



CHINESE CHESS BOARD RECOGNIZATION

Outline

- * Introduction
- * Methodology
- * Result

Introduction

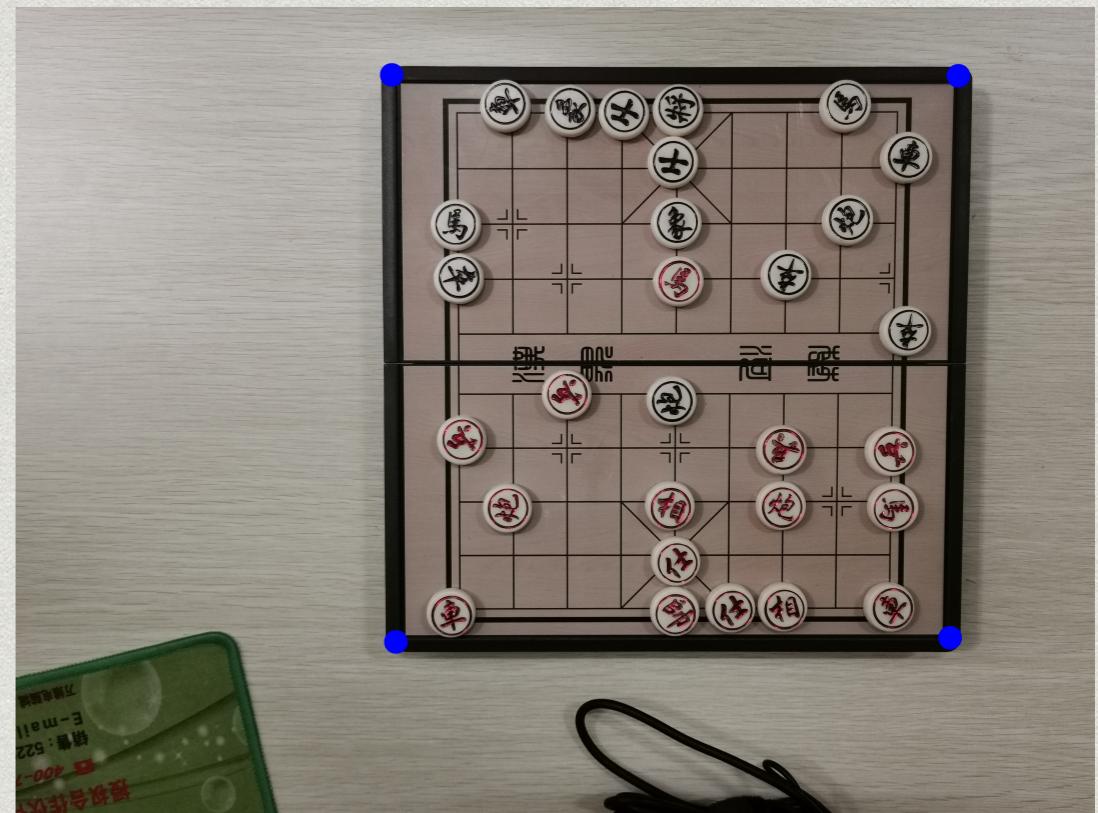
- * Goal: develop an algorithm that can automatically recognize the state of the chess game from a photo.
- * A major component of a human-robot interface for chess-playing robots.

Methodology

- * Chessboard Segmentation
- * Chess Piece Detection
- * Chess Piece Recognition

Dataset Description

- * The first group of photos of chess board are manually taken by cell phone according to the following rules:
 - (a) The camera is vertical to the chess board.
 - (b) The position of the camera is approximately fixed.
 - (c) The direction of the chessboard is fixed.



Dataset Description

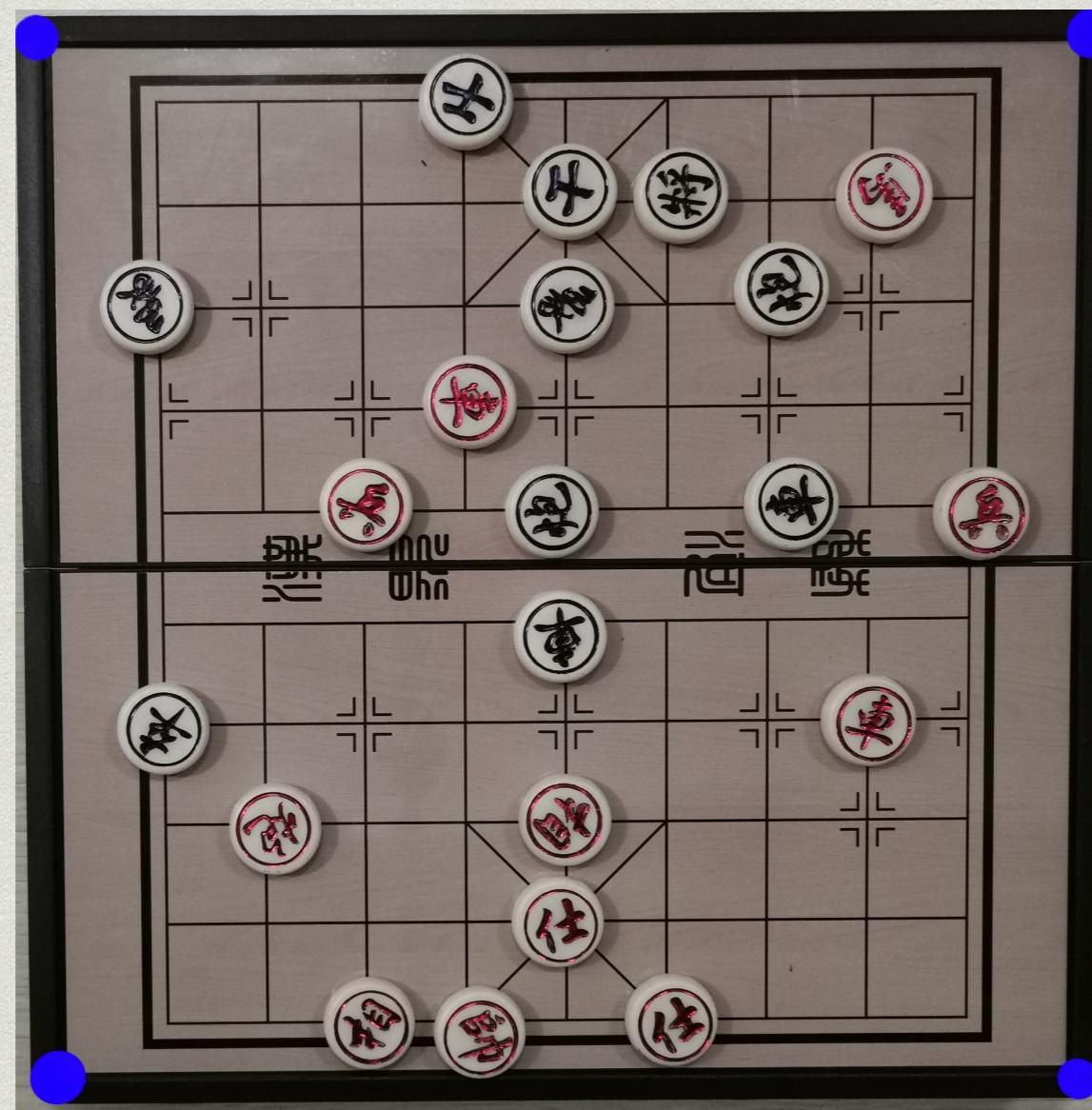
- * The second group of photos of chess board are taken randomly.



Chessboard Segmentation

- * Mark blue on the four corners of the board
- * After detecting four blue dots, rectify the board

Chessboard Segmentation



Chess Piece Detection

- * Sample a small window of image around each intersection
- * Perform circular Hough transformation to detect circles

Chess Piece Recognition

- * SIFT feature (Scale-invariant feature transform)
- * KNN for classification of each of the chess piece

Related work

- * Counting the number of rounds.
- * The annual ring method is based on the characteristics of the number of rounds, and construct an encoder to recognize text.
- * The advantage of this method is that it is invariant to the direction of the text, but the the accuracy depends on the font



表 2 象棋棋子文字的特征值及编码器

| 文字 | 将 | 象 | 士 | 车 | 马 | 炮 | 卒 | 帅 | 相 | 仕 | 車 | 馬 | 砲 | 兵 |
|--------|-----|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| $1/4R$ | 5 | 6 | 2 | 3 | 4 | 4 | 5 | 3 | 5 | 3 | 6 | 8 | 5 | 4 |
| $1/2R$ | 8 | 10 | 5 | 6 | 4 | 8 | 6 | 5 | 7 | 5 | 9 | 6 | 7 | 7 |
| $3/4R$ | 2 | 1 | 1 | 1 | 0 | 2 | 0 | 2 | 2 | 0 | 2 | 0 | 1 | 0 |
| 识别码 | 582 | 6101 | 251 | 361 | 440 | 482 | 560 | 352 | 572 | 350 | 692 | 860 | 571 | 470 |

Related work

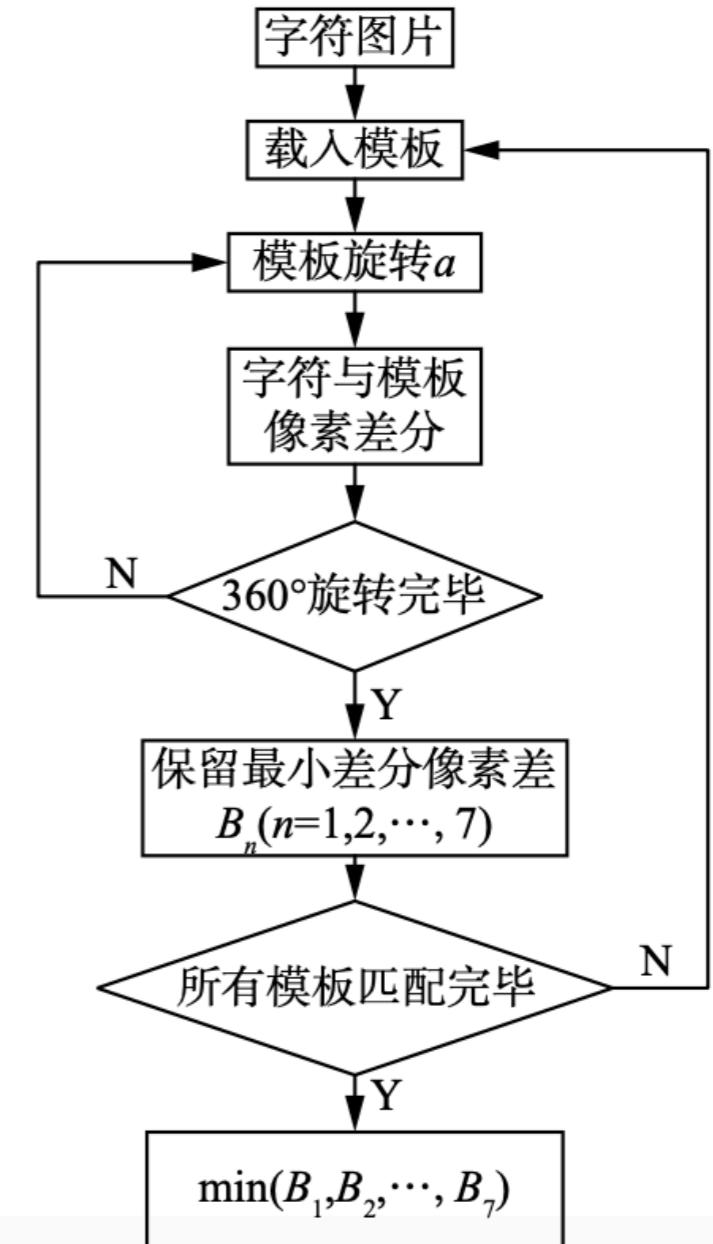
- * Counting the connected number and the number of holes
- * Connected number means how many connected part a word contains, eg, connected number of “帅” is 3
- * Number of holes is the number of closed area in the background, eg, number of holes in “相” is 3
- * The advantage of this method is that it is invariant to the direction of the text and robust to noise, but the accuracy depends on the font

表 1 棋子文字的连通数和孔数统计值及编码器

| 棋子文字 | 将 | 象 | 士 | 车 | 马 | 炮 | 卒 | 帅 | 相 | 仕 | 車 | 馬 | 砲 | 兵 |
|------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| 连通数 | 6 | 1 | 1 | 1 | 2 | 5 | 1 | 3 | 2 | 2 | 1 | 5 | 3 | 3 |
| 孔数 | 1 | 3 | 0 | 1 | 1 | 1 | 3 | 0 | 3 | 0 | 4 | 3 | 2 | 1 |
| 编码器 | 61 | 13 | 10 | 11 | 21 | 51 | 13 | 30 | 23 | 20 | 14 | 53 | 32 | 31 |

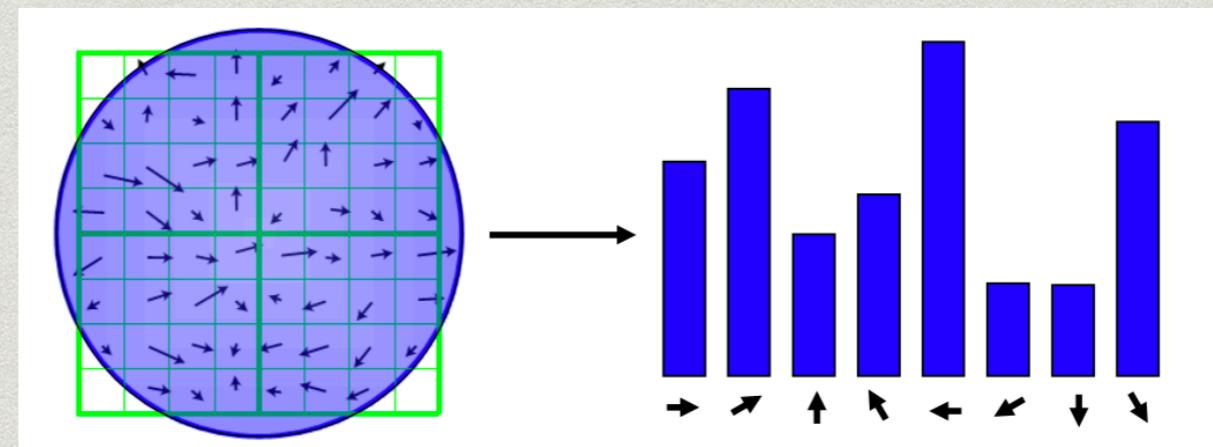
Related work

- * Difference of rotation
- * Advantages: no requirements for template orientation; independent with the fonts.
- * Disadvantage: accuracy depends on angle of rotation, time consuming



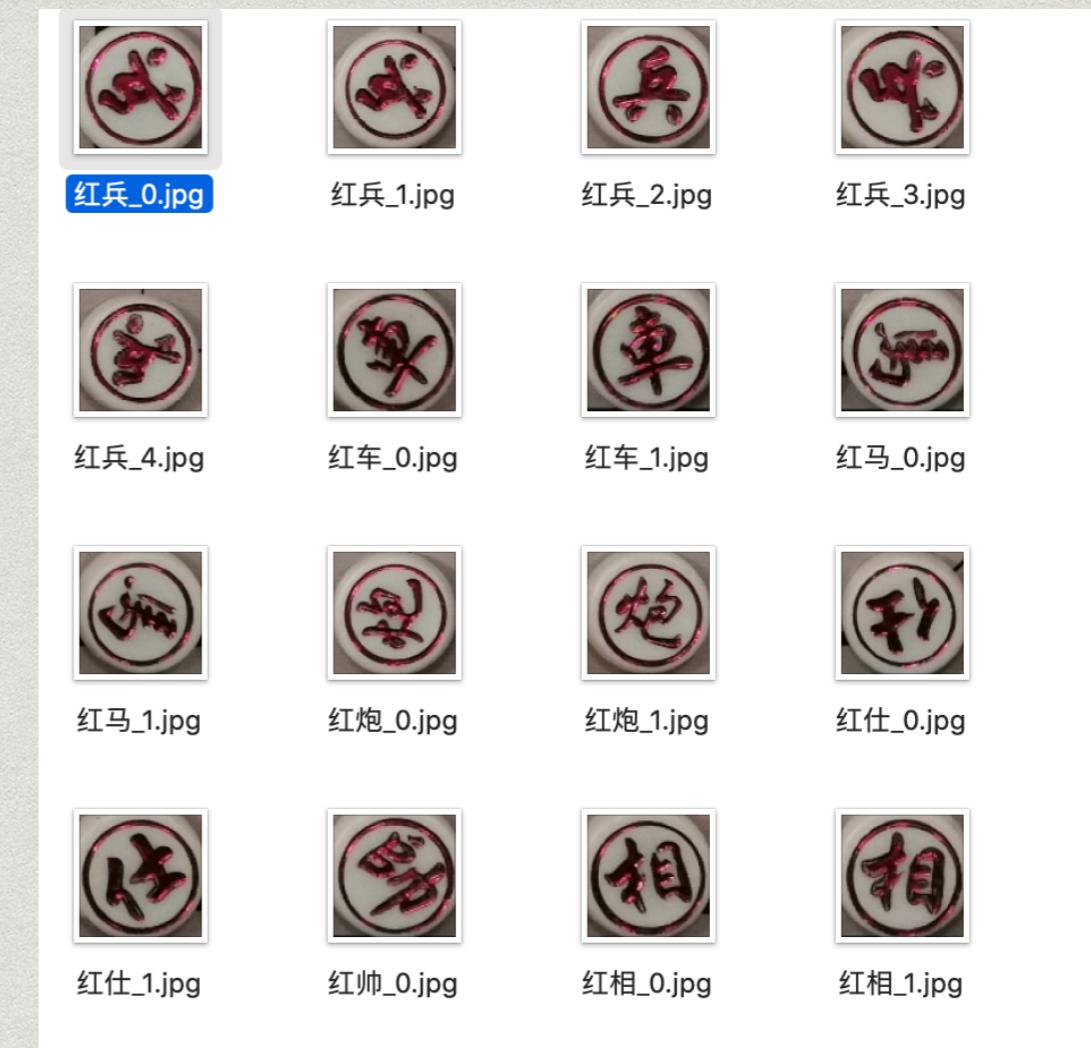
SIFT (Scale invariant Feature transform)

- * Empirically found to show very good performance, invariant to image rotation, scale, intensity change
- * SIFT is based on orientation histogram (weighted by magnitude)



- * Select canonical orientation
- * Rotate all orientations by the dominant orientation

Chess Piece Samples



Output



Result

| | Images | No. of chess | Right | Wrong | Accuracy |
|----------------|--------|--------------|-------|-------|----------|
| Fixed camera | 42 | 1018 | 1017 | 1 | 99.9% |
| Taken randomly | 42 | 827 | 794 | 33 | 96.0% |

Thank you !

References

1. Chess board image Retrieved December 23, 2019 from

[http://image.baidu.com/search/index?](http://image.baidu.com/search/index?tn=baiduimage&ps=1&ct=201326592&lm=-1&cl=2&nc=1&ie=utf-8&word=%E4%B8%8B%E8%99%A5%E6%A0%A1)

[tn=baiduimage&ps=1&ct=201326592&lm=-1&cl=2&nc=1&ie=utf-8&word=%E4%B8%8B%E8%99%A5%E6%A0%A1](#)

2. Du Junli, Zhang Jinfei & Huang Xinhua, 基于视觉的象棋棋盘识别.

Retrieved December 23, 2019 from <https://www.google.com.sg/url?sa=t&rct=j&q=&esrc=s&source=web&cd=2&ved=2ahUKEwjx7-rL69LmAhUQXSsKHadIB8QQFjABegQIBBAC&url=http%3A%2F%2Fceaj.org%2FCN%2Farticle%2FdownloadArticleFile.do%3FattachType%3DF%26id%3D23266&usg=AOvVaw0UKU1Wzw4bbwskH1QbdTjy>