

Road Quality Analysis and Clustering

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OVERVIEW

Road anomalies have negative effects on passengers and vehicles. Nowadays, smartphones are ubiquitous and used by many drivers, at least to know the driving routes. In this project, smartphone sensor data is collected, and data is then analyzed by identifying features that contribute to the roughness. Road segments are then clustered into segments based on their roughness using Unsupervised learning techniques. The clusters are presented on a geospatial map to make the analyses useful.

DATASET

The raw dataset contains all the sensor data exported as a csv from the AndroSensor android application. We consider only the z-Acceleration, latitude, longitude and time offset data for the analysis.

ACCELEROMETER Z (m/s ²)	LOCATION Latitude :	LOCATION Longitude :	Time since start in ms
10.5536	12.288645	76.59817	24
10.5536	12.288645	76.59817	28
10.5536	12.288645	76.59817	34

Road Quality Analysis - steps

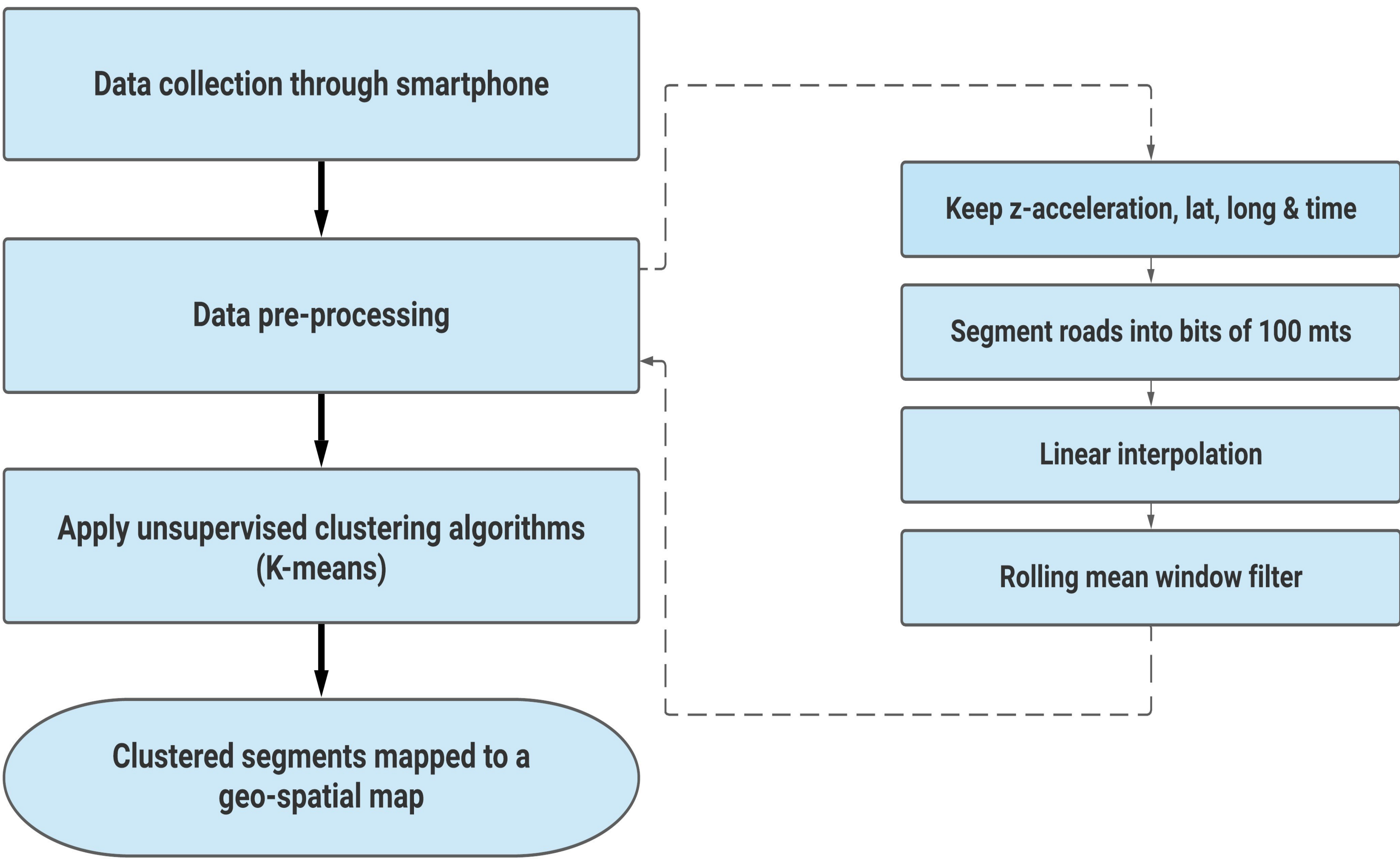


Fig 1. Road Quality Analysis flow chart

NOISE REDUCTION

The z-Acceleration samples are linearly interpolated to equal the length of the longest segment of 100 mts with respect to the time offset. The interpolated signal is then passed through a mean-averaging rolling window to obtain a noise reduced signal. The window size is chosen carefully to retain the prominent features of the signal.

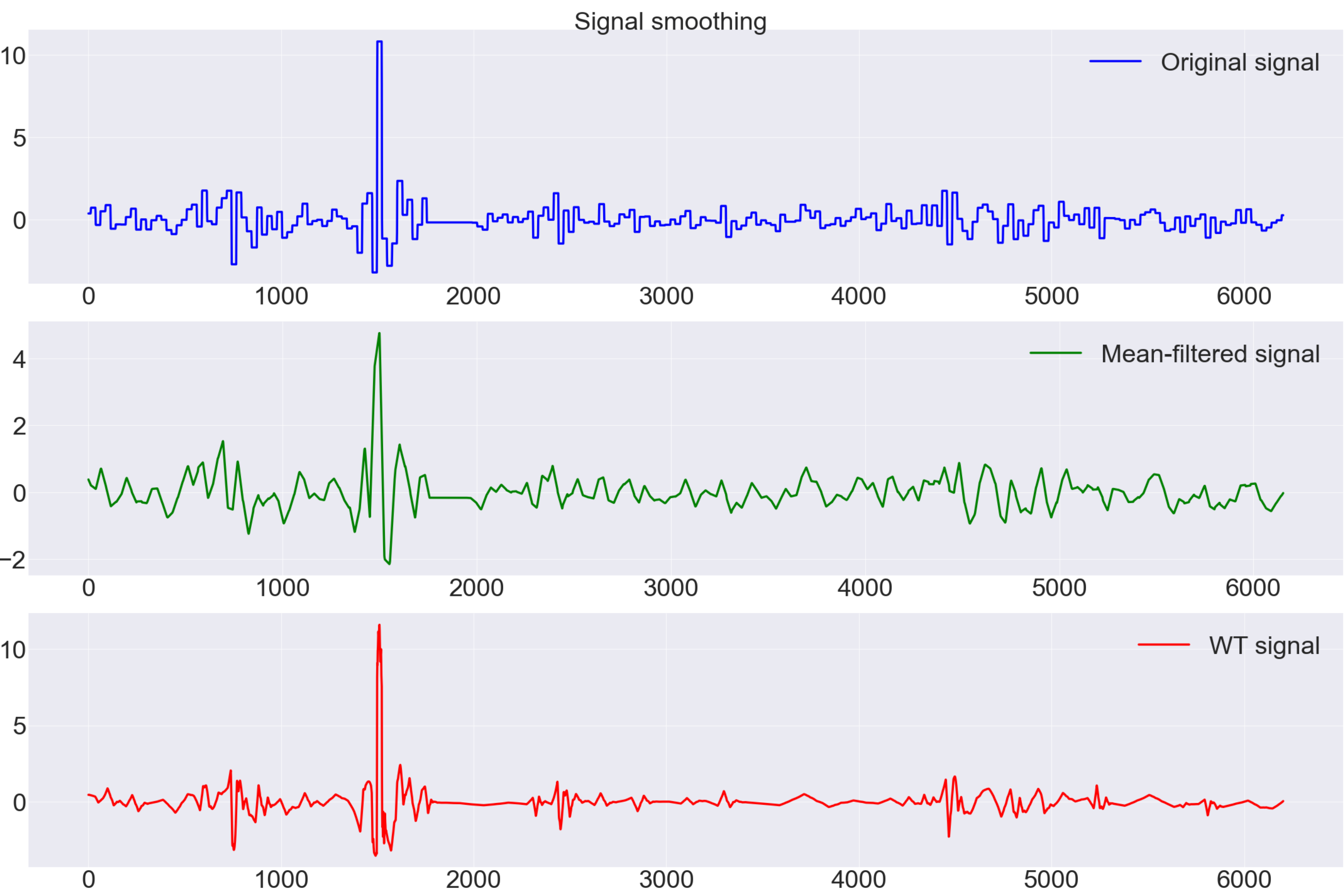


Fig 2. Original vs. Mean-filtered signal vs. WT signal

The Mean-filter worked best for reducing the noise. Other noise removal techniques attempted were filtering in frequency domain, savitzky-golay filter, wavelet Daubechies 3, Median filter.

APPLYING K-MEANS

The noise reduced signals are then passed to a K-means clustering algorithm using K-means++ initialization of initial centroids. K-means++ is an algorithm to choose initial values to avoid sometimes poor clustering done by the standard K-means algorithm. The cluster centroids looked as the shown in the following Fig 3.

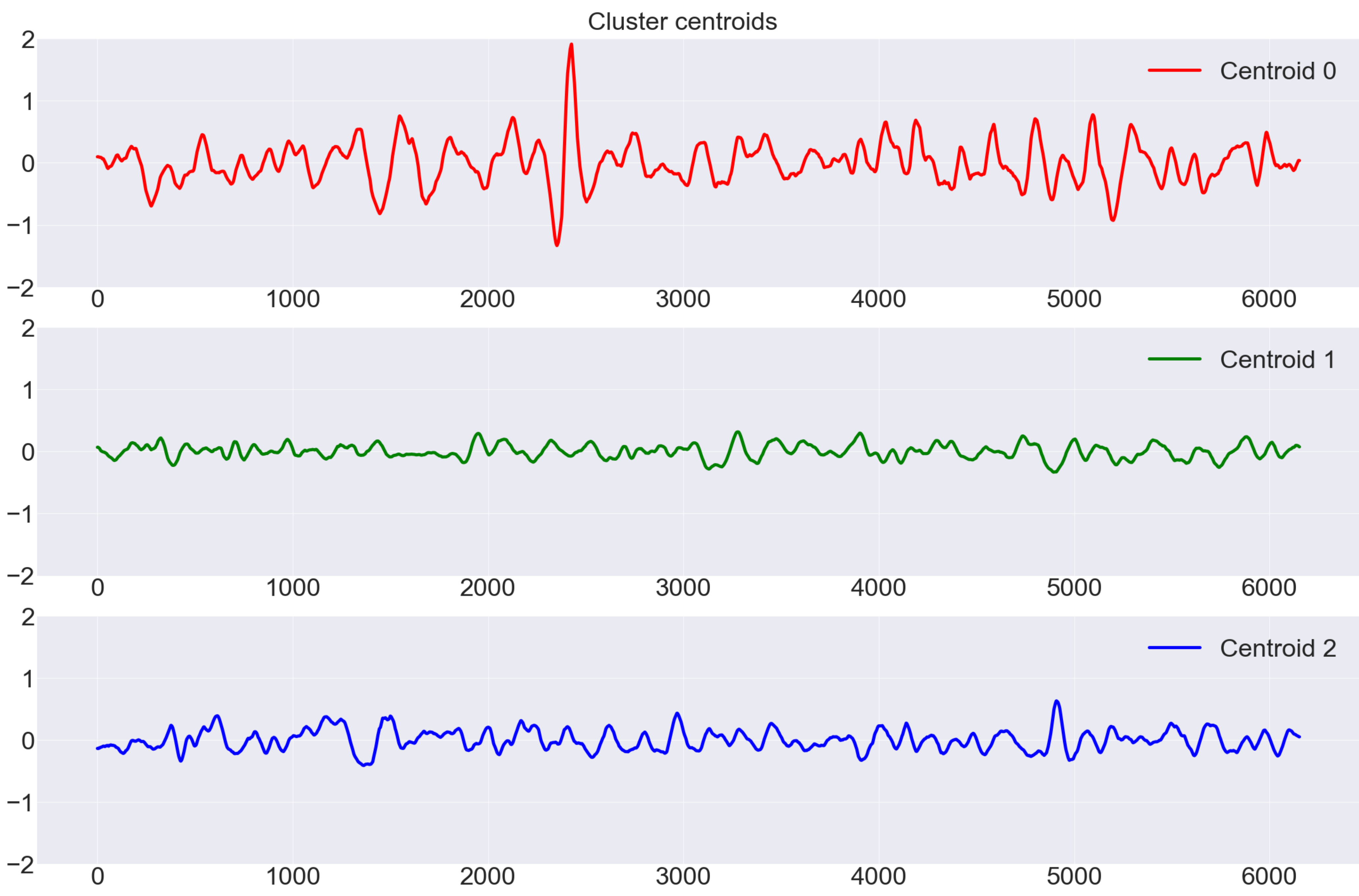


Fig 3. Cluster Centroids

RESULTS

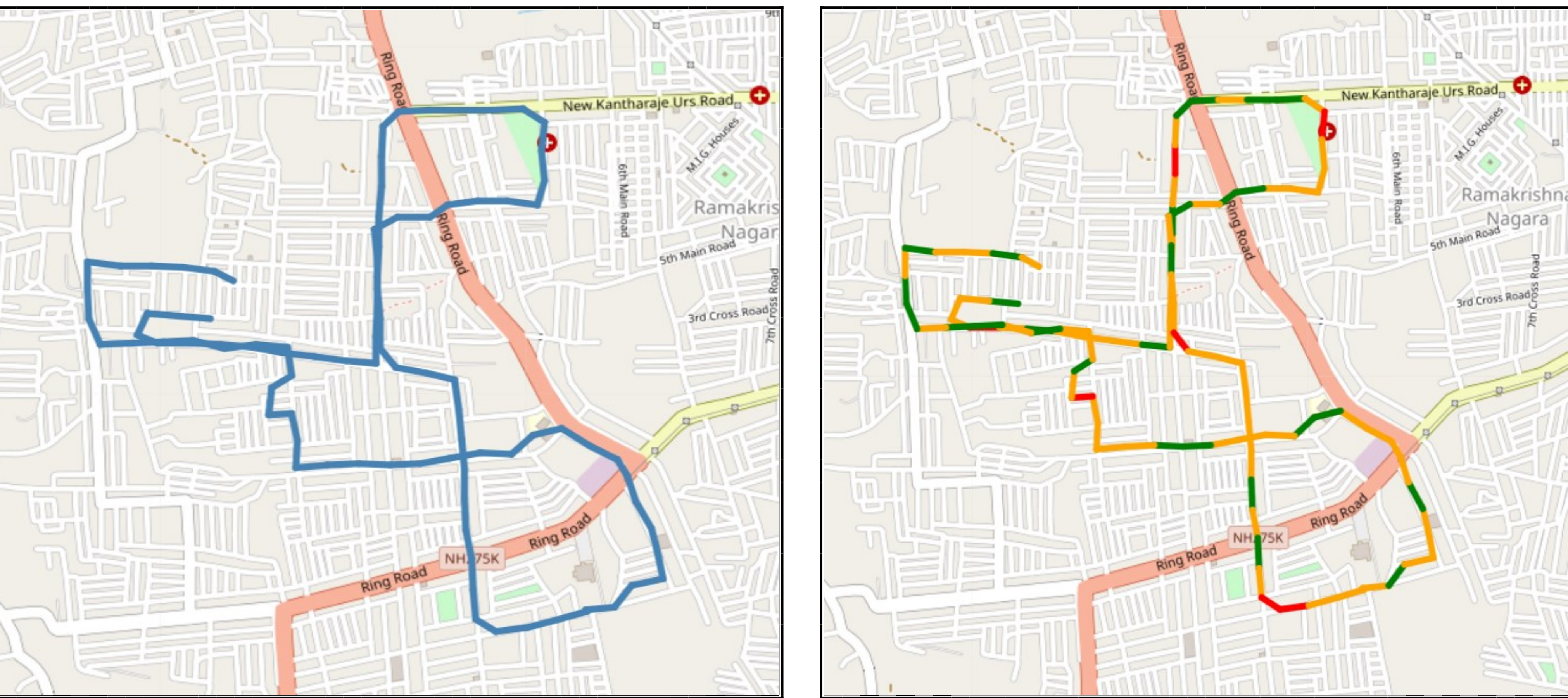


Fig 4. Clustered road segments

FUTURE WORK

- K-NN can be applied with centroids using model road segments.
- The maps with Road Quality information can be presented to user as a webpage / haptic feed via smart wearables.