ENG4000

Distributed Camera Surveillance Network for Multi-Object Tracking

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Group 1 (Trackingineers)

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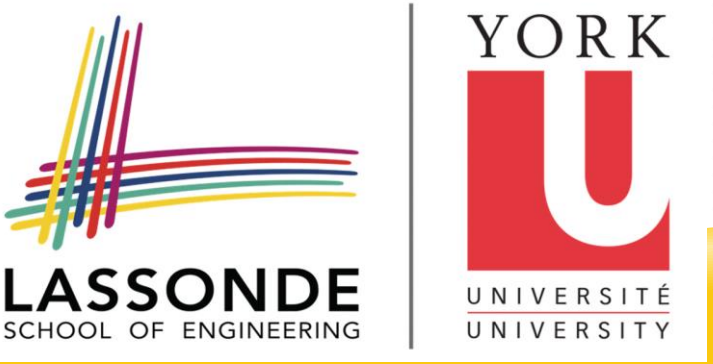
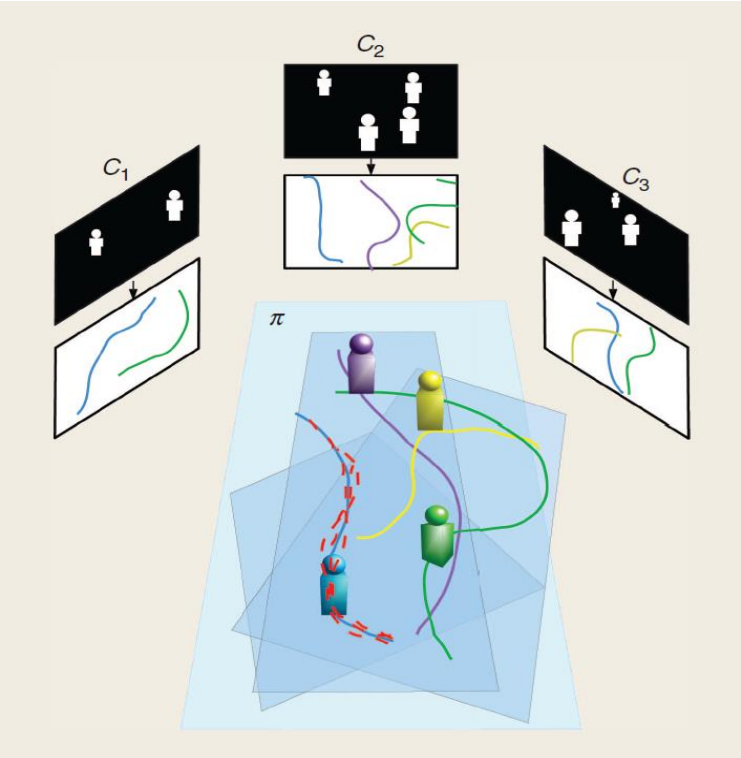


Motivation

- Existing technology involves analyzing video streams at a central location concurrently
- Current setup introduces latency and is not conducive to real time surveillance
- Manual handling of individual data streams is tedious and time consuming
- Our solution aims to provide greater flexibility for the end user in analyzing captured data streams
- It is a great opportunity to assess the commercialization of our project in the field of security and surveillance

Source: http://www.ianvisits.co.uk/blog/2008/06/27/too-many-security-cameras-or-too-much-hype

Background



Source:
Multi-view multi-object detection and tracking,
in Computer Vision: Detection, Recognition and Reconstruction,
R. Cipolla,S. Battiato, and G. M.Farinella, Eds. New York:
Springer-Verlag, 2010, ch. 8, pp.263–280

- Technical Step #1: Finding homography matrices to obtain global coordinates
- Technical Step #2: Obtain tracking information of moving target in global reference frame

Methodology

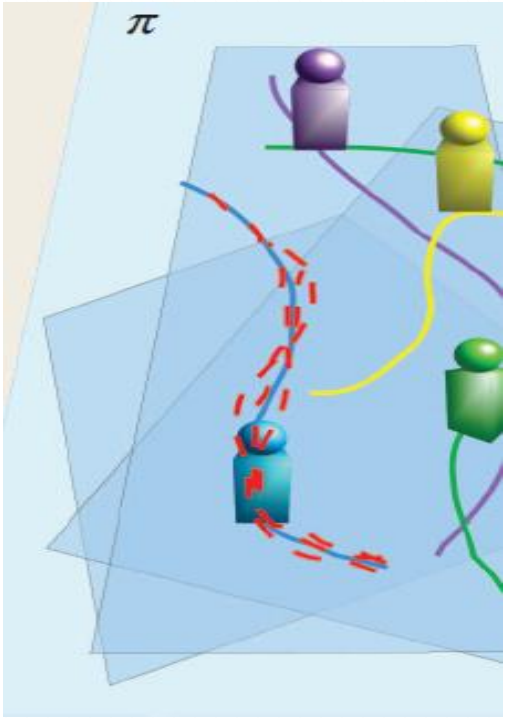
- Using SIFT algorithm to find corresponding points between frames.
- These points are provide as input to calculate the homography matrix using DLT algorithm.
- Once the matrix is found for every pair of views, a global reference frame can be obtained.

$$p_a = \begin{bmatrix} x_a \\ y_a \\ 1 \end{bmatrix}, p'_b = \begin{bmatrix} w'x_b \\ w'y_b \\ w' \end{bmatrix}, \mathbf{H}_{ab} = \begin{bmatrix} h_{11} & h_{12} & h_{13} \\ h_{21} & h_{22} & h_{23} \\ h_{31} & h_{32} & h_{33} \end{bmatrix} \quad p'_b = \mathbf{H}_{ab} p_a$$

Source: http://www.cmap.polytechnique.fr/~yu/research/ASIFT/demo.html

Methodology (continued)

- Tracking of individual objects is performed using Kalman Filter and blob analysis.
- The track of any given object from the different views will be projected into a global reference frame.
- Once the global reference frame has been found, the tracks for a single object as seen from different views are averaged to arrive at a consensus for the most accurate track.



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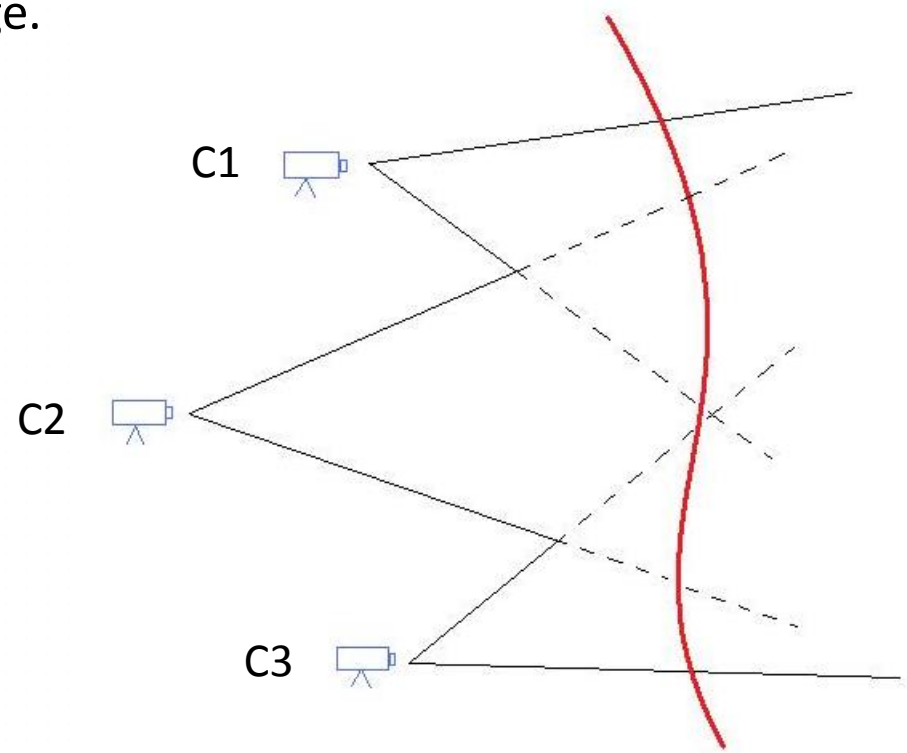
Objective

- Tracking a target through a network of video cameras with partial overlaps in their coverage.



Techniques

- Technique 1:
  Finding homography matrices to obtain global coordinates

- Technique 2:
  Obtain tracking information of moving target in global reference frame

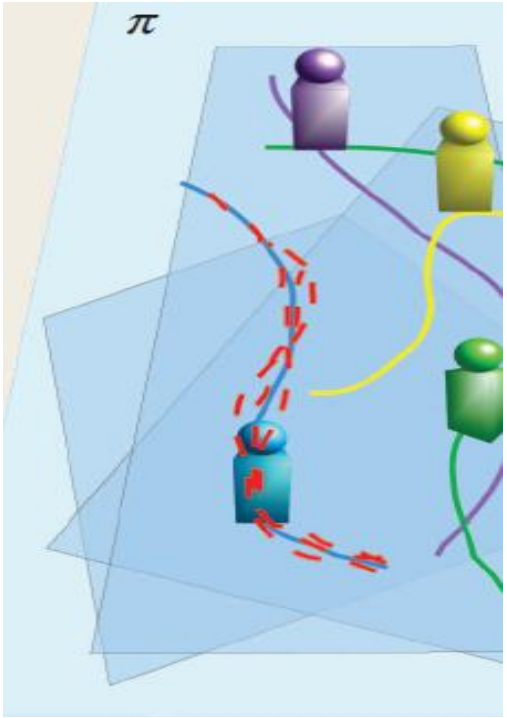
Technique 1

- Obtain the points that represent the track of a given moving object from video frames.
- These points are provided as input to calculate the homography matrix using DLT algorithm.
- Once the matrix is found for every pair of views, a global reference frame can be obtained.

$$p_a = \begin{bmatrix} x_a \\ y_a \\ 1 \end{bmatrix}, p'_b = \begin{bmatrix} w'x_b \\ w'y_b \\ w' \end{bmatrix}, \mathbf{H}_{ab} = \begin{bmatrix} h_{11} & h_{12} & h_{13} \\ h_{21} & h_{22} & h_{23} \\ h_{31} & h_{32} & h_{33} \end{bmatrix} \quad p'_b = \mathbf{H}_{ab} p_a$$

Technique 2

- Tracking of individual objects is performed using Kalman Filter and blob analysis.
- The track of any given object from the different views will be projected into a global reference frame.
- Once the global reference frame has been found, the tracks for a single object as seen from different views are averaged to arrive at a consensus for the most accurate track.



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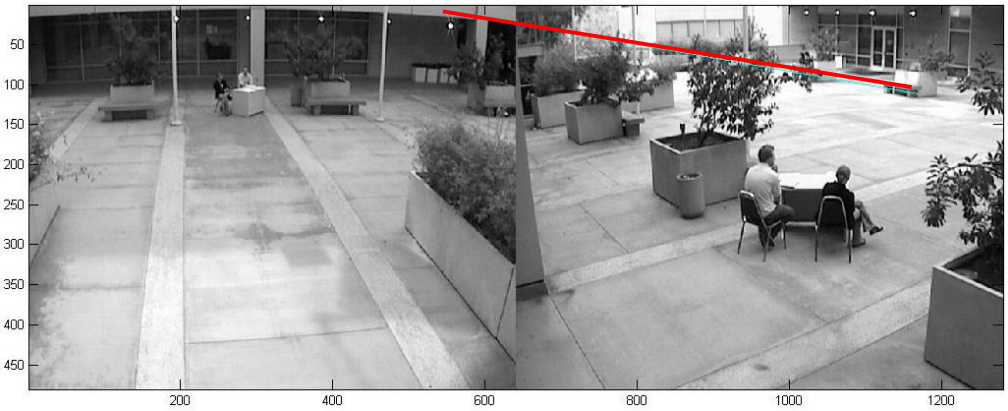
Discussion From the last presentation

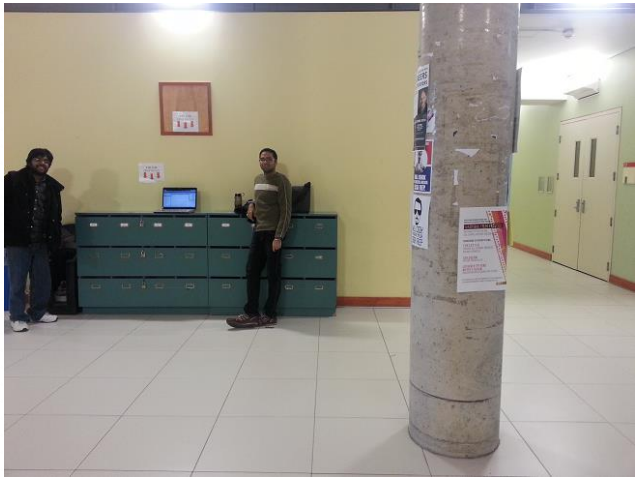
Problem: SIFT algorithm not powerful enough to find point correspondences from views with significant difference in the positioning of the cameras.

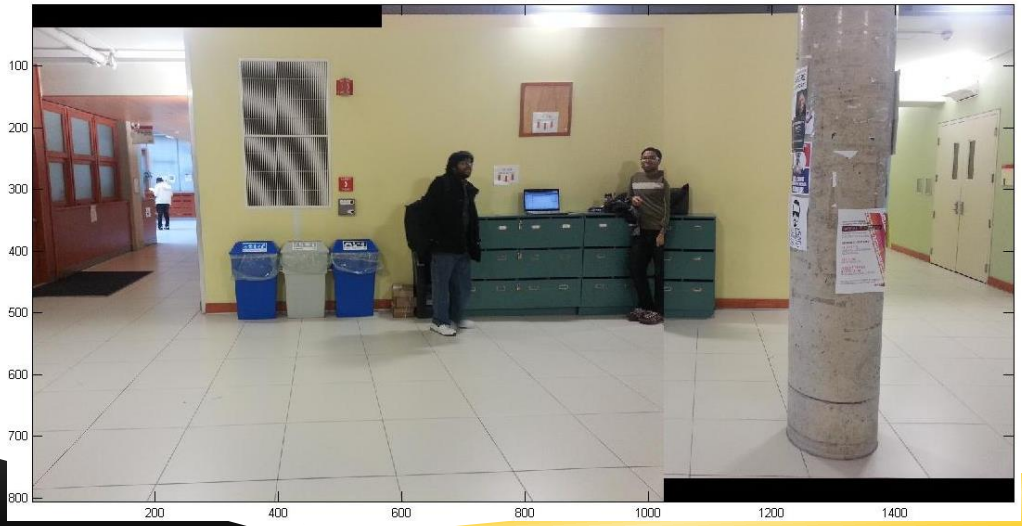
Solution: Obtain the points from the track of a given moving object.



Discussion From today's presentation

Preliminary testing shows that we need to be more accurate in creating a global view





Progress Results To Date

We have been able to develop an algorithm to calculate the Homography Matrix with 4 points from two partially overlapping images as input

We captured data of one moving object from two surveillance cameras to perform parameter estimation through tracking

Discussion – Current Focus

- Tracking Algorithm – Raiyan
- DLT Algorithm – Varun
- Global reference frame Algorithm – Manfred
- Camera Network Protocol – Tayo

Time Management

STEP	DATE	DESCRIPTION
1	September 25, 2013	Literature Review
2	October 2, 2013	Collection of Data
3	October 17, 2013	Initial System Design
4	Ongoing	Designing Tracking algorithm

Acknowledgement

Thanks to Professor Asif and Arash Mohammadi for supporting our project

THANKS