Teleoperation of Robotic Arm Using Leap Motion Controller

CSCI 5551- Introduction to Intelligent Robotic Systems

PROJECT PRESENTATION

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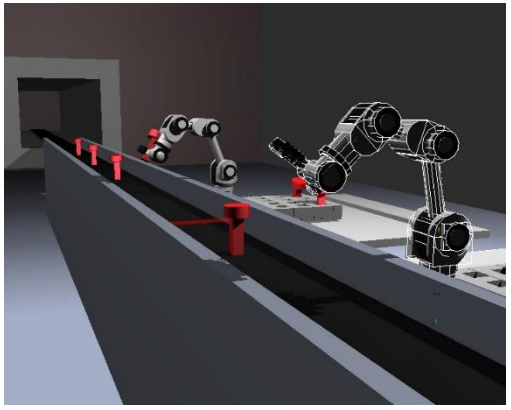
Agenda

- 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 and 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



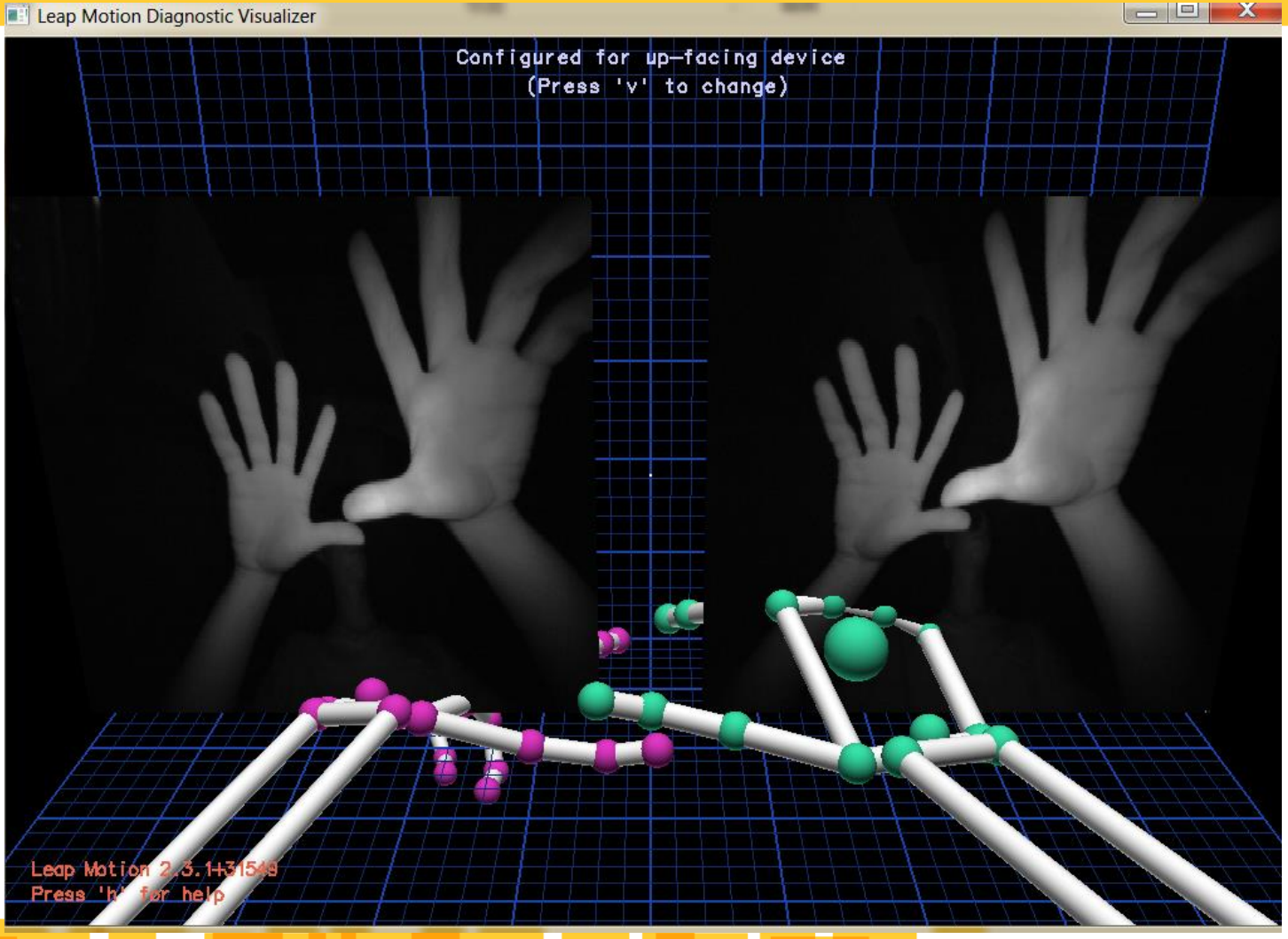
Project Overview

- 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

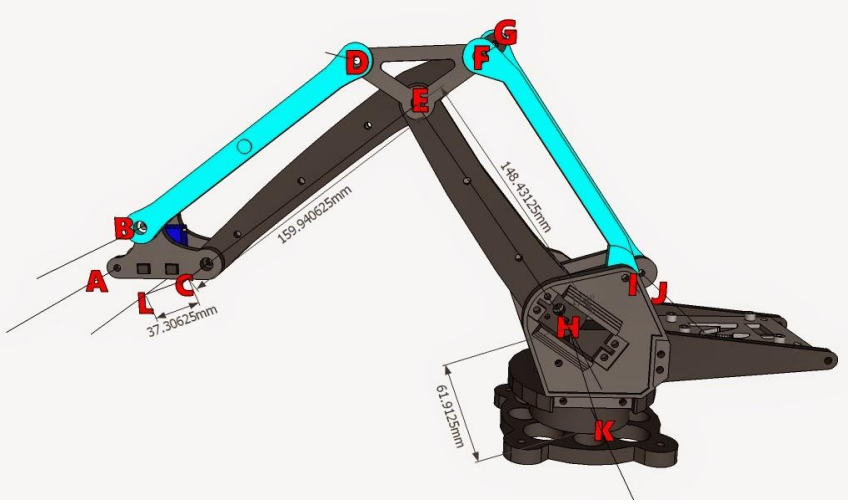


Overview- uArm

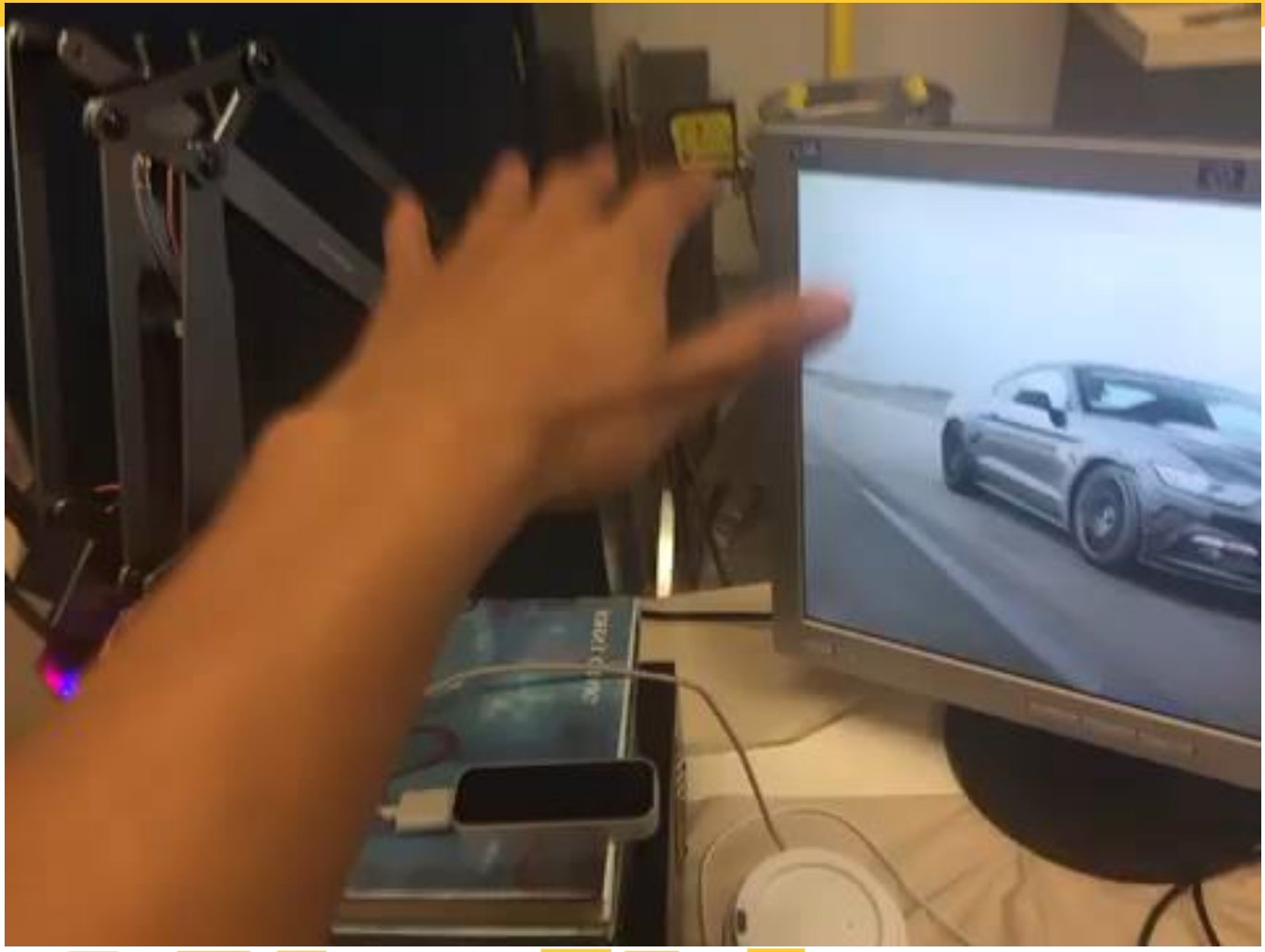
- Features:
  - 4 DOF
  - Arduino controlled
  - 3 high torque servos
- Customizable end effector
  - Vacuum pump
  - Gripper
  - Pen holder

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- LeapMotion

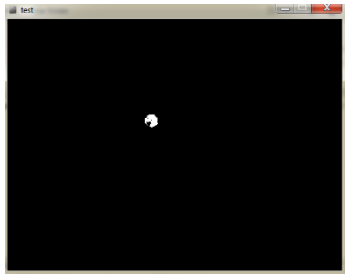


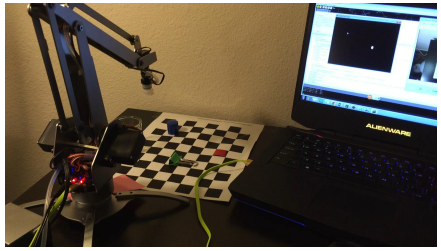
Webcam Controlling

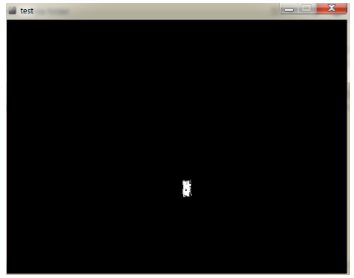
Calibrate Image ⟹ Image Processing ⟹ uArm

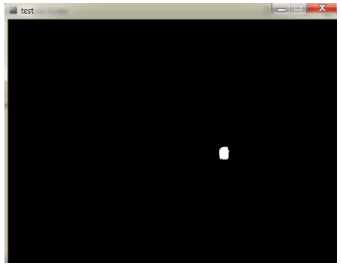
Undistort image

(Color and location Identification)









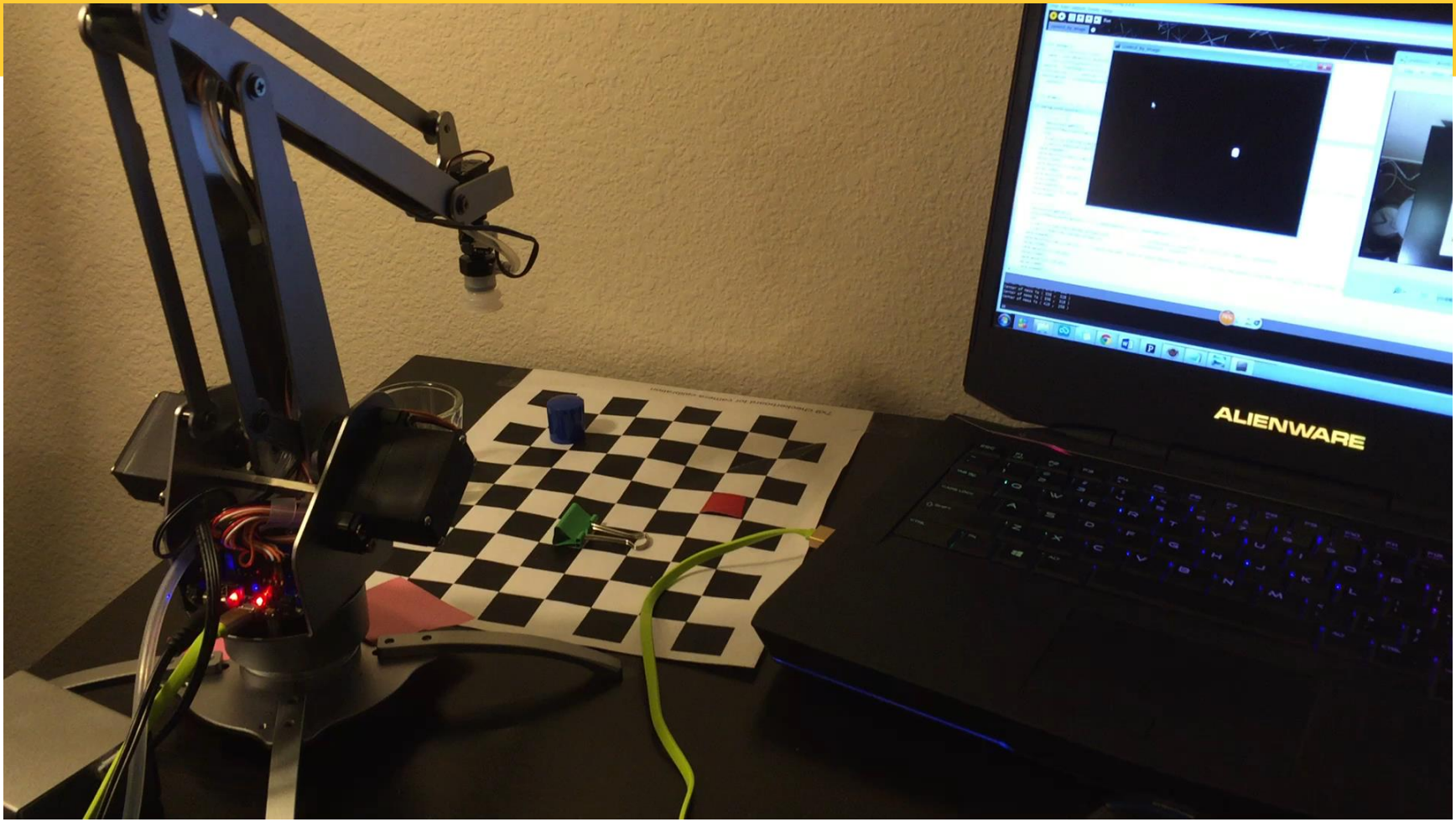
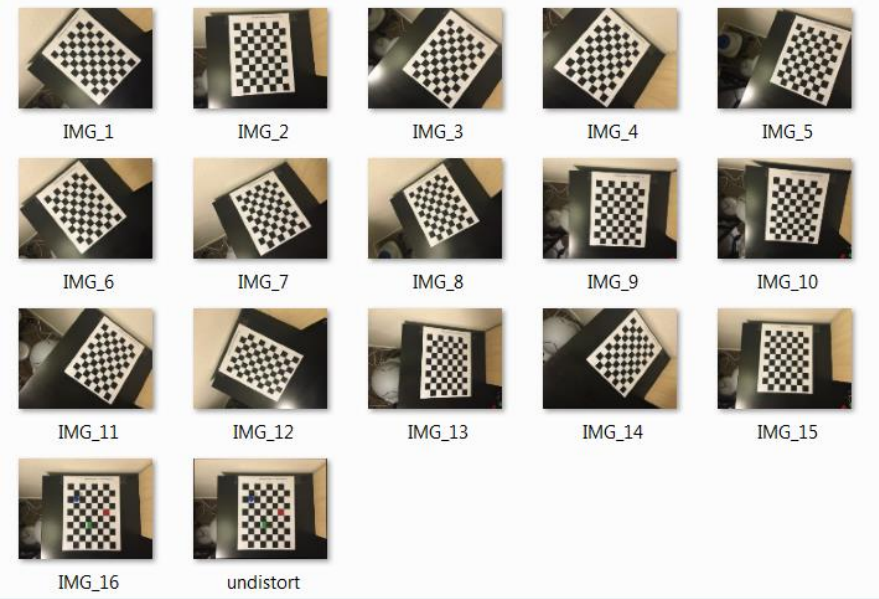

ALIENWARE

Image Calibration Using MATLAB

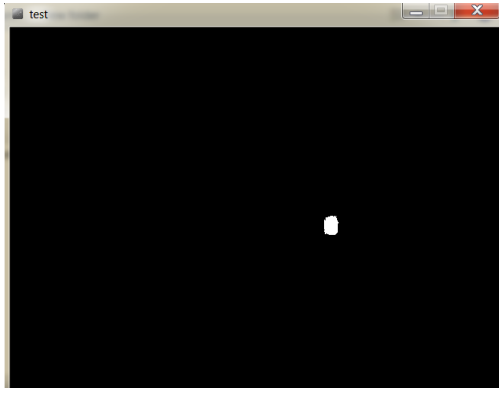
- Geometric camera calibration

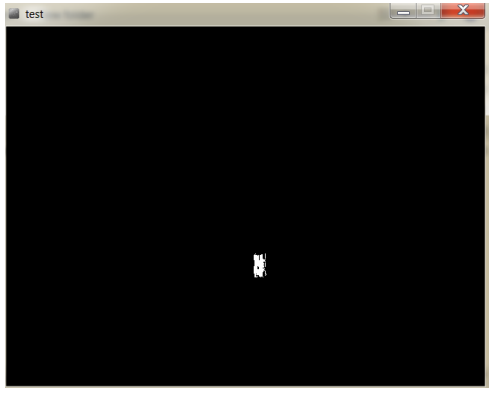


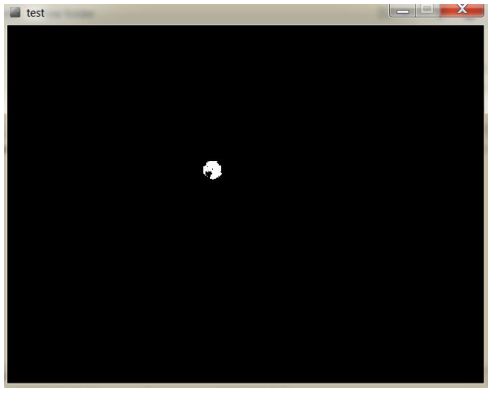
Calibration patterns

Image Processing and mapping

- Color Identification: RGB



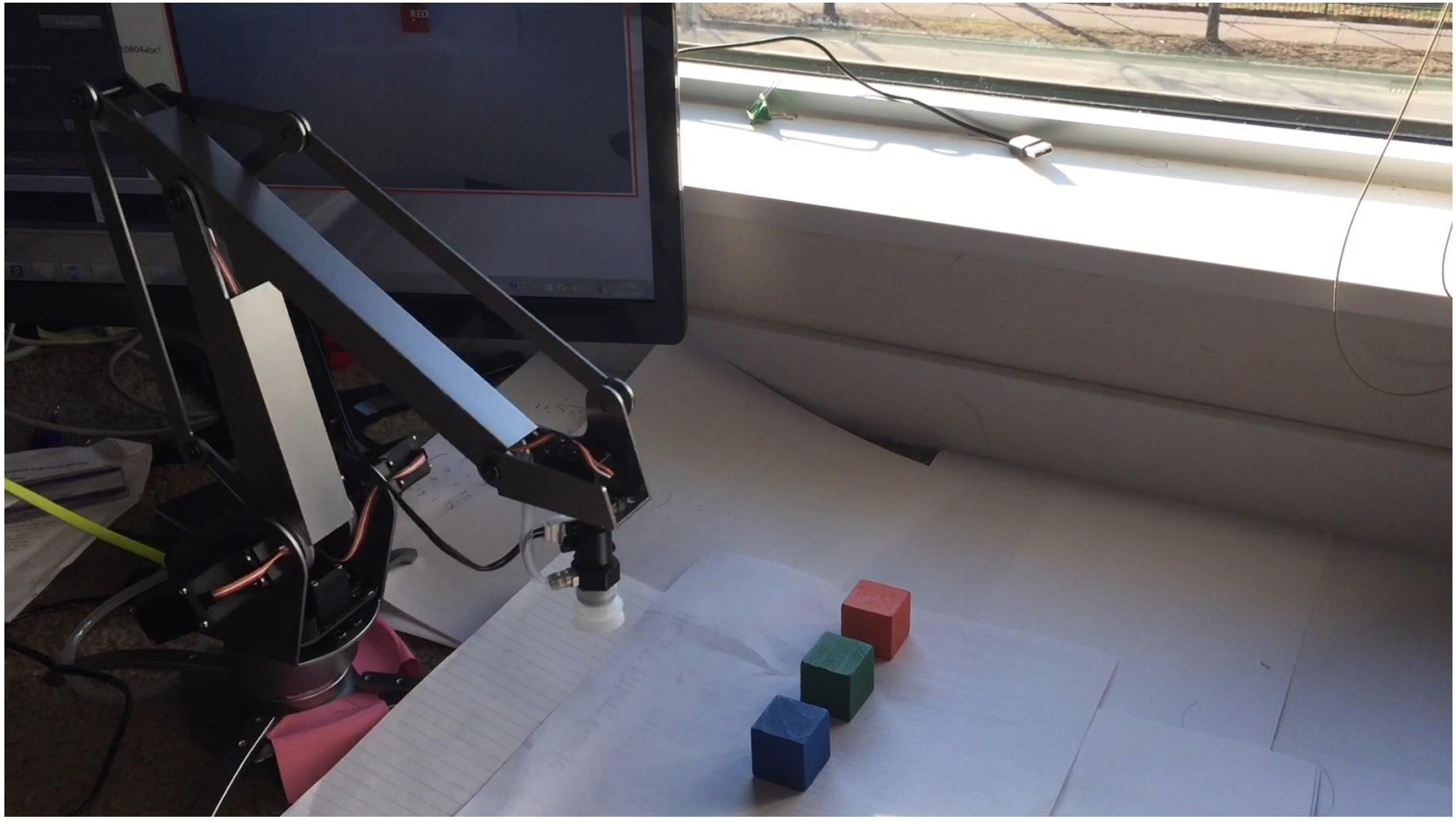




- Location of object in Image: Center of mass

- 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