Spring 2019 CS543/ECE549 Projects

1. Group Members
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2. Project description and goals

   The aim of the proposed work is to inspect the geometry in computer vision based on what we have learned from this course. In fact, we desire to reconstruct the 3D model from some famous sports courts, Rod Laver Arena, for example, based on a single-view image acquired from the Internet.

   This project will be separated into several parts:
   - Firstly, we will base on test images [1], which contains a myriad of lines, thus enabling us to find vanishing points easily, to verify our developed algorithms
   - To verify the reconstruct sizes are correct or not, we will confirm our reconstructed views with the true dimensions of the sport courts [2]
   - Apply the algorithms into Rod Laver Arena [3] in order to reconstruct the 3D views of the court, especially in fine details, including nets and posts in the center of the court
   - Evaluate to construct difficult parts of the courts, like bleachers and roofs

   If the time is permitted, we will extend our project in the following directions:
   - Use our developed algorithm to label a considerable number of images to obtain vanishing points, and then train a neural network model to fit these data to investigate how deep learning can be applied into this field
   - Add textures of the surface of our 3D reconstructed model
   - Evaluate our method with much more sports courts, like baseball fields and table tennis

   We expect to construct a 3D model such that we can use the computer mouse to move around in different view angles. Moreover, if the time is permitted, we aspire to develop a trained model compared with our original algorithm and add extra decorations on the surfaces of the courts.

3. Member roles

   We divide the project into two checkpoints. The first checkpoint is to find the vanishing point of the single-view image. By using blob detections, Hough transform and RANSAC, we should be able to find several plausible vanishing points. By utilizing either a algorithm or doing manually, the final consequences of vanishing points are extracted.

   Moreover, the second checkpoint is to build the 3D model. The Single View Metrology [4] states how to construct the 3D views from a single image. We will base on this paper and try to construct the whole 3D model as well. If we have extra time, we will extend our work in the directions mentioned in the previous part.
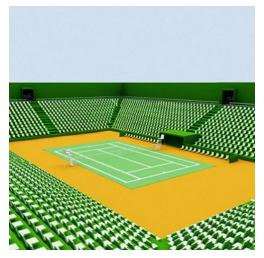
For each part, each one of us will be responsible for it, but we'll work together to finish it. We expect to work together in the following ways.

For the detecting vanishing points and deep learning part, Hsiu-Yao Chang will take responsibility. For the verifying the true dimensions and restructuring challenging parts, Bo-Rong Chen will take responsibility. For building the 3D model and adding extra textures, Hsin-Yu Hou will take responsibility.

Albeit such cooperating ways is a reference, we will still do some part of them in matrix and the final debugging together.

4. Resources

We will use the virtual 3d model of the tennis court to test our implementation.

Tennis 3D model [1]

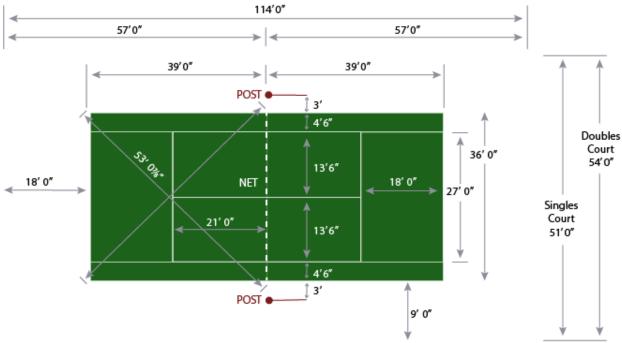We will then apply our model on the real-world image into evaluation.

Rod Laver Arena [3]

For edge detection and 3d reconstruction, we plan to utilize skimage library.

TENNIS COURT SIZE in FEET

This plan shows a court fence of 114 feet x 54 feet.
This can be reduced to 108 x 54 or increased to 120 x 60.
A singles court can be 45 feet wide.

Tennis-court size [2]

5. Reservations

For our initial approach, we'll first try to reconstruct the court without the bleacher.

We expect that we will encounter difficulties for the reconstruction of the bleacher in that some parts of them are too dark to find vanishing points. Moreover, the vanishing point is different from the court, and the line detection on the bleacher is more difficult. Thus, this part may be arduous.

Our minimal goal is to reconstruct a 3d model of the tennis court, especially Rod Laver Arena, and make it intractable that users can rotate and change the camera angles.

6. Relationship to your background

Two of us are Master student and one of us is PhD student. We have several experiences in conducting experiments and doing research. However, our previous research topics are not related to computer vision. All the knowledge is from lectures.

7. References

[1] tennis 3d model https://www.turbosquid.com/3d-models/tennis-court-3d-model/247731

[2] Tennis-court size
https://www.amss.co.uk/wp-content/uploads/2018/02/Tennis-court-size-in-feet.png
[3] Rod Laver Arena
https://cdn.cnn.com/cnnnext/dam/assets/140109103343-rod-laver-arena-horizontal-large-gallery.jpg
[4] A. Criminisi, I. Reid, and A. Zisserman, Single View Metrology, IJCV 2000
[5] N. Owens, C. Harris, C. Stennett, Hawk-eye tennis system, International Conference on Visual Information Engineering VIE 2003