Lightweight changepoint detection from multivariate streamed sensor data

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Project Description
Sensor technology and sensor networks are becoming ubiquitous for a wide range of devices, environments and applications. For example, in a smart home, sensors can capture the home’s status, activities of inhabitants and their interactions with the home. Such sensors can also be used to monitor health status and provide alerts or reminders when patient health or activities become critical. The sensors may be purpose designed or provided as part of smart phone technology.

Aims
Typically a large amount of sensor data can be collected in a short time. Typically a number of data streams occur at the same time e.g. from the three accelerometer directions and GPS position; this is known as multivariate data. We aim to develop algorithms to analyse these data in real time and detect when a change has taken place so that appropriate alerts or reminders can be issued.

Objectives
The objective is to develop lightweight statistical and machine learning algorithms for change-point detection using streamed multivariate data and compare the results with a standard approach.

Rationale
Statistical and Machine Learning approaches have been used in our preliminary work for off-line change-point detection from accelerometer and physiological data collected from wearable sensors. The current work will propose lightweight algorithms to identify changes from streamed sensor data in real time. Such algorithms need to be lightweight with regard to fast processing and economical storage as the devices typically have limited memory and processing power.

Methodology
Suitable algorithms are (1) multivariate analysis for detection of changes in the mean vector or variance-covariance matrix (2) CUSUM, used for statistical quality control. Various heavyweight solutions have also been used such as Gaussian mixture models.

Anticipated outcomes
Several algorithms for changepoint detection from multivariate streamed sensor data will be developed, implemented and evaluated with regard to accuracy, processing time and memory.

Resources Required
Matlab. Some datasets are available. More may be sourced from the Internet.

Health and Safety Issues
None

Ethical Considerations
None
Relevant publications:


