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Team G: Excalibr
Teammates:
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ILR02
10/21 2016

Individual Progress

1. Calibration Target

I was responsible for calibration target design and manufacture. In the first stage, we planned to create a quick framework to test each subsystem. In calibration target part, I choose using 3D printer to make a prototype and using the checkerboard printed by Xerox printer(Fig 1).

In the processing of design, we choose 3D target because we can get the multi-face checkerboard information at a single image,and if the faces' geometric relationships were known, we can use that information to do camera calibration.

The reason why choosing this shape rather than cubic shape was because the accuracy. When using checkerboard to calibrate camera, the angle of the normal of the checkerboard and the camera should be limited in certain angle (i.e. 60 degree) to reduce the distortion by the lens. We could take that the 3D target would be the assembling of multi 2D checkerboards, Therefore, the angle between the face wouldn't be too large to reduce the distortion. The Rhombicuboctahedron shape has 45 degree in each square which could get better image than cubic shape(90 degree).

For deciding the size of the target, we want our target can fill the image, so that our calibration can cover the whole image. Because our future application was doing human face reconstruction, our camera's image field of view was almost as same as the human's face. Thence, our target should be as big as a human face(Fig 2).

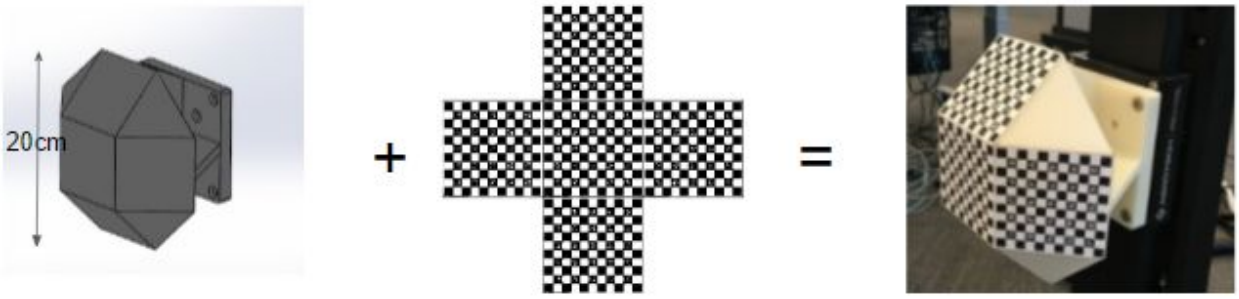

Fig 1. Design and fabricate the calibration target

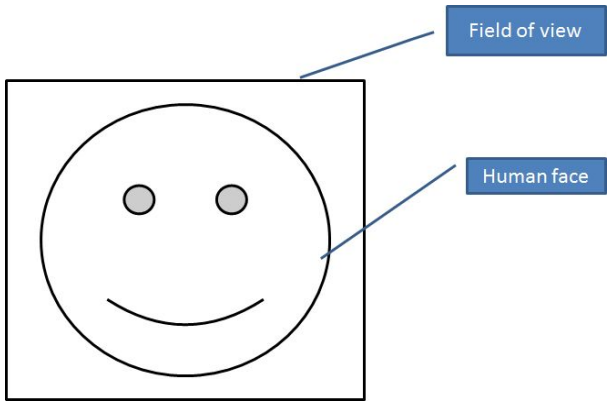

Fig 2. Human face will fill the field of view

2. Robot arm operation

In the future application, the robot arm will move calibration target in some specific movement for requirement from calibration. Therefore, we had to designed some movement template for future usage. The control method of Aerotech robot arm was similar with G code. The movement was based on two basic movement(linear movement or rotation by z axis). We could use these two basic movement function to create the predefined move pattern. For current usage, I developed a type movement (Fig 3). Besides, because I had understood the movement control method, I could design the different movement pattern for other situations.

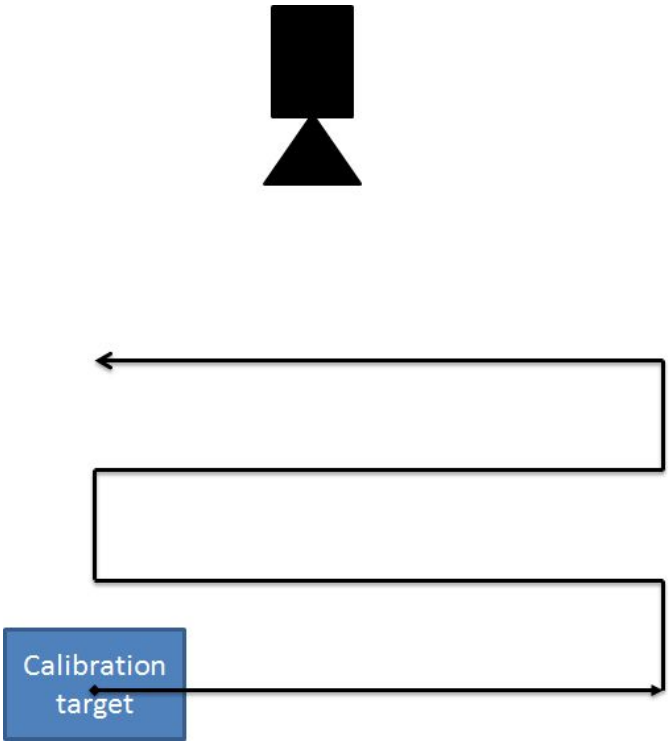

Fig 3. Movement plan for calibration target.

3. subsystem verification

Setting the prototype was our first milestone. According the requirements, I developed a verification plan for this prototype(Fig 4).

Test ID	V1.1	Test People	Peter
Test Name	Prototype test	Test Type	Demonstration
Target requirement	M.F.3: Control and manipulate the calibration target		

	M.F.5: Take high-resolution, stable and clear pictures of calibration target		
Test description	To test prototype system		
Date	2016/10/16	Place	Oculus research
Test necessary	Camera, Robot arm(AEROTECH), calibration target, control system		
Date collect	Problem	Post-test actions	problem report
Steps	Description	Successful Criteria	
1	Move robot arm	Can move in X Y Z direction	
2	Trigger the camera	When arm moved to specific position, trigger the camera	
3	Capture Image	Capture Images and Store them.	

Fig 4. Test plan for proto

We found a problem in this validation test, one is we found the y axis couldn't trigger the camera and the wire carrier would sometimes touch the itself.

Challenges

1. Loss of basic camera calibration knowledge

Our project was aiming to reach the high accuracy in camera calibration, and it needed us have a solid knowledge about the state-of-the art calibration methods(Zhang's method and Tasi's method). In the future, we might will develop a new method (maybe mix the two methods) to do the camera calibration. Thence, our background knowledge would need immediate improvement. Thence, the lecture study is necessary for us.

2. Aerotech robot arm Y axis movement cannot trigger the camera.

In the robot arm control system, the main controller(X axis) used PISS port to communicate with other sub-controller(Y axis and Z axis). Therefore, the function of control Z and Y axis would be different from X axis. I plan to use some tracking function to detect the PSO situation when Y axis move. And I would also contact the vendor for technical help.

Teamwork

Sam and I were working on the robot arm control.We helped to set up the linear actuator and control the movement of robot arm. Yiqing, Mandy and Sid were working on camera interface and Fix Pattern Noise (FPN).

Plans

In the next step, I planned to fix the Y axis trigger problem and get the data set (image, position) ,start literature study and use the off the shelf geometry algorithm to test in order to understand their pros and cons.