

Image Registration

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1. Blue Scantrons

The blue scantron was fairly straightforward. I used SIFT features (Figure 1) with a strong confidence level filter (.5) in order to give good features. Since there are so many duplicates on a scantron, using RANSAC and a strong confidence level led to finding features in the title box and around the edges.

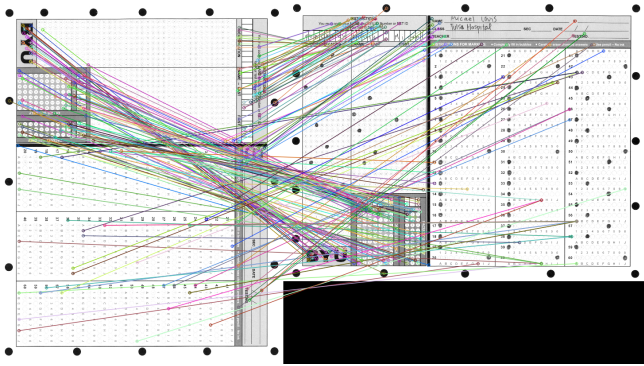


Figure 1. SIFT feature matches between reference and target

Using these matched features, I calculated a homography in order to orient the target image into the reference image's frame. Then an absolute difference showed which bubbles were filled clearly.

I manually selected specific areas of the scantron and divided it up into 3 answer fields, with small rectangles around each possible answer as shown in Figure 2.

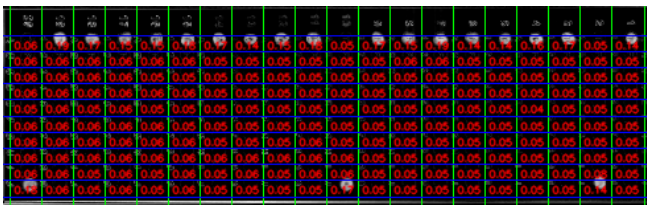


Figure 2. Grid lines in green and blue, with pixel sums in red text

For each answer field, I calculate a matrix of pixel sums (shown in red in Figure 2). The most probable bubble corresponds to the grid entry with the highest pixel value for each column. Then the grid location is mapped to a letter answer with a lookup table.

2. Red Scantrons

I used the same feature matching and homography calculation with SIFT as in with the blue scantrons. I also used a very similar grid method for the red scantrons as well, shown in Figure 3.

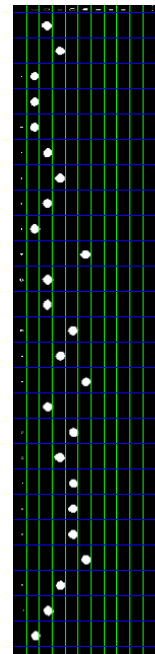


Figure 3. Grid for bubbles on red scantron

The biggest difference was the difficulty of dealing with the red dots that are present all over the red scantrons. In order to eliminate this, I used an adaptive gaussian threshold and a gaussian blur to clean up the image before taking the absolute difference (see Figure 4). This resulted in a much cleaner image that eliminates false positives because of background noise.

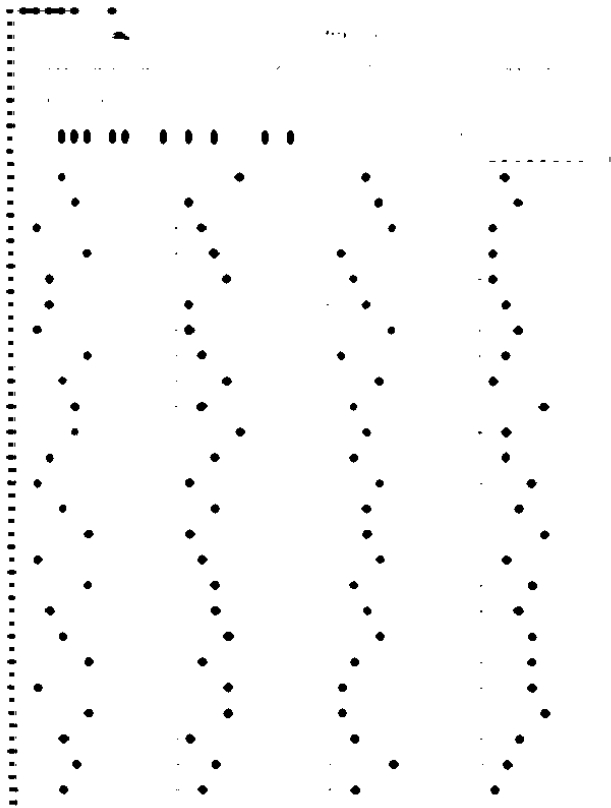


Figure 4. Results of the adaptive threshold with a gaussian filter