**INFO ABOUT CONVEYOR TRACKING:**

Issues while taking picture samples:

Gaussian noise in conveyor tracking refers to random fluctuations or errors in sensor measurements that follow a Gaussian (or normal) distribution. These errors can affect the accuracy of tracking objects on a conveyor belt, typically in systems that use sensors like cameras, lasers, or proximity detectors to monitor the position, speed, or other characteristics of items as they move.

**Impact on Conveyor Tracking:**

* **Position Estimation Errors**: The tracking system may inaccurately estimate the position of items due to the noise.
* **Measurement Noise in Speed and Timing**: If the noise affects timing sensors, the speed of items could be miscalculated, causing synchronization issues.
* **Filtering**: Techniques like Kalman filtering or other noise-reduction algorithms are commonly used to reduce the effect of Gaussian noise and improve the reliability of tracking systems.

IMPORTANT THINGS TO NOTICE FOR CONVEYOR TRACKING:

Position Localization:

After the contours of objects are derived from the camera, we want to get the instant position of the tracker(gripper) and the target (Workpiece) seperately. First, the contour is the difference between reference and current frame from the color frame. Afterward we get the coordinate of the objects in depth frame. The desired data include situtation along the y axis and z axis from the Kinect color frame x-y planes that tht etracker and target belong to, we can separate the objects by a threshold about the data along z axis object is higher than threshold, then it is defined as the robot palm; otherwise, it’s the industrial component. The concept of multi-objects tracking is indicated.

Position Calibration

From Kinect view, we can get the information about depth along z axis. However, true position is altered due to quantization level among pixels. The scale from color frame to depth map should be measured before tracking. The length between each pixel is proportional to the vertical distance between the targets and Kinect. This relationship is also the same as the content mentioned in Object Recognition. Once the tracking strategy is actuated, the static pose recognition will stop. The data include the position of the end-effector and object on the conveyor. The workpiece will move straight forward through the conveyor. Thus, only the pose of workpieces will be updated and orientation maintain present. Then, the control center will convey new command to the manipulator for grasping tasks.

A webcam camera is allocated for optimized grasping. When the robot receives instruction from control center to start tracking, the difference among frames will be recorded through the process. First of all, check the direction of gripper. Next, webcam records the frame while the gripper has been grabbing. Last, revision including grasping pose and orientation will be saved and will update the next pose and orientation if the system recognizes the same object again.

The **Hough Transform** is a feature extraction technique used in image analysis and computer vision to detect shapes, particularly lines, circles, and ellipses, within an image. In the context of **object detection for conveyor tracking**, the Hough Transform is primarily used to detect geometric shapes (like edges or boundaries) that represent objects on a conveyor belt. Here's a more detailed explanation of its application:

**1. Detecting Edges or Lines**

* **Conveyor Belt Detection**: Conveyor belts typically consist of straight lines that can be detected using the **Hough Line Transform**. By detecting these lines, the position and orientation of the conveyor belt can be identified, which helps in tracking objects as they move.
* **Object Detection**: Objects on the conveyor belt often have sharp edges that can be detected as lines or boundaries using edge detection techniques (like the Canny Edge Detector) followed by a Hough Line Transform. This can provide the framework for locating and tracking objects.

**2. Shape Detection**

* **Circle Detection**: If the objects on the conveyor have circular features (e.g., cylindrical objects), the **Hough Circle Transform** can be applied. It identifies circles within the image, which helps to track or detect these types of objects.