

# Virtual Blackboard

## Proposal

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# General Objective

Design a vision system able to recognize the strokes made with a marker in a flat surface and to transform the strokes into drawings for later projection.

# Specific Objectives

- ▶ Capture videos simultaneously from two sources.
- ▶ Detect of a specified marker and obtain its coordinates from a frame-to-frame analysis.
- ▶ Identification of color of the lid of the marker.
- ▶ Draw the detected stroke, simulating an actual marker over a black-board.

# Data

- ▶ 5 minute video obtained from two sources.
- ▶ Number of frames is a function of the fps of the cameras.
- ▶ \* So far, our cameras have a 90fps. It means, 27000 frames per video, for a total of 54000 frames.
- ▶ Expected to run live at the end of the project.

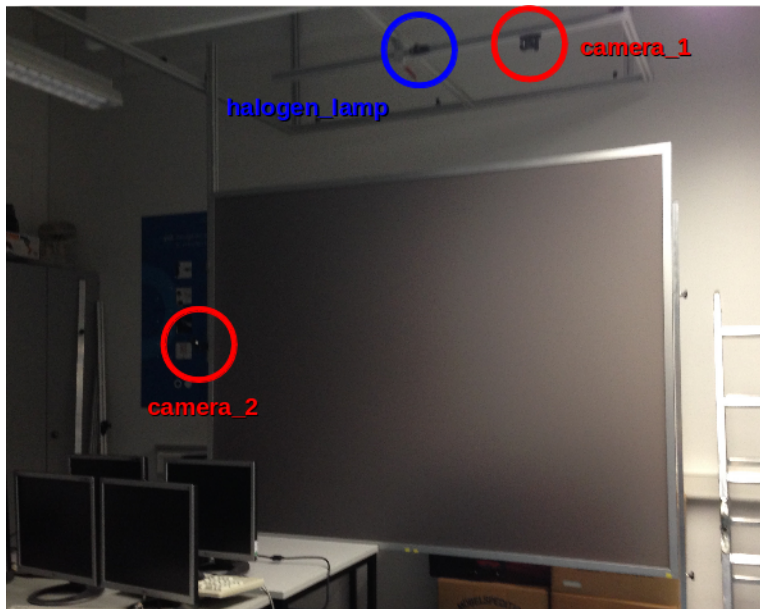
# Assumptions

- ▶ Cameras need to be calibrated every session.
- ▶ The marker should be sufficiently long to minimize the possibility of occlusions.
- ▶ A screen fit for back-projection and a video-beam.
- ▶ Polystyrene material with a colored sheet of paper as a marker. (Given the current screen).

# Hardware

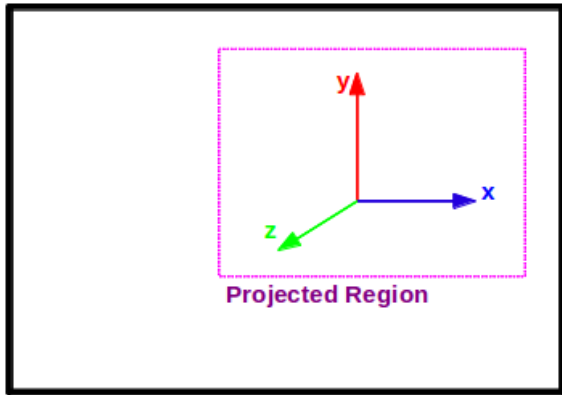
- ▶ Glass screen for back-projection.
- ▶ Video-beam.
- ▶ Self-built marker.
- ▶ Two cameras (MatrixVision BlueCougar-S 120aC - 90fps, Color, 652x490, Ethernet interface).
- ▶ Halogen lamp.
- ▶ Hub or Switch
- ▶ Three Ethernet Cables.
- ▶ Camera mounts.

# SetUp



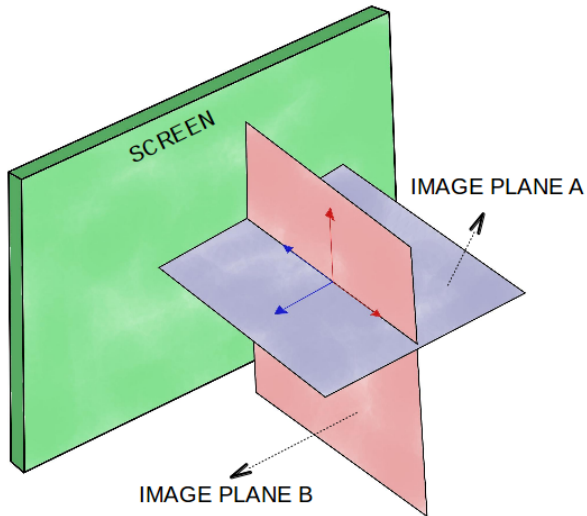
# Visual Description

## Black-board





# Visual Analysis



# Structure

- ▶ Calibration and Synchronization
- ▶ Video capture
- ▶ Pre-processing
- ▶ Marker detection [\*]
- ▶ Color recognition [\*]
- ▶ Position detection [\*]
- ▶ Stroke draw

Note\*: Can be developed in parallel.

# Approach

- ▶ Calibration: intrinsic and extrinsic parameters of the cameras (Caltech Calibration Toolbox for Matlab).
- ▶ Synchronization: trigger control.
- ▶ Pre-processing: filtering and video compression (reduction of frames).
- ▶ Marker detection: edge detection, Otsu method (binary conversion).
- ▶ Color recognition: histograms, different color spaces (RGB, HSV, YCrCb)
- ▶ Position detection: frame by frame, optical flow.

# Expected Results

- ▶ Video captured simultaneously from both cameras.
- ▶ Identification of at least 3 colors to be used on three different markers.
- ▶ Set of  $(x, y)$  coordinates of the movement painted
- ▶ Algorithm that draws a line connecting a given set of points.