Automatic Evaluation of Black Line Following Robot

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Problem: Participants of the e-yantra robotics competition submit videos for evaluation. It is time consuming to go through all the videos manually.There is also possibilty of error in evaluating the video.

Solution: Create automatic evaluation process to aid the judges. Evaluate all videos with reasonable accuracy so as to give the top 25% teams. This can be divided into two steps - *localization* and *evaluation*

A trace is a sequence of (x,y,O,t) values giving position(x,y), orientation(O) of robot at time t

Localization
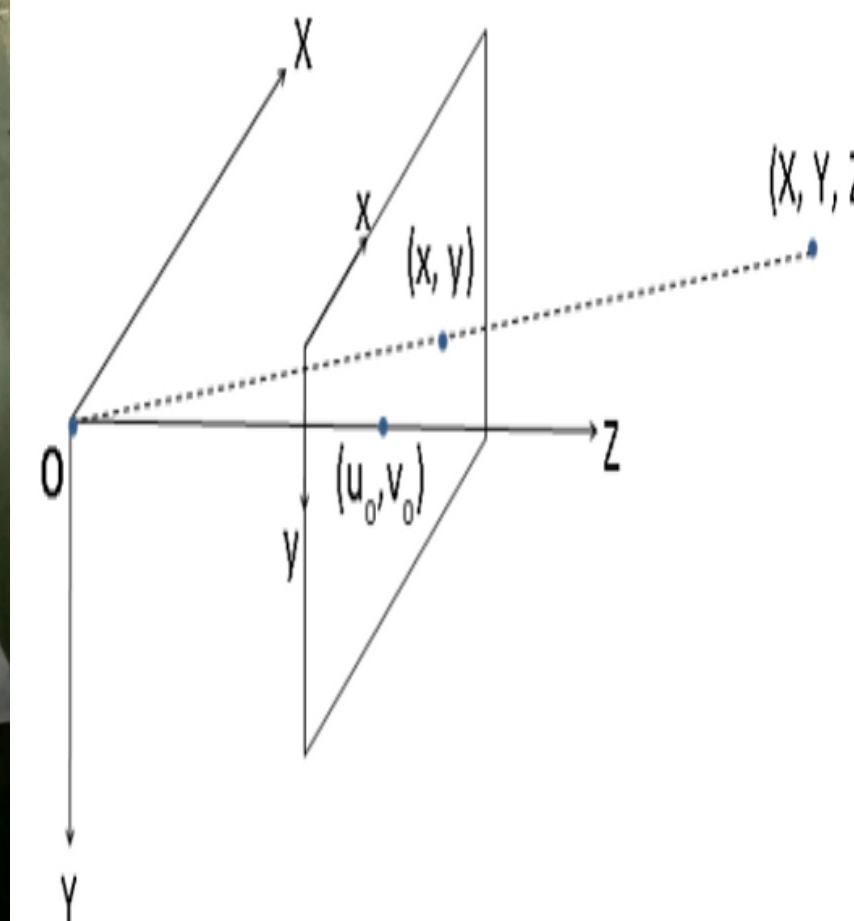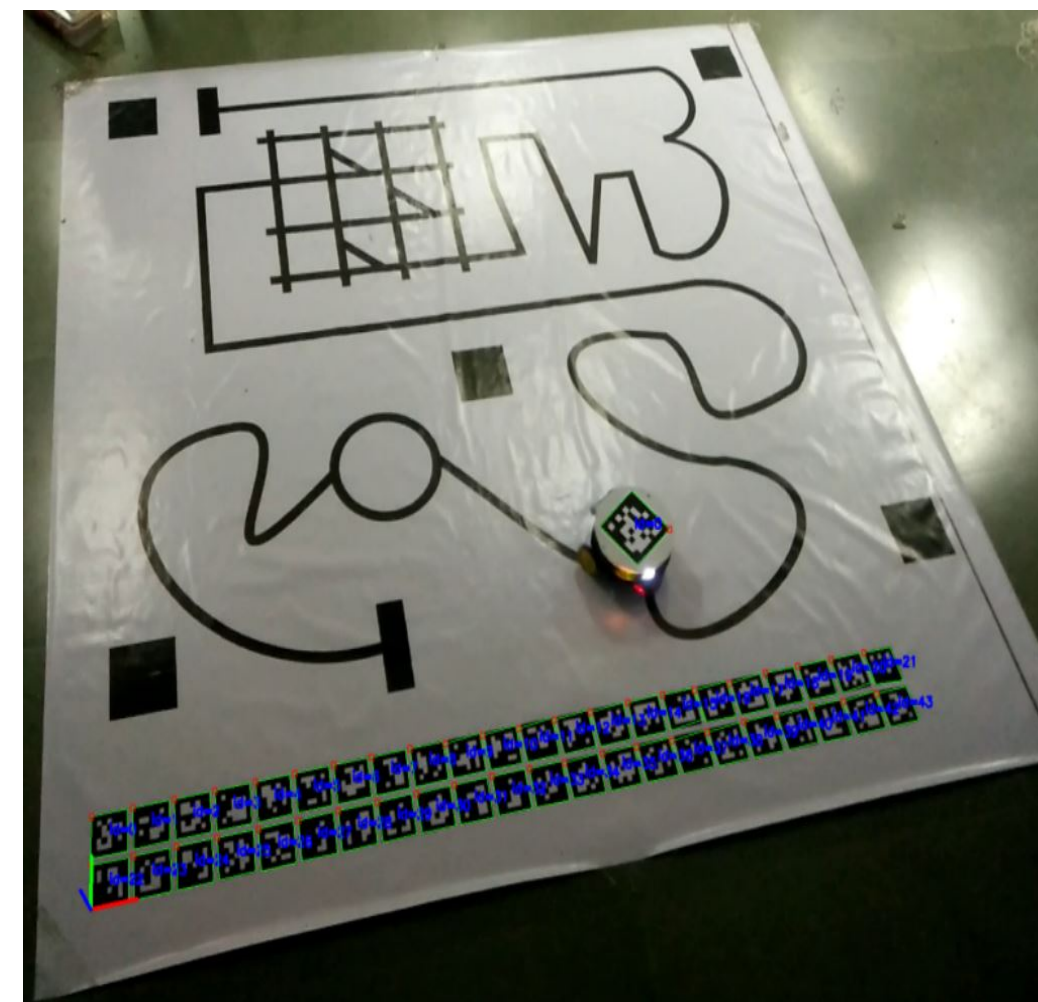
Camera Calibration
In videos, angles and dimensions of various objects get distorted. To be able to correctly get the 3D world coordinates of the 2D image points, the camera must be calibrated. Our process makes use of aruco markers for calibration. A strip of aruco markers is present on the arena that acts as a reference. Using these markers, camera parameters required for predicting world coordinates are found.

Generating Trace Files
An aruco marker is also placed on the robot. As the robot moves on the arena, its 2D coordinates are generated with respect to the reference strip. Using the intrinsic and extrinsic parameters, and 2D coordinates, the process predicts 3D coordinates with timing information. Thus, generating the trace file.

Evaluation

Compare With Ideal Path
A trace file containing the actual path values is considered to be the ideal trace file. Each trace file generated is compared with the ideal trace file. A circular window is used to check whether a point lies on the ideal path or not. If it does not, the error is calculated using Euclidean distance of how much it has deviated from the ideal path, how much distance it skips on the path, and time duration for which the robot is off the path.

Rank The Teams
Once the error is found for each of the videos, the teams are ranked in order of increasing error. The different types of errors can be given different gains for evaluation based on priority.