

Teleoperation of Robotic Arm Using Leap Motion Controller and Webcam

CSCI 5551- Introduction to Intelligent Robotic Systems
PROJECT PRESENTATION

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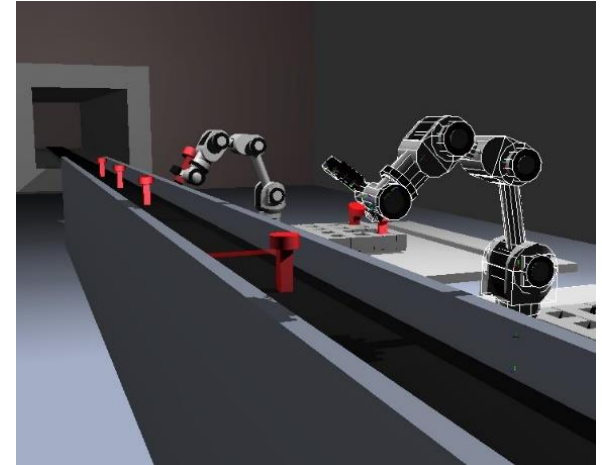
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Agenda

- Introduction and Project Objectives
- Architecture and Design
 - Leap Motion sensor technology
 - uArm robot (robotic arm)
 - Software (Processing, Color/object recognition)
- Tests and Results
- Problems faced
- Conclusion and Future work

Background and Introduction

- Robots and scope of robotic arms
 - Today, robots are ubiquitous
 - Widespread in industrial environments
 - Need for human-like robotic capabilities
- Intelligent and smart robots
 - Require wide variety of sensors
 - Need real-time sensor data processing



Project Overview

- Leap motion device – Hand Tracking
- Processing software – Positional & Skeletal Data
- Computer vision + Movement Algorithms - Calculation of joint angles

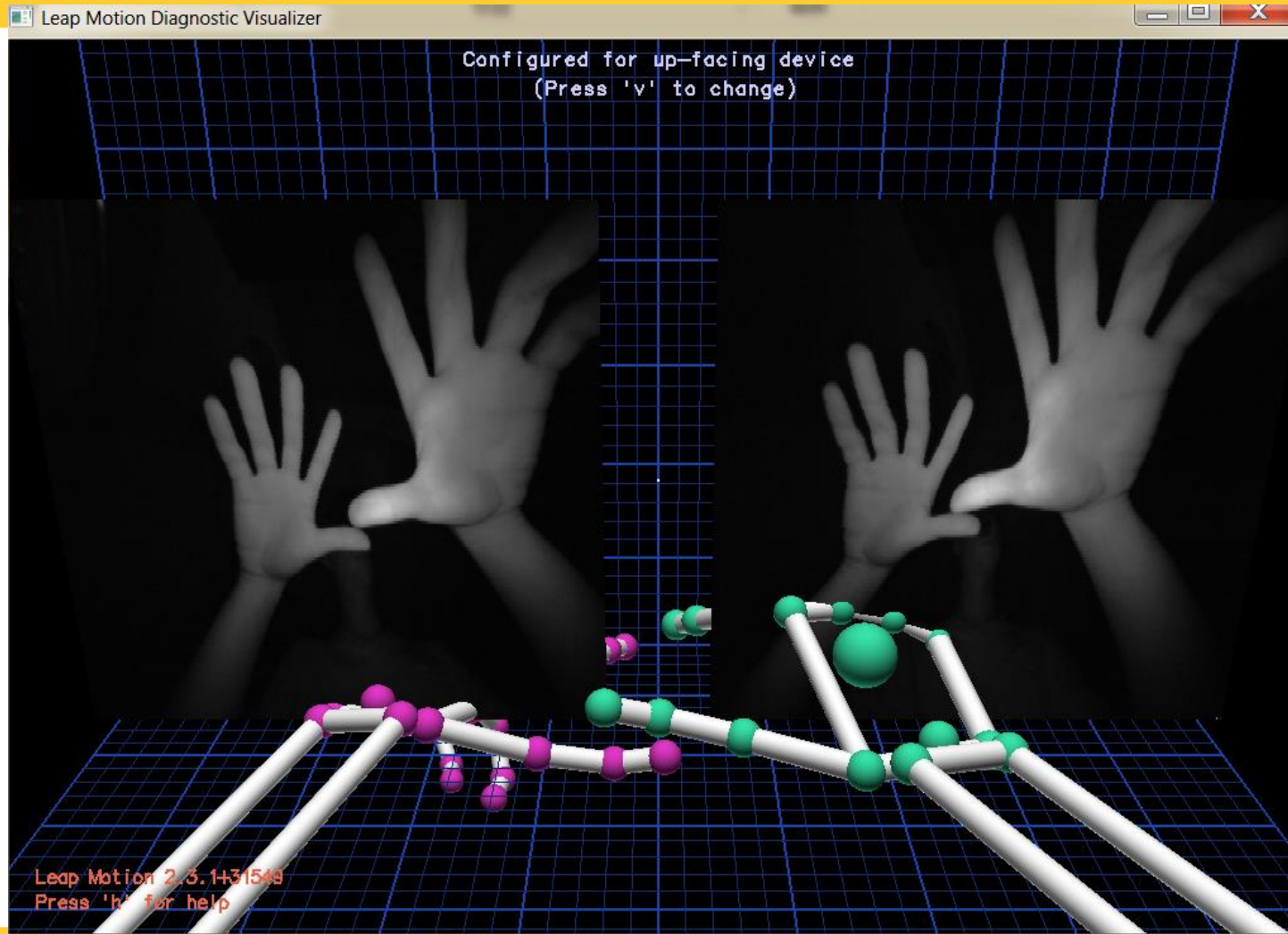


Overview- Leap Motion sensor

- Advanced motion sensor
- Captures human hand movement
- Internals:
 - 2 cameras (300 fps)
 - 3 infrared LEDs
 - USB interface
- Range: 1 inch to 2 feet



Overview- Leap Motion sensor



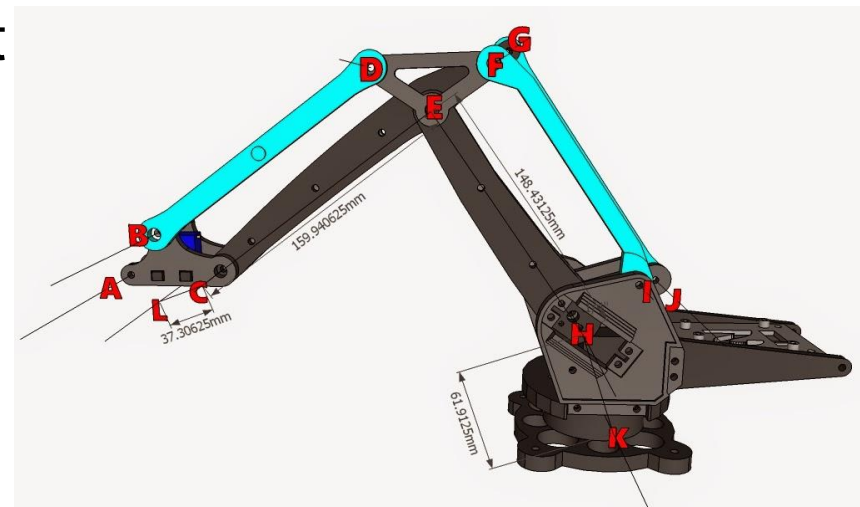
Overview- uArm

- Features:
 - 4 DOF
 - Arduino controlled
 - 3 high torque servos
- Customizable end effector
 - Vacuum pump
 - Gripper
 - Pen holder



Overview- uArm

- Parallel-mechanism robotic arm
 - Mass concentrated on base
 - More stable
- Popular in high-speed/high-precision environments
 - Faster upper arm movement
 - Averaged error



Demo Video- Leap Motion



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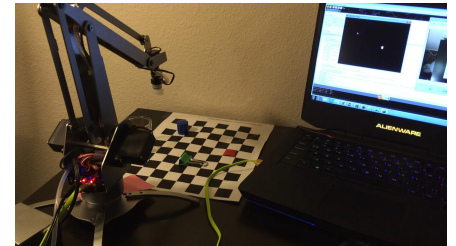
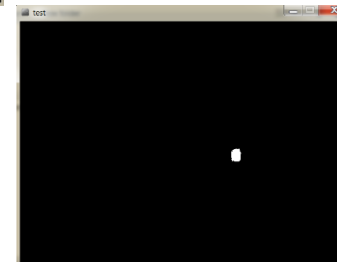
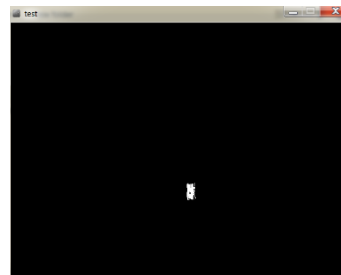
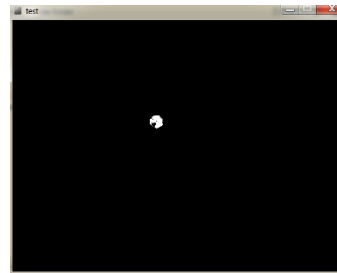
Webcam Controlling

Calibrate Image → Image Processing → uArm

(Color and location Identification)



Undistort image



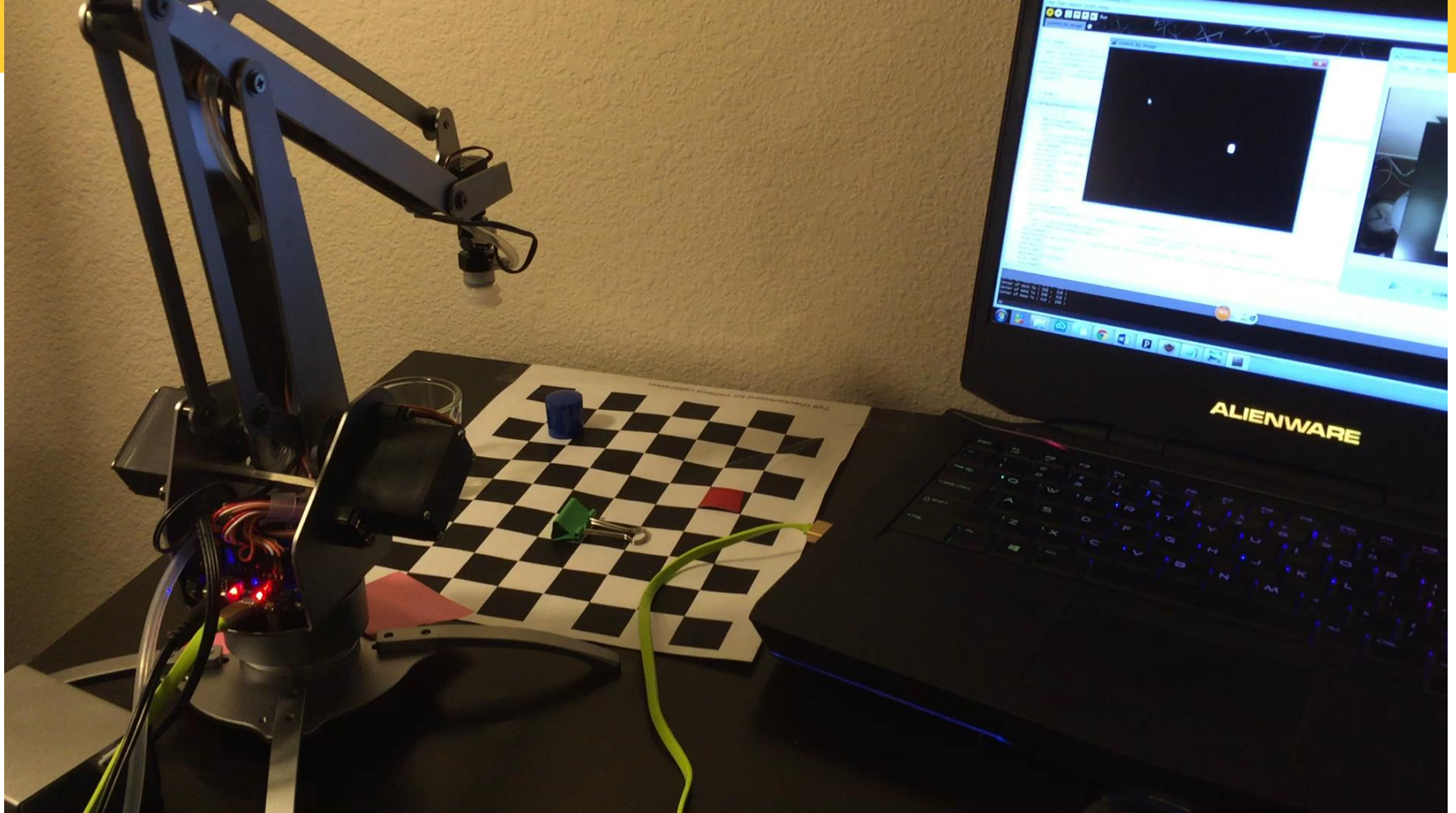
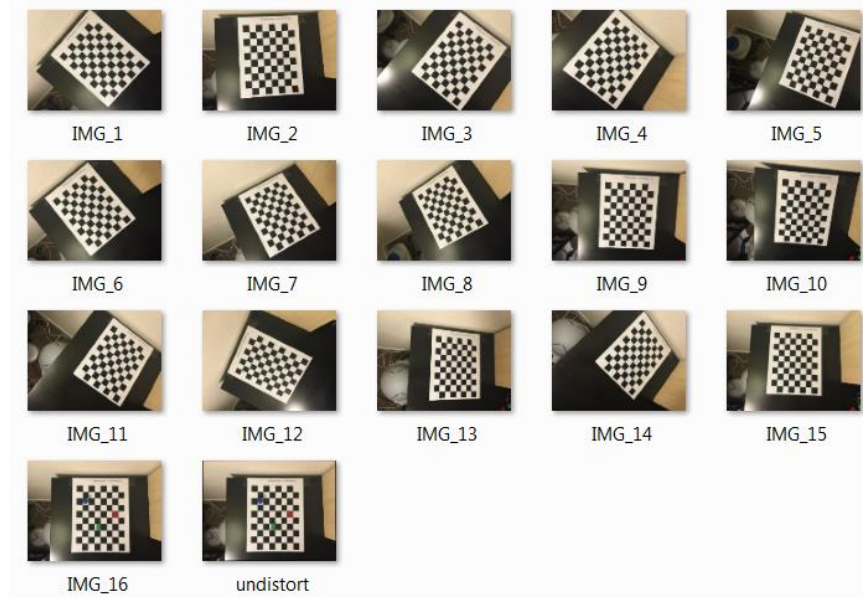


Image Calibration Using MATLAB

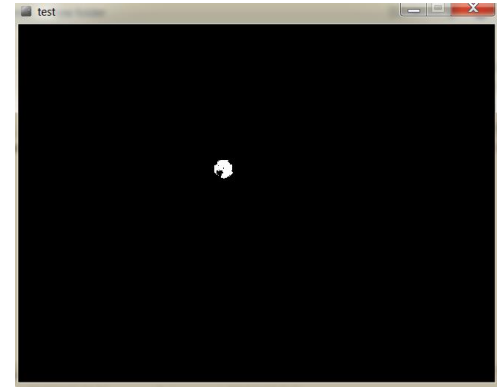
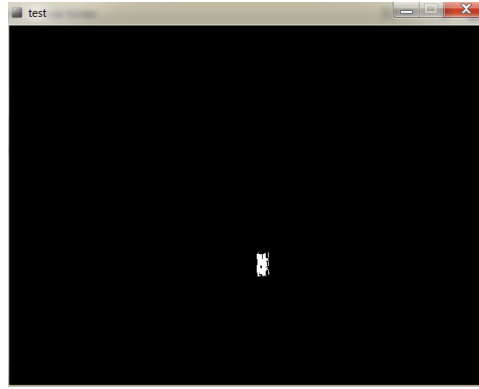
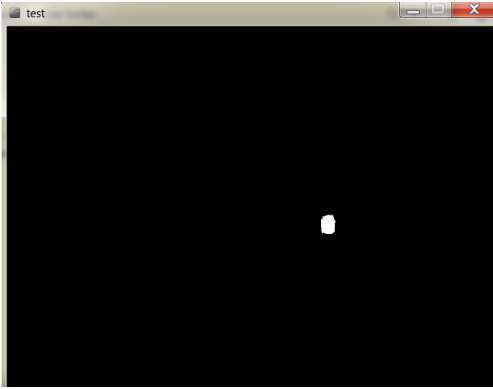
- Geometric camera calibration



Calibration patterns

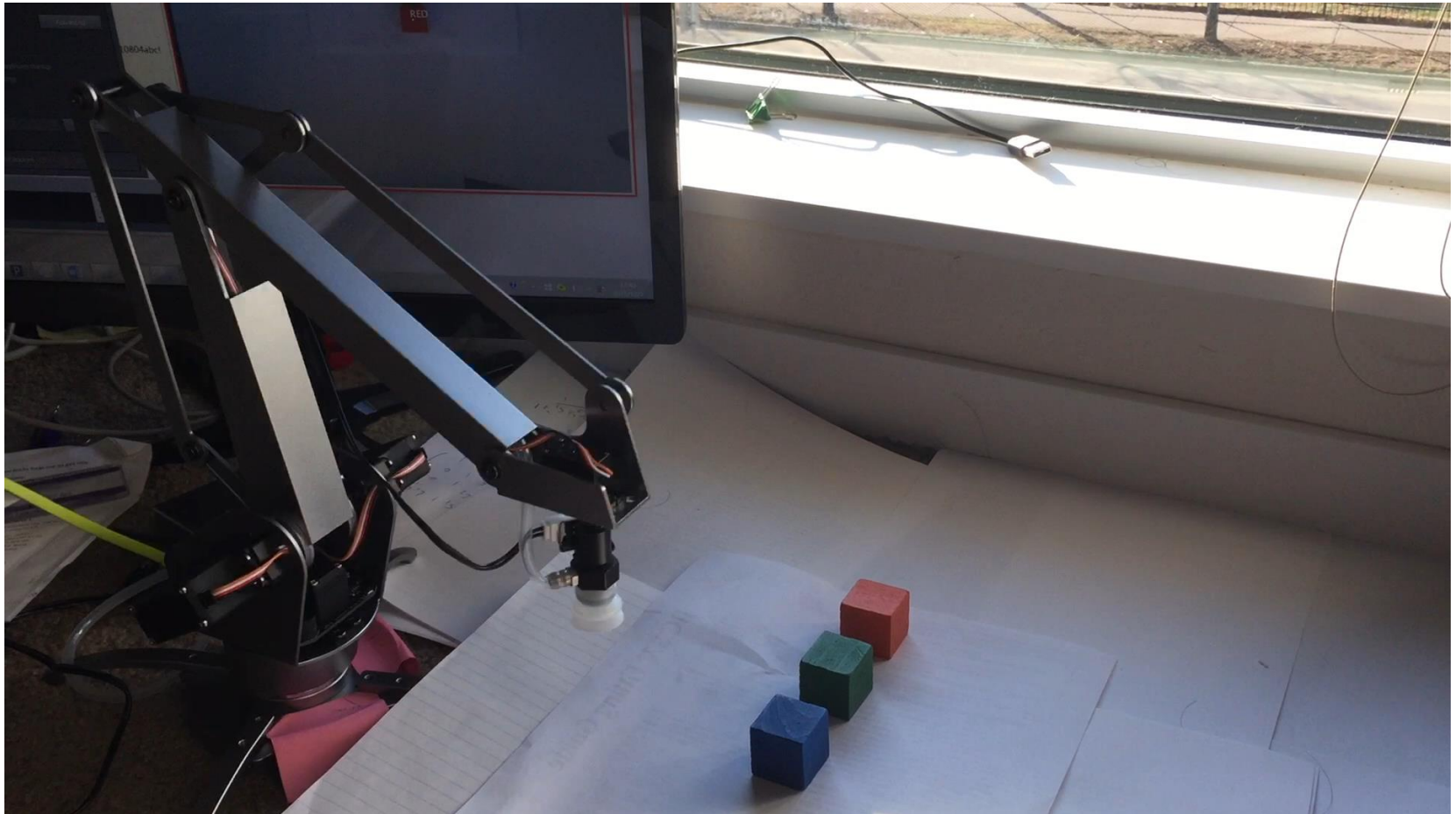
Image Processing and mapping

- Color Identification: RGB



- Location of object in Image: Center of mass
- Location of object in real world: Mapping

Real-time Control



Limitations and Problems Faced

- Errors (Precision)
 - Resolution
 - Coordinate transformation
- Color Identification
 - RGB values varies when light changing
 - Color interaction and objects oversampling

Improvement and Future work

- More accurate coordinate establishment
- More advanced color and objects detecting algorithm
- Build dynamic equations, trajectory, velocity, acceleration control

Questions

