January 2022

Using Word Boundaries for Automatic Reflowing of Text within an Image

Jacob Davies

Using Word Boundaries for Automatic Reflowing of Text within an Image

ABSTRACT

When using a mobile device in portrait mode to view an image of wider text content, the text within the image is sometimes too small to be readable without zooming. To view such text, users need to engage in zooming and horizontal scrolling, or changing device orientation to landscape mode which increases the amount of vertical scrolling required to read the content. This disclosure describes techniques to automatically reflow text content within an image such that wide passages of text within the image are displayed in an easily readable form that fits narrower screens of mobile devices used in portrait mode. Lines within the text content of the image that do not fit within the screen width are flagged and divided into two or more parts. Each part is narrow enough to fit on a single line on screen without breaking up any words. Each line is cut into multiple images at recognized word boundaries such that each image represents a single word in the original text. The images are arranged in succession in lines such that each line is within the width of the device screen.

KEYWORDS

- Image reformatting
- Image retargeting
- Text reflow
- Scanned book
- Screenshot
- Optical character recognition (OCR)
- Word boundary detection
- Paste-up
- Pan and zoom
- Screen width

BACKGROUND

Most desktop and laptop computers have screens with aspect ratios that provide more horizontal space than vertical space. The horizontal space is larger than the minimum needed for optimum readability requirements, such as approximately 80 characters per line. However, mobile devices such as smartphones or tablets, when used in portrait mode, have screens that are much narrower in relation to their height. To accommodate such differences in aspect ratios, text content within web pages, such as news articles, is dynamically formatted to fit within the screen of the device from which a user accesses the content.

Yet, the overall width of the screen for typical mobile devices used in portrait mode is relatively narrow as well. As a result, the number of characters per line that can be displayed on the device screen in portrait mode is sometimes lower than that required for optimal readability. On the other hand, if the number of characters per line is kept constant and high enough for optimal readability on wider displays, as is the case with websites that do not permit dynamic text flow or with content in non-web file formats such as PDF, accessing such content from mobile devices with narrow screens requires horizontal scrolling. Reading text that requires scrolling in both dimensions is cumbersome and degrades the user experience (UX).

A common content format is screenshots of online text content or images containing text content such as photos of pages of a book. For example, when using their devices to communicate with others online for personal or professional purposes, users often send messages that include such images that include text. Some operating systems and applications include features to perform optical character recognition (OCR) to recognize text present within images.

In some cases, such images may include text content that does not fully display each line because it requires horizontal scrolling to view each line completely. In other cases, screenshots

taken on a computer may be viewed on mobile devices. When recipients try to use a mobile device in portrait mode to view wide screenshots that include text content, the text is often too small to be readable without zooming. If the viewer zooms in to enlarge the text to make it big enough to be readable, each line of the text no longer fits within the device screen, thus requiring horizontal scrolling. While viewing the mobile device screen in landscape mode can sometimes be sufficient to render the text at a readable size, it typically increases the amount of vertical scrolling required to read the content, thus degrading the user experience.

DESCRIPTION

This disclosure describes techniques for automatically reflowing text content within an image such that wide passages of text within the image can be displayed in an easily readable form that fits the narrow screens of mobile devices used in portrait mode.

With user permission, automatic detection of attempts to view an image, such as a screenshot is performed. It is determined whether the screenshot contains text content that is too wide to be easily readable without requiring zooming, horizontal scrolling, or changing the aspect ratio. Lines within the image that do not fit within the screen width are flagged. The content of each flagged line is automatically divided into two or more parts without breaking up any words. After the dividing, the text within each part is narrow enough to fit on a single line within the width of the device screen. Each line can be cut into two or more images, with each image representing a single word in the original text. The images are then arranged in succession in lines such that each line fits within the width of the device screen.

Each part of the original line of text divided in such a manner is shown as a vertical sequential stack of lines in a new image that preserves the order of the original text. This achieves results similar to reflow of text content within web pages for text content within images.

With appropriate user settings in place, the image with text content automatically rearranged as described herein is automatically displayed in place of the original screenshot or as an alternate view that the user can switch to as necessary. The user is provided with options to export the image composed of the automatically rearranged text.

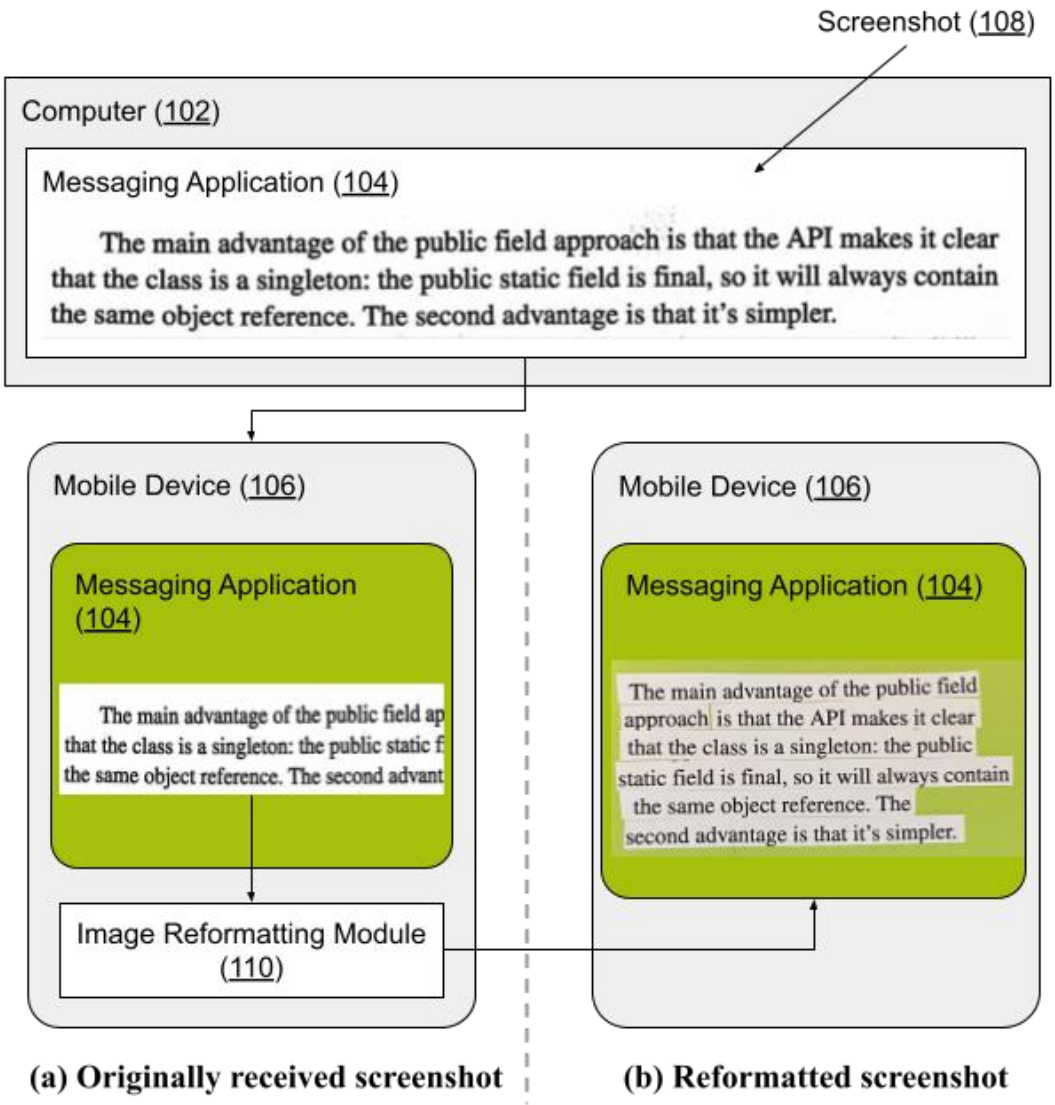

Fig. 1: Automatically reflowing text content within an image to fit screen width

Fig. 1 shows an example of operational implementation of the techniques described in this disclosure. A user of a messaging application (104) accessing the application via a computer

(102) sends a screenshot of text content (108) taken on the computer to another user. The other user is using a mobile device (106) to access messages. As seen in Fig. 1(a), the text within the screenshot that is received is too wide to fit within the screen width of the device in portrait mode. The screenshot is automatically rearranged via an image reformatting module (110) (e.g., provided as part of the messaging application or the device operating system) to reflow the text and generate a reformatted screenshot, shown in Fig. 1(b). As illustrated in Fig. 1(b), the entire text content within the original screenshot is visible within the screen width of the mobile device in portrait mode.

The operation described above is akin to manual paste-ups of newsprint stories that paste together small pieces of printed paper to prepare camera-ready stories to be distributed as images printed onto paper. When stitching the images of individual words within the text content together for reflow as described above, empty background areas can be filled with matching background color or text recognized with user permission. For instance, the green background in Fig. 1 illustrates the need to recolor the background to match the text background after generating the reformatted screenshot by pasting together images of individual parts of the original screenshot.

While it may be possible to reflow the text content within images based on optical character recognition (OCR), the reflowed text is usually rendered in a standard style that lacks the look and feel of the original text content. In contrast, the techniques described in this disclosure preserve the look and feel of the original text, thereby enabling readers to maintain the same affective engagement with the text as in the case of the original. Moreover, the operation is unaffected by OCR errors, as it involves recognizing overly wide lines, word boundaries, and

background colors, all of which are easier, faster, and less resource intensive than recognizing individual characters with text.

Implementation of the techniques with user permission eliminates the need for a user to engage in cumbersome operations such as zooming, panning, scrolling, or changing device orientation to view images with text content, thereby enhancing the user experience of engaging with such images.

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 images, device screen and its orientation, or a user's preferences), 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. 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 automatically reflow text content within an image such that wide passages of text within the image are displayed in an easily readable form that fits narrower screens of mobile devices used in portrait mode. Lines within the text content of the image that do not fit within the screen width are flagged and divided into two or more parts. Each part is narrow enough to fit on a single line on screen without breaking up any words. Each line is cut into multiple images at recognized word boundaries such that each image represents a

single word in the original text. The images are arranged in succession in lines such that each line is within the width of the device screen.

REFERENCES

1. Ho, Ronald, and Andrew A. Grieve. “Rendering or resizing of text and images for display on mobile/small screen devices.” U.S. Patent Application 12/907,661 filed April 19, 2012.
2. Potluck, Michael. “Hands-on: Here’s how iPhone’s Live Text OCR works in iOS 15.” https://9to5mac.com/2021/06/10/how-iphone-live-text-ocr-works-in-ios-15/ accessed December 20, 2021.
3. Friedman, Vitaly. “Responsive Web Design - What It Is And How To Use It.” https://www.smashingmagazine.com/2011/01/guidelines-for-responsive-web-design/ accessed December 21, 2021.