val_acc: 0.5922
```

```
Epoch 00003: val_acc improved from 0.53898 to 0.59220, saving model to model_v5  
accY_LF-accX_RF.hdf5
```

```
Epoch 4/20
```

```
19084/19084 [=====] - 29s 2ms/step - loss: 1.0408 - ac  
c: 0.5778 - val_loss: 1.0155 - val_acc: 0.5989
```

```
Epoch 00004: val_acc improved from 0.59220 to 0.59891, saving model to model_v5  
accY_LF-accX_RF.hdf5
```

```
Epoch 5/20
```

```
19084/19084 [=====] - 30s 2ms/step - loss: 1.0209 - ac  
c: 0.5948 - val_loss: 0.9656 - val_acc: 0.6224
```

```
Epoch 00005: val_acc improved from 0.59891 to 0.62238, saving model to model_v5  
accY_LF-accX_RF.hdf5
```

```
Epoch 6/20
```

```
19084/19084 [=====] - 30s 2ms/step - loss: 1.0496 - ac  
c: 0.5888 - val_loss: 1.0363 - val_acc: 0.5930
```

```
Epoch 00006: val_acc did not improve from 0.62238
```

```
Epoch 7/20
```

```
19084/19084 [=====] - 29s 2ms/step - loss: 0.9527 - ac  
c: 0.6341 - val_loss: 0.8743 - val_acc: 0.6593
```

```
Epoch 00007: val_acc improved from 0.62238 to 0.65926, saving model to model_v5  
accY_LF-accX_RF.hdf5
```

```
Epoch 8/20
```

```
19084/19084 [=====] - 29s 2ms/step - loss: 0.8884 - ac  
c: 0.6584 - val_loss: 0.8416 - val_acc: 0.6773
```

```
Epoch 00008: val_acc improved from 0.65926 to 0.67728, saving model to model_v5  
accY_LF-accX_RF.hdf5
```

```
Epoch 9/20
```

```
19084/19084 [=====] - 29s 2ms/step - loss: 0.8563 - ac  
c: 0.6756 - val_loss: 0.8788 - val_acc: 0.6695
```

```
Epoch 00009: val_acc did not improve from 0.67728
Epoch 10/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.8285 - ac
c: 0.6932 - val_loss: 0.7577 - val_acc: 0.7282

Epoch 00010: val_acc improved from 0.67728 to 0.72821, saving model to model_v5
accY_LF-accX_RF.hdf5
Epoch 11/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.7463 - ac
c: 0.7248 - val_loss: 0.7004 - val_acc: 0.7404

Epoch 00011: val_acc improved from 0.72821 to 0.74036, saving model to model_v5
accY_LF-accX_RF.hdf5
Epoch 12/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.7122 - ac
c: 0.7384 - val_loss: 0.7862 - val_acc: 0.7217

Epoch 00012: val_acc did not improve from 0.74036
Epoch 13/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.7121 - ac
c: 0.7429 - val_loss: 0.6546 - val_acc: 0.7617

Epoch 00013: val_acc improved from 0.74036 to 0.76174, saving model to model_v5
accY_LF-accX_RF.hdf5
Epoch 14/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.7212 - ac
c: 0.7368 - val_loss: 0.6232 - val_acc: 0.7680

Epoch 00014: val_acc improved from 0.76174 to 0.76802, saving model to model_v5
accY_LF-accX_RF.hdf5
Epoch 15/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.6557 - ac
c: 0.7643 - val_loss: 0.6813 - val_acc: 0.7544

Epoch 00015: val_acc did not improve from 0.76802
Epoch 16/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.6558 - ac
c: 0.7651 - val_loss: 0.6044 - val_acc: 0.7745

Epoch 00016: val_acc improved from 0.76802 to 0.77452, saving model to model_v5
accY_LF-accX_RF.hdf5
Epoch 17/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.5865 - ac
c: 0.7866 - val_loss: 0.5507 - val_acc: 0.7940

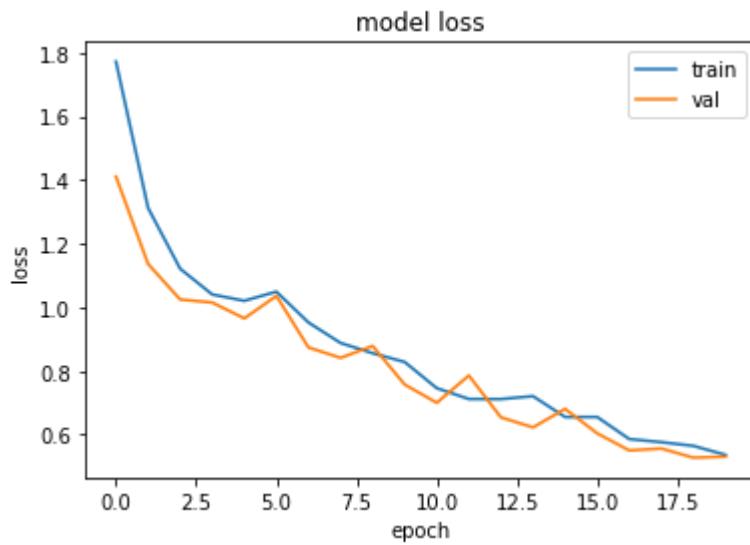
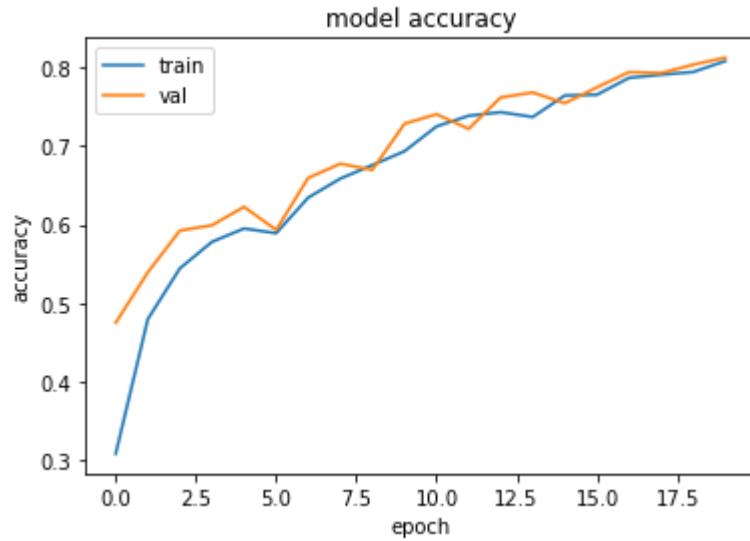
Epoch 00017: val_acc improved from 0.77452 to 0.79401, saving model to model_v5
accY_LF-accX_RF.hdf5
Epoch 18/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.5767 - ac
c: 0.7907 - val_loss: 0.5567 - val_acc: 0.7927

Epoch 00018: val_acc did not improve from 0.79401
Epoch 19/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.5650 - ac
c: 0.7941 - val_loss: 0.5281 - val_acc: 0.8034

Epoch 00019: val_acc improved from 0.79401 to 0.80344, saving model to model_v5
```

accY\_LF-accX\_RF.hdf5

Epoch 20/20

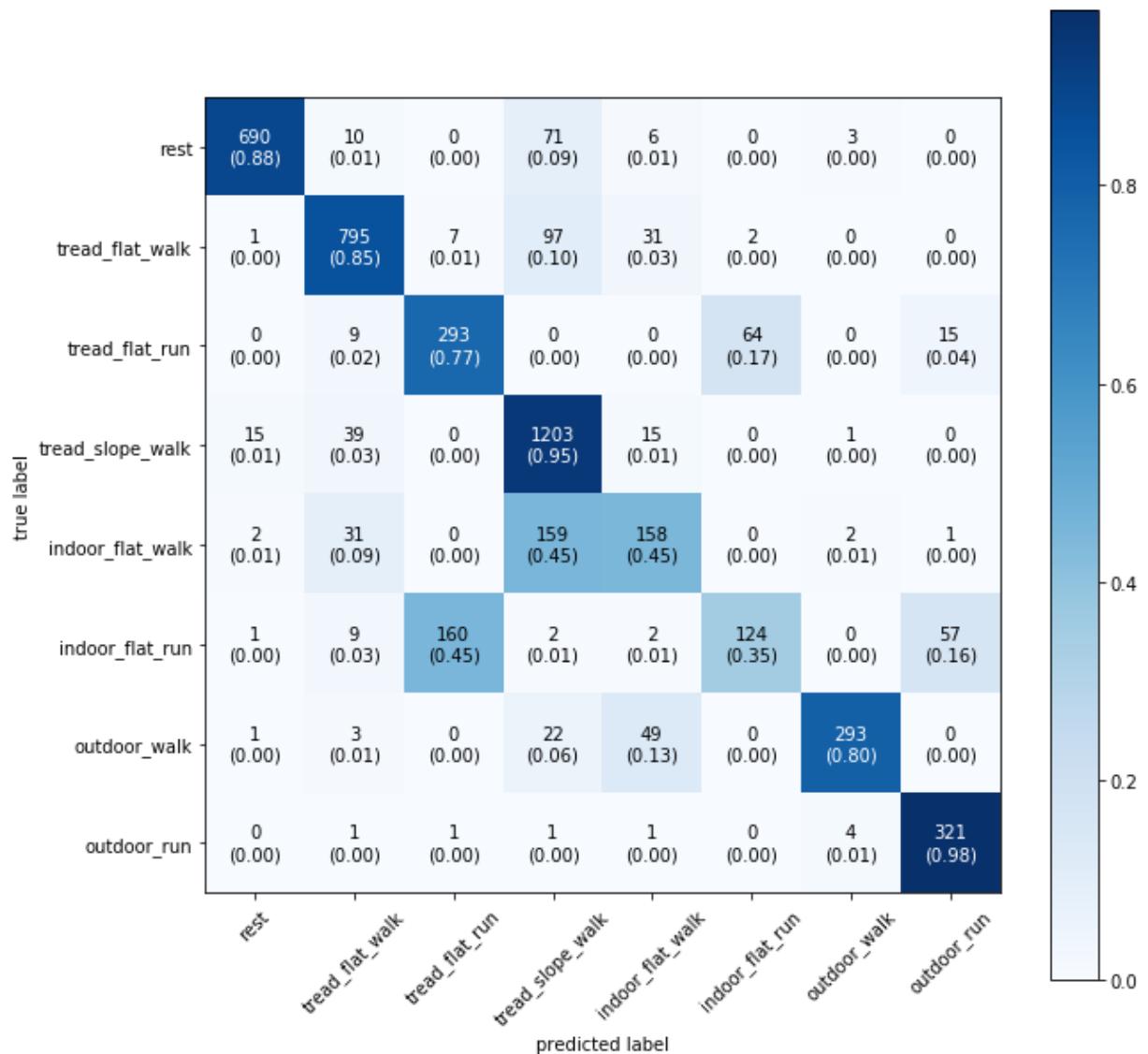
19084/19084 [=====] - 29s 2ms/step - loss: 0.5367 - ac  
c: 0.8080 - val\_loss: 0.5312 - val\_acc: 0.8124Epoch 00020: val\_acc improved from 0.80344 to 0.81245, saving model to model\_v5  
accY\_LF-accX\_RF.hdf5

Best accuracy (on validation dataset): 81.24%

```
[[ 690   10     0    71     6     0     3     0]
 [   1   795     7    97    31     2     0     0]
 [   0     9   293     0     0    64     0    15]
 [  15    39     0  1203    15     0     1     0]
 [   2    31     0   159   158     0     2     1]]
```

```
[ 1  9 160  2  2 124  0  57]
[ 1  3  0 22 49  0 293  0]
[ 0  1  1  1  1  0  4 221 1]
```

&lt;Figure size 432x288 with 0 Axes&gt;



## Classification Report:

	precision	recall	f1-score	support
rest	0.9718	0.8846	0.9262	780
tread_flat_walk	0.8863	0.8521	0.8689	933
tread_flat_run	0.6356	0.7690	0.6960	381
tread_slope_walk	0.7736	0.9450	0.8508	1273
indoor_flat_walk	0.6031	0.4476	0.5138	353
indoor_flat_run	0.6526	0.3493	0.4550	355
outdoor_walk	0.9670	0.7962	0.8733	368
outdoor_run	0.8147	0.9757	0.8880	329
accuracy			0.8124	4772
macro avg	0.7881	0.7524	0.7590	4772
weighted avg	0.8132	0.8124	0.8042	4772

Trying for these features ['accY\_LF', 'accY\_RF']  
(19084, 256, 2)

```
(19084, 8)
(4772, 256, 2)
(4772, 8)
256
2
8
```

Layer (type)	Output Shape	Param #
<hr/>		
input_15 (InputLayer)	(None, 256, 2)	0
lstm_14 (LSTM)	(None, 100)	41200
dropout_14 (Dropout)	(None, 100)	0
dense_28 (Dense)	(None, 100)	10100
dense_29 (Dense)	(None, 8)	808
<hr/>		
Total params: 52,108		
Trainable params: 52,108		
Non-trainable params: 0		

---

Train on 19084 samples, validate on 4772 samples

Epoch 1/20

19084/19084 [=====] - 31s 2ms/step - loss: 1.7127 - acc: 0.3478 - val\_loss: 1.2971 - val\_acc: 0.4992

Epoch 00001: val\_acc improved from -inf to 0.49916, saving model to model\_v5accY\_LF-accY\_RF.hdf5

Epoch 2/20

19084/19084 [=====] - 29s 2ms/step - loss: 1.2246 - acc: 0.5086 - val\_loss: 1.0545 - val\_acc: 0.5712

Epoch 00002: val\_acc improved from 0.49916 to 0.57125, saving model to model\_v5accY\_LF-accY\_RF.hdf5

Epoch 3/20

19084/19084 [=====] - 29s 2ms/step - loss: 1.1462 - acc: 0.5341 - val\_loss: 1.0687 - val\_acc: 0.5671

Epoch 00003: val\_acc did not improve from 0.57125

Epoch 4/20

19084/19084 [=====] - 29s 2ms/step - loss: 1.0624 - acc: 0.5559 - val\_loss: 1.0054 - val\_acc: 0.5805

Epoch 00004: val\_acc improved from 0.57125 to 0.58047, saving model to model\_v5accY\_LF-accY\_RF.hdf5

Epoch 5/20

19084/19084 [=====] - 29s 2ms/step - loss: 1.0319 - acc: 0.5668 - val\_loss: 0.9658 - val\_acc: 0.5953

Epoch 00005: val\_acc improved from 0.58047 to 0.59535, saving model to model\_v5accY\_LF-accY\_RF.hdf5

Epoch 6/20

19084/19084 [=====] - 29s 2ms/step - loss: 0.9876 - acc: 0.5844 - val\_loss: 1.1644 - val\_acc: 0.5295

```
Epoch 00006: val_acc did not improve from 0.59535
Epoch 7/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.9778 - acc: 0.5929 - val_loss: 0.9238 - val_acc: 0.6241

Epoch 00007: val_acc improved from 0.59535 to 0.62406, saving model to model_v5
accY_LF-accY_RF.hdf5
Epoch 8/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.9320 - acc: 0.6078 - val_loss: 0.8897 - val_acc: 0.6379

Epoch 00008: val_acc improved from 0.62406 to 0.63789, saving model to model_v5
accY_LF-accY_RF.hdf5
Epoch 9/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.8935 - acc: 0.6205 - val_loss: 0.8333 - val_acc: 0.6477

Epoch 00009: val_acc improved from 0.63789 to 0.64774, saving model to model_v5
accY_LF-accY_RF.hdf5
Epoch 10/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.9246 - acc: 0.6206 - val_loss: 0.8802 - val_acc: 0.6412

Epoch 00010: val_acc did not improve from 0.64774
Epoch 11/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.8850 - acc: 0.6382 - val_loss: 0.8367 - val_acc: 0.6645

Epoch 00011: val_acc improved from 0.64774 to 0.66450, saving model to model_v5
accY_LF-accY_RF.hdf5
Epoch 12/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.8321 - acc: 0.6576 - val_loss: 0.7996 - val_acc: 0.6781

Epoch 00012: val_acc improved from 0.66450 to 0.67812, saving model to model_v5
accY_LF-accY_RF.hdf5
Epoch 13/20
19084/19084 [=====] - 32s 2ms/step - loss: 0.8535 - acc: 0.6618 - val_loss: 0.7796 - val_acc: 0.6804

Epoch 00013: val_acc improved from 0.67812 to 0.68043, saving model to model_v5
accY_LF-accY_RF.hdf5
Epoch 14/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.8265 - acc: 0.6632 - val_loss: 0.7803 - val_acc: 0.6752

Epoch 00014: val_acc did not improve from 0.68043
Epoch 15/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.7747 - acc: 0.6815 - val_loss: 0.7366 - val_acc: 0.7062

Epoch 00015: val_acc improved from 0.68043 to 0.70620, saving model to model_v5
accY_LF-accY_RF.hdf5
Epoch 16/20
19084/19084 [=====] - 31s 2ms/step - loss: 0.7640 - acc: 0.6956 - val_loss: 0.7601 - val_acc: 0.6945
```

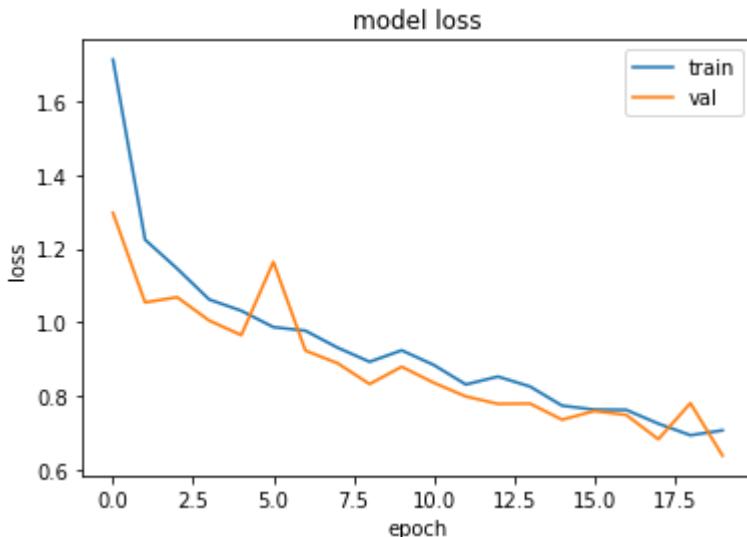
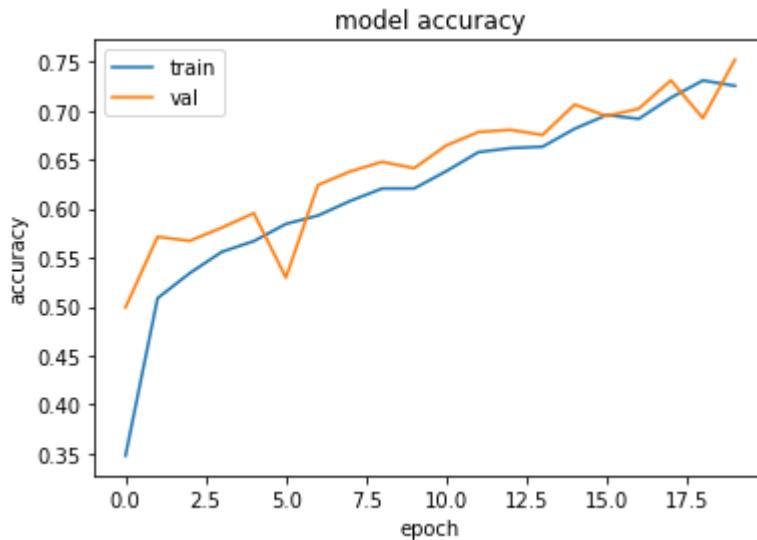
Epoch 00016: val\_acc did not improve from 0.70620  
 Epoch 17/20  
 19084/19084 [=====] - 29s 2ms/step - loss: 0.7633 - ac  
 c: 0.6916 - val\_loss: 0.7495 - val\_acc: 0.7020

Epoch 00017: val\_acc did not improve from 0.70620  
 Epoch 18/20  
 19084/19084 [=====] - 29s 2ms/step - loss: 0.7259 - ac  
 c: 0.7132 - val\_loss: 0.6837 - val\_acc: 0.7309

Epoch 00018: val\_acc improved from 0.70620 to 0.73093, saving model to model\_v5  
 accY\_LF-accY\_RF.hdf5  
 Epoch 19/20  
 19084/19084 [=====] - 29s 2ms/step - loss: 0.6945 - ac  
 c: 0.7308 - val\_loss: 0.7813 - val\_acc: 0.6924

Epoch 00019: val\_acc did not improve from 0.73093  
 Epoch 20/20  
 19084/19084 [=====] - 29s 2ms/step - loss: 0.7077 - ac  
 c: 0.7253 - val\_loss: 0.6392 - val\_acc: 0.7521

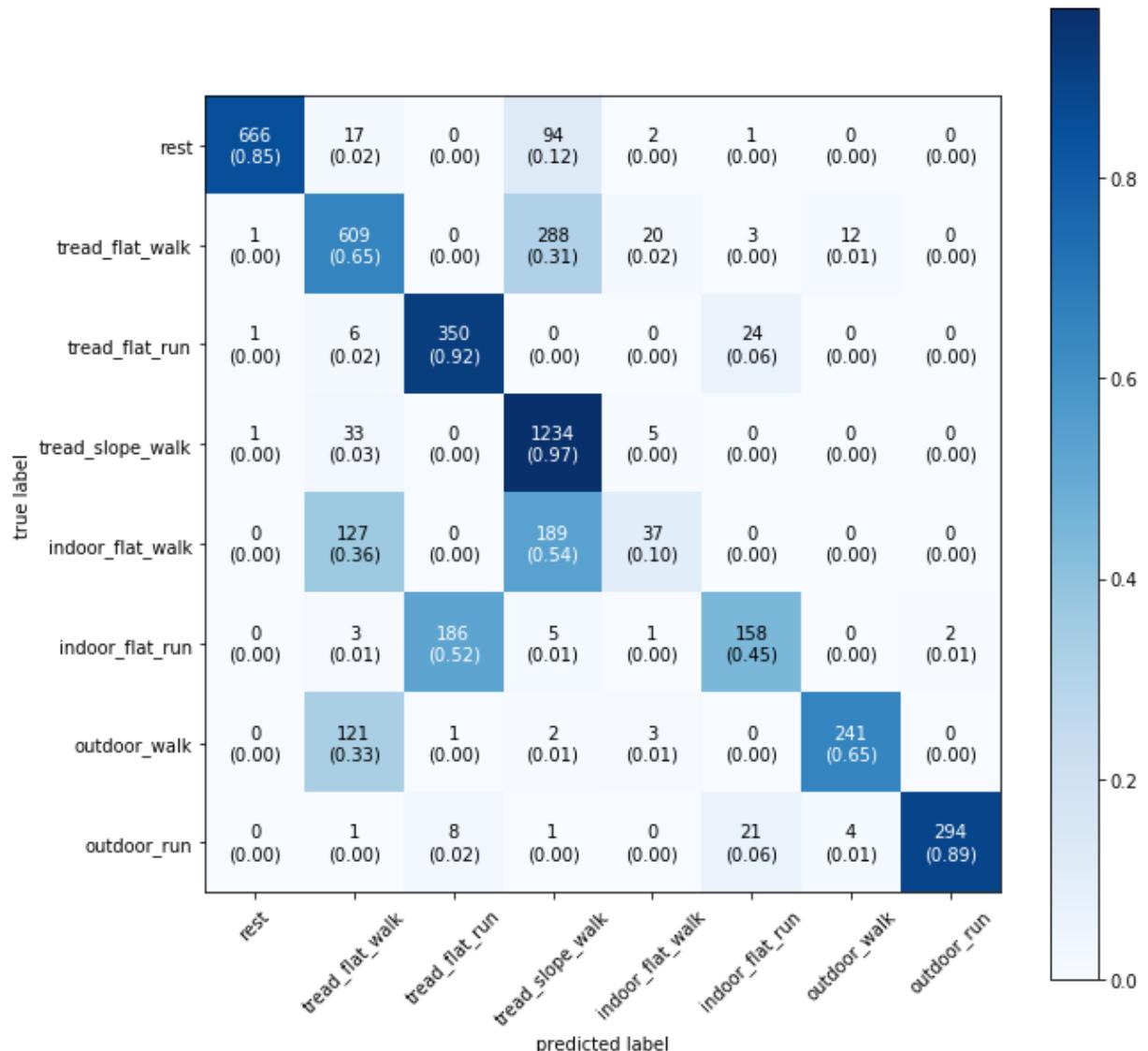
Epoch 00020: val\_acc improved from 0.73093 to 0.75210, saving model to model\_v5  
 accY\_LF-accY\_RF.hdf5



Best accuracy (on validation dataset): 75.21%

```
[[ 666   17    0   94    2    1    0    0]
 [  1  609    0  288   20    3   12    0]
 [  1    6  350    0    0   24    0    0]
 [  1   33    0 1234    5    0    0    0]
 [  0  127    0  189   37    0    0    0]
 [  0    3  186    5    1  158    0    2]
 [  0  121    1    2    3    0  241    0]
 [  0    1    8    1    0   21    4  294]]
```

<Figure size 432x288 with 0 Axes>



#### Classification Report:

	precision	recall	f1-score	support
rest	0.9955	0.8538	0.9193	780
tread_flat_walk	0.6641	0.6527	0.6584	933
tread_flat_run	0.6422	0.9186	0.7559	381
tread_slope_walk	0.6806	0.9694	0.7997	1273
indoor_flat_walk	0.5441	0.1048	0.1758	353
indoor_flat_run	0.7633	0.4451	0.5623	355

outdoor_walk	0.9377	0.6549	0.7712	368
outdoor_run	0.9932	0.8936	0.9408	329
			0.7521	4772
accuracy			0.7776	4772
macro avg	0.7776	0.6866	0.6979	4772
weighted avg	0.7632	0.7521	0.7318	4772

Trying for these features ['accY\_LF', 'accZ\_RF']

(19084, 256, 2)

(19084, 8)

(4772, 256, 2)

(4772, 8)

256

2

8

Layer (type)	Output Shape	Param #
<hr/>		
input_16 (InputLayer)	(None, 256, 2)	0
lstm_15 (LSTM)	(None, 100)	41200
dropout_15 (Dropout)	(None, 100)	0
dense_30 (Dense)	(None, 100)	10100
dense_31 (Dense)	(None, 8)	808
<hr/>		

Total params: 52,108

Trainable params: 52,108

Non-trainable params: 0

---

Train on 19084 samples, validate on 4772 samples

Epoch 1/20

19084/19084 [=====] - 31s 2ms/step - loss: 1.7597 - acc: 0.3274 - val\_loss: 1.3733 - val\_acc: 0.4644

Epoch 00001: val\_acc improved from -inf to 0.46438, saving model to model\_v5accY\_LF-accZ\_RF.hdf5

Epoch 2/20

19084/19084 [=====] - 29s 2ms/step - loss: 1.2497 - acc: 0.5002 - val\_loss: 1.1807 - val\_acc: 0.5291

Epoch 00002: val\_acc improved from 0.46438 to 0.52913, saving model to model\_v5accY\_LF-accZ\_RF.hdf5

Epoch 3/20

19084/19084 [=====] - 29s 2ms/step - loss: 1.1136 - acc: 0.5454 - val\_loss: 1.0147 - val\_acc: 0.5813

Epoch 00003: val\_acc improved from 0.52913 to 0.58131, saving model to model\_v5accY\_LF-accZ\_RF.hdf5

Epoch 4/20

19084/19084 [=====] - 29s 2ms/step - loss: 1.0248 - acc: 0.5829 - val\_loss: 0.9218 - val\_acc: 0.6297

Epoch 00004: val\_acc improved from 0.58131 to 0.62972, saving model to model\_v5accY\_LF-accZ\_RF.hdf5

```
Epoch 5/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.9955 - ac
c: 0.5989 - val_loss: 0.8743 - val_acc: 0.6417

Epoch 00005: val_acc improved from 0.62972 to 0.64166, saving model to model_v5
accY_LF-accZ_RF.hdf5
Epoch 6/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.9212 - ac
c: 0.6272 - val_loss: 0.8467 - val_acc: 0.6509

Epoch 00006: val_acc improved from 0.64166 to 0.65088, saving model to model_v5
accY_LF-accZ_RF.hdf5
Epoch 7/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.8412 - ac
c: 0.6586 - val_loss: 0.7500 - val_acc: 0.7001

Epoch 00007: val_acc improved from 0.65088 to 0.70013, saving model to model_v5
accY_LF-accZ_RF.hdf5
Epoch 8/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.7780 - ac
c: 0.6949 - val_loss: 0.7171 - val_acc: 0.7179

Epoch 00008: val_acc improved from 0.70013 to 0.71794, saving model to model_v5
accY_LF-accZ_RF.hdf5
Epoch 9/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.7230 - ac
c: 0.7145 - val_loss: 0.7585 - val_acc: 0.6934

Epoch 00009: val_acc did not improve from 0.71794
Epoch 10/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.7252 - ac
c: 0.7235 - val_loss: 0.6615 - val_acc: 0.7487

Epoch 00010: val_acc improved from 0.71794 to 0.74874, saving model to model_v5
accY_LF-accZ_RF.hdf5
Epoch 11/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.6898 - ac
c: 0.7384 - val_loss: 0.6310 - val_acc: 0.7659

Epoch 00011: val_acc improved from 0.74874 to 0.76593, saving model to model_v5
accY_LF-accZ_RF.hdf5
Epoch 12/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.6418 - ac
c: 0.7565 - val_loss: 0.6061 - val_acc: 0.7768

Epoch 00012: val_acc improved from 0.76593 to 0.77682, saving model to model_v5
accY_LF-accZ_RF.hdf5
Epoch 13/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.6124 - ac
c: 0.7715 - val_loss: 0.5769 - val_acc: 0.7754

Epoch 00013: val_acc did not improve from 0.77682
Epoch 14/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.6133 - ac
c: 0.7695 - val_loss: 0.5794 - val_acc: 0.7917

Epoch 00014: val_acc improved from 0.77682 to 0.79170, saving model to model_v5
```

```
accY_LF-accZ_RF.hdf5
Epoch 15/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.5745 - ac
c: 0.7912 - val_loss: 0.5139 - val_acc: 0.8164

Epoch 00015: val_acc improved from 0.79170 to 0.81643, saving model to model_v5
accY_LF-accZ_RF.hdf5
Epoch 16/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.5538 - ac
c: 0.7997 - val_loss: 0.5108 - val_acc: 0.8164

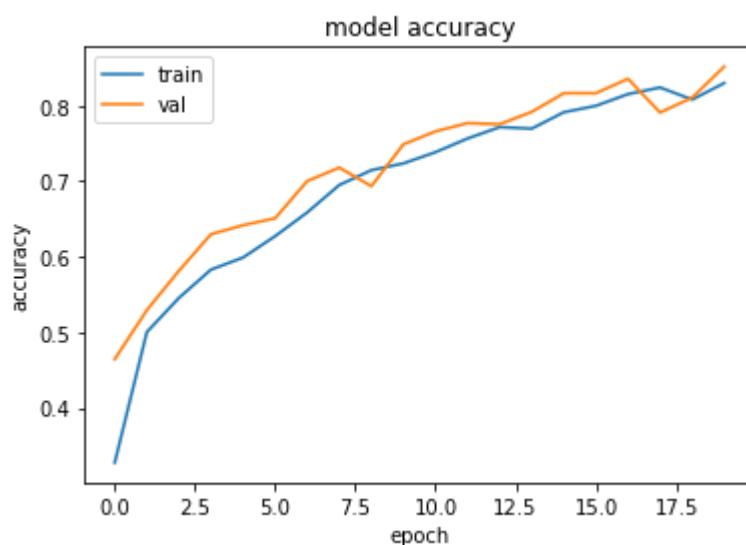
Epoch 00016: val_acc did not improve from 0.81643
Epoch 17/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.5127 - ac
c: 0.8152 - val_loss: 0.4569 - val_acc: 0.8355

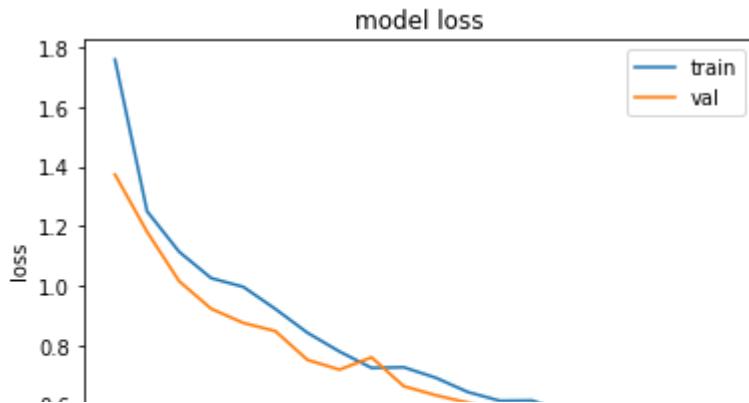
Epoch 00017: val_acc improved from 0.81643 to 0.83550, saving model to model_v5
accY_LF-accZ_RF.hdf5
Epoch 18/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.4943 - ac
c: 0.8240 - val_loss: 0.5740 - val_acc: 0.7909

Epoch 00018: val_acc did not improve from 0.83550
Epoch 19/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.5410 - ac
c: 0.8080 - val_loss: 0.5185 - val_acc: 0.8106

Epoch 00019: val_acc did not improve from 0.83550
Epoch 20/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.4815 - ac
c: 0.8299 - val_loss: 0.4280 - val_acc: 0.8516

Epoch 00020: val_acc improved from 0.83550 to 0.85163, saving model to model_v5
accY_LF-accZ_RF.hdf5
```

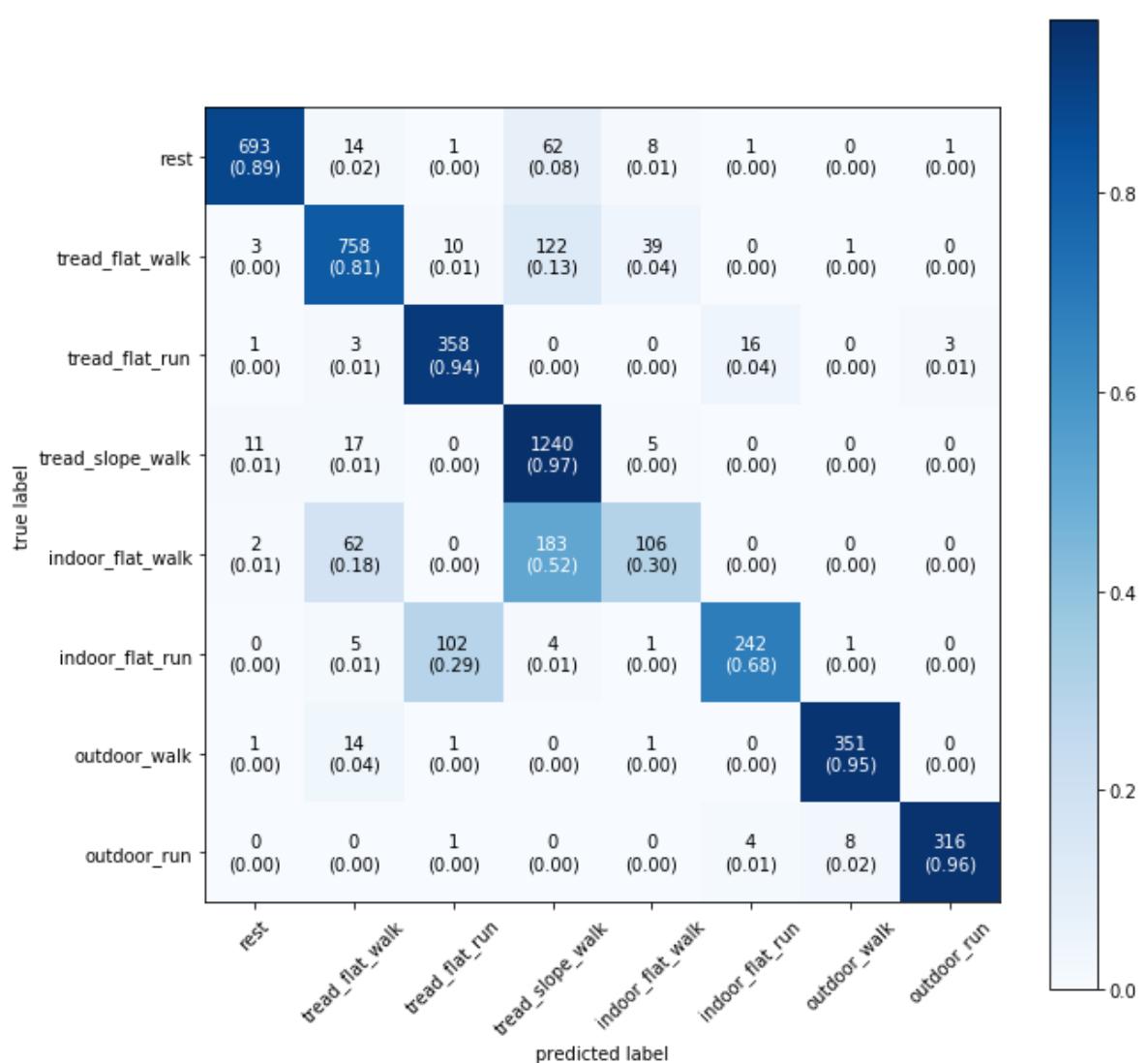




Best accuracy (on validation dataset): 85.16%

```
[[ 693   14    1   62    8    1    0    1]
 [  3   758   10  122   39    0    1    0]
 [  1    3  358    0    0   16    0    3]
 [ 11   17    0 1240    5    0    0    0]
 [  2   62    0  183   106   0    0    0]
 [  0    5 102    4    1  242    1    0]
 [  1   14    1    0    1    0  351    0]
 [  0    0    1    0    0    4    8  316]]
```

<Figure size 432x288 with 0 Axes>



**Classification Report:**

	precision	recall	f1-score	support
rest	0.9747	0.8885	0.9296	780
tread_flat_walk	0.8683	0.8124	0.8394	933
tread_flat_run	0.7569	0.9396	0.8384	381
tread_slope_walk	0.7697	0.9741	0.8599	1273
indoor_flat_walk	0.6625	0.3003	0.4133	353
indoor_flat_run	0.9202	0.6817	0.7832	355
outdoor_walk	0.9723	0.9538	0.9630	368
outdoor_run	0.9875	0.9605	0.9738	329
accuracy			0.8516	4772
macro avg	0.8640	0.8139	0.8251	4772
weighted avg	0.8554	0.8516	0.8426	4772

```
Trying for these features ['accZ_LF', 'accX_RF']
(19084, 256, 2)
(19084, 8)
(4772, 256, 2)
(4772, 8)
256
2
8
```

Layer (type)	Output Shape	Param #
input_17 (InputLayer)	(None, 256, 2)	0

lstm_16 (LSTM)	(None, 100)	41200
dropout_16 (Dropout)	(None, 100)	0
dense_32 (Dense)	(None, 100)	10100
dense_33 (Dense)	(None, 8)	808
<hr/>		
Total params: 52,108		
Trainable params: 52,108		
Non-trainable params: 0		

Train on 19084 samples, validate on 4772 samples  
Epoch 1/20  
19084/19084 [=====] - 32s 2ms/step - loss: 1.8393 - ac  
c: 0.2861 - val\_loss: 1.5263 - val\_acc: 0.4413

Epoch 00001: val\_acc improved from -inf to 0.44132, saving model to model\_v5accZ\_LF-accX\_RF.hdf5  
Epoch 2/20  
19084/19084 [=====] - 29s 2ms/step - loss: 1.3592 - ac  
c: 0.4665 - val\_loss: 1.2591 - val\_acc: 0.5069

Epoch 00002: val\_acc improved from 0.44132 to 0.50692, saving model to model\_v5accZ\_LF-accX\_RF.hdf5  
Epoch 3/20  
19084/19084 [=====] - 29s 2ms/step - loss: 1.2295 - ac  
c: 0.5053 - val\_loss: 1.1407 - val\_acc: 0.5392

Epoch 00003: val\_acc improved from 0.50692 to 0.53919, saving model to model\_v5accZ\_LF-accX\_RF.hdf5  
Epoch 4/20  
19084/19084 [=====] - 30s 2ms/step - loss: 1.1745 - ac  
c: 0.5264 - val\_loss: 1.0735 - val\_acc: 0.5543

Epoch 00004: val\_acc improved from 0.53919 to 0.55427, saving model to model\_v5accZ\_LF-accX\_RF.hdf5  
Epoch 5/20  
19084/19084 [=====] - 29s 2ms/step - loss: 1.0593 - ac  
c: 0.5747 - val\_loss: 1.0076 - val\_acc: 0.5987

Epoch 00005: val\_acc improved from 0.55427 to 0.59870, saving model to model\_v5accZ\_LF-accX\_RF.hdf5  
Epoch 6/20  
19084/19084 [=====] - 29s 2ms/step - loss: 1.1567 - ac  
c: 0.5555 - val\_loss: 1.2351 - val\_acc: 0.5316

Epoch 00006: val\_acc did not improve from 0.59870  
Epoch 7/20  
19084/19084 [=====] - 30s 2ms/step - loss: 1.1513 - ac  
c: 0.5476 - val\_loss: 1.0625 - val\_acc: 0.5725

Epoch 00007: val\_acc did not improve from 0.59870  
Epoch 8/20  
19084/19084 [=====] - 30s 2ms/step - loss: 1.0688 - ac  
c: 0.5744 - val\_loss: 1.0276 - val\_acc: 0.6071

```
Epoch 00008: val_acc improved from 0.59870 to 0.60708, saving model to model_v5  
accZ_LF-accX_RF.hdf5  
Epoch 9/20  
19084/19084 [=====] - 29s 2ms/step - loss: 1.0359 - ac  
c: 0.5907 - val_loss: 1.0428 - val_acc: 0.6134  
  
Epoch 00009: val_acc improved from 0.60708 to 0.61337, saving model to model_v5  
accZ_LF-accX_RF.hdf5  
Epoch 10/20  
19084/19084 [=====] - 30s 2ms/step - loss: 1.2357 - ac  
c: 0.5369 - val_loss: 1.0137 - val_acc: 0.5979  
  
Epoch 00010: val_acc did not improve from 0.61337  
Epoch 11/20  
19084/19084 [=====] - 29s 2ms/step - loss: 1.0165 - ac  
c: 0.5968 - val_loss: 0.9603 - val_acc: 0.6228  
  
Epoch 00011: val_acc improved from 0.61337 to 0.62280, saving model to model_v5  
accZ_LF-accX_RF.hdf5  
Epoch 12/20  
19084/19084 [=====] - 30s 2ms/step - loss: 0.9846 - ac  
c: 0.6096 - val_loss: 1.1091 - val_acc: 0.5897  
  
Epoch 00012: val_acc did not improve from 0.62280  
Epoch 13/20  
19084/19084 [=====] - 29s 2ms/step - loss: 0.9739 - ac  
c: 0.6156 - val_loss: 0.8721 - val_acc: 0.6567  
  
Epoch 00013: val_acc improved from 0.62280 to 0.65675, saving model to model_v5  
accZ_LF-accX_RF.hdf5  
Epoch 14/20  
19084/19084 [=====] - 29s 2ms/step - loss: 0.9572 - ac  
c: 0.6269 - val_loss: 0.9517 - val_acc: 0.6278  
  
Epoch 00014: val_acc did not improve from 0.65675  
Epoch 15/20  
19084/19084 [=====] - 29s 2ms/step - loss: 0.9079 - ac  
c: 0.6445 - val_loss: 0.8760 - val_acc: 0.6570  
  
Epoch 00015: val_acc improved from 0.65675 to 0.65696, saving model to model_v5  
accZ_LF-accX_RF.hdf5  
Epoch 16/20  
19084/19084 [=====] - 29s 2ms/step - loss: 0.9035 - ac  
c: 0.6524 - val_loss: 0.8199 - val_acc: 0.6855  
  
Epoch 00016: val_acc improved from 0.65696 to 0.68546, saving model to model_v5  
accZ_LF-accX_RF.hdf5  
Epoch 17/20  
19084/19084 [=====] - 30s 2ms/step - loss: 0.8633 - ac  
c: 0.6655 - val_loss: 0.8617 - val_acc: 0.6630  
  
Epoch 00017: val_acc did not improve from 0.68546  
Epoch 18/20  
19084/19084 [=====] - 30s 2ms/step - loss: 0.8692 - ac  
c: 0.6614 - val_loss: 0.8847 - val_acc: 0.6576
```

Epoch 00018: val\_acc did not improve from 0.68546

Epoch 19/20

19084/19084 [=====] - 29s 2ms/step - loss: 0.9136 - ac

c: 0.6508 - val\_loss: 0.8481 - val\_acc: 0.6547

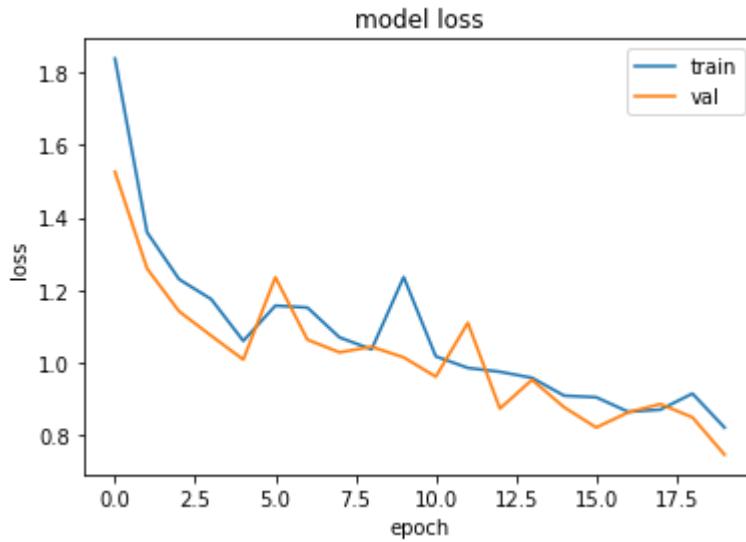
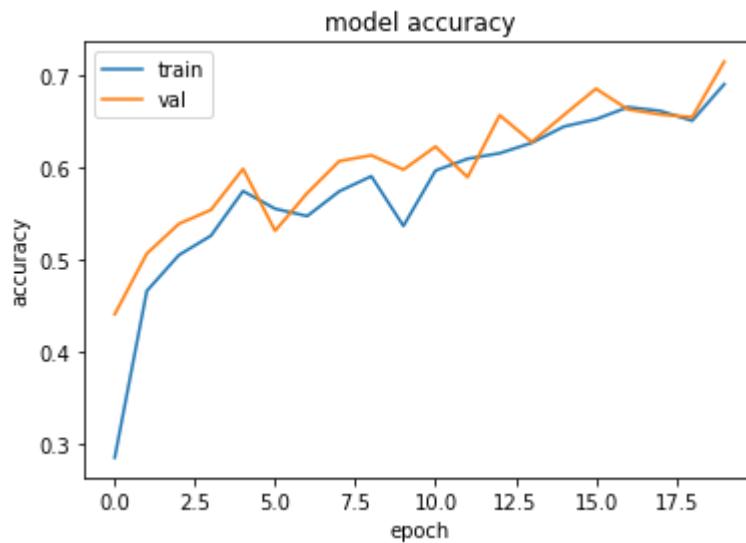
Epoch 00019: val\_acc did not improve from 0.68546

Epoch 20/20

19084/19084 [=====] - 29s 2ms/step - loss: 0.8199 - ac

c: 0.6904 - val\_loss: 0.7449 - val\_acc: 0.7148

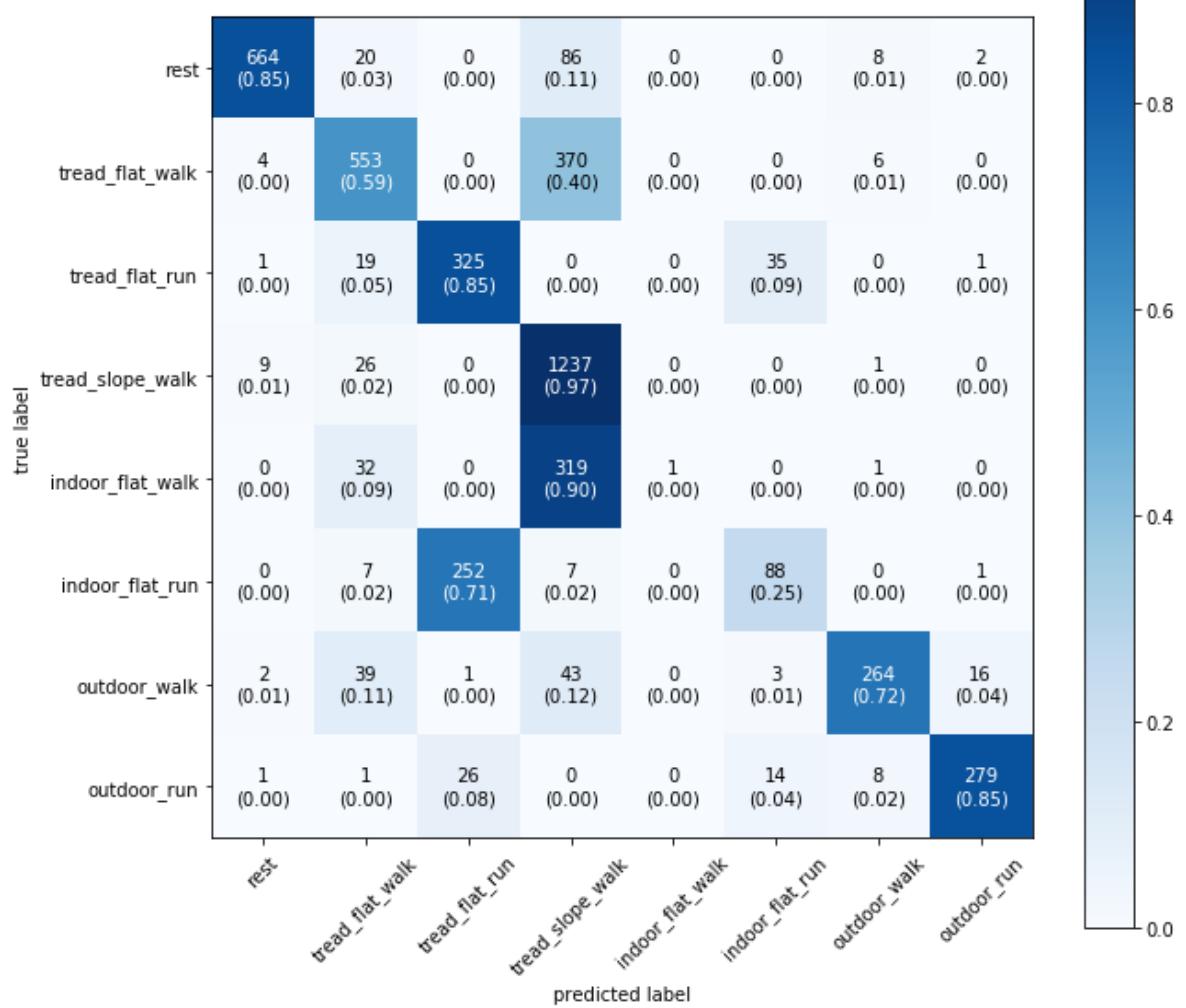
Epoch 00020: val\_acc improved from 0.68546 to 0.71479, saving model to model\_v5  
accZ\_LF-accX\_RF.hdf5



Best accuracy (on validation dataset): 71.48%

```
[[ 664   20    0   86    0    0    8    2]
 [  4   553    0  370    0    0    6    0]
 [  1   19   325    0    0   35    0    1]
 [  9   26    0 1237    0    0    1    0]
 [  0   32    0  319    1    0    1    0]
 [  0     7  252    7    0   88    0    1]
 [  2   39    1   43    0    3  264   16]
 [  1     1   26    0    0   14    8 279]]
```

<Figure size 432x288 with 0 Axes>



## Classification Report:

	precision	recall	f1-score	support
rest	0.9750	0.8513	0.9090	780
tread_flat_walk	0.7934	0.5927	0.6785	933
tread_flat_run	0.5381	0.8530	0.6599	381
tread_slope_walk	0.5999	0.9717	0.7418	1273
indoor_flat_walk	1.0000	0.0028	0.0056	353
indoor_flat_run	0.6286	0.2479	0.3556	355
outdoor_walk	0.9167	0.7174	0.8049	368
outdoor_run	0.9331	0.8480	0.8885	329
accuracy			0.7148	4772

macro avg	0.7981	0.6356	0.6305	4772
weighted avg	0.7732	0.7148	0.6820	4772

Trying for these features ['accZ\_LF', 'accY\_RF']  
(19084, 256, 2)  
(19084, 8)  
(4772, 256, 2)  
(4772, 8)  
256  
2  
8

Layer (type)	Output Shape	Param #
input_18 (InputLayer)	(None, 256, 2)	0
lstm_17 (LSTM)	(None, 100)	41200
dropout_17 (Dropout)	(None, 100)	0
dense_34 (Dense)	(None, 100)	10100
dense_35 (Dense)	(None, 8)	808

Total params: 52,108  
Trainable params: 52,108  
Non-trainable params: 0

---

Train on 19084 samples, validate on 4772 samples  
Epoch 1/20  
19084/19084 [=====] - 32s 2ms/step - loss: 1.7714 - acc: 0.3206 - val\_loss: 1.4911 - val\_acc: 0.4248

Epoch 00001: val\_acc improved from -inf to 0.42477, saving model to model\_v5accZ\_LF-accY\_RF.hdf5  
Epoch 2/20  
19084/19084 [=====] - 30s 2ms/step - loss: 1.2862 - acc: 0.4821 - val\_loss: 1.1427 - val\_acc: 0.5375

Epoch 00002: val\_acc improved from 0.42477 to 0.53751, saving model to model\_v5accZ\_LF-accY\_RF.hdf5  
Epoch 3/20  
19084/19084 [=====] - 29s 2ms/step - loss: 1.1650 - acc: 0.5283 - val\_loss: 1.0459 - val\_acc: 0.5968

Epoch 00003: val\_acc improved from 0.53751 to 0.59681, saving model to model\_v5accZ\_LF-accY\_RF.hdf5  
Epoch 4/20  
19084/19084 [=====] - 29s 2ms/step - loss: 1.0755 - acc: 0.5738 - val\_loss: 0.9544 - val\_acc: 0.6398

Epoch 00004: val\_acc improved from 0.59681 to 0.63977, saving model to model\_v5accZ\_LF-accY\_RF.hdf5  
Epoch 5/20  
19084/19084 [=====] - 30s 2ms/step - loss: 0.9639 - acc: 0.6218 - val\_loss: 0.8385 - val\_acc: 0.6859

```
Epoch 00005: val_acc improved from 0.63977 to 0.68588, saving model to model_v5
accZ_LF-accY_RF.hdf5
Epoch 6/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.8862 - ac
c: 0.6654 - val_loss: 0.8131 - val_acc: 0.7016

Epoch 00006: val_acc improved from 0.68588 to 0.70159, saving model to model_v5
accZ_LF-accY_RF.hdf5
Epoch 7/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.8076 - ac
c: 0.6930 - val_loss: 0.7745 - val_acc: 0.7022

Epoch 00007: val_acc improved from 0.70159 to 0.70222, saving model to model_v5
accZ_LF-accY_RF.hdf5
Epoch 8/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.7815 - ac
c: 0.7071 - val_loss: 0.7370 - val_acc: 0.7397

Epoch 00008: val_acc improved from 0.70222 to 0.73973, saving model to model_v5
accZ_LF-accY_RF.hdf5
Epoch 9/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.7450 - ac
c: 0.7184 - val_loss: 0.6817 - val_acc: 0.7429

Epoch 00009: val_acc improved from 0.73973 to 0.74288, saving model to model_v5
accZ_LF-accY_RF.hdf5
Epoch 10/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.7329 - ac
c: 0.7267 - val_loss: 0.6818 - val_acc: 0.7469

Epoch 00010: val_acc improved from 0.74288 to 0.74686, saving model to model_v5
accZ_LF-accY_RF.hdf5
Epoch 11/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.6762 - ac
c: 0.7477 - val_loss: 0.5818 - val_acc: 0.7890

Epoch 00011: val_acc improved from 0.74686 to 0.78898, saving model to model_v5
accZ_LF-accY_RF.hdf5
Epoch 12/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.6339 - ac
c: 0.7683 - val_loss: 0.5891 - val_acc: 0.7833

Epoch 00012: val_acc did not improve from 0.78898
Epoch 13/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.5849 - ac
c: 0.7927 - val_loss: 0.4885 - val_acc: 0.8342

Epoch 00013: val_acc improved from 0.78898 to 0.83424, saving model to model_v5
accZ_LF-accY_RF.hdf5
Epoch 14/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.5293 - ac
c: 0.8184 - val_loss: 0.4780 - val_acc: 0.8386

Epoch 00014: val_acc improved from 0.83424 to 0.83864, saving model to model_v5
accZ_LF-accY_RF.hdf5
Epoch 15/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.5182 - ac
```

```
c: 0.8251 - val_loss: 0.4689 - val_acc: 0.8445
```

```
Epoch 00015: val_acc improved from 0.83864 to 0.84451, saving model to model_v5
accZ_LF-accY_RF.hdf5
Epoch 16/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.4833 - ac
c: 0.8389 - val_loss: 0.4257 - val_acc: 0.8613
```

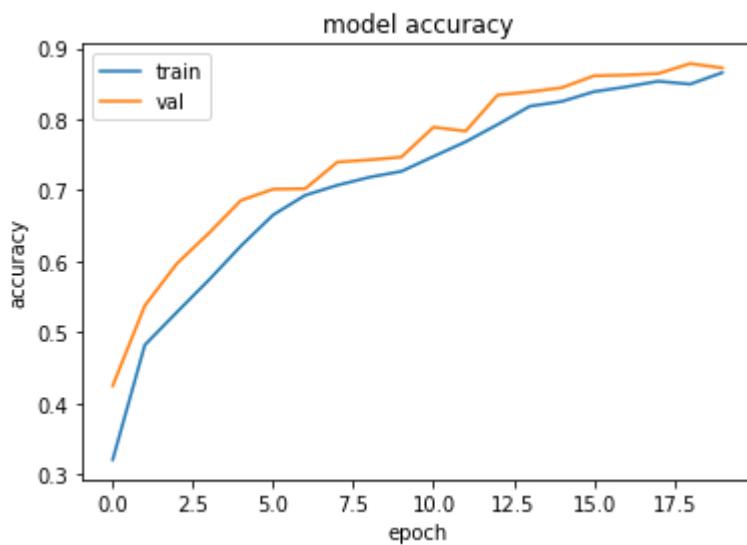
```
Epoch 00016: val_acc improved from 0.84451 to 0.86127, saving model to model_v5
accZ_LF-accY_RF.hdf5
Epoch 17/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.4653 - ac
c: 0.8456 - val_loss: 0.4087 - val_acc: 0.8623
```

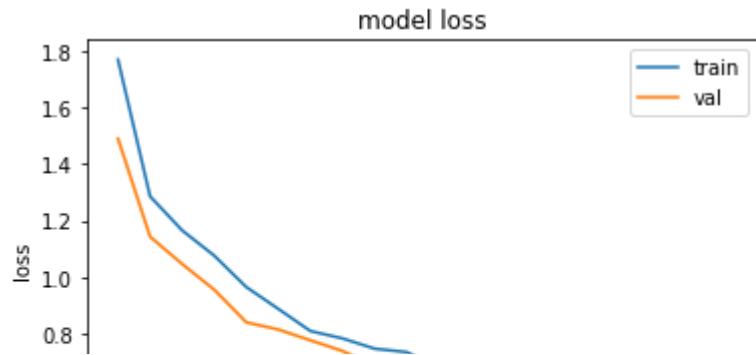
```
Epoch 00017: val_acc improved from 0.86127 to 0.86232, saving model to model_v5
accZ_LF-accY_RF.hdf5
Epoch 18/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.4455 - ac
c: 0.8536 - val_loss: 0.4125 - val_acc: 0.8644
```

```
Epoch 00018: val_acc improved from 0.86232 to 0.86442, saving model to model_v5
accZ_LF-accY_RF.hdf5
Epoch 19/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.4550 - ac
c: 0.8495 - val_loss: 0.3653 - val_acc: 0.8785
```

```
Epoch 00019: val_acc improved from 0.86442 to 0.87846, saving model to model_v5
accZ_LF-accY_RF.hdf5
Epoch 20/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.4206 - ac
c: 0.8658 - val_loss: 0.3886 - val_acc: 0.8724
```

Epoch 00020: val\_acc did not improve from 0.87846

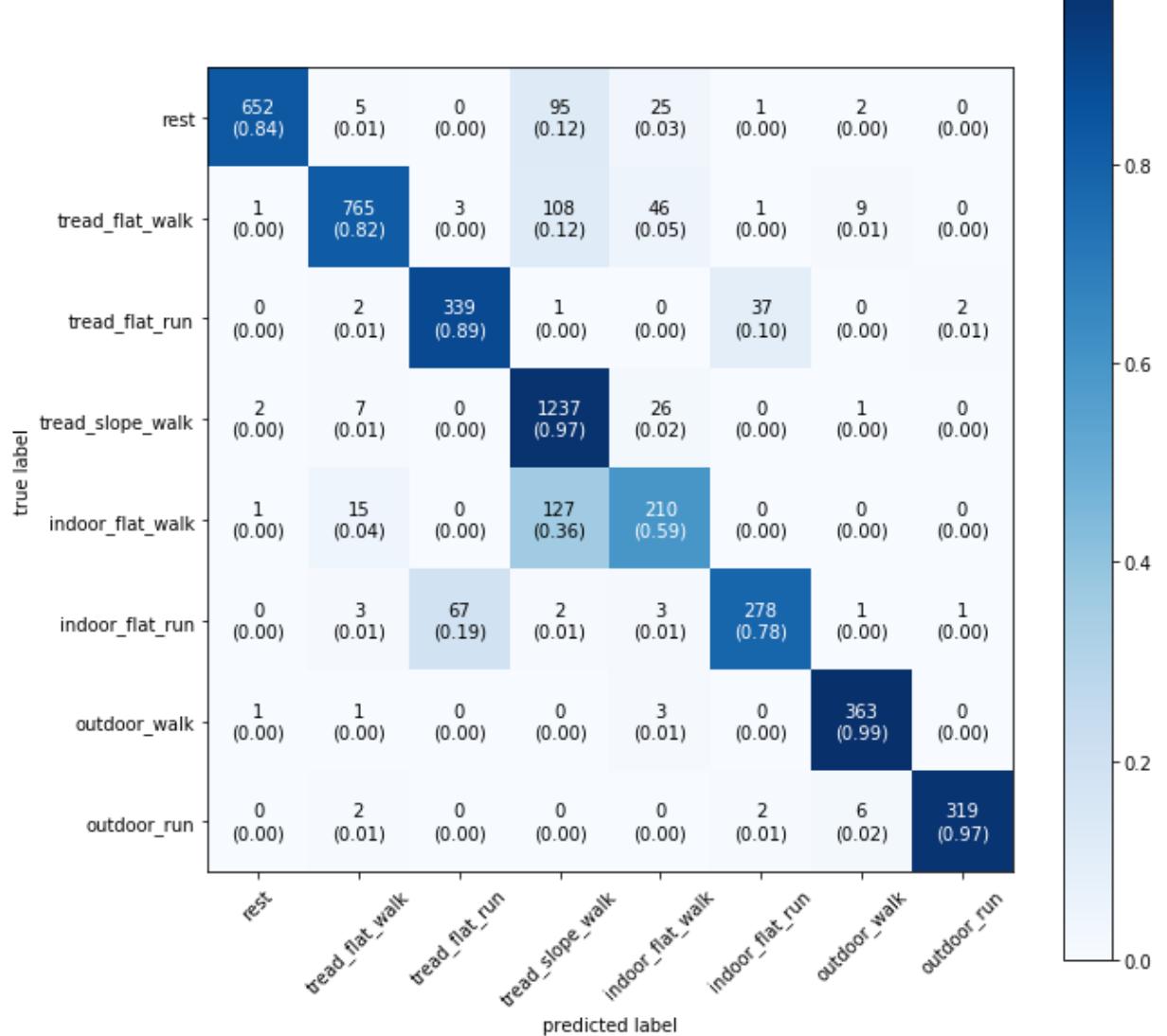




Best accuracy (on validation dataset): 87.24%

```
[[ 652    5    0   95   25    1    2    0]
 [  1  765    3  108   46    1    9    0]
 [  0    2  339    1    0   37    0    2]
 [  2    7    0 1237   26    0    1    0]
 [  1   15    0  127  210    0    0    0]
 [  0    3   67    2    3  278    1    1]
 [  1    1    0    0    3    0  363    0]
 [  0    2    0    0    0    2    6  319]]
```

<Figure size 432x288 with 0 Axes>



## Classification Report:

	precision	recall	f1-score	support
rest	0.9924	0.8359	0.9074	780
tread_flat_walk	0.9563	0.8199	0.8829	933
tread_flat_run	0.8289	0.8898	0.8582	381
tread_slope_walk	0.7879	0.9717	0.8702	1273
indoor_flat_walk	0.6709	0.5949	0.6306	353
indoor_flat_run	0.8715	0.7831	0.8249	355
outdoor_walk	0.9503	0.9864	0.9680	368
outdoor_run	0.9907	0.9696	0.9800	329
accuracy			0.8724	4772
macro avg	0.8811	0.8564	0.8653	4772
weighted avg	0.8816	0.8724	0.8718	4772

Trying for these features ['accZ\_LF', 'accZ\_RF']  
(19084, 256, 2)  
(19084, 8)  
(4772, 256, 2)  
(4772, 8)  
256  
2  
8

Layer (type)	Output Shape	Param #
<hr/>		
input_19 (InputLayer)	(None, 256, 2)	0
lstm_18 (LSTM)	(None, 100)	41200
dropout_18 (Dropout)	(None, 100)	0
dense_36 (Dense)	(None, 100)	10100
dense_37 (Dense)	(None, 8)	808
<hr/>		
Total params: 52,108		
Trainable params: 52,108		
Non-trainable params: 0		

---

Train on 19084 samples, validate on 4772 samples  
Epoch 1/20  
19084/19084 [=====] - 32s 2ms/step - loss: 1.7588 - acc: 0.3229 - val\_loss: 1.4666 - val\_acc: 0.4443

Epoch 00001: val\_acc improved from -inf to 0.44426, saving model to model\_v5accZ\_LF-accZ\_RF.hdf5  
Epoch 2/20  
19084/19084 [=====] - 29s 2ms/step - loss: 1.4307 - acc: 0.4396 - val\_loss: 1.2933 - val\_acc: 0.4937

Epoch 00002: val\_acc improved from 0.44426 to 0.49371, saving model to model\_v5accZ\_LF-accZ\_RF.hdf5  
Epoch 3/20  
19084/19084 [=====] - 29s 2ms/step - loss: 1.2910 - acc: 0.4884 - val\_loss: 1.1839 - val\_acc: 0.5580

```
Epoch 00003: val_acc improved from 0.49371 to 0.55805, saving model to model_v5  
accZ_LF-accZ_RF.hdf5  
Epoch 4/20  
19084/19084 [=====] - 29s 2ms/step - loss: 1.1355 - ac  
c: 0.5346 - val_loss: 1.0107 - val_acc: 0.5824  
  
Epoch 00004: val_acc improved from 0.55805 to 0.58236, saving model to model_v5  
accZ_LF-accZ_RF.hdf5  
Epoch 5/20  
19084/19084 [=====] - 29s 2ms/step - loss: 1.0491 - ac  
c: 0.5759 - val_loss: 0.9727 - val_acc: 0.6276  
  
Epoch 00005: val_acc improved from 0.58236 to 0.62762, saving model to model_v5  
accZ_LF-accZ_RF.hdf5  
Epoch 6/20  
19084/19084 [=====] - 29s 2ms/step - loss: 1.0565 - ac  
c: 0.5913 - val_loss: 1.2931 - val_acc: 0.5082  
  
Epoch 00006: val_acc did not improve from 0.62762  
Epoch 7/20  
19084/19084 [=====] - 29s 2ms/step - loss: 1.1883 - ac  
c: 0.5334 - val_loss: 1.1089 - val_acc: 0.5291  
  
Epoch 00007: val_acc did not improve from 0.62762  
Epoch 8/20  
19084/19084 [=====] - 29s 2ms/step - loss: 1.1389 - ac  
c: 0.5348 - val_loss: 1.0463 - val_acc: 0.5775  
  
Epoch 00008: val_acc did not improve from 0.62762  
Epoch 9/20  
19084/19084 [=====] - 30s 2ms/step - loss: 1.0933 - ac  
c: 0.5467 - val_loss: 1.0835 - val_acc: 0.5970  
  
Epoch 00009: val_acc did not improve from 0.62762  
Epoch 10/20  
19084/19084 [=====] - 29s 2ms/step - loss: 1.0284 - ac  
c: 0.5765 - val_loss: 0.9343 - val_acc: 0.6259  
  
Epoch 00010: val_acc did not improve from 0.62762  
Epoch 11/20  
19084/19084 [=====] - 29s 2ms/step - loss: 1.1193 - ac  
c: 0.5529 - val_loss: 0.9372 - val_acc: 0.6339  
  
Epoch 00011: val_acc improved from 0.62762 to 0.63391, saving model to model_v5  
accZ_LF-accZ_RF.hdf5  
Epoch 12/20  
19084/19084 [=====] - 29s 2ms/step - loss: 0.9380 - ac  
c: 0.6289 - val_loss: 0.8528 - val_acc: 0.6591  
  
Epoch 00012: val_acc improved from 0.63391 to 0.65905, saving model to model_v5  
accZ_LF-accZ_RF.hdf5  
Epoch 13/20  
19084/19084 [=====] - 29s 2ms/step - loss: 0.8759 - ac  
c: 0.6428 - val_loss: 0.8303 - val_acc: 0.6750  
  
Epoch 00013: val_acc improved from 0.65905 to 0.67498, saving model to model_v5
```

```
accZ_LF-accZ_RF.hdf5
Epoch 14/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.8405 - ac
c: 0.6616 - val_loss: 0.7880 - val_acc: 0.6976

Epoch 00014: val_acc improved from 0.67498 to 0.69761, saving model to model_v5
accZ_LF-accZ_RF.hdf5
Epoch 15/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.8373 - ac
c: 0.6654 - val_loss: 0.7631 - val_acc: 0.7054

Epoch 00015: val_acc improved from 0.69761 to 0.70536, saving model to model_v5
accZ_LF-accZ_RF.hdf5
Epoch 16/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.8567 - ac
c: 0.6640 - val_loss: 0.7672 - val_acc: 0.7054

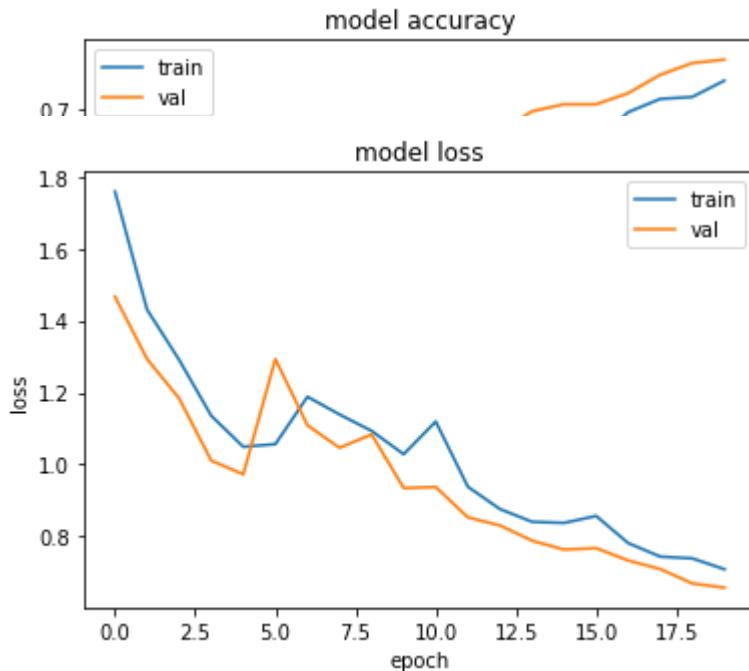
Epoch 00016: val_acc did not improve from 0.70536
Epoch 17/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.7811 - ac
c: 0.6967 - val_loss: 0.7328 - val_acc: 0.7173

Epoch 00017: val_acc improved from 0.70536 to 0.71731, saving model to model_v5
accZ_LF-accZ_RF.hdf5
Epoch 18/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.7436 - ac
c: 0.7112 - val_loss: 0.7089 - val_acc: 0.7374

Epoch 00018: val_acc improved from 0.71731 to 0.73743, saving model to model_v5
accZ_LF-accZ_RF.hdf5
Epoch 19/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.7386 - ac
c: 0.7133 - val_loss: 0.6689 - val_acc: 0.7502

Epoch 00019: val_acc improved from 0.73743 to 0.75021, saving model to model_v5
accZ_LF-accZ_RF.hdf5
Epoch 20/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.7084 - ac
c: 0.7310 - val_loss: 0.6573 - val_acc: 0.7540

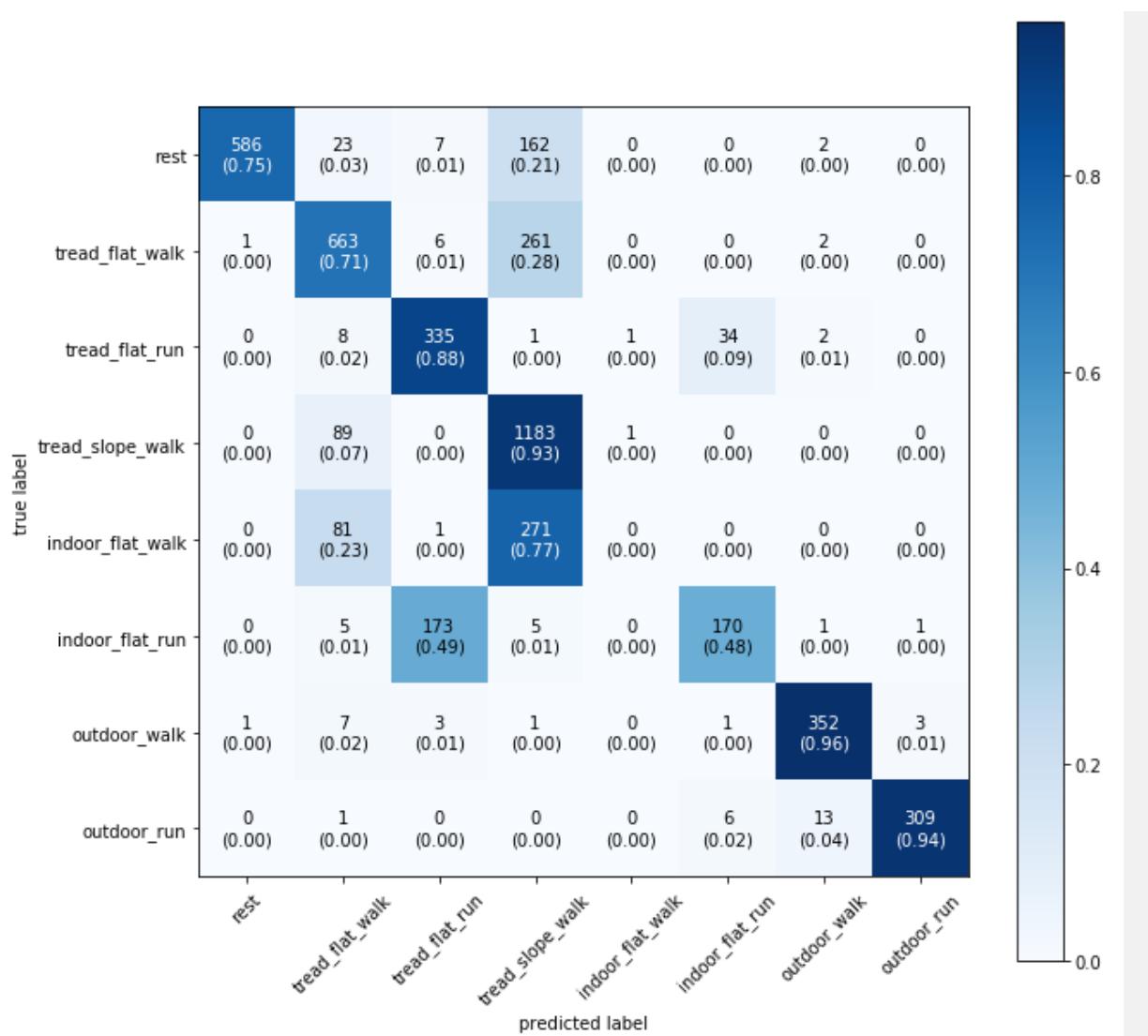
Epoch 00020: val_acc improved from 0.75021 to 0.75398, saving model to model_v5
accZ_LF-accZ_RF.hdf5
```



Best accuracy (on validation dataset): 75.40%

```
[[ 586   23     7   162     0     0     2     0]
 [  1   663     6   261     0     0     2     0]
 [  0     8   335     1     1    34     2     0]
 [  0    89     0  1183     1     0     0     0]
 [  0    81     1   271     0     0     0     0]
 [  0     5   173     5     0   170     1     1]
 [  1     7     3     1     0     1   352     3]
 [  0     1     0     0     0     6    13  309]]
```

<Figure size 432x288 with 0 Axes>



## Classification Report:

	precision	recall	f1-score	support
rest	0.9966	0.7513	0.8567	780
tread_flat_walk	0.7560	0.7106	0.7326	933
tread_flat_run	0.6381	0.8793	0.7395	381
tread_slope_walk	0.6279	0.9293	0.7494	1273
indoor_flat_walk	0.0000	0.0000	0.0000	353
indoor_flat_run	0.8057	0.4789	0.6007	355
outdoor_walk	0.9462	0.9565	0.9514	368
outdoor_run	0.9872	0.9392	0.9626	329
accuracy			0.7540	4772
macro avg	0.7197	0.7056	0.6991	4772
weighted avg	0.7301	0.7540	0.7267	4772

Trying for these features ['accX\_RF', 'accY\_RF']  
(19084, 256, 2)

```
(19084, 8)
(4772, 256, 2)
(4772, 8)
256
2
8
```

Layer (type)	Output Shape	Param #
<hr/>		
input_20 (InputLayer)	(None, 256, 2)	0
lstm_19 (LSTM)	(None, 100)	41200
dropout_19 (Dropout)	(None, 100)	0
dense_38 (Dense)	(None, 100)	10100
dense_39 (Dense)	(None, 8)	808
<hr/>		
Total params: 52,108		
Trainable params: 52,108		
Non-trainable params: 0		

---

Train on 19084 samples, validate on 4772 samples

Epoch 1/20

19084/19084 [=====] - 32s 2ms/step - loss: 1.7531 - acc: 0.3196 - val\_loss: 1.3298 - val\_acc: 0.4755

Epoch 00001: val\_acc improved from -inf to 0.47548, saving model to model\_v5accX\_RF-accY\_RF.hdf5

Epoch 2/20

19084/19084 [=====] - 29s 2ms/step - loss: 1.2464 - acc: 0.5035 - val\_loss: 1.0896 - val\_acc: 0.5782

Epoch 00002: val\_acc improved from 0.47548 to 0.57816, saving model to model\_v5accX\_RF-accY\_RF.hdf5

Epoch 3/20

19084/19084 [=====] - 29s 2ms/step - loss: 1.1025 - acc: 0.5453 - val\_loss: 1.0056 - val\_acc: 0.5899

Epoch 00003: val\_acc improved from 0.57816 to 0.58990, saving model to model\_v5accX\_RF-accY\_RF.hdf5

Epoch 4/20

19084/19084 [=====] - 29s 2ms/step - loss: 1.0203 - acc: 0.5784 - val\_loss: 0.9144 - val\_acc: 0.6383

Epoch 00004: val\_acc improved from 0.58990 to 0.63831, saving model to model\_v5accX\_RF-accY\_RF.hdf5

Epoch 5/20

19084/19084 [=====] - 29s 2ms/step - loss: 1.0198 - acc: 0.5768 - val\_loss: 0.9174 - val\_acc: 0.6326

Epoch 00005: val\_acc did not improve from 0.63831

Epoch 6/20

19084/19084 [=====] - 29s 2ms/step - loss: 0.9302 - acc: 0.6191 - val\_loss: 0.8251 - val\_acc: 0.6655

```
Epoch 00006: val_acc improved from 0.63831 to 0.66555, saving model to model_v5
accX_RF-accY_RF.hdf5
Epoch 7/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.8711 - ac
c: 0.6423 - val_loss: 0.7901 - val_acc: 0.6649

Epoch 00007: val_acc did not improve from 0.66555
Epoch 8/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.8899 - ac
c: 0.6229 - val_loss: 0.7813 - val_acc: 0.6720

Epoch 00008: val_acc improved from 0.66555 to 0.67205, saving model to model_v5
accX_RF-accY_RF.hdf5
Epoch 9/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.8259 - ac
c: 0.6571 - val_loss: 0.7429 - val_acc: 0.6949

Epoch 00009: val_acc improved from 0.67205 to 0.69489, saving model to model_v5
accX_RF-accY_RF.hdf5
Epoch 10/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.7957 - ac
c: 0.6714 - val_loss: 0.7056 - val_acc: 0.7014

Epoch 00010: val_acc improved from 0.69489 to 0.70138, saving model to model_v5
accX_RF-accY_RF.hdf5
Epoch 11/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.7594 - ac
c: 0.6940 - val_loss: 0.7002 - val_acc: 0.7133

Epoch 00011: val_acc improved from 0.70138 to 0.71333, saving model to model_v5
accX_RF-accY_RF.hdf5
Epoch 12/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.7474 - ac
c: 0.6975 - val_loss: 0.7141 - val_acc: 0.7024

Epoch 00012: val_acc did not improve from 0.71333
Epoch 13/20
19084/19084 [=====] - 31s 2ms/step - loss: 0.7207 - ac
c: 0.7051 - val_loss: 0.6723 - val_acc: 0.7238

Epoch 00013: val_acc improved from 0.71333 to 0.72381, saving model to model_v5
accX_RF-accY_RF.hdf5
Epoch 14/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.7013 - ac
c: 0.7186 - val_loss: 0.6472 - val_acc: 0.7360

Epoch 00014: val_acc improved from 0.72381 to 0.73596, saving model to model_v5
accX_RF-accY_RF.hdf5
Epoch 15/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.6542 - ac
c: 0.7411 - val_loss: 0.5973 - val_acc: 0.7517

Epoch 00015: val_acc improved from 0.73596 to 0.75168, saving model to model_v5
accX_RF-accY_RF.hdf5
Epoch 16/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.6265 - ac
c: 0.7498 - val_loss: 0.5992 - val_acc: 0.7452
```

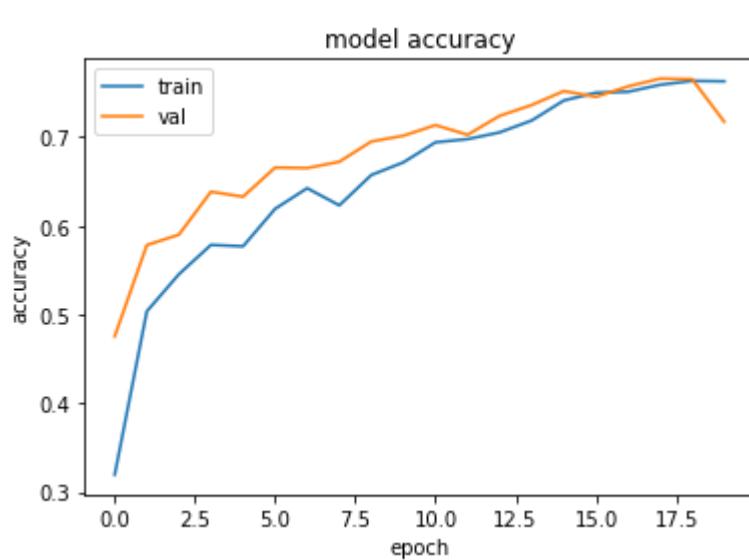
```
Epoch 00016: val_acc did not improve from 0.75168
Epoch 17/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.6368 - ac
c: 0.7508 - val_loss: 0.5855 - val_acc: 0.7569

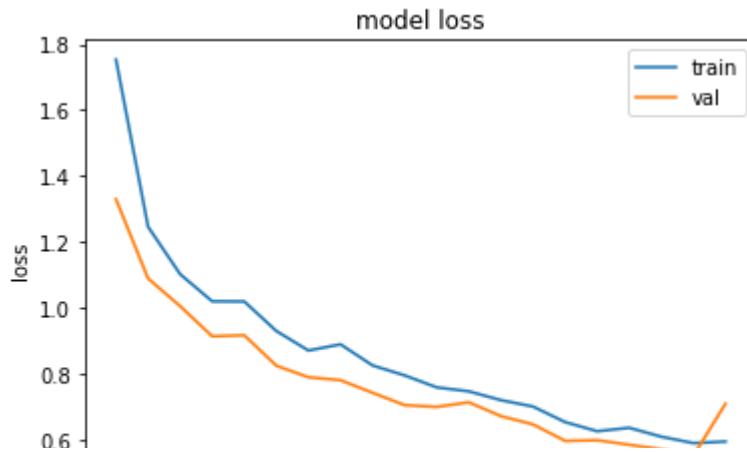
Epoch 00017: val_acc improved from 0.75168 to 0.75692, saving model to model_v5
accX_RF-accY_RF.hdf5
Epoch 18/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.6098 - ac
c: 0.7588 - val_loss: 0.5717 - val_acc: 0.7657

Epoch 00018: val_acc improved from 0.75692 to 0.76572, saving model to model_v5
accX_RF-accY_RF.hdf5
Epoch 19/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.5905 - ac
c: 0.7632 - val_loss: 0.5525 - val_acc: 0.7651

Epoch 00019: val_acc did not improve from 0.76572
Epoch 20/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.5952 - ac
c: 0.7627 - val_loss: 0.7098 - val_acc: 0.7171

Epoch 00020: val_acc did not improve from 0.76572
```

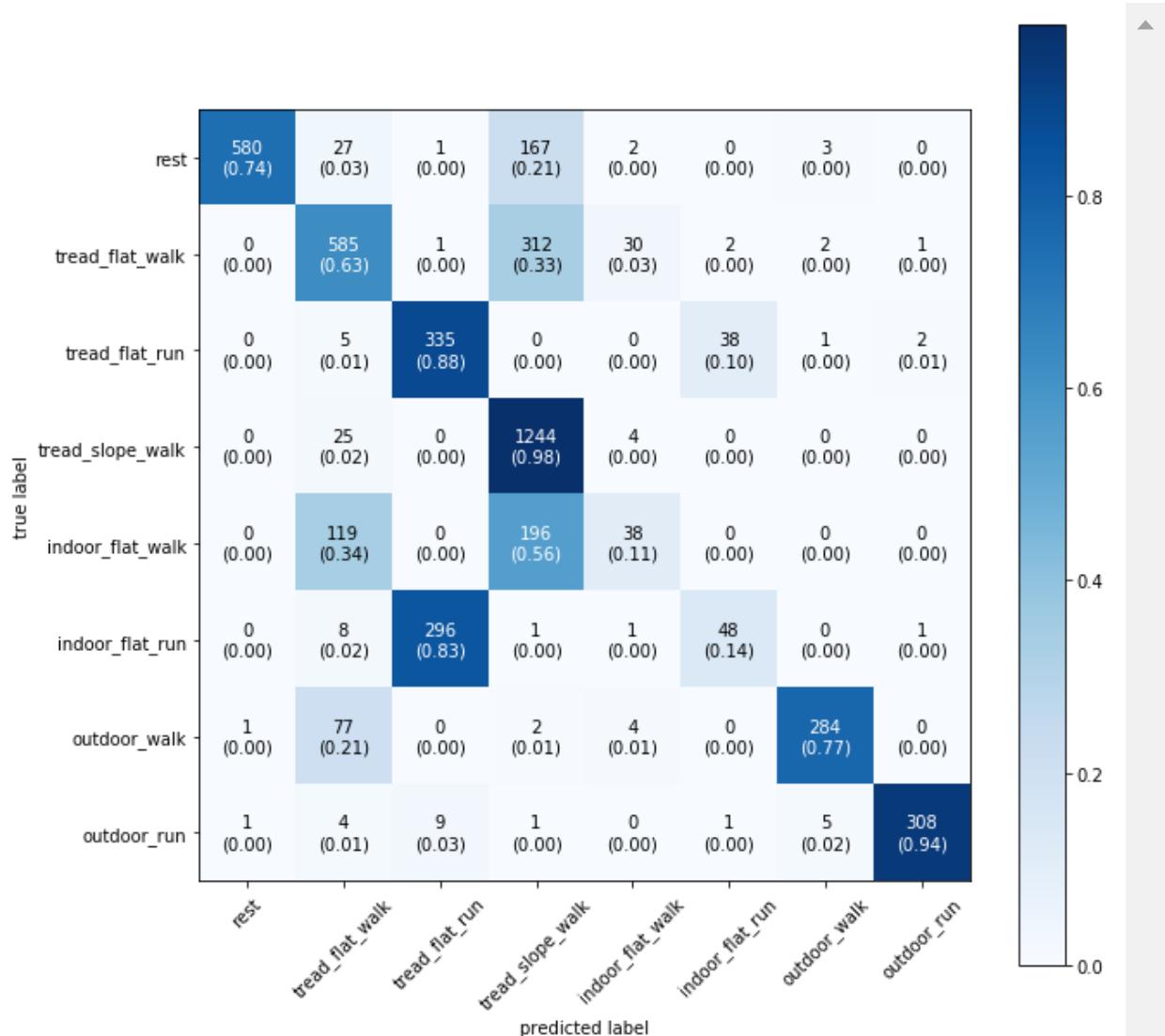




Best accuracy (on validation dataset): 71.71%

```
[[ 580   27    1   167    2    0    3    0]
 [  0   585   1   312   30    2    2    1]
 [  0    5  335    0    0   38    1    2]
 [  0   25    0 1244    4    0    0    0]
 [  0   119   0   196   38    0    0    0]
 [  0    8  296    1    1   48    0    1]
 [  1   77    0    2    4    0  284    0]
 [  1    4    9    1    0    1    5  308]]
```

<Figure size 432x288 with 0 Axes>



**Classification Report:**

	precision	recall	f1-score	support
rest	0.9966	0.7436	0.8517	780
tread_flat_walk	0.6882	0.6270	0.6562	933
tread_flat_run	0.5218	0.8793	0.6549	381
tread_slope_walk	0.6469	0.9772	0.7785	1273
indoor_flat_walk	0.4810	0.1076	0.1759	353
indoor_flat_run	0.5393	0.1352	0.2162	355
outdoor_walk	0.9627	0.7717	0.8567	368
outdoor_run	0.9872	0.9362	0.9610	329
accuracy			0.7171	4772
macro avg	0.7280	0.6472	0.6439	4772
weighted avg	0.7297	0.7171	0.6889	4772

Trying for these features ['accX\_RF', 'accZ\_RF']

(19084, 256, 2)

(19084, 8)

(4772, 256, 2)

(4772, 8)

256

2

8

Layer (type)	Output Shape	Param #
<hr/>		
input_21 (InputLayer)	(None, 256, 2)	0
lstm_20 (LSTM)	(None, 100)	41200
dropout_20 (Dropout)	(None, 100)	0
dense_40 (Dense)	(None, 100)	10100

```
dense_41 (Dense)           (None, 8)          808
=====
Total params: 52,108
Trainable params: 52,108
Non-trainable params: 0

Train on 19084 samples, validate on 4772 samples
Epoch 1/20
19084/19084 [=====] - 32s 2ms/step - loss: 1.8183 - ac
c: 0.2766 - val_loss: 1.5232 - val_acc: 0.3990

Epoch 00001: val_acc improved from -inf to 0.39899, saving model to model_v5acc
X_RF-accZ_RF.hdf5
Epoch 2/20
19084/19084 [=====] - 29s 2ms/step - loss: 1.4530 - ac
c: 0.4143 - val_loss: 1.2839 - val_acc: 0.4577

Epoch 00002: val_acc improved from 0.39899 to 0.45767, saving model to model_v5
accX_RF-accZ_RF.hdf5
Epoch 3/20
19084/19084 [=====] - 29s 2ms/step - loss: 1.2959 - ac
c: 0.4859 - val_loss: 1.1130 - val_acc: 0.5335

Epoch 00003: val_acc improved from 0.45767 to 0.53353, saving model to model_v5
accX_RF-accZ_RF.hdf5
Epoch 4/20
19084/19084 [=====] - 29s 2ms/step - loss: 1.1854 - ac
c: 0.5264 - val_loss: 1.0970 - val_acc: 0.5501

Epoch 00004: val_acc improved from 0.53353 to 0.55008, saving model to model_v5
accX_RF-accZ_RF.hdf5
Epoch 5/20
19084/19084 [=====] - 29s 2ms/step - loss: 1.0744 - ac
c: 0.5572 - val_loss: 1.0037 - val_acc: 0.5794

Epoch 00005: val_acc improved from 0.55008 to 0.57942, saving model to model_v5
accX_RF-accZ_RF.hdf5
Epoch 6/20
19084/19084 [=====] - 29s 2ms/step - loss: 1.0108 - ac
c: 0.5785 - val_loss: 0.9444 - val_acc: 0.5979

Epoch 00006: val_acc improved from 0.57942 to 0.59786, saving model to model_v5
accX_RF-accZ_RF.hdf5
Epoch 7/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.9662 - ac
c: 0.6091 - val_loss: 0.8780 - val_acc: 0.6389

Epoch 00007: val_acc improved from 0.59786 to 0.63894, saving model to model_v5
accX_RF-accZ_RF.hdf5
Epoch 8/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.9326 - ac
c: 0.6237 - val_loss: 0.8638 - val_acc: 0.6425

Epoch 00008: val_acc improved from 0.63894 to 0.64250, saving model to model_v5
accX_RF-accZ_RF.hdf5
Epoch 9/20
```

```
19084/19084 [=====] - 29s 2ms/step - loss: 0.8959 - ac  
c: 0.6280 - val_loss: 0.8442 - val_acc: 0.6586
```

Epoch 00009: val\_acc improved from 0.64250 to 0.65863, saving model to model\_v5  
accX\_RF-accZ\_RF.hdf5

Epoch 10/20

```
19084/19084 [=====] - 30s 2ms/step - loss: 0.8528 - ac  
c: 0.6474 - val_loss: 0.8094 - val_acc: 0.6609
```

Epoch 00010: val\_acc improved from 0.65863 to 0.66094, saving model to model\_v5  
accX\_RF-accZ\_RF.hdf5

Epoch 11/20

```
19084/19084 [=====] - 30s 2ms/step - loss: 0.8419 - ac  
c: 0.6577 - val_loss: 0.7888 - val_acc: 0.6760
```

Epoch 00011: val\_acc improved from 0.66094 to 0.67603, saving model to model\_v5  
accX\_RF-accZ\_RF.hdf5

Epoch 12/20

```
19084/19084 [=====] - 29s 2ms/step - loss: 0.8657 - ac  
c: 0.6552 - val_loss: 0.7665 - val_acc: 0.6790
```

Epoch 00012: val\_acc improved from 0.67603 to 0.67896, saving model to model\_v5  
accX\_RF-accZ\_RF.hdf5

Epoch 13/20

```
19084/19084 [=====] - 29s 2ms/step - loss: 0.8029 - ac  
c: 0.6690 - val_loss: 0.8249 - val_acc: 0.6605
```

Epoch 00013: val\_acc did not improve from 0.67896

Epoch 14/20

```
19084/19084 [=====] - 29s 2ms/step - loss: 0.8015 - ac  
c: 0.6710 - val_loss: 0.7227 - val_acc: 0.6993
```

Epoch 00014: val\_acc improved from 0.67896 to 0.69929, saving model to model\_v5  
accX\_RF-accZ\_RF.hdf5

Epoch 15/20

```
19084/19084 [=====] - 29s 2ms/step - loss: 0.7492 - ac  
c: 0.6881 - val_loss: 0.6896 - val_acc: 0.7215
```

Epoch 00015: val\_acc improved from 0.69929 to 0.72150, saving model to model\_v5  
accX\_RF-accZ\_RF.hdf5

Epoch 16/20

```
19084/19084 [=====] - 30s 2ms/step - loss: 0.7318 - ac  
c: 0.6979 - val_loss: 0.7213 - val_acc: 0.6968
```

Epoch 00016: val\_acc did not improve from 0.72150

Epoch 17/20

```
19084/19084 [=====] - 30s 2ms/step - loss: 0.9706 - ac  
c: 0.6334 - val_loss: 0.7708 - val_acc: 0.6850
```

Epoch 00017: val\_acc did not improve from 0.72150

Epoch 18/20

```
19084/19084 [=====] - 30s 2ms/step - loss: 0.7904 - ac  
c: 0.6816 - val_loss: 0.7364 - val_acc: 0.6892
```

Epoch 00018: val\_acc did not improve from 0.72150

Epoch 19/20

```
19084/19084 [=====] - 30s 2ms/step - loss: 0.7290 - ac
```

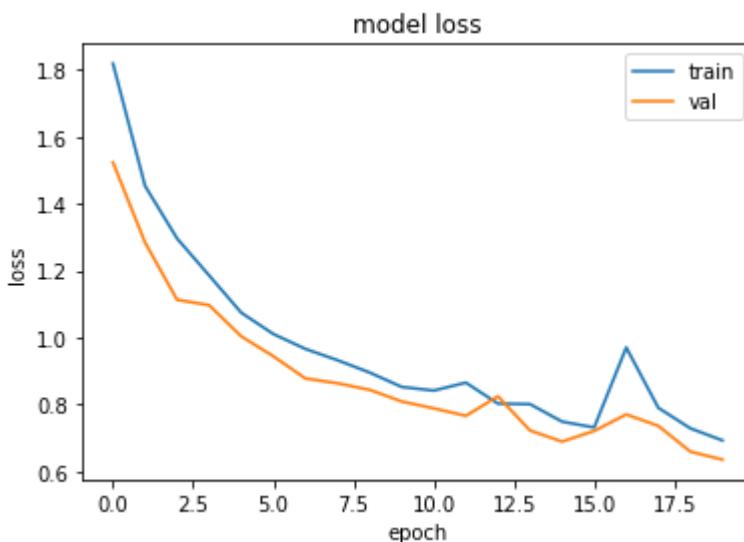
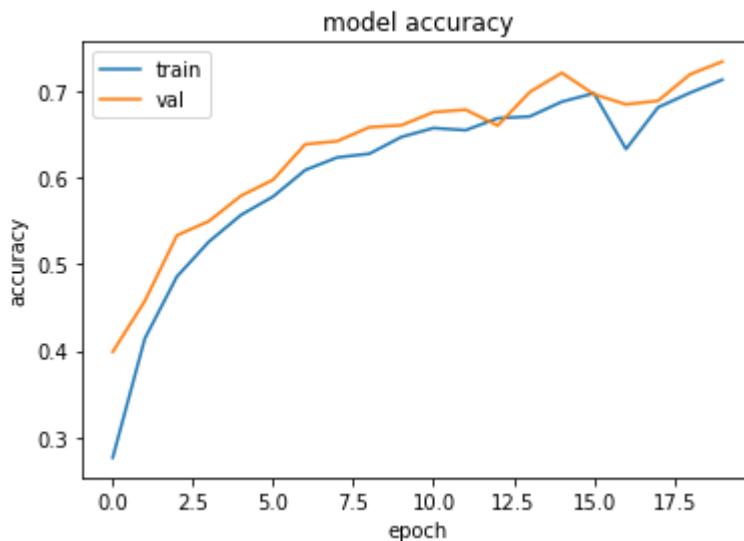
c: 0.6985 - val\_loss: 0.6596 - val\_acc: 0.7198

Epoch 00019: val\_acc did not improve from 0.72150

Epoch 20/20

19084/19084 [=====] - 30s 2ms/step - loss: 0.6930 - ac  
c: 0.7135 - val\_loss: 0.6357 - val\_acc: 0.7345

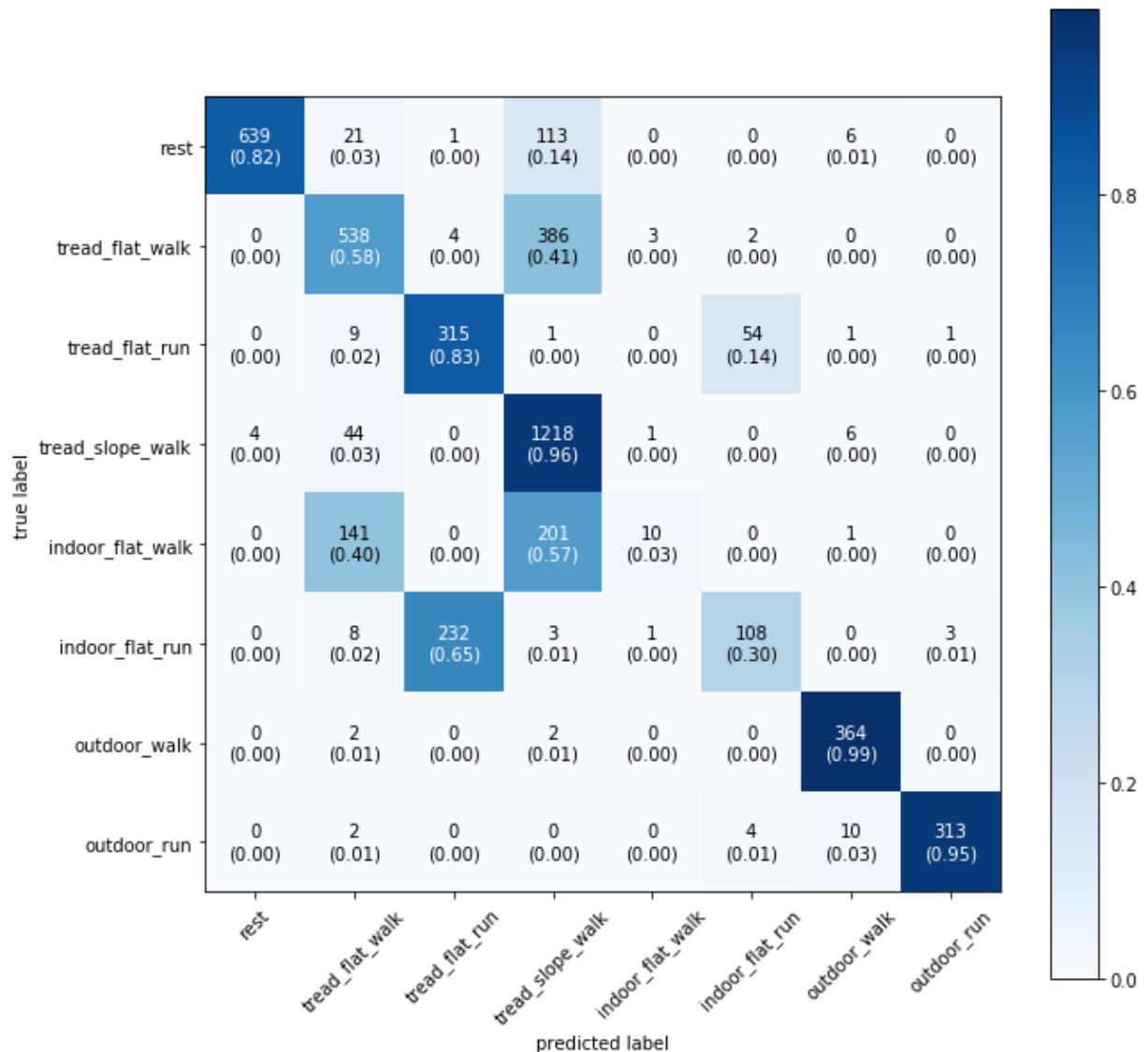
Epoch 00020: val\_acc improved from 0.72150 to 0.73449, saving model to model\_v5  
accX\_RF-accZ\_RF.hdf5



Best accuracy (on validation dataset): 73.45%

```
[[ 639   21     1   113     0     0     6     0]
 [  0   538     4   386     3     2     0     0]
 [  0     9   315     1     0    54     1     1]
 [  4    44     0  1218     1     0     6     0]
 [  0   141     0   201    10     0     1     0]
 [  0     8   232     3     1   108     0     3]
 [  0     2     0     2     0     0   364     0]
 [  0     2     0     0     0     4    10  313]]
```

/Figure size 122x222 with a axes



## Classification Report:

	precision	recall	f1-score	support
rest	0.9938	0.8192	0.8981	780
tread_flat_walk	0.7033	0.5766	0.6337	933
tread_flat_run	0.5707	0.8268	0.6752	381
tread_slope_walk	0.6331	0.9568	0.7620	1273
indoor_flat_walk	0.6667	0.0283	0.0543	353
indoor_flat_run	0.6429	0.3042	0.4130	355
outdoor_walk	0.9381	0.9891	0.9630	368
outdoor_run	0.9874	0.9514	0.9690	329
accuracy			0.7345	4772
macro avg	0.7670	0.6816	0.6710	4772
weighted avg	0.7519	0.7345	0.7037	4772

Trying for these features ['accY\_RF', 'accZ\_RF']

(19084, 256, 2)

(19084, 8)

(4772, 256, 2)

(4772, 8)

256

2  
8

Layer (type)	Output Shape	Param #
<hr/>		
input_22 (InputLayer)	(None, 256, 2)	0
lstm_21 (LSTM)	(None, 100)	41200
dropout_21 (Dropout)	(None, 100)	0
dense_42 (Dense)	(None, 100)	10100
dense_43 (Dense)	(None, 8)	808
<hr/>		
Total params:	52,108	
Trainable params:	52,108	
Non-trainable params:	0	

---

Train on 19084 samples, validate on 4772 samples

Epoch 1/20

19084/19084 [=====] - 32s 2ms/step - loss: 1.7715 - acc: 0.3084 - val\_loss: 1.3815 - val\_acc: 0.4369

Epoch 00001: val\_acc improved from -inf to 0.43692, saving model to model\_v5accY\_RF-accZ\_RF.hdf5

Epoch 2/20

19084/19084 [=====] - 29s 2ms/step - loss: 1.2562 - acc: 0.4942 - val\_loss: 1.0482 - val\_acc: 0.5650

Epoch 00002: val\_acc improved from 0.43692 to 0.56496, saving model to model\_v5accY\_RF-accZ\_RF.hdf5

Epoch 3/20

19084/19084 [=====] - 29s 2ms/step - loss: 1.0645 - acc: 0.5613 - val\_loss: 0.9573 - val\_acc: 0.6157

Epoch 00003: val\_acc improved from 0.56496 to 0.61567, saving model to model\_v5accY\_RF-accZ\_RF.hdf5

Epoch 4/20

19084/19084 [=====] - 31s 2ms/step - loss: 1.0379 - acc: 0.5824 - val\_loss: 0.9007 - val\_acc: 0.6377

Epoch 00004: val\_acc improved from 0.61567 to 0.63768, saving model to model\_v5accY\_RF-accZ\_RF.hdf5

Epoch 5/20

19084/19084 [=====] - 29s 2ms/step - loss: 0.9250 - acc: 0.6235 - val\_loss: 0.8237 - val\_acc: 0.6775

Epoch 00005: val\_acc improved from 0.63768 to 0.67749, saving model to model\_v5accY\_RF-accZ\_RF.hdf5

Epoch 6/20

19084/19084 [=====] - 29s 2ms/step - loss: 0.8568 - acc: 0.6541 - val\_loss: 0.7632 - val\_acc: 0.7022

Epoch 00006: val\_acc improved from 0.67749 to 0.70222, saving model to model\_v5accY\_RF-accZ\_RF.hdf5

Epoch 7/20

```
19084/19084 [=====] - 29s 2ms/step - loss: 0.8489 - ac  
c: 0.6644 - val_loss: 0.7643 - val_acc: 0.6813

Epoch 00007: val_acc did not improve from 0.70222
Epoch 8/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.7706 - ac  
c: 0.6901 - val_loss: 0.6999 - val_acc: 0.7148

Epoch 00008: val_acc improved from 0.70222 to 0.71479, saving model to model_v5  
accY_RF-accZ_RF.hdf5
Epoch 9/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.7905 - ac  
c: 0.6836 - val_loss: 0.7140 - val_acc: 0.7108

Epoch 00009: val_acc did not improve from 0.71479
Epoch 10/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.7117 - ac  
c: 0.7106 - val_loss: 0.6359 - val_acc: 0.7397

Epoch 00010: val_acc improved from 0.71479 to 0.73973, saving model to model_v5  
accY_RF-accZ_RF.hdf5
Epoch 11/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.6771 - ac  
c: 0.7209 - val_loss: 0.6005 - val_acc: 0.7376

Epoch 00011: val_acc did not improve from 0.73973
Epoch 12/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.6455 - ac  
c: 0.7320 - val_loss: 0.5697 - val_acc: 0.7699

Epoch 00012: val_acc improved from 0.73973 to 0.76991, saving model to model_v5  
accY_RF-accZ_RF.hdf5
Epoch 13/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.6145 - ac  
c: 0.7523 - val_loss: 0.5292 - val_acc: 0.7842

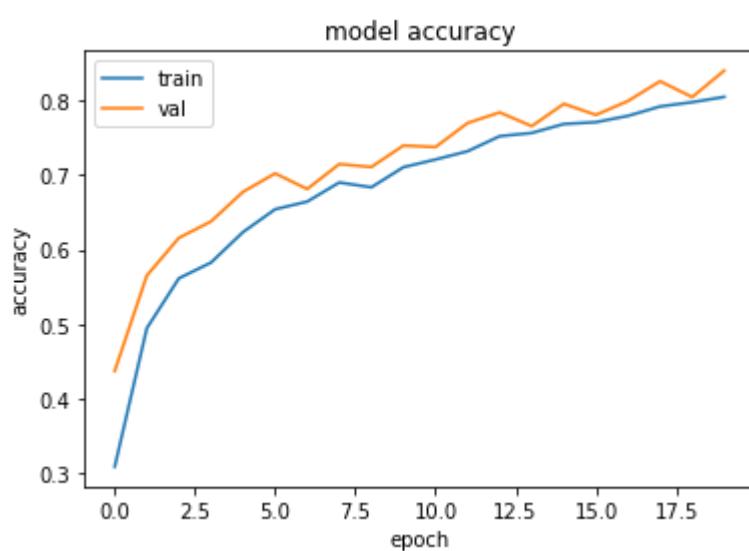
Epoch 00013: val_acc improved from 0.76991 to 0.78416, saving model to model_v5  
accY_RF-accZ_RF.hdf5
Epoch 14/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.6053 - ac  
c: 0.7565 - val_loss: 0.5900 - val_acc: 0.7657

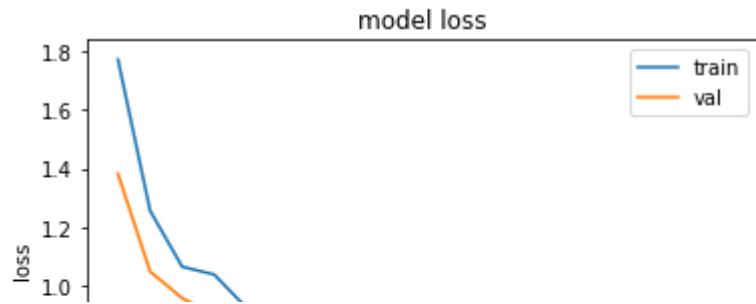
Epoch 00014: val_acc did not improve from 0.78416
Epoch 15/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.5683 - ac  
c: 0.7686 - val_loss: 0.5112 - val_acc: 0.7957

Epoch 00015: val_acc improved from 0.78416 to 0.79568, saving model to model_v5  
accY_RF-accZ_RF.hdf5
Epoch 16/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.5623 - ac  
c: 0.7711 - val_loss: 0.5312 - val_acc: 0.7808

Epoch 00016: val_acc did not improve from 0.79568
Epoch 17/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.5423 - ac  
c: 0.7795 - val_loss: 0.5133 - val_acc: 0.7995
```

```
Epoch 00017: val_acc improved from 0.79568 to 0.79946, saving model to model_v5  
accY_RF-accZ_RF.hdf5  
Epoch 18/20  
19084/19084 [=====] - 29s 2ms/step - loss: 0.5197 - ac  
c: 0.7921 - val_loss: 0.4746 - val_acc: 0.8261  
  
Epoch 00018: val_acc improved from 0.79946 to 0.82607, saving model to model_v5  
accY_RF-accZ_RF.hdf5  
Epoch 19/20  
19084/19084 [=====] - 30s 2ms/step - loss: 0.5031 - ac  
c: 0.7979 - val_loss: 0.4904 - val_acc: 0.8047  
  
Epoch 00019: val_acc did not improve from 0.82607  
Epoch 20/20  
19084/19084 [=====] - 29s 2ms/step - loss: 0.5013 - ac  
c: 0.8050 - val_loss: 0.4197 - val_acc: 0.8403  
  
Epoch 00020: val_acc improved from 0.82607 to 0.84032, saving model to model_v5  
accY_RF-accZ_RF.hdf5
```

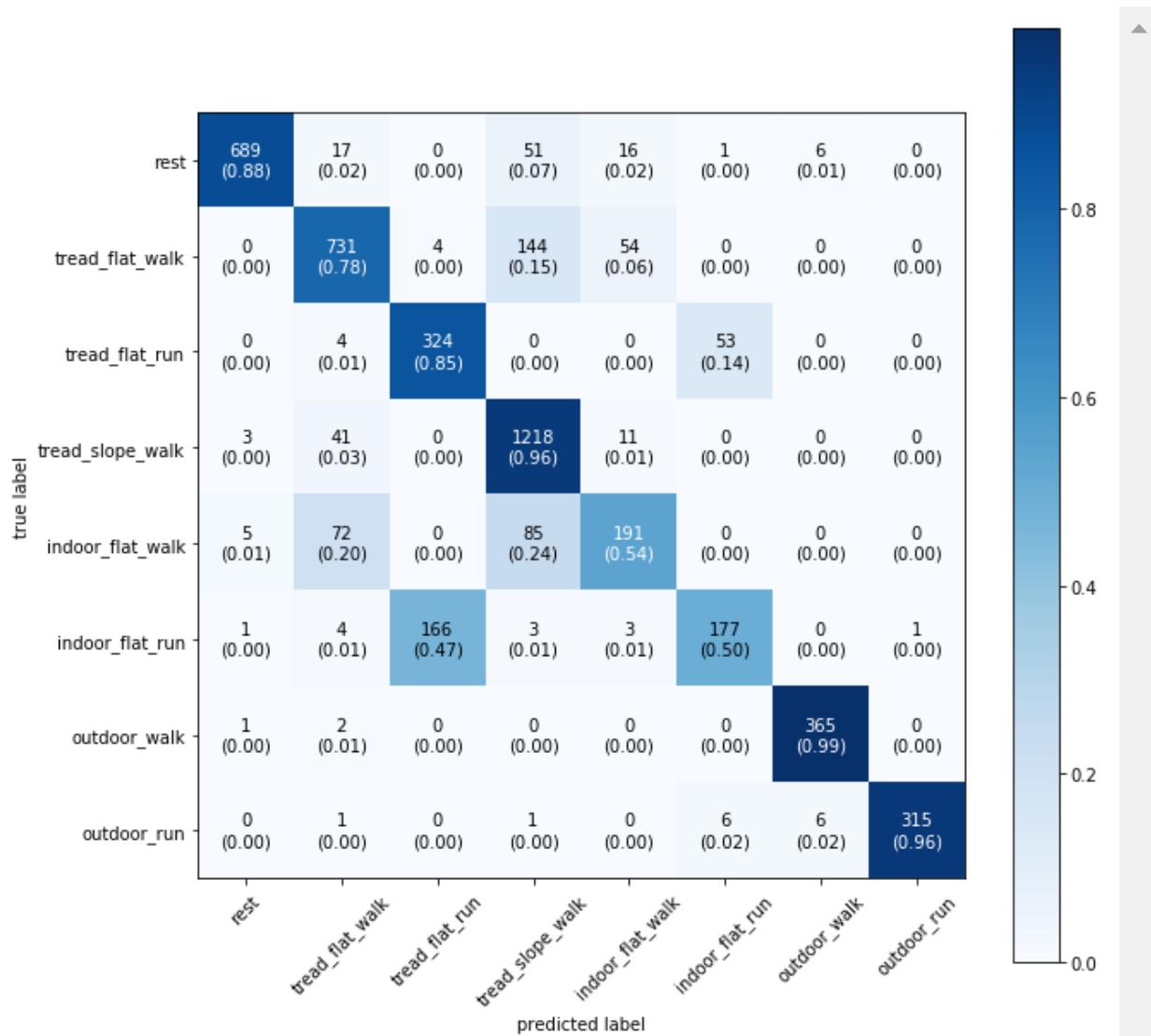




Best accuracy (on validation dataset): 84.03%

```
[[ 689   17     0    51    16     1     6     0]
 [  0   731     4   144    54     0     0     0]
 [  0     4   324     0     0    53     0     0]
 [  3     41     0  1218    11     0     0     0]
 [  5    72     0    85   191     0     0     0]
 [  1     4   166     3     3   177     0     1]
 [  1     2     0     0     0     0   365     0]
 [  0     1     0     1     0     6     6  315]]
```

<Figure size 432x288 with 0 Axes>



## Classification Report:

	precision	recall	f1-score	support
rest	0.9857	0.8833	0.9317	780
tread_flat_walk	0.8383	0.7835	0.8100	933
tread_flat_run	0.6559	0.8504	0.7406	381
tread_slope_walk	0.8109	0.9568	0.8778	1273
indoor_flat_walk	0.6945	0.5411	0.6083	353
indoor_flat_run	0.7468	0.4986	0.5980	355
outdoor_walk	0.9682	0.9918	0.9799	368
outdoor_run	0.9968	0.9574	0.9767	329
accuracy			0.8403	4772
macro avg	0.8371	0.8079	0.8154	4772
weighted avg	0.8440	0.8403	0.8363	4772

```
Trying for these features ['accX_LF', 'accY_LF', 'accZ_LF', 'accX_Wrist', 'accY_Wrist', 'accZ_Wrist']
(19084, 256, 6)
(19084, 8)
(4772, 256, 6)
(4772, 8)
256
6
8
```

Layer (type)	Output Shape	Param #
input_23 (InputLayer)	(None, 256, 6)	0
lstm_22 (LSTM)	(None, 100)	42800
dropout_22 (Dropout)	(None, 100)	0
dense_44 (Dense)	(None, 100)	10100
dense_45 (Dense)	(None, 8)	808

Total params: 53,708

Trainable params: 53,708

Non-trainable params: 0

---

Train on 19084 samples, validate on 4772 samples

Epoch 1/20

19084/19084 [=====] - 32s 2ms/step - loss: 1.6826 - acc: 0.3303 - val\_loss: 1.2969 - val\_acc: 0.4665

Epoch 00001: val\_acc improved from -inf to 0.46647, saving model to model\_v5accX\_LF-accY\_LF-accZ\_LF-accX\_Wrist-accY\_Wrist-accZ\_Wrist.hdf5

Epoch 2/20

19084/19084 [=====] - 29s 2ms/step - loss: 1.1672 - acc: 0.5187 - val\_loss: 0.9335 - val\_acc: 0.6563

Epoch 00002: val\_acc improved from 0.46647 to 0.65633, saving model to model\_v5accX\_LF-accY\_LF-accZ\_LF-accX\_Wrist-accY\_Wrist-accZ\_Wrist.hdf5

Epoch 3/20

19084/19084 [=====] - 29s 2ms/step - loss: 0.9222 - acc: 0.6370 - val\_loss: 0.7810 - val\_acc: 0.7269

Epoch 00003: val\_acc improved from 0.65633 to 0.72695, saving model to model\_v5accX\_LF-accY\_LF-accZ\_LF-accX\_Wrist-accY\_Wrist-accZ\_Wrist.hdf5

Epoch 4/20

19084/19084 [=====] - 29s 2ms/step - loss: 0.8226 - acc: 0.6857 - val\_loss: 0.6889 - val\_acc: 0.7531

Epoch 00004: val\_acc improved from 0.72695 to 0.75314, saving model to model\_v5accX\_LF-accY\_LF-accZ\_LF-accX\_Wrist-accY\_Wrist-accZ\_Wrist.hdf5

Epoch 5/20

19084/19084 [=====] - 29s 2ms/step - loss: 0.7242 - acc: 0.7353 - val\_loss: 0.6953 - val\_acc: 0.7487

Epoch 00005: val\_acc did not improve from 0.75314

Epoch 6/20

19084/19084 [=====] - 29s 2ms/step - loss: 0.6709 - acc: 0.7588 - val\_loss: 0.5115 - val\_acc: 0.8198

Epoch 00006: val\_acc improved from 0.75314 to 0.81978, saving model to model\_v5accX\_LF-accY\_LF-accZ\_LF-accX\_Wrist-accY\_Wrist-accZ\_Wrist.hdf5

Epoch 7/20

19084/19084 [=====] - 29s 2ms/step - loss: 0.5630 - acc: 0.8048 - val\_loss: 0.4917 - val\_acc: 0.8359

Epoch 00007: val\_acc improved from 0.81978 to 0.83592, saving model to model\_v5accX\_LF-accY\_LF-accZ\_LF-accX\_Wrist-accY\_Wrist-accZ\_Wrist.hdf5

Epoch 8/20

19084/19084 [=====] - 34s 2ms/step - loss: 0.5727 - acc: 0.7992 - val\_loss: 0.4555 - val\_acc: 0.8512

Epoch 00008: val\_acc improved from 0.83592 to 0.85122, saving model to model\_v5accX\_LF-accY\_LF-accZ\_LF-accX\_Wrist-accY\_Wrist-accZ\_Wrist.hdf5

Epoch 9/20

19084/19084 [=====] - 30s 2ms/step - loss: 0.4895 - acc: 0.8328 - val\_loss: 0.4490 - val\_acc: 0.8389

Epoch 00009: val\_acc did not improve from 0.85122

```
Epoch 10/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.4615 - ac
c: 0.8452 - val_loss: 0.4307 - val_acc: 0.8613

Epoch 00010: val_acc improved from 0.85122 to 0.86127, saving model to model_v5
accX_LF-accY_LF-accZ_LF-accX_Wrist-accY_Wrist-accZ_Wrist.hdf5
Epoch 11/20
19084/19084 [=====] - 31s 2ms/step - loss: 0.4269 - ac
c: 0.8614 - val_loss: 0.3339 - val_acc: 0.8933

Epoch 00011: val_acc improved from 0.86127 to 0.89334, saving model to model_v5
accX_LF-accY_LF-accZ_LF-accX_Wrist-accY_Wrist-accZ_Wrist.hdf5
Epoch 12/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.3795 - ac
c: 0.8743 - val_loss: 0.3085 - val_acc: 0.9013

Epoch 00012: val_acc improved from 0.89334 to 0.90130, saving model to model_v5
accX_LF-accY_LF-accZ_LF-accX_Wrist-accY_Wrist-accZ_Wrist.hdf5
Epoch 13/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.3648 - ac
c: 0.8826 - val_loss: 0.2824 - val_acc: 0.9030

Epoch 00013: val_acc improved from 0.90130 to 0.90298, saving model to model_v5
accX_LF-accY_LF-accZ_LF-accX_Wrist-accY_Wrist-accZ_Wrist.hdf5
Epoch 14/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.3662 - ac
c: 0.8829 - val_loss: 0.3491 - val_acc: 0.8852

Epoch 00014: val_acc did not improve from 0.90298
Epoch 15/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.3598 - ac
c: 0.8817 - val_loss: 0.2816 - val_acc: 0.9118

Epoch 00015: val_acc improved from 0.90298 to 0.91178, saving model to model_v5
accX_LF-accY_LF-accZ_LF-accX_Wrist-accY_Wrist-accZ_Wrist.hdf5
Epoch 16/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.3043 - ac
c: 0.9035 - val_loss: 0.2493 - val_acc: 0.9176

Epoch 00016: val_acc improved from 0.91178 to 0.91764, saving model to model_v5
accX_LF-accY_LF-accZ_LF-accX_Wrist-accY_Wrist-accZ_Wrist.hdf5
Epoch 17/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.2986 - ac
c: 0.9067 - val_loss: 0.2259 - val_acc: 0.9277

Epoch 00017: val_acc improved from 0.91764 to 0.92770, saving model to model_v5
accX_LF-accY_LF-accZ_LF-accX_Wrist-accY_Wrist-accZ_Wrist.hdf5
Epoch 18/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.2942 - ac
c: 0.9068 - val_loss: 0.2422 - val_acc: 0.9241

Epoch 00018: val_acc did not improve from 0.92770
Epoch 19/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.2880 - ac
c: 0.9116 - val_loss: 0.2204 - val_acc: 0.9340

Epoch 00019: val_acc improved from 0.92770 to 0.93399, saving model to model_v5
```

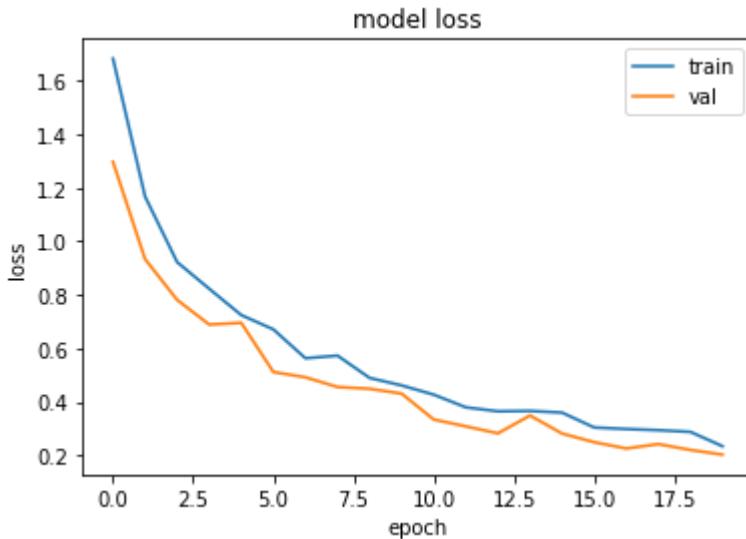
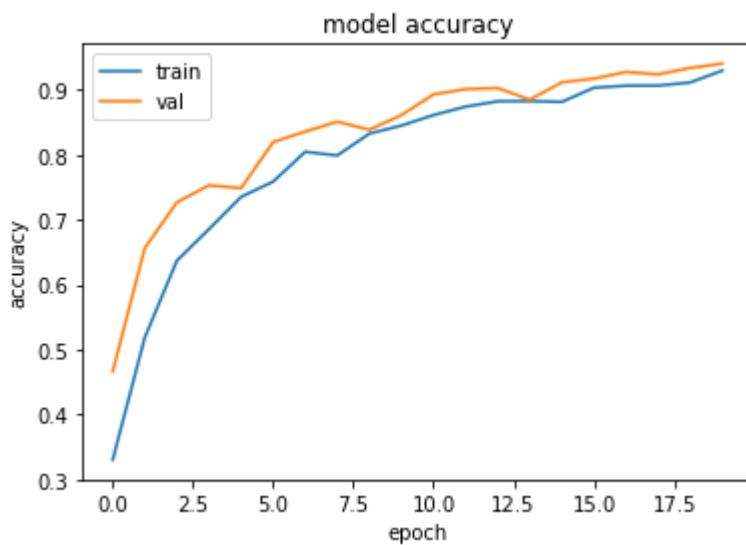
accX\_LF-accY\_LF-accZ\_LF-accX\_Wrist-accY\_Wrist-accZ\_Wrist.hdf5

Epoch 20/20

19084/19084 [=====] - 29s 2ms/step - loss: 0.2342 - ac

c: 0.9299 - val\_loss: 0.2028 - val\_acc: 0.9407

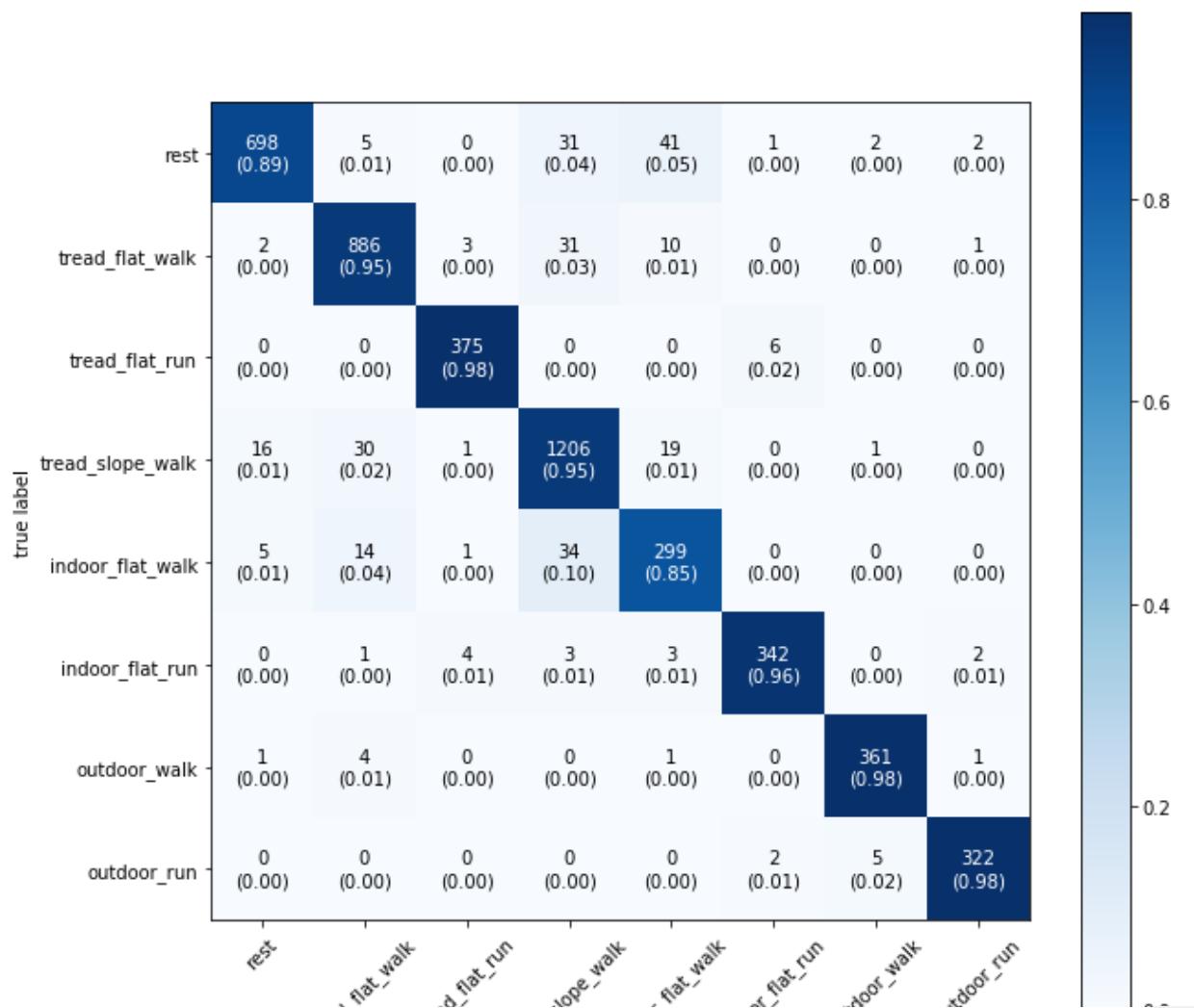
Epoch 00020: val\_acc improved from 0.93399 to 0.94070, saving model to model\_v5  
accX\_LF-accY\_LF-accZ\_LF-accX\_Wrist-accY\_Wrist-accZ\_Wrist.hdf5



Best accuracy (on validation dataset): 94.07%

```
[[ 698    5    0   31   41    1    2    2]
 [ 2   886    3   31   10    0    0    1]
 [ 0     0  375    0    0    6    0    0]
 [ 16    30    1 1206   19    0    1    0]
 [ 5    14    1   34  299    0    0    0]
 [ 0     1    4    3    3  342    0    2]
 [ 1     4    0    0    1    0  361    1]
 [ 0     0    0    0    0    2    5  322]]
```

&lt;Figure size 432x288 with 0 Axes&gt;



## Classification Report:

	precision	recall	f1-score	support
rest	0.9668	0.8949	0.9294	780
tread_flat_walk	0.9426	0.9496	0.9461	933
tread_flat_run	0.9766	0.9843	0.9804	381
tread_slope_walk	0.9241	0.9474	0.9356	1273
indoor_flat_walk	0.8016	0.8470	0.8237	353
indoor_flat_run	0.9744	0.9634	0.9688	355
outdoor_walk	0.9783	0.9810	0.9796	368
outdoor_run	0.9817	0.9787	0.9802	329
accuracy			0.9407	4772
macro avg	0.9433	0.9433	0.9430	4772
weighted avg	0.9417	0.9407	0.9409	4772

Trying for these features ['accX\_LF', 'accY\_LF']

(19084, 256, 2)

(19084, 8)

(4772, 256, 2)

(4772, 8)

256

2

8

Layer (type)	Output Shape	Param #
--------------	--------------	---------

```
=====
input_24 (InputLayer)          (None, 256, 2)          0
=====
lstm_23 (LSTM)                (None, 100)           41200
=====
dropout_23 (Dropout)          (None, 100)           0
=====
dense_46 (Dense)              (None, 100)           10100
=====
dense_47 (Dense)              (None, 8)             808
=====
Total params: 52,108
Trainable params: 52,108
Non-trainable params: 0
```

---

```
Train on 19084 samples, validate on 4772 samples
```

```
Epoch 1/20
```

```
19084/19084 [=====] - 32s 2ms/step - loss: 1.7694 -  
acc: 0.3102 - val_loss: 1.3617 - val_acc: 0.4673
```

```
Epoch 00001: val_acc improved from -inf to 0.46731, saving model to model_v5a  
ccX_LF-accY_LF.hdf5
```

```
Epoch 2/20
```

```
19084/19084 [=====] - 29s 2ms/step - loss: 1.2578 -  
acc: 0.4828 - val_loss: 1.1137 - val_acc: 0.5289
```

```
Epoch 00002: val_acc improved from 0.46731 to 0.52892, saving model to model_v5a  
ccX_LF-accY_LF.hdf5
```

```
Epoch 3/20
```

```
19084/19084 [=====] - 29s 2ms/step - loss: 1.1050 -  
acc: 0.5311 - val_loss: 1.0450 - val_acc: 0.5495
```

```
Epoch 00003: val_acc improved from 0.52892 to 0.54946, saving model to model_v5a  
ccX_LF-accY_LF.hdf5
```

```
Epoch 4/20
```

```
19084/19084 [=====] - 29s 2ms/step - loss: 1.0454 -  
acc: 0.5527 - val_loss: 1.0426 - val_acc: 0.5555
```

```
Epoch 00004: val_acc improved from 0.54946 to 0.55553, saving model to model_v5a  
ccX_LF-accY_LF.hdf5
```

```
Epoch 5/20
```

```
19084/19084 [=====] - 29s 2ms/step - loss: 0.9945 -  
acc: 0.5743 - val_loss: 0.9472 - val_acc: 0.6039
```

```
Epoch 00005: val_acc improved from 0.55553 to 0.60394, saving model to model_v5a  
ccX_LF-accY_LF.hdf5
```

```
Epoch 6/20
```

```
19084/19084 [=====] - 29s 2ms/step - loss: 0.9482 -  
acc: 0.6087 - val_loss: 0.8900 - val_acc: 0.6496
```

```
Epoch 00006: val_acc improved from 0.60394 to 0.64962, saving model to model_v5a  
ccX_LF-accY_LF.hdf5
```

```
Epoch 7/20
```

```
19084/19084 [=====] - 29s 2ms/step - loss: 0.8944 -  
acc: 0.6424 - val_loss: 0.8035 - val_acc: 0.6794
```

```
Epoch 00007: val_acc improved from 0.64962 to 0.67938, saving model to model_v5a  
ccX_LF-accY_LF.hdf5
```

```
v5accX_LF-accY_LF.hdf5
Epoch 8/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.8570 -
acc: 0.6569 - val_loss: 0.8376 - val_acc: 0.6616

Epoch 00008: val_acc did not improve from 0.67938
Epoch 9/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.7754 -
acc: 0.6940 - val_loss: 0.7087 - val_acc: 0.7236

Epoch 00009: val_acc improved from 0.67938 to 0.72360, saving model to model_
v5accX_LF-accY_LF.hdf5
Epoch 10/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.7437 -
acc: 0.7072 - val_loss: 0.7342 - val_acc: 0.7083

Epoch 00010: val_acc did not improve from 0.72360
Epoch 11/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.7277 -
acc: 0.7104 - val_loss: 0.6940 - val_acc: 0.7339

Epoch 00011: val_acc improved from 0.72360 to 0.73386, saving model to model_
v5accX_LF-accY_LF.hdf5
Epoch 12/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.7091 -
acc: 0.7170 - val_loss: 0.6699 - val_acc: 0.7408

Epoch 00012: val_acc improved from 0.73386 to 0.74078, saving model to model_
v5accX_LF-accY_LF.hdf5
Epoch 13/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.6922 -
acc: 0.7272 - val_loss: 0.6482 - val_acc: 0.7397

Epoch 00013: val_acc did not improve from 0.74078
Epoch 14/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.6575 -
acc: 0.7377 - val_loss: 0.5994 - val_acc: 0.7634

Epoch 00014: val_acc improved from 0.74078 to 0.76341, saving model to model_
v5accX_LF-accY_LF.hdf5
Epoch 15/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.6633 -
acc: 0.7326 - val_loss: 0.6138 - val_acc: 0.7611

Epoch 00015: val_acc did not improve from 0.76341
Epoch 16/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.6435 -
acc: 0.7419 - val_loss: 0.6246 - val_acc: 0.7557

Epoch 00016: val_acc did not improve from 0.76341
Epoch 17/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.6307 -
acc: 0.7528 - val_loss: 0.5982 - val_acc: 0.7603

Epoch 00017: val_acc did not improve from 0.76341
Epoch 18/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.5900 -
```

```
acc: 0.7681 - val_loss: 0.5406 - val_acc: 0.7948
```

```
Epoch 00018: val_acc improved from 0.76341 to 0.79484, saving model to model_v5accX_LF-accY_LF.hdf5
```

```
Epoch 19/20
```

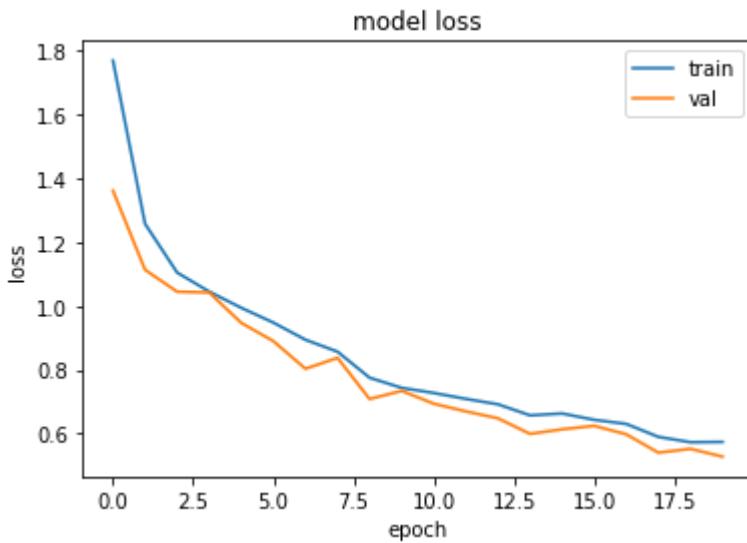
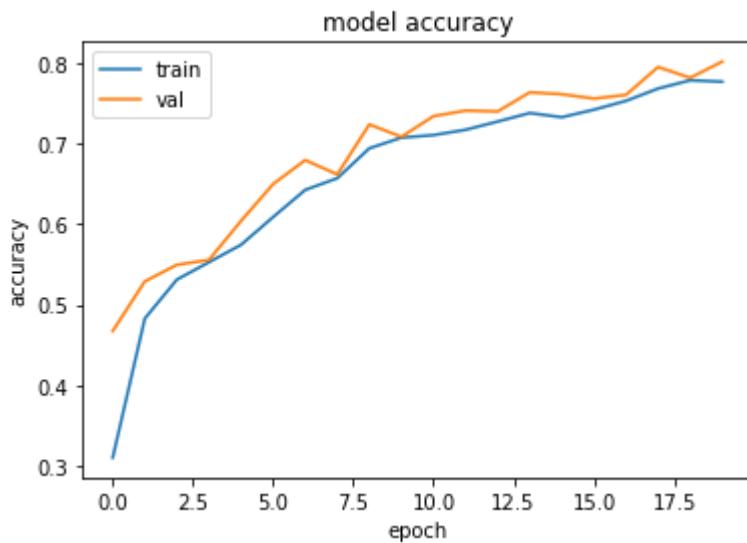
```
19084/19084 [=====] - 29s 2ms/step - loss: 0.5733 - acc: 0.7783 - val_loss: 0.5525 - val_acc: 0.7814
```

```
Epoch 00019: val_acc did not improve from 0.79484
```

```
Epoch 20/20
```

```
19084/19084 [=====] - 29s 2ms/step - loss: 0.5743 - acc: 0.7766 - val_loss: 0.5281 - val_acc: 0.8016
```

```
Epoch 00020: val_acc improved from 0.79484 to 0.80155, saving model to model_v5accX_LF-accY_LF.hdf5
```

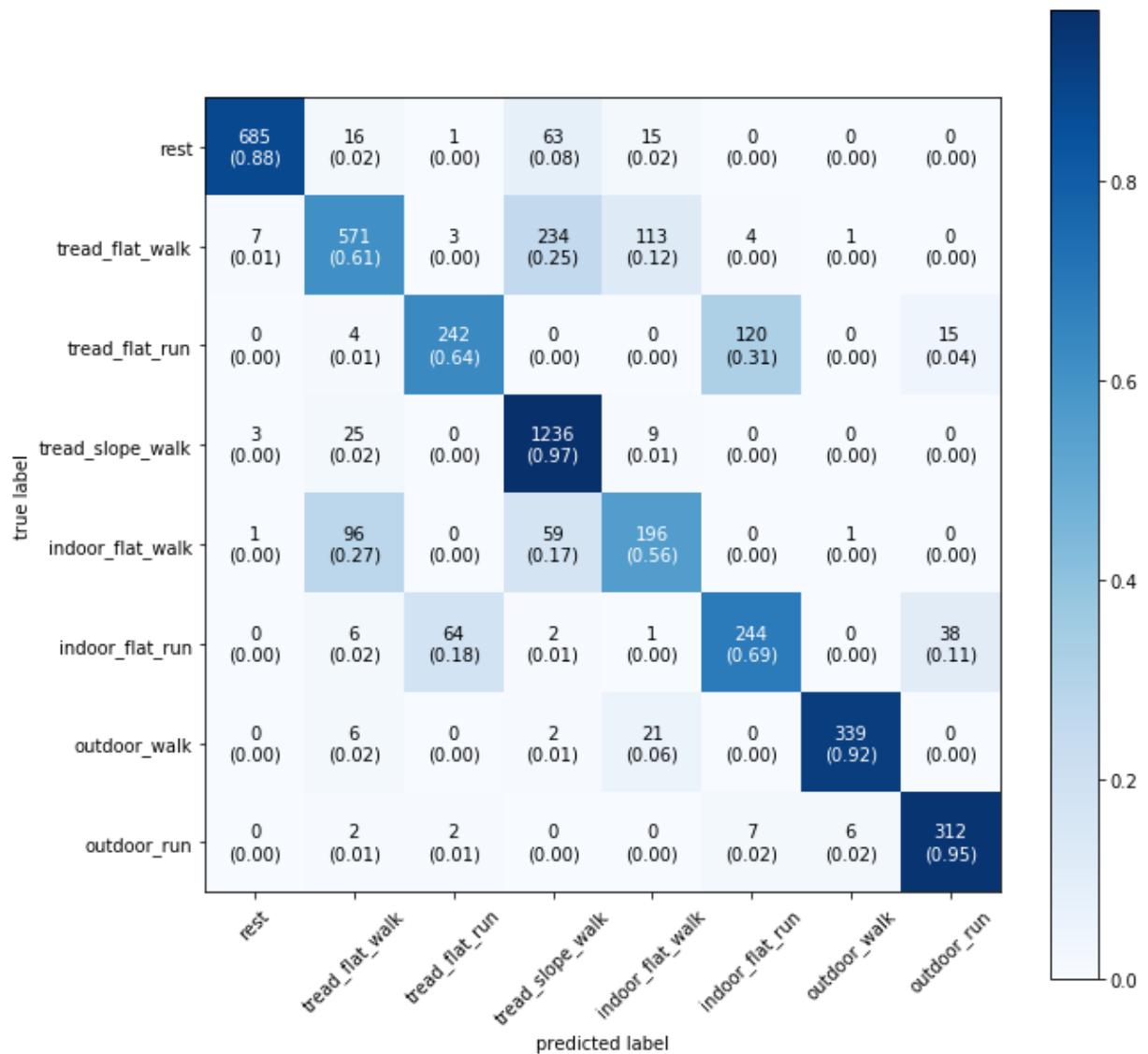


Best accuracy (on validation dataset): 80.16%

```
[[ 685   16     1    63    15     0     0     0]
 [   7   571     3   234   113     4     1     0]
 [   0     4   242     0     0   120     0    15]
 [   3    25     0  1236     9     0     0     0]
 [   1    96     0    59   196     0     1     0]
 [   0     6    64     2     1   244     0    38]]
```

```
[  0   6   0   2  21   0 339   0]
[  0   2   2   0   0    7   6 312]]
```

<Figure size 432x288 with 0 Axes>



#### Classification Report:

	precision	recall	f1-score	support
rest	0.9842	0.8782	0.9282	780
tread_flat_walk	0.7865	0.6120	0.6884	933
tread_flat_run	0.7756	0.6352	0.6984	381
tread_slope_walk	0.7744	0.9709	0.8616	1273
indoor_flat_walk	0.5521	0.5552	0.5537	353
indoor_flat_run	0.6507	0.6873	0.6685	355
outdoor_walk	0.9769	0.9212	0.9483	368
outdoor_run	0.8548	0.9483	0.8991	329
accuracy			0.8016	4772
macro avg	0.7944	0.7761	0.7808	4772
weighted avg	0.8067	0.8016	0.7977	4772

Trying for these features ['accX\_LF', 'accZ\_LF']  
(19084, 256, 2)  
(19084, 8)

(4772, 256, 2)

(4772, 8)

256

2

8

Layer (type)	Output Shape	Param #
<hr/>		
input_25 (InputLayer)	(None, 256, 2)	0
lstm_24 (LSTM)	(None, 100)	41200
dropout_24 (Dropout)	(None, 100)	0
dense_48 (Dense)	(None, 100)	10100
dense_49 (Dense)	(None, 8)	808
<hr/>		

Total params: 52,108

Trainable params: 52,108

Non-trainable params: 0

---

Train on 19084 samples, validate on 4772 samples

Epoch 1/20

19084/19084 [=====] - 34s 2ms/step - loss: 1.8658 - acc: 0.2703 - val\_loss: 1.6285 - val\_acc: 0.3904

Epoch 00001: val\_acc improved from -inf to 0.39040, saving model to model\_v5accX\_LF-accZ\_LF.hdf5

Epoch 2/20

19084/19084 [=====] - 31s 2ms/step - loss: 1.5308 - acc: 0.4041 - val\_loss: 1.5097 - val\_acc: 0.4363

Epoch 00002: val\_acc improved from 0.39040 to 0.43630, saving model to model\_v5accX\_LF-accZ\_LF.hdf5

Epoch 3/20

19084/19084 [=====] - 32s 2ms/step - loss: 1.4349 - acc: 0.4573 - val\_loss: 1.2926 - val\_acc: 0.4971

Epoch 00003: val\_acc improved from 0.43630 to 0.49707, saving model to model\_v5accX\_LF-accZ\_LF.hdf5

Epoch 4/20

19084/19084 [=====] - 31s 2ms/step - loss: 1.2791 - acc: 0.4940 - val\_loss: 1.2168 - val\_acc: 0.5134

Epoch 00004: val\_acc improved from 0.49707 to 0.51341, saving model to model\_v5accX\_LF-accZ\_LF.hdf5

Epoch 5/20

19084/19084 [=====] - 32s 2ms/step - loss: 1.2337 - acc: 0.5117 - val\_loss: 1.1555 - val\_acc: 0.5319

Epoch 00005: val\_acc improved from 0.51341 to 0.53185, saving model to model\_v5accX\_LF-accZ\_LF.hdf5

Epoch 6/20

19084/19084 [=====] - 30s 2ms/step - loss: 1.1711 - acc: 0.5271 - val\_loss: 1.0826 - val\_acc: 0.5635

```
Epoch 00006: val_acc improved from 0.53185 to 0.56350, saving model to model_v5
accX_LF-accZ_LF.hdf5
Epoch 7/20
19084/19084 [=====] - 29s 2ms/step - loss: 1.1145 - ac
c: 0.5418 - val_loss: 1.0972 - val_acc: 0.5476

Epoch 00007: val_acc did not improve from 0.56350
Epoch 8/20
19084/19084 [=====] - 29s 2ms/step - loss: 1.1062 - ac
c: 0.5457 - val_loss: 1.2646 - val_acc: 0.4922

Epoch 00008: val_acc did not improve from 0.56350
Epoch 9/20
19084/19084 [=====] - 29s 2ms/step - loss: 1.1243 - ac
c: 0.5396 - val_loss: 1.0417 - val_acc: 0.5759

Epoch 00009: val_acc improved from 0.56350 to 0.57586, saving model to model_v5
accX_LF-accZ_LF.hdf5
Epoch 10/20
19084/19084 [=====] - 29s 2ms/step - loss: 1.2214 - ac
c: 0.5481 - val_loss: 1.5719 - val_acc: 0.4495

Epoch 00010: val_acc did not improve from 0.57586
Epoch 11/20
19084/19084 [=====] - 29s 2ms/step - loss: 1.3732 - ac
c: 0.4816 - val_loss: 1.1428 - val_acc: 0.5658

Epoch 00011: val_acc did not improve from 0.57586
Epoch 12/20
19084/19084 [=====] - 29s 2ms/step - loss: 1.1312 - ac
c: 0.5574 - val_loss: 1.0586 - val_acc: 0.5922

Epoch 00012: val_acc improved from 0.57586 to 0.59220, saving model to model_v5
accX_LF-accZ_LF.hdf5
Epoch 13/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.0806 - ac
c: 0.5719 - val_loss: 1.0295 - val_acc: 0.5966

Epoch 00013: val_acc improved from 0.59220 to 0.59661, saving model to model_v5
accX_LF-accZ_LF.hdf5
Epoch 14/20
19084/19084 [=====] - 29s 2ms/step - loss: 1.0465 - ac
c: 0.5859 - val_loss: 0.9999 - val_acc: 0.6113

Epoch 00014: val_acc improved from 0.59661 to 0.61127, saving model to model_v5
accX_LF-accZ_LF.hdf5
Epoch 15/20
19084/19084 [=====] - 31s 2ms/step - loss: 1.0247 - ac
c: 0.5978 - val_loss: 0.9457 - val_acc: 0.6253

Epoch 00015: val_acc improved from 0.61127 to 0.62531, saving model to model_v5
accX_LF-accZ_LF.hdf5
Epoch 16/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.9978 - ac
c: 0.6000 - val_loss: 0.9191 - val_acc: 0.6287

Epoch 00016: val_acc improved from 0.62531 to 0.62867, saving model to model_v5
```

```
accX_LF-accZ_LF.hdf5
```

```
Epoch 17/20
```

```
19084/19084 [=====] - 29s 2ms/step - loss: 0.9611 - ac  
c: 0.6186 - val_loss: 0.8874 - val_acc: 0.6507
```

```
Epoch 00017: val_acc improved from 0.62867 to 0.65067, saving model to model_v5  
accX_LF-accZ_LF.hdf5
```

```
Epoch 18/20
```

```
19084/19084 [=====] - 29s 2ms/step - loss: 0.9651 - ac  
c: 0.6203 - val_loss: 0.8649 - val_acc: 0.6513
```

```
Epoch 00018: val_acc improved from 0.65067 to 0.65130, saving model to model_v5  
accX_LF-accZ_LF.hdf5
```

```
Epoch 19/20
```

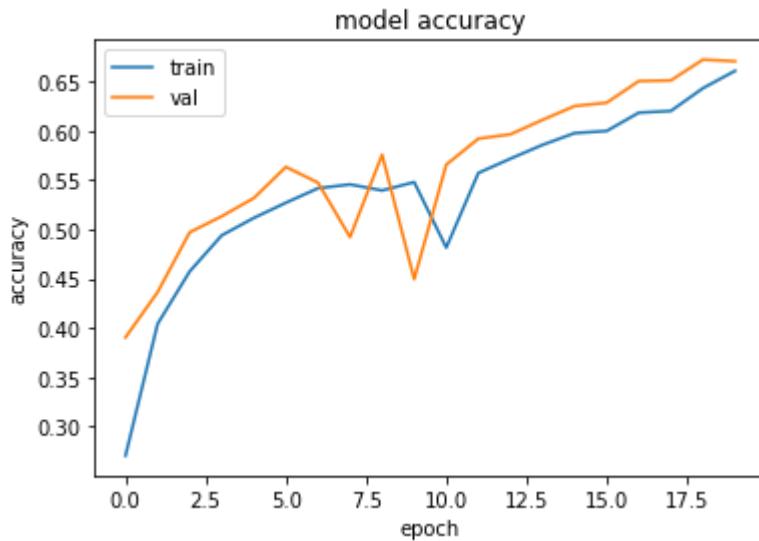
```
19084/19084 [=====] - 29s 2ms/step - loss: 0.8875 - ac  
c: 0.6434 - val_loss: 0.8215 - val_acc: 0.6725
```

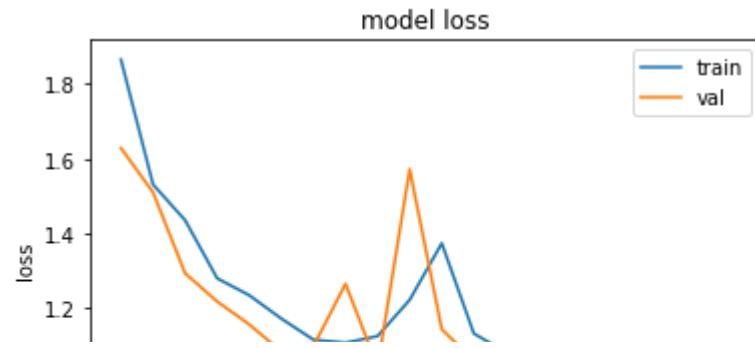
```
Epoch 00019: val_acc improved from 0.65130 to 0.67246, saving model to model_v5  
accX_LF-accZ_LF.hdf5
```

```
Epoch 20/20
```

```
19084/19084 [=====] - 29s 2ms/step - loss: 0.8551 - ac  
c: 0.6610 - val_loss: 0.8036 - val_acc: 0.6708
```

```
Epoch 00020: val_acc did not improve from 0.67246
```

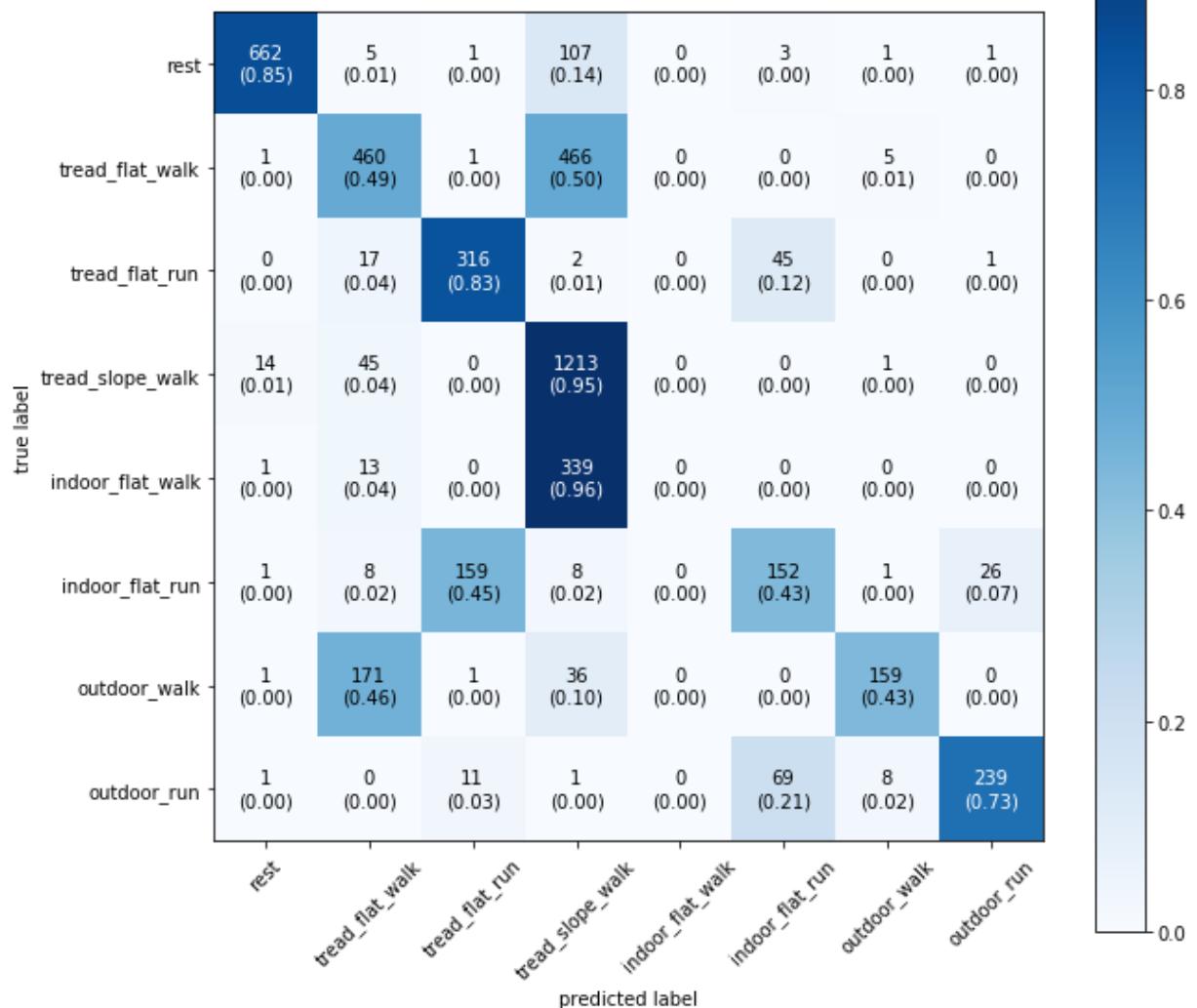




Best accuracy (on validation dataset): 67.08%

```
[[ 662      5      1    107      0      3      1      1]
 [ 1     460      1    466      0      0      5      0]
 [ 0     17    316      2      0     45      0      1]
 [ 14     45      0   1213      0      0      1      0]
 [ 1     13      0    339      0      0      0      0]
 [ 1      8    159      8      0    152      1    26]
 [ 1    171      1    36      0      0   159      0]
 [ 1      0    11      1      0     69      8   239]]
```

<Figure size 432x288 with 0 Axes>



### Classification Report:

	precision	recall	f1-score	support
rest	0.9721	0.8487	0.9062	780
tread_flat_walk	0.6398	0.4930	0.5569	933
tread_flat_run	0.6462	0.8294	0.7264	381
tread_slope_walk	0.5585	0.9529	0.7042	1273
indoor_flat_walk	0.0000	0.0000	0.0000	353
indoor_flat_run	0.5651	0.4282	0.4872	355
outdoor_walk	0.9086	0.4321	0.5856	368
outdoor_run	0.8951	0.7264	0.8020	329
accuracy			0.6708	4772
macro avg	0.6482	0.5888	0.5961	4772
weighted avg	0.6584	0.6708	0.6396	4772

Trying for these features ['accX\_LF', 'accX\_Wrist']

(19084, 256, 2)

(19084, 8)

(4772, 256, 2)

(4772, 8)

256

2

8

Layer (type)	Output Shape	Param #
<hr/>		
input_26 (InputLayer)	(None, 256, 2)	0
lstm_25 (LSTM)	(None, 100)	41200
dropout_25 (Dropout)	(None, 100)	0
dense_50 (Dense)	(None, 100)	10100
dense_51 (Dense)	(None, 8)	808
<hr/>		

Total params: 52,108

Trainable params: 52,108

Non-trainable params: 0

---

Train on 19084 samples, validate on 4772 samples

Epoch 1/20

19084/19084 [=====] - 33s 2ms/step - loss: 1.7897 - acc: 0.2743 - val\_loss: 1.4246 - val\_acc: 0.3738

Epoch 00001: val\_acc improved from -inf to 0.37385, saving model to model\_v5accX\_LF-accX\_Wrist.hdf5

Epoch 2/20

19084/19084 [=====] - 30s 2ms/step - loss: 1.3672 - acc: 0.4010 - val\_loss: 1.3676 - val\_acc: 0.4516

Epoch 00002: val\_acc improved from 0.37385 to 0.45159, saving model to model\_v5accX\_LF-accX\_Wrist.hdf5

Epoch 3/20

19084/19084 [=====] - 30s 2ms/step - loss: 1.2397 - acc: 0.4742 - val\_loss: 1.1415 - val\_acc: 0.5327

```
Epoch 00003: val_acc improved from 0.45159 to 0.53269, saving model to model_
v5accX_LF-accX_Wrist.hdf5
Epoch 4/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.1584 -
acc: 0.5107 - val_loss: 1.0729 - val_acc: 0.5612

Epoch 00004: val_acc improved from 0.53269 to 0.56119, saving model to model_
v5accX_LF-accX_Wrist.hdf5
Epoch 5/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.1003 -
acc: 0.5403 - val_loss: 0.9996 - val_acc: 0.5953

Epoch 00005: val_acc improved from 0.56119 to 0.59535, saving model to model_
v5accX_LF-accX_Wrist.hdf5
Epoch 6/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.0374 -
acc: 0.5615 - val_loss: 0.9814 - val_acc: 0.5935

Epoch 00006: val_acc did not improve from 0.59535
Epoch 7/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.0482 -
acc: 0.5565 - val_loss: 0.9700 - val_acc: 0.6014

Epoch 00007: val_acc improved from 0.59535 to 0.60142, saving model to model_
v5accX_LF-accX_Wrist.hdf5
Epoch 8/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.0691 -
acc: 0.5546 - val_loss: 1.0463 - val_acc: 0.5738

Epoch 00008: val_acc did not improve from 0.60142
Epoch 9/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.0432 -
acc: 0.5631 - val_loss: 0.9407 - val_acc: 0.6291

Epoch 00009: val_acc improved from 0.60142 to 0.62909, saving model to model_
v5accX_LF-accX_Wrist.hdf5
Epoch 10/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.9710 -
acc: 0.6024 - val_loss: 0.8991 - val_acc: 0.6391

Epoch 00010: val_acc improved from 0.62909 to 0.63915, saving model to model_
v5accX_LF-accX_Wrist.hdf5
Epoch 11/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.9698 -
acc: 0.6033 - val_loss: 0.9217 - val_acc: 0.6329

Epoch 00011: val_acc did not improve from 0.63915
Epoch 12/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.9342 -
acc: 0.6198 - val_loss: 0.8739 - val_acc: 0.6603

Epoch 00012: val_acc improved from 0.63915 to 0.66031, saving model to model_
v5accX_LF-accX_Wrist.hdf5
Epoch 13/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.9116 -
acc: 0.6281 - val_loss: 0.8492 - val_acc: 0.6607
```

```
Epoch 00013: val_acc improved from 0.66031 to 0.66073, saving model to model_v5accX_LF-accX_Wrist.hdf5
Epoch 14/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.8955 - acc: 0.6398 - val_loss: 0.8347 - val_acc: 0.6752

Epoch 00014: val_acc improved from 0.66073 to 0.67519, saving model to model_v5accX_LF-accX_Wrist.hdf5
Epoch 15/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.8799 - acc: 0.6492 - val_loss: 0.8024 - val_acc: 0.6928

Epoch 00015: val_acc improved from 0.67519 to 0.69279, saving model to model_v5accX_LF-accX_Wrist.hdf5
Epoch 16/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.8887 - acc: 0.6409 - val_loss: 0.9806 - val_acc: 0.5876

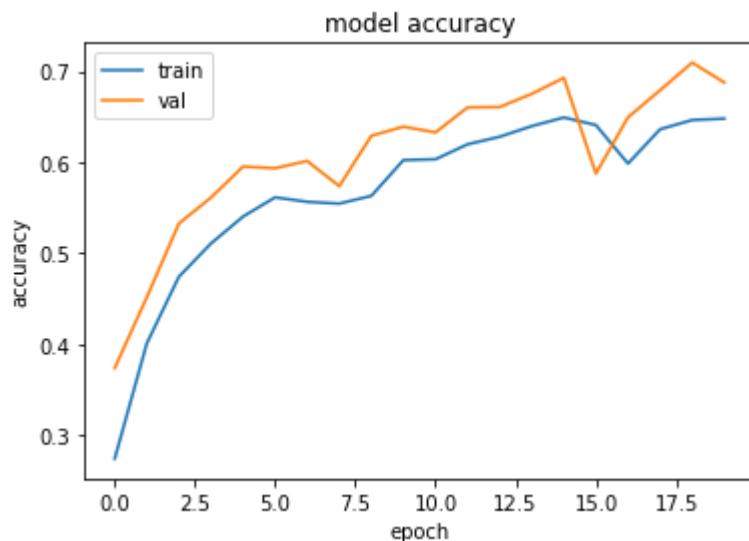
Epoch 00016: val_acc did not improve from 0.69279
Epoch 17/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.0500 - acc: 0.5986 - val_loss: 0.8873 - val_acc: 0.6494

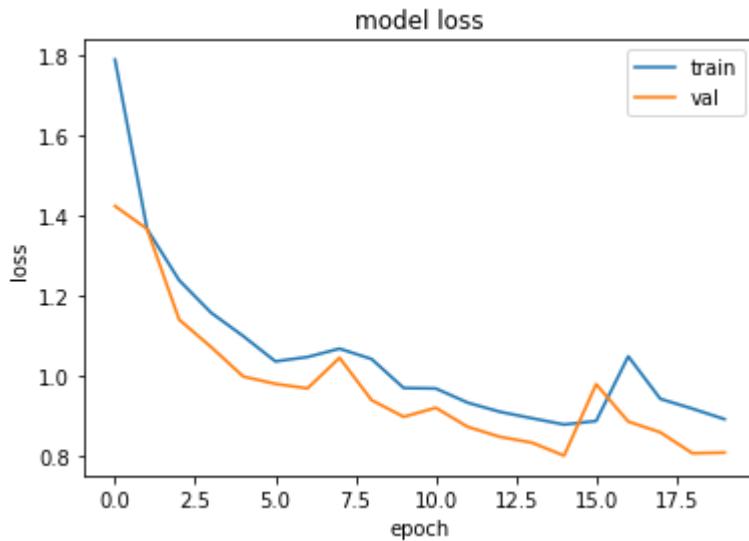
Epoch 00017: val_acc did not improve from 0.69279
Epoch 18/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.9439 - acc: 0.6363 - val_loss: 0.8605 - val_acc: 0.6792

Epoch 00018: val_acc did not improve from 0.69279
Epoch 19/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.9194 - acc: 0.6465 - val_loss: 0.8083 - val_acc: 0.7096

Epoch 00019: val_acc improved from 0.69279 to 0.70956, saving model to model_v5accX_LF-accX_Wrist.hdf5
Epoch 20/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.8933 - acc: 0.6480 - val_loss: 0.8100 - val_acc: 0.6878

Epoch 00020: val_acc did not improve from 0.70956
```

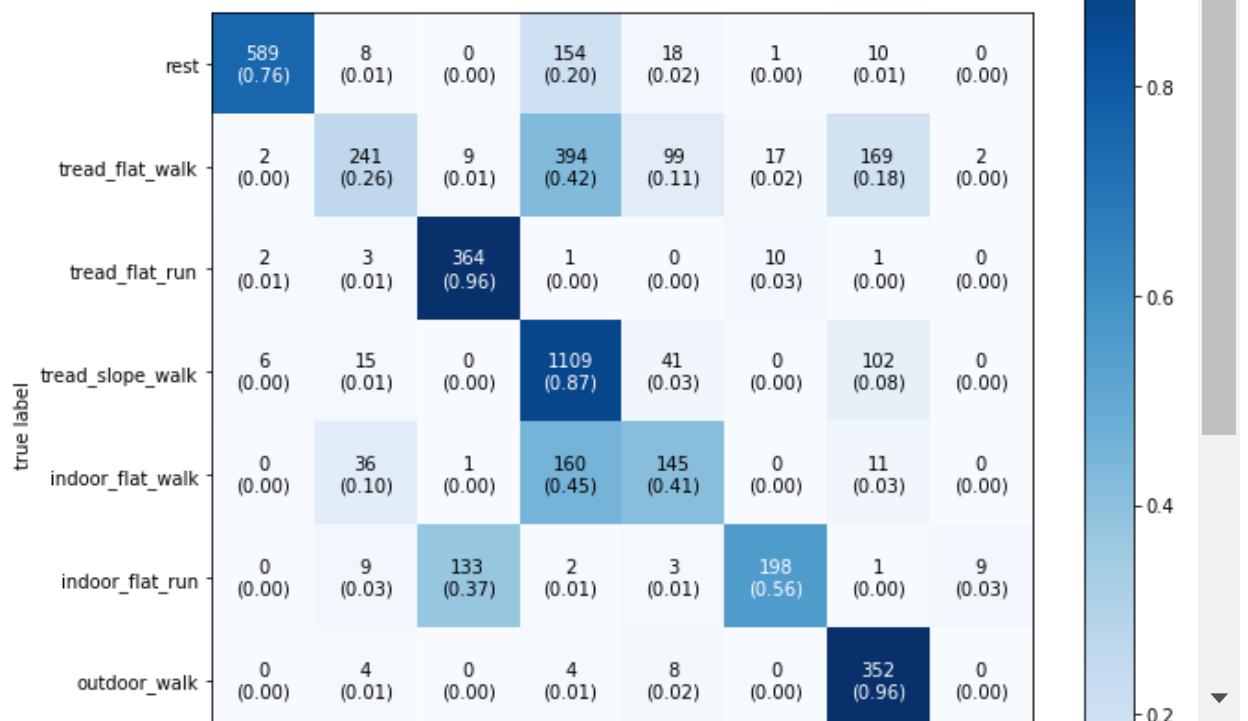




Best accuracy (on validation dataset): 68.78%

```
[[ 589    8    0  154   18    1   10    0]
 [  2   241    9  394   99   17  169    2]
 [  2    3  364    1    0   10    1    0]
 [  6   15    0 1109   41    0  102    0]
 [  0   36    1  160  145    0   11    0]
 [  0     9  133    2    3  198    1    9]
 [  0     4    0    4    8    0  352    0]
 [  0     3   12    1    1   25    3 284]]
```

<Figure size 432x288 with 0 Axes>



## Classification Report:

	precision	recall	f1-score	support
rest	0.9833	0.7551	0.8542	780
tread_flat_walk	0.7555	0.2583	0.3850	933
tread_flat_run	0.7013	0.9554	0.8089	381
tread_slope_walk	0.6077	0.8712	0.7159	1273
indoor_flat_walk	0.4603	0.4108	0.4341	353
indoor_flat_run	0.7888	0.5577	0.6535	355
outdoor_walk	0.5424	0.9565	0.6922	368
outdoor_run	0.9627	0.8632	0.9103	329
accuracy			0.6878	4772
macro avg	0.7253	0.7035	0.6818	4772
weighted avg	0.7275	0.6878	0.6673	4772

Trying for these features ['accX\_LF', 'accY\_Wrist']

(19084, 256, 2)

(19084, 8)

(4772, 256, 2)

(4772, 8)

256

2

8

Layer (type)	Output Shape	Param #
<hr/>		
input_27 (InputLayer)	(None, 256, 2)	0
lstm_26 (LSTM)	(None, 100)	41200
dropout_26 (Dropout)	(None, 100)	0

dense\_52 (Dense)

(None, 100)

10100

dense\_53 (Dense)

(None, 8)

808

Total params: 52,108

Trainable params: 52,108

Non-trainable params: 0

Train on 19084 samples, validate on 4772 samples

Epoch 1/20

19084/19084 [=====] - 33s 2ms/step - loss: 1.7808 - acc: 0.2967 - val\_loss: 1.4727 - val\_acc: 0.4149

Epoch 00001: val\_acc improved from -inf to 0.41492, saving model to model\_v5accX\_LF-accY\_Wrist.hdf5

Epoch 2/20

19084/19084 [=====] - 30s 2ms/step - loss: 1.3715 - acc: 0.4354 - val\_loss: 1.3169 - val\_acc: 0.4692

Epoch 00002: val\_acc improved from 0.41492 to 0.46920, saving model to model\_v5accX\_LF-accY\_Wrist.hdf5

Epoch 3/20

19084/19084 [=====] - 31s 2ms/step - loss: 1.2086 - acc: 0.4970 - val\_loss: 1.0915 - val\_acc: 0.5513

Epoch 00003: val\_acc improved from 0.46920 to 0.55134, saving model to model\_v5accX\_LF-accY\_Wrist.hdf5

Epoch 4/20

19084/19084 [=====] - 29s 2ms/step - loss: 1.1261 - acc: 0.5358 - val\_loss: 1.1159 - val\_acc: 0.5474

Epoch 00004: val\_acc did not improve from 0.55134

Epoch 5/20

19084/19084 [=====] - 29s 2ms/step - loss: 1.0869 - acc: 0.5470 - val\_loss: 0.9853 - val\_acc: 0.6123

Epoch 00005: val\_acc improved from 0.55134 to 0.61232, saving model to model\_v5accX\_LF-accY\_Wrist.hdf5

Epoch 6/20

19084/19084 [=====] - 29s 2ms/step - loss: 1.0130 - acc: 0.5881 - val\_loss: 0.9788 - val\_acc: 0.6153

Epoch 00006: val\_acc improved from 0.61232 to 0.61526, saving model to model\_v5accX\_LF-accY\_Wrist.hdf5

Epoch 7/20

19084/19084 [=====] - 29s 2ms/step - loss: 0.9964 - acc: 0.6028 - val\_loss: 0.9102 - val\_acc: 0.6473

Epoch 00007: val\_acc improved from 0.61526 to 0.64732, saving model to model\_v5accX\_LF-accY\_Wrist.hdf5

Epoch 8/20

19084/19084 [=====] - 29s 2ms/step - loss: 0.9474 - acc: 0.6178 - val\_loss: 0.9174 - val\_acc: 0.6299

Epoch 00008: val\_acc did not improve from 0.64732

Epoch 9/20

19084/19084 [=====] - 29s 2ms/step - loss: 0.9621 - acc:

c: 0.6144 - val\_loss: 0.8521 - val\_acc: 0.6735

Epoch 00009: val\_acc improved from 0.64732 to 0.67351, saving model to model\_v5  
accX\_LF-accY\_Wrist.hdf5  
Epoch 10/20  
19084/19084 [=====] - 29s 2ms/step - loss: 0.9562 - ac  
c: 0.6278 - val\_loss: 0.9245 - val\_acc: 0.6285

Epoch 00010: val\_acc did not improve from 0.67351  
Epoch 11/20  
19084/19084 [=====] - 30s 2ms/step - loss: 0.9834 - ac  
c: 0.6143 - val\_loss: 0.9095 - val\_acc: 0.6475

Epoch 00011: val\_acc did not improve from 0.67351  
Epoch 12/20  
19084/19084 [=====] - 29s 2ms/step - loss: 0.9207 - ac  
c: 0.6360 - val\_loss: 0.8198 - val\_acc: 0.6865

Epoch 00012: val\_acc improved from 0.67351 to 0.68650, saving model to model\_v5  
accX\_LF-accY\_Wrist.hdf5  
Epoch 13/20  
19084/19084 [=====] - 29s 2ms/step - loss: 0.8400 - ac  
c: 0.6782 - val\_loss: 0.7730 - val\_acc: 0.7100

Epoch 00013: val\_acc improved from 0.68650 to 0.70997, saving model to model\_v5  
accX\_LF-accY\_Wrist.hdf5  
Epoch 14/20  
19084/19084 [=====] - 29s 2ms/step - loss: 0.7991 - ac  
c: 0.6988 - val\_loss: 0.7256 - val\_acc: 0.7358

Epoch 00014: val\_acc improved from 0.70997 to 0.73575, saving model to model\_v5  
accX\_LF-accY\_Wrist.hdf5  
Epoch 15/20  
19084/19084 [=====] - 30s 2ms/step - loss: 0.8074 - ac  
c: 0.7007 - val\_loss: 0.8285 - val\_acc: 0.6947

Epoch 00015: val\_acc did not improve from 0.73575  
Epoch 16/20  
19084/19084 [=====] - 29s 2ms/step - loss: 0.8494 - ac  
c: 0.6822 - val\_loss: 0.7393 - val\_acc: 0.7295

Epoch 00016: val\_acc did not improve from 0.73575  
Epoch 17/20  
19084/19084 [=====] - 29s 2ms/step - loss: 0.7945 - ac  
c: 0.7067 - val\_loss: 0.7150 - val\_acc: 0.7517

Epoch 00017: val\_acc improved from 0.73575 to 0.75168, saving model to model\_v5  
accX\_LF-accY\_Wrist.hdf5  
Epoch 18/20  
19084/19084 [=====] - 29s 2ms/step - loss: 0.7470 - ac  
c: 0.7272 - val\_loss: 0.7222 - val\_acc: 0.7370

Epoch 00018: val\_acc did not improve from 0.75168  
Epoch 19/20  
19084/19084 [=====] - 29s 2ms/step - loss: 0.9005 - ac  
c: 0.6568 - val\_loss: 0.8534 - val\_acc: 0.6882

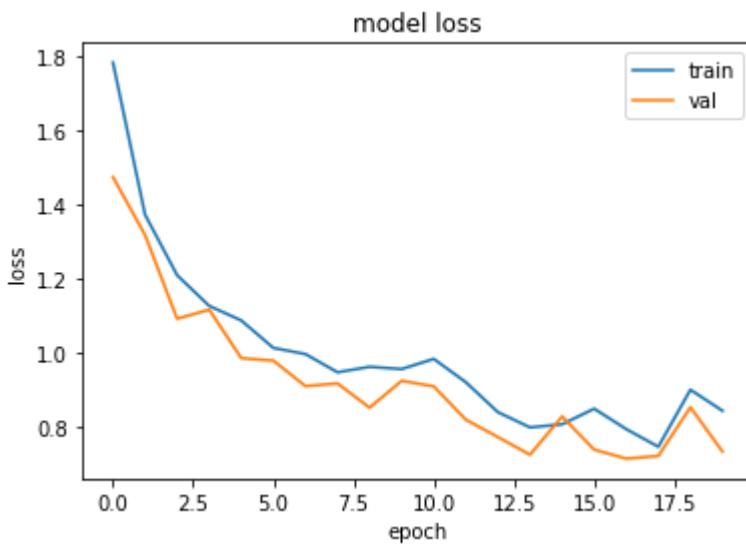
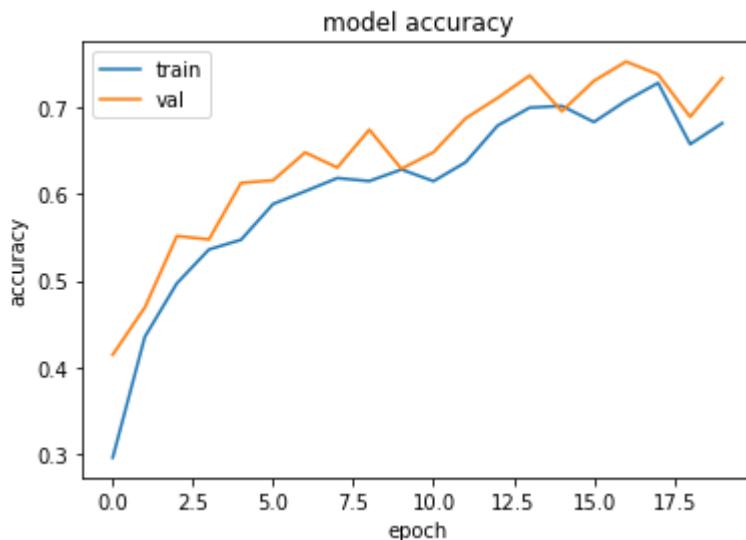
```
Epoch 00019: val_acc did not improve from 0.75168
```

```
Epoch 20/20
```

```
19084/19084 [=====] - 30s 2ms/step - loss: 0.8438 - ac
```

```
c: 0.6809 - val_loss: 0.7341 - val_acc: 0.7328
```

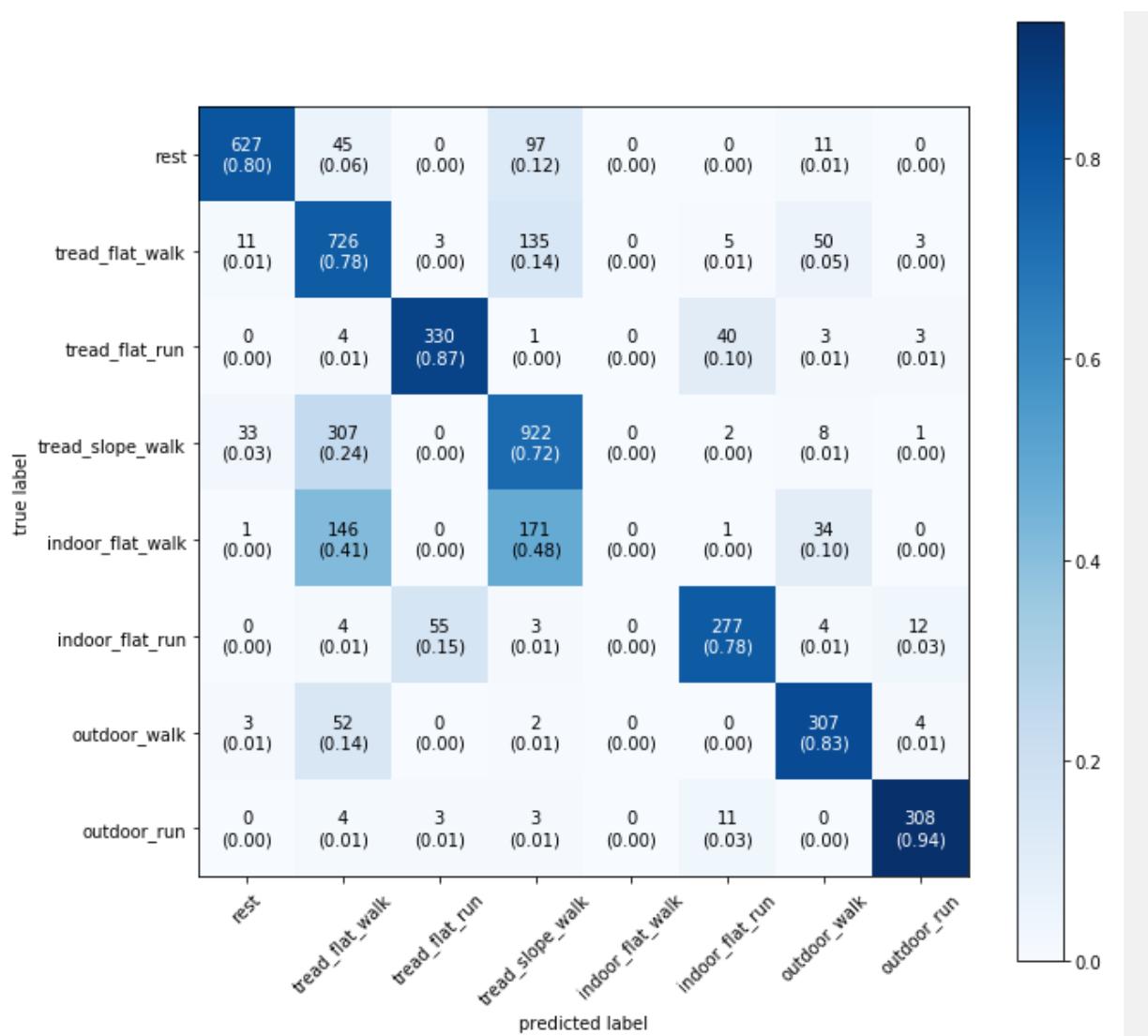
```
Epoch 00020: val_acc did not improve from 0.75168
```



Best accuracy (on validation dataset): 73.28%

```
[[627 45 0 97 0 0 11 0]
 [ 11 726 3 135 0 5 50 3]
 [ 0 4 330 1 0 40 3 3]
 [ 33 307 0 922 0 2 8 1]
 [ 1 146 0 171 0 1 34 0]
 [ 0 4 55 3 0 277 4 12]
 [ 3 52 0 2 0 0 307 4]
 [ 0 4 3 3 0 11 0 308]]
```

<Figure size 432x288 with 0 Axes>



### Classification Report:

	precision	recall	f1-score	support
rest	0.9289	0.8038	0.8619	780
tread_flat_walk	0.5637	0.7781	0.6538	933
tread_flat_run	0.8440	0.8661	0.8549	381
tread_slope_walk	0.6912	0.7243	0.7073	1273
indoor_flat_walk	0.0000	0.0000	0.0000	353
indoor_flat_run	0.8244	0.7803	0.8017	355
outdoor_walk	0.7362	0.8342	0.7822	368
outdoor_run	0.9305	0.9362	0.9333	329

accuracy		0.7328	4772
macro avg	0.6899	0.7154	0.6994
weighted avg	0.6961	0.7328	0.7099

Trying for these features ['accX\_LF', 'accZ\_Wrist']

(19084, 256, 2)

(19084, 8)

(4772, 256, 2)

(4772, 8)

256

2

8

Layer (type)	Output Shape	Param #
<hr/>		
input_28 (InputLayer)	(None, 256, 2)	0
lstm_27 (LSTM)	(None, 100)	41200
dropout_27 (Dropout)	(None, 100)	0
dense_54 (Dense)	(None, 100)	10100
dense_55 (Dense)	(None, 8)	808
<hr/>		
Total params:	52,108	
Trainable params:	52,108	
Non-trainable params:	0	

---

Train on 19084 samples, validate on 4772 samples

Epoch 1/20

19084/19084 [=====] - 33s 2ms/step - loss: 1.8861 - acc: 0.2696 - val\_loss: 1.6299 - val\_acc: 0.3554

Epoch 00001: val\_acc improved from -inf to 0.35541, saving model to model\_v5accX\_LF-accZ\_Wrist.hdf5

Epoch 2/20

19084/19084 [=====] - 29s 2ms/step - loss: 1.5278 - acc: 0.3767 - val\_loss: 1.3852 - val\_acc: 0.4407

Epoch 00002: val\_acc improved from 0.35541 to 0.44070, saving model to model\_v5accX\_LF-accZ\_Wrist.hdf5

Epoch 3/20

19084/19084 [=====] - 29s 2ms/step - loss: 1.3261 - acc: 0.4571 - val\_loss: 1.3584 - val\_acc: 0.4778

Epoch 00003: val\_acc improved from 0.44070 to 0.47779, saving model to model\_v5accX\_LF-accZ\_Wrist.hdf5

Epoch 4/20

19084/19084 [=====] - 29s 2ms/step - loss: 1.4668 - acc: 0.4220 - val\_loss: 1.3686 - val\_acc: 0.4577

Epoch 00004: val\_acc did not improve from 0.47779

Epoch 5/20

19084/19084 [=====] - 30s 2ms/step - loss: 1.2874 - acc: 0.4843 - val\_loss: 1.1950 - val\_acc: 0.5134

```
Epoch 00005: val_acc improved from 0.47779 to 0.51341, saving model to model_v5
accX_LF-accZ_Wrist.hdf5
Epoch 6/20
19084/19084 [=====] - 29s 2ms/step - loss: 1.1894 - ac
c: 0.5132 - val_loss: 1.1428 - val_acc: 0.5415

Epoch 00006: val_acc improved from 0.51341 to 0.54149, saving model to model_v5
accX_LF-accZ_Wrist.hdf5
Epoch 7/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.1320 - ac
c: 0.5362 - val_loss: 1.0876 - val_acc: 0.5622

Epoch 00007: val_acc improved from 0.54149 to 0.56224, saving model to model_v5
accX_LF-accZ_Wrist.hdf5
Epoch 8/20
19084/19084 [=====] - 29s 2ms/step - loss: 1.1010 - ac
c: 0.5485 - val_loss: 1.0718 - val_acc: 0.5780

Epoch 00008: val_acc improved from 0.56224 to 0.57795, saving model to model_v5
accX_LF-accZ_Wrist.hdf5
Epoch 9/20
19084/19084 [=====] - 29s 2ms/step - loss: 1.0514 - ac
c: 0.5841 - val_loss: 0.9885 - val_acc: 0.6174

Epoch 00009: val_acc improved from 0.57795 to 0.61735, saving model to model_v5
accX_LF-accZ_Wrist.hdf5
Epoch 10/20
19084/19084 [=====] - 29s 2ms/step - loss: 1.0020 - ac
c: 0.6040 - val_loss: 0.9369 - val_acc: 0.6333

Epoch 00010: val_acc improved from 0.61735 to 0.63328, saving model to model_v5
accX_LF-accZ_Wrist.hdf5
Epoch 11/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.9869 - ac
c: 0.6130 - val_loss: 0.9350 - val_acc: 0.6306

Epoch 00011: val_acc did not improve from 0.63328
Epoch 12/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.9704 - ac
c: 0.6240 - val_loss: 0.9165 - val_acc: 0.6559

Epoch 00012: val_acc improved from 0.63328 to 0.65591, saving model to model_v5
accX_LF-accZ_Wrist.hdf5
Epoch 13/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.9407 - ac
c: 0.6319 - val_loss: 0.9232 - val_acc: 0.6505

Epoch 00013: val_acc did not improve from 0.65591
Epoch 14/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.9247 - ac
c: 0.6396 - val_loss: 0.8650 - val_acc: 0.6653

Epoch 00014: val_acc improved from 0.65591 to 0.66534, saving model to model_v5
accX_LF-accZ_Wrist.hdf5
Epoch 15/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.9569 - ac
c: 0.6247 - val_loss: 0.8869 - val_acc: 0.6632
```

```
Epoch 00015: val_acc did not improve from 0.66534
Epoch 16/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.9005 - ac
c: 0.6495 - val_loss: 0.8639 - val_acc: 0.6681

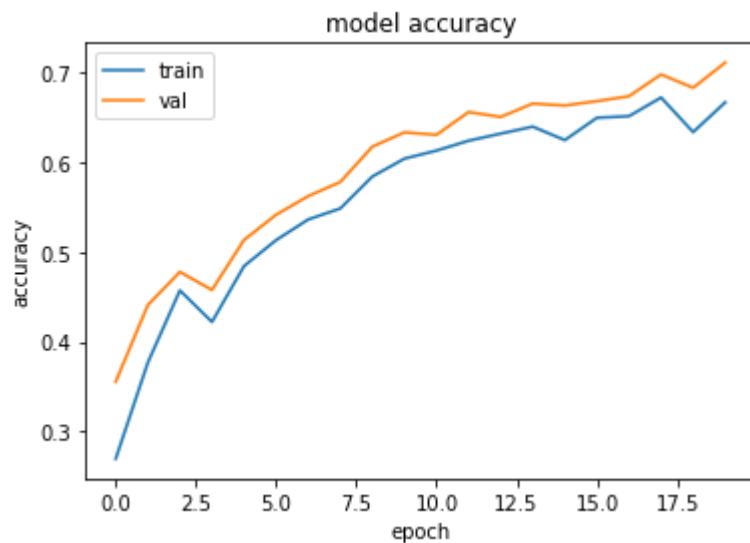
Epoch 00016: val_acc improved from 0.66534 to 0.66806, saving model to model_v5
accX_LF-accZ_Wrist.hdf5
Epoch 17/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.9107 - ac
c: 0.6513 - val_loss: 0.8679 - val_acc: 0.6735

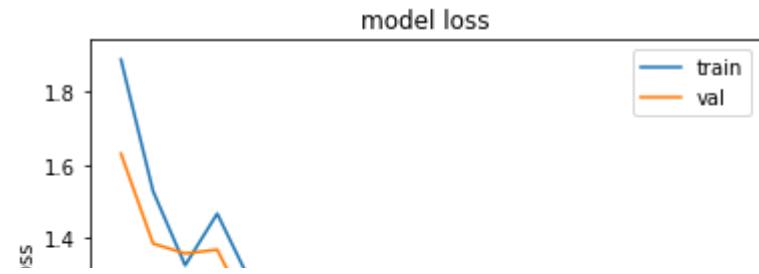
Epoch 00017: val_acc improved from 0.66806 to 0.67351, saving model to model_v5
accX_LF-accZ_Wrist.hdf5
Epoch 18/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.8605 - ac
c: 0.6721 - val_loss: 0.8185 - val_acc: 0.6978

Epoch 00018: val_acc improved from 0.67351 to 0.69782, saving model to model_v5
accX_LF-accZ_Wrist.hdf5
Epoch 19/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.9582 - ac
c: 0.6336 - val_loss: 0.8701 - val_acc: 0.6829

Epoch 00019: val_acc did not improve from 0.69782
Epoch 20/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.8833 - ac
c: 0.6667 - val_loss: 0.8080 - val_acc: 0.7110

Epoch 00020: val_acc improved from 0.69782 to 0.71102, saving model to model_v5
accX_LF-accZ_Wrist.hdf5
```

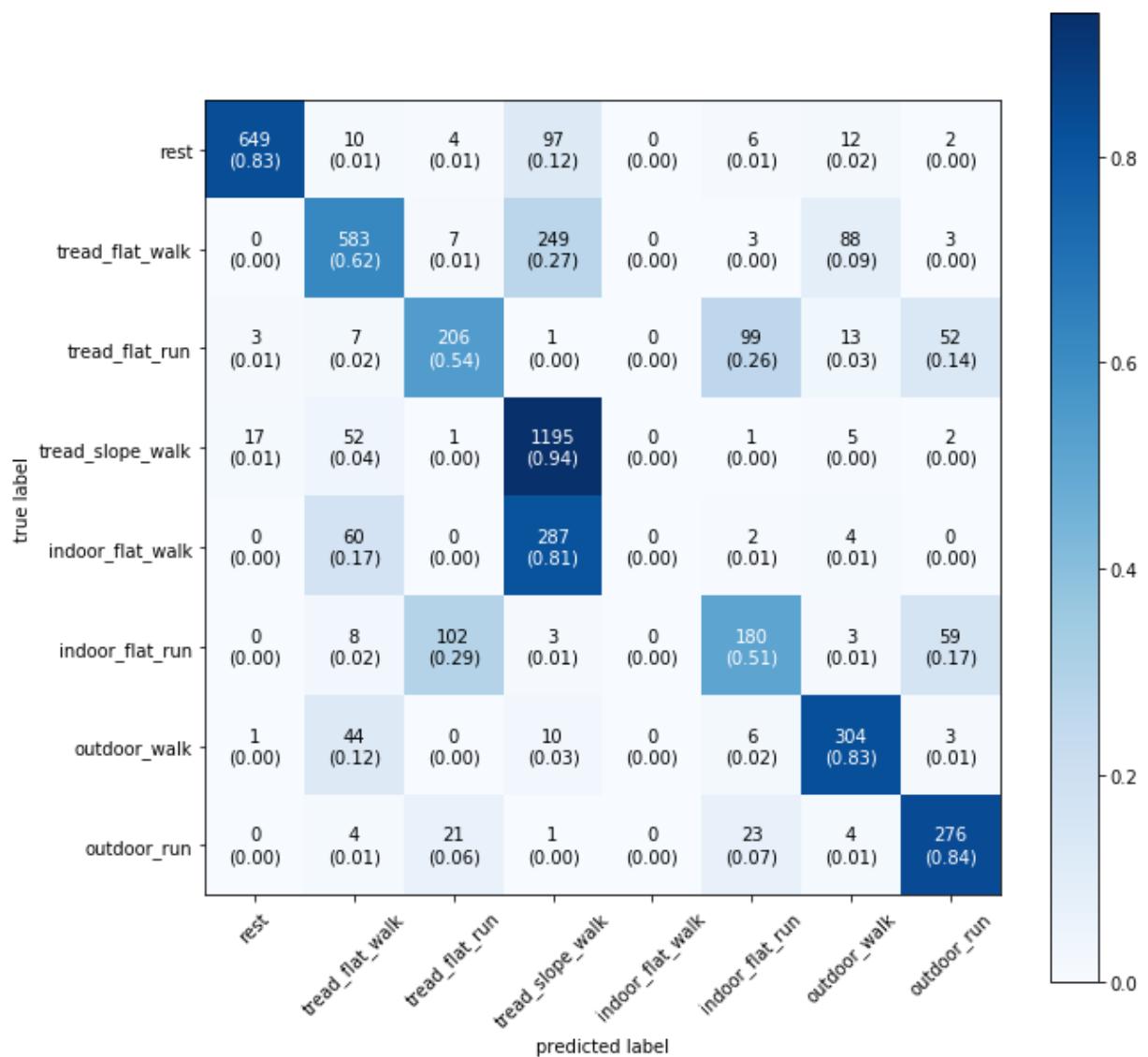




Best accuracy (on validation dataset): 71.10%

```
[[ 649   10    4   97    0    6   12    2]
 [  0   583    7  249    0    3   88    3]
 [  3    7  206    1    0   99   13   52]
 [ 17   52    1 1195    0    1    5   2]
 [  0   60    0  287    0    2    4   0]
 [  0    8 102    3    0  180    3   59]
 [  1   44    0   10    0    6  304    3]
 [  0    4   21    1    0   23    4  276]]
```

<Figure size 432x288 with 0 Axes>



## Classification Report:

	precision	recall	f1-score	support
rest	0.9687	0.8321	0.8952	780
tread_flat_walk	0.7591	0.6249	0.6855	933
tread_flat_run	0.6041	0.5407	0.5706	381
tread_slope_walk	0.6484	0.9387	0.7670	1273
indoor_flat_walk	0.0000	0.0000	0.0000	353
indoor_flat_run	0.5625	0.5070	0.5333	355
outdoor_walk	0.7021	0.8261	0.7591	368
outdoor_run	0.6952	0.8389	0.7603	329
accuracy			0.7110	4772
macro avg	0.6175	0.6385	0.6214	4772
weighted avg	0.6719	0.7110	0.6811	4772

Trying for these features ['accY\_LF', 'accZ\_LF']

(19084, 256, 2)

(19084, 8)

(4772, 256, 2)

(4772, 8)

256

2

8

Layer (type)	Output Shape	Param #
<hr/>		
input_29 (InputLayer)	(None, 256, 2)	0
lstm_28 (LSTM)	(None, 100)	41200
dropout_28 (Dropout)	(None, 100)	0
dense_56 (Dense)	(None, 100)	10100
dense_57 (Dense)	(None, 8)	808
<hr/>		

Total params: 52,108

Trainable params: 52,108

Non-trainable params: 0

---

Train on 19084 samples, validate on 4772 samples

Epoch 1/20

19084/19084 [=====] - 33s 2ms/step - loss: 1.8163 - acc: 0.3101 - val\_loss: 1.5787 - val\_acc: 0.3996

Epoch 00001: val\_acc improved from -inf to 0.39962, saving model to model\_v5accY\_LF-accZ\_LF.hdf5

Epoch 2/20

19084/19084 [=====] - 30s 2ms/step - loss: 1.3436 - acc: 0.4695 - val\_loss: 1.2173 - val\_acc: 0.4971

Epoch 00002: val\_acc improved from 0.39962 to 0.49707, saving model to model\_v5accY\_LF-accZ\_LF.hdf5

```
Epoch 3/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.1292 - ac
c: 0.5379 - val_loss: 1.0091 - val_acc: 0.6075

Epoch 00003: val_acc improved from 0.49707 to 0.60750, saving model to model_v5
accY_LF-accZ_LF.hdf5
Epoch 4/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.0560 - ac
c: 0.5655 - val_loss: 0.9708 - val_acc: 0.6276

Epoch 00004: val_acc improved from 0.60750 to 0.62762, saving model to model_v5
accY_LF-accZ_LF.hdf5
Epoch 5/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.9938 - ac
c: 0.5975 - val_loss: 0.9194 - val_acc: 0.6406

Epoch 00005: val_acc improved from 0.62762 to 0.64061, saving model to model_v5
accY_LF-accZ_LF.hdf5
Epoch 6/20
19084/19084 [=====] - 32s 2ms/step - loss: 0.9287 - ac
c: 0.6224 - val_loss: 0.8728 - val_acc: 0.6488

Epoch 00006: val_acc improved from 0.64061 to 0.64878, saving model to model_v5
accY_LF-accZ_LF.hdf5
Epoch 7/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.8676 - ac
c: 0.6505 - val_loss: 0.8035 - val_acc: 0.6928

Epoch 00007: val_acc improved from 0.64878 to 0.69279, saving model to model_v5
accY_LF-accZ_LF.hdf5
Epoch 8/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.8294 - ac
c: 0.6711 - val_loss: 0.7530 - val_acc: 0.7085

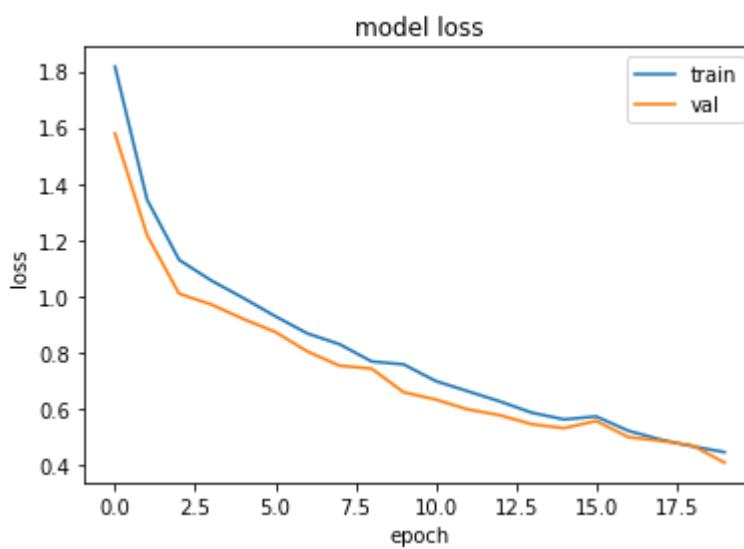
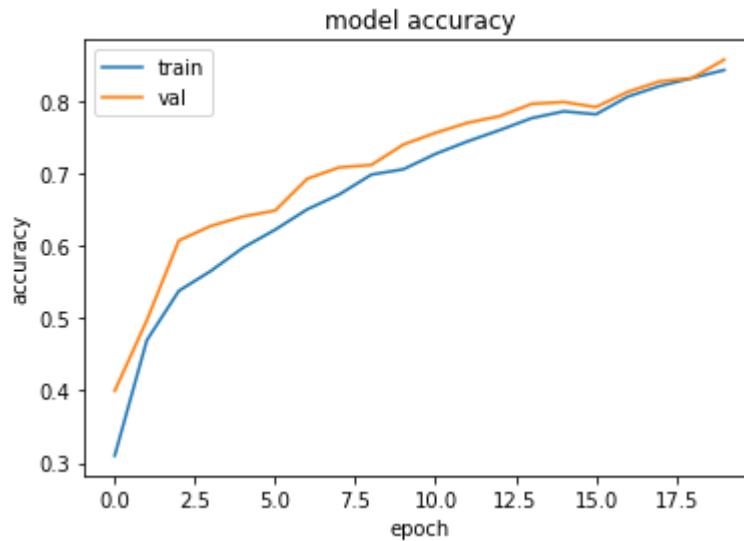
Epoch 00008: val_acc improved from 0.69279 to 0.70851, saving model to model_v5
accY_LF-accZ_LF.hdf5
Epoch 9/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.7683 - ac
c: 0.6985 - val_loss: 0.7426 - val_acc: 0.7119

Epoch 00009: val_acc improved from 0.70851 to 0.71186, saving model to model_v5
accY_LF-accZ_LF.hdf5
Epoch 10/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.7577 - ac
c: 0.7060 - val_loss: 0.6588 - val_acc: 0.7402

Epoch 00010: val_acc improved from 0.71186 to 0.74015, saving model to model_v5
accY_LF-accZ_LF.hdf5
Epoch 11/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.6984 - ac
c: 0.7272 - val_loss: 0.6327 - val_acc: 0.7563

Epoch 00011: val_acc improved from 0.74015 to 0.75629, saving model to model_v5
accY_LF-accZ_LF.hdf5
Epoch 12/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.6623 - ac
c: 0.7445 - val_loss: 0.5977 - val_acc: 0.7701
```

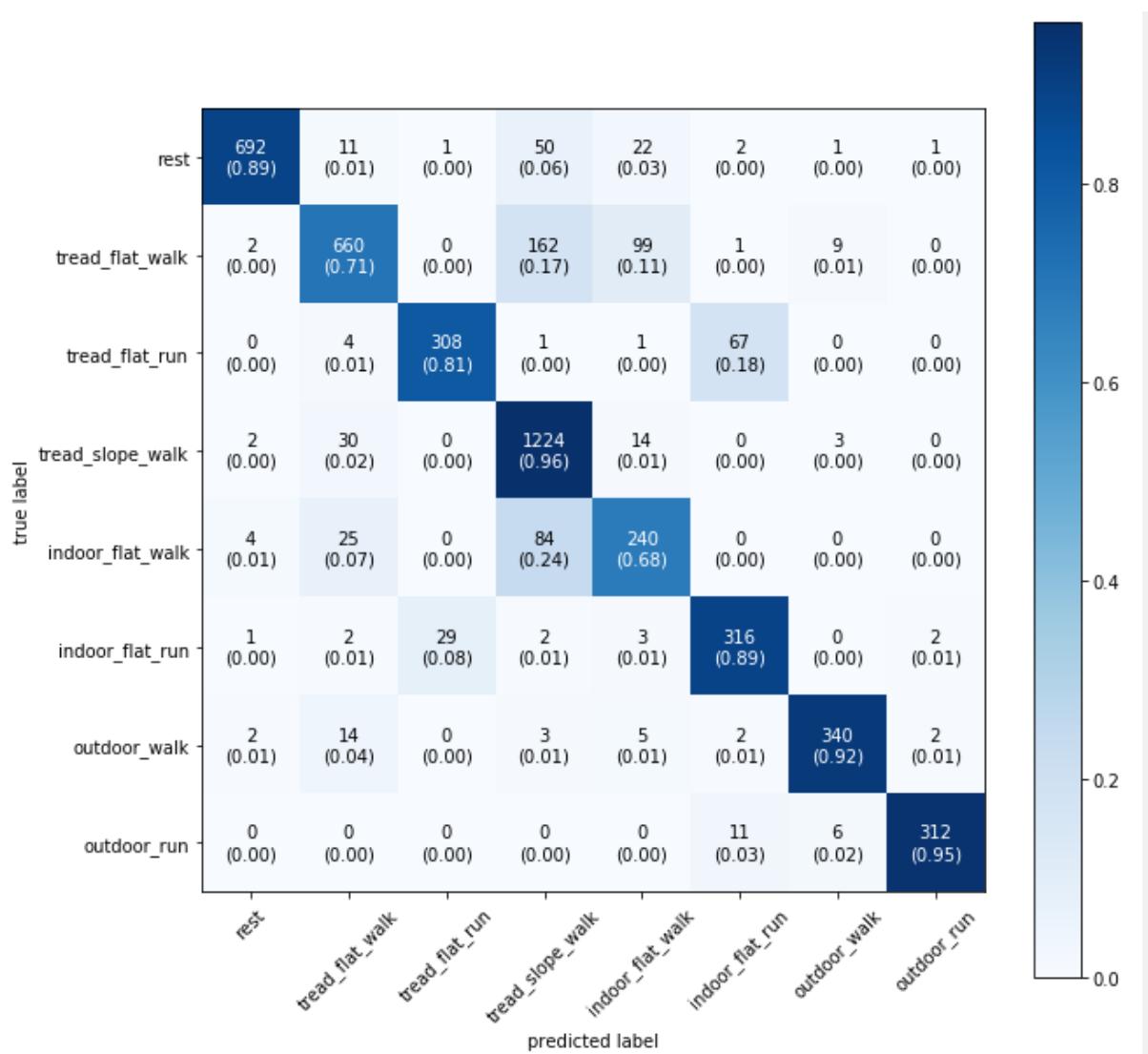
```
Epoch 00012: val_acc improved from 0.75629 to 0.77012, saving model to model_v5  
accY_LF-accZ_LF.hdf5  
Epoch 13/20  
19084/19084 [=====] - 30s 2ms/step - loss: 0.6261 - ac  
c: 0.7601 - val_loss: 0.5771 - val_acc: 0.7793  
  
Epoch 00013: val_acc improved from 0.77012 to 0.77934, saving model to model_v5  
accY_LF-accZ_LF.hdf5  
Epoch 14/20  
19084/19084 [=====] - 30s 2ms/step - loss: 0.5859 - ac  
c: 0.7766 - val_loss: 0.5448 - val_acc: 0.7963  
  
Epoch 00014: val_acc improved from 0.77934 to 0.79631, saving model to model_v5  
accY_LF-accZ_LF.hdf5  
Epoch 15/20  
19084/19084 [=====] - 29s 2ms/step - loss: 0.5622 - ac  
c: 0.7860 - val_loss: 0.5312 - val_acc: 0.7988  
  
Epoch 00015: val_acc improved from 0.79631 to 0.79883, saving model to model_v5  
accY_LF-accZ_LF.hdf5  
Epoch 16/20  
19084/19084 [=====] - 29s 2ms/step - loss: 0.5727 - ac  
c: 0.7819 - val_loss: 0.5567 - val_acc: 0.7919  
  
Epoch 00016: val_acc did not improve from 0.79883  
Epoch 17/20  
19084/19084 [=====] - 29s 2ms/step - loss: 0.5219 - ac  
c: 0.8065 - val_loss: 0.4994 - val_acc: 0.8131  
  
Epoch 00017: val_acc improved from 0.79883 to 0.81308, saving model to model_v5  
accY_LF-accZ_LF.hdf5  
Epoch 18/20  
19084/19084 [=====] - 30s 2ms/step - loss: 0.4906 - ac  
c: 0.8211 - val_loss: 0.4862 - val_acc: 0.8275  
  
Epoch 00018: val_acc improved from 0.81308 to 0.82754, saving model to model_v5  
accY_LF-accZ_LF.hdf5  
Epoch 19/20  
19084/19084 [=====] - 30s 2ms/step - loss: 0.4664 - ac  
c: 0.8320 - val_loss: 0.4696 - val_acc: 0.8319  
  
Epoch 00019: val_acc improved from 0.82754 to 0.83194, saving model to model_v5  
accY_LF-accZ_LF.hdf5  
Epoch 20/20  
19084/19084 [=====] - 30s 2ms/step - loss: 0.4459 - ac  
c: 0.8431 - val_loss: 0.4086 - val_acc: 0.8575  
  
Epoch 00020: val_acc improved from 0.83194 to 0.85750, saving model to model_v5  
accY_LF-accZ_LF.hdf5
```



Best accuracy (on validation dataset): 85.75%

```
[[ 692   11    1   50   22    2    1    1]
 [  2   660    0  162   99    1    9    0]
 [  0    4  308    1    1   67    0    0]
 [  2   30    0 1224   14    0    3    0]
 [  4   25    0   84  240    0    0    0]
 [  1    2   29    2    3   316    0    2]
 [  2   14    0    3    5    2   340    2]
 [  0    0    0    0    0   11    6  312]]
```

<Figure size 432x288 with 0 Axes>

**Classification Report:**

	precision	recall	f1-score	support
rest	0.9844	0.8872	0.9332	780
tread_flat_walk	0.8847	0.7074	0.7862	933
tread_flat_run	0.9112	0.8084	0.8567	381

tread_slope_walk	0.8021	0.9615	0.8746	1273
indoor_flat_walk	0.6250	0.6799	0.6513	353
indoor_flat_run	0.7920	0.8901	0.8382	355
outdoor_walk	0.9471	0.9239	0.9354	368
outdoor_run	0.9842	0.9483	0.9659	329
accuracy			0.8575	4772
macro avg	0.8663	0.8508	0.8552	4772
weighted avg	0.8666	0.8575	0.8572	4772

Trying for these features ['accY\_LF', 'accX\_Wrist']

(19084, 256, 2)

(19084, 8)

(4772, 256, 2)

(4772, 8)

256

2

8

Layer (type)	Output Shape	Param #
<hr/>		
input_30 (InputLayer)	(None, 256, 2)	0
lstm_29 (LSTM)	(None, 100)	41200
dropout_29 (Dropout)	(None, 100)	0
dense_58 (Dense)	(None, 100)	10100
dense_59 (Dense)	(None, 8)	808
<hr/>		

Total params: 52,108

Trainable params: 52,108

Non-trainable params: 0

---

Train on 19084 samples, validate on 4772 samples

Epoch 1/20

19084/19084 [=====] - 33s 2ms/step - loss: 1.6696 - acc: 0.3290 - val\_loss: 1.3618 - val\_acc: 0.4130

Epoch 00001: val\_acc improved from -inf to 0.41303, saving model to model\_v5accY\_LF-accX\_Wrist.hdf5

Epoch 2/20

19084/19084 [=====] - 29s 2ms/step - loss: 1.3895 - acc: 0.3919 - val\_loss: 1.3130 - val\_acc: 0.4405

Epoch 00002: val\_acc improved from 0.41303 to 0.44049, saving model to model\_v5accY\_LF-accX\_Wrist.hdf5

Epoch 3/20

19084/19084 [=====] - 29s 2ms/step - loss: 1.2269 - acc: 0.4669 - val\_loss: 1.1520 - val\_acc: 0.5084

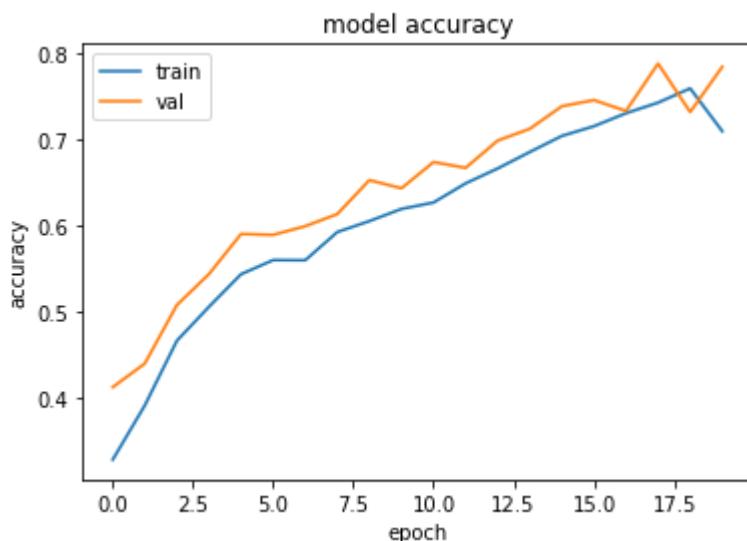
Epoch 00003: val\_acc improved from 0.44049 to 0.50838, saving model to model\_v5accY\_LF-accX\_Wrist.hdf5

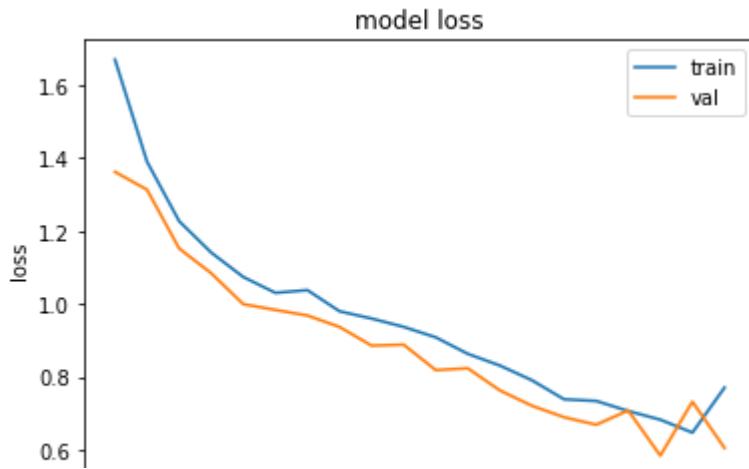
Epoch 4/20

19084/19084 [=====] - 30s 2ms/step - loss: 1.1407 - acc: 0.5063 - val\_loss: 1.0841 - val\_acc: 0.5442

```
Epoch 00004: val_acc improved from 0.50838 to 0.54422, saving model to model_v5  
accY_LF-accX_Wrist.hdf5  
Epoch 5/20  
19084/19084 [=====] - 30s 2ms/step - loss: 1.0737 - ac  
c: 0.5441 - val_loss: 0.9992 - val_acc: 0.5907  
  
Epoch 00005: val_acc improved from 0.54422 to 0.59074, saving model to model_v5  
accY_LF-accX_Wrist.hdf5  
Epoch 6/20  
19084/19084 [=====] - 30s 2ms/step - loss: 1.0303 - ac  
c: 0.5605 - val_loss: 0.9834 - val_acc: 0.5897  
  
Epoch 00006: val_acc did not improve from 0.59074  
Epoch 7/20  
19084/19084 [=====] - 30s 2ms/step - loss: 1.0376 - ac  
c: 0.5603 - val_loss: 0.9681 - val_acc: 0.5997  
  
Epoch 00007: val_acc improved from 0.59074 to 0.59975, saving model to model_v5  
accY_LF-accX_Wrist.hdf5  
Epoch 8/20  
19084/19084 [=====] - 29s 2ms/step - loss: 0.9797 - ac  
c: 0.5930 - val_loss: 0.9368 - val_acc: 0.6138  
  
Epoch 00008: val_acc improved from 0.59975 to 0.61379, saving model to model_v5  
accY_LF-accX_Wrist.hdf5  
Epoch 9/20  
19084/19084 [=====] - 29s 2ms/step - loss: 0.9598 - ac  
c: 0.6057 - val_loss: 0.8855 - val_acc: 0.6532  
  
Epoch 00009: val_acc improved from 0.61379 to 0.65319, saving model to model_v5  
accY_LF-accX_Wrist.hdf5  
Epoch 10/20  
19084/19084 [=====] - 29s 2ms/step - loss: 0.9369 - ac  
c: 0.6198 - val_loss: 0.8883 - val_acc: 0.6438  
  
Epoch 00010: val_acc did not improve from 0.65319  
Epoch 11/20  
19084/19084 [=====] - 29s 2ms/step - loss: 0.9083 - ac  
c: 0.6272 - val_loss: 0.8184 - val_acc: 0.6741  
  
Epoch 00011: val_acc improved from 0.65319 to 0.67414, saving model to model_v5  
accY_LF-accX_Wrist.hdf5  
Epoch 12/20  
19084/19084 [=====] - 30s 2ms/step - loss: 0.8630 - ac  
c: 0.6494 - val_loss: 0.8234 - val_acc: 0.6674  
  
Epoch 00012: val_acc did not improve from 0.67414  
Epoch 13/20  
19084/19084 [=====] - 29s 2ms/step - loss: 0.8309 - ac  
c: 0.6667 - val_loss: 0.7627 - val_acc: 0.6991  
  
Epoch 00013: val_acc improved from 0.67414 to 0.69908, saving model to model_v5  
accY_LF-accX_Wrist.hdf5  
Epoch 14/20  
19084/19084 [=====] - 29s 2ms/step - loss: 0.7905 - ac  
c: 0.6858 - val_loss: 0.7206 - val_acc: 0.7127
```

```
Epoch 00014: val_acc improved from 0.69908 to 0.71270, saving model to model_v5  
accY_LF-accX_Wrist.hdf5  
Epoch 15/20  
19084/19084 [=====] - 30s 2ms/step - loss: 0.7384 - ac  
c: 0.7045 - val_loss: 0.6893 - val_acc: 0.7389  
  
Epoch 00015: val_acc improved from 0.71270 to 0.73889, saving model to model_v5  
accY_LF-accX_Wrist.hdf5  
Epoch 16/20  
19084/19084 [=====] - 29s 2ms/step - loss: 0.7339 - ac  
c: 0.7157 - val_loss: 0.6686 - val_acc: 0.7460  
  
Epoch 00016: val_acc improved from 0.73889 to 0.74602, saving model to model_v5  
accY_LF-accX_Wrist.hdf5  
Epoch 17/20  
19084/19084 [=====] - 29s 2ms/step - loss: 0.7063 - ac  
c: 0.7308 - val_loss: 0.7079 - val_acc: 0.7334  
  
Epoch 00017: val_acc did not improve from 0.74602  
Epoch 18/20  
19084/19084 [=====] - 29s 2ms/step - loss: 0.6825 - ac  
c: 0.7431 - val_loss: 0.5840 - val_acc: 0.7883  
  
Epoch 00018: val_acc improved from 0.74602 to 0.78835, saving model to model_v5  
accY_LF-accX_Wrist.hdf5  
Epoch 19/20  
19084/19084 [=====] - 30s 2ms/step - loss: 0.6471 - ac  
c: 0.7596 - val_loss: 0.7318 - val_acc: 0.7322  
  
Epoch 00019: val_acc did not improve from 0.78835  
Epoch 20/20  
19084/19084 [=====] - 29s 2ms/step - loss: 0.7704 - ac  
c: 0.7100 - val_loss: 0.6052 - val_acc: 0.7846  
  
Epoch 00020: val_acc did not improve from 0.78835
```





Best accuracy (on validation dataset): 78.46%

```
[[ 678   20     0    74     1     2     4     1]
 [   8   600     6   201     5     0   111     2]
 [   1     2   287     1     0    81     1     8]
 [  13    45     0  1176    33     0     6     0]
 [   3    30     0   222    73     0    24     1]
 [   2     3    18     1     0   311     2   18]
 [   1    35     0    12     1     0   319     0]
 [   0     7     0     2     0    15     5  300]]
```

<Figure size 432x288 with 0 Axes>

## Classification Report:

	precision	recall	f1-score	support
rest	0.9603	0.8692	0.9125	780
tread_flat_walk	0.8086	0.6431	0.7164	933
tread_flat_run	0.9228	0.7533	0.8295	381
tread_slope_walk	0.6963	0.9238	0.7941	1273
indoor_flat_walk	0.6460	0.2068	0.3133	353
indoor_flat_run	0.7604	0.8761	0.8141	355
outdoor_walk	0.6758	0.8668	0.7595	368
outdoor_run	0.9091	0.9119	0.9105	329
accuracy			0.7846	4772
macro avg	0.7974	0.7564	0.7562	4772
weighted avg	0.7936	0.7846	0.7724	4772

Trying for these features ['accY\_LF', 'accY\_Wrist']

(19084, 256, 2)

(19084, 8)

(4772, 256, 2)

(4772, 8)

256

2

8

Layer (type)	Output Shape	Param #
<hr/>		
input_31 (InputLayer)	(None, 256, 2)	0
lstm_30 (LSTM)	(None, 100)	41200
dropout_30 (Dropout)	(None, 100)	0
dense_60 (Dense)	(None, 100)	10100
dense_61 (Dense)	(None, 8)	808
<hr/>		

Total params: 52,108

Trainable params: 52,108

Non-trainable params: 0

---

Train on 19084 samples, validate on 4772 samples

Epoch 1/20

19084/19084 [=====] - 33s 2ms/step - loss: 1.7719 - acc: 0.3012 - val\_loss: 1.4860 - val\_acc: 0.4086

Epoch 00001: val\_acc improved from -inf to 0.40863, saving model to model\_v5accY\_LF-accY\_Wrist.hdf5

Epoch 2/20

19084/19084 [=====] - 29s 2ms/step - loss: 1.3425 - acc: 0.4364 - val\_loss: 1.1983 - val\_acc: 0.4851

Epoch 00002: val\_acc improved from 0.40863 to 0.48512, saving model to model\_v5accY\_LF-accY\_Wrist.hdf5

Epoch 3/20

19084/19084 [=====] - 30s 2ms/step - loss: 1.2163 - acc:

c: 0.4811 - val\_loss: 1.1042 - val\_acc: 0.5323

Epoch 00003: val\_acc improved from 0.48512 to 0.53227, saving model to model\_v5  
accY\_LF-accY\_Wrist.hdf5  
Epoch 4/20  
19084/19084 [=====] - 30s 2ms/step - loss: 1.1188 - ac  
c: 0.5219 - val\_loss: 1.0519 - val\_acc: 0.5555

Epoch 00004: val\_acc improved from 0.53227 to 0.55553, saving model to model\_v5  
accY\_LF-accY\_Wrist.hdf5  
Epoch 5/20  
19084/19084 [=====] - 29s 2ms/step - loss: 1.0720 - ac  
c: 0.5493 - val\_loss: 0.9976 - val\_acc: 0.5870

Epoch 00005: val\_acc improved from 0.55553 to 0.58697, saving model to model\_v5  
accY\_LF-accY\_Wrist.hdf5  
Epoch 6/20  
19084/19084 [=====] - 30s 2ms/step - loss: 1.0395 - ac  
c: 0.5609 - val\_loss: 0.9693 - val\_acc: 0.5914

Epoch 00006: val\_acc improved from 0.58697 to 0.59137, saving model to model\_v5  
accY\_LF-accY\_Wrist.hdf5  
Epoch 7/20  
19084/19084 [=====] - 29s 2ms/step - loss: 0.9875 - ac  
c: 0.6017 - val\_loss: 0.8910 - val\_acc: 0.6542

Epoch 00007: val\_acc improved from 0.59137 to 0.65423, saving model to model\_v5  
accY\_LF-accY\_Wrist.hdf5  
Epoch 8/20  
19084/19084 [=====] - 30s 2ms/step - loss: 0.9160 - ac  
c: 0.6451 - val\_loss: 0.8513 - val\_acc: 0.6808

Epoch 00008: val\_acc improved from 0.65423 to 0.68085, saving model to model\_v5  
accY\_LF-accY\_Wrist.hdf5  
Epoch 9/20  
19084/19084 [=====] - 30s 2ms/step - loss: 0.9241 - ac  
c: 0.6591 - val\_loss: 0.7745 - val\_acc: 0.7146

Epoch 00009: val\_acc improved from 0.68085 to 0.71459, saving model to model\_v5  
accY\_LF-accY\_Wrist.hdf5  
Epoch 10/20  
19084/19084 [=====] - 30s 2ms/step - loss: 0.7950 - ac  
c: 0.7156 - val\_loss: 0.7392 - val\_acc: 0.7427

Epoch 00010: val\_acc improved from 0.71459 to 0.74267, saving model to model\_v5  
accY\_LF-accY\_Wrist.hdf5  
Epoch 11/20  
19084/19084 [=====] - 30s 2ms/step - loss: 0.7657 - ac  
c: 0.7291 - val\_loss: 0.7170 - val\_acc: 0.7481

Epoch 00011: val\_acc improved from 0.74267 to 0.74811, saving model to model\_v5  
accY\_LF-accY\_Wrist.hdf5  
Epoch 12/20  
19084/19084 [=====] - 30s 2ms/step - loss: 0.7408 - ac  
c: 0.7456 - val\_loss: 0.6248 - val\_acc: 0.7917

Epoch 00012: val\_acc improved from 0.74811 to 0.79170, saving model to model\_v5

```
accY_LF-accY_Wrist.hdf5
Epoch 13/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.6654 - ac
c: 0.7753 - val_loss: 0.6180 - val_acc: 0.7900

Epoch 00013: val_acc did not improve from 0.79170
Epoch 14/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.6882 - ac
c: 0.7683 - val_loss: 0.6332 - val_acc: 0.7802

Epoch 00014: val_acc did not improve from 0.79170
Epoch 15/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.6885 - ac
c: 0.7633 - val_loss: 0.5914 - val_acc: 0.7986

Epoch 00015: val_acc improved from 0.79170 to 0.79862, saving model to model_v5
accY_LF-accY_Wrist.hdf5
Epoch 16/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.6235 - ac
c: 0.7886 - val_loss: 0.6127 - val_acc: 0.7867

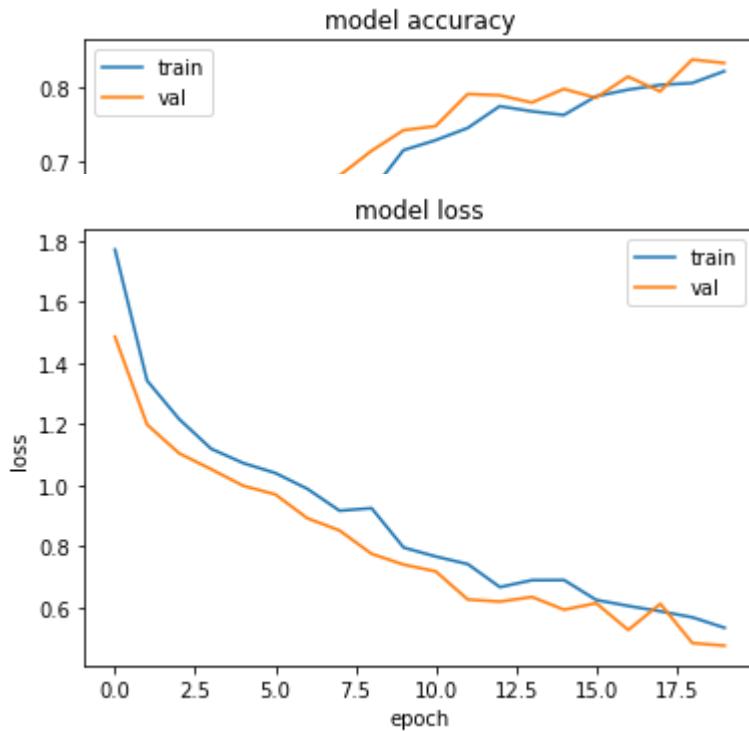
Epoch 00016: val_acc did not improve from 0.79862
Epoch 17/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.6037 - ac
c: 0.7976 - val_loss: 0.5250 - val_acc: 0.8154

Epoch 00017: val_acc improved from 0.79862 to 0.81538, saving model to model_v5
accY_LF-accY_Wrist.hdf5
Epoch 18/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.5862 - ac
c: 0.8041 - val_loss: 0.6107 - val_acc: 0.7953

Epoch 00018: val_acc did not improve from 0.81538
Epoch 19/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.5664 - ac
c: 0.8066 - val_loss: 0.4819 - val_acc: 0.8384

Epoch 00019: val_acc improved from 0.81538 to 0.83843, saving model to model_v5
accY_LF-accY_Wrist.hdf5
Epoch 20/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.5321 - ac
c: 0.8227 - val_loss: 0.4735 - val_acc: 0.8338

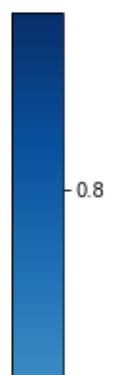
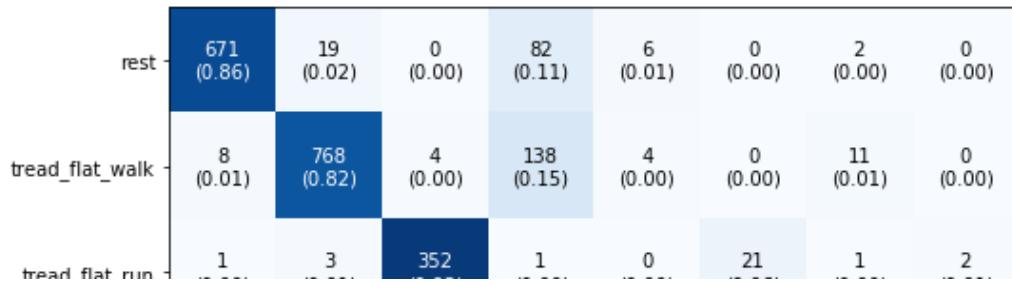
Epoch 00020: val_acc did not improve from 0.83843
```



Best accuracy (on validation dataset): 83.38%

```
[[ 671   19    0   82     6    0    2    0]
 [  8  768    4  138     4    0   11    0]
 [  1    3  352    1    0   21    1    2]
 [ 19   75    0 1164    13    0    2    0]
 [  0  186    0  101    47    1   18    0]
 [  0    6    5    2    0  318    0   24]
 [  1   18    0    3    3    0  342    1]
 [  0    4    2    2    0    2    2  317]]
```

<Figure size 432x288 with 0 Axes>



## Classification Report:

	precision	recall	f1-score	support
rest	0.9586	0.8603	0.9068	780
tread_flat_walk	0.7118	0.8232	0.7634	933
tread_flat_run	0.9697	0.9239	0.9462	381
tread_slope_walk	0.7796	0.9144	0.8416	1273
indoor_flat_walk	0.6438	0.1331	0.2207	353
indoor_flat_run	0.9298	0.8958	0.9125	355
outdoor_walk	0.9048	0.9293	0.9169	368
outdoor_run	0.9215	0.9635	0.9421	329
accuracy			0.8338	4772
macro avg	0.8525	0.8054	0.8063	4772
weighted avg	0.8313	0.8338	0.8174	4772

Trying for these features ['accY\_LF', 'accZ\_Wrist']

(19084, 256, 2)

(19084, 8)

(4772, 256, 2)

(4772, 8)

256

2

8

Layer (type)	Output Shape	Param #
<hr/>		
input_32 (InputLayer)	(None, 256, 2)	0
lstm_31 (LSTM)	(None, 100)	41200
dropout_31 (Dropout)	(None, 100)	0
dense_62 (Dense)	(None, 100)	10100
dense_63 (Dense)	(None, 8)	808
<hr/>		

Total params: 52,108

Trainable params: 52,108

Non-trainable params: 0

---

Train on 19084 samples, validate on 4772 samples

Epoch 1/20

19084/19084 [=====] - 35s 2ms/step - loss: 1.7831 - ac  
c: 0.3072 - val\_loss: 1.4207 - val\_acc: 0.4325

```
Epoch 00001: val_acc improved from -inf to 0.43252, saving model to model_v5accY_LF-accZ_Wrist.hdf5
Epoch 2/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.2900 - acc: 0.4777 - val_loss: 1.1499 - val_acc: 0.5457

Epoch 00002: val_acc improved from 0.43252 to 0.54568, saving model to model_v5accY_LF-accZ_Wrist.hdf5
Epoch 3/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.1662 - acc: 0.5223 - val_loss: 1.1679 - val_acc: 0.5111

Epoch 00003: val_acc did not improve from 0.54568
Epoch 4/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.1402 - acc: 0.5352 - val_loss: 1.0460 - val_acc: 0.5926

Epoch 00004: val_acc improved from 0.54568 to 0.59262, saving model to model_v5accY_LF-accZ_Wrist.hdf5
Epoch 5/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.1081 - acc: 0.5504 - val_loss: 1.1170 - val_acc: 0.5635

Epoch 00005: val_acc did not improve from 0.59262
Epoch 6/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.0905 - acc: 0.5741 - val_loss: 1.1009 - val_acc: 0.5786

Epoch 00006: val_acc did not improve from 0.59262
Epoch 7/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.0315 - acc: 0.5974 - val_loss: 0.9120 - val_acc: 0.6555

Epoch 00007: val_acc improved from 0.59262 to 0.65549, saving model to model_v5accY_LF-accZ_Wrist.hdf5
Epoch 8/20
19084/19084 [=====] - 32s 2ms/step - loss: 1.0382 - acc: 0.5963 - val_loss: 1.0502 - val_acc: 0.5849

Epoch 00008: val_acc did not improve from 0.65549
Epoch 9/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.9908 - acc: 0.6117 - val_loss: 0.8671 - val_acc: 0.6681

Epoch 00009: val_acc improved from 0.65549 to 0.66806, saving model to model_v5accY_LF-accZ_Wrist.hdf5
Epoch 10/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.9233 - acc: 0.6421 - val_loss: 0.8581 - val_acc: 0.6708

Epoch 00010: val_acc improved from 0.66806 to 0.67079, saving model to model_v5accY_LF-accZ_Wrist.hdf5
Epoch 11/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.9116 - acc: 0.6459 - val_loss: 0.8613 - val_acc: 0.6746

Epoch 00011: val_acc improved from 0.67079 to 0.67456, saving model to model_v5
```

```
accY_LF-accZ_Wrist.hdf5
Epoch 12/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.8787 - ac
c: 0.6694 - val_loss: 0.8096 - val_acc: 0.6968

Epoch 00012: val_acc improved from 0.67456 to 0.69677, saving model to model_v5
accY_LF-accZ_Wrist.hdf5
Epoch 13/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.8331 - ac
c: 0.6885 - val_loss: 0.7919 - val_acc: 0.7083

Epoch 00013: val_acc improved from 0.69677 to 0.70830, saving model to model_v5
accY_LF-accZ_Wrist.hdf5
Epoch 14/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.8171 - ac
c: 0.6984 - val_loss: 0.7797 - val_acc: 0.7085

Epoch 00014: val_acc improved from 0.70830 to 0.70851, saving model to model_v5
accY_LF-accZ_Wrist.hdf5
Epoch 15/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.7787 - ac
c: 0.7149 - val_loss: 0.7267 - val_acc: 0.7360

Epoch 00015: val_acc improved from 0.70851 to 0.73596, saving model to model_v5
accY_LF-accZ_Wrist.hdf5
Epoch 16/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.7270 - ac
c: 0.7409 - val_loss: 0.6948 - val_acc: 0.7483

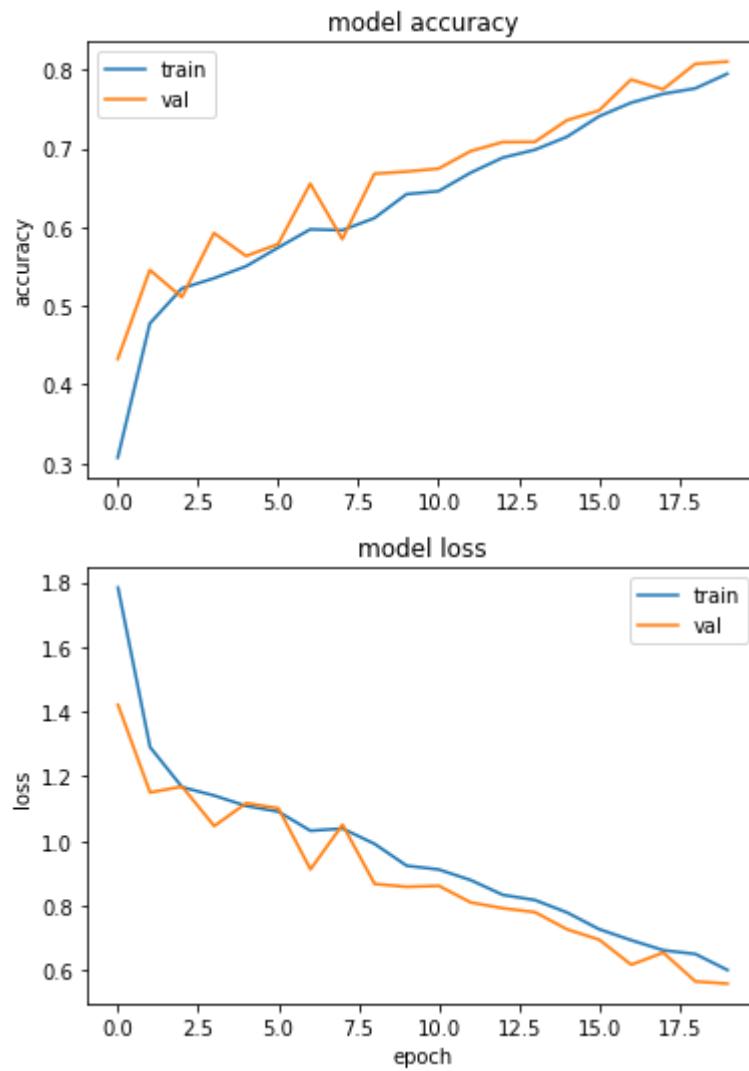
Epoch 00016: val_acc improved from 0.73596 to 0.74832, saving model to model_v5
accY_LF-accZ_Wrist.hdf5
Epoch 17/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.6931 - ac
c: 0.7583 - val_loss: 0.6174 - val_acc: 0.7877

Epoch 00017: val_acc improved from 0.74832 to 0.78772, saving model to model_v5
accY_LF-accZ_Wrist.hdf5
Epoch 18/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.6620 - ac
c: 0.7696 - val_loss: 0.6547 - val_acc: 0.7754

Epoch 00018: val_acc did not improve from 0.78772
Epoch 19/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.6504 - ac
c: 0.7765 - val_loss: 0.5655 - val_acc: 0.8076

Epoch 00019: val_acc improved from 0.78772 to 0.80763, saving model to model_v5
accY_LF-accZ_Wrist.hdf5
Epoch 20/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.6008 - ac
c: 0.7951 - val_loss: 0.5588 - val_acc: 0.8106

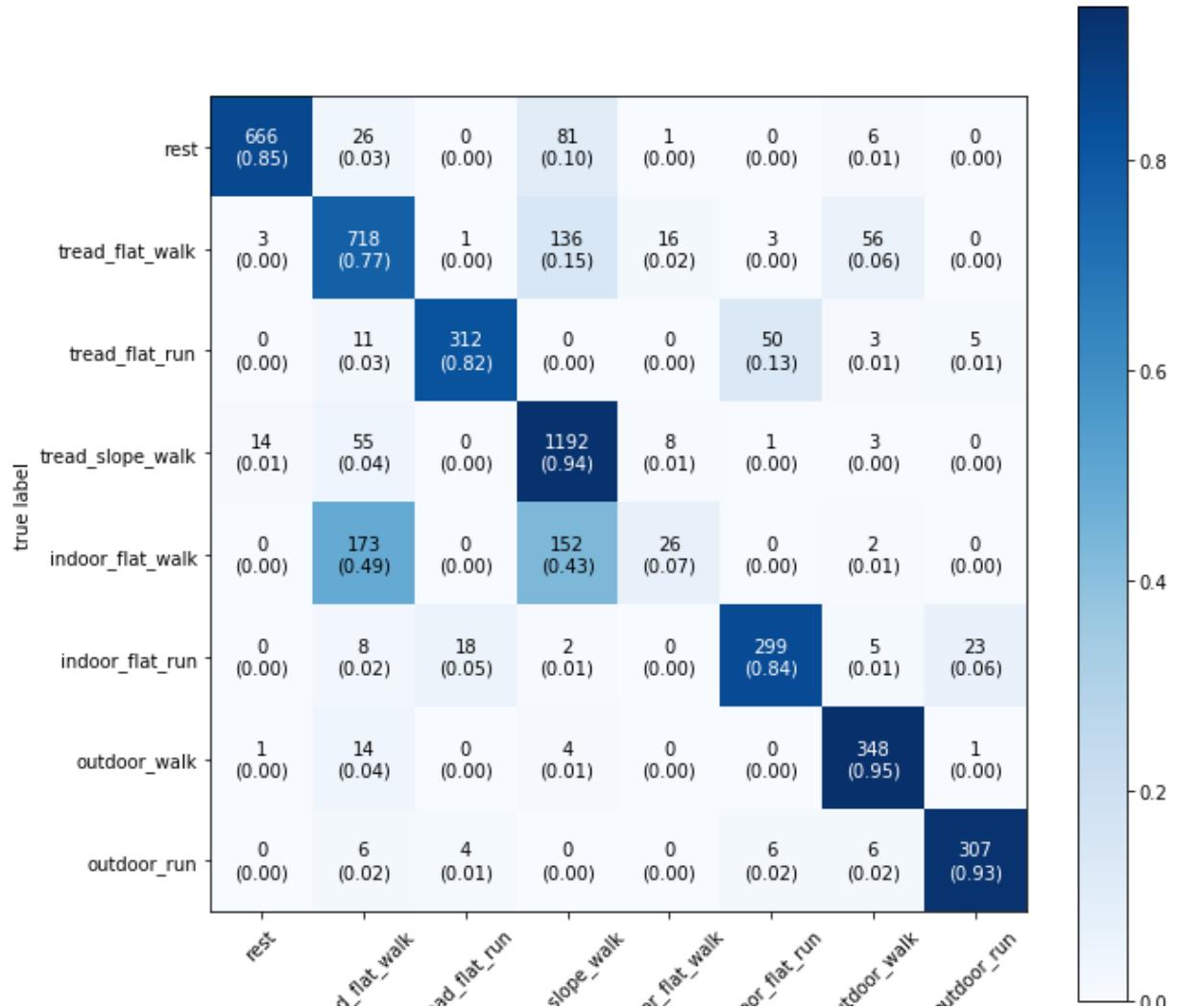
Epoch 00020: val_acc improved from 0.80763 to 0.81056, saving model to model_v5
accY_LF-accZ_Wrist.hdf5
```



Best accuracy (on validation dataset): 81.06%

```
[[ 666   26     0    81     1     0     6     0]
 [  3   718     1   136    16     3    56     0]
 [  0    11   312     0     0    50     3     5]
 [ 14    55     0  1192     8     1     3     0]
 [  0   173     0   152    26     0     2     0]
 [  0     8    18     2     0   299     5   23]
 [  1    14     0     4     0     0   348     1]
 [  0     6     4     0     0     6     6  307]]
```

<Figure size 432x288 with 0 Axes>



## Classification Report:

	precision	recall	f1-score	support
rest	0.9737	0.8538	0.9098	780
tread_flat_walk	0.7102	0.7696	0.7387	933
tread_flat_run	0.9313	0.8189	0.8715	381
tread_slope_walk	0.7607	0.9364	0.8394	1273
indoor_flat_walk	0.5098	0.0737	0.1287	353
indoor_flat_run	0.8329	0.8423	0.8375	355
outdoor_walk	0.8112	0.9457	0.8733	368
outdoor_run	0.9137	0.9331	0.9233	329
accuracy			0.8106	4772
macro avg	0.8054	0.7717	0.7653	4772
weighted avg	0.8005	0.8106	0.7895	4772

Trying for these features ['accZ\_LF', 'accX\_Wrist']

(19084, 256, 2)

(19084, 8)

(4772, 256, 2)

(4772, 8)

256

2

8

Layer (type)	Output Shape	Param #
--------------	--------------	---------

input_33 (InputLayer)	(None, 256, 2)	0
lstm_32 (LSTM)	(None, 100)	41200
dropout_32 (Dropout)	(None, 100)	0
dense_64 (Dense)	(None, 100)	10100
dense_65 (Dense)	(None, 8)	808
<hr/>		
Total params:	52,108	
Trainable params:	52,108	
Non-trainable params:	0	

---

Train on 19084 samples, validate on 4772 samples

Epoch 1/20

19084/19084 [=====] - 34s 2ms/step - loss: 1.6712 - acc: 0.3274 - val\_loss: 1.3742 - val\_acc: 0.4130

Epoch 00001: val\_acc improved from -inf to 0.41303, saving model to model\_v5accZ\_LF-accX\_Wrist.hdf5

Epoch 2/20

19084/19084 [=====] - 29s 2ms/step - loss: 1.3925 - acc: 0.4044 - val\_loss: 1.3212 - val\_acc: 0.4432

Epoch 00002: val\_acc improved from 0.41303 to 0.44321, saving model to model\_v5accZ\_LF-accX\_Wrist.hdf5

Epoch 3/20

19084/19084 [=====] - 29s 2ms/step - loss: 1.3101 - acc: 0.4403 - val\_loss: 1.2978 - val\_acc: 0.4663

Epoch 00003: val\_acc improved from 0.44321 to 0.46626, saving model to model\_v5accZ\_LF-accX\_Wrist.hdf5

Epoch 4/20

19084/19084 [=====] - 29s 2ms/step - loss: 1.2478 - acc: 0.4657 - val\_loss: 1.1838 - val\_acc: 0.4855

Epoch 00004: val\_acc improved from 0.46626 to 0.48554, saving model to model\_v5accZ\_LF-accX\_Wrist.hdf5

Epoch 5/20

19084/19084 [=====] - 30s 2ms/step - loss: 1.1888 - acc: 0.4896 - val\_loss: 1.1449 - val\_acc: 0.5132

Epoch 00005: val\_acc improved from 0.48554 to 0.51320, saving model to model\_v5accZ\_LF-accX\_Wrist.hdf5

Epoch 6/20

19084/19084 [=====] - 29s 2ms/step - loss: 1.1704 - acc: 0.4991 - val\_loss: 1.1274 - val\_acc: 0.5174

Epoch 00006: val\_acc improved from 0.51320 to 0.51739, saving model to model\_v5accZ\_LF-accX\_Wrist.hdf5

Epoch 7/20

19084/19084 [=====] - 29s 2ms/step - loss: 1.1248 - acc: 0.5164 - val\_loss: 1.0916 - val\_acc: 0.5419

Epoch 00007: val\_acc improved from 0.51739 to 0.54191, saving model to model\_v5

```
accZ_LF-accX_Wrist.hdf5
Epoch 8/20
19084/19084 [=====] - 29s 2ms/step - loss: 1.1216 - ac
c: 0.5238 - val_loss: 1.0366 - val_acc: 0.5773

Epoch 00008: val_acc improved from 0.54191 to 0.57733, saving model to model_v5
accZ_LF-accX_Wrist.hdf5
Epoch 9/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.0566 - ac
c: 0.5589 - val_loss: 1.0305 - val_acc: 0.5759

Epoch 00009: val_acc did not improve from 0.57733
Epoch 10/20
19084/19084 [=====] - 29s 2ms/step - loss: 1.0212 - ac
c: 0.5875 - val_loss: 1.0671 - val_acc: 0.5780

Epoch 00010: val_acc improved from 0.57733 to 0.57795, saving model to model_v5
accZ_LF-accX_Wrist.hdf5
Epoch 11/20
19084/19084 [=====] - 29s 2ms/step - loss: 1.0008 - ac
c: 0.5895 - val_loss: 0.9157 - val_acc: 0.6333

Epoch 00011: val_acc improved from 0.57795 to 0.63328, saving model to model_v5
accZ_LF-accX_Wrist.hdf5
Epoch 12/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.9301 - ac
c: 0.6230 - val_loss: 0.8491 - val_acc: 0.6731

Epoch 00012: val_acc improved from 0.63328 to 0.67309, saving model to model_v5
accZ_LF-accX_Wrist.hdf5
Epoch 13/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.8992 - ac
c: 0.6426 - val_loss: 0.8408 - val_acc: 0.6655

Epoch 00013: val_acc did not improve from 0.67309
Epoch 14/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.9001 - ac
c: 0.6450 - val_loss: 0.8406 - val_acc: 0.6769

Epoch 00014: val_acc improved from 0.67309 to 0.67687, saving model to model_v5
accZ_LF-accX_Wrist.hdf5
Epoch 15/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.8835 - ac
c: 0.6489 - val_loss: 0.8788 - val_acc: 0.6408

Epoch 00015: val_acc did not improve from 0.67687
Epoch 16/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.8743 - ac
c: 0.6500 - val_loss: 0.7915 - val_acc: 0.6838

Epoch 00016: val_acc improved from 0.67687 to 0.68378, saving model to model_v5
accZ_LF-accX_Wrist.hdf5
Epoch 17/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.8426 - ac
c: 0.6678 - val_loss: 0.7795 - val_acc: 0.6995

Epoch 00017: val_acc improved from 0.68378 to 0.69950, saving model to model_v5
```

```
accZ_LF-accX_Wrist.hdf5
```

```
Epoch 18/20
```

```
19084/19084 [=====] - 29s 2ms/step - loss: 0.7977 - ac  
c: 0.6908 - val_loss: 0.7171 - val_acc: 0.7219
```

```
Epoch 00018: val_acc improved from 0.69950 to 0.72192, saving model to model_v5  
accZ_LF-accX_Wrist.hdf5
```

```
Epoch 19/20
```

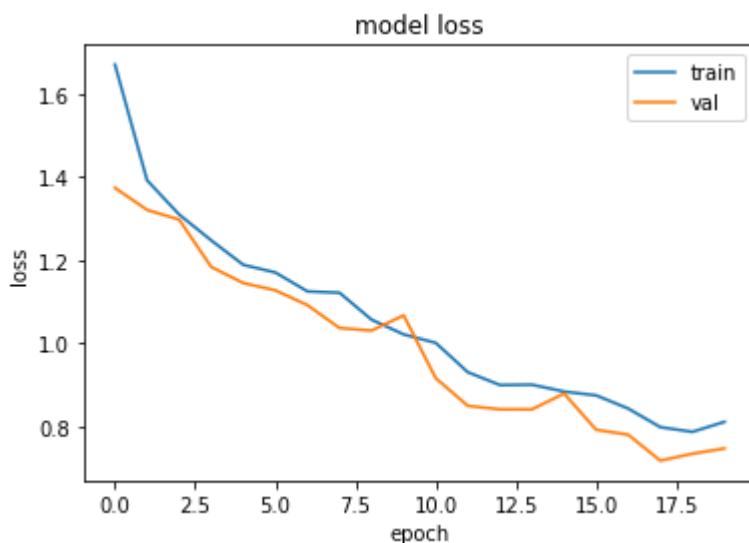
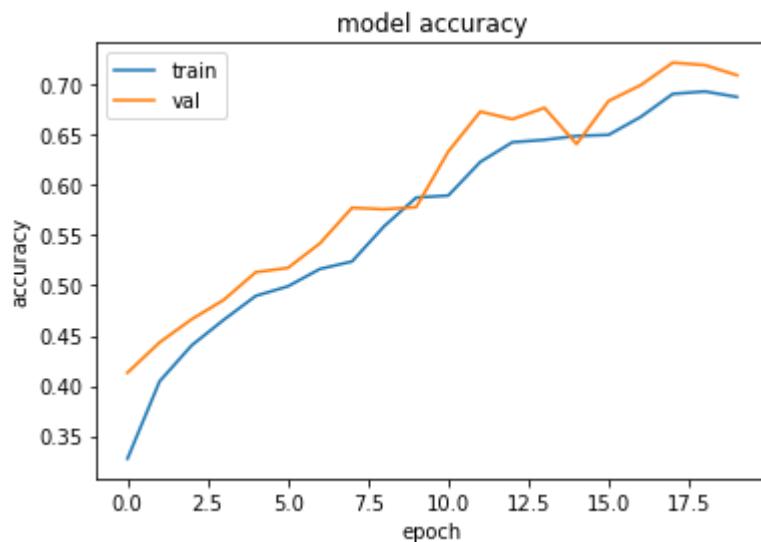
```
19084/19084 [=====] - 29s 2ms/step - loss: 0.7865 - ac  
c: 0.6932 - val_loss: 0.7338 - val_acc: 0.7194
```

```
Epoch 00019: val_acc did not improve from 0.72192
```

```
Epoch 20/20
```

```
19084/19084 [=====] - 29s 2ms/step - loss: 0.8106 - ac  
c: 0.6877 - val_loss: 0.7465 - val_acc: 0.7093
```

```
Epoch 00020: val_acc did not improve from 0.72192
```

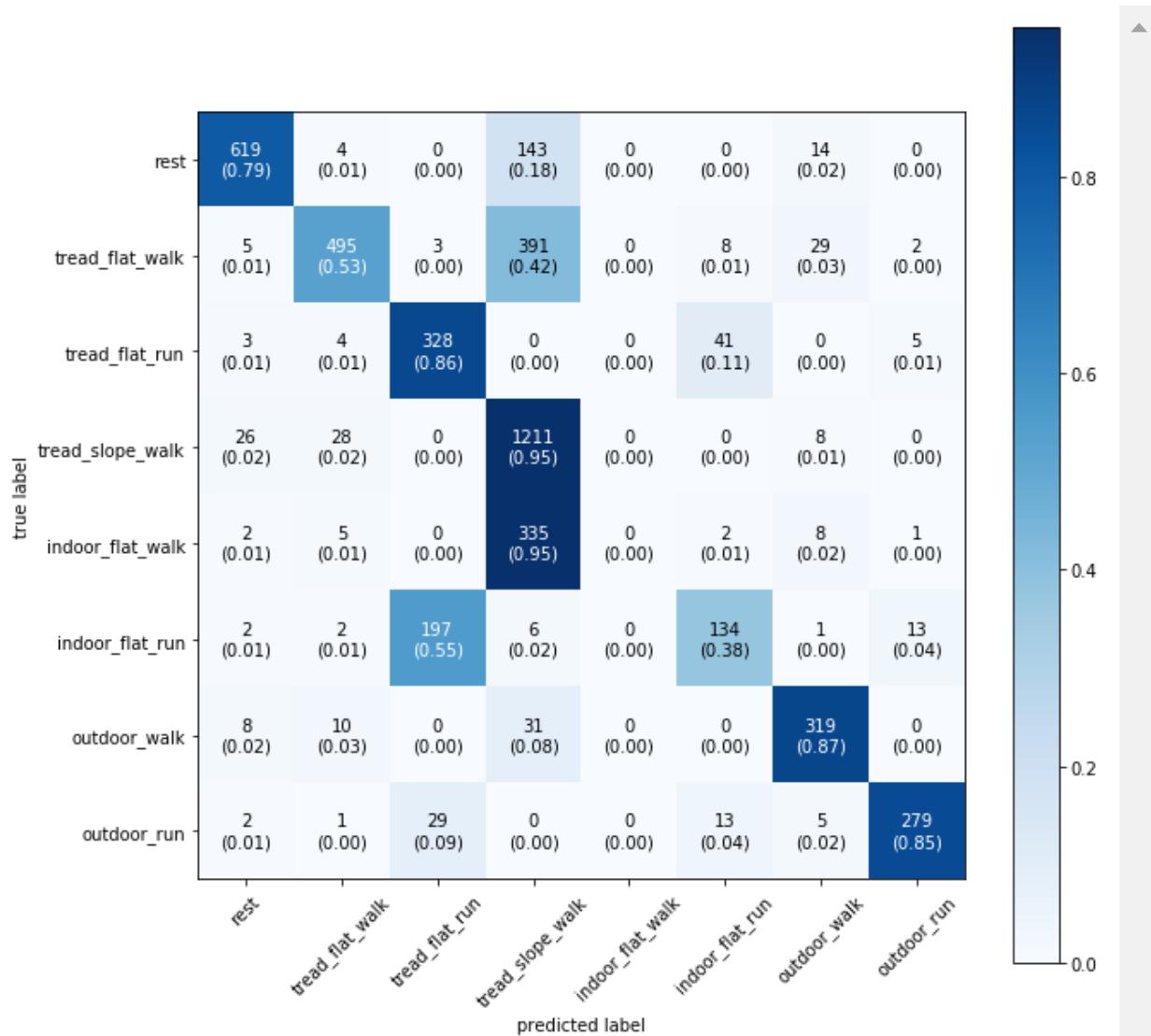


Best accuracy (on validation dataset): 70.93%

```
[[ 619    4     0   143     0     0    14     0]
 [  5   495     3   391     0     8    29     2]]
```

```
[ 3   4  328   0    0   41   0   5]
[ 26  28   0 1211   0   0    8   0]
[ 2   5   0  335   0   2    8   1]
[ 2   2  197   6   0  134   1  13]
[ 8   10   0   31   0   0  319   0]
[ 2   1   29   0   0   13   5 27911
```

&lt;Figure size 432x288 with 0 Axes&gt;



**Classification Report:**

	precision	recall	f1-score	support
rest	0.9280	0.7936	0.8556	780
tread_flat_walk	0.9016	0.5305	0.6680	933
tread_flat_run	0.5889	0.8609	0.6994	381
tread_slope_walk	0.5720	0.9513	0.7145	1273
indoor_flat_walk	0.0000	0.0000	0.0000	353
indoor_flat_run	0.6768	0.3775	0.4846	355
outdoor_walk	0.8307	0.8668	0.8484	368
outdoor_run	0.9300	0.8480	0.8871	329
accuracy			0.7093	4772
macro avg	0.6785	0.6536	0.6447	4772
weighted avg	0.7061	0.7093	0.6795	4772

Trying for these features ['accZ\_LF', 'accY\_Wrist']

(19084, 256, 2)

(19084, 8)

(4772, 256, 2)

(4772, 8)

256

2

8

Layer (type)	Output Shape	Param #
<hr/>		
input_34 (InputLayer)	(None, 256, 2)	0
lstm_33 (LSTM)	(None, 100)	41200
dropout_33 (Dropout)	(None, 100)	0
dense_66 (Dense)	(None, 100)	10100
dense_67 (Dense)	(None, 8)	808
<hr/>		

Total params: 52,108

Trainable params: 52,108

Non-trainable params: 0

---

Train on 19084 samples, validate on 4772 samples  
Epoch 1/20

```
19084/19084 [=====] - 34s 2ms/step - loss: 1.7779 - ac  
c: 0.3050 - val_loss: 1.4721 - val_acc: 0.4220

Epoch 00001: val_acc improved from -inf to 0.42205, saving model to model_v5acc  
Z_LF-accY_Wrist.hdf5
Epoch 2/20
19084/19084 [=====] - 29s 2ms/step - loss: 1.3932 - ac  
c: 0.4283 - val_loss: 1.2426 - val_acc: 0.4549

Epoch 00002: val_acc improved from 0.42205 to 0.45495, saving model to model_v5  
accZ_LF-accY_Wrist.hdf5
Epoch 3/20
19084/19084 [=====] - 29s 2ms/step - loss: 1.2325 - ac  
c: 0.4830 - val_loss: 1.1807 - val_acc: 0.5145

Epoch 00003: val_acc improved from 0.45495 to 0.51446, saving model to model_v5  
accZ_LF-accY_Wrist.hdf5
Epoch 4/20
19084/19084 [=====] - 29s 2ms/step - loss: 1.1877 - ac  
c: 0.4937 - val_loss: 1.1315 - val_acc: 0.5272

Epoch 00004: val_acc improved from 0.51446 to 0.52724, saving model to model_v5  
accZ_LF-accY_Wrist.hdf5
Epoch 5/20
19084/19084 [=====] - 29s 2ms/step - loss: 1.1812 - ac  
c: 0.5202 - val_loss: 1.2740 - val_acc: 0.5084

Epoch 00005: val_acc did not improve from 0.52724
Epoch 6/20
19084/19084 [=====] - 29s 2ms/step - loss: 1.2728 - ac  
c: 0.5003 - val_loss: 1.0622 - val_acc: 0.5704

Epoch 00006: val_acc improved from 0.52724 to 0.57041, saving model to model_v5  
accZ_LF-accY_Wrist.hdf5
Epoch 7/20
19084/19084 [=====] - 29s 2ms/step - loss: 1.1151 - ac  
c: 0.5465 - val_loss: 1.0473 - val_acc: 0.5759

Epoch 00007: val_acc improved from 0.57041 to 0.57586, saving model to model_v5  
accZ_LF-accY_Wrist.hdf5
Epoch 8/20
19084/19084 [=====] - 29s 2ms/step - loss: 1.0670 - ac  
c: 0.5707 - val_loss: 0.9743 - val_acc: 0.6188

Epoch 00008: val_acc improved from 0.57586 to 0.61882, saving model to model_v5  
accZ_LF-accY_Wrist.hdf5
Epoch 9/20
19084/19084 [=====] - 29s 2ms/step - loss: 1.0240 - ac  
c: 0.5870 - val_loss: 0.9246 - val_acc: 0.6364

Epoch 00009: val_acc improved from 0.61882 to 0.63642, saving model to model_v5  
accZ_LF-accY_Wrist.hdf5
Epoch 10/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.9718 - ac  
c: 0.6101 - val_loss: 0.9021 - val_acc: 0.6406

Epoch 00010: val_acc improved from 0.63642 to 0.64061, saving model to model_v5
```

```
accZ_LF-accY_Wrist.hdf5
Epoch 11/20
19084/19084 [=====] - 31s 2ms/step - loss: 0.9884 - ac
c: 0.6120 - val_loss: 0.9734 - val_acc: 0.6190

Epoch 00011: val_acc did not improve from 0.64061
Epoch 12/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.9748 - ac
c: 0.6086 - val_loss: 0.9282 - val_acc: 0.6205

Epoch 00012: val_acc did not improve from 0.64061
Epoch 13/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.9267 - ac
c: 0.6283 - val_loss: 0.8348 - val_acc: 0.6704

Epoch 00013: val_acc improved from 0.64061 to 0.67037, saving model to model_v5
accZ_LF-accY_Wrist.hdf5
Epoch 14/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.9001 - ac
c: 0.6437 - val_loss: 0.8949 - val_acc: 0.6484

Epoch 00014: val_acc did not improve from 0.67037
Epoch 15/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.9177 - ac
c: 0.6390 - val_loss: 0.8275 - val_acc: 0.6827

Epoch 00015: val_acc improved from 0.67037 to 0.68273, saving model to model_v5
accZ_LF-accY_Wrist.hdf5
Epoch 16/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.9060 - ac
c: 0.6435 - val_loss: 0.8718 - val_acc: 0.6513

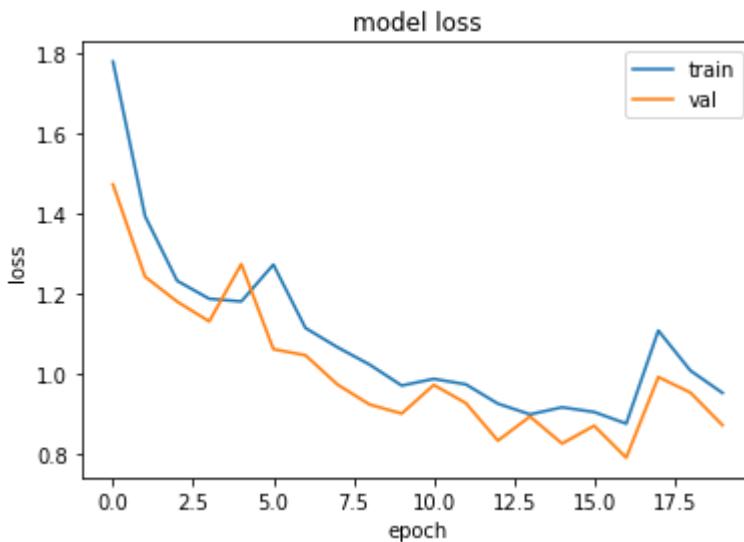
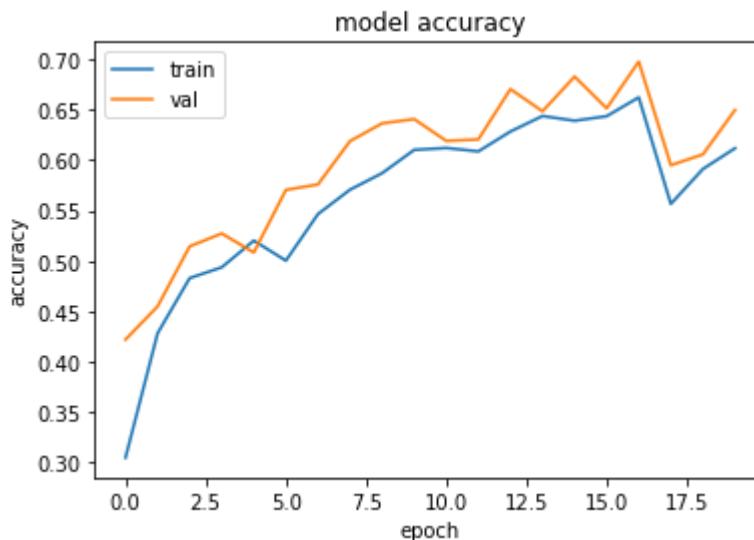
Epoch 00016: val_acc did not improve from 0.68273
Epoch 17/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.8771 - ac
c: 0.6622 - val_loss: 0.7925 - val_acc: 0.6976

Epoch 00017: val_acc improved from 0.68273 to 0.69761, saving model to model_v5
accZ_LF-accY_Wrist.hdf5
Epoch 18/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.1087 - ac
c: 0.5565 - val_loss: 0.9930 - val_acc: 0.5949

Epoch 00018: val_acc did not improve from 0.69761
Epoch 19/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.0091 - ac
c: 0.5912 - val_loss: 0.9544 - val_acc: 0.6056

Epoch 00019: val_acc did not improve from 0.69761
Epoch 20/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.9534 - ac
c: 0.6117 - val_loss: 0.8731 - val_acc: 0.6496

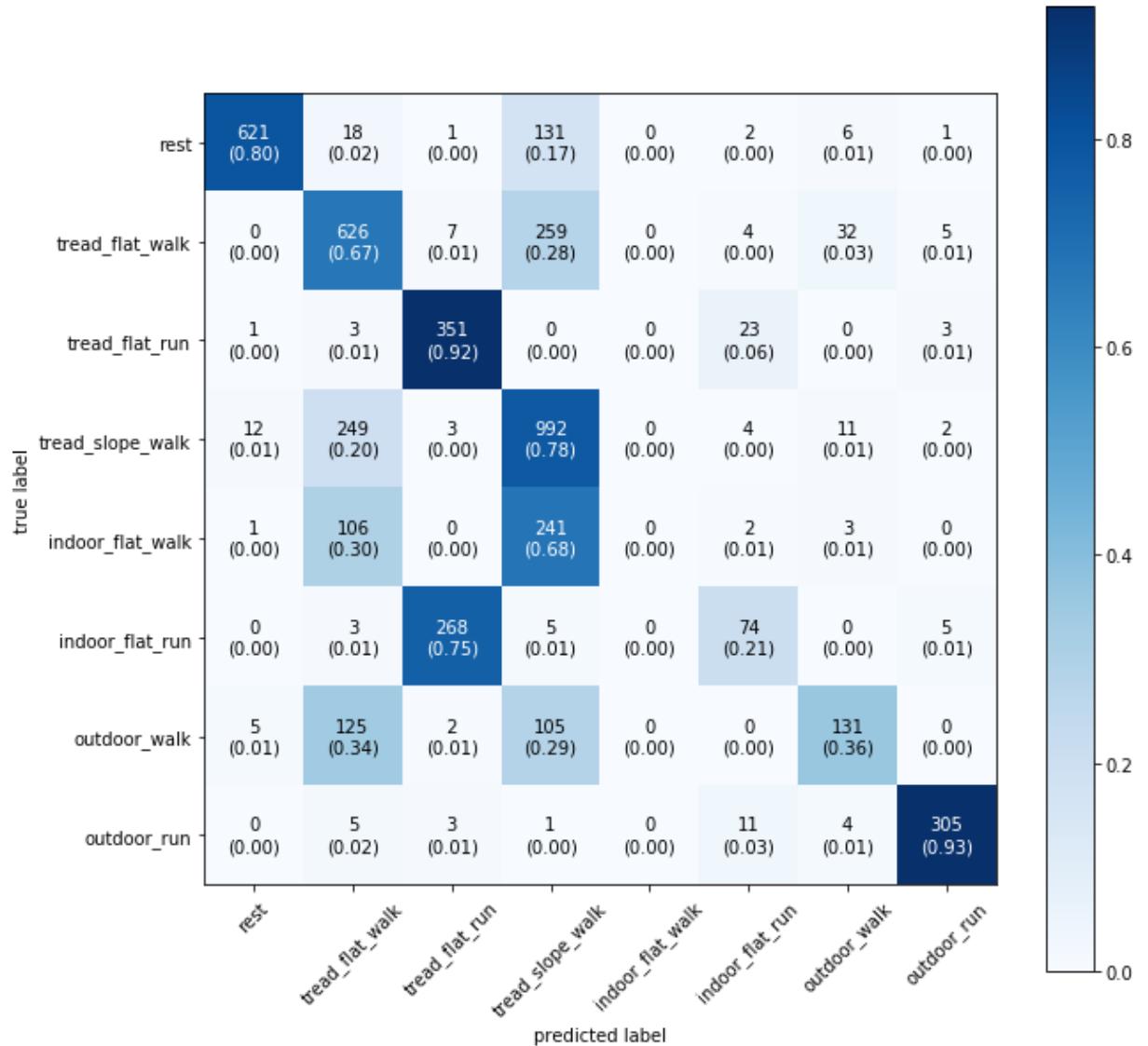
Epoch 00020: val_acc did not improve from 0.69761
```



Best accuracy (on validation dataset): 64.96%

```
[[621 18 1 131 0 2 6 1]
 [ 0 626 7 259 0 4 32 5]
 [ 1 3 351 0 0 23 0 3]
 [ 12 249 3 992 0 4 11 2]
 [ 1 106 0 241 0 2 3 0]
 [ 0 3 268 5 0 74 0 5]
 [ 5 125 2 105 0 0 131 0]
 [ 0 5 3 1 0 11 4 305]]
```

<Figure size 432x288 with 0 Axes>



## Classification Report:

	precision	recall	f1-score	support
rest	0.9703	0.7962	0.8746	780
tread_flat_walk	0.5515	0.6710	0.6054	933
tread_flat_run	0.5528	0.9213	0.6909	381
tread_slope_walk	0.5721	0.7793	0.6598	1273
indoor_flat_walk	0.0000	0.0000	0.0000	353
indoor_flat_run	0.6167	0.2085	0.3116	355
outdoor_walk	0.7005	0.3560	0.4721	368
outdoor_run	0.9502	0.9271	0.9385	329
accuracy			0.6496	4772
macro avg	0.6143	0.5824	0.5691	4772
weighted avg	0.6286	0.6496	0.6168	4772

Trying for these features ['accZ\_LF', 'accZ\_Wrist']

(19084, 256, 2)

(19084, 8)

(4772, 256, 2)

(4772, 8)

256

2

8

Layer (type)	Output Shape	Param #
<hr/>		
input_35 (InputLayer)	(None, 256, 2)	0
lstm_34 (LSTM)	(None, 100)	41200
dropout_34 (Dropout)	(None, 100)	0
dense_68 (Dense)	(None, 100)	10100
dense_69 (Dense)	(None, 8)	808
<hr/>		
Total params: 52,108		
Trainable params: 52,108		
Non-trainable params: 0		

---

Train on 19084 samples, validate on 4772 samples

Epoch 1/20

19084/19084 [=====] - 34s 2ms/step - loss: 1.8154 - acc: 0.3099 - val\_loss: 1.5493 - val\_acc: 0.3948

Epoch 00001: val\_acc improved from -inf to 0.39480, saving model to model\_v5accZ\_LF-accZ\_Wrist.hdf5

Epoch 2/20

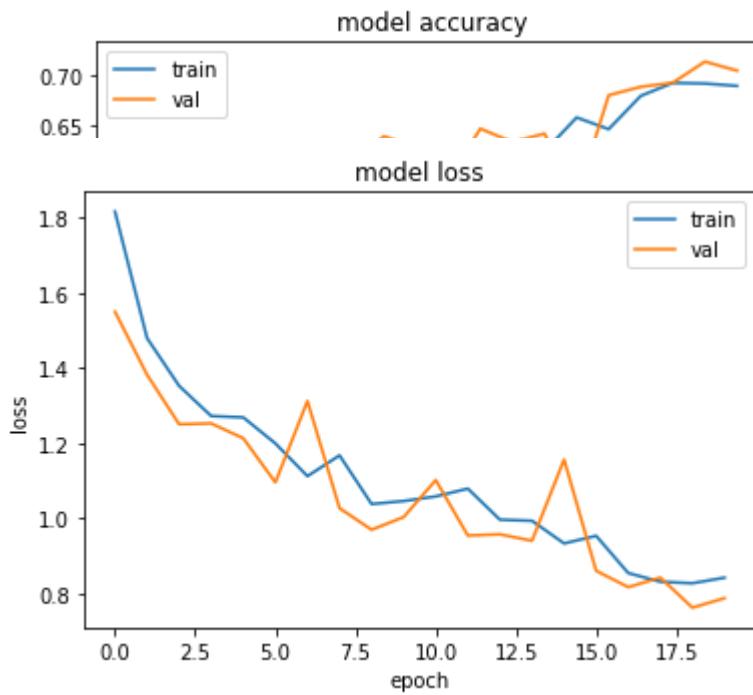
19084/19084 [=====] - 30s 2ms/step - loss: 1.4793 - acc: 0.4457 - val\_loss: 1.3819 - val\_acc: 0.4711

Epoch 00002: val\_acc improved from 0.39480 to 0.47108, saving model to model\_v5accZ\_LF-accZ\_Wrist.hdf5

Epoch 3/20

```
19084/19084 [=====] - 30s 2ms/step - loss: 1.3521 -  
acc: 0.4939 - val_loss: 1.2503 - val_acc: 0.5256  
  
Epoch 00003: val_acc improved from 0.47108 to 0.52557, saving model to model_  
v5accZ_LF-accZ_Wrist.hdf5  
Epoch 4/20  
19084/19084 [=====] - 30s 2ms/step - loss: 1.2721 -  
acc: 0.5310 - val_loss: 1.2525 - val_acc: 0.5329  
  
Epoch 00004: val_acc improved from 0.52557 to 0.53290, saving model to model_  
v5accZ_LF-accZ_Wrist.hdf5  
Epoch 5/20  
19084/19084 [=====] - 30s 2ms/step - loss: 1.2685 -  
acc: 0.5255 - val_loss: 1.2130 - val_acc: 0.5342  
  
Epoch 00005: val_acc improved from 0.53290 to 0.53416, saving model to model_  
v5accZ_LF-accZ_Wrist.hdf5  
Epoch 6/20  
19084/19084 [=====] - 30s 2ms/step - loss: 1.1993 -  
acc: 0.5548 - val_loss: 1.0958 - val_acc: 0.6025  
  
Epoch 00006: val_acc improved from 0.53416 to 0.60247, saving model to model_  
v5accZ_LF-accZ_Wrist.hdf5  
Epoch 7/20  
19084/19084 [=====] - 30s 2ms/step - loss: 1.1123 -  
acc: 0.5907 - val_loss: 1.3120 - val_acc: 0.5228  
  
Epoch 00007: val_acc did not improve from 0.60247  
Epoch 8/20  
19084/19084 [=====] - 30s 2ms/step - loss: 1.1675 -  
acc: 0.5680 - val_loss: 1.0273 - val_acc: 0.6140  
  
Epoch 00008: val_acc improved from 0.60247 to 0.61400, saving model to model_  
v5accZ_LF-accZ_Wrist.hdf5  
Epoch 9/20  
19084/19084 [=====] - 30s 2ms/step - loss: 1.0383 -  
acc: 0.6207 - val_loss: 0.9700 - val_acc: 0.6383  
  
Epoch 00009: val_acc improved from 0.61400 to 0.63831, saving model to model_  
v5accZ_LF-accZ_Wrist.hdf5  
Epoch 10/20  
19084/19084 [=====] - 30s 2ms/step - loss: 1.0462 -  
acc: 0.6184 - val_loss: 1.0037 - val_acc: 0.6268  
  
Epoch 00010: val_acc did not improve from 0.63831  
Epoch 11/20  
19084/19084 [=====] - 30s 2ms/step - loss: 1.0585 -  
acc: 0.6100 - val_loss: 1.1020 - val_acc: 0.5941  
  
Epoch 00011: val_acc did not improve from 0.63831  
Epoch 12/20  
19084/19084 [=====] - 32s 2ms/step - loss: 1.0792 -  
acc: 0.6088 - val_loss: 0.9545 - val_acc: 0.6461  
  
Epoch 00012: val_acc improved from 0.63831 to 0.64606, saving model to model_  
v5accZ_LF-accZ_Wrist.hdf5  
Epoch 13/20
```

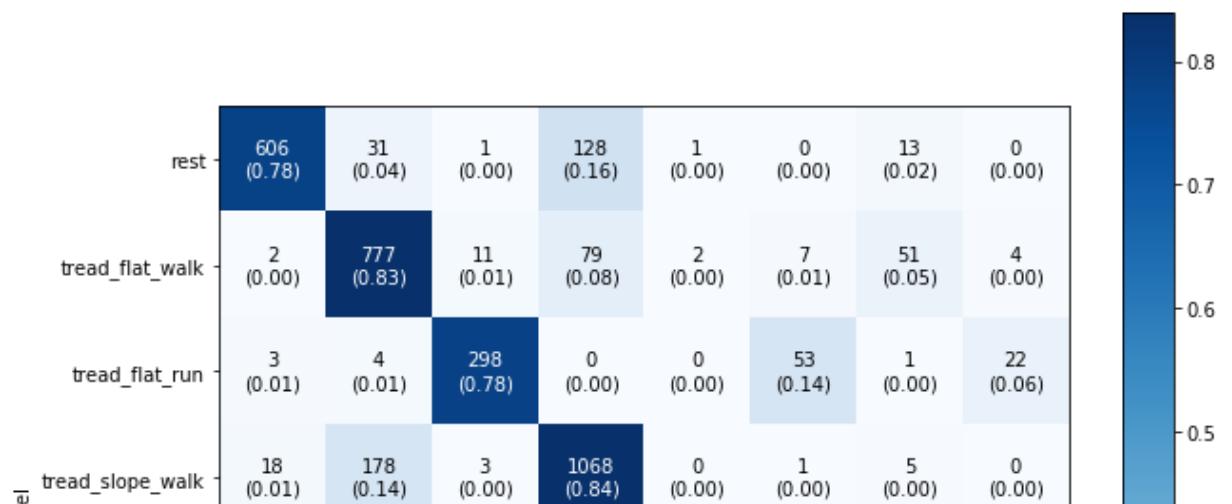
```
19084/19084 [=====] - 30s 2ms/step - loss: 0.9967 -  
acc: 0.6321 - val_loss: 0.9578 - val_acc: 0.6324  
  
Epoch 00013: val_acc did not improve from 0.64606  
Epoch 14/20  
19084/19084 [=====] - 30s 2ms/step - loss: 0.9938 -  
acc: 0.6228 - val_loss: 0.9407 - val_acc: 0.6410  
  
Epoch 00014: val_acc did not improve from 0.64606  
Epoch 15/20  
19084/19084 [=====] - 30s 2ms/step - loss: 0.9336 -  
acc: 0.6575 - val_loss: 1.1565 - val_acc: 0.5748  
  
Epoch 00015: val_acc did not improve from 0.64606  
Epoch 16/20  
19084/19084 [=====] - 31s 2ms/step - loss: 0.9537 -  
acc: 0.6456 - val_loss: 0.8608 - val_acc: 0.6802  
  
Epoch 00016: val_acc improved from 0.64606 to 0.68022, saving model to model_  
v5accZ_LF-accZ_Wrist.hdf5  
Epoch 17/20  
19084/19084 [=====] - 30s 2ms/step - loss: 0.8548 -  
acc: 0.6796 - val_loss: 0.8174 - val_acc: 0.6888  
  
Epoch 00017: val_acc improved from 0.68022 to 0.68881, saving model to model_  
v5accZ_LF-accZ_Wrist.hdf5  
Epoch 18/20  
19084/19084 [=====] - 30s 2ms/step - loss: 0.8317 -  
acc: 0.6928 - val_loss: 0.8428 - val_acc: 0.6930  
  
Epoch 00018: val_acc improved from 0.68881 to 0.69300, saving model to model_  
v5accZ_LF-accZ_Wrist.hdf5  
Epoch 19/20  
19084/19084 [=====] - 30s 2ms/step - loss: 0.8277 -  
acc: 0.6922 - val_loss: 0.7629 - val_acc: 0.7146  
  
Epoch 00019: val_acc improved from 0.69300 to 0.71459, saving model to model_  
v5accZ_LF-accZ_Wrist.hdf5  
Epoch 20/20  
19084/19084 [=====] - 30s 2ms/step - loss: 0.8425 -  
acc: 0.6897 - val_loss: 0.7880 - val_acc: 0.7054  
  
Epoch 00020: val_acc did not improve from 0.71459
```



Best accuracy (on validation dataset): 70.54%

```
[[ 606   31     1   128     1     0    13     0]
 [  2   777    11    79     2     7    51     4]
 [  3     4   298     0     0    53     1    22]
 [ 18   178     3 1068     0     1     5     0]
 [  4    63     0   271     6     0     9     0]
 [  2    11   202     3     1   103     2    31]
 [  2    85     2     8     0     1   248    22]
 [  1     9    23     3     0    12    21  260]]
```

<Figure size 432x288 with 0 Axes>



## Classification Report:

	precision	recall	f1-score	support
rest	0.9498	0.7769	0.8547	780
tread_flat_walk	0.6710	0.8328	0.7432	933
tread_flat_run	0.5519	0.7822	0.6471	381
tread_slope_walk	0.6846	0.8390	0.7540	1273
indoor_flat_walk	0.6000	0.0170	0.0331	353
indoor_flat_run	0.5819	0.2901	0.3872	355
outdoor_walk	0.7086	0.6739	0.6908	368
outdoor_run	0.7670	0.7903	0.7784	329
accuracy			0.7054	4772
macro avg	0.6893	0.6253	0.6111	4772
weighted avg	0.7083	0.7054	0.6760	4772

Trying for these features ['accX\_Wrist', 'accY\_Wrist']

(19084, 256, 2)

(19084, 8)

(4772, 256, 2)

(4772, 8)

256

2

8

Layer (type)	Output Shape	Param #
<hr/>		
input_36 (InputLayer)	(None, 256, 2)	0
lstm_35 (LSTM)	(None, 100)	41200
dropout_35 (Dropout)	(None, 100)	0
dense_70 (Dense)	(None, 100)	10100
dense_71 (Dense)	(None, 8)	808
<hr/>		

Total params: 52,108

Trainable params: 52,108

Non-trainable params: 0

---

Train on 19084 samples, validate on 4772 samples

```
Epoch 1/20
19084/19084 [=====] - 34s 2ms/step - loss: 1.7337 -
acc: 0.2989 - val_loss: 1.4535 - val_acc: 0.3925

Epoch 00001: val_acc improved from -inf to 0.39250, saving model to model_v5a
ccX_Wrist-accY_Wrist.hdf5
Epoch 2/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.4120 -
acc: 0.3933 - val_loss: 1.2825 - val_acc: 0.4428

Epoch 00002: val_acc improved from 0.39250 to 0.44279, saving model to model_
v5accX_Wrist-accY_Wrist.hdf5
Epoch 3/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.3425 -
acc: 0.4183 - val_loss: 1.2563 - val_acc: 0.4631

Epoch 00003: val_acc improved from 0.44279 to 0.46312, saving model to model_
v5accX_Wrist-accY_Wrist.hdf5
Epoch 4/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.2880 -
acc: 0.4378 - val_loss: 1.2365 - val_acc: 0.4568

Epoch 00004: val_acc did not improve from 0.46312
Epoch 5/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.2443 -
acc: 0.4680 - val_loss: 1.1665 - val_acc: 0.5222

Epoch 00005: val_acc improved from 0.46312 to 0.52221, saving model to model_
v5accX_Wrist-accY_Wrist.hdf5
Epoch 6/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.2215 -
acc: 0.4873 - val_loss: 1.1535 - val_acc: 0.5344

Epoch 00006: val_acc improved from 0.52221 to 0.53437, saving model to model_
v5accX_Wrist-accY_Wrist.hdf5
Epoch 7/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.1672 -
acc: 0.5179 - val_loss: 1.0701 - val_acc: 0.5685

Epoch 00007: val_acc improved from 0.53437 to 0.56852, saving model to model_
v5accX_Wrist-accY_Wrist.hdf5
Epoch 8/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.1109 -
acc: 0.5519 - val_loss: 1.0187 - val_acc: 0.5857

Epoch 00008: val_acc improved from 0.56852 to 0.58571, saving model to model_
v5accX_Wrist-accY_Wrist.hdf5
Epoch 9/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.0400 -
acc: 0.5793 - val_loss: 0.9445 - val_acc: 0.6186

Epoch 00009: val_acc improved from 0.58571 to 0.61861, saving model to model_
v5accX_Wrist-accY_Wrist.hdf5
Epoch 10/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.0200 -
acc: 0.5921 - val_loss: 0.9203 - val_acc: 0.6165
```

```
Epoch 00010: val_acc did not improve from 0.61861
Epoch 11/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.9993 -
acc: 0.5896 - val_loss: 0.9365 - val_acc: 0.6218

Epoch 00011: val_acc improved from 0.61861 to 0.62175, saving model to model_
v5accX_Wrist-accY_Wrist.hdf5
Epoch 12/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.9720 -
acc: 0.6025 - val_loss: 0.8952 - val_acc: 0.6507

Epoch 00012: val_acc improved from 0.62175 to 0.65067, saving model to model_
v5accX_Wrist-accY_Wrist.hdf5
Epoch 13/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.9390 -
acc: 0.6206 - val_loss: 0.8971 - val_acc: 0.6339

Epoch 00013: val_acc did not improve from 0.65067
Epoch 14/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.9318 -
acc: 0.6172 - val_loss: 0.8495 - val_acc: 0.6618

Epoch 00014: val_acc improved from 0.65067 to 0.66178, saving model to model_
v5accX_Wrist-accY_Wrist.hdf5
Epoch 15/20
19084/19084 [=====] - 31s 2ms/step - loss: 0.9453 -
acc: 0.6110 - val_loss: 0.9256 - val_acc: 0.6136

Epoch 00015: val_acc did not improve from 0.66178
Epoch 16/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.9379 -
acc: 0.6161 - val_loss: 0.8652 - val_acc: 0.6507

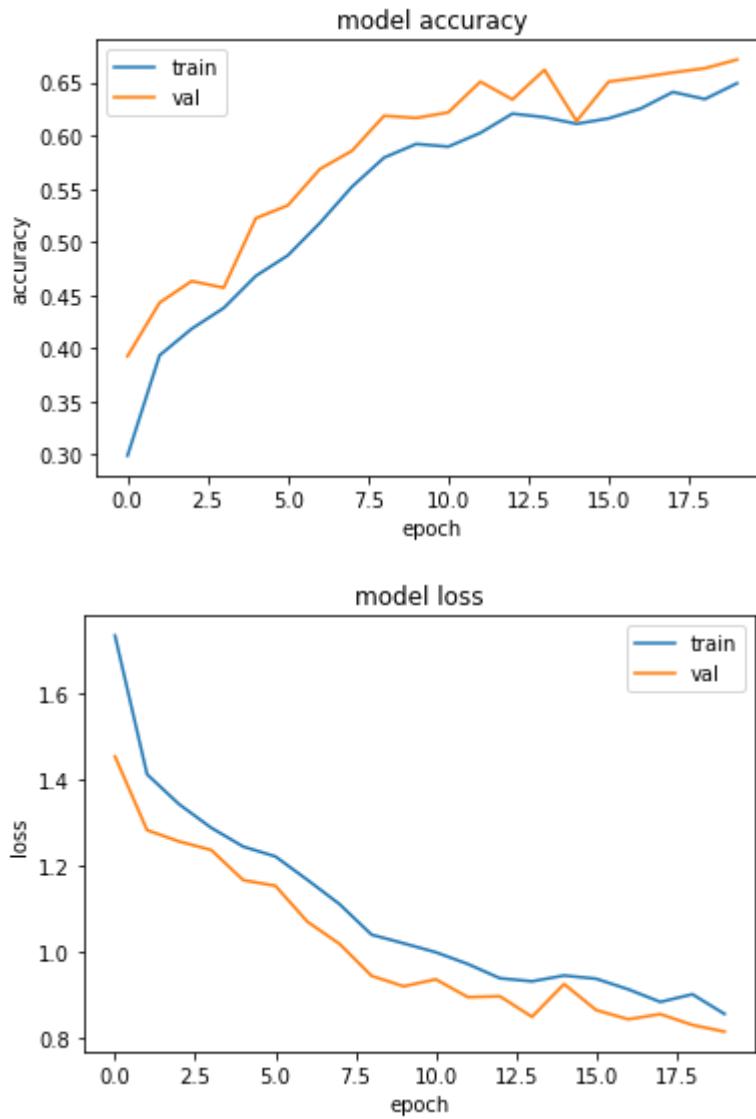
Epoch 00016: val_acc did not improve from 0.66178
Epoch 17/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.9133 -
acc: 0.6254 - val_loss: 0.8438 - val_acc: 0.6547

Epoch 00017: val_acc did not improve from 0.66178
Epoch 18/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.8841 -
acc: 0.6409 - val_loss: 0.8558 - val_acc: 0.6593

Epoch 00018: val_acc did not improve from 0.66178
Epoch 19/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.9018 -
acc: 0.6343 - val_loss: 0.8307 - val_acc: 0.6632

Epoch 00019: val_acc improved from 0.66178 to 0.66324, saving model to model_
v5accX_Wrist-accY_Wrist.hdf5
Epoch 20/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.8562 -
acc: 0.6491 - val_loss: 0.8152 - val_acc: 0.6714

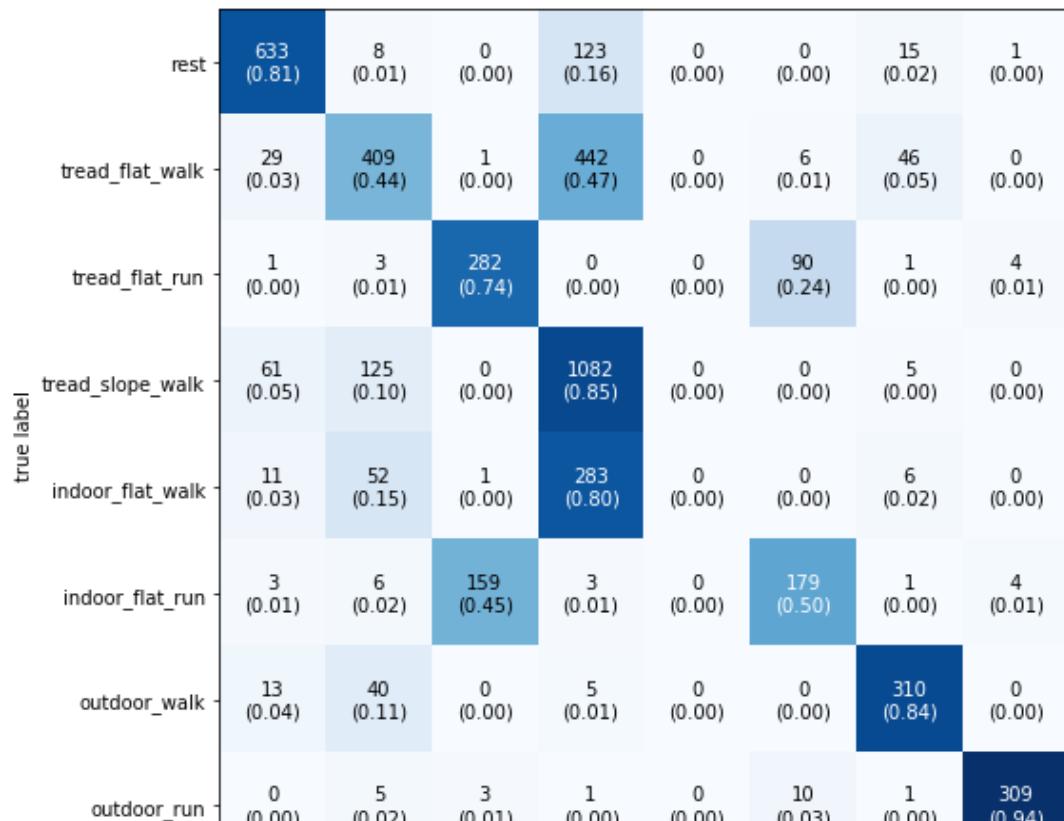
Epoch 00020: val_acc improved from 0.66324 to 0.67142, saving model to model_
v5accX_Wrist-accY_Wrist.hdf5
```



Best accuracy (on validation dataset): 67.14%

```
[[ 633    8    0   123    0    0   15    1]
 [ 29   409    1   442    0    6   46    0]
 [  1     3   282    0    0   90    1    4]
 [ 61   125    0  1082    0    0    5    0]
 [ 11    52    1   283    0    0    6    0]
 [  3     6   159    3    0  179    1    4]
 [ 13    40    0     5    0    0  310    0]
 [  0     5    3     1    0   10    1  309]]
```

<Figure size 432x288 with 0 Axes>



## Classification Report:

	precision	recall	f1-score	support
rest	0.8429	0.8115	0.8269	780
tread_flat_walk	0.6312	0.4384	0.5174	933
tread_flat_run	0.6323	0.7402	0.6820	381
tread_slope_walk	0.5580	0.8500	0.6737	1273
indoor_flat_walk	0.0000	0.0000	0.0000	353
indoor_flat_run	0.6281	0.5042	0.5594	355
outdoor_walk	0.8052	0.8424	0.8234	368
outdoor_run	0.9717	0.9392	0.9552	329
accuracy			0.6714	4772
macro avg	0.6337	0.6407	0.6297	4772
weighted avg	0.6363	0.6714	0.6415	4772

Trying for these features ['accX\_Wrist', 'accZ\_Wrist']

(19084, 256, 2)

(19084, 8)

(4772, 256, 2)

(4772, 8)

256

2

8

Layer (type)	Output Shape	Param #
input_37 (InputLayer)	(None, 256, 2)	0
lstm_36 (LSTM)	(None, 100)	41200

dropout_36 (Dropout)	(None, 100)	0
dense_72 (Dense)	(None, 100)	10100
dense_73 (Dense)	(None, 8)	808
=====		
Total params: 52,108		
Trainable params: 52,108		
Non-trainable params: 0		

Train on 19084 samples, validate on 4772 samples

Epoch 1/20

19084/19084 [=====] - 34s 2ms/step - loss: 1.7483 - acc: 0.2893 - val\_loss: 1.4429 - val\_acc: 0.3634

Epoch 00001: val\_acc improved from -inf to 0.36337, saving model to model\_v5accX\_Wrist-accZ\_Wrist.hdf5

Epoch 2/20

19084/19084 [=====] - 29s 2ms/step - loss: 1.4080 - acc: 0.3734 - val\_loss: 1.3122 - val\_acc: 0.4285

Epoch 00002: val\_acc improved from 0.36337 to 0.42854, saving model to model\_v5accX\_Wrist-accZ\_Wrist.hdf5

Epoch 3/20

19084/19084 [=====] - 30s 2ms/step - loss: 1.3277 - acc: 0.4108 - val\_loss: 1.2200 - val\_acc: 0.4738

Epoch 00003: val\_acc improved from 0.42854 to 0.47381, saving model to model\_v5accX\_Wrist-accZ\_Wrist.hdf5

Epoch 4/20

19084/19084 [=====] - 29s 2ms/step - loss: 1.2653 - acc: 0.4513 - val\_loss: 1.2122 - val\_acc: 0.4721

Epoch 00004: val\_acc did not improve from 0.47381

Epoch 5/20

19084/19084 [=====] - 30s 2ms/step - loss: 1.2599 - acc: 0.4482 - val\_loss: 1.1949 - val\_acc: 0.4960

Epoch 00005: val\_acc improved from 0.47381 to 0.49602, saving model to model\_v5accX\_Wrist-accZ\_Wrist.hdf5

Epoch 6/20

19084/19084 [=====] - 29s 2ms/step - loss: 1.2585 - acc: 0.4540 - val\_loss: 1.1620 - val\_acc: 0.5195

Epoch 00006: val\_acc improved from 0.49602 to 0.51949, saving model to model\_v5accX\_Wrist-accZ\_Wrist.hdf5

Epoch 7/20

19084/19084 [=====] - 30s 2ms/step - loss: 1.2479 - acc: 0.4727 - val\_loss: 1.1833 - val\_acc: 0.4908

Epoch 00007: val\_acc did not improve from 0.51949

Epoch 8/20

19084/19084 [=====] - 30s 2ms/step - loss: 1.1963 - acc: 0.4823 - val\_loss: 1.1427 - val\_acc: 0.5078

Epoch 00008: val\_acc did not improve from 0.51949

```
Epoch 9/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.2235 -
acc: 0.4749 - val_loss: 1.3207 - val_acc: 0.4420

Epoch 00009: val_acc did not improve from 0.51949
Epoch 10/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.3018 -
acc: 0.4442 - val_loss: 1.2048 - val_acc: 0.4795

Epoch 00010: val_acc did not improve from 0.51949
Epoch 11/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.3382 -
acc: 0.4293 - val_loss: 1.2365 - val_acc: 0.4560

Epoch 00011: val_acc did not improve from 0.51949
Epoch 12/20
19084/19084 [=====] - 29s 2ms/step - loss: 1.2531 -
acc: 0.4514 - val_loss: 1.1983 - val_acc: 0.4734

Epoch 00012: val_acc did not improve from 0.51949
Epoch 13/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.2369 -
acc: 0.4667 - val_loss: 1.1822 - val_acc: 0.4849

Epoch 00013: val_acc did not improve from 0.51949
Epoch 14/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.2029 -
acc: 0.4818 - val_loss: 1.1711 - val_acc: 0.5027

Epoch 00014: val_acc did not improve from 0.51949
Epoch 15/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.2028 -
acc: 0.4787 - val_loss: 1.1617 - val_acc: 0.4956

Epoch 00015: val_acc did not improve from 0.51949
Epoch 16/20
19084/19084 [=====] - 29s 2ms/step - loss: 1.1720 -
acc: 0.4964 - val_loss: 1.1439 - val_acc: 0.5023

Epoch 00016: val_acc did not improve from 0.51949
Epoch 17/20
19084/19084 [=====] - 29s 2ms/step - loss: 1.1769 -
acc: 0.4929 - val_loss: 1.1320 - val_acc: 0.5094

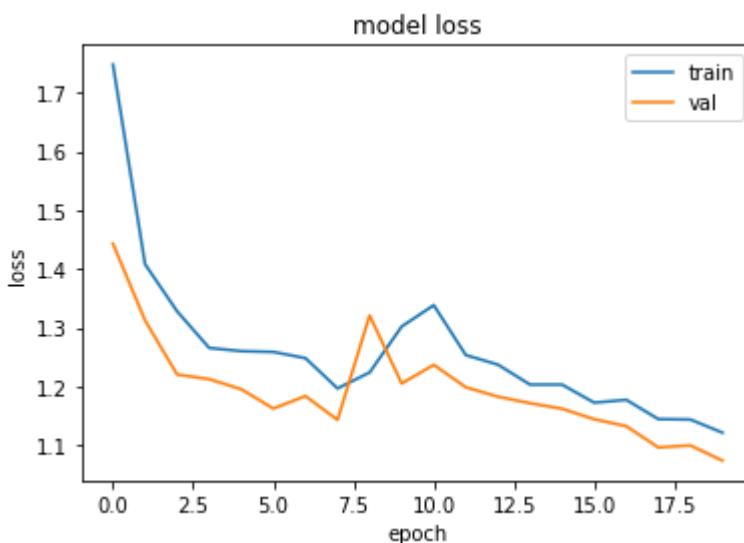
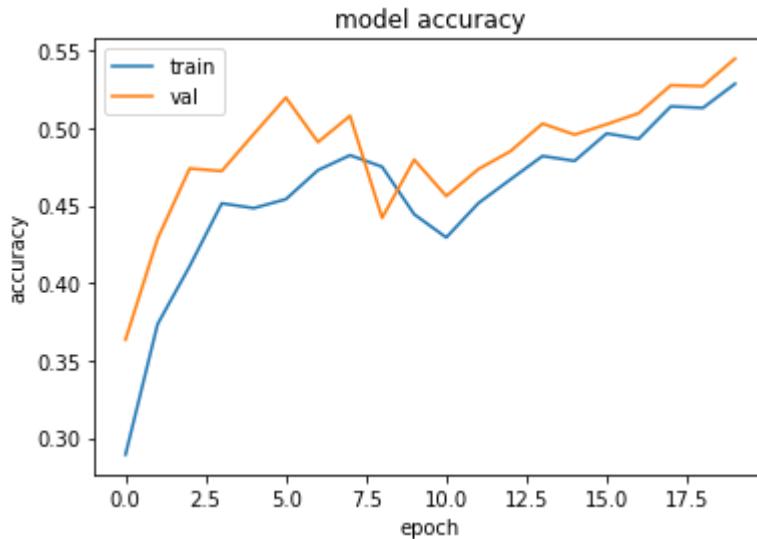
Epoch 00017: val_acc did not improve from 0.51949
Epoch 18/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.1440 -
acc: 0.5138 - val_loss: 1.0957 - val_acc: 0.5275

Epoch 00018: val_acc improved from 0.51949 to 0.52745, saving model to model_v5accX_Wrist-accZ_Wrist.hdf5
Epoch 19/20
19084/19084 [=====] - 29s 2ms/step - loss: 1.1433 -
acc: 0.5128 - val_loss: 1.0991 - val_acc: 0.5268

Epoch 00019: val_acc did not improve from 0.52745
Epoch 20/20
```

```
19084/19084 [=====] - 30s 2ms/step - loss: 1.1209 -
acc: 0.5284 - val_loss: 1.0732 - val_acc: 0.5446
```

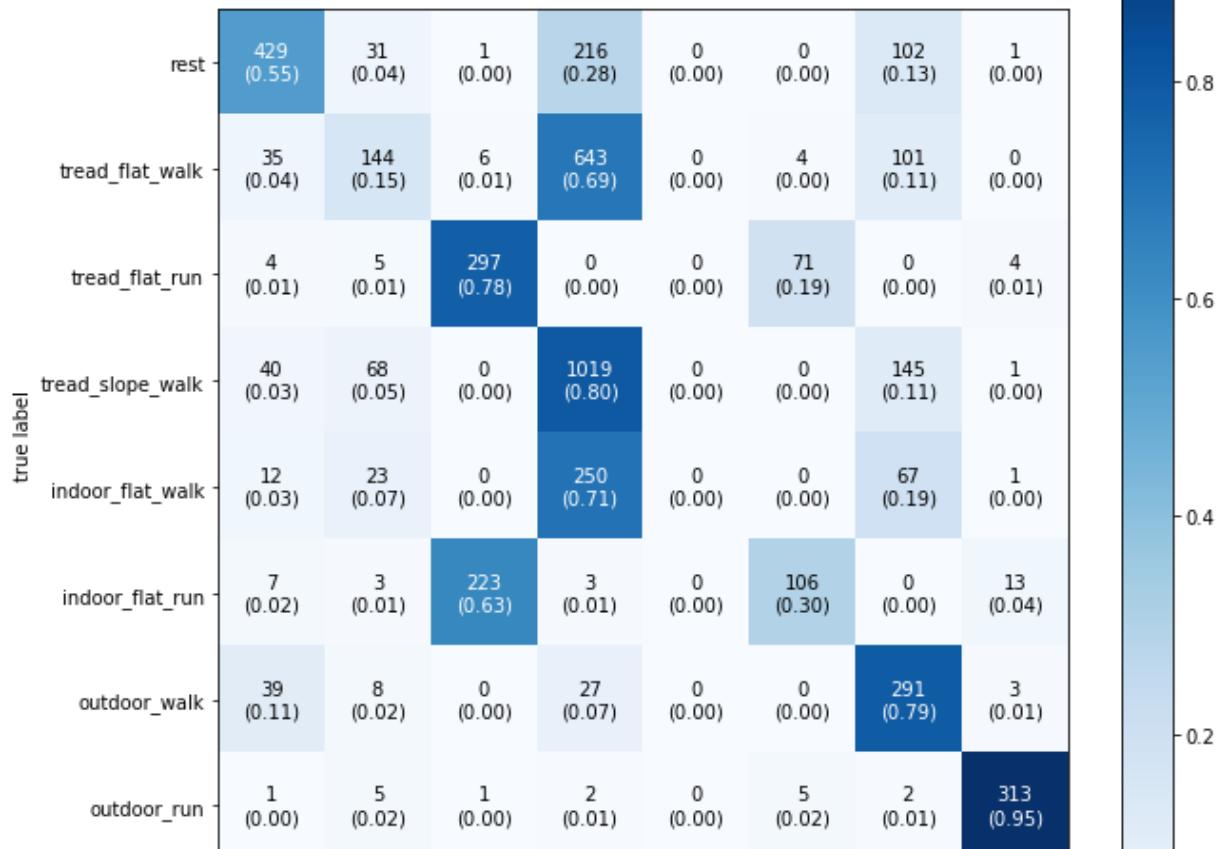
Epoch 00020: val\_acc improved from 0.52745 to 0.54464, saving model to model\_v5accX\_Wrist-accZ\_Wrist.hdf5



Best accuracy (on validation dataset): 54.46%

```
[[ 429   31    1   216    0    0  102    1]
 [ 35   144    6   643    0    4  101    0]
 [  4     5   297    0    0   71    0    4]
 [ 40    68    0 1019    0    0  145    1]
 [ 12    23    0   250    0    0   67    1]
 [  7     3   223    3    0  106    0   13]
 [ 39     8    0   27    0    0  291    3]
 [  1     5    1    2    0    5    2 313]]
```

<Figure size 432x288 with 0 Axes>



## Classification Report:

	precision	recall	f1-score	support
rest	0.7566	0.5500	0.6370	780
tread_flat_walk	0.5017	0.1543	0.2361	933
tread_flat_run	0.5625	0.7795	0.6535	381
tread_slope_walk	0.4718	0.8005	0.5936	1273
indoor_flat_walk	0.0000	0.0000	0.0000	353
indoor_flat_run	0.5699	0.2986	0.3919	355
outdoor_walk	0.4110	0.7908	0.5409	368
outdoor_run	0.9315	0.9514	0.9414	329
accuracy			0.5446	4772
macro avg	0.5256	0.5406	0.4993	4772
weighted avg	0.5308	0.5446	0.4966	4772

Trying for these features ['accY\_Wrist', 'accZ\_Wrist']

(19084, 256, 2)

(19084, 8)

(4772, 256, 2)

(4772, 8)

256

2

8

Layer (type)	Output Shape	Param #
input_38 (InputLayer)	(None, 256, 2)	0

lstm_37 (LSTM)	(None, 100)	41200
dropout_37 (Dropout)	(None, 100)	0
dense_74 (Dense)	(None, 100)	10100
dense_75 (Dense)	(None, 8)	808
<hr/>		
Total params: 52,108		
Trainable params: 52,108		
Non-trainable params: 0		

Train on 19084 samples, validate on 4772 samples

Epoch 1/20

19084/19084 [=====] - 34s 2ms/step - loss: 1.8236 - acc: 0.2894 - val\_loss: 1.6011 - val\_acc: 0.3623

Epoch 00001: val\_acc improved from -inf to 0.36232, saving model to model\_v5accY\_Wrist-accZ\_Wrist.hdf5

Epoch 2/20

19084/19084 [=====] - 29s 2ms/step - loss: 1.5704 - acc: 0.3649 - val\_loss: 1.4478 - val\_acc: 0.4078

Epoch 00002: val\_acc improved from 0.36232 to 0.40780, saving model to model\_v5accY\_Wrist-accZ\_Wrist.hdf5

Epoch 3/20

19084/19084 [=====] - 29s 2ms/step - loss: 1.3952 - acc: 0.4063 - val\_loss: 1.3073 - val\_acc: 0.4399

Epoch 00003: val\_acc improved from 0.40780 to 0.43986, saving model to model\_v5accY\_Wrist-accZ\_Wrist.hdf5

Epoch 4/20

19084/19084 [=====] - 29s 2ms/step - loss: 1.2840 - acc: 0.4522 - val\_loss: 1.2258 - val\_acc: 0.4893

Epoch 00004: val\_acc improved from 0.43986 to 0.48931, saving model to model\_v5accY\_Wrist-accZ\_Wrist.hdf5

Epoch 5/20

19084/19084 [=====] - 29s 2ms/step - loss: 1.2393 - acc: 0.4761 - val\_loss: 1.1814 - val\_acc: 0.5094

Epoch 00005: val\_acc improved from 0.48931 to 0.50943, saving model to model\_v5accY\_Wrist-accZ\_Wrist.hdf5

Epoch 6/20

19084/19084 [=====] - 29s 2ms/step - loss: 1.1655 - acc: 0.5203 - val\_loss: 1.1112 - val\_acc: 0.5182

Epoch 00006: val\_acc improved from 0.50943 to 0.51823, saving model to model\_v5accY\_Wrist-accZ\_Wrist.hdf5

Epoch 7/20

19084/19084 [=====] - 29s 2ms/step - loss: 1.1182 - acc: 0.5340 - val\_loss: 1.0565 - val\_acc: 0.5612

Epoch 00007: val\_acc improved from 0.51823 to 0.56119, saving model to model\_v5accY\_Wrist-accZ\_Wrist.hdf5

Epoch 8/20

19084/19084 [=====] - 29s 2ms/step - loss: 1.1517 - acc:

```
c: 0.5160 - val_loss: 1.0471 - val_acc: 0.5740
```

```
Epoch 00008: val_acc improved from 0.56119 to 0.57397, saving model to model_v5  
accY_Wrist-accZ_Wrist.hdf5
```

```
Epoch 9/20
```

```
19084/19084 [=====] - 29s 2ms/step - loss: 1.1005 - ac  
c: 0.5388 - val_loss: 1.0672 - val_acc: 0.5679
```

```
Epoch 00009: val_acc did not improve from 0.57397
```

```
Epoch 10/20
```

```
19084/19084 [=====] - 30s 2ms/step - loss: 1.0564 - ac  
c: 0.5726 - val_loss: 1.0107 - val_acc: 0.5882
```

```
Epoch 00010: val_acc improved from 0.57397 to 0.58822, saving model to model_v5  
accY_Wrist-accZ_Wrist.hdf5
```

```
Epoch 11/20
```

```
19084/19084 [=====] - 29s 2ms/step - loss: 1.0591 - ac  
c: 0.5717 - val_loss: 1.0340 - val_acc: 0.5761
```

```
Epoch 00011: val_acc did not improve from 0.58822
```

```
Epoch 12/20
```

```
19084/19084 [=====] - 29s 2ms/step - loss: 1.0560 - ac  
c: 0.5714 - val_loss: 1.0062 - val_acc: 0.5970
```

```
Epoch 00012: val_acc improved from 0.58822 to 0.59702, saving model to model_v5  
accY_Wrist-accZ_Wrist.hdf5
```

```
Epoch 13/20
```

```
19084/19084 [=====] - 29s 2ms/step - loss: 1.0106 - ac  
c: 0.5907 - val_loss: 0.9278 - val_acc: 0.6184
```

```
Epoch 00013: val_acc improved from 0.59702 to 0.61840, saving model to model_v5  
accY_Wrist-accZ_Wrist.hdf5
```

```
Epoch 14/20
```

```
19084/19084 [=====] - 29s 2ms/step - loss: 0.9655 - ac  
c: 0.6094 - val_loss: 0.9208 - val_acc: 0.6308
```

```
Epoch 00014: val_acc improved from 0.61840 to 0.63076, saving model to model_v5  
accY_Wrist-accZ_Wrist.hdf5
```

```
Epoch 15/20
```

```
19084/19084 [=====] - 29s 2ms/step - loss: 0.9751 - ac  
c: 0.6034 - val_loss: 0.9392 - val_acc: 0.6031
```

```
Epoch 00015: val_acc did not improve from 0.63076
```

```
Epoch 16/20
```

```
19084/19084 [=====] - 29s 2ms/step - loss: 0.9474 - ac  
c: 0.6109 - val_loss: 0.8870 - val_acc: 0.6461
```

```
Epoch 00016: val_acc improved from 0.63076 to 0.64606, saving model to model_v5  
accY_Wrist-accZ_Wrist.hdf5
```

```
Epoch 17/20
```

```
19084/19084 [=====] - 29s 2ms/step - loss: 1.0047 - ac  
c: 0.5902 - val_loss: 0.9914 - val_acc: 0.6205
```

```
Epoch 00017: val_acc did not improve from 0.64606
```

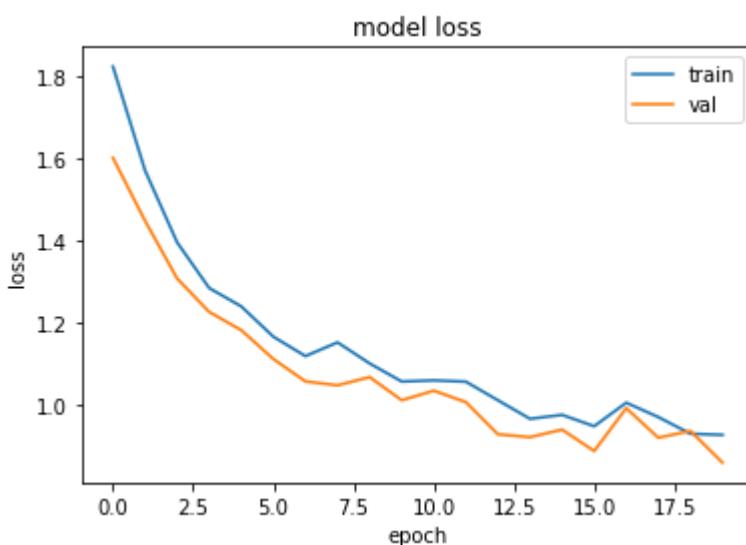
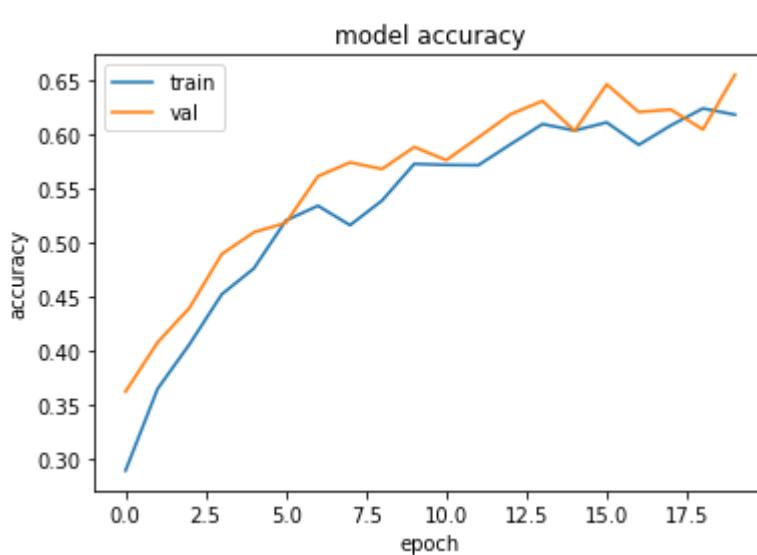
```
Epoch 18/20
```

```
19084/19084 [=====] - 29s 2ms/step - loss: 0.9697 - ac  
c: 0.6082 - val_loss: 0.9194 - val_acc: 0.6228
```

```
Epoch 00018: val_acc did not improve from 0.64606
Epoch 19/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.9292 - ac
c: 0.6238 - val_loss: 0.9360 - val_acc: 0.6044

Epoch 00019: val_acc did not improve from 0.64606
Epoch 20/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.9263 - ac
c: 0.6181 - val_loss: 0.8587 - val_acc: 0.6551

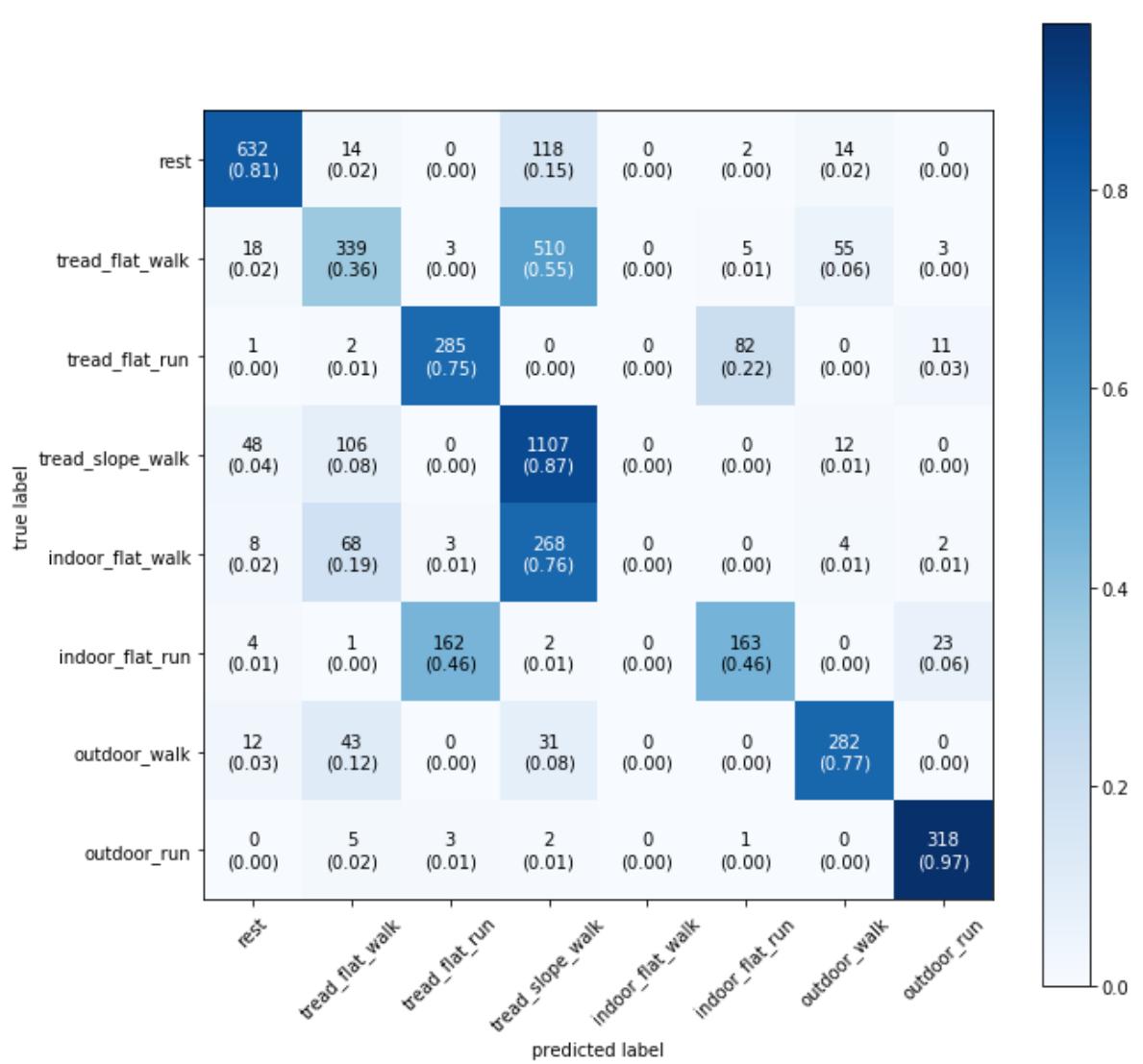
Epoch 00020: val_acc improved from 0.64606 to 0.65507, saving model to model_v5
accY_Wrist-accZ_Wrist.hdf5
```



Best accuracy (on validation dataset): 65.51%

```
[[ 632   14    0  118    0    2   14    0]
 [ 18   339    3  510    0    5   55    3]
 [  1     2  285    0    0   82    0   11]
 [ 48   106    0 1107    0    0   12    0]
 [  8    68    3  268    0    0    4    2]
 [  4     1 162    2    0 163    0   23]
 [ 12    43    0   31    0    0 282    0]
 [  0     5    3    2    0    1    0 318]
 [  0     0    0    0    0    0    0 11]
```

<Figure size 432x288 with 0 Axes>



## Classification Report:

	precision	recall	f1-score	support
rest	0.8741	0.8103	0.8410	780
tread_flat_walk	0.5865	0.3633	0.4487	933
tread_flat_run	0.6250	0.7480	0.6810	381
tread_slope_walk	0.5432	0.8696	0.6687	1273
indoor_flat_walk	0.0000	0.0000	0.0000	353
indoor_flat_run	0.6443	0.4592	0.5362	355
outdoor_walk	0.7684	0.7663	0.7673	368
outdoor_run	0.8908	0.9666	0.9271	329
accuracy			0.6551	4772
macro avg	0.6165	0.6229	0.6088	4772
weighted avg	0.6209	0.6551	0.6209	4772

Trying for these features ['accX\_LF', 'accY\_LF', 'accZ\_LF', 'accX\_Waist', 'accY\_Waist', 'accZ\_Waist']  
(19084, 256, 6)  
(19084, 8)  
(4772, 256, 6)  
(4772, 8)  
256  
6  
8

Layer (type)	Output Shape	Param #
<hr/>		
input_39 (InputLayer)	(None, 256, 6)	0
lstm_38 (LSTM)	(None, 100)	42800
dropout_38 (Dropout)	(None, 100)	0
dense_76 (Dense)	(None, 100)	10100
dense_77 (Dense)	(None, 8)	808
<hr/>		

Total params: 53,708

Trainable params: 53,708

Non-trainable params: 0

---

Train on 19084 samples, validate on 4772 samples

Epoch 1/20

19084/19084 [=====] - 34s 2ms/step - loss: 1.6589 - acc: 0.3380 - val\_loss: 1.1443 - val\_acc: 0.5404

Epoch 00001: val\_acc improved from -inf to 0.54044, saving model to model\_v5accX\_LF-accY\_LF-accZ\_LF-accX\_Waist-accY\_Waist-accZ\_Waist.hdf5

Epoch 2/20

19084/19084 [=====] - 29s 2ms/step - loss: 1.0234 - acc:

c: 0.5862 - val\_loss: 0.8151 - val\_acc: 0.6951

Epoch 00002: val\_acc improved from 0.54044 to 0.69510, saving model to model\_v5  
accX\_LF-accY\_LF-accZ\_LF-accX\_Waist-accY\_Waist-accZ\_Waist.hdf5

Epoch 3/20

19084/19084 [=====] - 30s 2ms/step - loss: 0.7987 - ac  
c: 0.7049 - val\_loss: 0.6490 - val\_acc: 0.7707

Epoch 00003: val\_acc improved from 0.69510 to 0.77075, saving model to model\_v5  
accX\_LF-accY\_LF-accZ\_LF-accX\_Waist-accY\_Waist-accZ\_Waist.hdf5

Epoch 4/20

19084/19084 [=====] - 29s 2ms/step - loss: 0.6278 - ac  
c: 0.7783 - val\_loss: 0.4827 - val\_acc: 0.8328

Epoch 00004: val\_acc improved from 0.77075 to 0.83277, saving model to model\_v5  
accX\_LF-accY\_LF-accZ\_LF-accX\_Waist-accY\_Waist-accZ\_Waist.hdf5

Epoch 5/20

19084/19084 [=====] - 29s 2ms/step - loss: 0.5429 - ac  
c: 0.8052 - val\_loss: 0.4145 - val\_acc: 0.8590

Epoch 00005: val\_acc improved from 0.83277 to 0.85897, saving model to model\_v5  
accX\_LF-accY\_LF-accZ\_LF-accX\_Waist-accY\_Waist-accZ\_Waist.hdf5

Epoch 6/20

19084/19084 [=====] - 29s 2ms/step - loss: 0.4459 - ac  
c: 0.8492 - val\_loss: 0.3436 - val\_acc: 0.8822

Epoch 00006: val\_acc improved from 0.85897 to 0.88223, saving model to model\_v5  
accX\_LF-accY\_LF-accZ\_LF-accX\_Waist-accY\_Waist-accZ\_Waist.hdf5

Epoch 7/20

19084/19084 [=====] - 29s 2ms/step - loss: 0.3900 - ac  
c: 0.8685 - val\_loss: 0.4828 - val\_acc: 0.8374

Epoch 00007: val\_acc did not improve from 0.88223

Epoch 8/20

19084/19084 [=====] - 29s 2ms/step - loss: 0.3881 - ac  
c: 0.8703 - val\_loss: 0.2517 - val\_acc: 0.9185

Epoch 00008: val\_acc improved from 0.88223 to 0.91848, saving model to model\_v5  
accX\_LF-accY\_LF-accZ\_LF-accX\_Waist-accY\_Waist-accZ\_Waist.hdf5

Epoch 9/20

19084/19084 [=====] - 29s 2ms/step - loss: 0.3034 - ac  
c: 0.9013 - val\_loss: 0.3489 - val\_acc: 0.8770

Epoch 00009: val\_acc did not improve from 0.91848

Epoch 10/20

19084/19084 [=====] - 29s 2ms/step - loss: 0.2813 - ac  
c: 0.9114 - val\_loss: 0.1842 - val\_acc: 0.9470

Epoch 00010: val\_acc improved from 0.91848 to 0.94698, saving model to model\_v5  
accX\_LF-accY\_LF-accZ\_LF-accX\_Waist-accY\_Waist-accZ\_Waist.hdf5

Epoch 11/20

19084/19084 [=====] - 29s 2ms/step - loss: 0.2351 - ac  
c: 0.9276 - val\_loss: 0.1570 - val\_acc: 0.9560

Epoch 00011: val\_acc improved from 0.94698 to 0.95599, saving model to model\_v5  
accX\_LF-accY\_LF-accZ\_LF-accX\_Waist-accY\_Waist-accZ\_Waist.hdf5

Epoch 12/20

```
19084/19084 [=====] - 29s 2ms/step - loss: 0.2526 - ac  
c: 0.9251 - val_loss: 0.2744 - val_acc: 0.9099

Epoch 00012: val_acc did not improve from 0.95599
Epoch 13/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.1932 - ac  
c: 0.9422 - val_loss: 0.1372 - val_acc: 0.9619

Epoch 00013: val_acc improved from 0.95599 to 0.96186, saving model to model_v5  
accX_LF-accY_LF-accZ_LF-accX_Waist-accY_Waist-accZ_Waist.hdf5
Epoch 14/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.1606 - ac  
c: 0.9562 - val_loss: 0.1475 - val_acc: 0.9600

Epoch 00014: val_acc did not improve from 0.96186
Epoch 15/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.1585 - ac  
c: 0.9564 - val_loss: 0.1163 - val_acc: 0.9669

Epoch 00015: val_acc improved from 0.96186 to 0.96689, saving model to model_v5  
accX_LF-accY_LF-accZ_LF-accX_Waist-accY_Waist-accZ_Waist.hdf5
Epoch 16/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.1359 - ac  
c: 0.9620 - val_loss: 0.1187 - val_acc: 0.9679

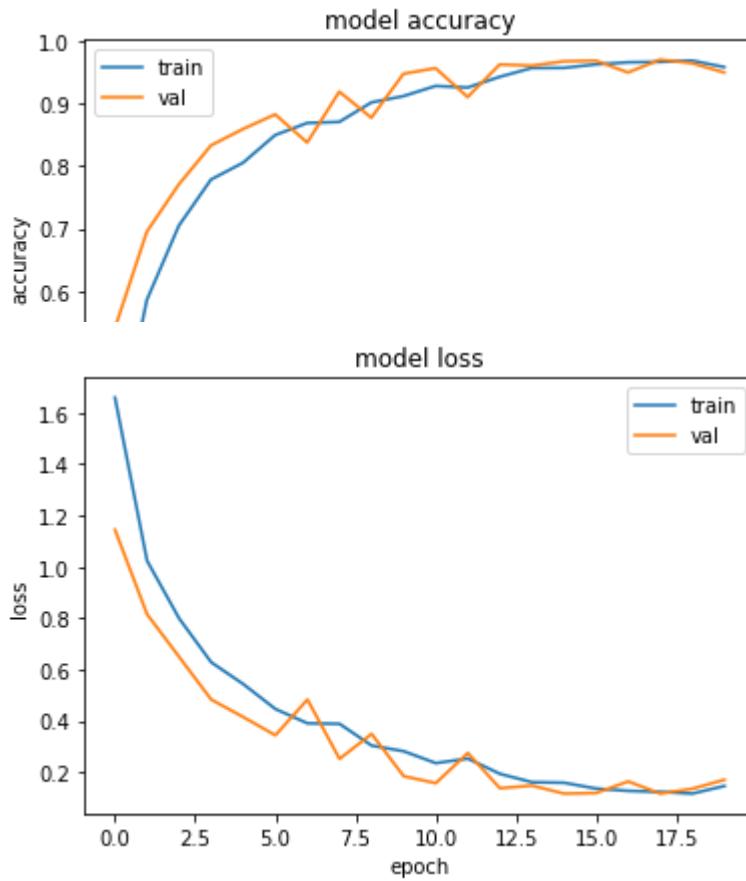
Epoch 00016: val_acc improved from 0.96689 to 0.96794, saving model to model_v5  
accX_LF-accY_LF-accZ_LF-accX_Waist-accY_Waist-accZ_Waist.hdf5
Epoch 17/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.1270 - ac  
c: 0.9653 - val_loss: 0.1636 - val_acc: 0.9491

Epoch 00017: val_acc did not improve from 0.96794
Epoch 18/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.1227 - ac  
c: 0.9659 - val_loss: 0.1161 - val_acc: 0.9696

Epoch 00018: val_acc improved from 0.96794 to 0.96961, saving model to model_v5  
accX_LF-accY_LF-accZ_LF-accX_Waist-accY_Waist-accZ_Waist.hdf5
Epoch 19/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.1165 - ac  
c: 0.9679 - val_loss: 0.1352 - val_acc: 0.9637

Epoch 00019: val_acc did not improve from 0.96961
Epoch 20/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.1459 - ac  
c: 0.9577 - val_loss: 0.1702 - val_acc: 0.9491

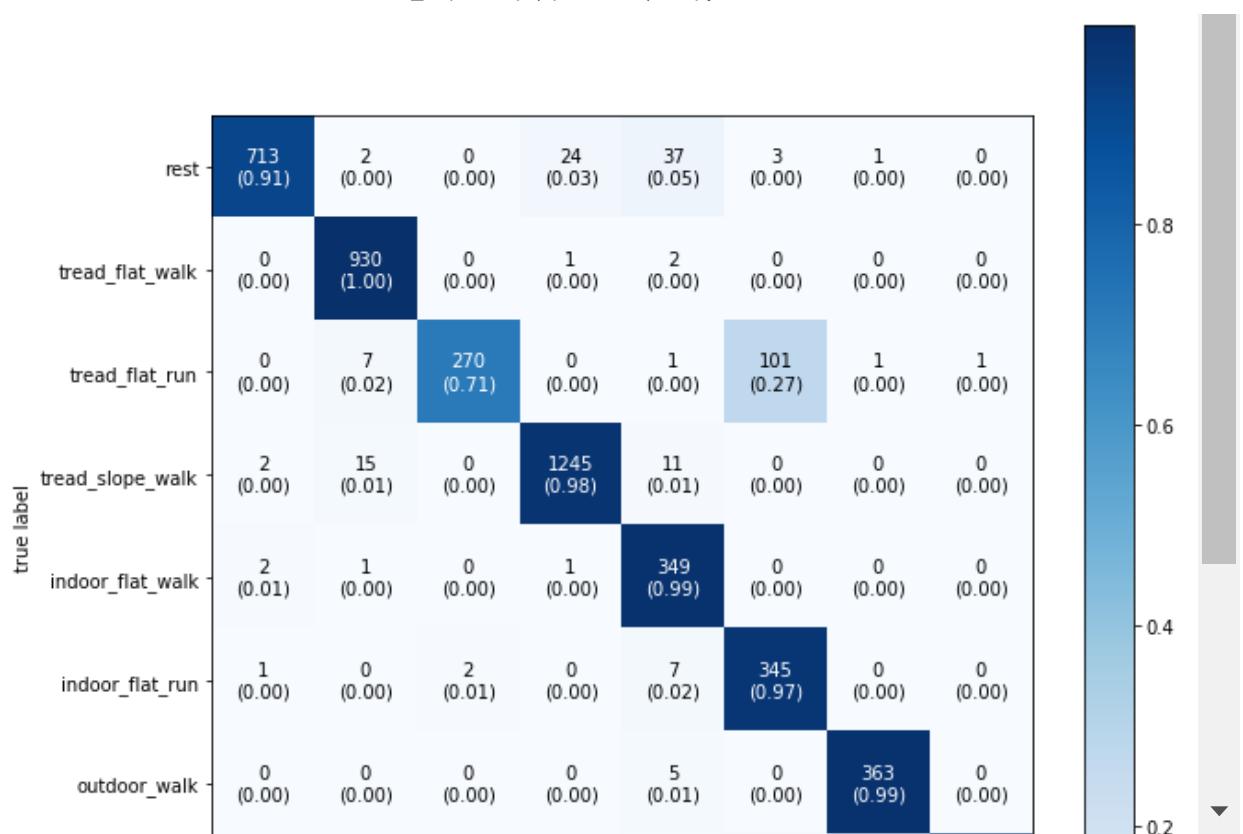
Epoch 00020: val_acc did not improve from 0.96961
```



Best accuracy (on validation dataset): 94.91%

```
[[ 713    2     0    24    37     3     1     0]
 [  0   930     0     1     2     0     0     0]
 [  0     7   270     0     1   101     1     1]
 [  2    15     0  1245    11     0     0     0]
 [  2     1     0     1   349     0     0     0]
 [  1     0     2     0     7   345     0     0]
 [  0     0     0     0     5     0   363     0]
 [  0     0     1     0     0     6     8  314]]
```

<Figure size 432x288 with 0 Axes>



## Classification Report:

	precision	recall	f1-score	support
rest	0.9930	0.9141	0.9519	780
tread_flat_walk	0.9738	0.9968	0.9852	933
tread_flat_run	0.9890	0.7087	0.8257	381
tread_slope_walk	0.9795	0.9780	0.9788	1273
indoor_flat_walk	0.8471	0.9887	0.9124	353
indoor_flat_run	0.7582	0.9718	0.8519	355
outdoor_walk	0.9732	0.9864	0.9798	368
outdoor_run	0.9968	0.9544	0.9752	329
accuracy			0.9491	4772
macro avg	0.9388	0.9374	0.9326	4772
weighted avg	0.9558	0.9491	0.9489	4772

Trying for these features ['accX\_LF', 'accY\_LF']  
(19084, 256, 2)  
(19084, 8)  
(4772, 256, 2)  
(4772, 8)  
256  
2  
8

Layer (type)	Output Shape	Param #
<hr/>		
input_40 (InputLayer)	(None, 256, 2)	0
lstm_39 (LSTM)	(None, 100)	41200
dropout_39 (Dropout)	(None, 100)	0

dense\_78 (Dense)

(None, 100)

10100

dense\_79 (Dense)

(None, 8)

808

Total params: 52,108

Trainable params: 52,108

Non-trainable params: 0

Train on 19084 samples, validate on 4772 samples

Epoch 1/20

19084/19084 [=====] - 34s 2ms/step - loss: 1.8334 - acc: 0.2947 - val\_loss: 1.4416 - val\_acc: 0.4352

Epoch 00001: val\_acc improved from -inf to 0.43525, saving model to model\_v5accX\_LF-accY\_LF.hdf5

Epoch 2/20

19084/19084 [=====] - 30s 2ms/step - loss: 1.2844 - acc: 0.4757 - val\_loss: 1.1019 - val\_acc: 0.5386

Epoch 00002: val\_acc improved from 0.43525 to 0.53856, saving model to model\_v5accX\_LF-accY\_LF.hdf5

Epoch 3/20

19084/19084 [=====] - 30s 2ms/step - loss: 1.1082 - acc: 0.5275 - val\_loss: 1.0195 - val\_acc: 0.5790

Epoch 00003: val\_acc improved from 0.53856 to 0.57900, saving model to model\_v5accX\_LF-accY\_LF.hdf5

Epoch 4/20

19084/19084 [=====] - 29s 2ms/step - loss: 1.0276 - acc: 0.5694 - val\_loss: 0.9422 - val\_acc: 0.6190

Epoch 00004: val\_acc improved from 0.57900 to 0.61903, saving model to model\_v5accX\_LF-accY\_LF.hdf5

Epoch 5/20

19084/19084 [=====] - 29s 2ms/step - loss: 0.9819 - acc: 0.5942 - val\_loss: 0.9170 - val\_acc: 0.6354

Epoch 00005: val\_acc improved from 0.61903 to 0.63537, saving model to model\_v5accX\_LF-accY\_LF.hdf5

Epoch 6/20

19084/19084 [=====] - 29s 2ms/step - loss: 0.9020 - acc: 0.6357 - val\_loss: 0.8321 - val\_acc: 0.6704

Epoch 00006: val\_acc improved from 0.63537 to 0.67037, saving model to model\_v5accX\_LF-accY\_LF.hdf5

Epoch 7/20

19084/19084 [=====] - 29s 2ms/step - loss: 0.9157 - acc: 0.6323 - val\_loss: 0.8660 - val\_acc: 0.6595

Epoch 00007: val\_acc did not improve from 0.67037

Epoch 8/20

19084/19084 [=====] - 29s 2ms/step - loss: 0.8737 - acc: 0.6478 - val\_loss: 0.8109 - val\_acc: 0.6882

Epoch 00008: val\_acc improved from 0.67037 to 0.68818, saving model to model\_v5accX\_LF-accY\_LF.hdf5

Epoch 9/20

```
19084/19084 [=====] - 30s 2ms/step - loss: 0.8190 - ac  
c: 0.6720 - val_loss: 0.7274 - val_acc: 0.7131
```

Epoch 00009: val\_acc improved from 0.68818 to 0.71312, saving model to model\_v5  
accX\_LF-accY\_LF.hdf5

Epoch 10/20

```
19084/19084 [=====] - 29s 2ms/step - loss: 0.7809 - ac  
c: 0.6857 - val_loss: 0.7394 - val_acc: 0.7077
```

Epoch 00010: val\_acc did not improve from 0.71312

Epoch 11/20

```
19084/19084 [=====] - 29s 2ms/step - loss: 0.7689 - ac  
c: 0.6947 - val_loss: 0.7190 - val_acc: 0.7123
```

Epoch 00011: val\_acc did not improve from 0.71312

Epoch 12/20

```
19084/19084 [=====] - 30s 2ms/step - loss: 0.7399 - ac  
c: 0.7081 - val_loss: 0.6814 - val_acc: 0.7345
```

Epoch 00012: val\_acc improved from 0.71312 to 0.73449, saving model to model\_v5  
accX\_LF-accY\_LF.hdf5

Epoch 13/20

```
19084/19084 [=====] - 29s 2ms/step - loss: 0.7142 - ac  
c: 0.7226 - val_loss: 0.6412 - val_acc: 0.7475
```

Epoch 00013: val\_acc improved from 0.73449 to 0.74749, saving model to model\_v5  
accX\_LF-accY\_LF.hdf5

Epoch 14/20

```
19084/19084 [=====] - 29s 2ms/step - loss: 0.8850 - ac  
c: 0.6563 - val_loss: 0.7522 - val_acc: 0.7137
```

Epoch 00014: val\_acc did not improve from 0.74749

Epoch 15/20

```
19084/19084 [=====] - 30s 2ms/step - loss: 0.8856 - ac  
c: 0.6799 - val_loss: 1.2759 - val_acc: 0.5612
```

Epoch 00015: val\_acc did not improve from 0.74749

Epoch 16/20

```
19084/19084 [=====] - 29s 2ms/step - loss: 0.9331 - ac  
c: 0.6433 - val_loss: 0.7382 - val_acc: 0.7169
```

Epoch 00016: val\_acc did not improve from 0.74749

Epoch 17/20

```
19084/19084 [=====] - 30s 2ms/step - loss: 0.7676 - ac  
c: 0.7100 - val_loss: 0.6773 - val_acc: 0.7433
```

Epoch 00017: val\_acc did not improve from 0.74749

Epoch 18/20

```
19084/19084 [=====] - 29s 2ms/step - loss: 0.7100 - ac  
c: 0.7245 - val_loss: 0.6513 - val_acc: 0.7525
```

Epoch 00018: val\_acc improved from 0.74749 to 0.75251, saving model to model\_v5  
accX\_LF-accY\_LF.hdf5

Epoch 19/20

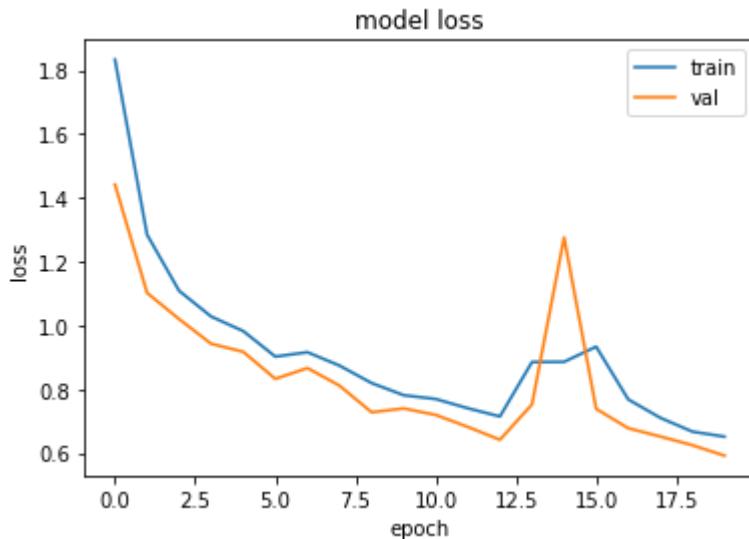
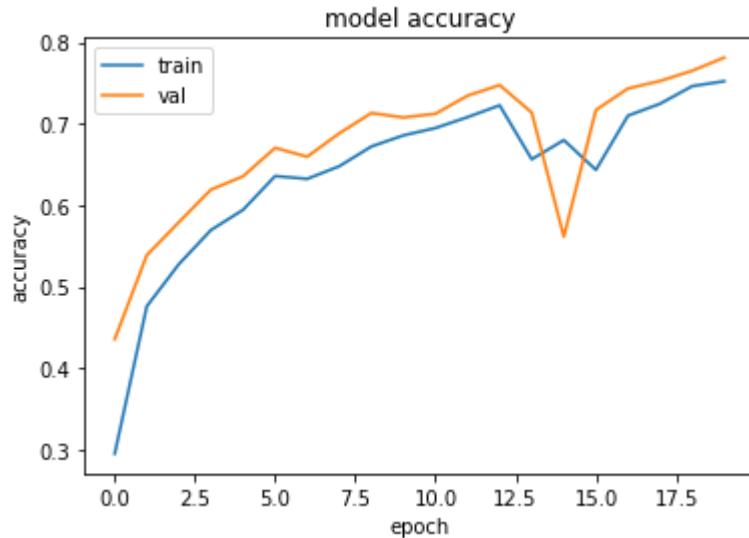
```
19084/19084 [=====] - 29s 2ms/step - loss: 0.6666 - ac  
c: 0.7462 - val_loss: 0.6241 - val_acc: 0.7651
```

Epoch 00019: val\_acc improved from 0.75251 to 0.76509, saving model to model\_v5  
accX\_LF-accY\_LF.hdf5

Epoch 20/20

19084/19084 [=====] - 29s 2ms/step - loss: 0.6509 - ac  
c: 0.7522 - val\_loss: 0.5914 - val\_acc: 0.7812

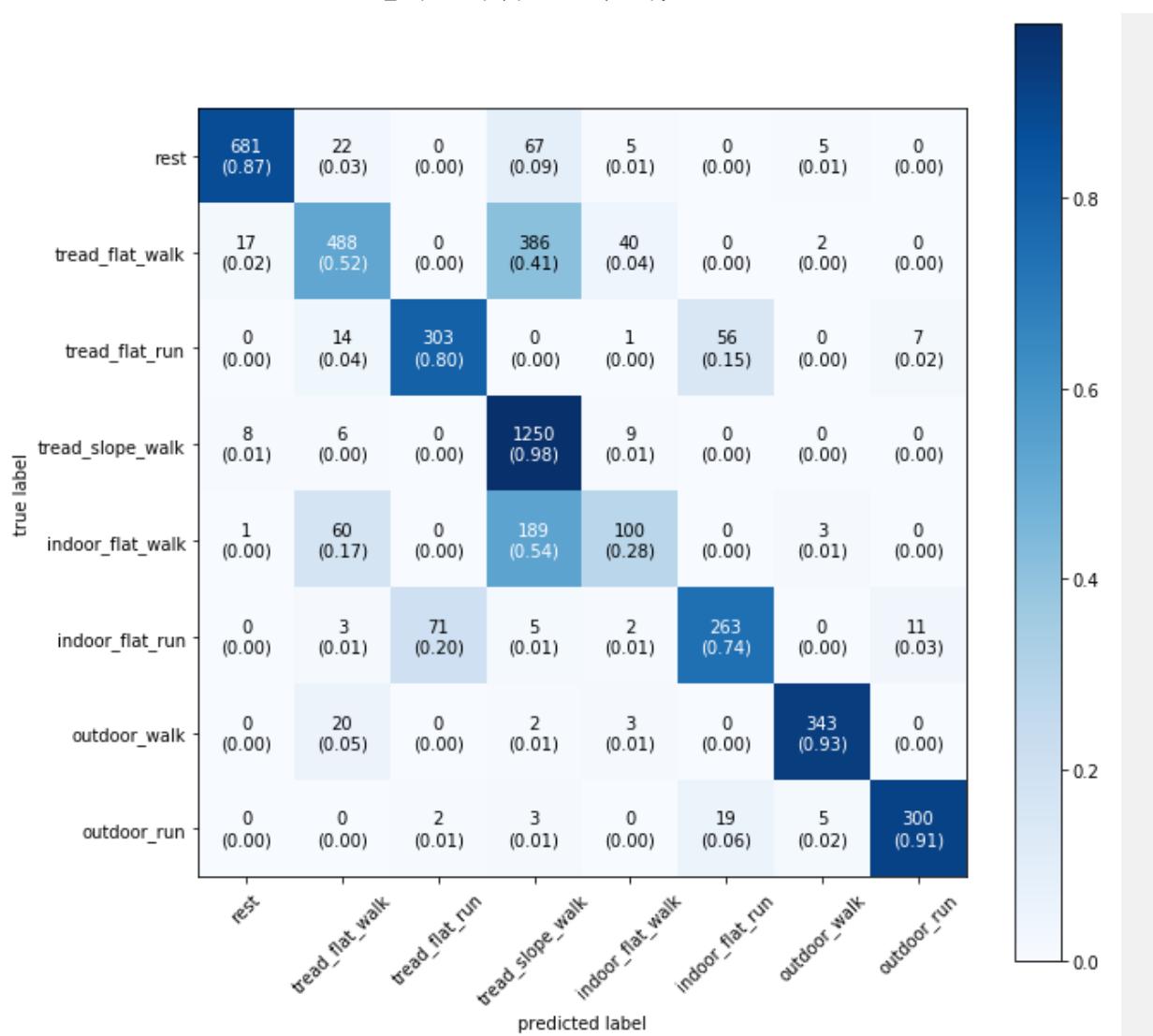
Epoch 00020: val\_acc improved from 0.76509 to 0.78122, saving model to model\_v5  
accX\_LF-accY\_LF.hdf5



Best accuracy (on validation dataset): 78.12%

```
[[ 681   22    0   67    5    0    5    0]
 [ 17  488    0  386   40    0    2    0]
 [  0   14  303    0    1   56    0    7]
 [  8    6    0 1250    9    0    0    0]
 [  1   60    0  189   100   0    3    0]
 [  0    3   71    5    2  263    0   11]
 [  0   20    0    2    3    0  343    0]
 [  0    0    2    3    0   19    5 300]]
```

<Figure size 432x288 with 0 Axes>



## Classification Report:

	precision	recall	f1-score	support
rest	0.9632	0.8731	0.9159	780
tread_flat_walk	0.7961	0.5230	0.6313	933
tread_flat_run	0.8059	0.7953	0.8005	381
tread_slope_walk	0.6572	0.9819	0.7874	1273
indoor_flat_walk	0.6250	0.2833	0.3899	353
indoor_flat_run	0.7781	0.7408	0.7590	355
outdoor_walk	0.9581	0.9321	0.9449	368
outdoor_run	0.9434	0.9119	0.9274	329
accuracy			0.7812	4772
macro avg	0.8159	0.7552	0.7695	4772
weighted avg	0.7958	0.7812	0.7692	4772

Trying for these features ['accX\_LF', 'accZ\_LF']

(19084, 256, 2)

(19084, 8)

(4772, 256, 2)

(4772, 8)

256

2

8

Layer (type)	Output Shape	Param #
<hr/>		
input_41 (InputLayer)	(None, 256, 2)	0
lstm_40 (LSTM)	(None, 100)	41200
dropout_40 (Dropout)	(None, 100)	0
dense_80 (Dense)	(None, 100)	10100
dense_81 (Dense)	(None, 8)	808
<hr/>		
Total params: 52,108		
Trainable params: 52,108		
Non-trainable params: 0		

---

Train on 19084 samples, validate on 4772 samples

Epoch 1/20

19084/19084 [=====] - 35s 2ms/step - loss: 1.8903 - acc: 0.2684 - val\_loss: 1.7253 - val\_acc: 0.3039

Epoch 00001: val\_acc improved from -inf to 0.30386, saving model to model\_v5accX\_LF-accZ\_LF.hdf5

Epoch 2/20

19084/19084 [=====] - 30s 2ms/step - loss: 1.5490 - acc: 0.3856 - val\_loss: 1.3537 - val\_acc: 0.4451

Epoch 00002: val\_acc improved from 0.30386 to 0.44510, saving model to model\_v5accX\_LF-accZ\_LF.hdf5

Epoch 3/20

19084/19084 [=====] - 30s 2ms/step - loss: 1.3525 - acc: 0.4564 - val\_loss: 1.2424 - val\_acc: 0.4975

Epoch 00003: val\_acc improved from 0.44510 to 0.49749, saving model to model\_v5accX\_LF-accZ\_LF.hdf5

Epoch 4/20

19084/19084 [=====] - 30s 2ms/step - loss: 1.2051 - acc: 0.5212 - val\_loss: 1.1722 - val\_acc: 0.5467

Epoch 00004: val\_acc improved from 0.49749 to 0.54673, saving model to model\_v5accX\_LF-accZ\_LF.hdf5

Epoch 5/20

19084/19084 [=====] - 29s 2ms/step - loss: 1.2003 - acc: 0.5355 - val\_loss: 1.1592 - val\_acc: 0.5608

Epoch 00005: val\_acc improved from 0.54673 to 0.56077, saving model to model\_v5accX\_LF-accZ\_LF.hdf5

Epoch 6/20

19084/19084 [=====] - 30s 2ms/step - loss: 1.2755 - acc: 0.5108 - val\_loss: 1.2128 - val\_acc: 0.5163

Epoch 00006: val\_acc did not improve from 0.56077

Epoch 7/20

19084/19084 [=====] - 30s 2ms/step - loss: 1.1720 - acc: 0.5286 - val\_loss: 1.0989 - val\_acc: 0.5593

```
Epoch 00007: val_acc did not improve from 0.56077
Epoch 8/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.0934 - ac
c: 0.5661 - val_loss: 1.0341 - val_acc: 0.5943

Epoch 00008: val_acc improved from 0.56077 to 0.59430, saving model to model_v5
accX_LF-accZ_LF.hdf5
Epoch 9/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.0599 - ac
c: 0.5793 - val_loss: 1.1003 - val_acc: 0.5717

Epoch 00009: val_acc did not improve from 0.59430
Epoch 10/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.0990 - ac
c: 0.5675 - val_loss: 0.9842 - val_acc: 0.6119

Epoch 00010: val_acc improved from 0.59430 to 0.61190, saving model to model_v5
accX_LF-accZ_LF.hdf5
Epoch 11/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.0333 - ac
c: 0.5956 - val_loss: 0.9366 - val_acc: 0.6343

Epoch 00011: val_acc improved from 0.61190 to 0.63433, saving model to model_v5
accX_LF-accZ_LF.hdf5
Epoch 12/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.9742 - ac
c: 0.6136 - val_loss: 0.9121 - val_acc: 0.6482

Epoch 00012: val_acc improved from 0.63433 to 0.64816, saving model to model_v5
accX_LF-accZ_LF.hdf5
Epoch 13/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.9357 - ac
c: 0.6268 - val_loss: 0.8863 - val_acc: 0.6521

Epoch 00013: val_acc improved from 0.64816 to 0.65214, saving model to model_v5
accX_LF-accZ_LF.hdf5
Epoch 14/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.9241 - ac
c: 0.6349 - val_loss: 0.8726 - val_acc: 0.6570

Epoch 00014: val_acc improved from 0.65214 to 0.65696, saving model to model_v5
accX_LF-accZ_LF.hdf5
Epoch 15/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.8926 - ac
c: 0.6447 - val_loss: 0.8786 - val_acc: 0.6584

Epoch 00015: val_acc improved from 0.65696 to 0.65842, saving model to model_v5
accX_LF-accZ_LF.hdf5
Epoch 16/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.9407 - ac
c: 0.6259 - val_loss: 0.9106 - val_acc: 0.6203

Epoch 00016: val_acc did not improve from 0.65842
Epoch 17/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.9228 - ac
c: 0.6320 - val_loss: 0.9141 - val_acc: 0.6370
```

```

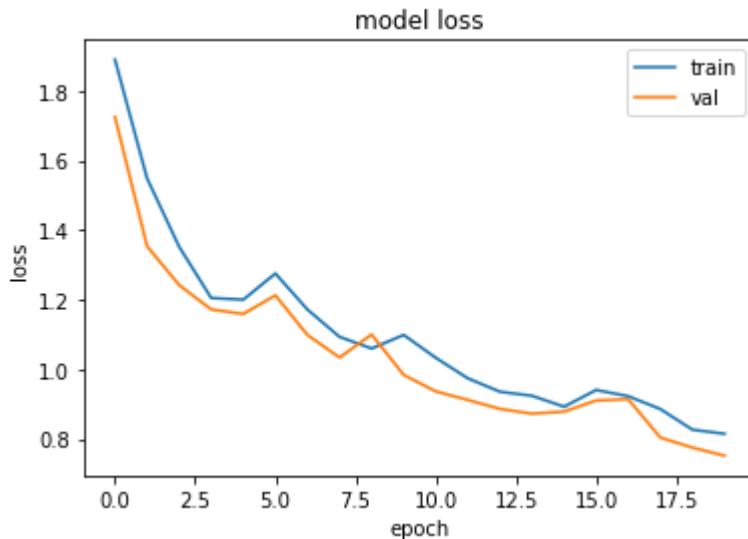
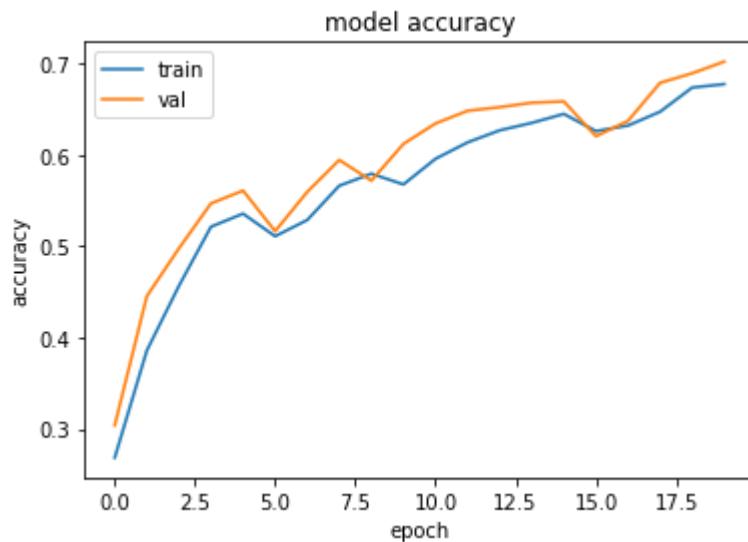
Epoch 00017: val_acc did not improve from 0.65842
Epoch 18/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.8859 - ac
c: 0.6471 - val_loss: 0.8041 - val_acc: 0.6788

Epoch 00018: val_acc improved from 0.65842 to 0.67875, saving model to model_v5
accX_LF-accZ_LF.hdf5
Epoch 19/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.8266 - ac
c: 0.6736 - val_loss: 0.7750 - val_acc: 0.6892

Epoch 00019: val_acc improved from 0.67875 to 0.68923, saving model to model_v5
accX_LF-accZ_LF.hdf5
Epoch 20/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.8148 - ac
c: 0.6773 - val_loss: 0.7520 - val_acc: 0.7020

Epoch 00020: val_acc improved from 0.68923 to 0.70201, saving model to model_v5
accX_LF-accZ_LF.hdf5

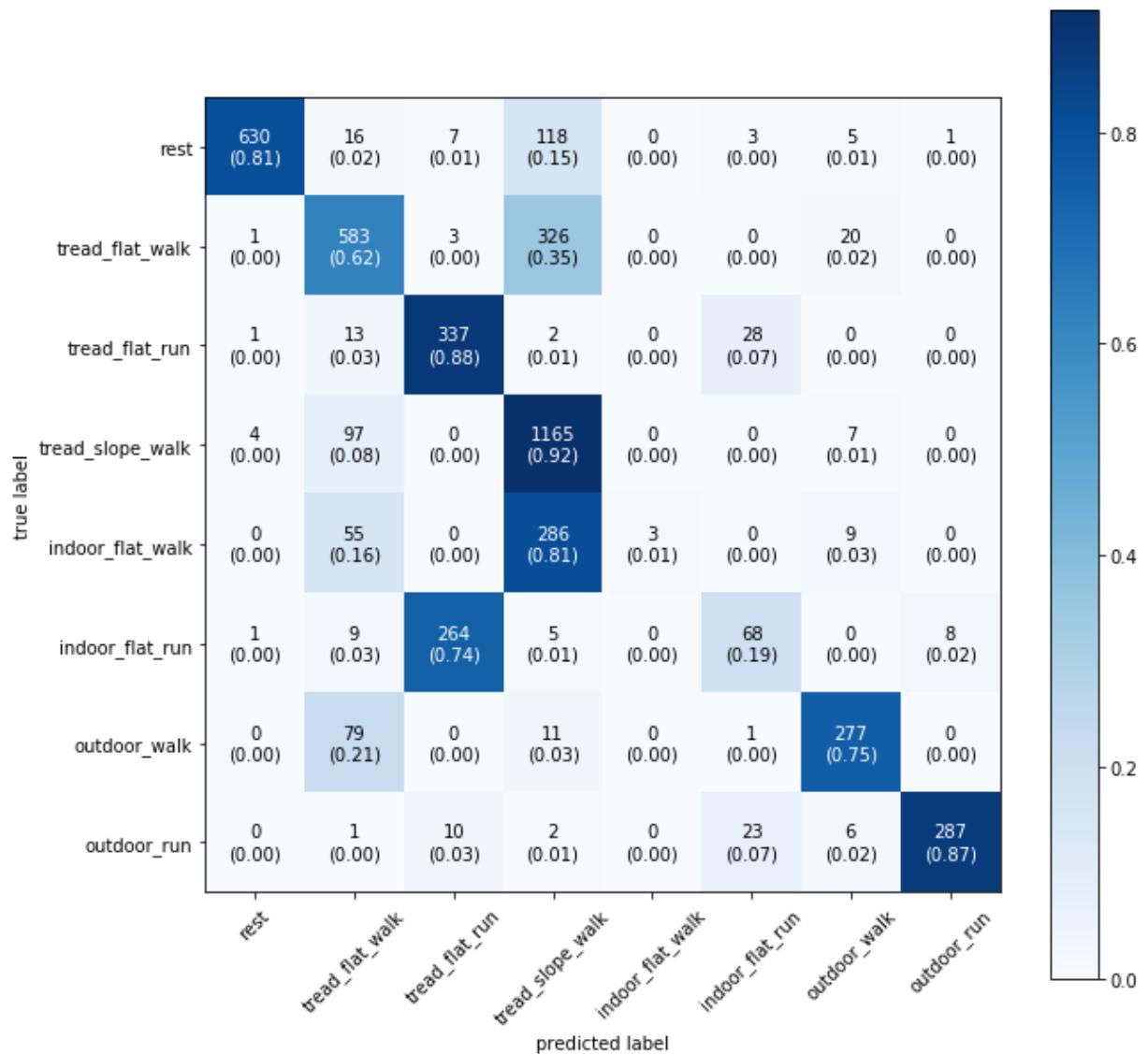
```



Best accuracy (on validation dataset): 70.20%  
[[ 630 16 7 118 0 3 5 1]]

```
[ 1 583 3 326 0 0 20 0]
[ 1 13 337 2 0 28 0 0]
[ 4 97 0 1165 0 0 7 0]
[ 0 55 0 286 3 0 9 0]
[ 1 9 264 5 0 68 0 8]
[ 0 79 0 11 0 1 277 0]
[ 0 1 10 2 0 23 6 287] ]
```

&lt;Figure size 432x288 with 0 Axes&gt;



## Classification Report:

	precision	recall	f1-score	support
rest	0.9890	0.8077	0.8892	780
tread_flat_walk	0.6835	0.6249	0.6529	933
tread_flat_run	0.5427	0.8845	0.6727	381
tread_slope_walk	0.6084	0.9152	0.7309	1273
indoor_flat_walk	1.0000	0.0085	0.0169	353
indoor_flat_run	0.5528	0.1915	0.2845	355
outdoor_walk	0.8549	0.7527	0.8006	368
outdoor_run	0.9696	0.8723	0.9184	329
accuracy			0.7020	4772
macro avg	0.7751	0.6322	0.6207	4772

weighted avg	0.7488	0.7020	0.6691	4772
--------------	--------	--------	--------	------

Trying for these features ['accX\_LF', 'accX\_Wrist']  
(19084, 256, 2)  
(19084, 8)  
(4772, 256, 2)  
(4772, 8)  
256  
2  
8

Layer (type)	Output Shape	Param #
<hr/>		
input_42 (InputLayer)	(None, 256, 2)	0
lstm_41 (LSTM)	(None, 100)	41200
dropout_41 (Dropout)	(None, 100)	0
dense_82 (Dense)	(None, 100)	10100
dense_83 (Dense)	(None, 8)	808
<hr/>		
Total params: 52,108		
Trainable params: 52,108		
Non-trainable params: 0		

---

Train on 19084 samples, validate on 4772 samples

Epoch 1/20

19084/19084 [=====] - 34s 2ms/step - loss: 1.7211 - ac  
c: 0.3097 - val\_loss: 1.4018 - val\_acc: 0.3793

Epoch 00001: val\_acc improved from -inf to 0.37930, saving model to model\_v5acc  
X\_LF-accX\_Wrist.hdf5

Epoch 2/20

19084/19084 [=====] - 29s 2ms/step - loss: 1.3981 - ac  
c: 0.3881 - val\_loss: 1.2957 - val\_acc: 0.4707

Epoch 00002: val\_acc improved from 0.37930 to 0.47066, saving model to model\_v5  
accX\_LF-accX\_Wrist.hdf5

Epoch 3/20

19084/19084 [=====] - 29s 2ms/step - loss: 1.2335 - ac  
c: 0.4799 - val\_loss: 1.1468 - val\_acc: 0.5249

Epoch 00003: val\_acc improved from 0.47066 to 0.52494, saving model to model\_v5  
accX\_LF-accX\_Wrist.hdf5

Epoch 4/20

19084/19084 [=====] - 29s 2ms/step - loss: 1.1518 - ac  
c: 0.5061 - val\_loss: 1.1044 - val\_acc: 0.5379

Epoch 00004: val\_acc improved from 0.52494 to 0.53793, saving model to model\_v5  
accX\_LF-accX\_Wrist.hdf5

Epoch 5/20

19084/19084 [=====] - 30s 2ms/step - loss: 1.1263 - ac  
c: 0.5244 - val\_loss: 1.0465 - val\_acc: 0.5578

Epoch 00005: val\_acc improved from 0.53793 to 0.55784, saving model to model\_v5

```
accX_LF-accX_Wrist.hdf5
Epoch 6/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.0637 - ac
c: 0.5506 - val_loss: 1.0466 - val_acc: 0.5696

Epoch 00006: val_acc improved from 0.55784 to 0.56957, saving model to model_v5
accX_LF-accX_Wrist.hdf5
Epoch 7/20
19084/19084 [=====] - 29s 2ms/step - loss: 1.0485 - ac
c: 0.5623 - val_loss: 0.9662 - val_acc: 0.6092

Epoch 00007: val_acc improved from 0.56957 to 0.60918, saving model to model_v5
accX_LF-accX_Wrist.hdf5
Epoch 8/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.0228 - ac
c: 0.5792 - val_loss: 0.9475 - val_acc: 0.6230

Epoch 00008: val_acc improved from 0.60918 to 0.62301, saving model to model_v5
accX_LF-accX_Wrist.hdf5
Epoch 9/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.0110 - ac
c: 0.5875 - val_loss: 0.9085 - val_acc: 0.6339

Epoch 00009: val_acc improved from 0.62301 to 0.63391, saving model to model_v5
accX_LF-accX_Wrist.hdf5
Epoch 10/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.9626 - ac
c: 0.6107 - val_loss: 0.8903 - val_acc: 0.6538

Epoch 00010: val_acc improved from 0.63391 to 0.65381, saving model to model_v5
accX_LF-accX_Wrist.hdf5
Epoch 11/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.9284 - ac
c: 0.6310 - val_loss: 0.8869 - val_acc: 0.6486

Epoch 00011: val_acc did not improve from 0.65381
Epoch 12/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.8807 - ac
c: 0.6513 - val_loss: 0.7936 - val_acc: 0.7104

Epoch 00012: val_acc improved from 0.65381 to 0.71039, saving model to model_v5
accX_LF-accX_Wrist.hdf5
Epoch 13/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.8695 - ac
c: 0.6585 - val_loss: 0.8412 - val_acc: 0.6855

Epoch 00013: val_acc did not improve from 0.71039
Epoch 14/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.8852 - ac
c: 0.6547 - val_loss: 0.8396 - val_acc: 0.6739

Epoch 00014: val_acc did not improve from 0.71039
Epoch 15/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.8494 - ac
c: 0.6746 - val_loss: 0.8144 - val_acc: 0.6964

Epoch 00015: val_acc did not improve from 0.71039
```

```
Epoch 16/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.8561 - ac
c: 0.6782 - val_loss: 0.8084 - val_acc: 0.6959

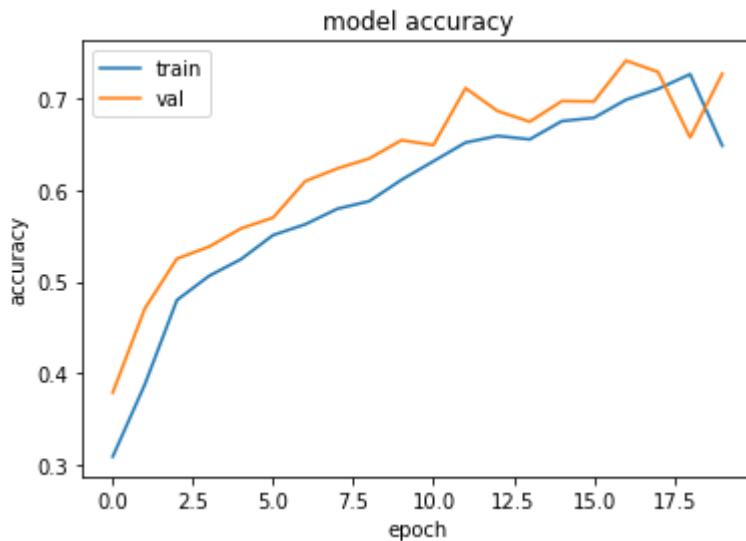
Epoch 00016: val_acc did not improve from 0.71039
Epoch 17/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.8010 - ac
c: 0.6978 - val_loss: 0.7273 - val_acc: 0.7404

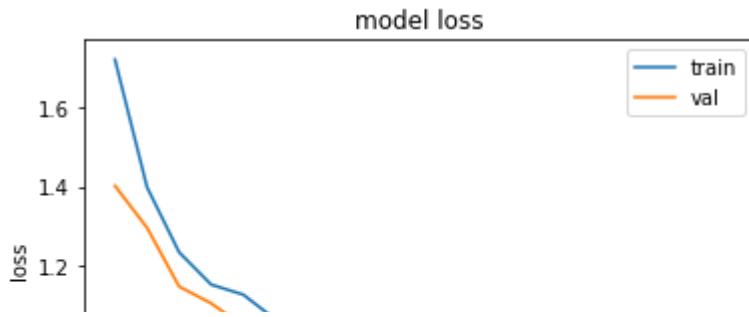
Epoch 00017: val_acc improved from 0.71039 to 0.74036, saving model to model_v5
accX_LF-accX_Wrist.hdf5
Epoch 18/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.7870 - ac
c: 0.7096 - val_loss: 0.7189 - val_acc: 0.7280

Epoch 00018: val_acc did not improve from 0.74036
Epoch 19/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.7642 - ac
c: 0.7256 - val_loss: 1.0372 - val_acc: 0.6567

Epoch 00019: val_acc did not improve from 0.74036
Epoch 20/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.9342 - ac
c: 0.6479 - val_loss: 0.7514 - val_acc: 0.7261

Epoch 00020: val_acc did not improve from 0.74036
```

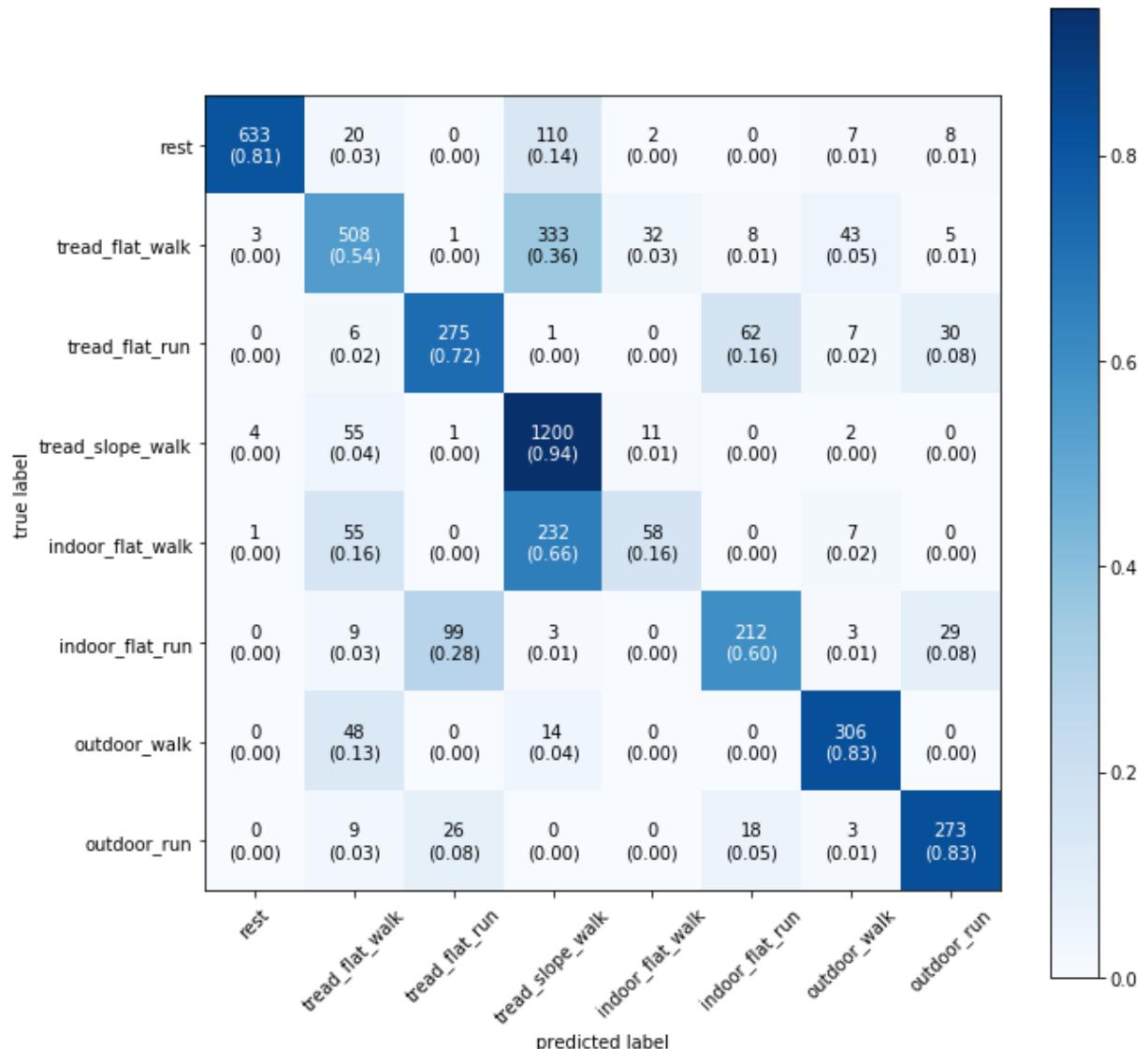




Best accuracy (on validation dataset): 72.61%

```
[[ 633   20    0   110    2    0    7    8]
 [  3   508   1   333   32    8   43    5]
 [  0    6  275   1    0   62    7  30]
 [  4   55   1 1200   11    0    2    0]
 [  1   55   0  232   58    0    7    0]
 [  0    9   99   3    0  212    3  29]
 [  0   48   0   14    0    0  306    0]
 [  0    9   26   0    0   18    3 273]]
```

<Figure size 432x288 with 0 Axes>



#### Classification Report:

	precision	recall	f1-score	support
--	-----------	--------	----------	---------

rest	0.9875	0.8115	0.8909	780
tread_flat_walk	0.7155	0.5445	0.6184	933
tread_flat_run	0.6841	0.7218	0.7024	381
tread_slope_walk	0.6339	0.9427	0.7581	1273
indoor_flat_walk	0.5631	0.1643	0.2544	353
indoor_flat_run	0.7067	0.5972	0.6473	355
outdoor_walk	0.8095	0.8315	0.8204	368
outdoor_run	0.7913	0.8298	0.8101	329
accuracy			0.7261	4772
macro avg	0.7365	0.6804	0.6877	4772
weighted avg	0.7362	0.7261	0.7109	4772

Trying for these features ['accX\_LF', 'accY\_Wrist']

(19084, 256, 2)

(19084, 8)

(4772, 256, 2)

(4772, 8)

256

2

8

Layer (type)	Output Shape	Param #
<hr/>		
input_43 (InputLayer)	(None, 256, 2)	0
lstm_42 (LSTM)	(None, 100)	41200
dropout_42 (Dropout)	(None, 100)	0
dense_84 (Dense)	(None, 100)	10100
dense_85 (Dense)	(None, 8)	808
<hr/>		

Total params: 52,108

Trainable params: 52,108

Non-trainable params: 0

---

Train on 19084 samples, validate on 4772 samples

Epoch 1/20

19084/19084 [=====] - 34s 2ms/step - loss: 1.8019 - acc: 0.2903 - val\_loss: 1.5109 - val\_acc: 0.3676

Epoch 00001: val\_acc improved from -inf to 0.36756, saving model to model\_v5a\_ccX\_LF-accY\_Wrist.hdf5

Epoch 2/20

19084/19084 [=====] - 29s 2ms/step - loss: 1.3255 - acc: 0.4560 - val\_loss: 1.1630 - val\_acc: 0.5019

Epoch 00002: val\_acc improved from 0.36756 to 0.50189, saving model to model\_v5accX\_LF-accY\_Wrist.hdf5

Epoch 3/20

19084/19084 [=====] - 29s 2ms/step - loss: 1.1595 - acc: 0.5161 - val\_loss: 1.0902 - val\_acc: 0.5495

Epoch 00003: val\_acc improved from 0.50189 to 0.54946, saving model to model\_

```
v5accX_LF-accY_Wrist.hdf5
Epoch 4/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.1355 -
acc: 0.5270 - val_loss: 1.0844 - val_acc: 0.5463

Epoch 00004: val_acc did not improve from 0.54946
Epoch 5/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.0997 -
acc: 0.5309 - val_loss: 1.0336 - val_acc: 0.5725

Epoch 00005: val_acc improved from 0.54946 to 0.57251, saving model to model_
v5accX_LF-accY_Wrist.hdf5
Epoch 6/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.0377 -
acc: 0.5677 - val_loss: 1.0059 - val_acc: 0.5855

Epoch 00006: val_acc improved from 0.57251 to 0.58550, saving model to model_
v5accX_LF-accY_Wrist.hdf5
Epoch 7/20
19084/19084 [=====] - 31s 2ms/step - loss: 1.0222 -
acc: 0.5776 - val_loss: 1.1191 - val_acc: 0.5497

Epoch 00007: val_acc did not improve from 0.58550
Epoch 8/20
19084/19084 [=====] - 31s 2ms/step - loss: 1.0172 -
acc: 0.5715 - val_loss: 0.9176 - val_acc: 0.6234

Epoch 00008: val_acc improved from 0.58550 to 0.62343, saving model to model_
v5accX_LF-accY_Wrist.hdf5
Epoch 9/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.9351 -
acc: 0.6175 - val_loss: 0.8618 - val_acc: 0.6683

Epoch 00009: val_acc improved from 0.62343 to 0.66827, saving model to model_
v5accX_LF-accY_Wrist.hdf5
Epoch 10/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.9007 -
acc: 0.6441 - val_loss: 0.8197 - val_acc: 0.6639

Epoch 00010: val_acc did not improve from 0.66827
Epoch 11/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.8902 -
acc: 0.6440 - val_loss: 0.8469 - val_acc: 0.6695

Epoch 00011: val_acc improved from 0.66827 to 0.66953, saving model to model_
v5accX_LF-accY_Wrist.hdf5
Epoch 12/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.8611 -
acc: 0.6599 - val_loss: 0.8775 - val_acc: 0.6488

Epoch 00012: val_acc did not improve from 0.66953
Epoch 13/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.9205 -
acc: 0.6302 - val_loss: 0.8265 - val_acc: 0.6714

Epoch 00013: val_acc improved from 0.66953 to 0.67142, saving model to model_
v5accX_LF-accY_Wrist.hdf5
```

```
Epoch 14/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.8577 -
acc: 0.6639 - val_loss: 0.8710 - val_acc: 0.6576

Epoch 00014: val_acc did not improve from 0.67142
Epoch 15/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.8386 -
acc: 0.6763 - val_loss: 0.7388 - val_acc: 0.7313

Epoch 00015: val_acc improved from 0.67142 to 0.73135, saving model to model_
v5accX_LF-accY_Wrist.hdf5
Epoch 16/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.7830 -
acc: 0.7061 - val_loss: 0.7359 - val_acc: 0.7244

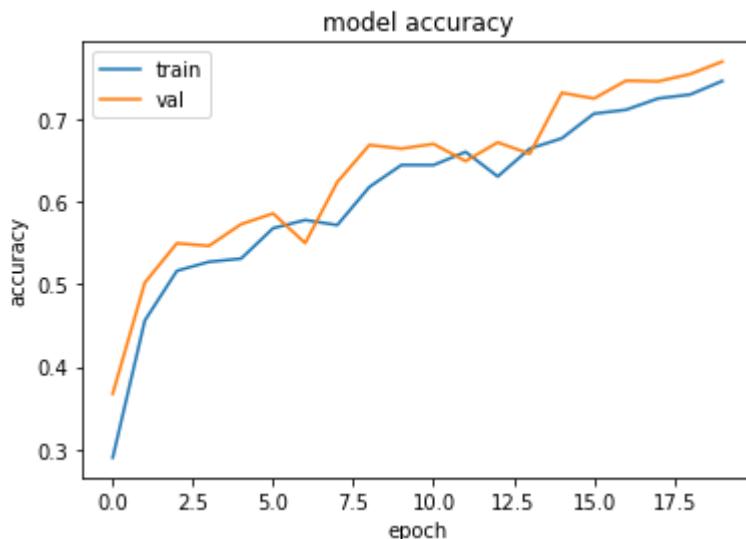
Epoch 00016: val_acc did not improve from 0.73135
Epoch 17/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.7769 -
acc: 0.7108 - val_loss: 0.6939 - val_acc: 0.7460

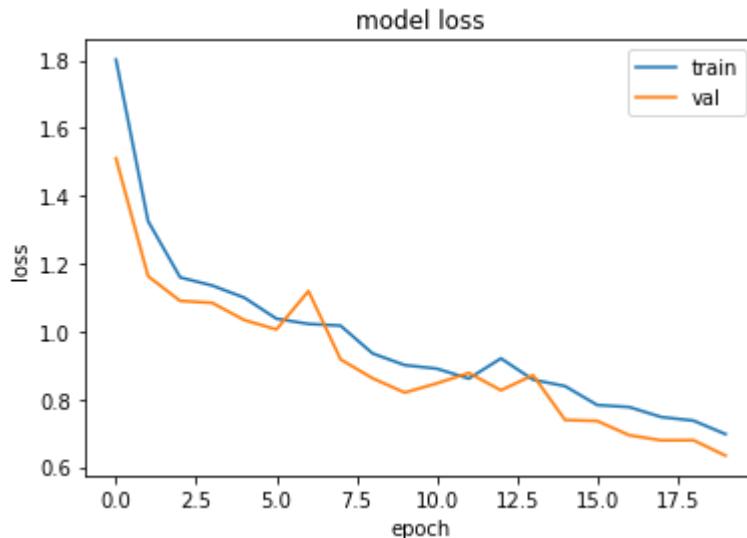
Epoch 00017: val_acc improved from 0.73135 to 0.74602, saving model to model_
v5accX_LF-accY_Wrist.hdf5
Epoch 18/20
19084/19084 [=====] - 31s 2ms/step - loss: 0.7475 -
acc: 0.7245 - val_loss: 0.6787 - val_acc: 0.7452

Epoch 00018: val_acc did not improve from 0.74602
Epoch 19/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.7370 -
acc: 0.7292 - val_loss: 0.6792 - val_acc: 0.7540

Epoch 00019: val_acc improved from 0.74602 to 0.75398, saving model to model_
v5accX_LF-accY_Wrist.hdf5
Epoch 20/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.6971 -
acc: 0.7456 - val_loss: 0.6336 - val_acc: 0.7691

Epoch 00020: val_acc improved from 0.75398 to 0.76907, saving model to model_
v5accX_LF-accY_Wrist.hdf5
```

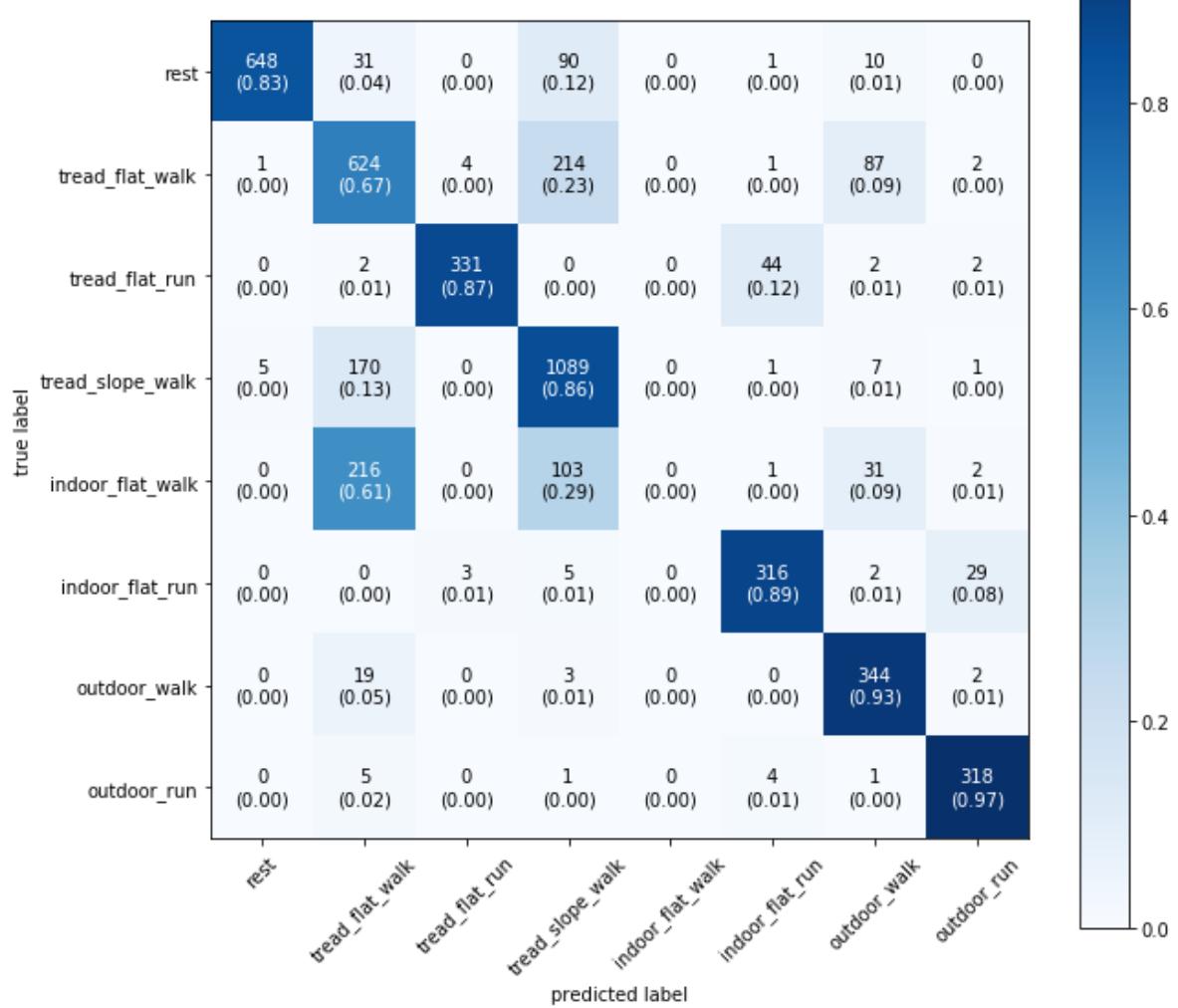




Best accuracy (on validation dataset): 76.91%

```
[[ 648   31     0    90     0     1    10     0]
 [  1   624     4   214     0     1    87     2]
 [  0     2  331     0     0    44     2     2]
 [  5   170     0 1089     0     1     7     1]
 [  0   216     0   103     0     1    31     2]
 [  0     0     3     5     0   316     2    29]
 [  0     19     0     3     0     0   344     2]
 [  0     5     0     1     0     4     1  318]]
```

<Figure size 432x288 with 0 Axes>



## Classification Report:

	precision	recall	f1-score	support
rest	0.9908	0.8308	0.9038	780
tread_flat_walk	0.5848	0.6688	0.6240	933
tread_flat_run	0.9793	0.8688	0.9207	381
tread_slope_walk	0.7236	0.8555	0.7840	1273
indoor_flat_walk	0.0000	0.0000	0.0000	353
indoor_flat_run	0.8587	0.8901	0.8741	355
outdoor_walk	0.7107	0.9348	0.8075	368
outdoor_run	0.8933	0.9666	0.9285	329
accuracy			0.7691	4772
macro avg	0.7177	0.7519	0.7303	4772
weighted avg	0.7278	0.7691	0.7437	4772

Trying for these features ['accX\_LF', 'accZ\_Wrist']  
(19084, 256, 2)  
(19084, 8)  
(4772, 256, 2)  
(4772, 8)

256

2

8

Layer (type)	Output Shape	Param #
<hr/>		
input_44 (InputLayer)	(None, 256, 2)	0
<hr/>		
lstm_43 (LSTM)	(None, 100)	41200
<hr/>		
dropout_43 (Dropout)	(None, 100)	0
<hr/>		
dense_86 (Dense)	(None, 100)	10100
<hr/>		
dense_87 (Dense)	(None, 8)	808
<hr/>		

Total params: 52,108

Trainable params: 52,108

Non-trainable params: 0

---

Train on 19084 samples, validate on 4772 samples

Epoch 1/20

19084/19084 [=====] - 35s 2ms/step - loss: 1.8651 - acc: 0.2743 - val\_loss: 1.6007 - val\_acc: 0.3504

Epoch 00001: val\_acc improved from -inf to 0.35038, saving model to model\_v5accX\_LF-accZ\_Wrist.hdf5

Epoch 2/20

19084/19084 [=====] - 30s 2ms/step - loss: 1.4852 - acc: 0.3900 - val\_loss: 1.3038 - val\_acc: 0.4623

Epoch 00002: val\_acc improved from 0.35038 to 0.46228, saving model to model\_v5accX\_LF-accZ\_Wrist.hdf5

Epoch 3/20

19084/19084 [=====] - 30s 2ms/step - loss: 1.3343 - acc: 0.4583 - val\_loss: 1.2431 - val\_acc: 0.5096

Epoch 00003: val\_acc improved from 0.46228 to 0.50964, saving model to model\_v5accX\_LF-accZ\_Wrist.hdf5

Epoch 4/20

19084/19084 [=====] - 30s 2ms/step - loss: 1.2091 - acc: 0.5078 - val\_loss: 1.1277 - val\_acc: 0.5438

Epoch 00004: val\_acc improved from 0.50964 to 0.54380, saving model to model\_v5accX\_LF-accZ\_Wrist.hdf5

Epoch 5/20

19084/19084 [=====] - 30s 2ms/step - loss: 1.1230 - acc: 0.5446 - val\_loss: 1.0481 - val\_acc: 0.5928

Epoch 00005: val\_acc improved from 0.54380 to 0.59283, saving model to model\_v5accX\_LF-accZ\_Wrist.hdf5

Epoch 6/20

19084/19084 [=====] - 30s 2ms/step - loss: 1.1011 - acc: 0.5602 - val\_loss: 1.0891 - val\_acc: 0.5863

Epoch 00006: val\_acc did not improve from 0.59283

Epoch 7/20

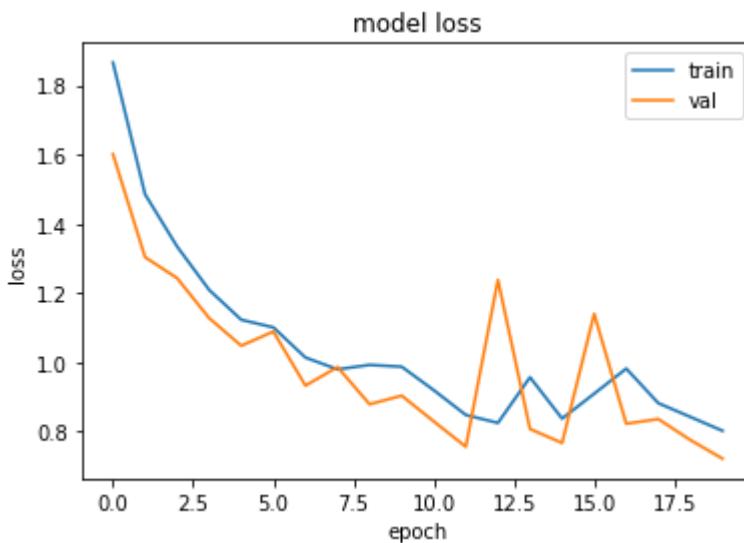
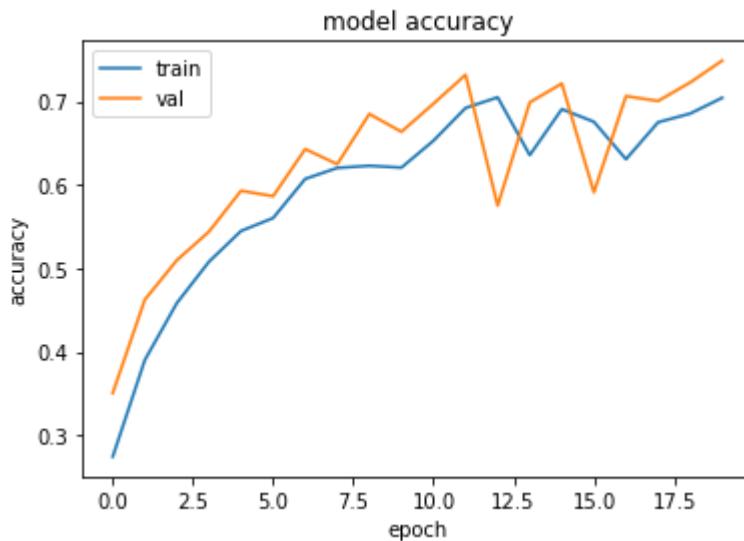
```
19084/19084 [=====] - 30s 2ms/step - loss: 1.0141 -  
acc: 0.6070 - val_loss: 0.9332 - val_acc: 0.6427  
  
Epoch 00007: val_acc improved from 0.59283 to 0.64271, saving model to model_  
v5accX_LF-accZ_Wrist.hdf5  
Epoch 8/20  
19084/19084 [=====] - 30s 2ms/step - loss: 0.9800 -  
acc: 0.6202 - val_loss: 0.9866 - val_acc: 0.6247  
  
Epoch 00008: val_acc did not improve from 0.64271  
Epoch 9/20  
19084/19084 [=====] - 30s 2ms/step - loss: 0.9929 -  
acc: 0.6228 - val_loss: 0.8793 - val_acc: 0.6848  
  
Epoch 00009: val_acc improved from 0.64271 to 0.68483, saving model to model_  
v5accX_LF-accZ_Wrist.hdf5  
Epoch 10/20  
19084/19084 [=====] - 29s 2ms/step - loss: 0.9876 -  
acc: 0.6206 - val_loss: 0.9041 - val_acc: 0.6635  
  
Epoch 00010: val_acc did not improve from 0.68483  
Epoch 11/20  
19084/19084 [=====] - 30s 2ms/step - loss: 0.9199 -  
acc: 0.6529 - val_loss: 0.8299 - val_acc: 0.6972  
  
Epoch 00011: val_acc improved from 0.68483 to 0.69719, saving model to model_  
v5accX_LF-accZ_Wrist.hdf5  
Epoch 12/20  
19084/19084 [=====] - 30s 2ms/step - loss: 0.8484 -  
acc: 0.6920 - val_loss: 0.7567 - val_acc: 0.7318  
  
Epoch 00012: val_acc improved from 0.69719 to 0.73177, saving model to model_  
v5accX_LF-accZ_Wrist.hdf5  
Epoch 13/20  
19084/19084 [=====] - 29s 2ms/step - loss: 0.8255 -  
acc: 0.7047 - val_loss: 1.2380 - val_acc: 0.5750  
  
Epoch 00013: val_acc did not improve from 0.73177  
Epoch 14/20  
19084/19084 [=====] - 30s 2ms/step - loss: 0.9572 -  
acc: 0.6355 - val_loss: 0.8080 - val_acc: 0.6987  
  
Epoch 00014: val_acc did not improve from 0.73177  
Epoch 15/20  
19084/19084 [=====] - 30s 2ms/step - loss: 0.8380 -  
acc: 0.6906 - val_loss: 0.7676 - val_acc: 0.7213  
  
Epoch 00015: val_acc did not improve from 0.73177  
Epoch 16/20  
19084/19084 [=====] - 30s 2ms/step - loss: 0.9098 -  
acc: 0.6754 - val_loss: 1.1402 - val_acc: 0.5909  
  
Epoch 00016: val_acc did not improve from 0.73177  
Epoch 17/20  
19084/19084 [=====] - 30s 2ms/step - loss: 0.9822 -  
acc: 0.6306 - val_loss: 0.8232 - val_acc: 0.7062
```

```
Epoch 00017: val_acc did not improve from 0.73177
Epoch 18/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.8825 -
acc: 0.6749 - val_loss: 0.8366 - val_acc: 0.7003

Epoch 00018: val_acc did not improve from 0.73177
Epoch 19/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.8427 -
acc: 0.6853 - val_loss: 0.7761 - val_acc: 0.7225

Epoch 00019: val_acc did not improve from 0.73177
Epoch 20/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.8028 -
acc: 0.7042 - val_loss: 0.7224 - val_acc: 0.7487

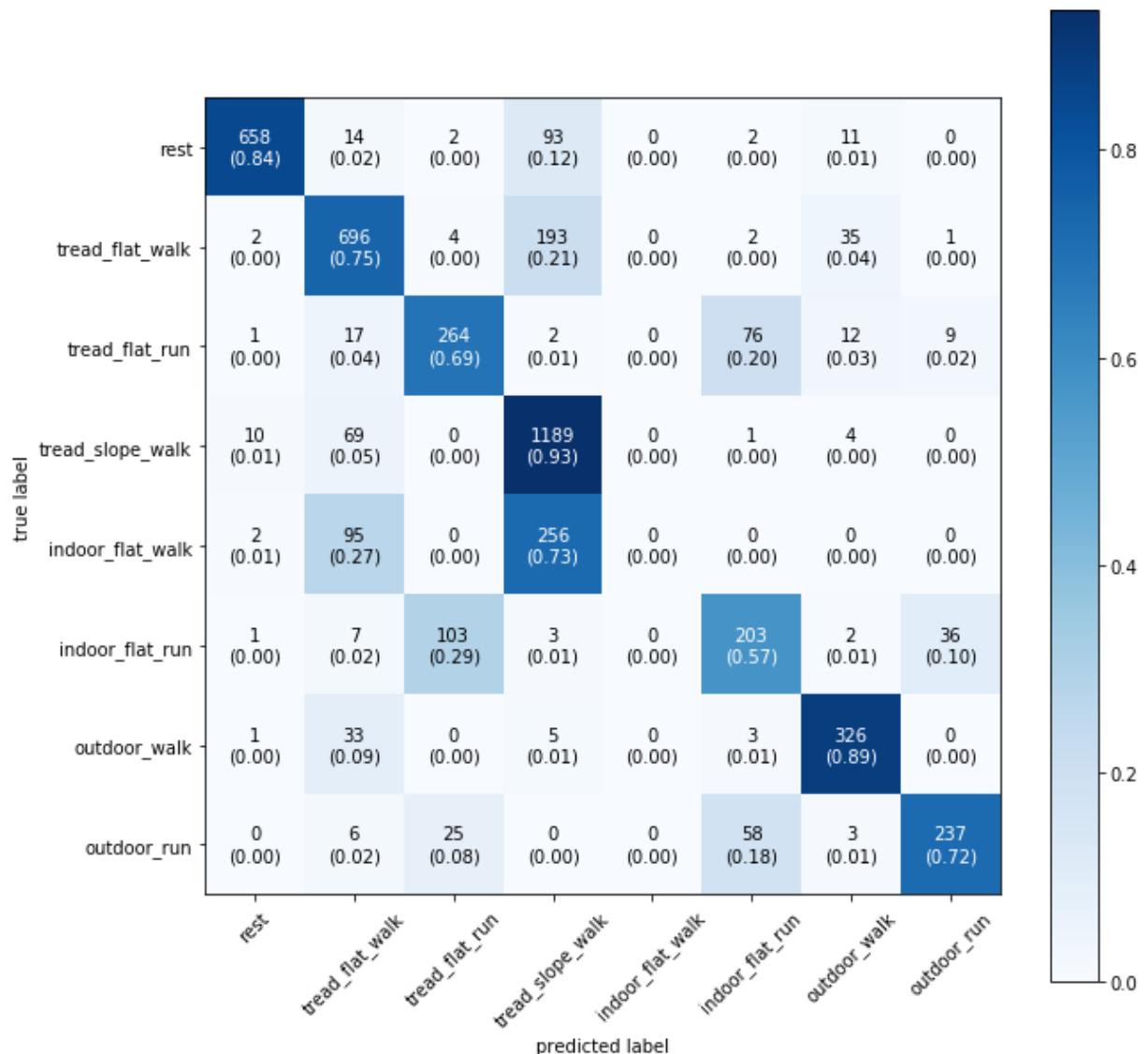
Epoch 00020: val_acc improved from 0.73177 to 0.74874, saving model to model_
v5accX_LF-accZ_Wrist.hdf5
```



Best accuracy (on validation dataset): 74.87%

```
[[ 658   14    2   93    0    2   11    0]
 [  2  696    4  193    0    2   35    1]
 [  1   17   264    2    0   76   12    9]
 [ 10   69    0 1189    0    1    4    0]
 [  2   95    0  256    0    0    0    0]
 [  1    7  103    3    0  203    2   36]
 [  1   33    0    5    0    3  326    0]
 [  0    6   25    0    0   58    3 237]]
```

<Figure size 432x288 with 0 Axes>



#### Classification Report:

	precision	recall	f1-score	support
rest	0.9748	0.8436	0.9045	780
tread_flat_walk	0.7428	0.7460	0.7444	933

tread_flat_run	0.6633	0.6929	0.6778	381
tread_slope_walk	0.6829	0.9340	0.7890	1273
indoor_flat_walk	0.0000	0.0000	0.0000	353
indoor_flat_run	0.5884	0.5718	0.5800	355
outdoor_walk	0.8295	0.8859	0.8568	368
outdoor_run	0.8375	0.7204	0.7745	329
accuracy			0.7487	4772
macro avg	0.6649	0.6743	0.6659	4772
weighted avg	0.7052	0.7487	0.7206	4772

Trying for these features ['accY\_LF', 'accZ\_LF']

(19084, 256, 2)

(19084, 8)

(4772, 256, 2)

(4772, 8)

256

2

8

Layer (type)	Output Shape	Param #
<hr/>		
input_45 (InputLayer)	(None, 256, 2)	0
lstm_44 (LSTM)	(None, 100)	41200
dropout_44 (Dropout)	(None, 100)	0
dense_88 (Dense)	(None, 100)	10100
dense_89 (Dense)	(None, 8)	808
<hr/>		

Total params: 52,108

Trainable params: 52,108

Non-trainable params: 0

---

Train on 19084 samples, validate on 4772 samples

Epoch 1/20

19084/19084 [=====] - 35s 2ms/step - loss: 1.7816 - acc: 0.3209 - val\_loss: 1.4953 - val\_acc: 0.4191

Epoch 00001: val\_acc improved from -inf to 0.41911, saving model to model\_v5accY\_LF-accZ\_LF.hdf5

Epoch 2/20

19084/19084 [=====] - 32s 2ms/step - loss: 1.3392 - acc: 0.4603 - val\_loss: 1.2195 - val\_acc: 0.5034

Epoch 00002: val\_acc improved from 0.41911 to 0.50335, saving model to model\_v5accY\_LF-accZ\_LF.hdf5

Epoch 3/20

19084/19084 [=====] - 30s 2ms/step - loss: 1.1856 - acc: 0.4995 - val\_loss: 1.0837 - val\_acc: 0.5516

Epoch 00003: val\_acc improved from 0.50335 to 0.55155, saving model to model\_v5accY\_LF-accZ\_LF.hdf5

Epoch 4/20

19084/19084 [=====] - 30s 2ms/step - loss: 1.1060 - acc:

c: 0.5427 - val\_loss: 1.0300 - val\_acc: 0.5752

Epoch 00004: val\_acc improved from 0.55155 to 0.57523, saving model to model\_v5  
accY\_LF-accZ\_LF.hdf5

Epoch 5/20

19084/19084 [=====] - 29s 2ms/step - loss: 1.0503 - ac  
c: 0.5657 - val\_loss: 0.9976 - val\_acc: 0.5951

Epoch 00005: val\_acc improved from 0.57523 to 0.59514, saving model to model\_v5  
accY\_LF-accZ\_LF.hdf5

Epoch 6/20

19084/19084 [=====] - 30s 2ms/step - loss: 0.9940 - ac  
c: 0.6006 - val\_loss: 0.9771 - val\_acc: 0.6079

Epoch 00006: val\_acc improved from 0.59514 to 0.60792, saving model to model\_v5  
accY\_LF-accZ\_LF.hdf5

Epoch 7/20

19084/19084 [=====] - 30s 2ms/step - loss: 0.9530 - ac  
c: 0.6167 - val\_loss: 0.8956 - val\_acc: 0.6398

Epoch 00007: val\_acc improved from 0.60792 to 0.63977, saving model to model\_v5  
accY\_LF-accZ\_LF.hdf5

Epoch 8/20

19084/19084 [=====] - 30s 2ms/step - loss: 0.9214 - ac  
c: 0.6357 - val\_loss: 0.9088 - val\_acc: 0.6484

Epoch 00008: val\_acc improved from 0.63977 to 0.64837, saving model to model\_v5  
accY\_LF-accZ\_LF.hdf5

Epoch 9/20

19084/19084 [=====] - 30s 2ms/step - loss: 0.8871 - ac  
c: 0.6501 - val\_loss: 0.8348 - val\_acc: 0.6683

Epoch 00009: val\_acc improved from 0.64837 to 0.66827, saving model to model\_v5  
accY\_LF-accZ\_LF.hdf5

Epoch 10/20

19084/19084 [=====] - 32s 2ms/step - loss: 0.8279 - ac  
c: 0.6795 - val\_loss: 0.7918 - val\_acc: 0.6947

Epoch 00010: val\_acc improved from 0.66827 to 0.69468, saving model to model\_v5  
accY\_LF-accZ\_LF.hdf5

Epoch 11/20

19084/19084 [=====] - 30s 2ms/step - loss: 0.7919 - ac  
c: 0.6982 - val\_loss: 0.7315 - val\_acc: 0.7225

Epoch 00011: val\_acc improved from 0.69468 to 0.72255, saving model to model\_v5  
accY\_LF-accZ\_LF.hdf5

Epoch 12/20

19084/19084 [=====] - 32s 2ms/step - loss: 0.7720 - ac  
c: 0.7054 - val\_loss: 0.7701 - val\_acc: 0.7154

Epoch 00012: val\_acc did not improve from 0.72255

Epoch 13/20

19084/19084 [=====] - 30s 2ms/step - loss: 0.7184 - ac  
c: 0.7279 - val\_loss: 0.6882 - val\_acc: 0.7456

Epoch 00013: val\_acc improved from 0.72255 to 0.74560, saving model to model\_v5  
accY\_LF-accZ\_LF.hdf5

```
Epoch 14/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.6900 - ac
c: 0.7433 - val_loss: 0.6398 - val_acc: 0.7628

Epoch 00014: val_acc improved from 0.74560 to 0.76278, saving model to model_v5
accY_LF-accZ_LF.hdf5
Epoch 15/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.6520 - ac
c: 0.7538 - val_loss: 0.6055 - val_acc: 0.7751

Epoch 00015: val_acc improved from 0.76278 to 0.77515, saving model to model_v5
accY_LF-accZ_LF.hdf5
Epoch 16/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.6191 - ac
c: 0.7723 - val_loss: 0.5806 - val_acc: 0.7795

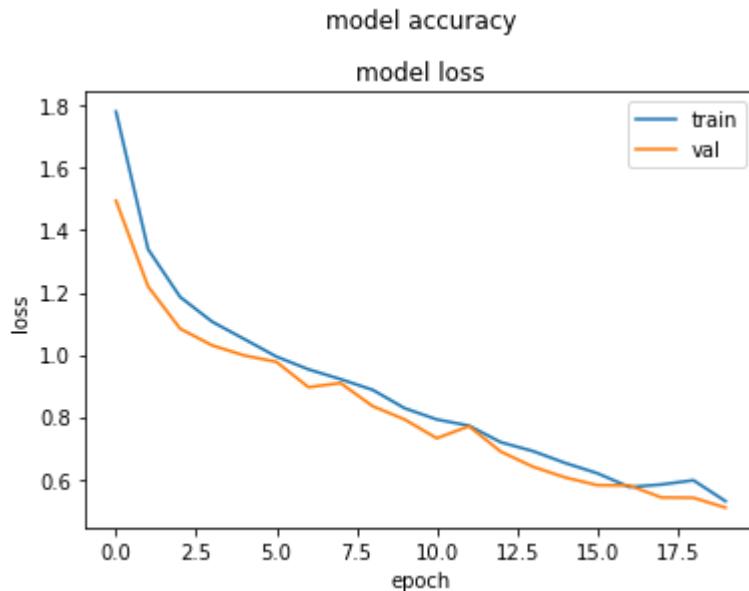
Epoch 00016: val_acc improved from 0.77515 to 0.77955, saving model to model_v5
accY_LF-accZ_LF.hdf5
Epoch 17/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.5747 - ac
c: 0.7861 - val_loss: 0.5799 - val_acc: 0.7741

Epoch 00017: val_acc did not improve from 0.77955
Epoch 18/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.5826 - ac
c: 0.7783 - val_loss: 0.5411 - val_acc: 0.7951

Epoch 00018: val_acc improved from 0.77955 to 0.79505, saving model to model_v5
accY_LF-accZ_LF.hdf5
Epoch 19/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.5963 - ac
c: 0.7748 - val_loss: 0.5401 - val_acc: 0.7974

Epoch 00019: val_acc improved from 0.79505 to 0.79736, saving model to model_v5
accY_LF-accZ_LF.hdf5
Epoch 20/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.5292 - ac
c: 0.8058 - val_loss: 0.5084 - val_acc: 0.8018

Epoch 00020: val_acc improved from 0.79736 to 0.80176, saving model to model_v5
accY_LF-accZ_LF.hdf5
```



Best accuracy (on validation dataset): 80.18%

```
[[ 681   32     0    43    21     3     0     0]
 [  1   683     1   171    76     0     1     0]
 [  1     6   356     0     0    18     0     0]
 [  5   104     0  1097    67     0     0     0]
 [  4   142     0     54   151     0     2     0]
 [  0     4   110     2     3   226     0    10]
 [  1     36     0     3     6     0   322     0]
 [  0     0     0     0     0    13     6  310]]
```

<Figure size 432x288 with 0 Axes>

rest	681 (0.87)	32 (0.04)	0 (0.00)	43 (0.06)	21 (0.03)	3 (0.00)	0 (0.00)	0 (0.00)
tread_flat_walk	1 (0.00)	683 (0.73)	1 (0.00)	171 (0.18)	76 (0.08)	0 (0.00)	1 (0.00)	0 (0.00)
...	1	6	356	0	0	18	0	0

## Classification Report:

	precision	recall	f1-score	support
rest	0.9827	0.8731	0.9246	780
tread_flat_walk	0.6783	0.7320	0.7041	933
tread_flat_run	0.7623	0.9344	0.8396	381
tread_slope_walk	0.8007	0.8617	0.8301	1273
indoor_flat_walk	0.4660	0.4278	0.4461	353
indoor_flat_run	0.8692	0.6366	0.7350	355
outdoor_walk	0.9728	0.8750	0.9213	368
outdoor_run	0.9688	0.9422	0.9553	329
accuracy			0.8018	4772
macro avg	0.8126	0.7854	0.7945	4772
weighted avg	0.8087	0.8018	0.8019	4772

Trying for these features ['accY\_LF', 'accX\_Wrist']

(19084, 256, 2)

(19084, 8)

(4772, 256, 2)

(4772, 8)

256

2

8

Layer (type)	Output Shape	Param #
<hr/>		
input_46 (InputLayer)	(None, 256, 2)	0
lstm_45 (LSTM)	(None, 100)	41200
dropout_45 (Dropout)	(None, 100)	0
dense_90 (Dense)	(None, 100)	10100
dense_91 (Dense)	(None, 8)	808
<hr/>		
Total params:	52,108	
Trainable params:	52,108	
Non-trainable params:	0	

---

Train on 19084 samples, validate on 4772 samples

Epoch 1/20

19084/19084 [=====] - 34s 2ms/step - loss: 1.6370 - acc: 0.3342 - val\_loss: 1.3064 - val\_acc: 0.4078

```
Epoch 00001: val_acc improved from -inf to 0.40780, saving model to model_v5a_ccY_LF-accX_Wrist.hdf5
Epoch 2/20
19084/19084 [=====] - 29s 2ms/step - loss: 1.2594 - acc: 0.4483 - val_loss: 1.1109 - val_acc: 0.5310

Epoch 00002: val_acc improved from 0.40780 to 0.53101, saving model to model_v5accY_LF-accX_Wrist.hdf5
Epoch 3/20
19084/19084 [=====] - 29s 2ms/step - loss: 1.1188 - acc: 0.5153 - val_loss: 1.0129 - val_acc: 0.5905

Epoch 00003: val_acc improved from 0.53101 to 0.59053, saving model to model_v5accY_LF-accX_Wrist.hdf5
Epoch 4/20
19084/19084 [=====] - 31s 2ms/step - loss: 1.0495 - acc: 0.5528 - val_loss: 0.9708 - val_acc: 0.6021

Epoch 00004: val_acc improved from 0.59053 to 0.60205, saving model to model_v5accY_LF-accX_Wrist.hdf5
Epoch 5/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.9943 - acc: 0.5874 - val_loss: 1.0855 - val_acc: 0.5666

Epoch 00005: val_acc did not improve from 0.60205
Epoch 6/20
19084/19084 [=====] - 31s 2ms/step - loss: 0.9889 - acc: 0.5863 - val_loss: 0.9075 - val_acc: 0.6398

Epoch 00006: val_acc improved from 0.60205 to 0.63977, saving model to model_v5accY_LF-accX_Wrist.hdf5
Epoch 7/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.9073 - acc: 0.6273 - val_loss: 0.8493 - val_acc: 0.6549

Epoch 00007: val_acc improved from 0.63977 to 0.65486, saving model to model_v5accY_LF-accX_Wrist.hdf5
Epoch 8/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.8879 - acc: 0.6361 - val_loss: 0.8394 - val_acc: 0.6557

Epoch 00008: val_acc improved from 0.65486 to 0.65570, saving model to model_v5accY_LF-accX_Wrist.hdf5
Epoch 9/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.8555 - acc: 0.6489 - val_loss: 0.7932 - val_acc: 0.6842

Epoch 00009: val_acc improved from 0.65570 to 0.68420, saving model to model_v5accY_LF-accX_Wrist.hdf5
Epoch 10/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.8408 - acc: 0.6574 - val_loss: 0.7858 - val_acc: 0.6865

Epoch 00010: val_acc improved from 0.68420 to 0.68650, saving model to model_v5accY_LF-accX_Wrist.hdf5
Epoch 11/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.8367 -
```

```
acc: 0.6612 - val_loss: 0.7309 - val_acc: 0.7016
```

```
Epoch 00011: val_acc improved from 0.68650 to 0.70159, saving model to model_v5accY_LF-accX_Wrist.hdf5
```

```
Epoch 12/20
```

```
19084/19084 [=====] - 29s 2ms/step - loss: 0.7630 - acc: 0.6936 - val_loss: 0.7488 - val_acc: 0.7064
```

```
Epoch 00012: val_acc improved from 0.70159 to 0.70641, saving model to model_v5accY_LF-accX_Wrist.hdf5
```

```
Epoch 13/20
```

```
19084/19084 [=====] - 29s 2ms/step - loss: 0.7494 - acc: 0.7016 - val_loss: 0.6692 - val_acc: 0.7305
```

```
Epoch 00013: val_acc improved from 0.70641 to 0.73051, saving model to model_v5accY_LF-accX_Wrist.hdf5
```

```
Epoch 14/20
```

```
19084/19084 [=====] - 29s 2ms/step - loss: 0.6935 - acc: 0.7301 - val_loss: 0.6140 - val_acc: 0.7687
```

```
Epoch 00014: val_acc improved from 0.73051 to 0.76865, saving model to model_v5accY_LF-accX_Wrist.hdf5
```

```
Epoch 15/20
```

```
19084/19084 [=====] - 29s 2ms/step - loss: 0.6717 - acc: 0.7441 - val_loss: 0.5874 - val_acc: 0.7775
```

```
Epoch 00015: val_acc improved from 0.76865 to 0.77745, saving model to model_v5accY_LF-accX_Wrist.hdf5
```

```
Epoch 16/20
```

```
19084/19084 [=====] - 29s 2ms/step - loss: 0.6484 - acc: 0.7560 - val_loss: 0.5907 - val_acc: 0.7846
```

```
Epoch 00016: val_acc improved from 0.77745 to 0.78458, saving model to model_v5accY_LF-accX_Wrist.hdf5
```

```
Epoch 17/20
```

```
19084/19084 [=====] - 30s 2ms/step - loss: 0.5892 - acc: 0.7840 - val_loss: 0.5206 - val_acc: 0.8160
```

```
Epoch 00017: val_acc improved from 0.78458 to 0.81601, saving model to model_v5accY_LF-accX_Wrist.hdf5
```

```
Epoch 18/20
```

```
19084/19084 [=====] - 29s 2ms/step - loss: 0.5679 - acc: 0.7954 - val_loss: 0.4927 - val_acc: 0.8244
```

```
Epoch 00018: val_acc improved from 0.81601 to 0.82439, saving model to model_v5accY_LF-accX_Wrist.hdf5
```

```
Epoch 19/20
```

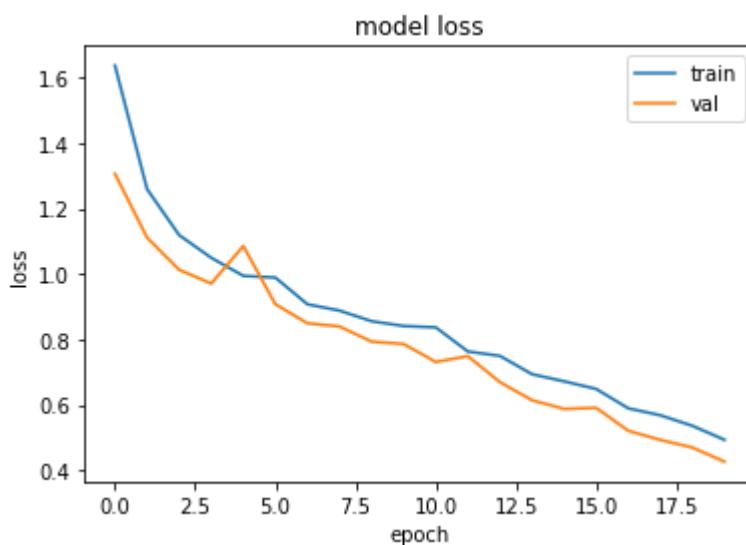
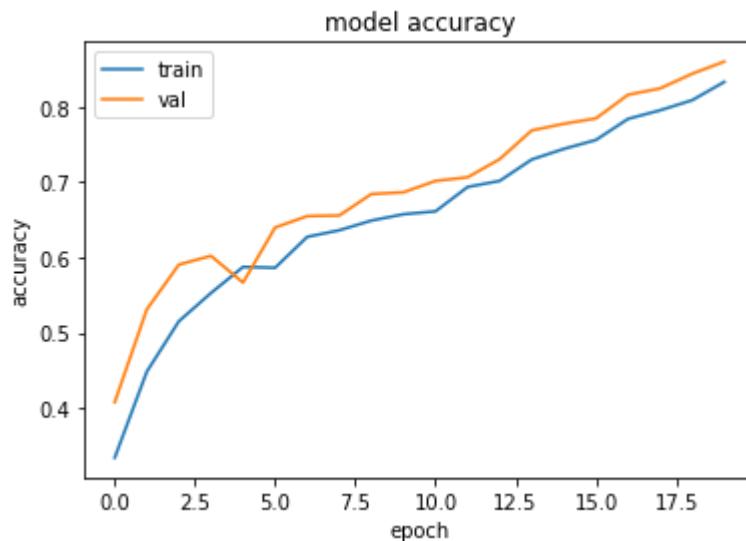
```
19084/19084 [=====] - 29s 2ms/step - loss: 0.5357 - acc: 0.8088 - val_loss: 0.4693 - val_acc: 0.8439
```

```
Epoch 00019: val_acc improved from 0.82439 to 0.84388, saving model to model_v5accY_LF-accX_Wrist.hdf5
```

```
Epoch 20/20
```

```
19084/19084 [=====] - 29s 2ms/step - loss: 0.4929 - acc: 0.8330 - val_loss: 0.4261 - val_acc: 0.8600
```

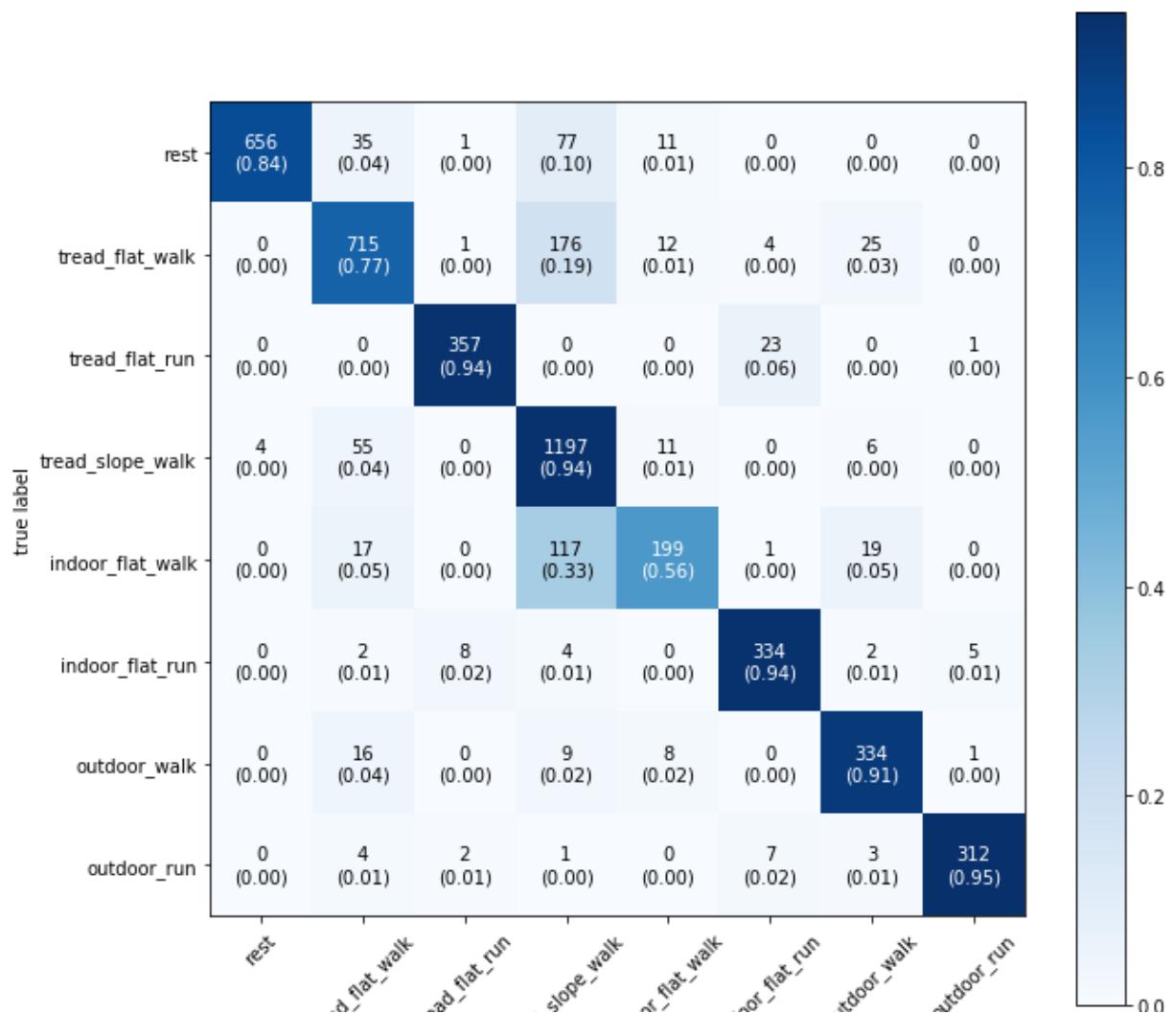
Epoch 00020: val\_acc improved from 0.84388 to 0.86002, saving model to model\_v5accY\_LF-accX\_Wrist.hdf5



Best accuracy (on validation dataset): 86.00%

```
[[ 656   35     1    77    11     0     0     0]
 [  0   715     1   176    12     4    25     0]
 [  0     0  357     0     0    23     0     1]
 [  4    55     0 1197    11     0     6     0]
 [  0    17     0   117   199     1    19     0]
 [  0     2     8     4     0   334     2     5]
 [  0    16     0     9     8     0   334     1]
 [  0     4     2     1     0     7     3  312]]
```

<Figure size 432x288 with 0 Axes>



## Classification Report:

	precision	recall	f1-score	support
rest	0.9939	0.8410	0.9111	780
tread_flat_walk	0.8472	0.7663	0.8047	933
tread_flat_run	0.9675	0.9370	0.9520	381
tread_slope_walk	0.7571	0.9403	0.8388	1273
indoor_flat_walk	0.8257	0.5637	0.6700	353
indoor_flat_run	0.9051	0.9408	0.9227	355
outdoor_walk	0.8586	0.9076	0.8824	368
outdoor_run	0.9781	0.9483	0.9630	329
accuracy			0.8600	4772
macro avg	0.8917	0.8556	0.8681	4772
weighted avg	0.8694	0.8600	0.8587	4772

Trying for these features ['accY\_LF', 'accY\_Wrist']

(19084, 256, 2)

(19084, 8)

(4772, 256, 2)

(4772, 8)

256

2

8

Layer (type)	Output Shape	Param #
--------------	--------------	---------

input_47 (InputLayer)	(None, 256, 2)	0
lstm_46 (LSTM)	(None, 100)	41200
dropout_46 (Dropout)	(None, 100)	0
dense_92 (Dense)	(None, 100)	10100
dense_93 (Dense)	(None, 8)	808

Total params: 52,108  
Trainable params: 52,108  
Non-trainable params: 0

---

Train on 19084 samples, validate on 4772 samples

Epoch 1/20

19084/19084 [=====] - 35s 2ms/step - loss: 1.7577 - acc: 0.3168 - val\_loss: 1.3997 - val\_acc: 0.4116

Epoch 00001: val\_acc improved from -inf to 0.41157, saving model to model\_v5accY\_LF-accY\_Wrist.hdf5

Epoch 2/20

19084/19084 [=====] - 30s 2ms/step - loss: 1.3167 - acc: 0.4445 - val\_loss: 1.1711 - val\_acc: 0.4929

Epoch 00002: val\_acc improved from 0.41157 to 0.49288, saving model to model\_v5accY\_LF-accY\_Wrist.hdf5

Epoch 3/20

19084/19084 [=====] - 30s 2ms/step - loss: 1.1830 - acc: 0.4834 - val\_loss: 1.1466 - val\_acc: 0.4855

Epoch 00003: val\_acc did not improve from 0.49288

Epoch 4/20

19084/19084 [=====] - 30s 2ms/step - loss: 1.1573 - acc: 0.4995 - val\_loss: 1.0989 - val\_acc: 0.5249

Epoch 00004: val\_acc improved from 0.49288 to 0.52494, saving model to model\_v5accY\_LF-accY\_Wrist.hdf5

Epoch 5/20

19084/19084 [=====] - 30s 2ms/step - loss: 1.1290 - acc: 0.5131 - val\_loss: 1.0714 - val\_acc: 0.5572

Epoch 00005: val\_acc improved from 0.52494 to 0.55721, saving model to model\_v5accY\_LF-accY\_Wrist.hdf5

Epoch 6/20

19084/19084 [=====] - 30s 2ms/step - loss: 1.0725 - acc: 0.5456 - val\_loss: 1.0887 - val\_acc: 0.5486

Epoch 00006: val\_acc did not improve from 0.55721

Epoch 7/20

19084/19084 [=====] - 30s 2ms/step - loss: 1.3427 - acc: 0.4935 - val\_loss: 1.0664 - val\_acc: 0.5731

Epoch 00007: val\_acc improved from 0.55721 to 0.57313, saving model to model\_v5accY\_LF-accY\_Wrist.hdf5

Epoch 8/20

```
19084/19084 [=====] - 30s 2ms/step - loss: 1.0941 - ac  
c: 0.5456 - val_loss: 1.0092 - val_acc: 0.5851
```

Epoch 00008: val\_acc improved from 0.57313 to 0.58508, saving model to model\_v5  
accY\_LF-accY\_Wrist.hdf5

Epoch 9/20

```
19084/19084 [=====] - 30s 2ms/step - loss: 1.0188 - ac  
c: 0.5831 - val_loss: 0.9694 - val_acc: 0.6094
```

Epoch 00009: val\_acc improved from 0.58508 to 0.60939, saving model to model\_v5  
accY\_LF-accY\_Wrist.hdf5

Epoch 10/20

```
19084/19084 [=====] - 30s 2ms/step - loss: 1.0124 - ac  
c: 0.5858 - val_loss: 0.9550 - val_acc: 0.6249
```

Epoch 00010: val\_acc improved from 0.60939 to 0.62490, saving model to model\_v5  
accY\_LF-accY\_Wrist.hdf5

Epoch 11/20

```
19084/19084 [=====] - 30s 2ms/step - loss: 0.9737 - ac  
c: 0.6138 - val_loss: 0.8918 - val_acc: 0.6515
```

Epoch 00011: val\_acc improved from 0.62490 to 0.65151, saving model to model\_v5  
accY\_LF-accY\_Wrist.hdf5

Epoch 12/20

```
19084/19084 [=====] - 30s 2ms/step - loss: 0.9255 - ac  
c: 0.6349 - val_loss: 0.8652 - val_acc: 0.6653
```

Epoch 00012: val\_acc improved from 0.65151 to 0.66534, saving model to model\_v5  
accY\_LF-accY\_Wrist.hdf5

Epoch 13/20

```
19084/19084 [=====] - 30s 2ms/step - loss: 0.8737 - ac  
c: 0.6609 - val_loss: 0.8244 - val_acc: 0.6957
```

Epoch 00013: val\_acc improved from 0.66534 to 0.69573, saving model to model\_v5  
accY\_LF-accY\_Wrist.hdf5

Epoch 14/20

```
19084/19084 [=====] - 30s 2ms/step - loss: 0.8295 - ac  
c: 0.6957 - val_loss: 0.7505 - val_acc: 0.7393
```

Epoch 00014: val\_acc improved from 0.69573 to 0.73931, saving model to model\_v5  
accY\_LF-accY\_Wrist.hdf5

Epoch 15/20

```
19084/19084 [=====] - 30s 2ms/step - loss: 0.7983 - ac  
c: 0.7131 - val_loss: 0.7322 - val_acc: 0.7370
```

Epoch 00015: val\_acc did not improve from 0.73931

Epoch 16/20

```
19084/19084 [=====] - 30s 2ms/step - loss: 0.7910 - ac  
c: 0.7166 - val_loss: 0.7134 - val_acc: 0.7548
```

Epoch 00016: val\_acc improved from 0.73931 to 0.75482, saving model to model\_v5  
accY\_LF-accY\_Wrist.hdf5

Epoch 17/20

```
19084/19084 [=====] - 30s 2ms/step - loss: 0.7325 - ac  
c: 0.7422 - val_loss: 0.7755 - val_acc: 0.7274
```

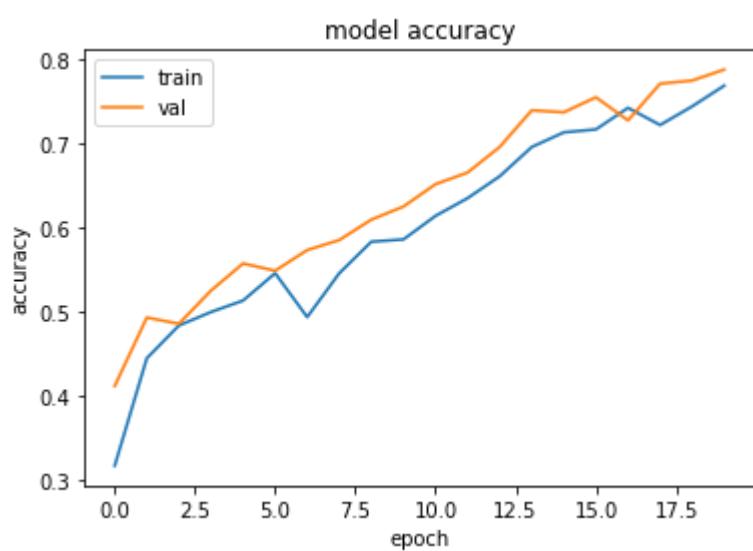
Epoch 00017: val\_acc did not improve from 0.75482

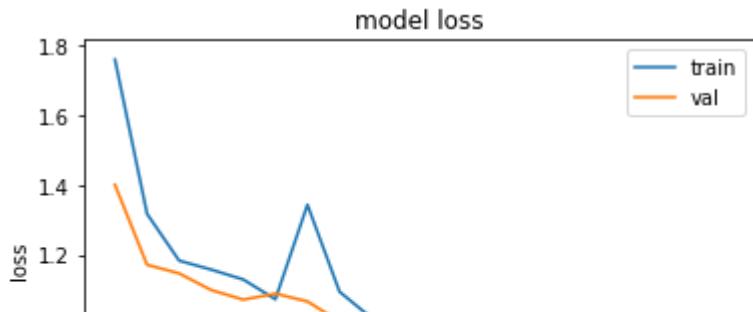
```
Epoch 18/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.7784 - ac
c: 0.7219 - val_loss: 0.6691 - val_acc: 0.7710

Epoch 00018: val_acc improved from 0.75482 to 0.77096, saving model to model_v5
accY_LF-accY_Wrist.hdf5
Epoch 19/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.7391 - ac
c: 0.7440 - val_loss: 0.6649 - val_acc: 0.7747

Epoch 00019: val_acc improved from 0.77096 to 0.77473, saving model to model_v5
accY_LF-accY_Wrist.hdf5
Epoch 20/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.6921 - ac
c: 0.7687 - val_loss: 0.6255 - val_acc: 0.7877

Epoch 00020: val_acc improved from 0.77473 to 0.78772, saving model to model_v5
accY_LF-accY_Wrist.hdf5
```

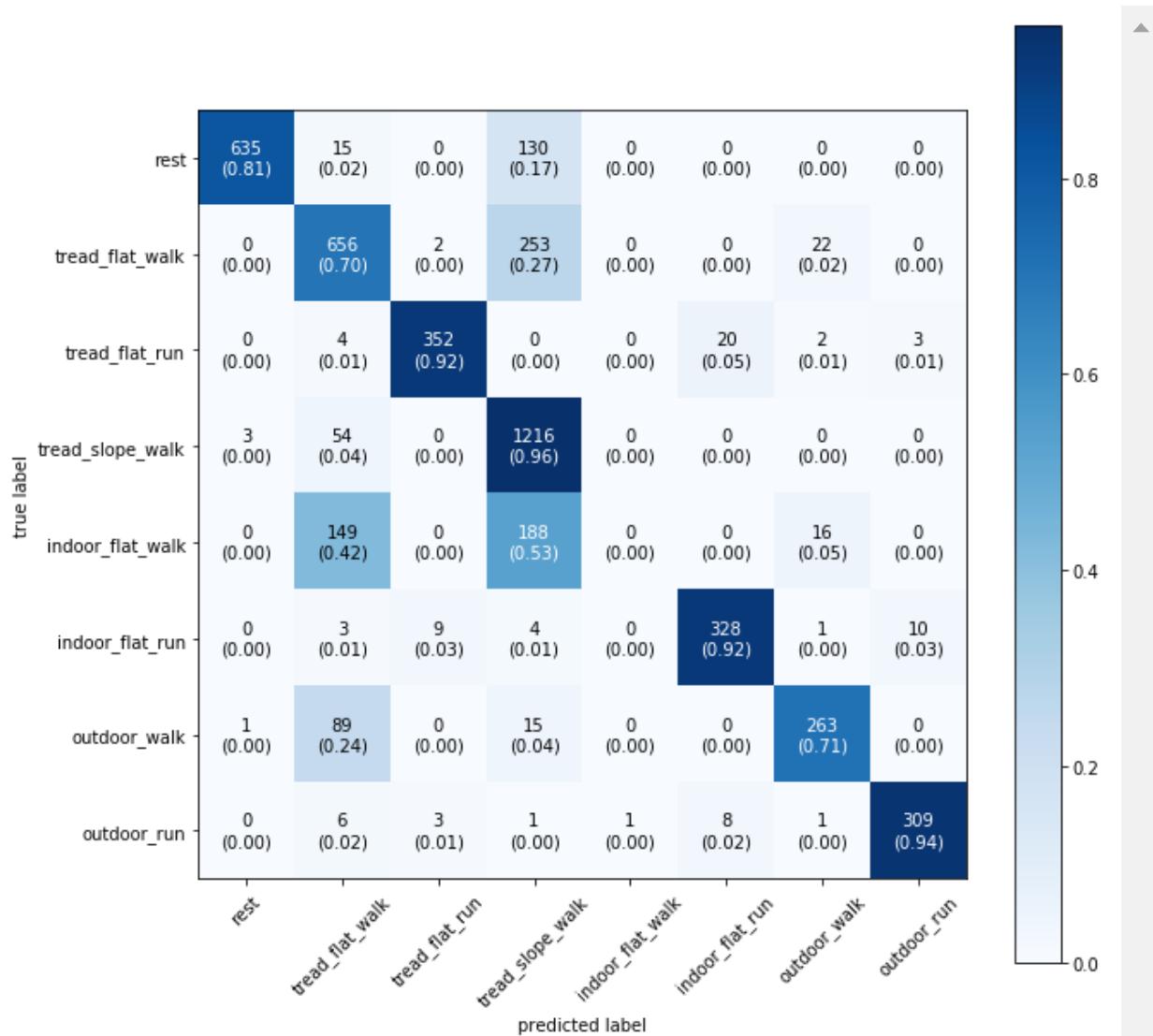




Best accuracy (on validation dataset): 78.77%

```
[[ 635   15     0   130     0     0     0     0]
 [  0   656     2   253     0     0    22     0]
 [  0     4   352     0     0    20     2     3]
 [  3    54     0  1216     0     0     0     0]
 [  0   149     0   188     0     0    16     0]
 [  0     3     9     4     0   328     1   10]
 [  1    89     0   15     0     0   263     0]
 [  0     6     3     1     1     8     1  309]]
```

<Figure size 432x288 with 0 Axes>



## Classification Report:

	precision	recall	f1-score	support
rest	0.9937	0.8141	0.8950	780
tread_flat_walk	0.6721	0.7031	0.6873	933
tread_flat_run	0.9617	0.9239	0.9424	381
tread_slope_walk	0.6729	0.9552	0.7896	1273
indoor_flat_walk	0.0000	0.0000	0.0000	353
indoor_flat_run	0.9213	0.9239	0.9226	355
outdoor_walk	0.8623	0.7147	0.7816	368
outdoor_run	0.9596	0.9392	0.9493	329
accuracy			0.7877	4772
macro avg	0.7555	0.7468	0.7460	4772
weighted avg	0.7513	0.7877	0.7609	4772

Trying for these features ['accY\_LF', 'accZ\_Wrist']

(19084, 256, 2)

(19084, 8)

(4772, 256, 2)

(4772, 8)

256

2

8

Layer (type)	Output Shape	Param #
input_48 (InputLayer)	(None, 256, 2)	0
lstm_47 (LSTM)	(None, 100)	41200
dropout_47 (Dropout)	(None, 100)	0
dense_94 (Dense)	(None, 100)	10100

dense_95 (Dense)	(None, 8)	808
=====		
Total params: 52,108		
Trainable params: 52,108		
Non-trainable params: 0		
<hr/>		
Train on 19084 samples, validate on 4772 samples		
Epoch 1/20		
19084/19084 [=====] - 35s 2ms/step - loss: 1.7945 - acc: 0.3145 - val_loss: 1.4890 - val_acc: 0.3854		
Epoch 00001: val_acc improved from -inf to 0.38537, saving model to model_v5accY_LF-accZ_Wrist.hdf5		
Epoch 2/20		
19084/19084 [=====] - 30s 2ms/step - loss: 1.3472 - acc: 0.4472 - val_loss: 1.1989 - val_acc: 0.5075		
Epoch 00002: val_acc improved from 0.38537 to 0.50754, saving model to model_v5accY_LF-accZ_Wrist.hdf5		
Epoch 3/20		
19084/19084 [=====] - 30s 2ms/step - loss: 1.2100 - acc: 0.5037 - val_loss: 1.4023 - val_acc: 0.3950		
Epoch 00003: val_acc did not improve from 0.50754		
Epoch 4/20		
19084/19084 [=====] - 30s 2ms/step - loss: 1.3001 - acc: 0.4757 - val_loss: 1.1408 - val_acc: 0.5394		
Epoch 00004: val_acc improved from 0.50754 to 0.53940, saving model to model_v5accY_LF-accZ_Wrist.hdf5		
Epoch 5/20		
19084/19084 [=====] - 29s 2ms/step - loss: 1.1325 - acc: 0.5378 - val_loss: 1.0816 - val_acc: 0.5725		
Epoch 00005: val_acc improved from 0.53940 to 0.57251, saving model to model_v5accY_LF-accZ_Wrist.hdf5		
Epoch 6/20		
19084/19084 [=====] - 29s 2ms/step - loss: 1.0948 - acc: 0.5494 - val_loss: 1.0653 - val_acc: 0.5648		
Epoch 00006: val_acc did not improve from 0.57251		
Epoch 7/20		
19084/19084 [=====] - 29s 2ms/step - loss: 1.0693 - acc: 0.5667 - val_loss: 1.0089 - val_acc: 0.5920		
Epoch 00007: val_acc improved from 0.57251 to 0.59199, saving model to model_v5accY_LF-accZ_Wrist.hdf5		
Epoch 8/20		
19084/19084 [=====] - 29s 2ms/step - loss: 1.0154 - acc: 0.5879 - val_loss: 0.9547 - val_acc: 0.6362		
Epoch 00008: val_acc improved from 0.59199 to 0.63621, saving model to model_v5accY_LF-accZ_Wrist.hdf5		
Epoch 9/20		
19084/19084 [=====] - 29s 2ms/step - loss: 0.9899 - acc: 0.6084 - val_loss: 0.9359 - val_acc: 0.6326		

```
Epoch 00009: val_acc did not improve from 0.63621
Epoch 10/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.9803 - ac
c: 0.6174 - val_loss: 0.9054 - val_acc: 0.6538

Epoch 00010: val_acc improved from 0.63621 to 0.65381, saving model to model_v5
accY_LF-accZ_Wrist.hdf5
Epoch 11/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.9291 - ac
c: 0.6431 - val_loss: 0.8628 - val_acc: 0.6723

Epoch 00011: val_acc improved from 0.65381 to 0.67225, saving model to model_v5
accY_LF-accZ_Wrist.hdf5
Epoch 12/20
19084/19084 [=====] - 32s 2ms/step - loss: 0.8723 - ac
c: 0.6690 - val_loss: 0.8366 - val_acc: 0.6922

Epoch 00012: val_acc improved from 0.67225 to 0.69216, saving model to model_v5
accY_LF-accZ_Wrist.hdf5
Epoch 13/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.8327 - ac
c: 0.6904 - val_loss: 0.8221 - val_acc: 0.6976

Epoch 00013: val_acc improved from 0.69216 to 0.69761, saving model to model_v5
accY_LF-accZ_Wrist.hdf5
Epoch 14/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.8267 - ac
c: 0.6898 - val_loss: 0.7784 - val_acc: 0.7154

Epoch 00014: val_acc improved from 0.69761 to 0.71542, saving model to model_v5
accY_LF-accZ_Wrist.hdf5
Epoch 15/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.8000 - ac
c: 0.7015 - val_loss: 0.7399 - val_acc: 0.7190

Epoch 00015: val_acc improved from 0.71542 to 0.71899, saving model to model_v5
accY_LF-accZ_Wrist.hdf5
Epoch 16/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.7611 - ac
c: 0.7193 - val_loss: 0.7212 - val_acc: 0.7366

Epoch 00016: val_acc improved from 0.71899 to 0.73659, saving model to model_v5
accY_LF-accZ_Wrist.hdf5
Epoch 17/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.7332 - ac
c: 0.7328 - val_loss: 0.7008 - val_acc: 0.7450

Epoch 00017: val_acc improved from 0.73659 to 0.74497, saving model to model_v5
accY_LF-accZ_Wrist.hdf5
Epoch 18/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.7135 - ac
c: 0.7412 - val_loss: 0.6476 - val_acc: 0.7651

Epoch 00018: val_acc improved from 0.74497 to 0.76509, saving model to model_v5
accY_LF-accZ_Wrist.hdf5
Epoch 19/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.6969 - ac
```

```
c: 0.7481 - val_loss: 0.6781 - val_acc: 0.7540
```

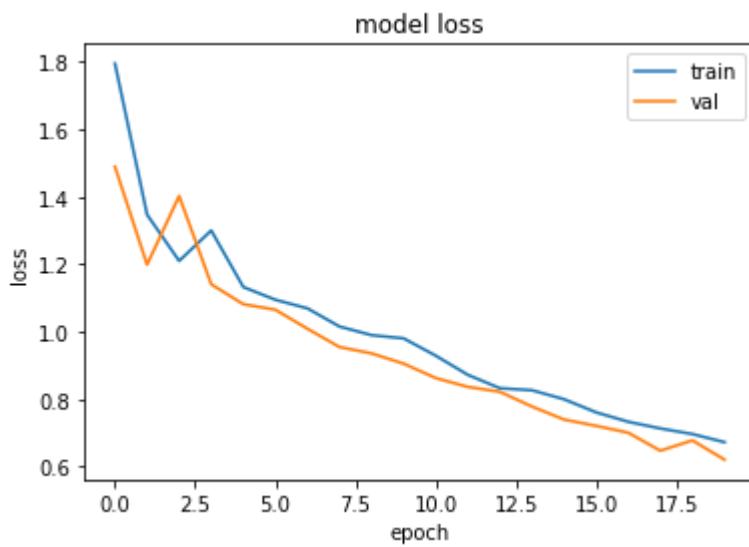
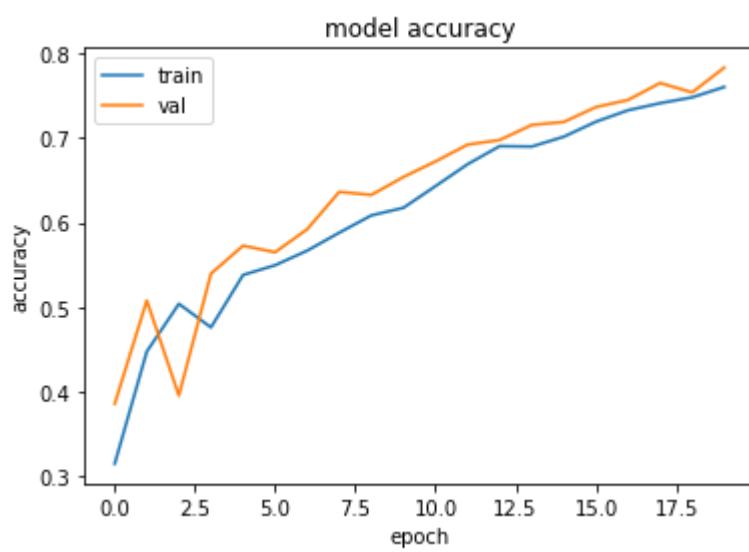
```
Epoch 00019: val_acc did not improve from 0.76509
```

```
Epoch 20/20
```

```
19084/19084 [=====] - 29s 2ms/step - loss: 0.6728 - ac
```

```
c: 0.7604 - val_loss: 0.6211 - val_acc: 0.7833
```

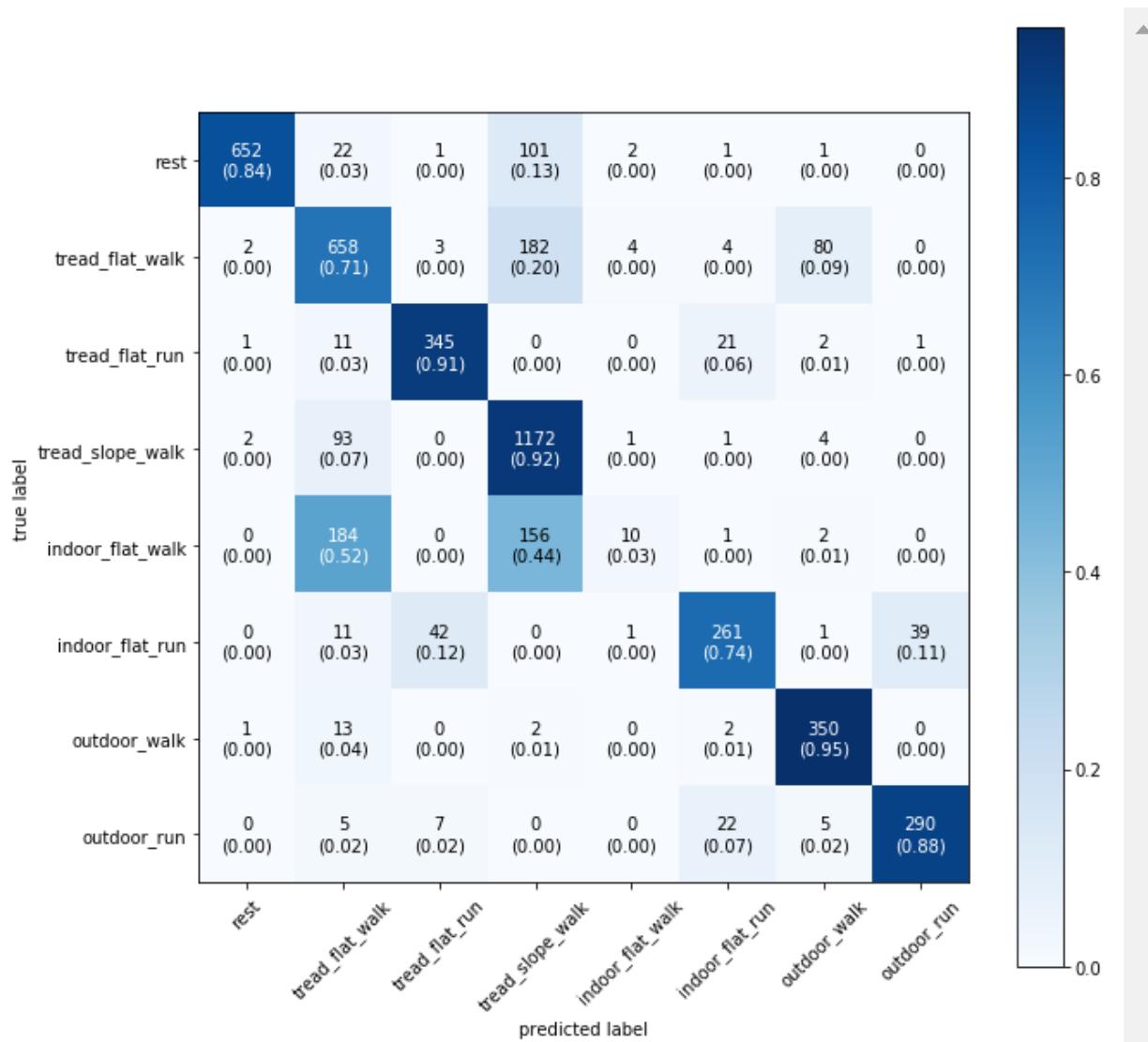
```
Epoch 00020: val_acc improved from 0.76509 to 0.78332, saving model to model_v5  
accY_LF-accZ_Wrist.hdf5
```



```
Best accuracy (on validation dataset): 78.33%
```

```
[[ 652   22     1   101     2     1     1     0]
 [  2   658     3   182     4     4    80     0]
 [  1    11   345     0     0    21     2     1]
 [  2    93     0  1172     1     1     4     0]
 [  0   184     0   156    10     1     2     0]
 [  0     11    42     0     1   261     1    39]
 [  1    13     0     2     0     2   350     0]
 [  0      5     7     0     0    22     5   290]]
```

&lt;Figure size 432x288 with 0 Axes&gt;

**Classification Report:**

	precision	recall	f1-score	support
rest	0.9909	0.8359	0.9068	780
tread_flat_walk	0.6600	0.7053	0.6819	933
tread_flat_run	0.8668	0.9055	0.8858	381

tread_slope_walk	0.7266	0.9207	0.8122	1273
indoor_flat_walk	0.5556	0.0283	0.0539	353
indoor_flat_run	0.8339	0.7352	0.7814	355
outdoor_walk	0.7865	0.9511	0.8610	368
outdoor_run	0.8788	0.8815	0.8801	329
accuracy			0.7833	4772
macro avg	0.7874	0.7454	0.7329	4772
weighted avg	0.7784	0.7833	0.7581	4772

Trying for these features ['accZ\_LF', 'accX\_Wrist']

(19084, 256, 2)

(19084, 8)

(4772, 256, 2)

(4772, 8)

256

2

8

Layer (type)	Output Shape	Param #
<hr/>		
input_49 (InputLayer)	(None, 256, 2)	0
lstm_48 (LSTM)	(None, 100)	41200
dropout_48 (Dropout)	(None, 100)	0
dense_96 (Dense)	(None, 100)	10100
dense_97 (Dense)	(None, 8)	808
<hr/>		

Total params: 52,108

Trainable params: 52,108

Non-trainable params: 0

---

Train on 19084 samples, validate on 4772 samples

Epoch 1/20

19084/19084 [=====] - 35s 2ms/step - loss: 1.6699 - acc: 0.3301 - val\_loss: 1.3277 - val\_acc: 0.4275

Epoch 00001: val\_acc improved from -inf to 0.42749, saving model to model\_v5a\_ccZ\_LF-accX\_Wrist.hdf5

Epoch 2/20

19084/19084 [=====] - 29s 2ms/step - loss: 1.3184 - acc: 0.4265 - val\_loss: 1.2128 - val\_acc: 0.4822

Epoch 00002: val\_acc improved from 0.42749 to 0.48219, saving model to model\_v5accZ\_LF-accX\_Wrist.hdf5

Epoch 3/20

19084/19084 [=====] - 30s 2ms/step - loss: 1.2273 - acc: 0.4742 - val\_loss: 1.1563 - val\_acc: 0.5086

Epoch 00003: val\_acc improved from 0.48219 to 0.50859, saving model to model\_v5accZ\_LF-accX\_Wrist.hdf5

Epoch 4/20

19084/19084 [=====] - 29s 2ms/step - loss: 1.1893 - acc: 0.4960 - val\_loss: 1.1332 - val\_acc: 0.5228

```
Epoch 00004: val_acc improved from 0.50859 to 0.52284, saving model to model_
v5accZ_LF-accX_Wrist.hdf5
Epoch 5/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.1249 -
acc: 0.5249 - val_loss: 1.0403 - val_acc: 0.5775

Epoch 00005: val_acc improved from 0.52284 to 0.57754, saving model to model_
v5accZ_LF-accX_Wrist.hdf5
Epoch 6/20
19084/19084 [=====] - 29s 2ms/step - loss: 1.1023 -
acc: 0.5417 - val_loss: 1.0391 - val_acc: 0.5495

Epoch 00006: val_acc did not improve from 0.57754
Epoch 7/20
19084/19084 [=====] - 29s 2ms/step - loss: 1.0496 -
acc: 0.5727 - val_loss: 0.9957 - val_acc: 0.5878

Epoch 00007: val_acc improved from 0.57754 to 0.58780, saving model to model_
v5accZ_LF-accX_Wrist.hdf5
Epoch 8/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.9784 -
acc: 0.6007 - val_loss: 0.9139 - val_acc: 0.6280

Epoch 00008: val_acc improved from 0.58780 to 0.62804, saving model to model_
v5accZ_LF-accX_Wrist.hdf5
Epoch 9/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.9461 -
acc: 0.6186 - val_loss: 0.8545 - val_acc: 0.6651

Epoch 00009: val_acc improved from 0.62804 to 0.66513, saving model to model_
v5accZ_LF-accX_Wrist.hdf5
Epoch 10/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.8958 -
acc: 0.6433 - val_loss: 0.8558 - val_acc: 0.6630

Epoch 00010: val_acc did not improve from 0.66513
Epoch 11/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.8802 -
acc: 0.6538 - val_loss: 0.7920 - val_acc: 0.6947

Epoch 00011: val_acc improved from 0.66513 to 0.69468, saving model to model_
v5accZ_LF-accX_Wrist.hdf5
Epoch 12/20
19084/19084 [=====] - 32s 2ms/step - loss: 0.8532 -
acc: 0.6664 - val_loss: 0.8085 - val_acc: 0.6852

Epoch 00012: val_acc did not improve from 0.69468
Epoch 13/20
19084/19084 [=====] - 29s 2ms/step - loss: 0.8193 -
acc: 0.6865 - val_loss: 0.7188 - val_acc: 0.7347

Epoch 00013: val_acc improved from 0.69468 to 0.73470, saving model to model_
v5accZ_LF-accX_Wrist.hdf5
Epoch 14/20
19084/19084 [=====] - 31s 2ms/step - loss: 0.7599 -
acc: 0.7182 - val_loss: 0.7106 - val_acc: 0.7441
```

```
Epoch 00014: val_acc improved from 0.73470 to 0.74413, saving model to model_
v5accZ_LF-accX_Wrist.hdf5
Epoch 15/20
19084/19084 [=====] - 41s 2ms/step - loss: 0.8211 -
acc: 0.7008 - val_loss: 0.7902 - val_acc: 0.7171

Epoch 00015: val_acc did not improve from 0.74413
Epoch 16/20
19084/19084 [=====] - 32s 2ms/step - loss: 0.8998 -
acc: 0.6660 - val_loss: 0.7404 - val_acc: 0.7265

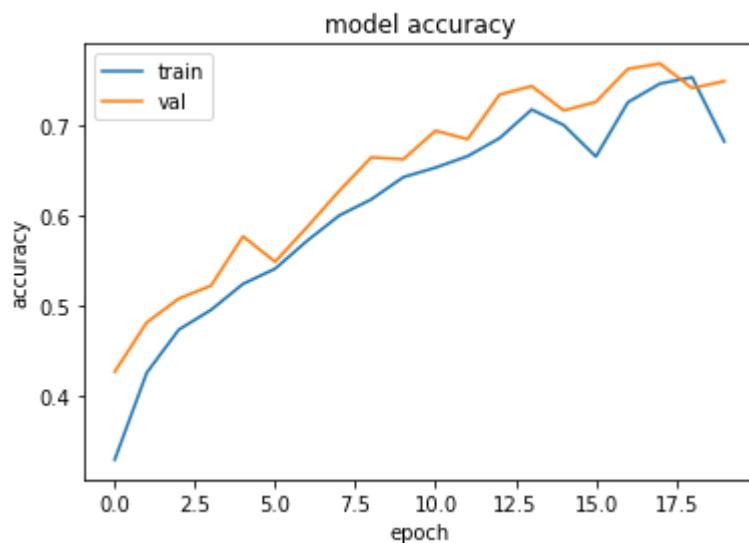
Epoch 00016: val_acc did not improve from 0.74413
Epoch 17/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.7472 -
acc: 0.7263 - val_loss: 0.6640 - val_acc: 0.7632

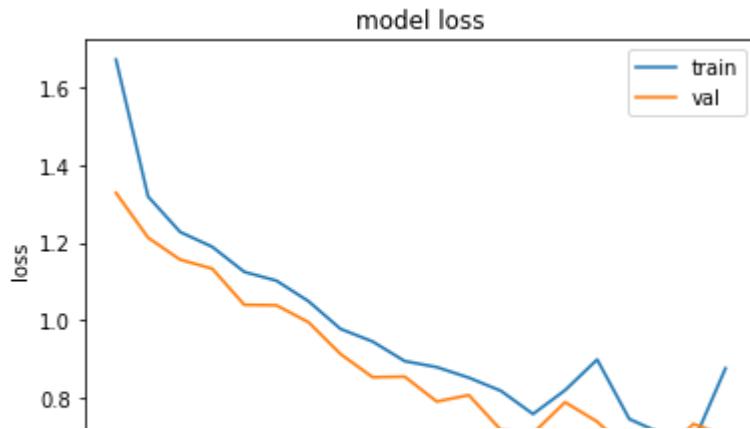
Epoch 00017: val_acc improved from 0.74413 to 0.76320, saving model to model_
v5accZ_LF-accX_Wrist.hdf5
Epoch 18/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.7101 -
acc: 0.7469 - val_loss: 0.6530 - val_acc: 0.7691

Epoch 00018: val_acc improved from 0.76320 to 0.76907, saving model to model_
v5accZ_LF-accX_Wrist.hdf5
Epoch 19/20
19084/19084 [=====] - 32s 2ms/step - loss: 0.6872 -
acc: 0.7539 - val_loss: 0.7345 - val_acc: 0.7418

Epoch 00019: val_acc did not improve from 0.76907
Epoch 20/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.8773 -
acc: 0.6828 - val_loss: 0.7037 - val_acc: 0.7496

Epoch 00020: val_acc did not improve from 0.76907
```

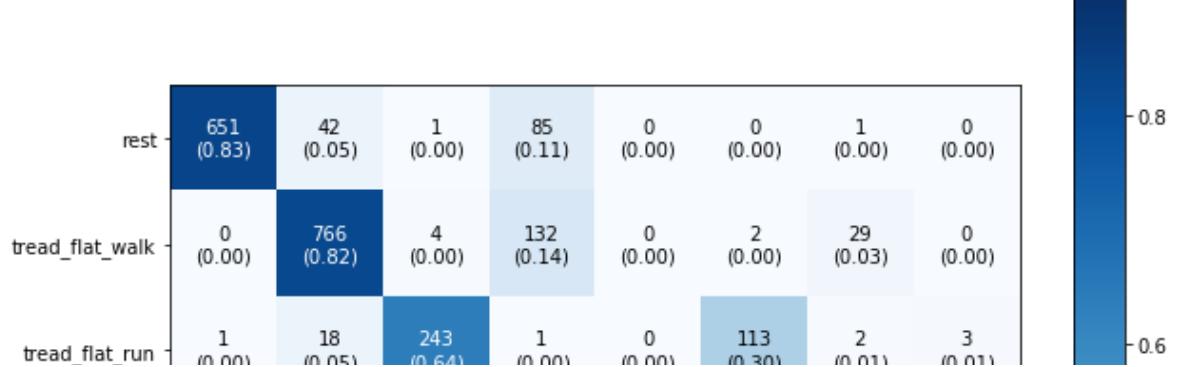




Best accuracy (on validation dataset): 74.96%

```
[[ 651   42    1   85    0    0    1    0]
 [  0   766    4  132    0    2   29    0]
 [  1   18   243    1    0   113    2    3]
 [ 34   80    0 1156    2    0    1    0]
 [  1   62    1  283    0    0    6    0]
 [  0   20   38    5    0   279    3   10]
 [  2  156    0   21    0    0  189    0]
 [  0   10    3    0    0   18    5 293]]
```

<Figure size 432x288 with 0 Axes>



## Classification Report:

	precision	recall	f1-score	support
rest	0.9448	0.8346	0.8863	780
tread_flat_walk	0.6638	0.8210	0.7341	933
tread_flat_run	0.8379	0.6378	0.7243	381
tread_slope_walk	0.6869	0.9081	0.7821	1273
indoor_flat_walk	0.0000	0.0000	0.0000	353
indoor_flat_run	0.6772	0.7859	0.7275	355
outdoor_walk	0.8008	0.5136	0.6258	368
outdoor_run	0.9575	0.8906	0.9228	329
accuracy			0.7496	4772
macro avg	0.6961	0.6739	0.6754	4772
weighted avg	0.7125	0.7496	0.7209	4772

Trying for these features ['accZ\_LF', 'accY\_Wrist']

(19084, 256, 2)

(19084, 8)

(4772, 256, 2)

(4772, 8)

256

2

8

Layer (type)	Output Shape	Param #
<hr/>		
input_50 (InputLayer)	(None, 256, 2)	0
lstm_49 (LSTM)	(None, 100)	41200
dropout_49 (Dropout)	(None, 100)	0
dense_98 (Dense)	(None, 100)	10100
dense_99 (Dense)	(None, 8)	808
<hr/>		

Total params: 52,108

Trainable params: 52,108

Non-trainable params: 0

---

Train on 19084 samples, validate on 4772 samples

Epoch 1/20

19084/19084 [=====] - 35s 2ms/step - loss: 1.8264 - ac  
c: 0.2824 - val\_loss: 1.6576 - val\_acc: 0.3282

```
Epoch 00001: val_acc improved from -inf to 0.32816, saving model to model_v5accZ_LF-accY_Wrist.hdf5
Epoch 2/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.5544 - acc: 0.3654 - val_loss: 1.3493 - val_acc: 0.4533

Epoch 00002: val_acc improved from 0.32816 to 0.45327, saving model to model_v5accZ_LF-accY_Wrist.hdf5
Epoch 3/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.3249 - acc: 0.4514 - val_loss: 1.3019 - val_acc: 0.4554

Epoch 00003: val_acc improved from 0.45327 to 0.45536, saving model to model_v5accZ_LF-accY_Wrist.hdf5
Epoch 4/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.3184 - acc: 0.4503 - val_loss: 1.2297 - val_acc: 0.4864

Epoch 00004: val_acc improved from 0.45536 to 0.48638, saving model to model_v5accZ_LF-accY_Wrist.hdf5
Epoch 5/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.2764 - acc: 0.4500 - val_loss: 1.2073 - val_acc: 0.4941

Epoch 00005: val_acc improved from 0.48638 to 0.49413, saving model to model_v5accZ_LF-accY_Wrist.hdf5
Epoch 6/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.2149 - acc: 0.4846 - val_loss: 1.1646 - val_acc: 0.5254

Epoch 00006: val_acc improved from 0.49413 to 0.52536, saving model to model_v5accZ_LF-accY_Wrist.hdf5
Epoch 7/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.1535 - acc: 0.5158 - val_loss: 1.0833 - val_acc: 0.5677

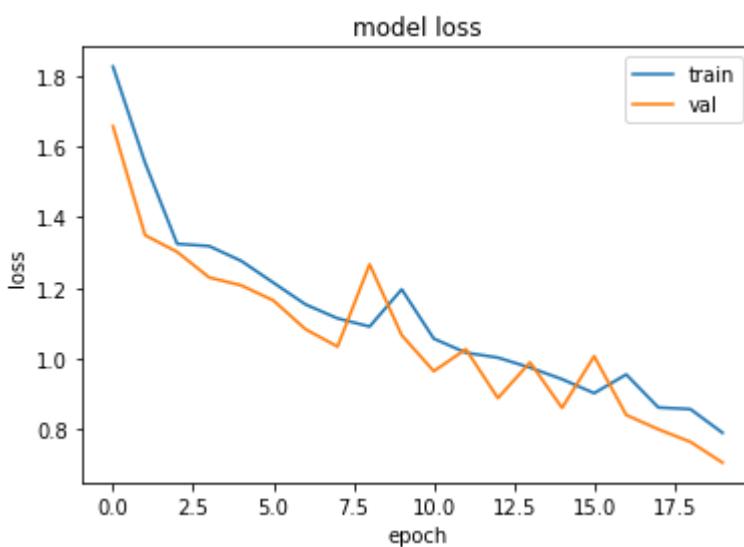
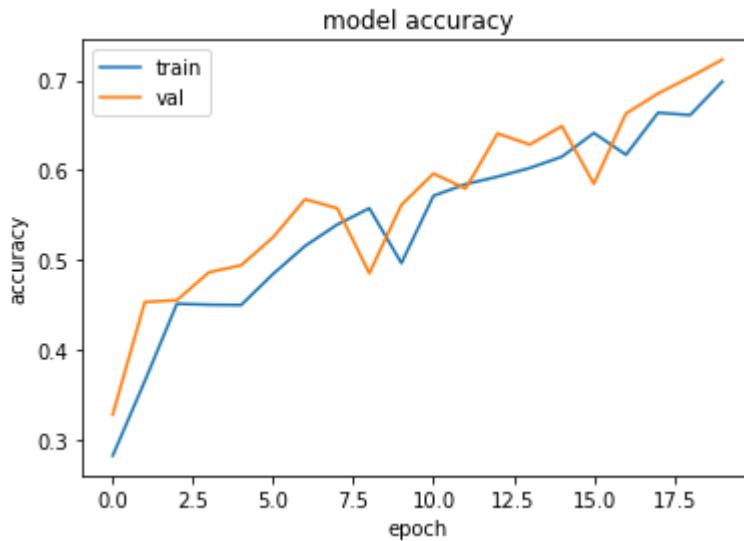
Epoch 00007: val_acc improved from 0.52536 to 0.56769, saving model to model_v5accZ_LF-accY_Wrist.hdf5
Epoch 8/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.1139 - acc: 0.5395 - val_loss: 1.0340 - val_acc: 0.5576

Epoch 00008: val_acc did not improve from 0.56769
Epoch 9/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.0907 - acc: 0.5576 - val_loss: 1.2669 - val_acc: 0.4853

Epoch 00009: val_acc did not improve from 0.56769
Epoch 10/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.1961 - acc: 0.4966 - val_loss: 1.0663 - val_acc: 0.5614

Epoch 00010: val_acc did not improve from 0.56769
Epoch 11/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.0566 - acc: 0.5715 - val_loss: 0.9645 - val_acc: 0.5962
```

```
Epoch 00011: val_acc improved from 0.56769 to 0.59619, saving model to model_v5  
accZ_LF-accY_Wrist.hdf5  
Epoch 12/20  
19084/19084 [=====] - 30s 2ms/step - loss: 1.0168 - ac  
c: 0.5844 - val_loss: 1.0265 - val_acc: 0.5794  
  
Epoch 00012: val_acc did not improve from 0.59619  
Epoch 13/20  
19084/19084 [=====] - 30s 2ms/step - loss: 1.0028 - ac  
c: 0.5928 - val_loss: 0.8883 - val_acc: 0.6408  
  
Epoch 00013: val_acc improved from 0.59619 to 0.64082, saving model to model_v5  
accZ_LF-accY_Wrist.hdf5  
Epoch 14/20  
19084/19084 [=====] - 30s 2ms/step - loss: 0.9746 - ac  
c: 0.6024 - val_loss: 0.9894 - val_acc: 0.6285  
  
Epoch 00014: val_acc did not improve from 0.64082  
Epoch 15/20  
19084/19084 [=====] - 30s 2ms/step - loss: 0.9417 - ac  
c: 0.6149 - val_loss: 0.8606 - val_acc: 0.6490  
  
Epoch 00015: val_acc improved from 0.64082 to 0.64899, saving model to model_v5  
accZ_LF-accY_Wrist.hdf5  
Epoch 16/20  
19084/19084 [=====] - 31s 2ms/step - loss: 0.9022 - ac  
c: 0.6413 - val_loss: 1.0069 - val_acc: 0.5849  
  
Epoch 00016: val_acc did not improve from 0.64899  
Epoch 17/20  
19084/19084 [=====] - 30s 2ms/step - loss: 0.9551 - ac  
c: 0.6171 - val_loss: 0.8404 - val_acc: 0.6630  
  
Epoch 00017: val_acc improved from 0.64899 to 0.66303, saving model to model_v5  
accZ_LF-accY_Wrist.hdf5  
Epoch 18/20  
19084/19084 [=====] - 30s 2ms/step - loss: 0.8617 - ac  
c: 0.6639 - val_loss: 0.8000 - val_acc: 0.6852  
  
Epoch 00018: val_acc improved from 0.66303 to 0.68525, saving model to model_v5  
accZ_LF-accY_Wrist.hdf5  
Epoch 19/20  
19084/19084 [=====] - 30s 2ms/step - loss: 0.8571 - ac  
c: 0.6613 - val_loss: 0.7645 - val_acc: 0.7035  
  
Epoch 00019: val_acc improved from 0.68525 to 0.70348, saving model to model_v5  
accZ_LF-accY_Wrist.hdf5  
Epoch 20/20  
19084/19084 [=====] - 30s 2ms/step - loss: 0.7901 - ac  
c: 0.6985 - val_loss: 0.7056 - val_acc: 0.7230  
  
Epoch 00020: val_acc improved from 0.70348 to 0.72297, saving model to model_v5  
accZ_LF-accY_Wrist.hdf5
```

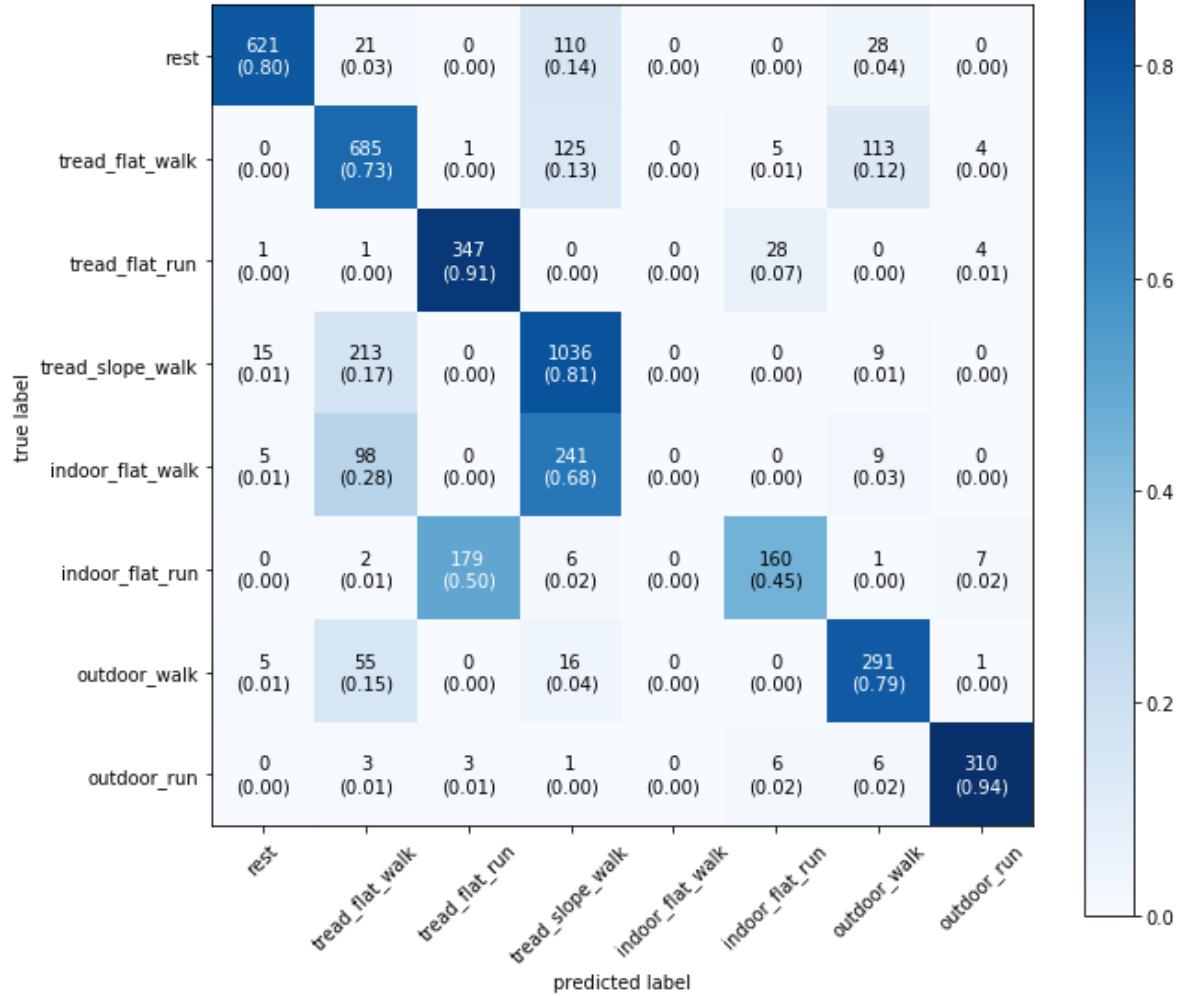


Best accuracy (on validation dataset): 72.30%

```
[[ 621   21     0   110     0     0    28     0]
 [  0   685     1   125     0     5   113     4]
 [  1     1   347     0     0    28     0     4]
 [ 15   213     0  1036     0     0     9     0]
 [  5    98     0   241     0     0     9     0]
 [  0     2   179     6     0   160     1     7]]
```

Γ 5 55 0 16 0 0 291 11

&lt;Figure size 432x288 with 0 Axes&gt;



## Classification Report:

	precision	recall	f1-score	support
rest	0.9598	0.7962	0.8704	780
tread_flat_walk	0.6354	0.7342	0.6813	933
tread_flat_run	0.6547	0.9108	0.7618	381
tread_slope_walk	0.6749	0.8138	0.7379	1273
indoor_flat_walk	0.0000	0.0000	0.0000	353
indoor_flat_run	0.8040	0.4507	0.5776	355
outdoor_walk	0.6368	0.7908	0.7055	368
outdoor_run	0.9509	0.9422	0.9466	329
accuracy			0.7230	4772
macro avg	0.6646	0.6798	0.6601	4772
weighted avg	0.6879	0.7230	0.6958	4772

Trying for these features ['accZ\_LF', 'accZ\_Wrist']

(19084, 256, 2)

(19084, 8)

(4772, 256, 2)

(4772, 8)

256

2

8

Layer (type)	Output Shape	Param #
<hr/>		
input_51 (InputLayer)	(None, 256, 2)	0
<hr/>		
lstm_50 (LSTM)	(None, 100)	41200
<hr/>		
dropout_50 (Dropout)	(None, 100)	0
<hr/>		
dense_100 (Dense)	(None, 100)	10100
<hr/>		
dense_101 (Dense)	(None, 8)	808
<hr/>		

Total params: 52,108

Trainable params: 52,108

Non-trainable params: 0

---

Train on 19084 samples, validate on 4772 samples

Epoch 1/20

19084/19084 [=====] - 36s 2ms/step - loss: 1.8347 - acc: 0.3121 - val\_loss: 1.5606 - val\_acc: 0.4105

Epoch 00001: val\_acc improved from -inf to 0.41052, saving model to model\_v5a\_ccZ\_LF-accZ\_Wrist.hdf5

Epoch 2/20

19084/19084 [=====] - 30s 2ms/step - loss: 1.5315 - acc: 0.4218 - val\_loss: 1.3757 - val\_acc: 0.4881

```
Epoch 00002: val_acc improved from 0.41052 to 0.48806, saving model to model_
v5accZ_LF-accZ_Wrist.hdf5
Epoch 3/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.3642 -
acc: 0.4915 - val_loss: 1.3212 - val_acc: 0.5059

Epoch 00003: val_acc improved from 0.48806 to 0.50587, saving model to model_
v5accZ_LF-accZ_Wrist.hdf5
Epoch 4/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.3309 -
acc: 0.5074 - val_loss: 1.2422 - val_acc: 0.5421

Epoch 00004: val_acc improved from 0.50587 to 0.54212, saving model to model_
v5accZ_LF-accZ_Wrist.hdf5
Epoch 5/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.4272 -
acc: 0.4591 - val_loss: 1.3232 - val_acc: 0.4971

Epoch 00005: val_acc did not improve from 0.54212
Epoch 6/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.3441 -
acc: 0.4914 - val_loss: 1.2618 - val_acc: 0.5187

Epoch 00006: val_acc did not improve from 0.54212
Epoch 7/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.2319 -
acc: 0.5406 - val_loss: 1.1240 - val_acc: 0.5972

Epoch 00007: val_acc improved from 0.54212 to 0.59723, saving model to model_
v5accZ_LF-accZ_Wrist.hdf5
Epoch 8/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.1389 -
acc: 0.5788 - val_loss: 1.1087 - val_acc: 0.6008

Epoch 00008: val_acc improved from 0.59723 to 0.60080, saving model to model_
v5accZ_LF-accZ_Wrist.hdf5
Epoch 9/20
19084/19084 [=====] - 32s 2ms/step - loss: 1.1424 -
acc: 0.5880 - val_loss: 1.1606 - val_acc: 0.5717

Epoch 00009: val_acc did not improve from 0.60080
Epoch 10/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.0994 -
acc: 0.5998 - val_loss: 0.9810 - val_acc: 0.6490

Epoch 00010: val_acc improved from 0.60080 to 0.64899, saving model to model_
v5accZ_LF-accZ_Wrist.hdf5
Epoch 11/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.0125 -
acc: 0.6340 - val_loss: 0.9265 - val_acc: 0.6664

Epoch 00011: val_acc improved from 0.64899 to 0.66639, saving model to model_
v5accZ_LF-accZ_Wrist.hdf5
Epoch 12/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.9768 -
acc: 0.6451 - val_loss: 0.9329 - val_acc: 0.6563
```

```
Epoch 00012: val_acc did not improve from 0.66639
Epoch 13/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.9355 -
acc: 0.6644 - val_loss: 0.8647 - val_acc: 0.6903

Epoch 00013: val_acc improved from 0.66639 to 0.69028, saving model to model_
v5accZ_LF-accZ_Wrist.hdf5
Epoch 14/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.9677 -
acc: 0.6514 - val_loss: 0.8879 - val_acc: 0.6699

Epoch 00014: val_acc did not improve from 0.69028
Epoch 15/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.8928 -
acc: 0.6794 - val_loss: 0.7948 - val_acc: 0.7131

Epoch 00015: val_acc improved from 0.69028 to 0.71312, saving model to model_
v5accZ_LF-accZ_Wrist.hdf5
Epoch 16/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.8069 -
acc: 0.7092 - val_loss: 0.7523 - val_acc: 0.7265

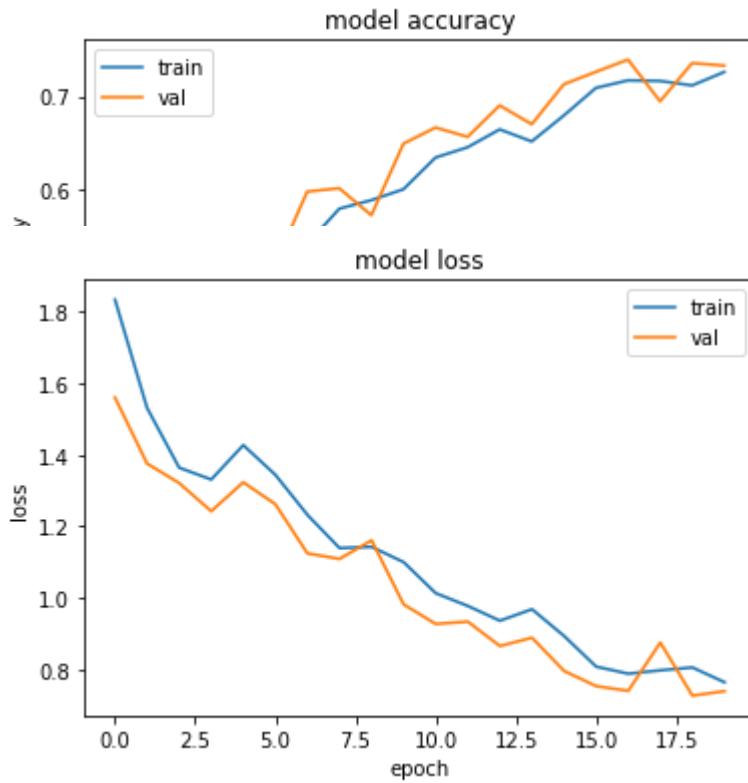
Epoch 00016: val_acc improved from 0.71312 to 0.72653, saving model to model_
v5accZ_LF-accZ_Wrist.hdf5
Epoch 17/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.7872 -
acc: 0.7173 - val_loss: 0.7391 - val_acc: 0.7397

Epoch 00017: val_acc improved from 0.72653 to 0.73973, saving model to model_
v5accZ_LF-accZ_Wrist.hdf5
Epoch 18/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.7965 -
acc: 0.7167 - val_loss: 0.8744 - val_acc: 0.6947

Epoch 00018: val_acc did not improve from 0.73973
Epoch 19/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.8046 -
acc: 0.7119 - val_loss: 0.7257 - val_acc: 0.7360

Epoch 00019: val_acc did not improve from 0.73973
Epoch 20/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.7632 -
acc: 0.7264 - val_loss: 0.7382 - val_acc: 0.7332

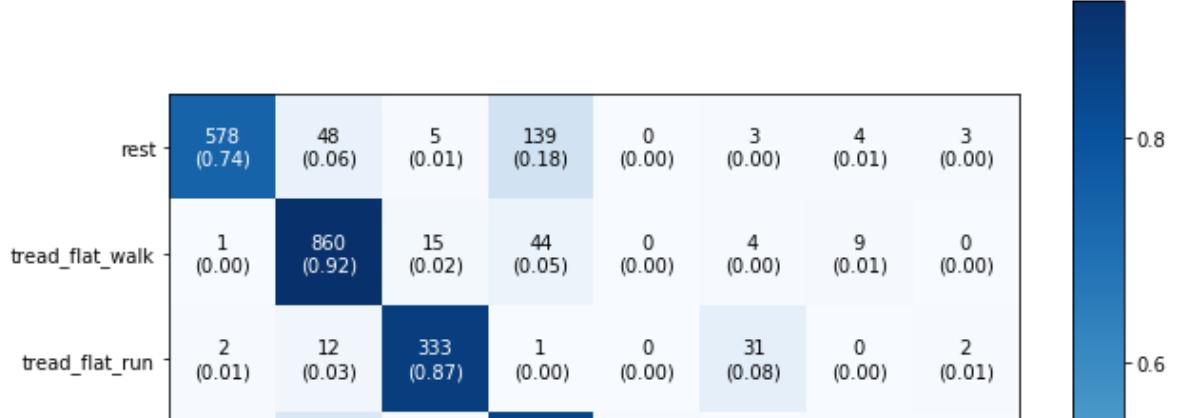
Epoch 00020: val_acc did not improve from 0.73973
```



Best accuracy (on validation dataset): 73.32%

```
[[ 578   48     5   139     0     3     4     3]
 [  1   860    15    44     0     4     9     0]
 [  2    12   333     1     0    31     0     2]
 [  5   173     7  1082     5     0     1     0]
 [  1    74     0   270     6     1     1     0]
 [  1     9   221     5     1   112     1     5]
 [  1   115     3    13     0     1   229     6]
 [  1     3   11     1     0     8     6   299]]
```

<Figure size 432x288 with 0 Axes>



## Classification Report:

	precision	recall	f1-score	support
rest	0.9797	0.7410	0.8438	780
tread_flat_walk	0.6646	0.9218	0.7723	933
tread_flat_run	0.5597	0.8740	0.6824	381
tread_slope_walk	0.6958	0.8500	0.7652	1273
indoor_flat_walk	0.5000	0.0170	0.0329	353
indoor_flat_run	0.7000	0.3155	0.4350	355
outdoor_walk	0.9124	0.6223	0.7399	368
outdoor_run	0.9492	0.9088	0.9286	329
accuracy			0.7332	4772
macro avg	0.7452	0.6563	0.6500	4772
weighted avg	0.7452	0.7332	0.7034	4772

Trying for these features ['accX\_Wrist', 'accY\_Wrist']

(19084, 256, 2)

(19084, 8)

(4772, 256, 2)

(4772, 8)

256

2

8

Layer (type)	Output Shape	Param #
<hr/>		
input_52 (InputLayer)	(None, 256, 2)	0
lstm_51 (LSTM)	(None, 100)	41200
dropout_51 (Dropout)	(None, 100)	0
dense_102 (Dense)	(None, 100)	10100
dense_103 (Dense)	(None, 8)	808
<hr/>		

Total params: 52,108

Trainable params: 52,108

Non-trainable params: 0

---

Train on 19084 samples, validate on 4772 samples

Epoch 1/20

19084/19084 [=====] - 35s 2ms/step - loss: 1.7549 - ac

```
c: 0.2946 - val_loss: 1.4407 - val_acc: 0.4042
```

```
Epoch 00001: val_acc improved from -inf to 0.40423, saving model to model_v5accX_Wrist-accY_Wrist.hdf5
Epoch 2/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.4009 - ac
c: 0.3913 - val_loss: 1.3339 - val_acc: 0.4290
```

```
Epoch 00002: val_acc improved from 0.40423 to 0.42896, saving model to model_v5accX_Wrist-accY_Wrist.hdf5
Epoch 3/20
19084/19084 [=====] - 29s 2ms/step - loss: 1.3436 - ac
c: 0.4133 - val_loss: 1.2555 - val_acc: 0.4604
```

```
Epoch 00003: val_acc improved from 0.42896 to 0.46039, saving model to model_v5accX_Wrist-accY_Wrist.hdf5
Epoch 4/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.3087 - ac
c: 0.4329 - val_loss: 1.2562 - val_acc: 0.4608
```

```
Epoch 00004: val_acc improved from 0.46039 to 0.46081, saving model to model_v5accX_Wrist-accY_Wrist.hdf5
Epoch 5/20
19084/19084 [=====] - 29s 2ms/step - loss: 1.2916 - ac
c: 0.4364 - val_loss: 1.2383 - val_acc: 0.4608
```

```
Epoch 00005: val_acc did not improve from 0.46081
Epoch 6/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.2182 - ac
c: 0.4746 - val_loss: 1.1408 - val_acc: 0.5151
```

```
Epoch 00006: val_acc improved from 0.46081 to 0.51509, saving model to model_v5accX_Wrist-accY_Wrist.hdf5
Epoch 7/20
19084/19084 [=====] - 31s 2ms/step - loss: 1.1663 - ac
c: 0.4952 - val_loss: 1.0993 - val_acc: 0.5367
```

```
Epoch 00007: val_acc improved from 0.51509 to 0.53667, saving model to model_v5accX_Wrist-accY_Wrist.hdf5
Epoch 8/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.1283 - ac
c: 0.5279 - val_loss: 1.0499 - val_acc: 0.5668
```

```
Epoch 00008: val_acc improved from 0.53667 to 0.56685, saving model to model_v5accX_Wrist-accY_Wrist.hdf5
Epoch 9/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.0975 - ac
c: 0.5457 - val_loss: 1.0645 - val_acc: 0.5706
```

```
Epoch 00009: val_acc improved from 0.56685 to 0.57062, saving model to model_v5accX_Wrist-accY_Wrist.hdf5
Epoch 10/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.0826 - ac
c: 0.5572 - val_loss: 1.0160 - val_acc: 0.5771
```

```
Epoch 00010: val_acc improved from 0.57062 to 0.57712, saving model to model_v5accX_Wrist-accY_Wrist.hdf5
```

```
Epoch 11/20
19084/19084 [=====] - 29s 2ms/step - loss: 1.0653 - ac
c: 0.5647 - val_loss: 1.0091 - val_acc: 0.5916

Epoch 00011: val_acc improved from 0.57712 to 0.59158, saving model to model_v5
accX_Wrist-accY_Wrist.hdf5
Epoch 12/20
19084/19084 [=====] - 29s 2ms/step - loss: 1.0427 - ac
c: 0.5783 - val_loss: 0.9803 - val_acc: 0.6115

Epoch 00012: val_acc improved from 0.59158 to 0.61148, saving model to model_v5
accX_Wrist-accY_Wrist.hdf5
Epoch 13/20
19084/19084 [=====] - 29s 2ms/step - loss: 1.0131 - ac
c: 0.5926 - val_loss: 0.9781 - val_acc: 0.5966

Epoch 00013: val_acc did not improve from 0.61148
Epoch 14/20
19084/19084 [=====] - 29s 2ms/step - loss: 1.1253 - ac
c: 0.5470 - val_loss: 1.0632 - val_acc: 0.5878

Epoch 00014: val_acc did not improve from 0.61148
Epoch 15/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.0411 - ac
c: 0.5809 - val_loss: 0.9581 - val_acc: 0.6069

Epoch 00015: val_acc did not improve from 0.61148
Epoch 16/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.0303 - ac
c: 0.5811 - val_loss: 0.9580 - val_acc: 0.6102

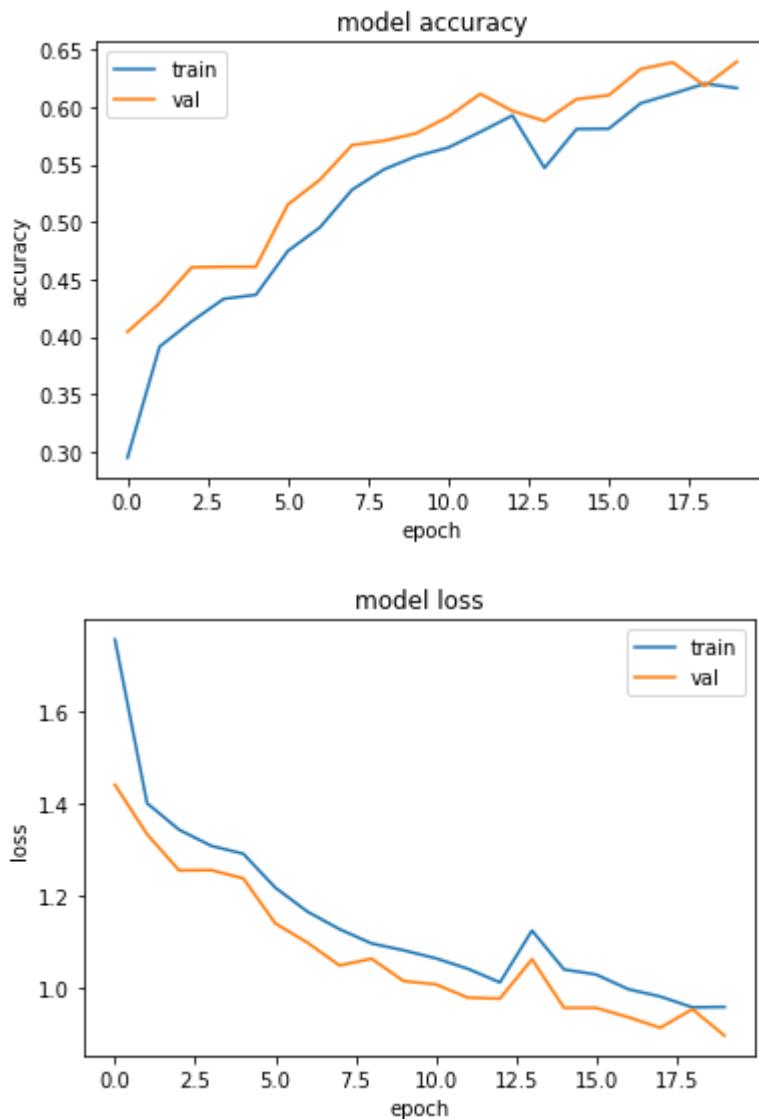
Epoch 00016: val_acc did not improve from 0.61148
Epoch 17/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.9985 - ac
c: 0.6033 - val_loss: 0.9380 - val_acc: 0.6331

Epoch 00017: val_acc improved from 0.61148 to 0.63307, saving model to model_v5
accX_Wrist-accY_Wrist.hdf5
Epoch 18/20
19084/19084 [=====] - 32s 2ms/step - loss: 0.9826 - ac
c: 0.6116 - val_loss: 0.9150 - val_acc: 0.6389

Epoch 00018: val_acc improved from 0.63307 to 0.63894, saving model to model_v5
accX_Wrist-accY_Wrist.hdf5
Epoch 19/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.9592 - ac
c: 0.6204 - val_loss: 0.9554 - val_acc: 0.6184

Epoch 00019: val_acc did not improve from 0.63894
Epoch 20/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.9601 - ac
c: 0.6165 - val_loss: 0.8980 - val_acc: 0.6396

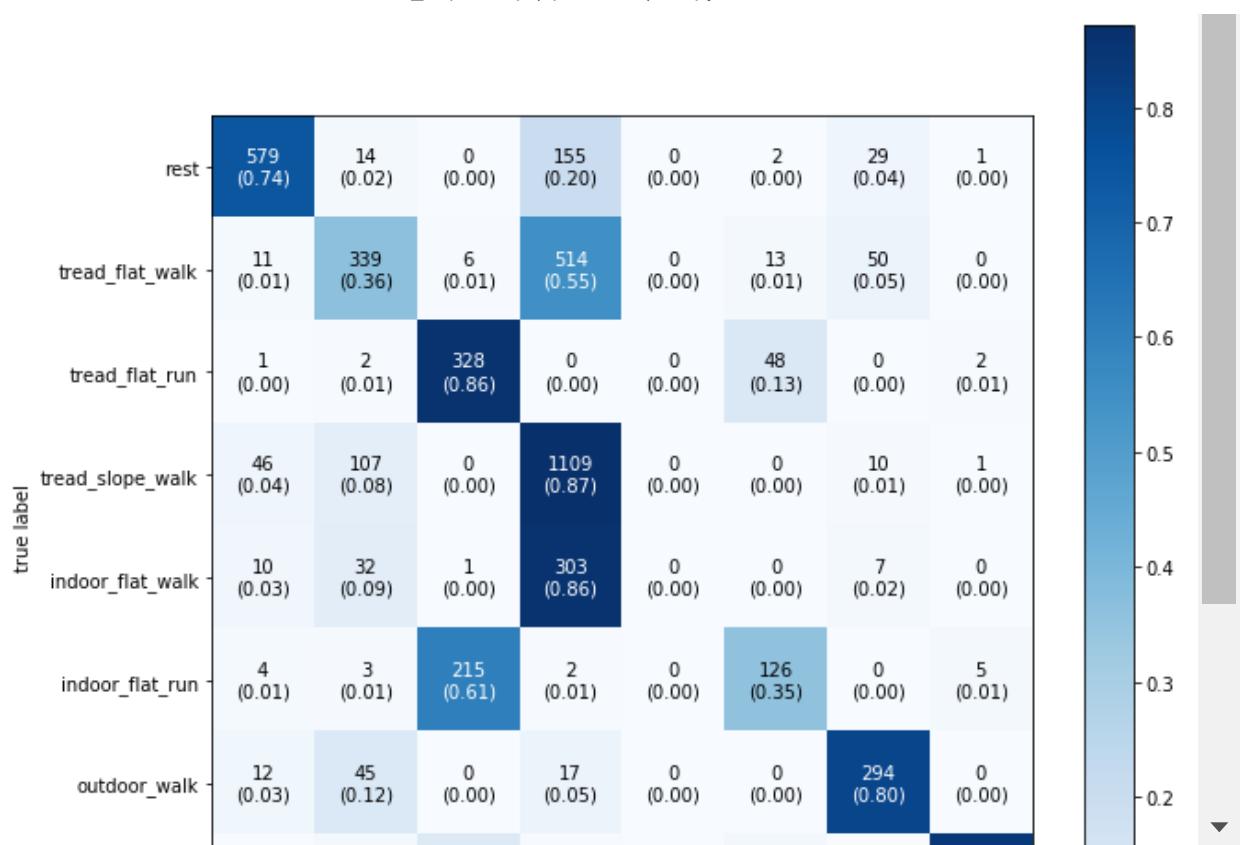
Epoch 00020: val_acc improved from 0.63894 to 0.63956, saving model to model_v5
accX_Wrist-accY_Wrist.hdf5
```



Best accuracy (on validation dataset): 63.96%

```
[[ 579   14     0  155     0     2    29     1]
 [  11   339     6  514     0    13    50     0]
 [   1     2  328     0     0    48     0     2]
 [  46   107     0 1109     0     0    10     1]
 [  10    32     1  303     0     0     7     0]
 [   4     3  215     2     0   126     0     5]
 [  12    45     0   17     0     0   294     0]
 [   0     5   37     2     0     7     1  277]]
```

<Figure size 432x288 with 0 Axes>



## Classification Report:

	precision	recall	f1-score	support
rest	0.8733	0.7423	0.8025	780
tread_flat_walk	0.6197	0.3633	0.4581	933
tread_flat_run	0.5588	0.8609	0.6777	381
tread_slope_walk	0.5276	0.8712	0.6572	1273
indoor_flat_walk	0.0000	0.0000	0.0000	353
indoor_flat_run	0.6429	0.3549	0.4574	355
outdoor_walk	0.7519	0.7989	0.7747	368
outdoor_run	0.9685	0.8419	0.9008	329
accuracy			0.6396	4772
macro avg	0.6178	0.6042	0.5910	4772
weighted avg	0.6219	0.6396	0.6060	4772

Trying for these features ['accX\_Wrist', 'accZ\_Wrist']  
(19084, 256, 2)  
(19084, 8)  
(4772, 256, 2)  
(4772, 8)  
256  
2  
8

Layer (type)	Output Shape	Param #
<hr/>		
input_53 (InputLayer)	(None, 256, 2)	0
lstm_52 (LSTM)	(None, 100)	41200
dropout_52 (Dropout)	(None, 100)	0

dense_104 (Dense)	(None, 100)	10100
dense_105 (Dense)	(None, 8)	808

---

Total params: 52,108  
Trainable params: 52,108  
Non-trainable params: 0

---

Train on 19084 samples, validate on 4772 samples

Epoch 1/20  
19084/19084 [=====] - 36s 2ms/step - loss: 1.7110 - ac  
c: 0.2944 - val\_loss: 1.4121 - val\_acc: 0.3755

Epoch 00001: val\_acc improved from -inf to 0.37552, saving model to model\_v5accX\_Wrist-accZ\_Wrist.hdf5

Epoch 2/20  
19084/19084 [=====] - 30s 2ms/step - loss: 1.3956 - ac  
c: 0.3901 - val\_loss: 1.3268 - val\_acc: 0.4304

Epoch 00002: val\_acc improved from 0.37552 to 0.43043, saving model to model\_v5accX\_Wrist-accZ\_Wrist.hdf5

Epoch 3/20  
19084/19084 [=====] - 30s 2ms/step - loss: 1.3258 - ac  
c: 0.4191 - val\_loss: 1.2698 - val\_acc: 0.4361

Epoch 00003: val\_acc improved from 0.43043 to 0.43609, saving model to model\_v5accX\_Wrist-accZ\_Wrist.hdf5

Epoch 4/20  
19084/19084 [=====] - 30s 2ms/step - loss: 1.2860 - ac  
c: 0.4339 - val\_loss: 1.2528 - val\_acc: 0.4526

Epoch 00004: val\_acc improved from 0.43609 to 0.45264, saving model to model\_v5accX\_Wrist-accZ\_Wrist.hdf5

Epoch 5/20  
19084/19084 [=====] - 30s 2ms/step - loss: 1.2817 - ac  
c: 0.4321 - val\_loss: 1.3896 - val\_acc: 0.3560

Epoch 00005: val\_acc did not improve from 0.45264

Epoch 6/20  
19084/19084 [=====] - 30s 2ms/step - loss: 1.3345 - ac  
c: 0.4213 - val\_loss: 1.2436 - val\_acc: 0.4715

Epoch 00006: val\_acc improved from 0.45264 to 0.47150, saving model to model\_v5accX\_Wrist-accZ\_Wrist.hdf5

Epoch 7/20  
19084/19084 [=====] - 30s 2ms/step - loss: 1.3018 - ac  
c: 0.4341 - val\_loss: 1.1922 - val\_acc: 0.4849

Epoch 00007: val\_acc improved from 0.47150 to 0.48491, saving model to model\_v5accX\_Wrist-accZ\_Wrist.hdf5

Epoch 8/20  
19084/19084 [=====] - 30s 2ms/step - loss: 1.2061 - ac  
c: 0.4851 - val\_loss: 1.1710 - val\_acc: 0.4994

Epoch 00008: val\_acc improved from 0.48491 to 0.49937, saving model to model\_v5accX\_Wrist-accZ\_Wrist.hdf5

```
Epoch 9/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.2410 - ac
c: 0.4648 - val_loss: 1.1649 - val_acc: 0.5090

Epoch 00009: val_acc improved from 0.49937 to 0.50901, saving model to model_v5
accX_Wrist-accZ_Wrist.hdf5
Epoch 10/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.2202 - ac
c: 0.4789 - val_loss: 1.2090 - val_acc: 0.4876

Epoch 00010: val_acc did not improve from 0.50901
Epoch 11/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.2656 - ac
c: 0.4506 - val_loss: 1.1482 - val_acc: 0.4998

Epoch 00011: val_acc did not improve from 0.50901
Epoch 12/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.1681 - ac
c: 0.4925 - val_loss: 1.1084 - val_acc: 0.5201

Epoch 00012: val_acc improved from 0.50901 to 0.52012, saving model to model_v5
accX_Wrist-accZ_Wrist.hdf5
Epoch 13/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.1314 - ac
c: 0.5058 - val_loss: 1.0809 - val_acc: 0.5266

Epoch 00013: val_acc improved from 0.52012 to 0.52661, saving model to model_v5
accX_Wrist-accZ_Wrist.hdf5
Epoch 14/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.1022 - ac
c: 0.5193 - val_loss: 1.0536 - val_acc: 0.5469

Epoch 00014: val_acc improved from 0.52661 to 0.54694, saving model to model_v5
accX_Wrist-accZ_Wrist.hdf5
Epoch 15/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.1205 - ac
c: 0.5100 - val_loss: 1.1015 - val_acc: 0.5251

Epoch 00015: val_acc did not improve from 0.54694
Epoch 16/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.1702 - ac
c: 0.4914 - val_loss: 1.1106 - val_acc: 0.5065

Epoch 00016: val_acc did not improve from 0.54694
Epoch 17/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.1375 - ac
c: 0.5126 - val_loss: 1.0819 - val_acc: 0.5365

Epoch 00017: val_acc did not improve from 0.54694
Epoch 18/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.1453 - ac
c: 0.4957 - val_loss: 1.0704 - val_acc: 0.5415

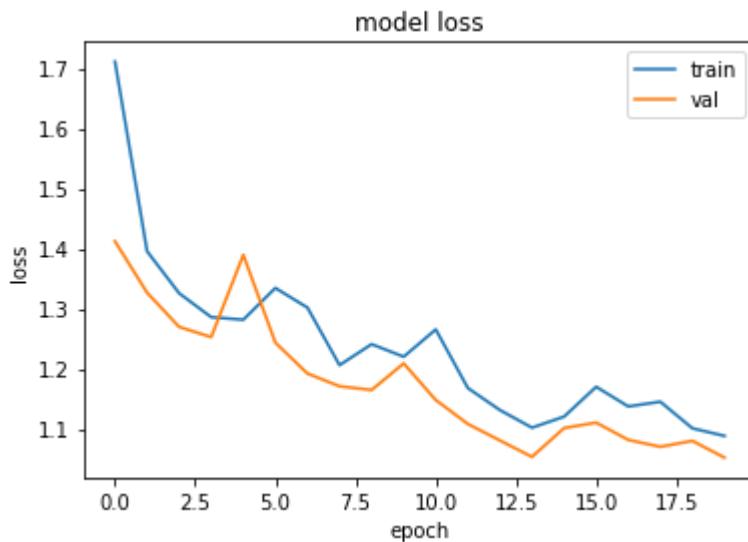
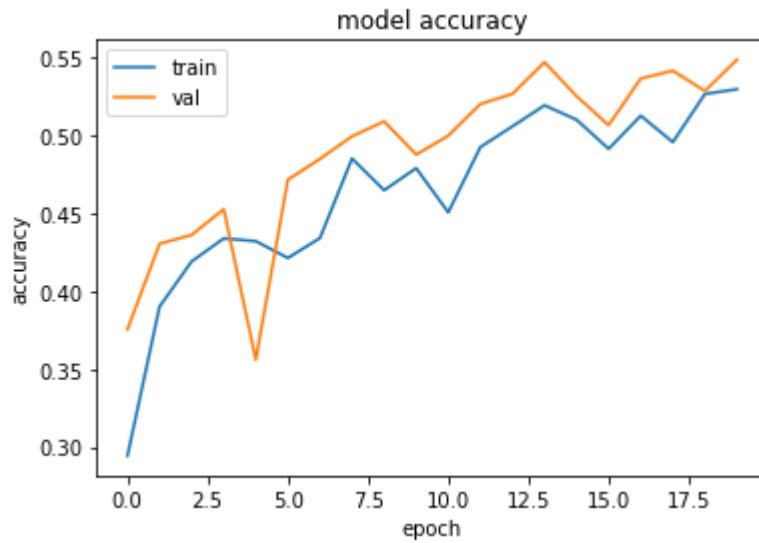
Epoch 00018: val_acc did not improve from 0.54694
Epoch 19/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.1011 - ac
c: 0.5266 - val_loss: 1.0802 - val_acc: 0.5285
```

```
Epoch 00019: val_acc did not improve from 0.54694
```

```
Epoch 20/20
```

```
19084/19084 [=====] - 30s 2ms/step - loss: 1.0885 - ac  
c: 0.5296 - val_loss: 1.0523 - val_acc: 0.5486
```

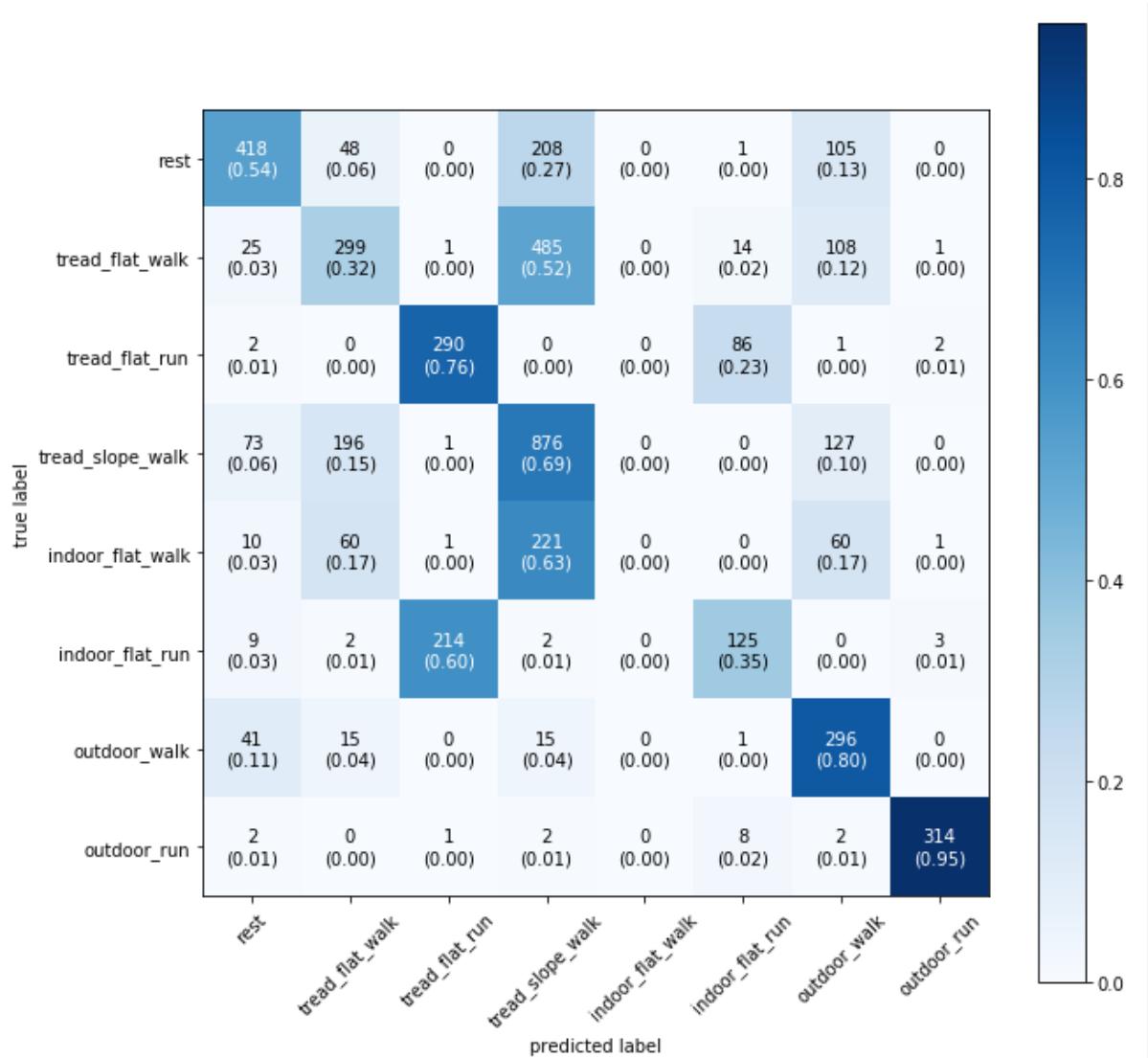
```
Epoch 00020: val_acc improved from 0.54694 to 0.54862, saving model to model_v5  
accX Wrist+accZ Wrist hdf5
```



Best accuracy (on validation dataset): 54.86%

```
[[418  48   0 208   0   1 105   0]
 [ 25 299   1 485   0  14 108   1]
 [  2   0 290   0   0  86   1   2]
 [ 73 196   1 876   0   0 127   0]
 [ 10  60   1 221   0   0  60   1]
 [  9   2 214   2   0 125   0   3]
 [ 41  15   0 15   0   1 296   0]
 [  2   0   1   2   0   8   2 31411]
```

<Figure size 432x288 with 0 Axes>



## Classification Report:

	precision	recall	f1-score	support
rest	0.7207	0.5359	0.6147	780
tread_flat_walk	0.4823	0.3205	0.3851	933
tread_flat_run	0.5709	0.7612	0.6524	381
tread_slope_walk	0.4842	0.6881	0.5685	1273
indoor_flat_walk	0.0000	0.0000	0.0000	353
indoor_flat_run	0.5319	0.3521	0.4237	355
outdoor_walk	0.4235	0.8043	0.5548	368
outdoor_run	0.9782	0.9544	0.9662	329
accuracy			0.5486	4772
macro avg	0.5240	0.5521	0.5207	4772
weighted avg	0.5265	0.5486	0.5204	4772

Trying for these features ['accY\_Wrist', 'accZ\_Wrist']

(19084, 256, 2)

(19084, 8)

(4772, 256, 2)

(4772, 8)

256

2

8

Layer (type)	Output Shape	Param #
<hr/>		
input_54 (InputLayer)	(None, 256, 2)	0
lstm_53 (LSTM)	(None, 100)	41200
dropout_53 (Dropout)	(None, 100)	0
dense_106 (Dense)	(None, 100)	10100
dense_107 (Dense)	(None, 8)	808
<hr/>		

Total params: 52,108

Trainable params: 52,108

Non-trainable params: 0

---

Train on 19084 samples, validate on 4772 samples

Epoch 1/20

19084/19084 [=====] - 36s 2ms/step - loss: 1.7794 - ac

```
c: 0.3045 - val_loss: 1.4967 - val_acc: 0.3929

Epoch 00001: val_acc improved from -inf to 0.39292, saving model to model_v5accY_Wrist-accZ_Wrist.hdf5
Epoch 2/20
19084/19084 [=====] - 29s 2ms/step - loss: 1.4385 - ac
c: 0.3911 - val_loss: 1.3296 - val_acc: 0.4294

Epoch 00002: val_acc improved from 0.39292 to 0.42938, saving model to model_v5accY_Wrist-accZ_Wrist.hdf5
Epoch 3/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.3612 - ac
c: 0.4126 - val_loss: 1.2842 - val_acc: 0.4396

Epoch 00003: val_acc improved from 0.42938 to 0.43965, saving model to model_v5accY_Wrist-accZ_Wrist.hdf5
Epoch 4/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.3095 - ac
c: 0.4305 - val_loss: 1.2613 - val_acc: 0.4606

Epoch 00004: val_acc improved from 0.43965 to 0.46060, saving model to model_v5accY_Wrist-accZ_Wrist.hdf5
Epoch 5/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.2812 - ac
c: 0.4513 - val_loss: 1.2125 - val_acc: 0.4824

Epoch 00005: val_acc improved from 0.46060 to 0.48240, saving model to model_v5accY_Wrist-accZ_Wrist.hdf5
Epoch 6/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.2255 - ac
c: 0.4777 - val_loss: 1.1444 - val_acc: 0.5275

Epoch 00006: val_acc improved from 0.48240 to 0.52745, saving model to model_v5accY_Wrist-accZ_Wrist.hdf5
Epoch 7/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.1866 - ac
c: 0.5052 - val_loss: 1.1172 - val_acc: 0.5375

Epoch 00007: val_acc improved from 0.52745 to 0.53751, saving model to model_v5accY_Wrist-accZ_Wrist.hdf5
Epoch 8/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.1690 - ac
c: 0.5027 - val_loss: 1.1356 - val_acc: 0.5285

Epoch 00008: val_acc did not improve from 0.53751
Epoch 9/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.1076 - ac
c: 0.5442 - val_loss: 1.0147 - val_acc: 0.5801

Epoch 00009: val_acc improved from 0.53751 to 0.58005, saving model to model_v5accY_Wrist-accZ_Wrist.hdf5
Epoch 10/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.0459 - ac
c: 0.5682 - val_loss: 1.0160 - val_acc: 0.5668

Epoch 00010: val_acc did not improve from 0.58005
Epoch 11/20
```

```
19084/19084 [=====] - 30s 2ms/step - loss: 1.0278 - ac  
c: 0.5785 - val_loss: 0.9957 - val_acc: 0.5870

Epoch 00011: val_acc improved from 0.58005 to 0.58697, saving model to model_v5  
accY_Wrist-accZ_Wrist.hdf5
Epoch 12/20
19084/19084 [=====] - 30s 2ms/step - loss: 1.0123 - ac  
c: 0.5876 - val_loss: 0.9498 - val_acc: 0.6090

Epoch 00012: val_acc improved from 0.58697 to 0.60897, saving model to model_v5  
accY_Wrist-accZ_Wrist.hdf5
Epoch 13/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.9901 - ac  
c: 0.5958 - val_loss: 1.0103 - val_acc: 0.5859

Epoch 00013: val_acc did not improve from 0.60897
Epoch 14/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.9894 - ac  
c: 0.6013 - val_loss: 0.9299 - val_acc: 0.6236

Epoch 00014: val_acc improved from 0.60897 to 0.62364, saving model to model_v5  
accY_Wrist-accZ_Wrist.hdf5
Epoch 15/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.9808 - ac  
c: 0.6094 - val_loss: 0.8911 - val_acc: 0.6387

Epoch 00015: val_acc improved from 0.62364 to 0.63873, saving model to model_v5  
accY_Wrist-accZ_Wrist.hdf5
Epoch 16/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.9623 - ac  
c: 0.6183 - val_loss: 0.9070 - val_acc: 0.6306

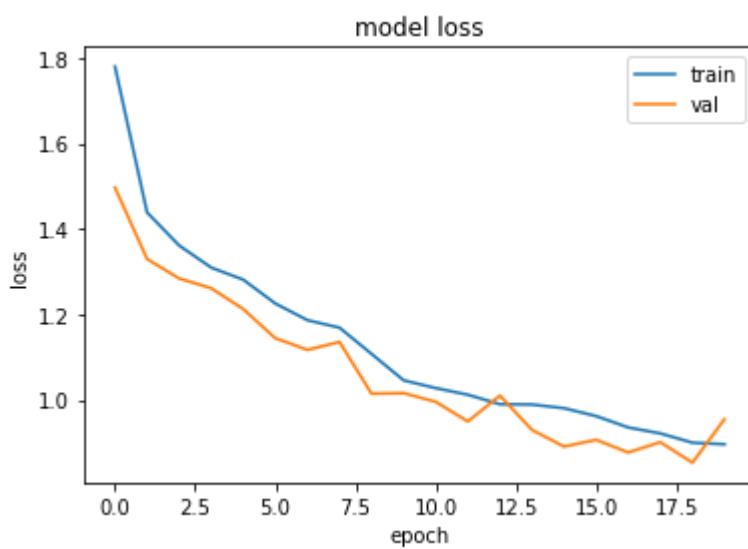
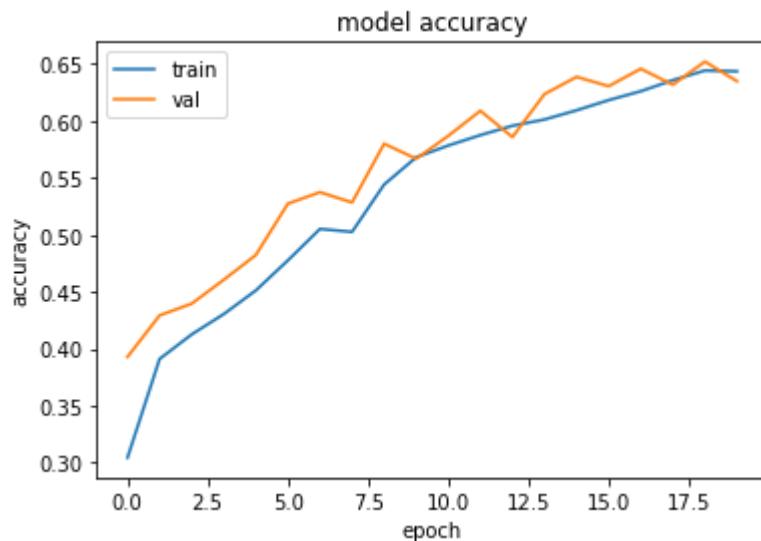
Epoch 00016: val_acc did not improve from 0.63873
Epoch 17/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.9358 - ac  
c: 0.6261 - val_loss: 0.8773 - val_acc: 0.6459

Epoch 00017: val_acc improved from 0.63873 to 0.64585, saving model to model_v5  
accY_Wrist-accZ_Wrist.hdf5
Epoch 18/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.9219 - ac  
c: 0.6358 - val_loss: 0.9015 - val_acc: 0.6318

Epoch 00018: val_acc did not improve from 0.64585
Epoch 19/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.9002 - ac  
c: 0.6443 - val_loss: 0.8535 - val_acc: 0.6521

Epoch 00019: val_acc improved from 0.64585 to 0.65214, saving model to model_v5  
accY_Wrist-accZ_Wrist.hdf5
Epoch 20/20
19084/19084 [=====] - 30s 2ms/step - loss: 0.8965 - ac  
c: 0.6436 - val_loss: 0.9552 - val_acc: 0.6350

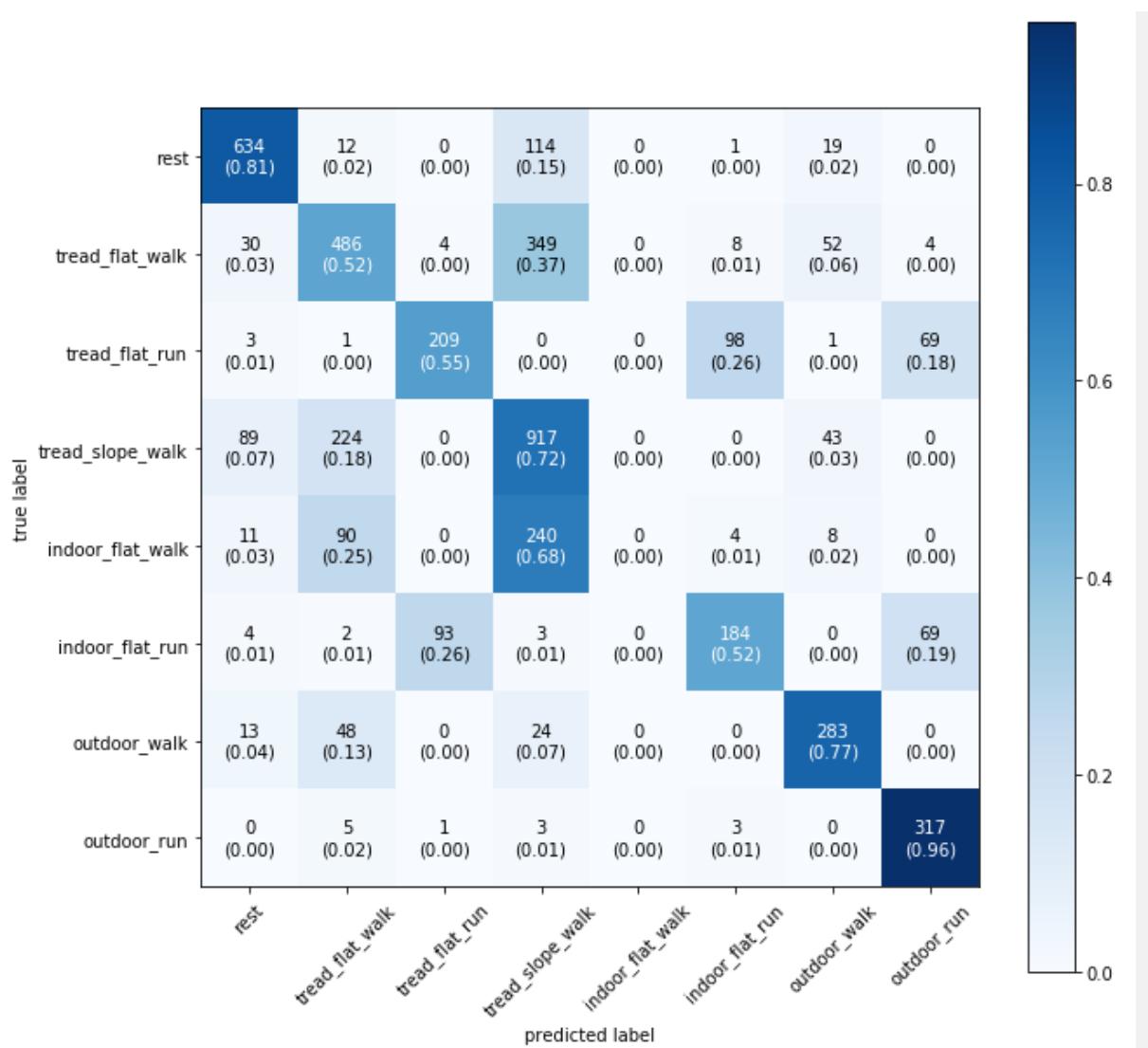
Epoch 00020: val_acc did not improve from 0.65214
```



Best accuracy (on validation dataset): 63.50%

```
[[634 12 0 114 0 1 19 0]
 [ 30 486 4 349 0 8 52 4]
 [ 3 1 209 0 0 98 1 69]
 [ 89 224 0 917 0 0 43 0]
 [ 11 90 0 240 0 4 8 0]
 [ 4 2 93 3 0 184 0 69]
 [ 13 48 0 24 0 0 283 0]
 [ 0 5 1 3 0 3 0 317]]
```

<Figure size 432x288 with 0 Axes>



### Classification Report:

	precision	recall	f1-score	support
rest	0.8087	0.8128	0.8107	780
tread_flat_walk	0.5599	0.5209	0.5397	933
tread_flat_run	0.6808	0.5486	0.6076	381
tread_slope_walk	0.5558	0.7203	0.6274	1273
indoor_flat_walk	0.0000	0.0000	0.0000	353
indoor_flat_run	0.6174	0.5183	0.5636	355
outdoor_walk	0.6970	0.7690	0.7313	368
outdoor_run	0.6906	0.9635	0.8046	329

accuracy		0.6350	4772
macro avg	0.5763	0.6067	0.5856
weighted avg	0.5916	0.6350	0.6077

In [20]:

```
from itertools import combinations
def rSubset(arr, r):

    # return list of all subsets of length r
    # to deal with duplicate subsets use
    # set(list(combinations(arr, r)))
    return list(combinations(arr, r))
```

In [ ]: