PLUM: A Photograph Browser with a Layout-Upon-Maps Algorithm

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ABSTRACT

This poster presents "PLUM", a photograph browser that places clusters of photographs onto a map while drawing trajectories of photographers. PLUM is useful to look at photographs while observing their activities. PLUM firstly clusters photographs based on places and times, and places representative photographs of the clusters onto a map. Selecting a representative photograph, PLUM shows all photographs in the specified cluster. It features an algorithm to avoid overlap among photographs and trajectories on the map to realize their all-in-one display.

KEYWORDS: photograph browser, layout upon maps.

1   INTRODUCTION

With the rapid spread of digital cameras, we have enormous digital images in recent yeas. On the other hand, it is a big burden for users to arrange such a large quantity of images. Actually, structures of images saved in their computers are often complicated. Therefore, automatic classification and effective visualization of large number of images are actively researched.

When a user looks at photographs on a computer, we may want to look at them based on the places where they are taken. In addition, it is convenient if we can observe them on a map, for example, we may want to know the activity of the photographer in the specific date from the photographs. There have been several software services which show photographs on a map at the positions specified by latitude and longitude; however, they cause many overlaps among photographs, or between a photograph and geographic information drawn on the map. Consequently, it is often difficult to understand the activity of the photographer.

On the basis of the above discussion, this poster presents "PLUM", a photograph browser featuring a "Layout-Upon-Maps" algorithm. PLUM firstly applies a clustering algorithm for all photographs according to their places and times. PLUM then arranges representative photographs of the clusters on a map, while avoiding overlaps among photographs on the map to realize their all-in-one display. In addition, PLUM has two modes named "Long span mode" and "One day mode". "Long span mode" displays many photographs for a long term in a mass, while "One day mode" displays the trajectories of the photographer with photographs on a day. Users can freely switch the two modes along their use scenarios. We expect users can intuitively understand not only where photographs were taken but also activities of the photographers. Also, we expect PLUM helps us to observe of the behaviour pattern of the photographers.

2   RELATED WORK

There have been several famous commercial software for image management and browsing of personal photographs, such as

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Picasa [1] and iPhoto[2]. Some of these systems support functions to arrange and display images according to their places, times, and photographers. Some of them also support functions to arrange the images onto maps; however, they often cause many overlaps among images on the maps. This problem may prevent all-in-one display and operability. MIAOW [3] is a photograph browser which overcomes the problem. MIAOW clusters photographs event-by-event based on their places and times. MIAOW arranges representative photographs of the events in a three-dimensional space where longitude corresponds to the X-axis, latitude corresponds to the Y-axis, and date and time correspond to the Z-axis. MIAOW displays all photographs belonging to an event along zoom operations. At the same time, MIAOW generates groups of persons taken in the photographs by calculating their co-occurrences in each event, and shows face images of the groups. MIAOW enables us to search for a lot of photographs intuitively by alternatively operating them.

3   PHOTOGRAPH BROWSING BY PLUM

This section presents technical components of PLUM. We suppose that all photographs browsed by PLUM have information of latitude, longitude, date and time.

3.1   Clustering

PLUM applies different implementation of clustering algorithms for "Long span mode" and "One day mode" respectively. Then, PLUM chooses representative photographs for each cluster.

3.1.1   Clustering in "Long span mode"

For "Long span mode", PLUM simply applies a clustering algorithm to all photographs based on longitude and latitude.

3.1.2   Clustering in "One day mode"

For "One day mode", PLUM firstly generates clusters according to the days of the photographs. This poster calls the clusters "high-level clusters". Next, PLUM applies another clustering based on the following two conditions for each high-level cluster:

- If the difference of times between the $(i\text{-}1)$-th and i-th photographs is more than α, PLUM generates a new cluster for the i-th photograph.
- If the distance in the Mercator projection space between the i-th photographs and the center of the cluster of the $(i\text{-}1)$-th photograph is more than β, PLUM generates a new cluster for the i-th photograph.

Though our current implementation of PLUM experimentally defines the values α and β, we would like to develop a technique to calculate optimal values of them in the future.

3.2   Trajectories of a photographer in "One day mode"

PLUM draws trajectories of photographers as polygonal lines in "One day mode". As vertices of the trajectories, PLUM calculates the means of latitudes and longitudes of low-level clusters, and plots the means onto a map. This poster defines positions of these vertices as ideal positions of representative photographs of low-level clusters. Next, PLUM connects the vertices in the order of times of photographs, as red lines shown in Figure 1 red line. Our

current implementation of PLUM treats them as trajectories of the photographers. We would like to incorporate GPS log to draw fine trajectories. The above function is only for "One day mode", not supported for "Long span mode".

3.3 Placement of representative images

PLUM displays representative photographs near their ideal positions with the trajectories. PLUM calculates positions of representative photographs while it avoids overlaps among photographs or between a photograph and a trajectory. Section 3.4 describes the algorithm to calculate the positions of representative photographs. Furthermore, it displays links between ideal positions and the centers of representative photographs to indicate the original positions of representative photographs. In addition, PLUM calculates the positions of photographs whenever scaling or translation is operated by users. Our current implementation of the position calculation function may suddenly move photographs while their scaling or translation operations, and may confuse the users. We experimentally solved this problem by calculating the middle point between the current placement position and its original ideal position as the tentative ideal position of a photograph, and attempts to place the photograph around the tentative ideal position.

3.4 Position calculation for representative photographs

Our implementation of position calculation method consists of 4 steps as shown in Figure 1. First, it divides a window space in state of lattice and draws a trajectory. Second, it excludes the rectangular domains the trajectory passes from candidates of positions, as yellow domains shown in Figure 1(2). Third, it searches for empty rectangular regions, as 2x2 red domains shown in Figure 1(3). It attempts find the empty regions as near as possible to the tentative ideal positions. Finally, it generates links between the centers of the photographs and the original ideal positions as straight segments, as shown in Figure 1(4).
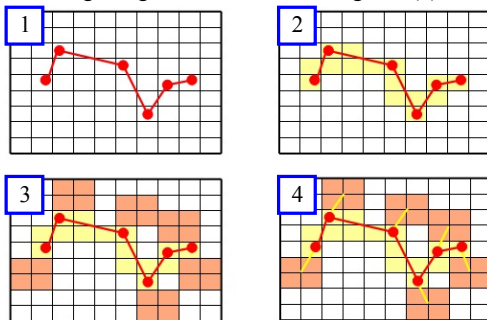

Figure.1: Position calculation and display of representative photographs

4 EXAMPLE

This section introduces an example of photograph browsing using PLUM. The photograph set used in our experiment consists of 1534 pieces taken in one month, extracted from photographs taken by a certain user as life log everyday (about 160000 pieces). Positions of photographs were recorded into the EXIF domain of JPEG by Sony GPS-CS3.

Our implementation of PLUM firstly displays in "Long span mode". In this mode, PLUM displays a map in the left of the window as a background image, and overlays representative photographs. Figure 2 is an example when a user selected a representative photograph surrounded with yellow in the map. Photographs in the cluster of the selected representative

photograph are listed in a tab posted in the right side of the browser. At the same time, PLUM automatically generates a list of the dates of the photographs in the cluster on another tab.

When a user selects a certain day from the list of dates, PLUM switches to "One day mode" in substitution for "Long span mode". In this mode, PLUM displays a map in the left of the browser as a background image, and overlays a trajectory and representative photographs. At the same time, PLUM lists photographs taken on the day in another tab displayed in the right side of the browser. Figure 3 is an example when a user selected a representative photograph surrounded in blue in the map. Then, the frame color of the photographs listed in the tab to be included in the cluster is turned to red.
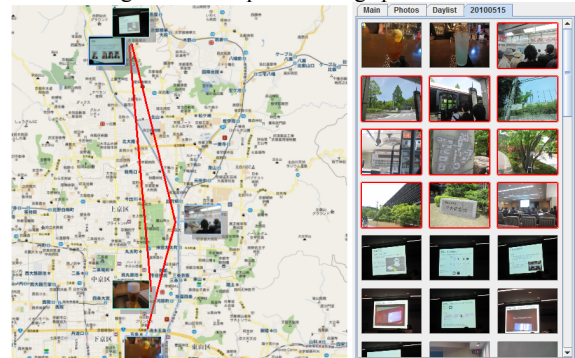

Figure 2: Example of "Long span mode"

Figure 3: Example of "One day mode"

5 CONCLUSION

This paper presented "PLUM", a photograph browser featuring a Layout-Upon-Maps algorithm taking places and times of the photographs into account and aiming all-in-one display. PLUM enables us to observe activities of photographers while looking at large number of photographs by switching two modes. As future work, we would like to apply GPS logs to draw finer trajectories, and develop a mechanism of synchronization with Google map. Also, we are going to develop a sophisticated representative photograph selection algorithm, and more effective photograph placement algorithm.

REFERENCES

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