Project: Real-Time Generation of Lecture Notes from Black/Whiteboard Video

Nicholas Su (njsu@stanford.edu) and Jamie Ray (jamieray@stanford.edu)

Overview:

The role of technology in education is increasing as online courses, 'paperless' handouts (distributed on CourseWork, for example), and PowerPoint presentations grow in popularity. These are all essentially predetermined teaching materials, and as such leave little flexibility to improvise – responding to questions in class, for example. As such, they often need to be supplemented by more traditional media like blackboards and/or whiteboards. This is especially true for students or topics to which 'visual learning' is relevant, and the motions that a lecturer makes (their cadence in writing and timing of text and diagrams) can be more valuable than static diagrams and text. To address this issue, expensive new 'digital whiteboards' are now available, or lecturers can annotate notes using tablets. Perhaps a more practical alternative would be to process video of teachers writing on the board as it occurs, replacing the hardware previously mentioned with a 'software solution.' We discuss this option below.

Plan:

There are several steps we need to carry out to capture the desired information from whiteboards, some of which are as follows:

1. Detect the board (and boundaries)
2. Attempt to correct for viewing angle (rectify to 'straight-on' view)
3. Find the lecturer and ignore their movements
4. Optionally pre-process (only the board?) for higher contrast between writing and board
5. Detect when new writing has been added
6. Extract and save that writing as a set of binarized frames, with its timing information included

The references below include some algorithmic jumping-off points to achieve these goals, but we hope that after learning more in the class we will have a more concrete handle on their implementation, and welcome any suggestions. There are also a few options we have been considering and believe that the final product could vary somewhat based on our choices. These include:

1. Should we maintain color information (what if the writing is in different colors)?
2. Assume that the instructor is aware of this? In other words, is the tool for the instructor's benefit (and the whole class) or just an individual student recording it?
3. If the instructor is aware, can implement certain tags or keywords, for example specifying that a certain section of writing should preserve color information.
4. How important is storage space? We might be able to compress the information on the board significantly by extracting only binary images of the writing, with the saved frame appropriately sized to the amount of writing, not having to store the whole board. In this scenario, one could write four lines of text at different spots on the board, and the program would save only the local writing so that in the processed output one would have the lines and not the extra whitespace.
5. Could include an option to train for handwriting recognition to the author in the video – would require text input to match what was written

References:

Proceedings of International Conference on Document Analysis and Recognition ('03)

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Whiteboard Scanning and Image Enhancement
Zhengyou Zhang and Li-wei He
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Stacy Branham, Gene Golovchinsky, Scott Carter, and Jacob Biehl
http://www.fxpal.com/publications/FXPAL-PR-10-547.pdf

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Erik Bruun
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Note: we plan to use a Droid phone after testing our algorithms in Matlab.