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IMAGE PROCESSING AND SEARCHING

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ABSTRACT

An image searching system is used to provide images in response to a query. The images can be captured by one or more users over a certain period of time. The system receives a query to search for images. The system parses the query and determines a type of request. The system then processes and searches for images in response to the determined request type. The system then presents the images to the user.

PROBLEM STATEMENT

Users routinely capture images at a particular event or a tourist location using electronic devices such as a digital cameras, smartphones, tablets, wearables, etc. These images are either stored locally on user devices, stored on a cloud server, or are shared on social networks by the users. Users can scroll through their collection of images on their devices. Also, users can search for publicly available images online. However, it is relatively difficult for users to locate specific images or sets of related images. For example, it is not very convenient for a user to locate all his pictures from a visit to a landmark in which his daughter appears, or to find all the pictures of the Eiffel Tower during sunset on a particular day. To locate images with such specific details requires manual searching on the user's part. For example, the user may have to scroll through their collection of images to identify the images in which the daughter appears at the landmark. Similarly, users may have to search publicly available image databases to locate images of the Eiffel Tower at sunset.

A unified system that returns image search results in accordance with specific image criteria would be useful. For example, in the case of missing persons, it would be helpful if an entire set of images can be searched for the presence of a missing person. Current technologies such as facial and clothing recognition can be utilized to identify the missing person in the available images taken by different users from different points of view.

An advanced image searching system that returns images in response to a query is disclosed.

IMAGE SEARCHING SYSTEM

The systems and techniques described here relate to an image searching system that returns relevant images in response to a query. The query may be related to a specific object, person, location, point in time, etc. The system can be implemented as program instructions locally on a client device or implemented across a client device and server environment. The client device can be any electronic device, e.g., a laptop, mobile phone, computer, tablet, wearable, etc.

FIG. 1 illustrates an example method to search images in response to a query. The method can be performed by a system that searches for one or more images, for example, the image searching system.

The system receives a query to search for images (Block 102). The query can include an input query, a search query and the like. The query can be related to, for example, images from a user's previous visit to a tourist location, images of a particular person or an object, images captured at a specific place, time, or a day, etc. Some example queries include "pictures of me at

the Butler County Fair last week" or "photos taken from the observation deck of the Empire State building." The system may receive the query via a user interface provided to a user to enter their query.

Images are generally captured using electronic devices such as a smartphones, tablets, digital cameras, etc. The image searching system has access to the user's captured images stored locally on the user's device, on a cloud server, or shared on a social network. In all cases, users must give their permission to the system in order for the system to access, process, and search through the user's images. The images generally have EXIF (Exchangeable Image file format) information associated with them. The EXIF information records a variety of data at the time of image capturing. The data can include, for example, current date, time, geolocation, capturing device orientation, aiming direction, etc. Some images may also have user-supplied tags or other annotations, for example, "Jane and me" or "Harry's Birthday Party."

The system analyzes the query to determine a type of request from the query (Block 104). The type of request indicates whether the query is for images captured at a specific location, images of a specific location, images captured from a certain position, images containing a specific face, etc. In order to determine the type of request, the system may parse the query to identify important keywords included in the query. For example, in a query "photos taken yesterday from the observation deck of the Empire State building," the system can detect important keywords such as "Empire State building," "observation deck," "taken," "photos," "yesterday".

Additionally, or alternatively, the system may also use the location history of a user along with the query keywords to determine the type of request. The user's location history can be

obtained from location sensors, such as GPS coordinates of user's image capturing device or other location triangulation methods. Over a period of time, a location map can be generated for the user which may list all the locations visited by the user over a predetermined period of time from which the system can obtain the user's location data. The system may need permission from the user in order to access location data from the user's electronic device.

Continuing with the same example, the system may determine from the user's location history that one of the locations the user visited yesterday is the Empire State Building. The system may use this information along with the parsed keywords, such as "Empire State building," "photos," "yesterday," "observation deck," to determine that the user is requesting all the images from the observation deck of the Empire State Building captured during his visit the day before.

The system then presents one or more images to the user after determining the type of request (Block 106). The system may search the EXIF information or user-supplied tags or annotations associated with the images. The system may first process the user's images using the location, date, time determined from the query. The system may also apply processing techniques such as facial recognition, clothing recognition, text matching, etc. Continuing with the same example as above, the system compares the determined information such as "Empire State building," "observation deck," and date and time of the request with the EXIF information and any other information associated with the images. The system may process the images according to the image capturing device orientation as well, in order to identify only those images which are taken from a particular direction. After all the images are identified, the system presents the images to the user.

Apart from requesting user's images, the system may also similarly process and search images taken by other users, after obtaining their permission to access the images. The system can use the EXIF information to identify images that also satisfies the user's request.

FIG. 2 shows an example graphical user interface 200 of the image searching system. The interface may be presented to a user on a display screen of an electronic device. The interface provides a search bar 202 where the user can input his query. In the example GUI shown, the search bar is provided along with some of the recent images (Image 1 to Image 8) captured by the user. The depicted images could be stored on the user device, on a cloud server, published on a social network, shared on a image sharing site, etc.

FIG. 3 shows an example GUI 300 after the user has entered a query. As depicted, a query, "pictures of me at Butler County fair last week" 302 is entered by the user. After receiving the query, the system determines the type of the query. The system parses the keywords of the query such as "pictures," "me," "Butler County fair," "last week." The system also has access to the user's geolocation data. Combining the user's location history information with that of the parsing of the query, the system determines that the search request is for images in which the user appears at the Butler County Fair last week (date of user's visit from the location history).

After the type of request is determined, the system processes all the images it has access to. The system identifies images with EXIF location coordinates as that of Butler County fair, and with EXIF date matching that of the determined criteria (last week). As the determined criteria is images in which the user himself appears, the system may run facial recognition on the identified images to identify just those photos where the user is present. The system may have

access to previous images in which the user's face is tagged. Using a combination of previous tags, the system may locate the user in the identified images. After identifying the relevant images, the system presents the images to the user. As depicted in GUI 200, four images (out of the original eight), Image 1, Image 3, Image 5, and Image 6, are identified by the system in which the user is present.

In another example implementation of the image searching system, the query may be "Images of eiffel tower during sunset from half a mile away." After receiving this query, the system determines the type of query by first parsing the query for major keywords such as "images," "eiffel tower," "during," "sunset," "1 mile," "away." The system determines that the request is for images of the Eiffel Tower captured in the evening half a mile from the Eiffel Tower. The system then processes the images (to which it has permission to access) to locate the appropriate images. The system first identifies the relevant images by matching the EXIF data of the images with that of the determined criteria. The images that are tagged with the location "eiffel tower" with a timestamp at sunset are shortlisted. The system then processes the shortlisted images. The system further uses the EXIF information of the shortlisted images such as camera orientation, zoom level information, camera directional information to determine the images taken from a radius of half a mile from the eiffel tower. The system may also process the images using lighting information of the images. Photos with lighting that more strongly indicate the type of lighting present at sunset would be ranked higher. The final shortlisted identified images are presented to the user.

The identified images can optionally be further processed by the system. For example, the system can edit unnecessary elements from the images such as people, lamp posts, power

lines, etc. The images may also be presented in form of a time-lapse movie. As an example, in the above scenario, a time-lapse movie of eiffel tower from sunrise to sunset could be presented to the user.

The subject matter described in this disclosure can be implemented in software and/or hardware (for example, computers, circuits, or processors). The subject matter can be implemented on a single device or across multiple devices (for example, a client device and a server device). Devices implementing the subject matter can be connected through a wired and/or wireless network. Such devices can receive inputs from a user (for example, from a mouse, keyboard, or touchscreen) and produce an output to a user (for example, through a display). Specific examples disclosed are provided for illustrative purposes and do not limit the scope of the disclosure.

FIGURES

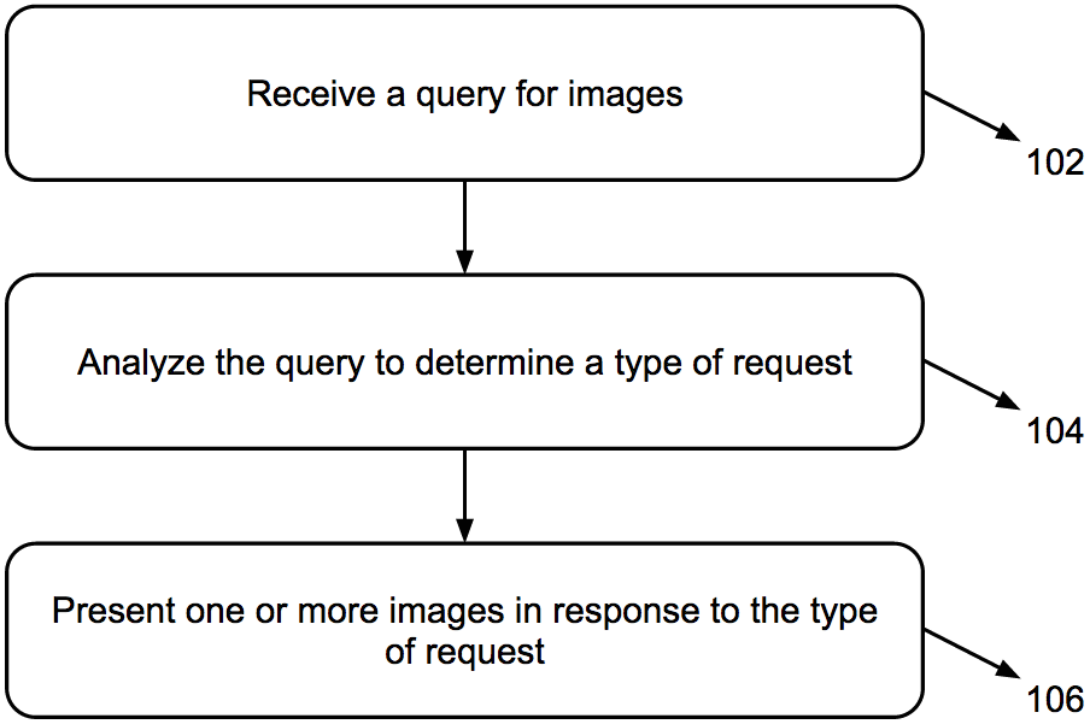

Figure 1

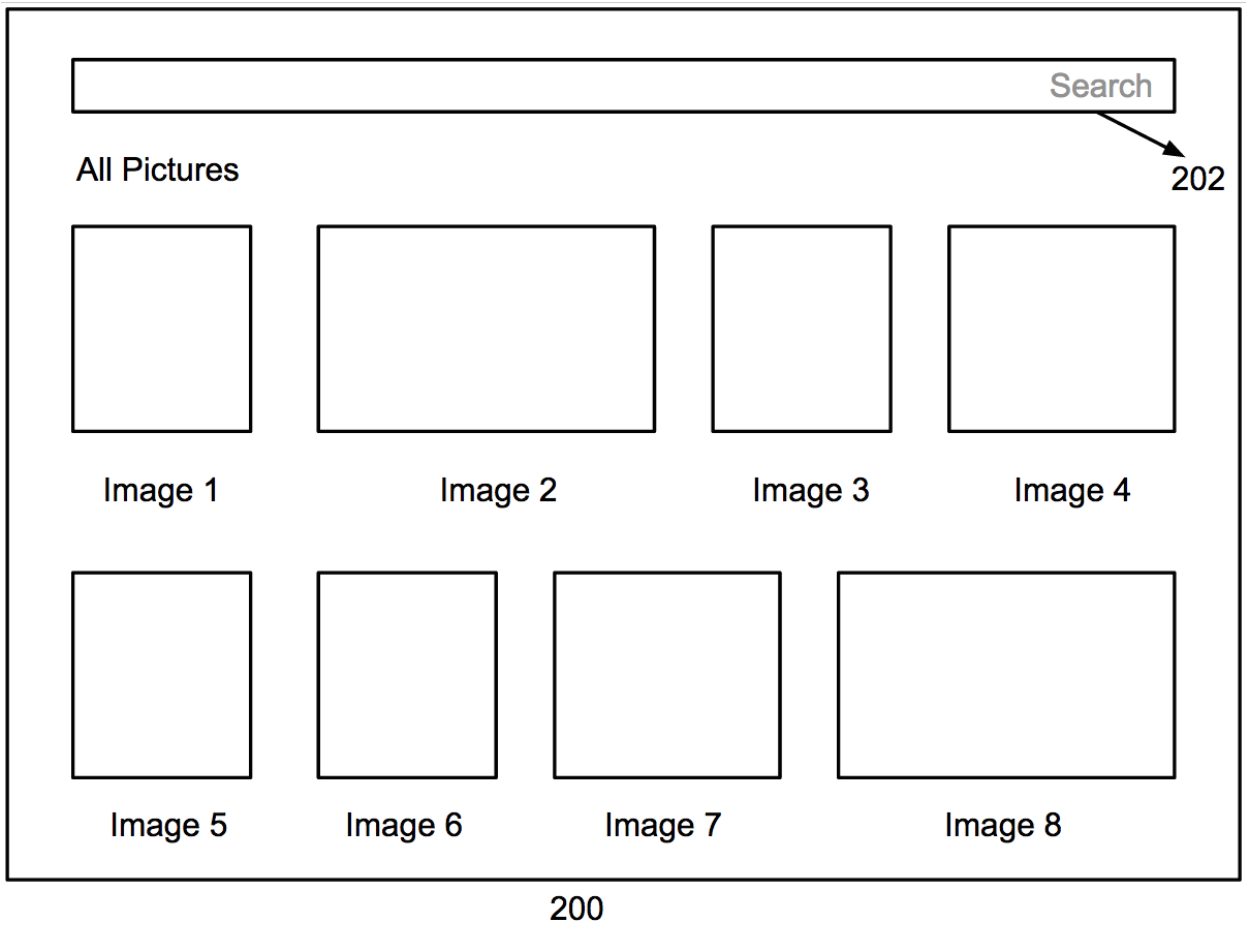
Search
202
All Pictures
Image 1
Image 2
Image 3
Image 4
Image 5
Image 6
Image 7
Image 8
200

Figure 2

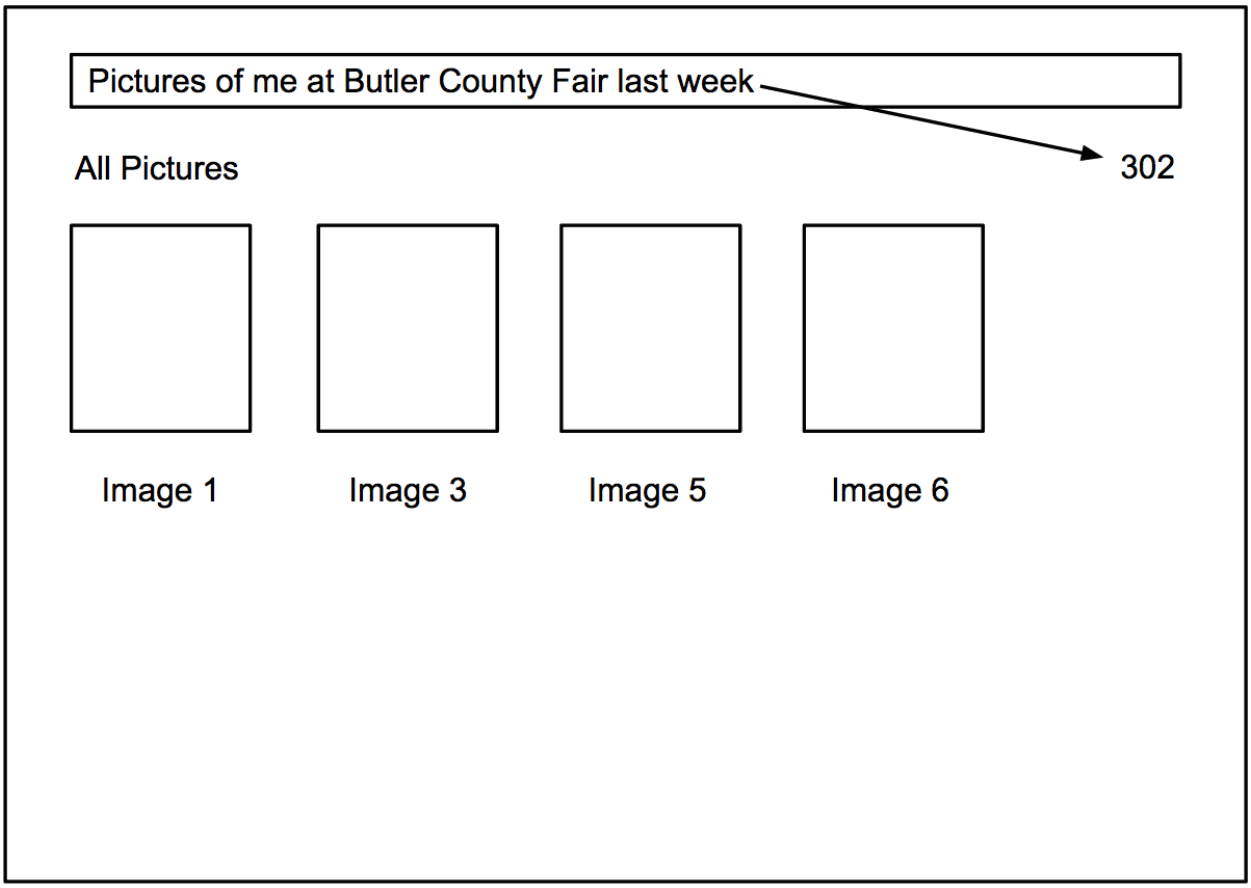
Pictures of me at Butler County Fair last week
302
All Pictures
Image 1
Image 3
Image 5
Image 6
300

Figure 3