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Duration of image display in a slide show based on image content

ABSTRACT

This disclosure describes techniques to automatically display images in a slide show for varying durations. With user permission, objects are automatically detected in images that are included in a slide show. The duration of the display of each image during the slide show is determined based on a number of detected objects in the image. For example, the objects can be faces, such that an image that includes a higher number of faces is automatically displayed for a longer time period than an image that includes a lower number of faces. Such dynamic display duration allows images having greater amounts of features or detail to be automatically displayed for an amount of time appropriate to allow viewers to explore the features of the image.

KEYWORDS

- slide show
- display duration
- slide show duration
- object count
- face count
- face detection

BACKGROUND

Users have many digital images in their collections, e.g., obtained from image capture devices such as cameras, messages received on personal devices, etc. Many users create slide shows from a subset of their images, e.g., using an application program. The slide show

presents the set of images on a display device such as a display screen and in a particular order that can be selected by the user.

In typical slide shows, each image (slide) is displayed for a predetermined amount of time, is replaced on the display screen with the next image that is displayed for the same amount of time, and so on. This can cause frustration to viewers when an image includes a greater amount of detail that viewers would like to view for a longer period of time. For example, viewers often prefer to view a photo showing many faces for a longer period of time so that they are able to look at all the faces.

Some slide show application programs allow the user to manually adjust the duration of all images or the duration of individual images presented in the slide show. However, increasing the duration of all images leads to a longer slide show, with simpler images displayed for too long a period of time. In addition, manual adjustment of individual durations of images can be time consuming, especially when many images are included in the slide show.

DESCRIPTION

This disclosure describes techniques to automatically display images in a slide show for varying durations based on content depicted in the images. Described techniques provide various settings to users to customize the types of content, the duration, and other characteristics of a slide show.

The techniques described herein are implemented upon specific user permission to access a user's images and to detect content in the images. Only those images for which the user grants permission are examined and processed.

Detecting Objects in Images

If a user has provided permission, a device analyzes images in the user's collection to detect particular objects for use in determining display durations of the images. The objects that are detected can be of a variety of types. For example, the object types can be faces, persons (e.g., a person's body or portion of body), animals, landscape features (trees, clouds, etc.), vehicles, etc. Stored user preferences can designate particular types of objects to be detected for use in the described techniques. In some examples, if the user has provided permission, the detection of objects can be performed on all of the images in the user's collection, or on a designated subset of images. The designated subset can include newly-captured images, downloaded or received images, images in a particular category, folder, storage area, etc. The types of objects detected in an image can be stored as metadata or other data associated with the image. Object detection can be performed automatically by the device, or performed in response to user input to the device.

The described techniques enable, with user permission, a device to automatically identify objects in images. For example, the techniques can utilize trained machine learning models and apply machine learning classification to identify and label objects in images. For example, the model may be trained with training data (e.g., images, videos, etc.) that includes images with various types of objects that are to be detected for the described techniques, e.g., training data that is obtained or created specifically for this purpose, and/or with user-specific training data, obtained with user permission. Such a model can then recognize such objects in new images. In some cases, image metadata can be used in the training process, e.g., time and location of image capture or image creation. For example, the device can start with a common model that identifies objects, and when the user permits, be trained further based on images in a user's image library.

The machine learning model can be implemented on a user device. If user permission is obtained, the model can be fully or partially implemented on a server or other remote device in communication with the user device. In some cases, heuristics and rules can be used instead of or in addition to a machine learning model.

A count of the objects that are detected in each examined image is also stored, e.g., as image metadata or in device memory. A count of each type of object, and/or a count of all types of objects can be stored, e.g., “5 faces,” “2 animals,” “7 objects,” etc. In some examples, the count of detected objects can be used to classify images, e.g., into categories such as images having one object, images having two objects, etc. Images can also or alternatively be clustered into different classifications according to different types of objects detected in the images, such that each type of object is represented by an associated classification.

Object detection in images for use in a slide show can be performed at any of various times and can depend on software architecture. For example, object detection can be performed for an image immediately before displaying the image in the slide show, when generating a movie file that is displayed as the slide show, or as pre-processing of a set of images before user input is received that designates which images are in a slide show.

Assigning Display Duration to Images

After the types of objects and count of objects are determined for an image, a display duration can be assigned to the image for use in a slide show. For example, the display duration can be stored as metadata for the image or can be stored in device memory. In some cases, the user selects a set of images to be included in a slide show, and display durations are determined for these images. In other examples, a display duration is assigned to any image in which objects were detected as described above. Display duration can be determined for an image

immediately before displaying the image in a slide show, when generating a movie file that is displayed as the slide show, or as pre-processing of a set of images before user input is received that designates which images are in a slide show.

The display duration for an image is based on a count of the objects detected in the image. In general, the display duration is varied directly in accordance with the count of objects, e.g., the greater the number of objects, the greater is the assigned display duration. In an example, the display duration of an image can be a sum (or other function) of durations associated with each detected object, where each duration has a particular value (e.g., 5 seconds). In another example, a base display duration is assigned to the image, and an amount of additional display duration over the base duration is assigned per additional object detected beyond a first detected object. A base duration and/or a duration associated with each object can be designated or adjusted by the user, e.g., in stored preferences. In various examples, the display duration can be linearly, exponentially, or otherwise varied based on the count of detected objects in the image.

The detected objects that are used to determine the display duration can be different in various implementations. In one example, the count of objects of a designated type (e.g., faces), or of multiple designated types, are used in the determination of display duration, and objects of other types are ignored for determining the display duration. For example, if the only designated type of object is faces, then the number of faces is used to determine the display duration, without using other types of detected objects. If the designated types of objects are faces and animals, then the total count of both faces and animals are used to determine display duration. Some types of objects can be weighted differently than other types of objects for determining display duration. For example, in a same slide show, faces can be associated with

a display duration of 5 seconds per detected face, while animals can be associated with a duration of 3 seconds per detected animal in an image.

A maximum display duration is provided for each image, regardless of the count of detected objects in the image. The maximum display duration can be specified by the user in user preferences. For example, the maximum display duration can be 20 seconds. Thus, images showing many objects (e.g., a large group of people with many faces) have a limit to the duration they are displayed.

Detected objects having particular characteristics can be ignored when determining display duration. Such characteristics can be specified in user settings or preferences. For example, one such characteristic can be size. In one example, faces that are under a threshold size can be ignored when determining display duration, e.g., faces in a crowd that are small or located behind closer faces in the image. Such a threshold size can be defined as a percentage area of the image area, or based on relative sizes of detected objects (e.g., a detected object that is less than 10% of the size of the largest detected object is ignored).

The display duration can also be based on the position of detected objects with respect to each other or with respect to the borders of the image. For example, an image showing detected objects that are positioned closer together can be assigned a shorter display duration than images in which detected objects are positioned further apart (e.g., separated by more than a threshold distance or fraction of image size), since it may take additional time for a viewer to scan the image for interesting objects spaced further apart in the image.

Displaying the images in a slide show

Images that have been assigned a display duration are each displayed in a slide show for a length of time equal to their associated display duration. In some examples, the images are

displayed in a sequence, one after the other, for a length of time based on their assigned display durations. Other examples can display multiple images of the slide show simultaneously based on the assigned display durations. In some cases, the actual displayed length of time of an image can be a fraction or multiple of the assigned display duration.

Examples of image display durations

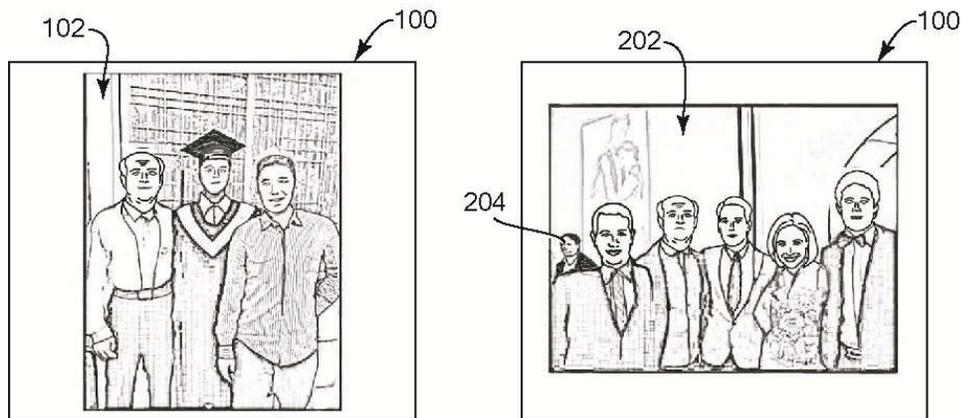


FIG. 1

FIG. 2

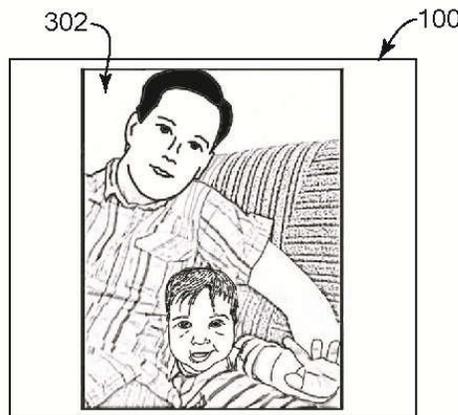


FIG. 3

Figs. 1-3: Example images displayed for a slide show

Figs. 1-3 show examples of images displayed in a slide show. In these examples, the display duration of the images are based on the number of objects that are faces as detected in

the images (with user permission). The images are displayed in sequence for the assigned display durations.

In Fig. 1, a display screen (100) displays a first image (102) of the slide show. Three faces are detected in the first image, which causes the first image to be displayed for a time period based on the count of three. In one example, each detected face causes three seconds of display duration, such that the first image is displayed for 9 seconds.

In Fig. 2, the first image has been replaced with a second image (202) in the slide show displayed by the display screen. In this example, six faces are detected and the five largest faces are used to determine the display duration of the second image based on the count of five (e.g., 15 seconds). A sixth face (204) was also detected in the second image, but this face is determined to be too small (e.g., under a particular threshold size) to contribute to the display duration of the second image.

In Fig. 3, the second image has been replaced with a third image (302) in the slide show displayed by the display screen. In this example, two faces are detected, which causes the display duration of the third image to be based on a count of two, similarly as described above (e.g., 6 seconds). In another example, the device can provide an additional display duration (greater than for the two faces alone) based on determining that the two faces are more than a threshold distance apart (e.g., a total duration of 8 seconds). This allows viewers of the third image additional time to find and view the faces located near opposing borders of the image as shown.

Machine learning models that are used to implement described techniques are trained and implemented only with user permission to access user data that serves as input to the models. Users are provided with options to indicate permission or denial of permission for

access to various data, e.g., images, image metadata, video, and other content in the user's image library, contextual factors such as time, location, application in use, etc. In implementing the described techniques, use is made only of user-permitted data, and certain techniques (e.g., ML models) are not implemented, if users deny permission. Model training is performed based on generalized data that is not attributable to individual users, and/or performed only locally on the user device with user data, e.g., using a federated learning approach. Object detection is performed with user permission, and if the user denies permission or if there are other reasons, detection for certain types of objects (e.g., faces) is disabled.

Further to the descriptions above, a user may be provided with controls allowing the user to make an election as to both if and when systems, programs or features described herein may enable collection of user information (e.g., information about a user's activities, social network, or social actions, profession, a user's preferences, or a user's current location), and if a user device is sent content or communications from a server. In addition, certain data may be treated in one or more ways before it is stored or used, so that personally identifiable information is removed. For example, a user's identity may be treated so that no personally identifiable information can be determined for the user, or a user's geographic location may be generalized where location information is obtained (such as to a city, ZIP code, or state level), so that a particular location of a user cannot be determined. Thus, the user may have control over what information is collected about the user, how that information is used, and what information is provided to the user.

CONCLUSION

This disclosure describes techniques to display images in a slide show with automatic adjustments to display duration of images based on image content. Image objects such as faces are detected in an image, with user permission, and the display duration of the image is selected to be higher when greater numbers of objects are detected. Further, a variety of user preferences allow the user to control the relationship between display duration and number of detected objects, the types of objects that influence display duration, and other factors influencing display duration. Such features allow a slide show to automatically adjust the display duration of images to be appropriate to the amount or complexity of image content, enabling more satisfying viewing of images in slide shows.