Outdoor Sports Performance Analysis Enhancement and Multimedia Documentation

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Resumo

Apresenta-se um demonstrador de conceito para o aumento da visualização integrada de dados registados por unidades GPS de pulso em provas desportivas e elementos de multimédia. Uma aplicação para análise de desempenho foi modificada para gerar descrições de percursos em KML, incluindo elementos multimédia.

Abstract

This paper presents a proof of concept for the multimedia visualization enhancement of data from sporting events recorded by wrist held GPS devices. An existing application for performance analysis was modified to generate KML representations that include multimedia.

Keywords

Visualization, animation, data analysis, sports, multimedia synchronization, GPS, KML.

1. INTRODUCTION

Outdoor sports data collecting devices that record GPS data and physiological data (e.g., heartbeat) are widespread now because these devices are sold at ever-cheaper prices with increased functionality, robustness, size and ease of use. Their use extends to a large number of outdoor sports such as mountaineering, tracking, cycling, BTT, ski and running. These devices process location data and produce, display and export data on location, height, speed, climbing speed, number of runs (or laps), etc.

Data can be extracted from these devices and uploaded to computers where it can be fully processed by vendor software or by software developed for extended capabilities that generic and limited vendor software does not support. Data can be exported to applications such as Google Earth but vendor software only use the most primitive features provided by KML (Keyhole Markup Language, [GOOGLE]).

1.1 The Need for Synchronization

Athletes started documenting events using media such as photography and video for publication (e.g., in social media) or practice evaluation, with digital cameras. It is natural then to bring together digital recordings and GPS data to obtain richer snapshots of sports and enable better documentation and analysis of training activities. However, users still have to use several applications to obtain consistent and synchronized multimedia documents.

1.2 Common Mistakes

But users are not experts and make mistakes when using GPS enabled devices. These keep correct time provided that time zone and daylight saving are properly set. Moreover, most users set camera time only once (right after buying a camera) from the time on a watch that might not be precise, and may confuse 12-hour display mode with 24-hour mode. In case known to us, a 12 hours clock offset camera was taken to a different time zone and photos taken without clock readjustment.

2. RECORDED DATA PROCESSING

GPS data from devices is usually exported using the de facto GPX standard (GPS Exchange Format), [GARMIN]. This lightweight XML format supports most GPS related data (time, position, altitude, speed, heartbeat rate) and features like annotations and media reference. KML (Keyhole Markup Language) lacks the lossless and compactness of GPX but is the logical export format for visualization with Google Earth.

To synchronize photos and video with GPX data one needs to ensure that time and location of both fit together. Good hints are locations where speed is (almost) zero but, for media taken on the run, such fit is not always ensured since any two GPS devices may show different locations. This requires user interaction for confirmation.

3. SOFTWARE DEVELOPMENT FOR PROOF OF CONCEPT

An existing software application ([Brisson11]) imports GPS track data in many formats, including GPX 1.0 and 1.1. It displays GPS data on maps, graphs and summaries and exports data to formats such as GPX and KML.

The application was modified to enable media reference. This called for obtaining date and time information from each media element and, if available, location data.

Digital photo files follow the JPEG (ISO/IEC 10918-1) standard [CCITT92]. The structure of a JPEG file contains several segments. The Exif standard (EXchangeable Image File format for digital still cameras) from the Japan Electronics and Information Technologies Industries Association [JEITA11] extends the JPEG format by specifying a structure for the data to store in the APP1 and APP2 JPEG marker segments. This data is very complete and includes data on the camera and lens and a full set of data on the actual shooting conditions (aperture, shutter speed, metering mode, exposure time, exposure program, focal length, white balance, ISO speed and many other). Date and time information from digital photos can thus be correlated with location and time from GPS devices.

The existing software was upgraded to automatically detect idle times and pauses and suggest locations for media elements. A dialogue to set Google Earth visualization options when saving a track in KML format allows users to specify how multimedia, waypoints, route and track data are to be shown on Google Earth. By setting the appropriate options in the dialogue one can display a more rich and complete picture of the data with location altitude and name, as Figure 1 shows.

3.1 Track and Media Display

The KML options setting dialogue allows referencing media files with route, track and waypoints data. Media thumbnails of the photos are then displayed on Google Earth at the appropriate locations. Clicking on the thumbnails opens up the full media file. For this to happen, the dialogue requests the user to input a file name containing the URL of the media location, the media file names and an optional time synchronization gap enable time fine-tuning of time stamps from the Exif information stored with each photo.

Figure 2 shows a track with a few image thumbnail holding billboards. Clicking on one of the billboards downloads its photo (Figure 3). The track and photos were recorded by a group of bike raiders on a bike raid.

4. CONCLUDING NOTES

The results reported above of a test and demonstration application for enhancing track data presentation together with multimedia show that the concept behind this work was solid and can now be fully extended.

In the present work we detected several types of errors that occur when GPS data is exported to GPX format by different exporters and their impact on multimedia synchronization. Media shooting location and time error sources were also identified. These will be addressed in future work.

Work will progress on the above and on the extension to support media types other than photographs and links or references to media files that were not shot at the time of the GPS recordings that will be referencing them.

5. REFERENCES

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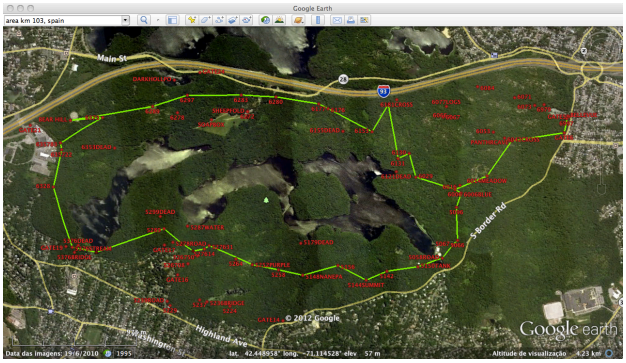

Figure 1: Route and waypoints showing altitude and name labels.

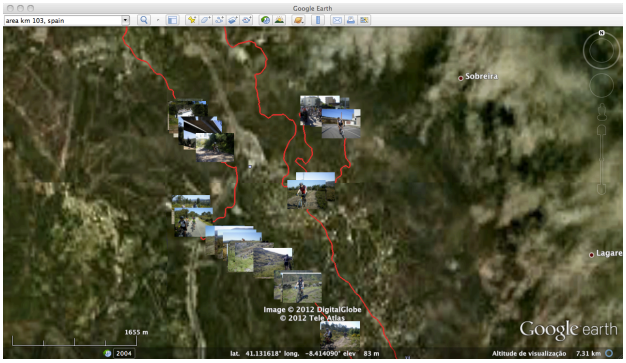

Figure 2: Track with thumbnail images of photos taken during a bike raid.

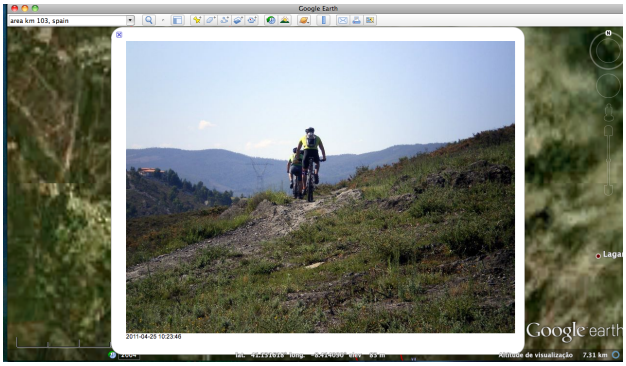

Figure 3: Image displayed by selecting its thumbnail on the track display of Figure 2.