

# Final Projects For 2018

## 1 Projects

### 1.1 Chinese Chess State Recognition

- Project Goal: The goal of the proposed project is to correctly recognize the state of a Chinese chess game by processing the images captured by the camera of an Android mobile phone. With the essential information extracted from the images, we will be able to save and share the record of a game very efficiently, see in the Figure 1.
- Work Flow: To reach the goal, we need to detect the chess board, identify the location of each chess piece and recognize the type of the piece.
  - Chess Board Detection To extract an accurate representation of the chess board, the following operations will most likely be applied, edge and corner detection, rectifying the image to a top-down view and line detection.
  - Chess Piece Location Identification Considering the similar disk shape of all the pieces, we can apply morphological operations to identify each chess piece. We can then map the center of the each piece to the closest line intersection on the chess board since all chess pieces are supposed to lie on the intersections.
  - Chess Type Recognition Several studies had been done regarding Chinese chess type recognition. Since the only difference between different chess types is the character printed on the center of the piece. The problem is very similar to a Chinese character recognition problem. Yang and Wang [2001] reported a 3D vector feature extraction method and compared it with the ring projection method. Chen et al. [Chen2011] extracted features by equally dividing the chess piece into 360 circular sectors and computing the mean distances from the contours of the character to the center of the piece in each sector. They also defined the sector with the max distance to be the first sector to achieve rotation invariance. Hu et al. [Hu2009] achieved rotation invariance by transferring the

signals into frequency domain and extract only the amplitudes. We will experiment with the methods mentioned above and the ones introduced in class to find a method sufficient to the systems needs.

- References

- [Yang2001] Tai-Ning Yang and Sheng-De Wang. A rotation invariant printed chinese character recognition system. *Pattern Recogn. Lett.*, 22(2):85C95, February 2001. ISSN 0167-8655. doi: 10.1016/S0167-8655(00)00089-1. URL [http://dx.doi.org/10.1016/S0167-8655\(00\)00089-1](http://dx.doi.org/10.1016/S0167-8655(00)00089-1).
- [Chen2011] Wen-Yuan Chen, Sheng-Yuan Heish, Chiu-Yu Yen, and Dang-Yi Kuo. The chinese-chess image identification techniques on spatial domain. In Intelligent Control and Automation (WCICA), 2011 9th World Congress on, pages 970C974, June 2011. doi: 10.1109/WCICA.2011.5970660.
- [Hu2009] Peng Hu, Yangyu Luo, and Chengrong Li. Chinese chess recognition based on projection histogram of polar coordinates image and fft. In Pattern Recognition, 2009. CCPR 2009. Chinese Conference on, pages 1-5, Nov 2009. doi: 10.1109/CCPR.2009.5344001.

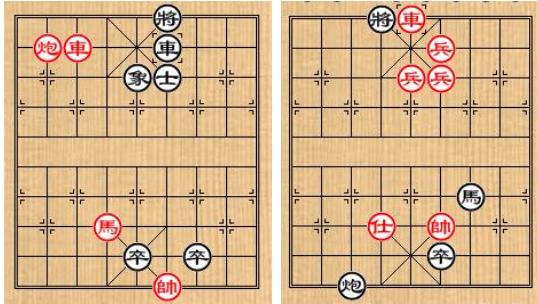


Figure 1: Chinese chess.

## 1.2 Vision Guided Whac-A-Mole Game

- Using a  $x - y - z$  table and a camera to set up a vision system.
- Using a pad to download a Whac-A-Mole game.

- Using the camera to capture images of the game and design a algorithm to locate the mole.
- According to the coordinates of the mole, to control the  $x - y - z$  table to touch the mole and get a score.
- Your system should be as fast as possible to catch the mole before it disappears.



Figure 2: Vision Guided Whac-A-Mole Game, the left is a  $xyz$  table with a camera and a pad, and the right is screenshot of a whac-a-mole game.

### 1.3 Vision Based Method for Space Rendezvous and Docking

- Rendezvous and docking of a space ship is a very important step, seeing top row in Fig.3.
- We can use a binocular vision system to simulate the docking process.
- First, the stereo camera should be calibrated.
- Then, the centers' coordinates of the circle patterns are computed, and according to the relation of the point  $O(x, y, z)$  and the circle patterns to compute the current position and orientation of the point  $O(x, y, z, R)$  in camera coordinate.
- Last, moving the spaceship and recomputing the position and orientation.

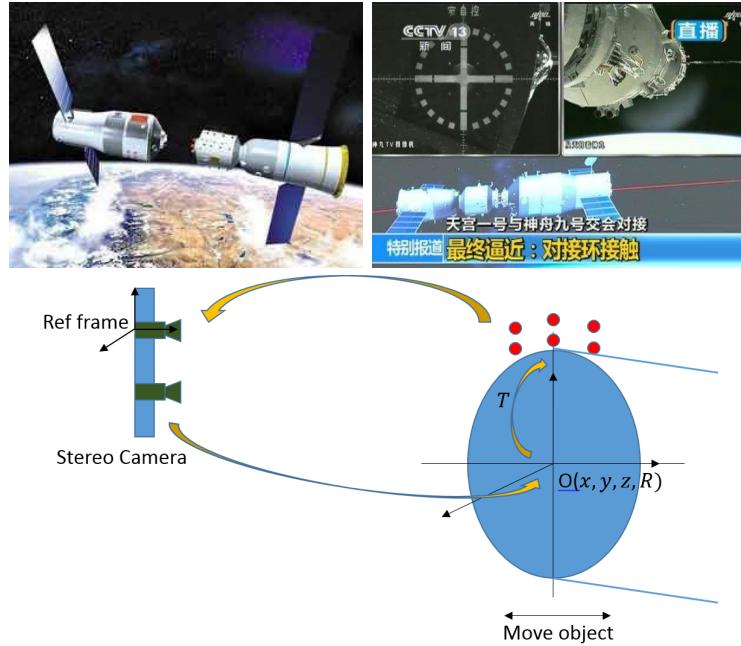


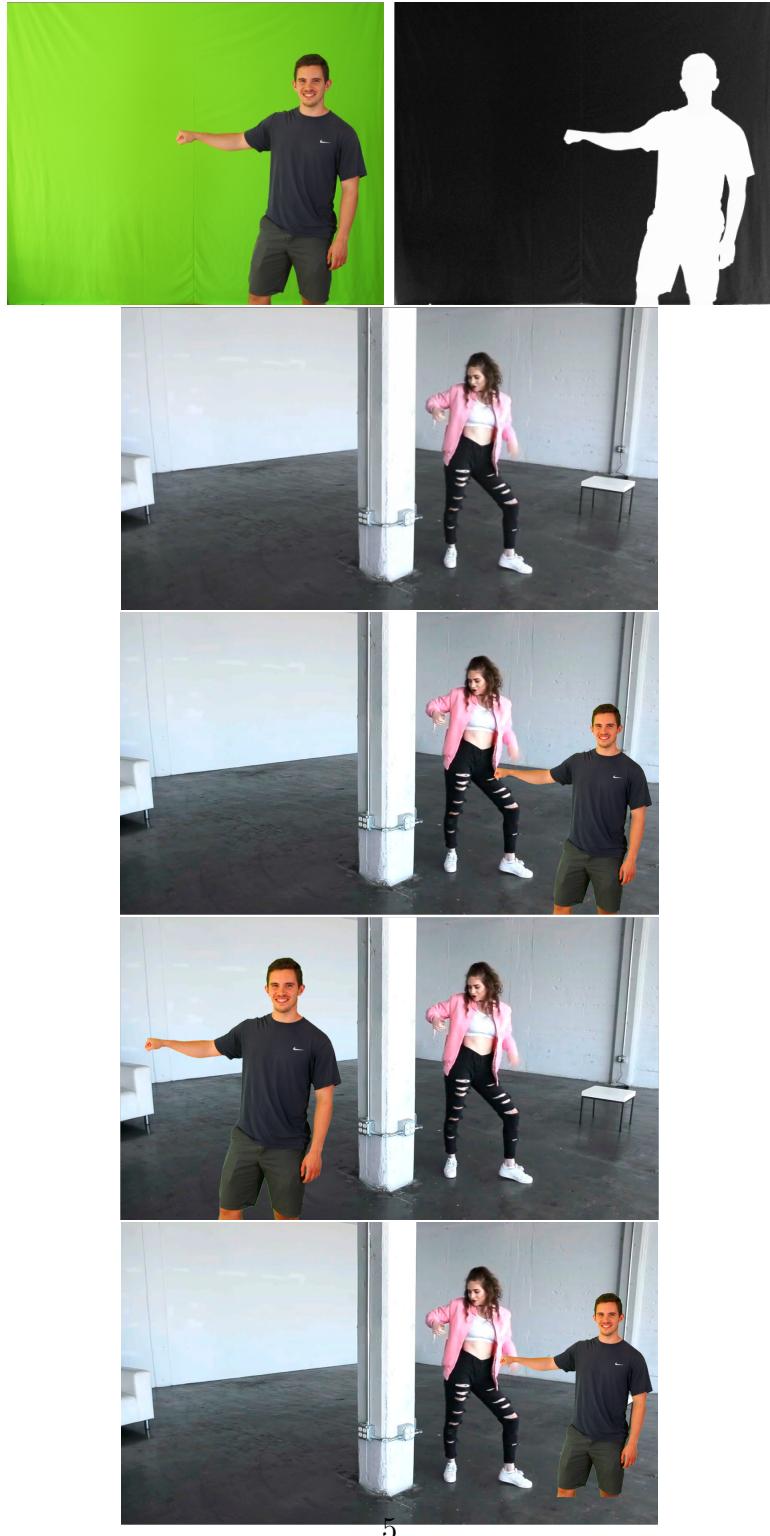
Figure 3: Rendezvous and docking of a space craft.

#### 1.4 Image segmentation and video composition

- Record a video of moving person in front of a green screen.
- Using image matting method to extract the foreground object.
- Take another video and insert the extracted object into the new video frame by frame.
- User can set the insertion position and scale of the extracted object.
- Save the video to computer.

## 2 Grading strategy

- There are three levels you can achieve for each project.
- Level I: survey most of the related references, understand the state-of-art of this area and give a comprehensive representation. (C grade just finish this stage).



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Figure 4: Image segmentation and video composition.

- Level II: your group can find a good source code to realize one of the peer-recognized method and show a few demos. (B grade when finishing Phase I and Phase II)
- Level III: your group can write your own source code to implement one of the algorithms ( $A^-$  grade), when your group has your own idea and design a new algorithm to get a good result, your group can get grade  $A^+$ .

### 3 Requests

- One group should elect a leader to organize and put the project in practice.
- The group members should be collaborative and take different roles.
- The presentation (prefer in English) and demo show is not less than 12 minutes for each group, the reporter will be selected randomly.
- The scope is not limited here, your group also can select other interesting topics. But you should offer a little proposal to TA before you set about it.
- Turn in the executable file and the source code, ppt slides and technique report.
- The technique report should include the survey of the method, description of the method, show the results and some discussions. It should be refined with much effort.