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Task List

Task 1

1. Comparing phone and watch by activities and listing the activities that are different between the two devices.

Task 2

1. Using unsupervised learning, grouping the activities into 3 groups - for phone and watch.
2. Comparing the groups between the two devices.

Task 3

1. Train a predictive model for first 2 mins data and predict the acceleration and gyro for the last 1 mins. [One activity from each - non-hand, hand (general) and hand (eating)]
2. Which activity can you predict best by using an appropriate metric.

Task 1 - Approach:

Observations:

- For some IDs, data pertaining to particular activity is missing, therefore did not analyze on a ID basis.

- Time stamp corresponding to the two devices are not the same.

- Incremental Timestamp for each person and each activity.

Activity	T2-Accln	T2-Gyro	Normalized T2-Accln	Normalized T2-Gyro	Mean
P	25837.496	6134.489	-1.379304541	3.932806962	1.276751
F	241463.68	37.89271	2.174562229	-0.307192294	0.933685
J	186919.16	145.36323	1.275580698	-0.232449782	0.521565
H	164018.44	686.9396	0.898139951	0.144200286	0.52117
K	156521.51	27.218392	0.774578471	-0.314615961	0.229981
E	156108.56	2.2139978	0.76777239	-0.332005765	0.217883
I	133073.32	93.45431	0.388114538	-0.268550874	0.059782
Q	134131.97	46.92631	0.405562795	-0.300909697	0.052327
L	131681.49	38.47411	0.365174938	-0.306787948	0.029193
D	124984.93	20.189751	0.254804844	-0.31950417	-0.03235
G	106330.42	2.6875879	-0.052651523	-0.331676397	-0.19216
C	89572.39	36.5947	-0.328850845	-0.308095021	-0.31847
R	84269.64	2.9232258	-0.416248705	-0.331512518	-0.37388
S	68320.99	21.842245	-0.679108142	-0.31835491	-0.49873
M	67535.55	3.748134	-0.692053458	-0.33093882	-0.5115
A	60779.13	15.64517	-0.803410141	-0.322664789	-0.56304
B	17480.175	1031.822	-1.517046651	0.384055617	-0.5665
O	22420.821	284.32807	-1.435616848	-0.135803917	-0.78571

Table1: Results obtained using Hotelling T2 test, along each axis for phone and watch. Activity P is the most different.

Activity	KS-accln	KS-gyro	Normalized KS-Accln	Normalized KS-Gyro	Mean
P	0.332282281	0.6347868	1.715629936	0.877259567	1.296444752
R	0.281976409	0.702735822	1.181502816	1.199748783	1.1906258
S	0.298820833	0.651671762	1.36035001	0.957396383	1.158873196
O	0.320350842	0.545033179	1.588946812	0.451284707	1.02011576
G	0.247835101	0.665221259	0.819004417	1.021702923	0.92035367
L	0.22230266	0.396574233	0.547911431	-0.253308349	0.147301541
J	0.109503971	0.63716352	-0.649738782	0.888539589	0.119400404
Q	0.109170606	0.631799705	-0.653278321	0.863082675	0.104902177
I	0.147537555	0.515276815	-0.245913787	0.31005962	0.032072917
H	0.08842127	0.614613799	-0.873586259	0.781517565	-0.046034347
F	0.079086573	0.591994079	-0.972698237	0.674163325	-0.149267456
K	0.150933387	0.424465757	-0.209858241	-0.120933879	-0.16539606
D	0.236038222	0.156981622	0.693749989	-1.390426019	-0.348338015
B	0.132336608	0.206045663	-0.407311206	-1.1575658	-0.782438503
A	0.100354718	0.216006154	-0.746881802	-1.110292849	-0.928587325
M	0.100955411	0.199668957	-0.740503887	-1.187829945	-0.964166916
C	0.05561319	0.162675652	-1.221928989	-1.363401886	-1.292665438
E	0.059053999	0.146326355	-1.185395898	-1.440996409	-1.313196154

Table 2: Results obtained using KS test metric on overall acceleration between the phone and watch for each activity. The highest distance is for activity P.

Task 2:

First Approach:

1. Clustering both accelerometer and gyroscope individually using K-means++.

2. Assigning one out of 3 label based on the highest frequency label assigned to samples from each activity.

3. Accelerometer was able to form clusters using K-means but Gyroscope created a single cluster.

Cluster 1

Watch	Phone
B H J O Q S	H

Cluster 2

Watch	Phone
A C E M P	A B C E J K L M O P

Cluster 3

Watch	Phone
D F G I K L R	D F G I R

Task 2:

Second Approach:

1. Calculating mean of each axis for each activity.

2. Using Agglomerative clustering on 18 6-D points.

Cluster 1

Watch	Phone
A B C E M O P	A C E M P

Cluster 2

Watch	Phone
J K L	D F G H I J K L R

Cluster 3

Watch	Phone
D F G H I Q R S	B O Q S

Task 3

Evaluated multiple LSTM Models for predicting the acceleration and gyroscope for one ID in one activity.

Activity A: ID1600: Accln: Phone

	Vanilla LSTM	Stacked LSTM	Bi- Directional LSTM
MAE	**1.7453**	1.8224	1.9021
RMSE	**2.36742**	2.4667	2.4197

Activity A: ID1600: Gyro: Phone

	Vanilla LSTM	Stacked LSTM	**Bi- Directional LSTM**
MAE	0.2934	0.2943	**0.2873**
RMSE	0.3753	0.3751	**0.3602**

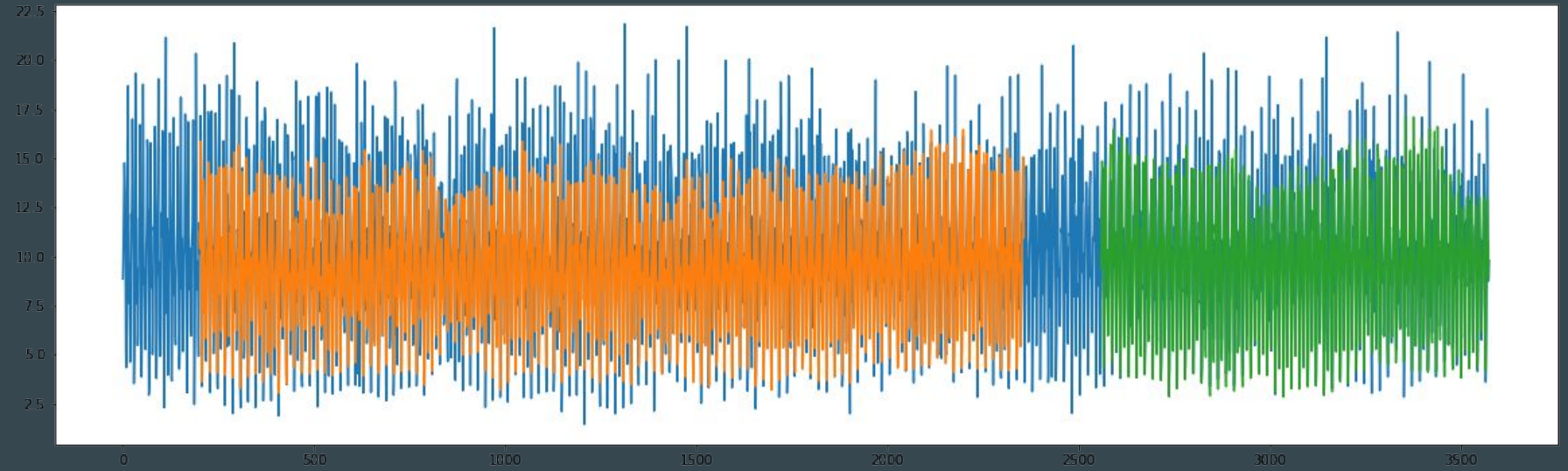

Fig1: Time series forecast for AccIn of Activity A for ID1600 using Vanilla LSTM.

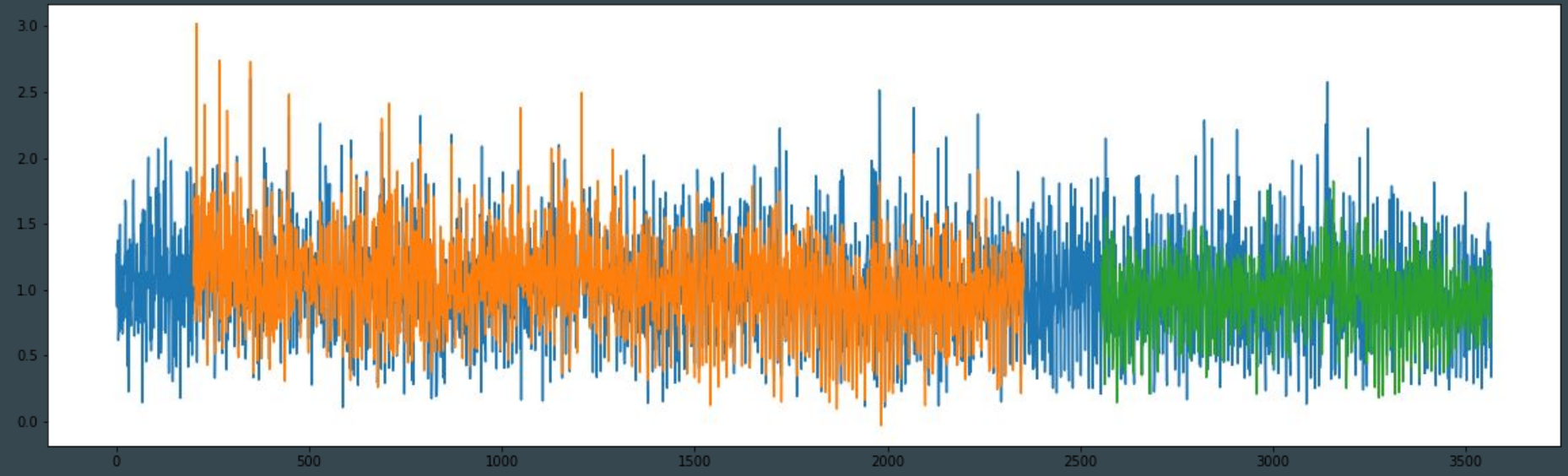

Fig2: Time series forecast for Gyro of Activity A for ID1600 using Bi-directional LSTM.

Activity P: ID1600: Accln: Phone

	Vanilla LSTM	Stacked LSTM	Bi- Directional LSTM
MAE	**0.7017**	0.7133	0.7621
RMSE	**0.9760**	0.9830	1.0162

Activity P: ID1600: Gyro: Phone

	Vanilla LSTM	Stacked LSTM	Bi- Directional LSTM
MAE	**0.2320**	0.2334	0.2493
RMSE	**0.3136**	0.3283	0.3432

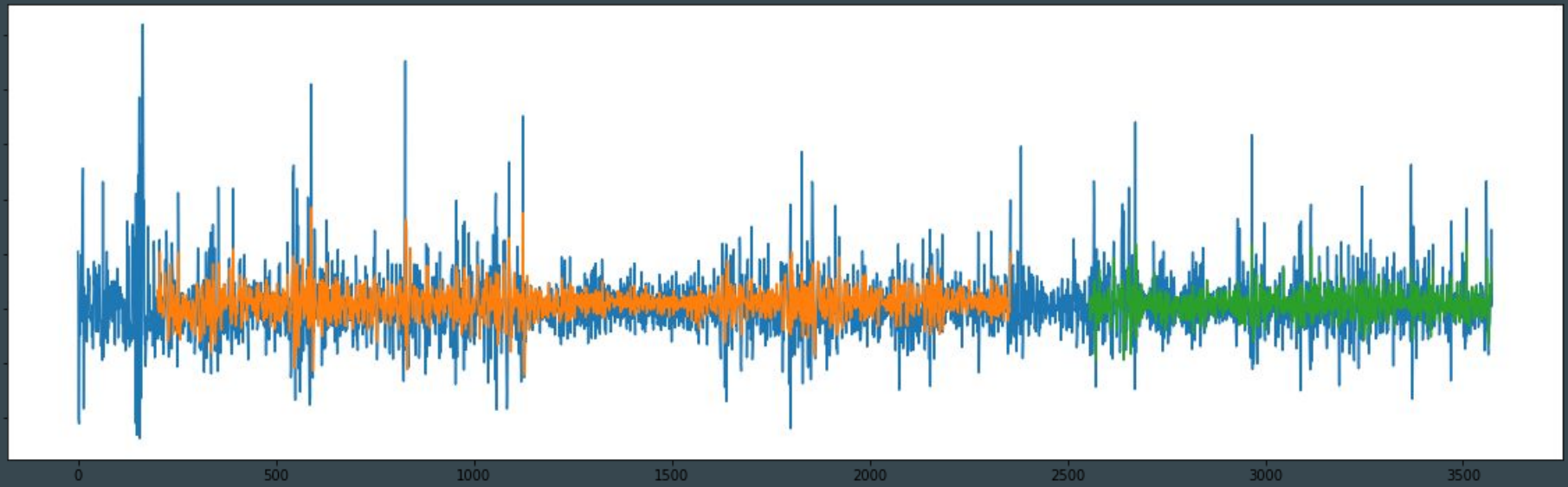

Fig3: Time series forecast for AccIn of Activity P for ID1600 using Vanilla LSTM.

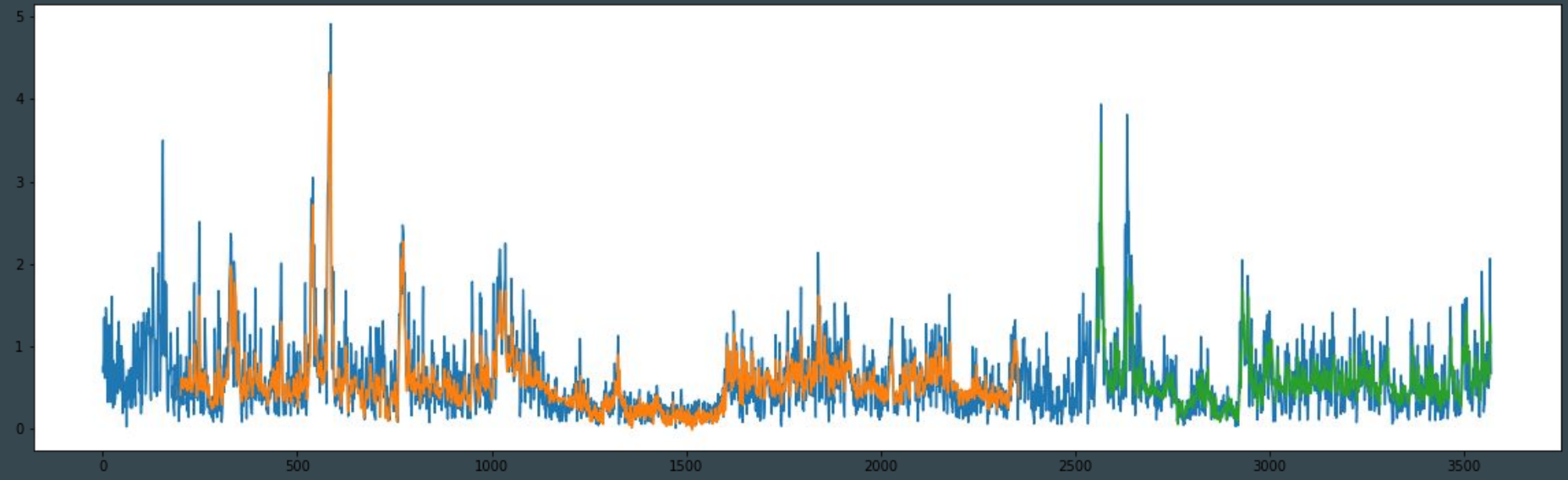

Fig4: Time series forecast for Gyro of Activity P for ID1600 using Vanilla LSTM.

Activity J: ID1600: Accln: Phone

	Vanilla LSTM	**Stacked LSTM**	Bi- Directional LSTM
MAE	0.0199	**0.0195**	0.0197
RMSE	0.0257	**0.0254**	0.0255

Activity J: ID1600: Gyro: Phone

	Vanilla LSTM	Stacked LSTM	Bi- Directional LSTM
MAE	**0.0090**	0.0119	0.0162
RMSE	**0.0130**	0.0210	0.0309

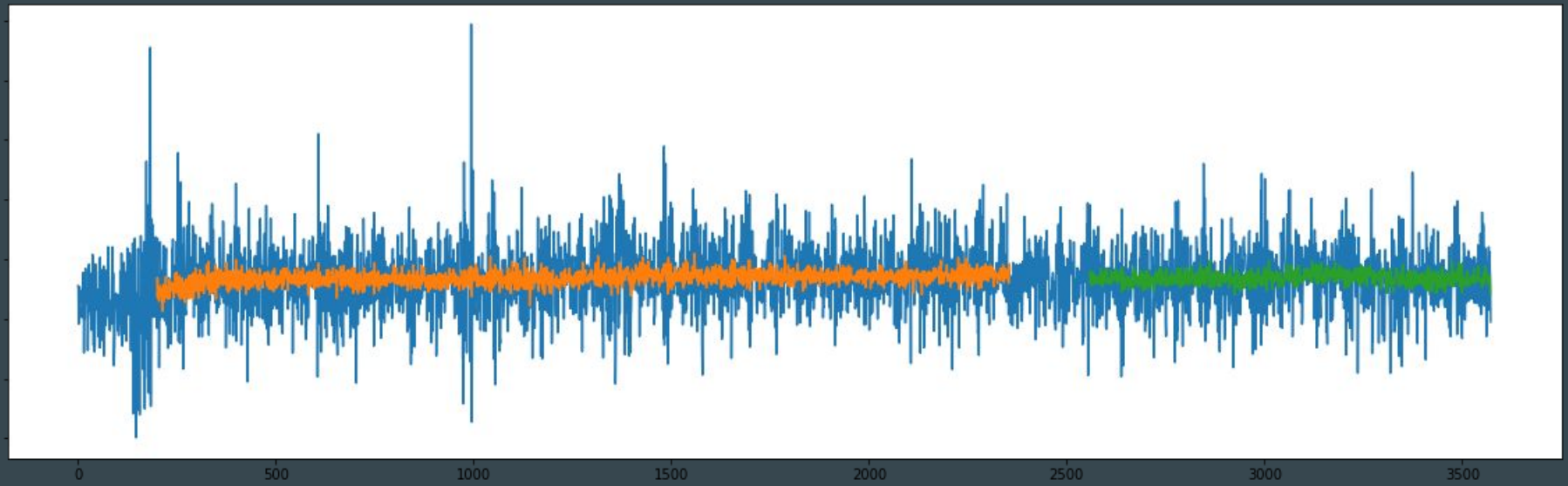

Fig5: Time series forecast for Accln of Activity J for ID1600 using Stacked LSTM.

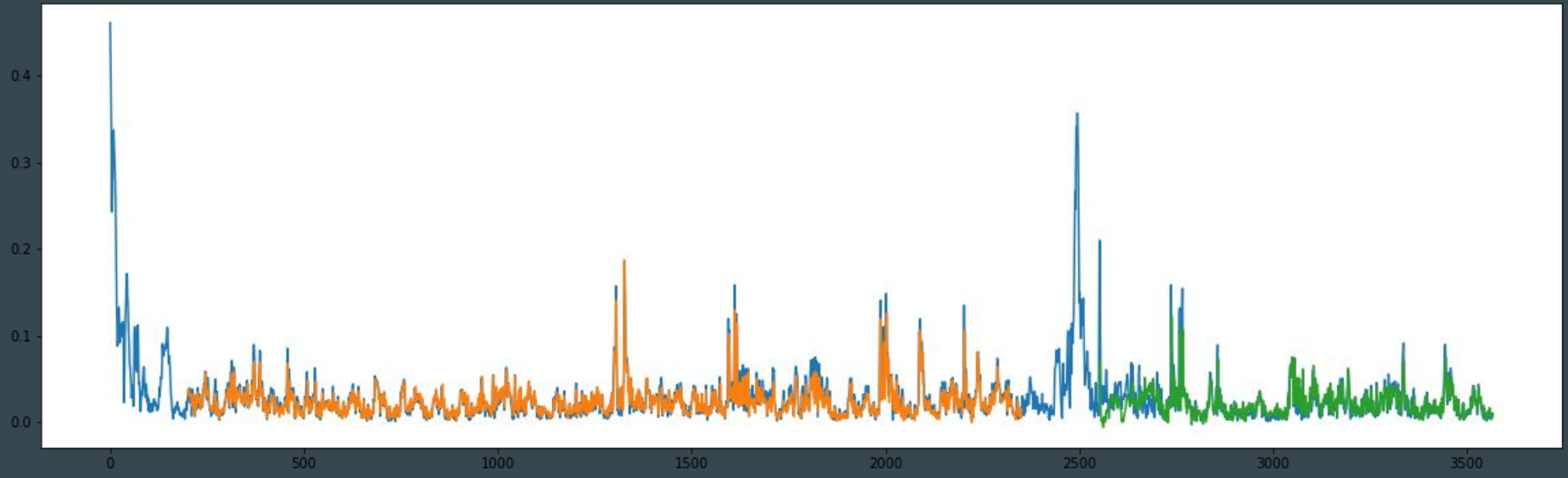

Fig6: Time series forecast for Gyro of Activity J for ID1600 using Vanilla LSTM.