

*Abstract*—abstract...

# Automated Conversion of Sketches into Source Game Engine Maps

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## I. INTRODUCTION

## II. PROPOSED METHOD

### A. Segmentation

We aim to find the segments divided by pencil lines.

The sketch is grayed, inverted, and blurred. An adaptive threshold highlights both sides of each pencil mark as black, with the background in white. This is inverted so pencil edges are white against a black background. A closing operation with 2 dilations and 1 erosion of a 5x5 kernel joins the two sides of each pencil mark, giving thick white pencil against a black background. These white edges may contain black pixels within them. This is acceptable as long as the edge has no black path between segments.

Now that black segments are divided by solid white boundaries, flood fill is used to identify internal segments and the external background. Each pixel in the image which is still black is used as a seed point for flood fill with intensity value 128. A segment is accepted as internal if it is large enough (more than a few pixels) and does not touch the image border. These segments are given intensity value 192 to indicate they are discovered. Rejected segments are given intensity value 255, so that they are treated as equivalent to pencil. The resulting image has background and pencil in white, and internal segments in gray.

### B. Text Recognition

Short handwritten text is used to label segments based on what they will be in a map (floors, walls etc.). We aim to locate text precisely enough for labelling, and recognise the handwritten letters.

The common method of detecting text with EAST and recognising text with Tesseract was tried. It was found to work best with longer words and a background without other pencil. Our application requires short labels (up to 2 letters at most) and text near other pencil, so this approach was unsuitable.

Instead convolution methods were tried. Inverted samples of handwritten letters were turned into kernels of various scales and convolved over the inverted image, with the idea being that highlights in the output showed presence of the letter. This detected well, but structural features in the sketches were also detected as text. Convolution by its definition rewards white overlap but does not reward black overlap, and does not explicitly punish opposites. For example a solid block of pencil would be detected as any sampled letter. A more specific sort of convolution is needed.

Template matching gives us the specificity needed by rewarding pixel similarity and punishing dissimilarity. Squared

difference template matching was used with the sampled letters at various scales over the image, to produce a mostly whitish image with black spots where letters are found. This is inverted and thresholded so that only confident highlights are retained. These highlights from all scales are merged into one image (as a weighted average where every scale has the same weight). It was found that each true highlight tends to appear on multiple scales, so thresholding this merged image retains these and discards some random highlights. Suzuki et al. [1] contour finding algorithm is used to find the location of remaining highlights. As a further step of narrowing down true highlights, on the sketch we use double letters as labels (e.g. "XX"). So we look for pairs of highlights within a certain distance and angle range. The midpoint of each pair and the letter is recorded. This gives us the text label letters and locations.

## REFERENCES

- [1] S. Suzuki *et al.*, "Topological structural analysis of digitized binary images by border following," *Computer vision, graphics, and image processing*, vol. 30, no. 1, pp. 32–46, 1985.