# Sports performance tracking project

## Data Description

### Definitions

1. **Accelerometer**

* Sensor that enables users with an upgraded experience by adjusting an orientation of the app screen in the smartphone and tablet.
* Core objective of the mobile phone accelerometer is, the device adapts the orientation as per the device position from horizontal to vertical and vice-versa.
* Also used as a pedometer to count steps, and based on the step it enables users with the detailed analysis of how many calories burnt, how many kilometers they walked and, and more.

1. **Gyroscope**

* Device that is used to maintain a reference direction or provide stability in navigation, stabilizers etc. (maintain balance/orientation).
* Present in your smartphone to sense angular rotational velocity and acceleration.
* Enables the phone to sense linear orientation of the phone to auto-rotate your screen.

N/B While the gyroscope takes care of rotational orientation, the accelerometer senses the linear changes relative to the frame of reference of the device.

In the Google glass an accelerometer tracks linear movement and the gyroscope maps head movement of the scene you are looking at, in relation to your head.

Problem Statement: To effectively monitor and analyze an athlete's performance in various sports activities, there is a need to collect, process, and interpret data from multiple sensors and sources. This data encompasses aspects such as movement, orientation, speed, and biomechanical metrics. The challenge is to develop a robust and accurate sports performance tracking system that can:

Acquire Data: Gather data from sensors like accelerometers, gyroscopes, GPS, heart rate monitors, and video cameras.

Process Data: Convert raw sensor data into meaningful metrics, such as distance covered, speed, acceleration, and technique quality.

Analyze Data: Utilize algorithms and machine learning techniques to interpret the data, identifying key performance indicators (KPIs) relevant to the sport and athlete.

Present Data: Display real-time feedback to athletes and coaches during training or competitions, as well as provide comprehensive post-activity reports for performance analysis.

Ensure Accuracy: Address challenges related to sensor accuracy, data synchronization, and noise reduction to provide reliable insights.

Customize for Sports: Adapt the tracking system to the specific requirements and nuances of different sports, as each may demand unique metrics and features.

Enable Actionable Insights: Translate data into actionable recommendations that athletes and coaches can use to optimize training strategies, technique, and overall performance.

Ensure Privacy and Ethics: Handle athlete data with privacy and ethical considerations, ensuring consent and compliance with data protection regulations.

Support Integration: Integrate with other sports technology solutions and platforms to offer a comprehensive ecosystem for athletes and teams.

The ultimate goal is to develop a sports performance tracking solution that enhances athlete performance, aids in injury prevention, and contributes to the advancement of sports science and coaching methodologies."

Describe the solution: To address the problem statement of sports performance tracking using gyroscope and accelerometer data from Google Glass, you can consider the following steps to develop a solution:

* Data Collection and Integration:
  + Collect raw data from the gyroscope and accelerometer sensors in Google Glass.
  + Integrate data from additional sensors, if available (e.g., GPS, heart rate monitors).
* Data Preprocessing:
  + Clean and preprocess the sensor data to remove noise and calibration errors.
  + Synchronize data from multiple sensors to ensure accurate timestamp alignment.
* Feature Extraction:
  + Extract relevant features from the sensor data. For example, calculate acceleration, angular velocity, and orientation.
* Sports-specific Algorithms:
  + Develop or utilize sports-specific algorithms to interpret the data. Different sports may require different metrics and analyses.
  + For running, calculate metrics like stride length, cadence, and ground contact time. For swimming, analyze stroke efficiency and lap times.
* Real-time Feedback:
  + Create a user-friendly interface on Google Glass to provide real-time feedback to athletes during training or competitions.
  + Display performance metrics, technique tips, and pacing information.
* Post-Activity Analysis:
  + Store and process historical data to offer comprehensive post-activity analysis.
  + Generate reports and insights that highlight trends, improvements, and areas for development.
* Machine Learning:
  + Implement machine learning models to predict performance and identify patterns.
  + For example, predict fatigue levels or injury risk based on sensor data and historical information.
* Customization for Sports:
  + Customize the solution for various sports, allowing users to select the sport they are participating in to receive tailored feedback.
* Data Privacy and Compliance:
  + Implement strict data privacy measures to protect user data.
  + Ensure compliance with relevant data protection regulations.
* Integration with Coaching Tools:
  + Integrate the solution with coaching platforms or other sports technology tools to provide a holistic approach to training and performance improvement.
* User Testing and Feedback:
  + Conduct extensive user testing with athletes and coaches to gather feedback and refine the system.
  + Continuously update and improve the solution based on user input.
* Scalability and Accessibility:
  + Ensure that the solution can scale to accommodate various levels of athletes, from amateurs to professionals.
  + Make the technology accessible and affordable to a wide range of users.

##### **Data Collection**

* The data is collected for 17 users in two different sessions for training and testing.
* All the training data is placed in “Training Data” folder and the testing data is placed in “Testing Data” folder.
* Both the folders have sub-folders, one for each participant’s data

Data is collected from Google glass and is arranged in each participant’s folder as follows:

*Google Glass:*

* “accelData.txt” – contains Accelerometer readings from google glass.
* “gyroData.txt” – contains Gyroscope readings from google glass.
* “linearAccelData.txt” – contains Linear Accelerometer readings from google glass.
* “magnetData.txt” – contains Magnetometer readings from google glass.

The readings in each of the above files are in the format: **timestamp, x-axis value, y-axis value, z-axis value.**