

Visual Analysis of Users' Performance Data in Fitness Activities

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Abstract

This paper presents a tool for the visual analysis of fitness performance data, such as running speed and heart rate. The tool, called MOPET Analyzer, provides a set of interactive visualizations that allow the user to analyze the relations among the different parameters of a fitness session. We developed two versions of MOPET Analyzer: one for desktop systems and one for mobile devices. The desktop version allows for an analysis of sets of different fitness sessions, also providing details for each single fitness session. The mobile version provides very simple visualizations that can be useful on the field. MOPET Analyzer allows the user to monitor her fitness activity and to analyze her fitness progress, helping her to continuously improve the quality of her training.

Key words:

Information visualization, visual analysis, fitness applications, mobile devices

1 Introduction

Scientific evidence shows that the regular practice of physical activity and sports provides people of all ages with physical, social and mental health benefits. Physical activity enhances functional capacity and promotes social interaction and integration. Physical activity also has economic benefits especially in terms of reduced health care costs, increased productivity, healthier physical and social environments. In particular, open-air physical activity is characterized by additional valuable aspects, such as natural environments,

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air quality and sunlight. On the contrary, physical inactivity is a common and avoidable risk factor for some chronic diseases. However, people may perform physical activity improperly, wasting its benefits. Typical errors consist in starting with too intensive exercises or performing them in an uncorrect way. These errors, in general, arise because people generally start to perform physical activity without the assistance of a professional trainer or using mobile devices or software that help them in correctly performing physical activity. People that use mobile devices or software for their physical activities can also make errors, which are generally due to:

- limitations of the current commercial products [10,3,15,13] for helping users in fitness activities. These products have limited user interfaces (digital-clock style), are often not easy-to-use, and do not focus much on users motivation. For example, Polar devices can give only a basic motivational feedback, called “calorie bullet”: every time a certain amount of calories is burnt, the device beeps, inciting the user to run more and burn other calories. Moreover, current products do not help users in performing exercises correctly.
- limitations of current visualizations tools for analyzing users’ performance data. The post session visualization tools offered by the heart rate monitors for fitness currently on the market [10,13] are in general plots of the user’s heart rate or running speed as a function of time. These visualizations allow only for a superficial analysis of the performance and usually and do not offer tools for querying data and comparing data of different sessions. Moreover, current tools do not allow the user to find relations between her performance data and her position.

To tackle the first problem, we introduced MOPET (MOBILE PErsonal Trainer) [1], a mobile application for supporting users in fitness trails. MOPET currently helps users in:

- training: MOPET employs a 3D embodied agent that shows the user how to correctly perform fitness exercises;
- navigation: MOPET helps users to follow the right path, constantly monitoring her position with a GPS device and providing visual and audio instructions;
- motivation: the embodied agent verbally incites the user to maintain an adequate fitness intensity during the sessions.

This paper focuses instead on the second problem. MOPET Analyzer is a visual tool we propose to help the user in analyzing her performance data. The tool generates its visualizations of the data recorded by the MOPET application. MOPET indeed logs user’s position and heart rate during each fitness session. MOPET Analyzer is able to produce interactive visualizations to answer questions such as:

- Where did the user run faster in a single session and over a number of sessions?
- Was the heart rate optimal for the user’s physical fitness in a single session and over a number of sessions?
- Has the user’s physical fitness improved with training? And how much?

Two versions of MOPET Analyzer have been developed. The first version is for mobile devices and shows a set of aggregated data (e.g, percentage of time during which heart rate was optimal for the user’s physical fitness, total energy consumption) which can be quickly explored by the user on the field. The second is for desktop systems and allows for a deeper analysis of user’s performance in a single session and over a number of sessions.

The paper is organized as follows. Section 2 describes the related work, covering different aspects of visual analysis of fitness performance and physiological parameters on desktop systems and on mobile devices. Section 3 presents the MOPET Analyzer tool and its visualizations. Section 4 demonstrates how the visualizations can help in analyzing fitness performance data, considering two case studies. Conclusions and future work are presented in Section 5.

2 Related work

Although visual analytics is employed in a wide range of domains, its application to sports and fitness has been scarcely explored.

LucentVision [8] is probably the most relevant work about sports and visual analytics in the literature. LucentVision uses real-time video analysis of tennis matches to obtain motion trajectories of players and the ball, and offers a rich set of visualizations based on these trajectory data. The visualizations help the analyst (a tennis coach, a tennis player or a sports journalist) to identify the strategy used by a tennis player during a single match or a set of matches. Some examples of visualizations offered by the system are coverage maps (i.e., 2D maps of the tennis court, colored based on how much a player stayed in every zone), players’ speed graphs, service landing position maps. Analysts can also query and filter data (e.g., coverage maps for the points won by player A). LucentVision has been used in the broadcast of international tennis tournaments, both on television and the Internet.

Goodman and Foucault [4] carried out a study concerning the problem of visualizing performance data of physical activities. After a three-month research, which included literature review, blog readings, interviews, and diary studies, the authors outlined the key challenges of using technology in fitness activities. They concluded that applying visualization technology to physical fitness

is a promising approach, but visualization designers should incorporate and display multiple indicators of progress to effectively support improvements in users' behavior. They also suggested that too much access to information can be demotivating when people do not meet goals as expected.

Some companies are devoting more and more attention to the visual analysis of fitness performance data. Heart rate monitor producers now offer visual tools that allow the user to visually analyze her performance on a PC, after downloading the data from her heart rate monitor. Three well-known commercial products on the market are: Suunto Activity Manager [14], Polar Pro Trainer [9] and Nikeplus [6]. Those products focus on the creation and the management of a fitness training plan and the interactive visualization of the main parameters of each session, such as heart rate, speed and altitude. Although the offered visualizations can be impressive from a graphic design point of view, they are basically simple plots of the parameters and they do not scale up very well when one tries to compare a large number of sessions (e.g., more than 10). Moreover, none of those products considers the position of the user during her performance.

The literature does not propose specific solutions for comparing performance data of different sessions, but solutions to compare temporal series can be a source of inspiration. For example, Kincaim and Lam [5] proposed a tool, called Line Graph Explorer, that allows one to easily analyze graphs by using a Focus+Context approach. Line Graph Explorer compresses a set of graphs to provide a compact overview of all of them by encoding their y-dimension with color instead of space. Line Graph Explorer displays data using a Table Lens approach [11] and provides interaction tools for viewing selected compressed graphs in detail as standard line graphs without losing visual information about general patterns. Moreover, Line Graph Explorer provides sorting and clustering algorithms, to further help the user in finding new patterns. The system has been used to visualize meteorological and biological data.

Literature does not discuss much the visualization of fitness performance data on mobile devices either. The products on the market that the user wears during training (e.g., heart rate monitors) offer extremely limited visualizations. A product that allows for post-training visualization of fitness performance on PDAs is the VidaOne MySportTraining [16] application. That application can acquire heart rate data from Polar devices via infrared, carrying out a simple analysis at post-training time. It offers various type of visualizations, two of them meant for analyzing data: the report visualization is a simple tabular visualization that gives an overview of the main parameters (e.g., duration, burnt kilocalories and distance run) of a set of sessions and the graph visualization is used to display both fitness performance data (e.g., heart rate) and health data (e.g., blood pressure and weight). Moreover, the application can visualize user's position during the fitness session by using a custom-made

visualizer or by using Google Maps, but it does not automatically relate the position of the user to her physiological data.

An interesting proposal for visualizing physiological parameters on a mobile device is described in [2] for a handheld medical device, called StressEraser. The device uses biofeedback to encourage deep breathing patterns that reduce stress and promote general health. After an initialization phase, during which the user is educated regarding heart rate and its connection to stress, the application shows her that there is a connection between physical actions (such as breathing) and the display by inviting the user to deeply breath and then to control her heart rate on the display. Then, after a calibration phase, where the system is calibrated to the breathing capacity of the individual user, StressEraser shows the heart rate variability to the user by using very simple visualizations: graphs with icons (inspired from the tokens of power that are collected in videogames like Zelda) that appear when the user’s breath is in sync with the ideal breathing rhythm. Those visualizations help the user to recognize when she is stressed and encourage her to perform physical actions that reduce her stress.

3 MOPET Analyzer

The ideas behind the visualizations described in the previous Section (e.g., using graphs for visualizing speed and using a Table Lens approach for multiple sessions) were the starting point in the design of MOPET Analyzer. We designed the tool for off-line (i.e., post-session) visual analysis of fitness performance data and we currently focus on positional and heart rate data. However, the visualizations could be easily applied to other physiological parameters, such as galvanic skin response or oxygen level in the blood.

We developed two versions of MOPET Analyzer: one for desktop systems and one for mobile devices. The mobile version shows a set of aggregated variables that give an idea of the overall performance of the fitness sessions. This visualization is very simple and does not contain too much information because it is meant to be used on the field immediately after the fitness session. At that time, the user is typically tired and staying outdoors without moving immediately after a fitness session can be dangerous for user’s health, especially in cold weather. The desktop version provides a set of visualizations that help the user to analyze more deeply her fitness performance. The user can discover where a single fitness session was optimal and where she can improve; moreover, the user can analyze her fitness progress by watching a multiple-session visualization. This Section first briefly describes the data that MOPET Analyzer handles, then illustrates in detail the two versions of our application, discussing the different aspects of the visualizations.

3.1 MOPET logs

MOPET Analyzer generates its visualizations from GPS and heart rate logs that the MOPET applications stores during each fitness session. The GPS logs are standard NMEA [7] files, from which MOPET Analyzer extracts position and time data. From this data, MOPET Analyzer derives user's speed by applying a linear regression filter over a window of 10 seconds. The heart rate logs are simple text files. Every row of these files contains a heart rate measurement and its timestamp based on GPS clock. Given that GPS receivers update the position every second, to be able to associate heart rate data with GPS data, heart rate is recorded in the log file by MOPET every second.

3.2 Desktop Version

The desktop version of MOPET Analyzer provides the user with two types of visualization:

- *single-session visualization*: aimed at analyzing user's performance in a single fitness session, e.g. to see where the heart rate was optimal for the user's physical fitness;
- *multiple-session visualization*: aimed at analyzing user's performance over a set of fitness sessions, e.g. to identify improvements.

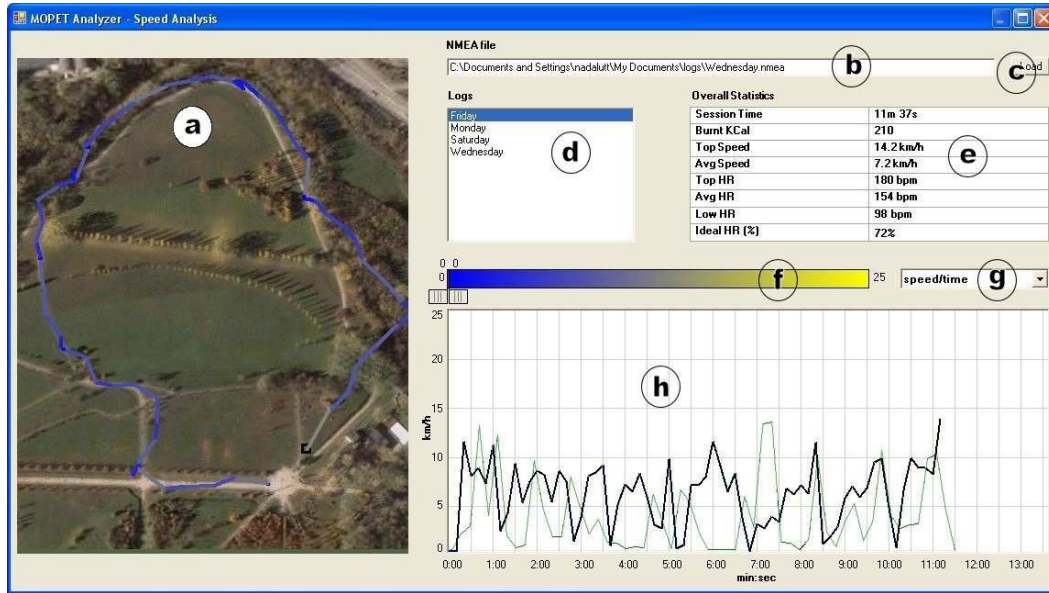


Fig. 1. Single session visualization window with speed data: a) map, b) pathname textbox, c) Load button, d) logs listbox, e) overall statistics, f) color scale, g) variable combobox, h) graph panel.

3.2.1 Single-session Visualization

Figure 1 illustrates the single-session visualization window of MOPET Analyzer. The interface is organized into the following elements: (i) map (Figure 1a): it represents the area where the user trained; (ii) pathname textbox (Figure 1b): it displays full pathname of the last loaded GPS log file; (iii) Load button (Figure 1c): it is used for loading GPS log files in memory; (iv) logs listbox (Figure 1d): it displays the list of loaded GPS log files; (v) overall statistics (Figure 1e): it shows some statistics for the visualized performance; (vi) color scale (Figure 1f): it is used for encoding the value of the fitness performance data displayed on the map, and has two selectors for highlighting a range and dynamically query [12] the data; (vii) variable combobox (Figure 1g): it is used for choosing the variable to display (e.g, speed, heart rate); (viii) graph panel (Figure 1h): it is used for displaying graphs of user's performance.

The user can load a GPS log of a session by pressing the Load button. After selecting the log file, the complete pathname of the file appears on the pathname textbox, and a new entry appears in the logs listbox. The user can load how many GPS logs she wants (e.g., sessions of the current week, sessions of the current month, a set of arbitrary sessions), and then she can analyze a single GPS log by selecting it in the logs listbox. After the selection, the path followed by the user is drawn on the map, and a graph appears in the graph panel. The user can choose between two different types of map: (i) a georeferenced picture/map of the area (if available) where she trained, and (ii) Google Maps. The first option is more accurate and is useful when the user always trains in the same place; the second option is less accurate, but allows the user to visualize her performance anywhere she trained. The variables in the visualization are chosen with the associated combobox. The user can choose among four different options: (i) user's speed as a function of distance run, (ii) user's speed as a function of time, (iii) user's heart rate as a function of distance run, and (iv) user's heart rate as a function of time. Moreover, the overall statistics displays: session time, energy consumption (in terms of burnt kilocalories), top and average speed, top, average and lowest heart rate and the percentage of time during which the heart rate of the user was suitable for a good training according to her physical fitness.

If speed is the chosen variable, the path on the map is colored according to the user's speed using a blue-yellow scale. In this scale, blue is a speed of 0 km/h and bright yellow a speed of 25 km/h, assumed as the maximum speed for jogging purposes (only professional marathon runners can jog at this speed).

The graph represents user's speed as a function of distance run or time. There are two reasons to choose distance for the X-axis: (i) the user often goes through the same path when she trains; (ii) when the start point of the path is always the same, user's speed in two different sessions can be easily compared

by left aligning two speed graphs. When the user chooses a session in the logs listbox, a black graph is used to represent the speed of the chosen session and a green graph represents the average speed of the sessions in the logs listbox. In this way, the user can easily check her speed performance, comparing it with her average speed.

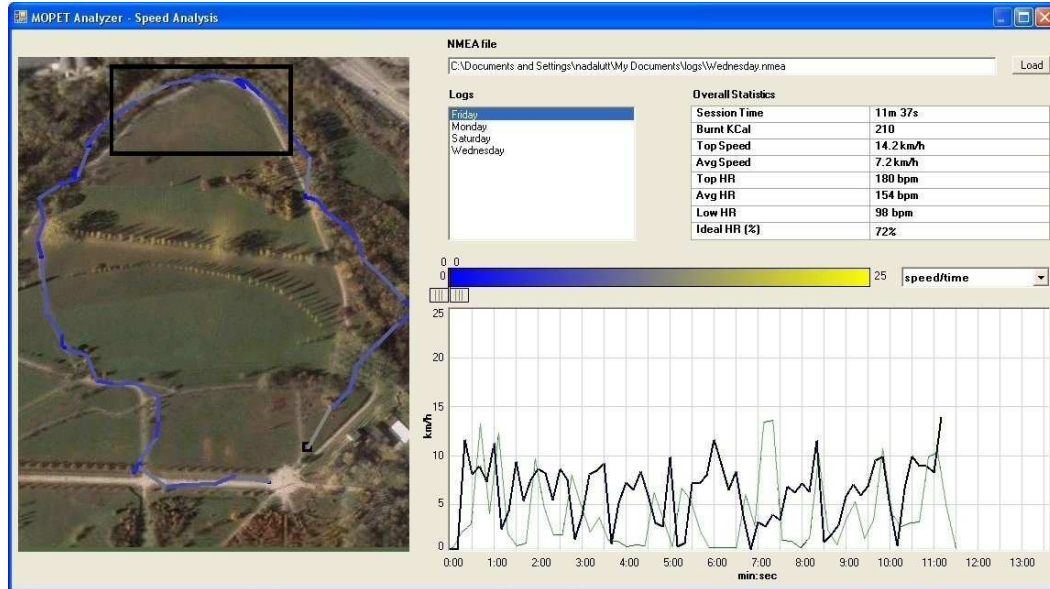


Fig. 2. Querying by selection on the map.

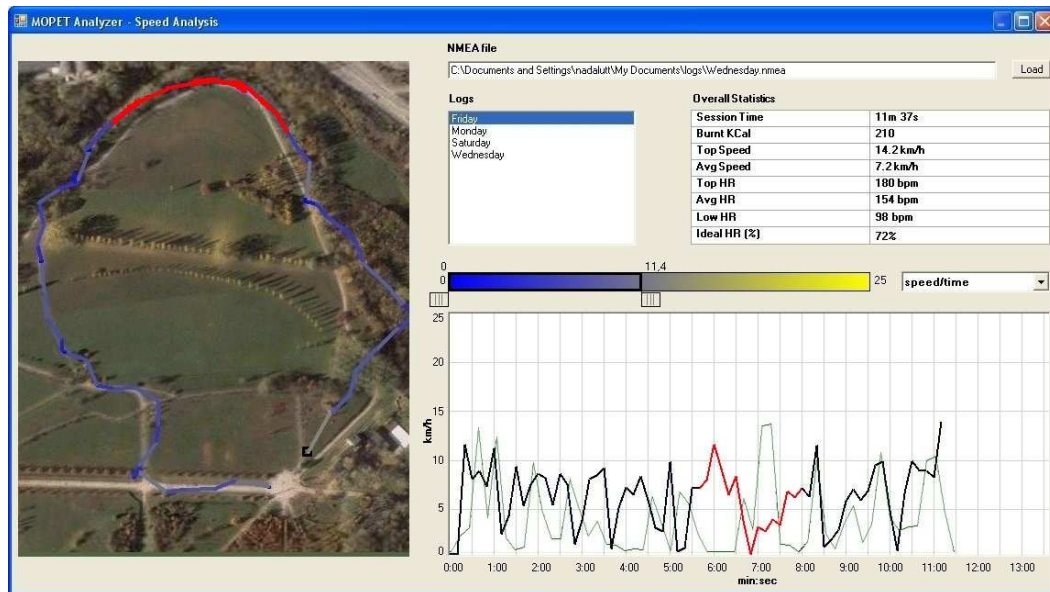


Fig. 3. Result of the query in Figure 2.

Once the map and graphs are plotted, the analyst can:

- choose a part of the path in the map by using a rectangular selection tool (Figure 2). In this case, the part of graph corresponding to the selected path is highlighted in red and the range between minimum and maximum

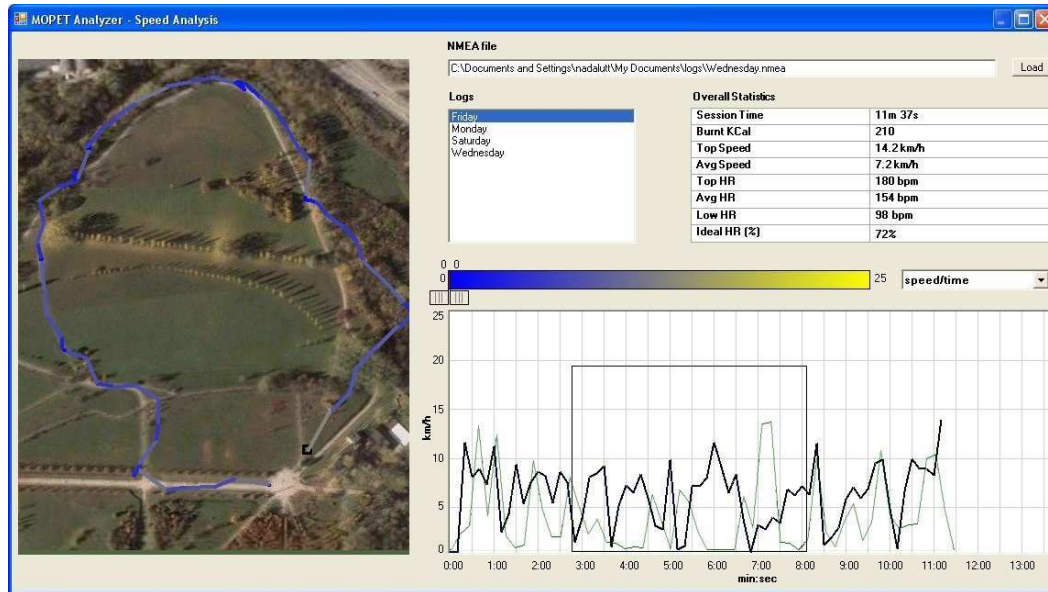


Fig. 4. Querying by selection on the graph.



Fig. 5. Result of the query in Figure 4.

- user's speed in the selected part of path is highlighted in the color scale by enclosing it in a rectangle and moving the selectors as seen in Figure 3;
- choose a part of the graph (Figure 4), by using a rectangular selection tool. In this case, the corresponding path in the map is colored in red and the speed range is highlighted as seen previously (Figure 5);
- choose a speed range by moving the two selectors of the color scale (Figure 6). In this case, the parts of the path in the map and the parts of the graph that correspond to speeds in the specified range are highlighted in red.

These three operations are useful, for example, to find out where the user ran

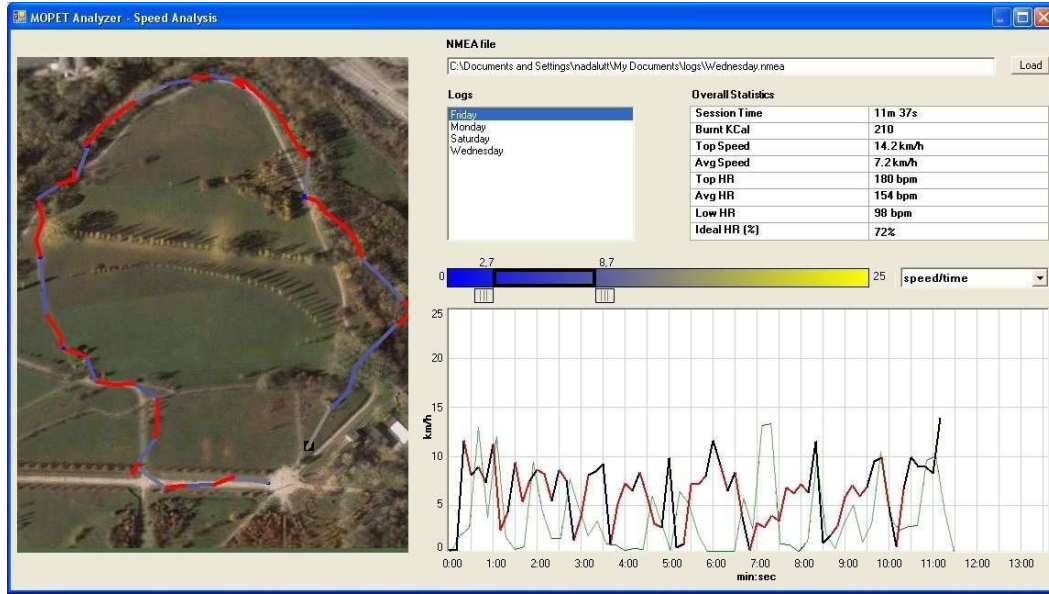


Fig. 6. Dynamic query on speed.

faster in a session or the parts of path where she ran slower than the average speed of the latest month.

The single-session visualization is used also for heart rate data. Figure 7 shows an example of heart rate visualization. There are noticeable differences with respect to speed visualization in the color scale that encodes heart rate. The scale goes from 50% of the specific user's maximum heart rate to the value of her maximum heart rate. Maximum heart rate is approximated by using a standard formula: $220 - a$, where a is the age of the user. In case the user had her precise maximum heart rate measured by a cardiologist, then that value can be entered in the system instead of the one estimated by the formula. Figure 7 considers a 25-years-old user, so maximum heart rate is 195 beats per minute.

MOPET Analyzer colors the path in the map according to user's heart rate in white when heart rate value is less than 60% of maximum heart rate (in this case, the exercise is scarcely useful), otherwise a green-red color scale from 60% of maximum heart rate to maximum heart rate is used. Green and red are associated to their usual meaning of safe and dangerous. The graph displays heart rate as a function of distance run or time. The background of the graph panel is colored according to the intensity of the exercise. Based on interviews to a sports physician, we divided intensity into three categories:

- *light*: from 60% to 70% of maximum heart rate. It is recommended for beginners or for overweight people and corresponds to the light green area in the background of the graph.
- *medium*: from 70% to 80% of maximum heart rate. It is recommended for

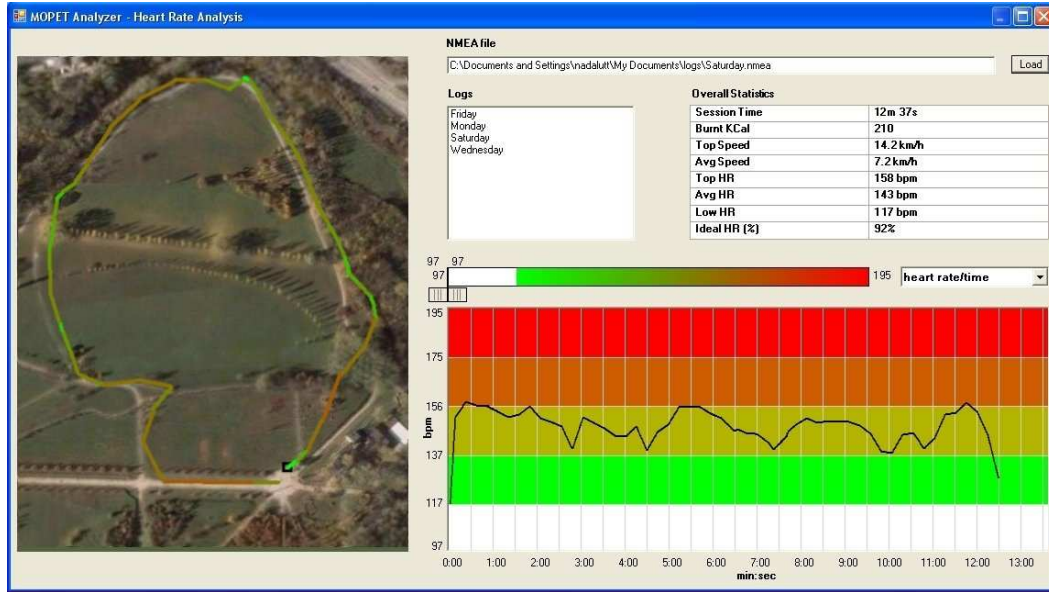


Fig. 7. Single-session visualization of heart rate data.

trained, but not athletic people and it corresponds to the dark green area in the background of the graph.

- *high*: from 80% to 90% of maximum heart rate. It is recommended for athletes and corresponds to the red area in the background of the graph.

The dark red area in the background is the danger zone where heart rate is over 90% of maximum heart rate.

This visualization helps the user to find the parts of the path where she trained ideally and the parts where her heart rate was too high or too low, according to her physical fitness. The user can then take this into account to improve her next sessions.

3.2.2 Multiple-session Visualization

Figure 10 illustrates the multiple-session visualization of MOPET Analyzer. This interactive visualization is partially inspired by the Focus+Context approach used in the Table Lens system [11]. Data is presented in a table, organized into two panels: (i) statistics panel (Figure 10a), which contains some statistics concerning the visualized performance, and (ii) graph panel (Figure 10b), which displays a collection of graphs of user's performance. Each table row is composed by a row of the statistics panel and the aligned row of the graph panel and represents a single fitness session. A row of the statistics panel illustrates the following numeric attributes: session date, session average speed, session average heart rate, energy in kilocalories burnt during the session. A row of the graph panel contains a graph of speed, heart rate or heart rate to speed ratio as a function of distance or time.

Each cell of the table can be visualized in two forms: compressed and detailed. In the statistics panel, each cell contains a numeric value, visualized as a number in detailed form and a vertical blue bar in the compressed form, as seen in Figure 8. The position of each vertical bar in compressed form is based on the value of the attribute.

In the graph panel, a graph is visualized as a standard XY plot in detailed form and as a multicolor line in compressed form, as shown in Figure 9. Multicolor lines are obtained by using the technique described in [5] (i.e., by mapping the y-value into color instead of vertical position), using color codings described in the previous subsection.

| Date | Avg. Speed | Avg. Heart Rate | Burnt KCal |
|-----------------------|------------|-----------------|------------|
| 16/06/2006 | 7.3 km/h | 145 | 351 |
| 14/06/2006 02/07/2006 | 3.7 | 9.0 | 103 |
| | | 185 | 302 |
| | | | 399 |

Fig. 8. Detailed and compressed form of a statistics panel row. Values below each blue vertical bar are the minimum and the maximum of the interval where the blue vertical bar is plotted.

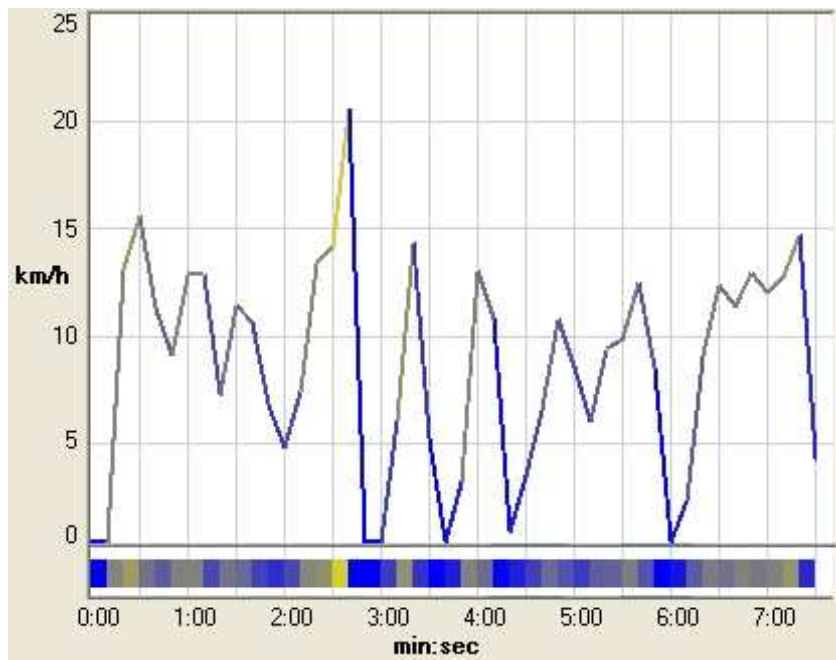


Fig. 9. A graph in detailed and compressed form.

The user initially looks at a set of sessions in compressed form, after choosing them from the following: (i) sessions of the current week, (ii) sessions of the current month, (iii) all available sessions, or (iv) an arbitrary set of directly chosen sessions. The visualization can be used also to compare performance of different users.

When the user clicks on a row, she can see it in detailed form with numeric

values and the full graph. To allow users to easily compare detailed data with compressed data, the blue vertical lines are visualized also in the detailed rows of the statistics panel and detailed graphs are colored based on the same scale of compressed graphs in the graph panel. Moreover, the user can sort the data according to every attribute value in increasing or decreasing order by clicking on the title of a column. This allows the user to find patterns relating, for example, energy consumption, average speed and heart rate graphs. In Figure 10, data is sorted by date.

With the multiple-session visualization, the user can see her fitness progress, in terms of speed, heart rate and heart rate to speed ratio. This ratio is very important to assess user's physical fitness and it begins to decrease after a few training sessions. This aspect is fundamental because, as discussed in Section 2, it is possible for the user to get discouraged and stop training if she does not quickly see some positive effects of training.

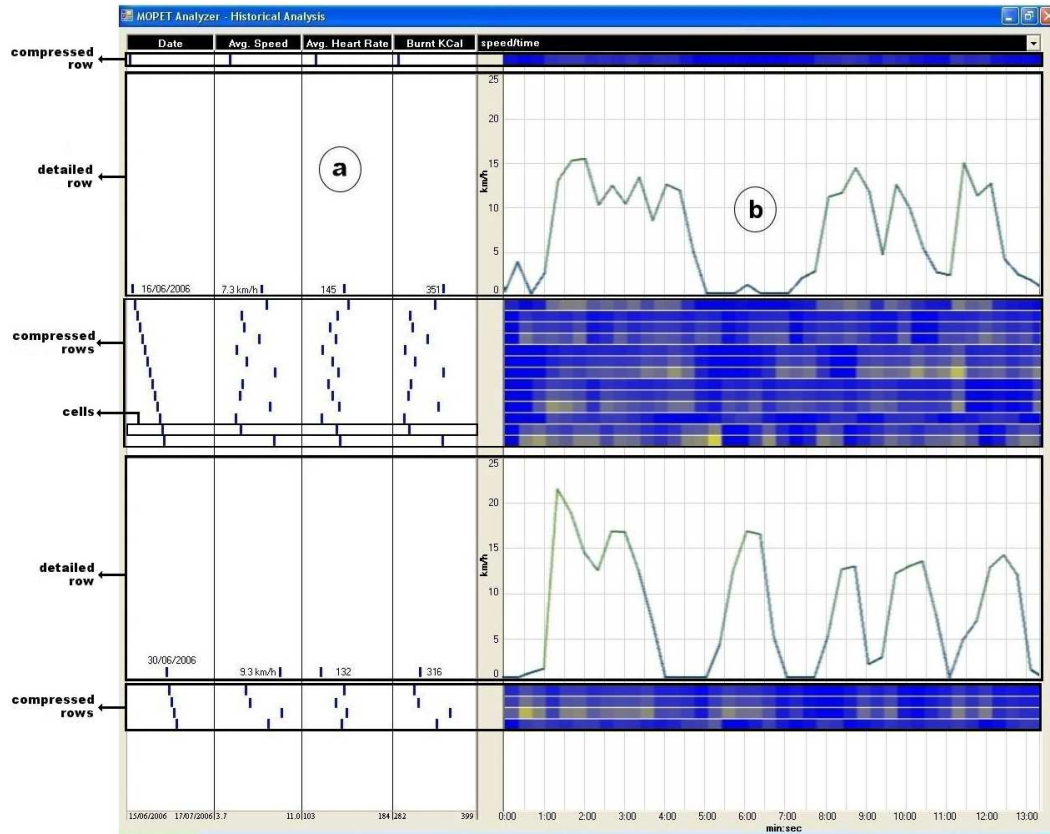


Fig. 10. Multiple session visualization: a) statistics panel, b) graph panel.

3.3 Mobile Version

Figure 11 shows the visualization employed in the mobile version of MOPET Analyzer. This visualization offers a set of statistics concerning the last finished

fitness session and the graphs of speed and heart rate described in the previous Section. The statistics are displayed in a set of textboxes. Each textbox is colored based on the average value of the correspondent statistic in a set of previous sessions. The user can select the set of previous sessions from the following: (i) sessions of the current week, (ii) sessions of the current month. Textbox are colored in green if the user performance is better by more than 5% with respect to the average, in red if her performance is worse by more than 5%, in yellow otherwise. The following statistics are displayed by the interface: session time; energy consumption (in terms of burnt kilocalories); top and average speed; top, average and lowest heart rate; percentage of time during which heart rate was suitable, according to her physical fitness and using the parameters discussed in Section 3.2.1.

The visualization is very simple and offers scarce interactivity because it should be consulted by the user immediately after her fitness session, giving her an immediate and preliminary feedback of her global performance. The user can switch the graph between heart rate graph and speed graph. The example in Figure 11 shows a speed graph, where the black line represents the speed of the last finished session and the green line the average speed of the chosen set of previous sessions. The heart rate graph is the same of the desktop version: the user can immediately see in the graph where her heart rate was optimal for her fitness condition.

4 Using MOPET Analyzer in practice

This Section presents two case studies where MOPET Analyzer has been used to analyze performance data. The first case concerns logs of different people, while in the second case concerns different logs of a single user. In the first case, we collected 24 logs, containing a total of about 5 MB of GPS and heart rate data. In the second case, a user went through a one-month training plan, with one training session every day. We collected 30 logs, containing a total of about 6.5 MB of GPS and heart rate data. All sessions took place in the same fitness trail of a public park. The trail is 1110 meters long and users may go through it several times during a session.

4.1 *Multiple users case study*

Figure 12 shows some examples of the compressed graphs of the multiple-session visualization discussed in Section 3.2. Figure 12a shows users' speed as a function of the distance: we can notice different behaviors in the training: some users kept their speed basically constant (compressed graphs in the first

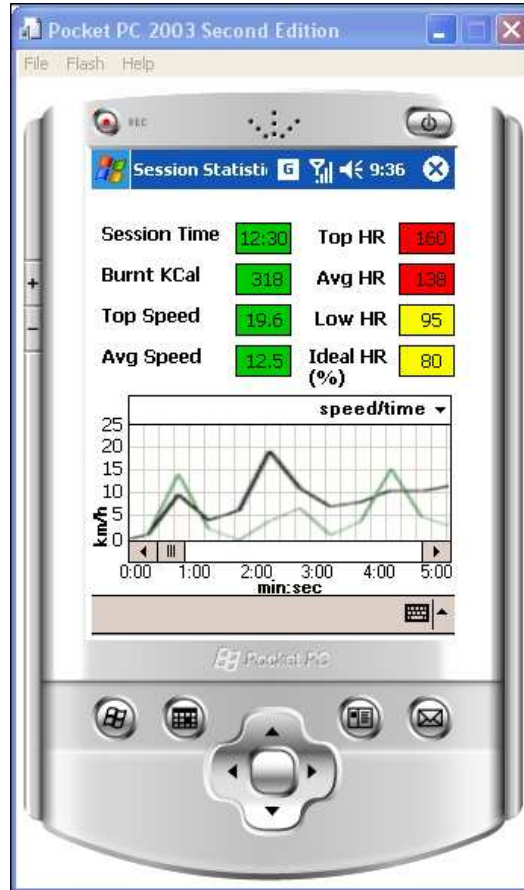


Fig. 11. Mobile interface of MOPET analyzer.

three rows), some users started their run slowly and then gradually accelerated until they reached a constant speed (compressed graphs from fifth row to seventh row), some users started too fast and finished their run walking (compressed graphs in the last three rows). Figure 12b shows users' heart rate as a function of distance. To compare heart rate of people of different ages, we plot it as a percentage of maximum heart rate instead of raw heart rate values. We can observe that, after an initial, rapid growth, most users have an approximately constant heart rate during the exercise. This happens because heart rate value tends to be stable only after about 2 minutes of continuous physical activity and is the reason why sports physicians measure heart rate in stress tests only after a 3-minutes exercise: before this time, the heart rate value could not be significant. Moreover, we can observe that the heart rate logs for the users that started too fast and finished their run walking are higher than the others (last three rows). We then analyze these heart rate logs and the related speed logs using the single session visualization. Heart rate stays in the high intensity zone for a moderate distance (about 500 meters) and the user stops running and begins walking after a short distance in the danger zone (about 200 meters).

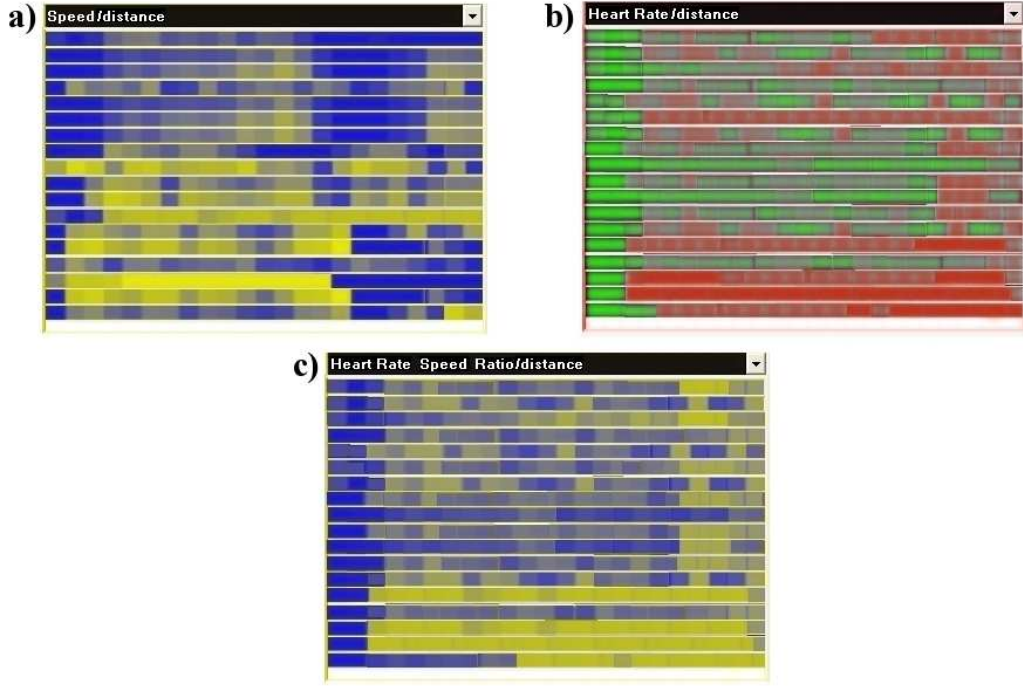


Fig. 12. MOPET Analyzer visualizations of data collected in the multiple users case study: a) users' speed compressed graphs, b) users' heart rate compressed graphs, c) heart rate to speed ratio compressed graphs

Figure 12c shows users' heart rate to speed ratio as a function of distance. We can clearly notice the physical fitness of every user: the lower this ratio, the more trained the user is. Moreover, we can notice that in every graph, after user's heart rate stabilization, this ratio is nearly constant. This is because heart rate is linearly proportional to the speed of run. We can also clearly notice that some graphs have growths of the ratio at specific points. Thus, we view the correspondent logs in the single session visualization and look at the parts of the path run where these growths happen in the map, finding that these parts correspond to the slopes.

4.2 One-month training case study

Figure 13 shows three screenshots of the compressed graphs of the multiple-session visualization, where data are referred to a single user who used MOPET for one month. The user is a 25-years-old male PhD Student at the University of Udine who trained every day for a month and did not use MOPET Analyzer to analyze his performance. Figure 13a shows user's speed. We can notice that the user tends to improve his speed more rapidly in the first sessions (first six rows) than in the last sessions (last six rows). The reason for this is probably that the user was not very physically fit when he began train-

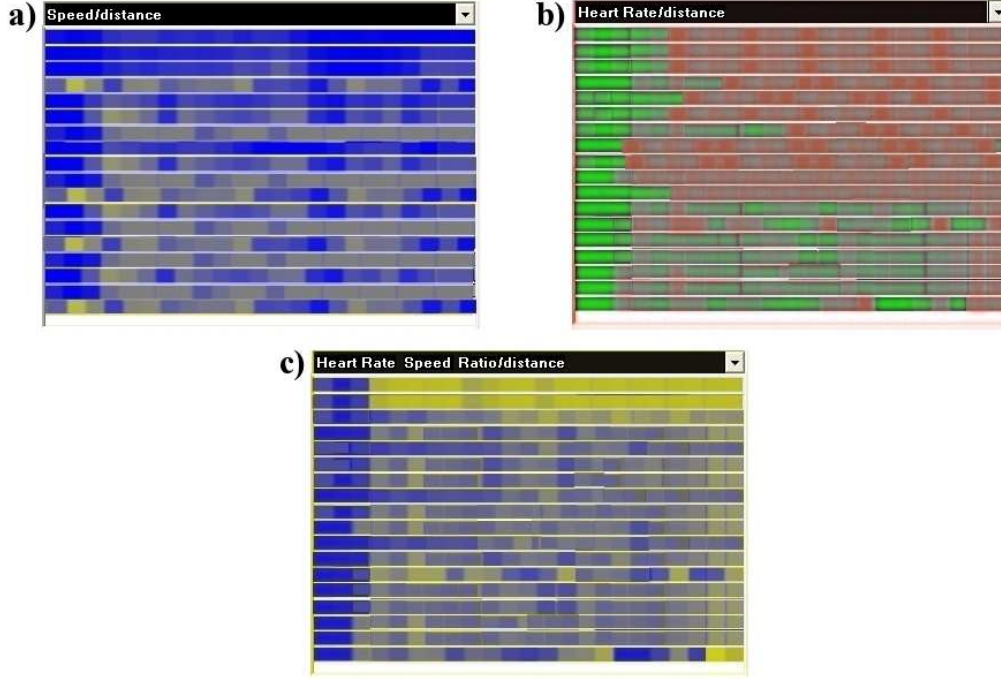


Fig. 13. MOPET Analyzer visualizations of data collected in the one-month training case study: a) user's speed compressed graphs, b) user's heart rate compressed graphs, c) heart rate to speed ratio compressed graphs

ing, and he rapidly improved his physical fitness with the first sessions. Once a sufficient fitness level was reached, speed performance did not increase too much. This is confirmed by looking at heart rate and the heart rate to speed ratio. Heart rate (Figure 13b) graphs have basically the same trend during the different sessions. Only in the last sessions (last seven rows) there is a little drop in the heart rate. We analyzed heart rate in detail with the single-session visualization and noticed that this user had a good control of the intensity of his training: heart rate graphs were contained in the medium intensity area (the area colored in dark green) for about 90% of the distance run. A speed increase with a basically constant heart rate indicates a decrease in heart rate to speed ratio (Figure 13c) along the sessions. This ratio is the main parameter to measure physical fitness and it decreased from the first sessions.

5 Conclusions and future work

This paper proposed MOPET Analyzer, a tool for visual analysis of fitness performance data. Although we have not yet used MOPET Analyzer on a large number of cases, results are promising. The tool allows the user to analyze relations between her physiological parameters and her speed, highlighting critical situations, and helping her to improve the quality of the training. Most of the

relations found in the examples are known by physiologists and physicians, but the usefulness of MOPET Analyzer for this class of users consists mainly in the possibility of visually detecting anomalies. MOPET Analyzer can be used by trainers (e.g., to analyze the physical fitness of their trainees) or physicians (e.g., to analyze fitness performance of people with heart disease and then suggest suitable exercises). However, given that the employed visualizations are thought mainly for personal use, they try to highlight the improvement of user's physical fitness, even from the first sessions, to encourage the user to perform her training program with commitment.

We plan to formally evaluate the effectiveness of the proposed visualizations in terms of discovered patterns and in terms of their usefulness for improving user's physical fitness. In particular, we plan to carry out a longitudinal study of the combined use of MOPET and MOPET Analyzer to evaluate if they help in improving users' sessions in terms of quality and motivation. Moreover, MOPET and MOPET Analyzer will be extended to measure additional physical (e.g., adding altitude profile) and physiological parameters (e.g., galvanic skin response, oxygen level in the blood), providing a more clear picture of user's physical fitness and allowing the user to find new relations between her performance and the recorded parameters.

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