Image-Based Competitive Printed Circuit Board Analysis
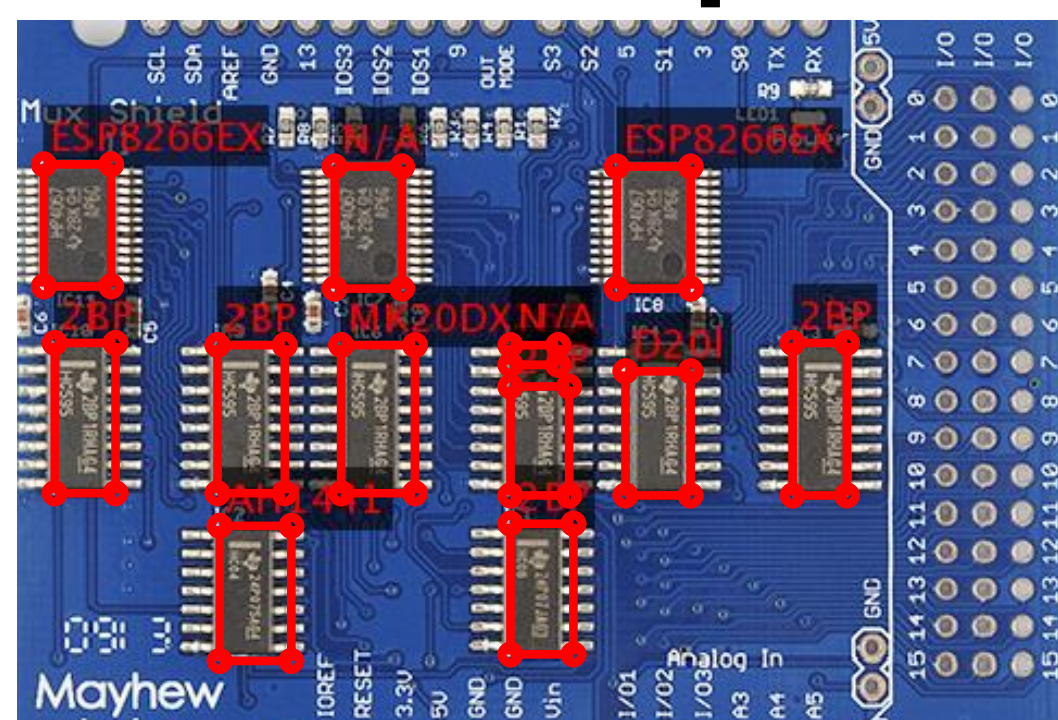
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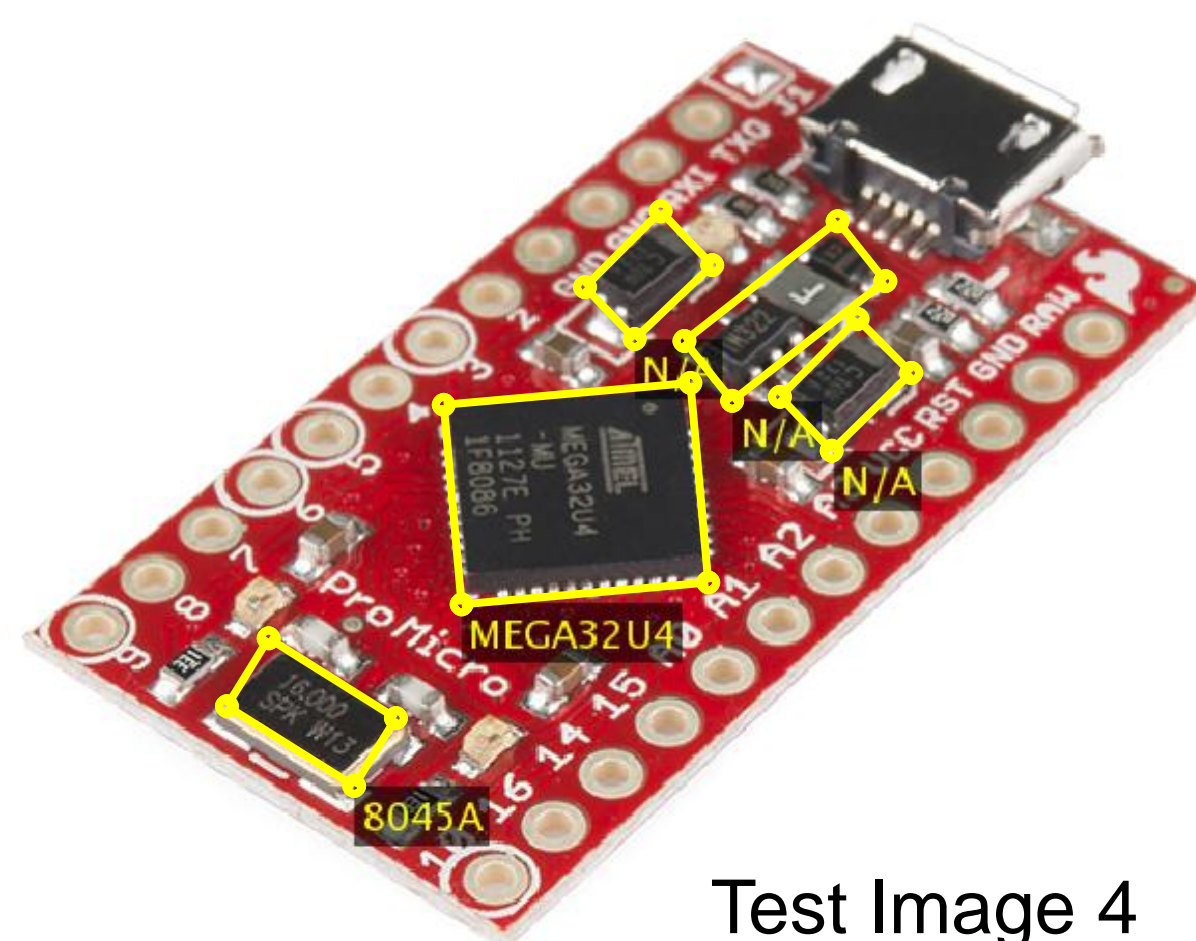
Motivation

Competitive analysis is a crucial task in the hardware electronics industry that drives both product pricing and functionality. Specifically, a list of the components on a printed circuit board (PCB), or a Bill of Materials (BoM), can be used to directly obtain a reliable cost estimate of a product. Compiling a BoM by means of manual analysis can be tedious, time consuming, and prone to human error. Instead, modern image processing techniques can be used to expediently produce a BoM.
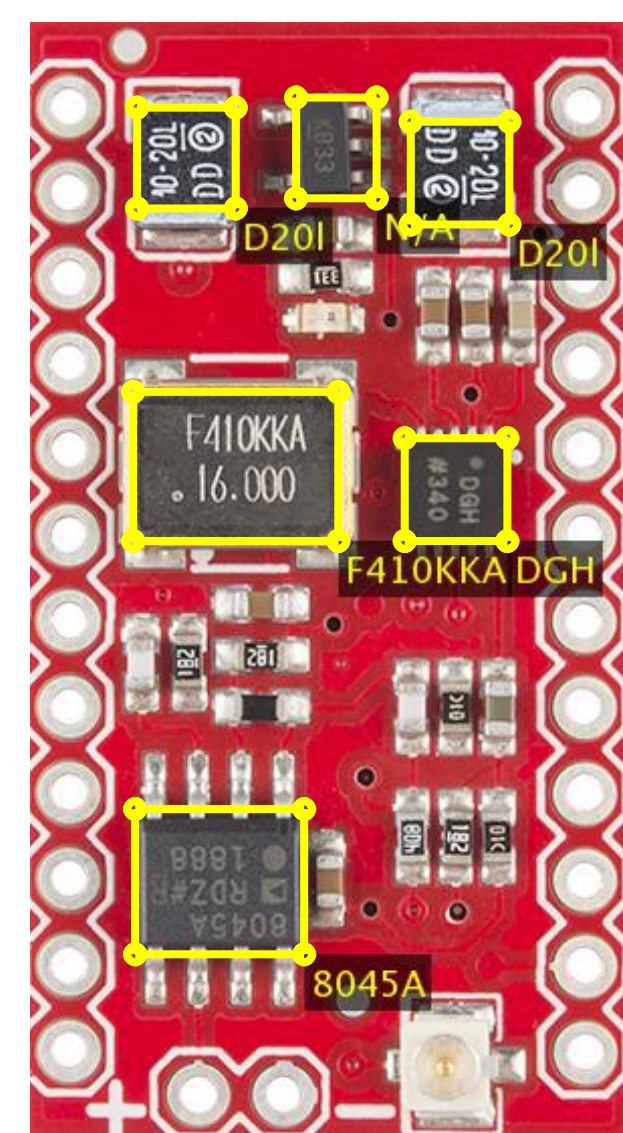
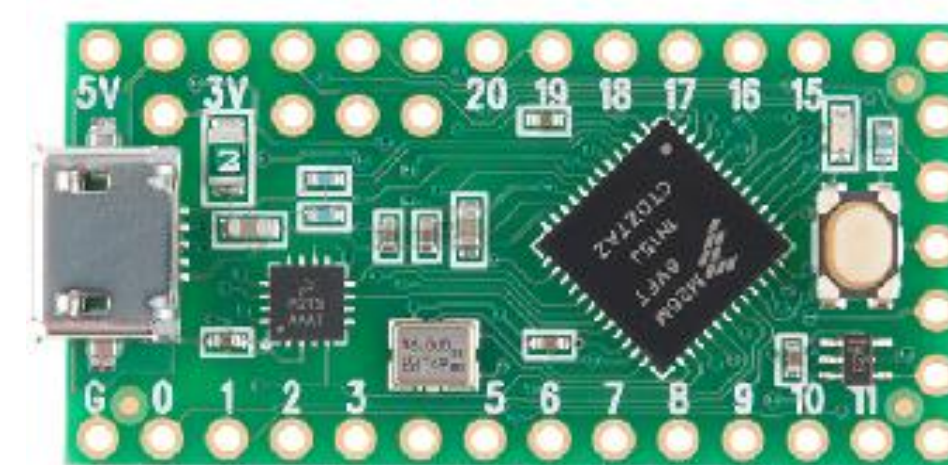## Experimental Results

Test Image 2

Test Image 4

Test Image 3

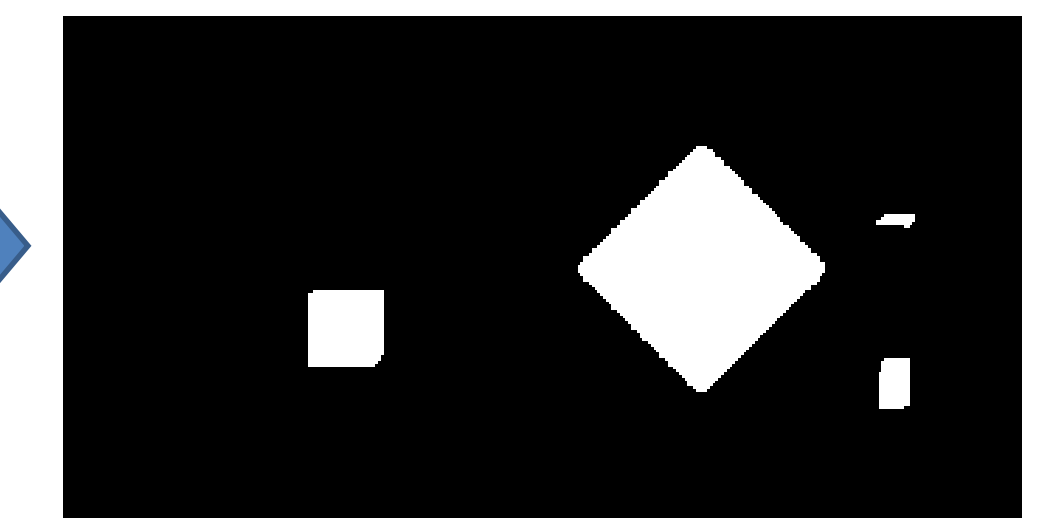| Image Number	Segmentation Rate	Identification Rate
1	0.75	0.67
2	0.92	0.27
3	1.0	0.83
4	0.8	0.25
Total	0.89	0.46

IC Recognition Algorithm

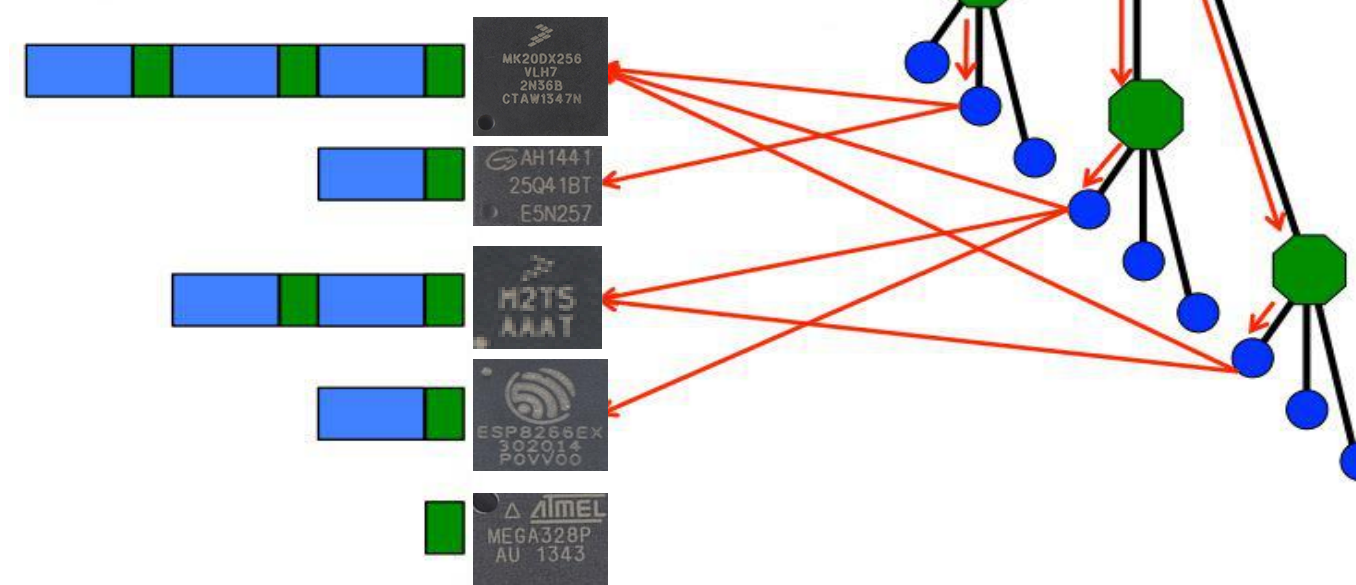Original Image

MAP Detector Output

Dilate+Close & Small Region Removal

Compute SIFT Descriptors and Index into Vocabulary Tree

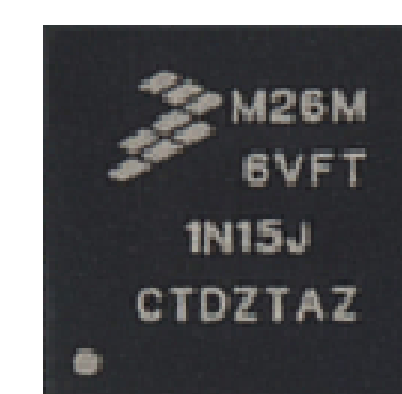Extract Database Query from Optimal Rectangle

Solve rectangle detection optimization problem:

$$s = \{ [x\; y] \mid (x, y) \in R_i \}, V_i = [s_1^T\; s_2^T\; ...\; s_n^T], A_{\theta_i} = \begin{bmatrix} \cos\theta_i & -\sin\theta_i \\ \sin\theta_i & \cos\theta_i \end{bmatrix}$$

$$\underset{\theta_i}{\operatorname{argmin}} \left(\left[\max_x(A_{\theta_i} V_i) - \min_x(A_{\theta_i} V_i) \right] * \left[\max_y(A_{\theta_i} V_i) - \min_y(A_{\theta_i} V_i) \right] \right)$$

Best Database Match (L1 Distance)

Test Image 1