Abstract
Create a vision-based system using a webcam to track a user’s hand and recognize gestures to allow human-computer interaction.

Motivation
- Provide unconstrained interaction.
- Allow gestures to emulate mouse function.
- Eliminate the need to touch peripherals.
- Freedom from wearing gloves or markers

Applications

Mobile Devices
- Freedom from physical interaction. (trackballs, touch-screen, buttons, etc.)
- Reduces size limitations.
- Touch-free interaction.

Projection Devices
- Interaction with projected screen.
- Imitate touch-screen.

Viewing Applications
- Google Map
  - Zooming
  - Navigating
- Image Libraries
  - Zooming
  - Rotating
  - Translating

Public Terminals
- Eliminate need for touch-screen.
- Reduce transfer of germs.

System Design

Detection
- Scanning Window Detector
- Haar Features
  - Express differences within local regions
- AdaBoost Classifier
  - Weighted ensemble of weak classifiers
  - Ensure > 97% recall
  - Ensure < 50% false alarms
- Viola-Jones Cascade
  - Sequential trimming of candidates
  - 20 stages
  - $0.97^{20}$ recall & $0.5^{20}$ false alarms

Tracking
- Lucas-Kanade Optical Flow Tracker
  - Track interest points
  - Initialize with corner detections
  - Remove outliers with RANSAC

Pose Recognition
- Eigenhands
  - Pose Matching
  - Search over scales and translations
  - Take eigenvectors of top 8 eigenvalues
  - Map image into eigenspace
  - Match with closest example

Pose Mapping
- Cursor Movement
- Background Subtraction

Senior Project Poster Day 2010, CIS Dept. University of Pennsylvania