December 2022

Reclaiming Storage Space by Removal of Unnecessary Frames from Multi-frame Photos

Benjamin Azose

Molly Clancy

Reclaiming Storage Space by Removal of Unnecessary Frames from Multi-frame Photos

ABSTRACT

Smartphones and other digital cameras enable users to capture photos that include several frames, including some prior to the instant of the user selecting the capture button and some after. This allows motion within the scene to be captured as well as for post-capture selection of a suitable still image, e.g., an image where the subjects are in the correct pose and/or are looking at the camera. However, this is wasteful of storage space when the captured image is of a still object. This disclosure describes techniques to automatically detect such multi-frame photos and enable users to remove excess frames and obtain a standard still image file that is of a smaller size. Automatic detection can be performed using two separate classifiers that employ suitable computer vision techniques to detect photos that contain static content and that do not depict living beings.

KEYWORDS

- Motion removal
- Frame selection
- Motion photo
- Live photo
- Photo burst
- Static scene
- People detection
- Storage cleanup
- Photo library

BACKGROUND

Many digital cameras, including smartphone cameras, provide users with the ability to take photos in a form that includes a capture of the scene for a few moments before and after the capture button is pressed. Such photos are akin to short video clips, or a burst of multiple photos taken in rapid succession as in the reel of a film. Such photos can include subject motion across the multiple captured images and are useful for capturing photos of situations that involve motion, such as people performing various activities, pets moving about, etc. This is useful when taking photos of pets or of children who typically find it difficult to stay still looking at the camera and wait for the photo to be captured. Having a photo with motion therein makes it much more likely that the subject will be looking at the camera at some moment during the motion captured just before and after the photo capture button is pressed.

In contrast, such photos are not useful in situations where the photographed scene is static and involves no movement. For instance, photos of stationary objects, such as documents, buildings, street signs, landmarks, etc., in this format contain the same frame repeated over the entire duration of motion capture. The file sizes of such photos can be substantially larger than those of corresponding still photos (single image) of the same scene which wastes device storage space, or cloud storage space when such photos are stored in the cloud.

If the user selects a capture mode that always includes multiple frames, local storage space consumed by a large number of such photos stored on the device can result in the device approaching the limits of its storage capacity. The user experience (UX) on such devices can be less than optimal and the lack of available storage space can cause various problems such as slow device operation, inability to install new applications, inability to store large content files, etc. In

such cases, users need to free up space on the device storage by deleting locally stored applications and/or data.

Some device operating systems and applications offer suggestions for content that can be removed from local storage to increase the amount of available space. The suggested removal choices can include the option to trim photos by removing the motion (i.e., the frames captured before and after the frame corresponding to the one at which the photo capture button was pressed) and retaining only the captured image corresponding to the instance at which the photo was captured or another automatically determined/user selected image. However, such operation is applied uniformly to all photos without taking into account whether the photo includes static or moving content.

DESCRIPTION

This disclosure describes techniques to enable users to reduce the amount of storage space occupied by the photos stored locally on a device by selectively converting multi-frame photos of static content to a single-frame still photo in a standard file format.

With user permission, photos stored locally on the device can be analyzed via a suitably trained machine learning classifier to determine whether a given photo depicts static content, such as documents, physical objects, etc. Alternatively, or in addition, a separate classifier can be employed to determine whether a photo contains living beings, such as people, animals, etc. For photos determined to include static content and/or depicting scenes that do not include living beings, users are offered the option to remove frames captured before and after the camera button was pressed, or to select a particular frame to retain. The operation converts the large-sized file for the photo into a much smaller-sized file that includes a single still image.

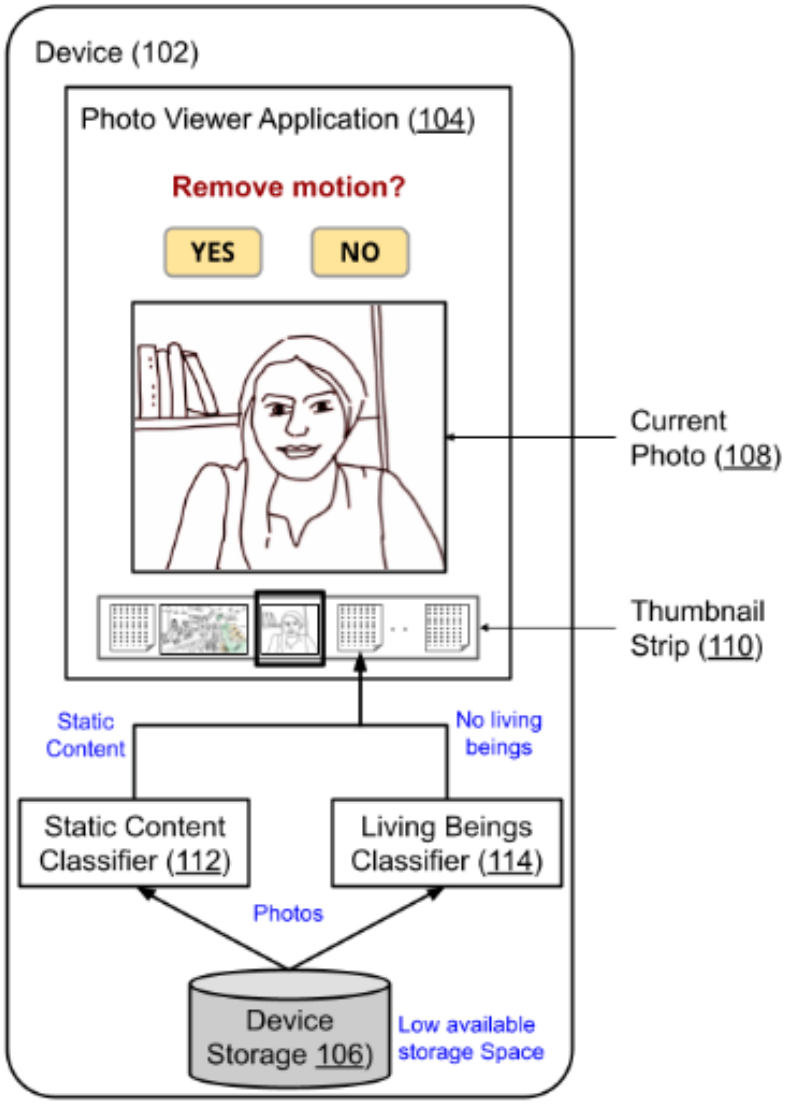

Fig. 1: Removing unnecessary frames from photos to reclaim storage space

Fig. 1 shows an example operational implementation of the techniques described in this disclosure. A user is running out of local storage space (106) on a device (102). With user permission, photos stored on the device are analyzed by two separate classifiers that employ suitable computer vision techniques to detect photos that contain static content (112) and do not depict any living beings (114). The user can view the photos with static content and those without living beings as detected via the classifiers as a thumbnail strip (110) within a photo

viewer application (104). Alternatively, the user can view all photos, and an option to "remove motion" can be selectively shown when the photo is detected as having only static content/no living beings.

The user is provided the option to remove extra frames from the currently selected photo (108) within the thumbnail strip. If the user selects the "Yes" button, all frames except the one captured at the time of shutter press (or another frame selected by the user/ automatically picked by the application) are removed from the photo. The retained still frame is saved on the device storage as a standard photo file. Alternatively, with user permission, removal of excess frames can be performed automatically on a selection of photos.

The user can choose manually to invoke the action to run the classifiers to reduce used storage space upon noticing that available disk space on the local device storage is running low. Alternatively, or in addition, the classifiers can be invoked automatically. The automatic operation can be performed as a background process, e.g., that runs at all times or at periodic intervals. Alternatively, the operation can be automatically initiated when available disk space falls below a threshold amount or percentage, or when the user is deemed to be engaged in task flows that indicate that storage space reduction is necessary. The threshold and periodic interval can be set by the developers and/or specified by the users and/or determined dynamically at runtime. Storage reduction task flows can be detected via any suitably trained machine learning model.

With user permission, the techniques can be implemented to modify photos in any format stored on any local device storage. The classifiers for detecting candidate photos for conversion to still photos can be implemented locally on the user's device, or with user permission, in the cloud (e.g., when the user's photos are stored in the cloud). The candidate photos identified by

the classifiers for removal of motion frames can be shown to the user via any suitable user interface (UI) mechanism within any suitable application, such as a photo viewer/editor application, a photo library, a file browser, etc. For instance, the collection of photos can be marked with a special tag that is visible when browsing local files on the device filesystem. Users can choose to remove excess frames from the flagged photos one at a time (as shown in Fig. 1) or as a batch of multiple files selected using any suitable UI mechanism.

Implementation of the described techniques enables reclaiming local storage space that is wasted in storing unnecessary image frames within photos that include multiple frames, thus optimizing the use of local storage and reducing the problems and inconveniences experienced because of running low on available local storage on the device. Further, automatic detection of candidate photos for the removal of unnecessary frames can reduce the time and effort for reducing the used storage space and makes the process less cumbersome. Moreover, implementation of the techniques enables users to retain photos with multiple frames only for content that requires the functionality of depicting motion, thus enhancing the user experience (UX) of managing and viewing a photo collection.

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 photos/videos, available storage space on a user device, a user's preferences, or a user's current location), and if the user 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

Smartphones and other digital cameras enable users to capture photos that include several frames, including some prior to the instant of the user selecting the capture button and some after. This allows motion within the scene to be captured as well as for post-capture selection of a suitable still image, e.g., an image where the subjects are in the correct pose and/or are looking at the camera. However, this is wasteful of storage space when the captured image is of a still object. This disclosure describes techniques to automatically detect such multi-frame photos and enable users to remove excess frames and obtain a standard still image file that is of a smaller size. Automatic detection can be performed using two separate classifiers that employ suitable computer vision techniques to detect photos that contain static content and that do not depict living beings.

REFERENCES

1. Sowden, Paul, and Leslie Ikemoto. "Image display with selective depiction of motion." U.S. Patent 10,775,977, issued September 15, 2020.