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Using A Camera to Capture Handwritten Notes in Digital Form in Real-Time

ABSTRACT

Converting a handwritten note to a digital format requires a user to obtain an image of the note via a camera or scanner and use suitable techniques to convert the content within the captured image to a user-manipulable digital form. Editing the handwritten note after capture requires a repeat of the process to update the digital version. This is cumbersome and time consuming. This disclosure describes techniques that use a digital camera to automatically capture handwritten notes. The camera is positioned such that the entire notetaking surface is within the field of view. As the user writes, the camera captures the handwritten notes as a succession of images or a video stream. On-device machine learning models or other suitable techniques are used to convert the captured note to well-structured digital text in real time. Content from newly captured notes is compared to previously stored notes and if a match is found, the previous note is automatically updated, e.g., to remove erased content, to add new content, etc. Implementation of the described techniques can provide users with a seamless and efficient user experience (UX) of automatically capturing their handwritten notes in a structured digital form.

KEYWORDS

- Notetaking
- Handwritten notes
- Digital notes
- Structured notes
- Handwriting recognition

BACKGROUND

Users often jot down handwritten notes that they wish to save in a digital form. Currently, converting such notes to a digital format requires performing a scan via a scanner or capturing images of the notes via the camera of a device such as a smartphone. To obtain the content within the photos in a user-manipulable digital form, the images thus obtained need to be processed via suitable techniques such as handwriting recognition, optical character recognition (OCR), document format and structure recognition and generation, etc. Such processing can be performed on the device on which the user captures and/or stores the images of the notes.

In such a setup, a user must first finish writing a note on paper before saving the note in a digital form. Any edits to the handwritten note after the capture require the user to repeat the process to update the digital version. As a result, the current approach for capturing handwritten notes and converting them to a suitable digital format is cumbersome and time consuming.

DESCRIPTION

This disclosure describes techniques to automatically convert handwritten notes to a digital format in real time by using the camera of a user device. When writing notes, a user can position a smartphone, tablet, or other device having a camera such that the entire note-taking surface is within the field of view of the camera. The camera can capture the handwritten note as the user writes and convert the captured image to well-structured digital text (and/or other formats) in real time.

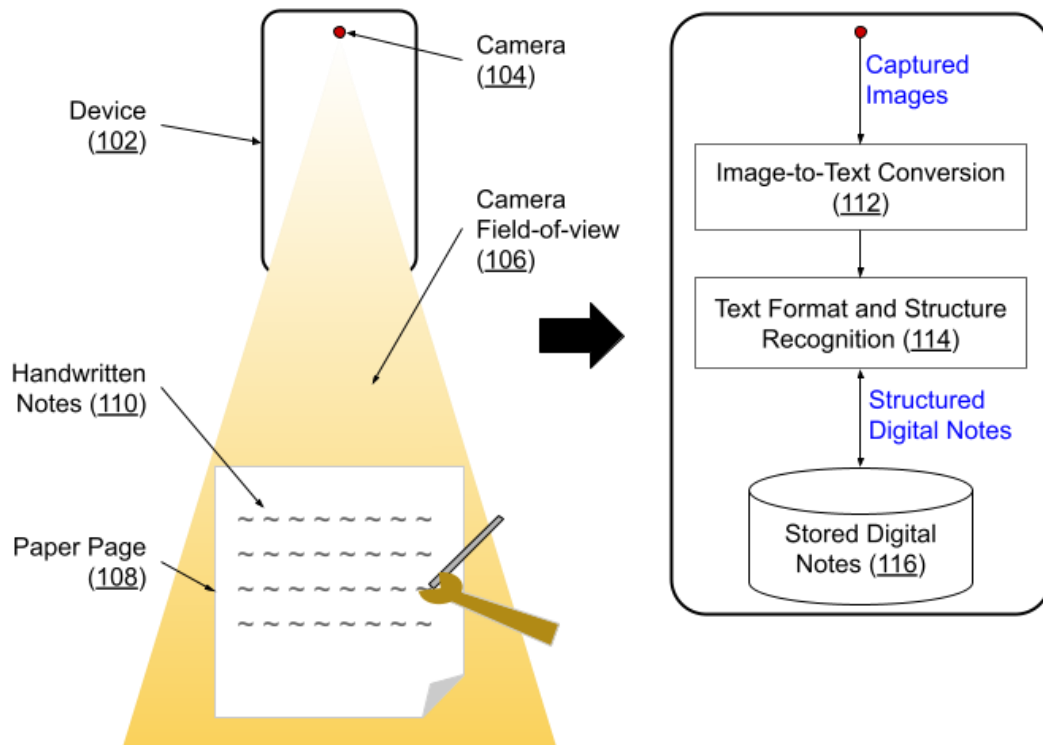


Fig. 1: Real-time capture of handwritten notes in digital format via the device camera

Fig. 1 shows an example of operational implementation of the techniques described in this disclosure. A user positions a device (102) such that the field-of-view (106) of the device camera (104) covers the entire surface on which the user is writing notes (110), e.g., the surface of a paper page (108). The captured images of the handwritten notes are processed by converting the text (112) to a digital text form. Subsequently, the structure and format of the content within the text can be recognized (114). The generated structured digital notes are saved on the device (116).

If the user makes any changes to previously captured and saved handwritten notes, the corresponding saved digital notes are updated accordingly. For instance, a user may cross or black out earlier writing. In such cases, the corresponding parts of the saved digital notes are deleted. Such updates to existing digital notes can be performed by checking whether the

currently captured structured text exists within the repository for saved notes. Appropriate version control mechanisms can be employed when updating saved digital notes such that each version of the saved notes can be made available as needed.

The operation described above can incorporate any suitable state-of-the art trained on-device machine learning models for converting handwritten notes to the structured digital format. Apart from recognizing the text content and structure within the handwritten notes, the models can detect various common forms of structured content, such as tables, emojis, sketches or other images, etc.

The techniques described in this disclosure can use the camera of any device, such as a smartphone, tablet, laptop, etc. The camera can capture multiple images of a handwritten note as the user is jotting down notes or can capture a video stream during the time the user is writing. The techniques can be employed to capture notes taken on any physical surface such as notepads, whiteboards, tabletops, e-ink displays or other digital devices, etc., as long as the capturing device can be positioned to capture the physical surface within the field-of-view of the device camera. After converting and storing the notes in a structured digital format as described herein, the users can choose to destroy the physical notes, for instance, by shredding the paper, erasing the whiteboard, etc., without needing to memorize the content being destroyed. Implementation of the described techniques thus provides users with a seamless and efficient user experience (UX) for capturing handwritten notes in a structured digital form.

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 written notes, profession, 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

This disclosure describes techniques that use a digital camera to automatically capture handwritten notes. The camera is positioned such that the entire notetaking surface is within the field of view. As the user writes, the camera captures the handwritten notes as a succession of images or a video stream. On-device machine learning models or other suitable techniques are used to convert the captured note to well-structured digital text in real time. Content from newly captured notes is compared to previously stored notes and if a match is found, the previous note is automatically updated, e.g., to remove erased content, to add new content, etc. Implementation of the described techniques can provide users with a seamless and efficient user experience (UX) of automatically capturing their handwritten notes in a structured digital form.

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