

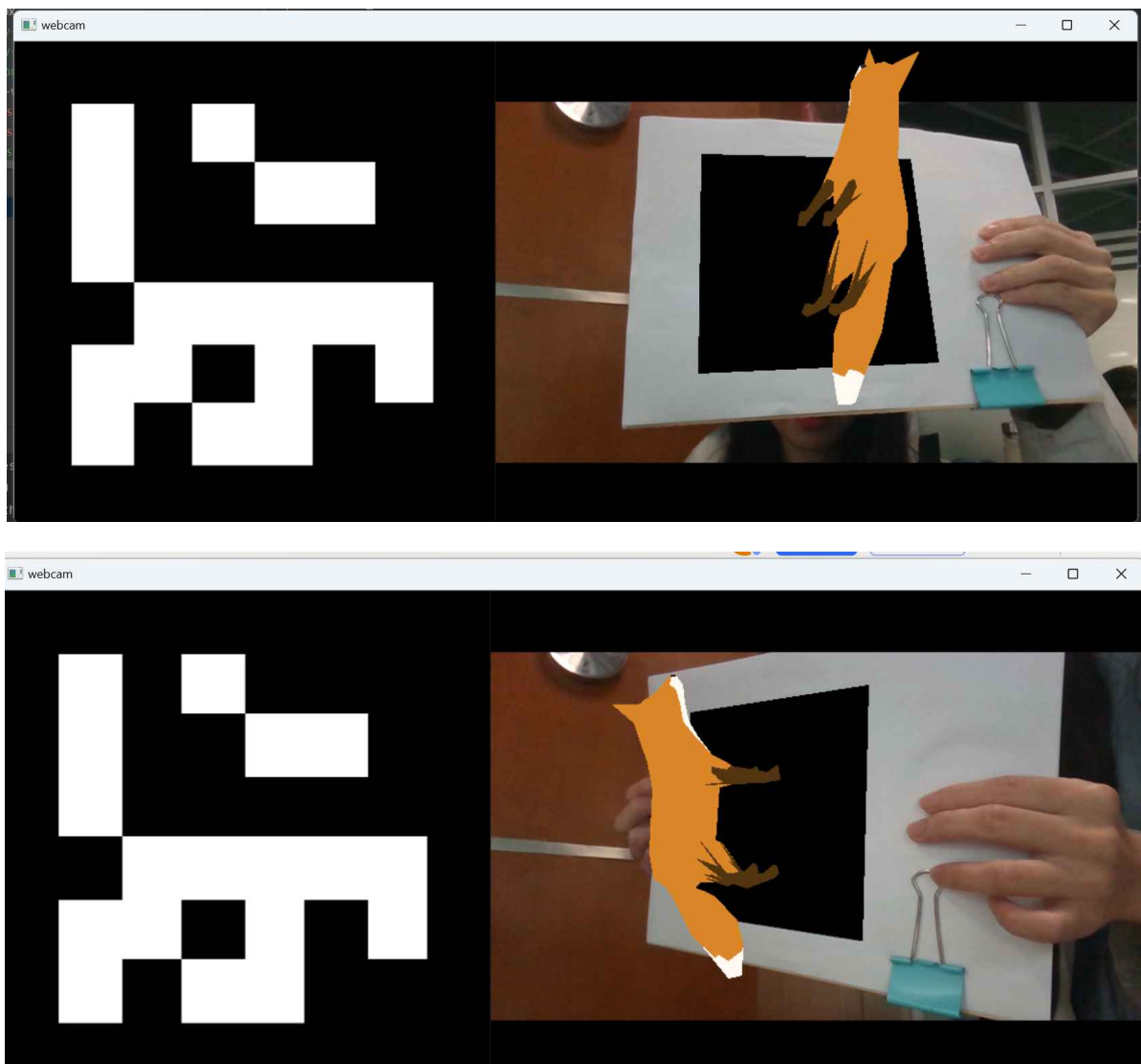
Augmented Reality Report

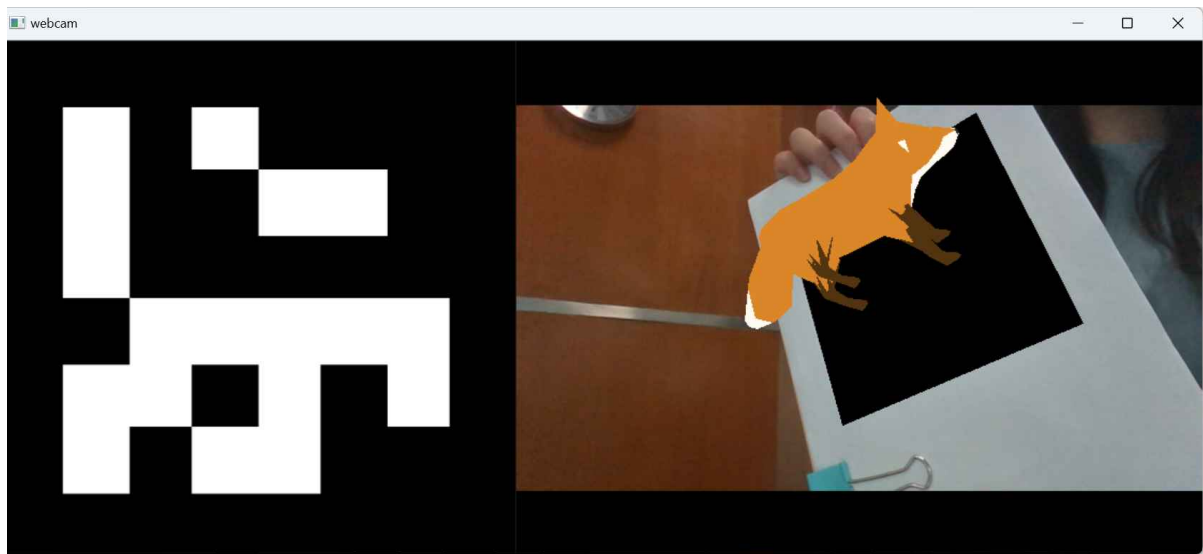
1. Brief Description

1.1 Intrduction

The augmented reality program using Python and OpenCV creates a 3D-object in reality. We choose a 3D fox from clara.io. And based on this, further development can change the 3d-object by replacing the .obj document.

The overall presentation is as follows:



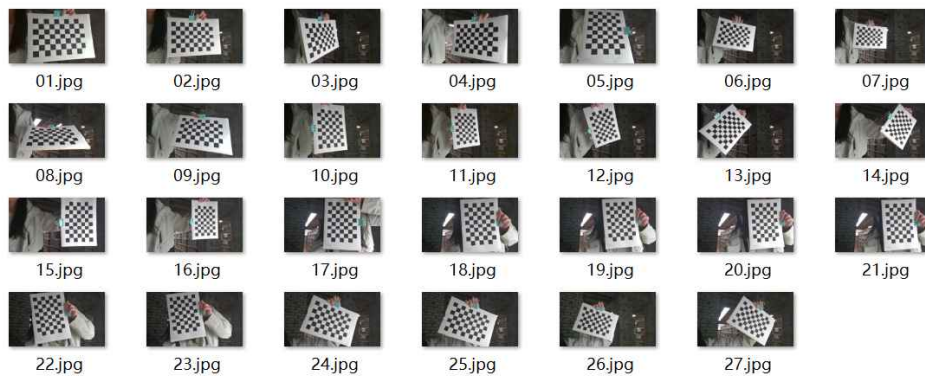


1.2 Major Modules

Our project mainly has 2 modules: one is used to calibrate my camera; and another one is used to create the augmented reality environment, which means you can see your 3d-object(fox) on your screen. And we also add sound-play function, it makes the fox more vivid.

Calibrate Camera

Since OpenCV has direct functions to help calibrate your web camera, we just need to follow their documentation. I collect some images of my camera of a 9*6 chess board to train the model and find matching parameters (the intrinsic matrix) of my camera.



Running the `camera_calib.py` , I got:

```
my_ar × camera_calib ×  
Processing: data/my_calibration_j\22.jpg  
Processing: data/my_calibration_j\23.jpg  
Processing: data/my_calibration_j\24.jpg  
Processing: data/my_calibration_j\25.jpg  
Processing: data/my_calibration_j\26.jpg  
Processing: data/my_calibration_j\27.jpg  
[[1.03461967e+03 0.00000000e+00 6.37580431e+02]  
 [0.00000000e+00 1.03731400e+03 2.89070396e+02]  
 [0.00000000e+00 0.00000000e+00 1.00000000e+00]]  
done
```



Augmented Reality

Create an augmented reality environment and show the fox.

2. The Implemented Requirements

2.1 Target Users & Requirements

Our AR project is aimed at users who are interested in exploring augmented reality technology. They may have the following requirements for our project:

- Stability and smooth performance. Users expect the application to run smoothly without crashes or lags. A stable user experience is a fundamental expectation.
- Accurate image recognition. Users expect the app to accurately recognize specified images to ensure the triggering of AR effects and rendering of virtual objects.
- Realistic virtual objects. Users desire realistic rendering of virtual objects that seamlessly blend with the real environment, creating an immersive augmented reality experience.
- High-quality sound effects. Users expect the fox's sound to have high-quality audio, making it more realistic and engaging.
- User-friendly interface. Users anticipate a clean and intuitive user interface that is easy to use, enabling them to initiate the AR experience effortlessly.

2.2 Implemented Functionalities

The project aims to achieve the following functionalities:

- Image recognition. The app should be able to recognize specific images captured by the camera and trigger a response accordingly.
- Virtual object rendering. Once the app recognizes the specified image, it will overlay a small fox at the recognized position using augmented reality, allowing users to see virtual objects in the real environment.
- Sound playback. When the virtual fox appears, the app will play the sound of a fox, enhancing the immersive experience for the user.

2.3 User-Friendliness

User interface and user friendliness are reflected in the following aspects:

- Accurate image recognition. The app should quickly and accurately recognize the specified image to ensure that users can trigger the AR effect seamlessly.
- Stability and realism of virtual objects. The app should ensure that virtual objects are stably rendered on the device screen and blend well with the real-world environment, striving for a realistic appearance.
- User interface design. The app's interface should be clean, intuitive, and easy to use.
- Audio feedback. The app should provide clear feedback, such as visual or audio cues when images are successfully recognized.

3. Advantages & Disadvantages

3.1 Advantages

- a. Accurate image recognition. Our project can quickly and accurately recognize the specified image to ensure that users can trigger the AR effect seamlessly.
- b. Good stability. Our project can ensure that virtual objects are stably rendered on the device screen and blend well with the real-world environment, striving for a realistic appearance.
- c. Clear feedback. Once the virtual fox appears, the app will play the sound of a fox to tell users that the images are successfully recognized.

3.2 Disadvantages

- a. Another way to create this augmented reality program would be to use any marker (not Aruco, something random like your name written on a piece of paper) and use SIFT feature descriptors. An advantage would be that it would work even if some part of the marker is occluded. The Aruco method fails if a part is outside because it's impossible to detect the contour though I found that method slower and more unstable.
- b. Due to time constraints, the number of interaction points of the model and design imported by this project is small.

4. How to Improve

Based on the project requirements and goals, we forecast the following aspects based on the existing achievements:

- a. Enhance visual experience. We can design multiple models to enrich the objects that interact with users, or build more diverse scenes.
- b. Increase the amount of interaction. Add model animations and trigger functions to meet more needs of users.
- c. Optimization. Model optimization, scenario optimization, target detection and tracking optimization, etc.
- d. Application scenario. We expect to introduce the 3d model of the Chinese zodiac in the next step, and enrich the introduction and guidance (such as texts, sounds, visual effects, etc.) to create more immersive scenarios.

The contribution of each member

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