Selfie Aligner - How it Works

The basic function of the Selfie Aligner

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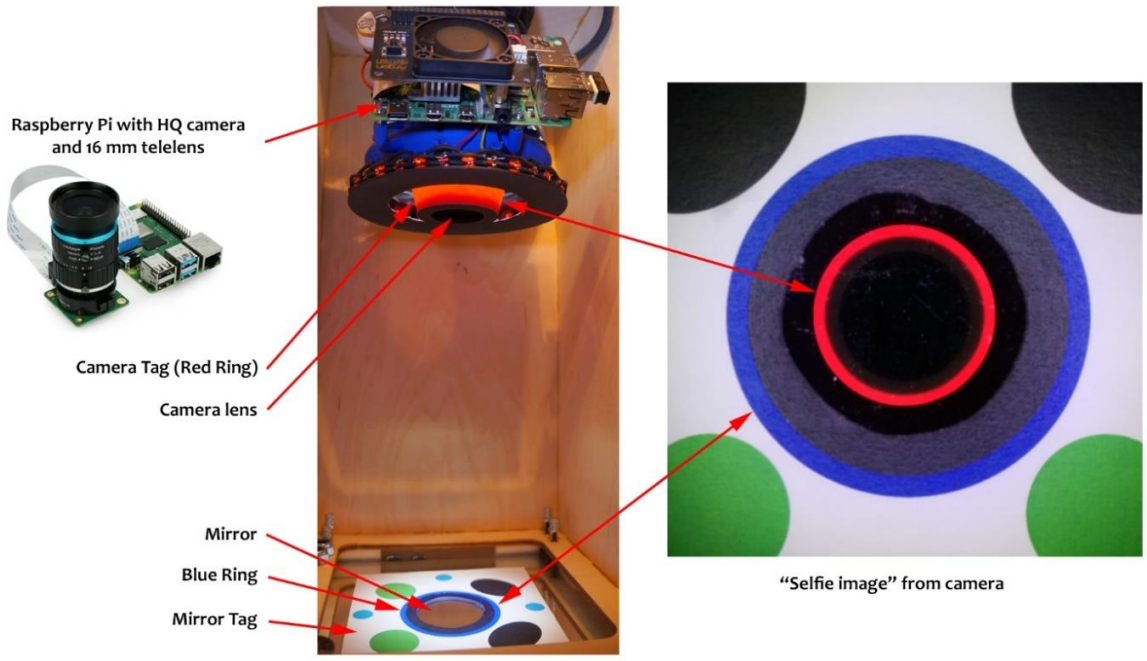
For a robot arm on a mobile platform to perform a task on a local workplace it will need to know how it is located in relation to the workplace. The mobile platform (AGV) can only navigate to a rough position from where the robot typically uses a vision system to align more precisely to the workplace. The quality of this alignment determines how precise the robot arm can perform tasks at the workplace.

The alignment is typically done with a camera on the robot arm that sees a graphical tag on the workplace. The relations between the two systems can then be found by analyzing the images.

Alignment systems based on cameras and graphical tags can typically establish the position relation with a precision of 1 mm but the angular alignment precision is often only 1°. This low angular precision limits the robot only to work very close to the alignment point or it will only be able to perform trivial tasks as moving boxes.

The Selfie Aligner is also based on a camera but a mirror in the calibration tag let the camera see itself in the image. This makes it possible to align with an angular precision of 1 mRad. That is 10-15 times better than traditional systems.
With this high-quality calibration, the robot can perform tasks at the work place with (almost) same accuracy as a fixed robot. See the demo videos for proof.



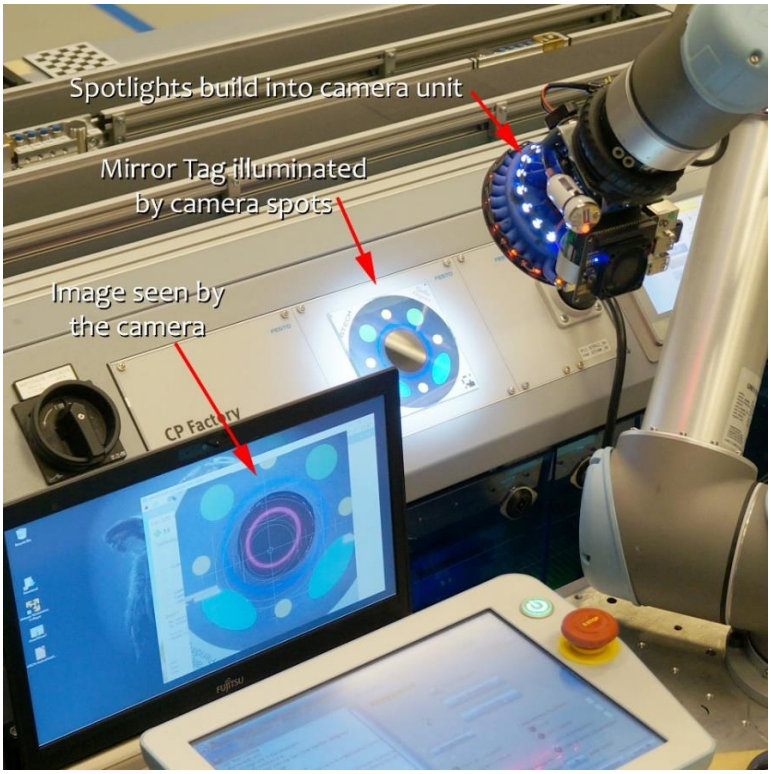
In this test setup a marker around the camera lens is illuminated with red light and the camera see this marker as a red ring in the mirror. When the camera is pointing perpendicular toward the mirror center the red ring will be at the image center.

It is relatively simple to detect the red ring in the image and by small adjustments to the orientation of the robot arm the center of the red ring can be brought to the center of the image. In the same way the blue ring on the Mirror Tag can used to bring the camera to a well-defined reference point right above the Mirror Tag.

This process of aiming the camera at itself in the mirror can be done with extremely high precision through a few iterations.

The Selfie Aligner is based on some very simple and robust principles. This makes the system very resilient and without high demands to equipment and surroundings.

The camera tool act as a black background for the red ring and the build in spotlights flood the Mirror Tag with light to out shine other light sources.
The camera will only see the mirror tag and itself.



The size and shape of the red ring in the image is not critical. Only the center of the ring is important. That is the red ring can be out of focus or the image stained by dust on the mirror without affecting the position of the center.

Lens distortion is also often an issue for vision systems. Distortion will disfigure an image but this deformation will be rotation symmetrical around the center axis of the lens. The center position of the image will (as the only part of the image) not be affected by lens distortion. The closer the red ring comes to the right position in the center of the image the less influence the lens distortion will have.

The Selfie Aligner is capable of retrieving information on all six degrees of freedom from a single image. Through a few iterations it can bring the robot arm to the calibration position with the precision decided by the user.

It is these robust design features that makes it possible for the Selfie Aligner to perform a first-class alignment with low quality lenses, dirty mirrors and out of focus images. It will even be possible to align a mobile robot to a workplace with an onboard camera stated for object recognition or visual inspections.

With the Selfie Aligner the mobile robot arm will be able to do much more delicate tasks and generate more value. This will help to take the use of mobile robots to a new level and it will help to open new markets for mobile robots.

Links to Transistor demo and Wax test:
https://vimeo.com/908762499/798a04ae5b
https://vimeo.com/848551417/f03f431220

Transistor demo

Vax demo with intro

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