SwimView 2.0

An autonomous camera tracking system for SwimView

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Existing System

- Remote controlled camera system
- Motorized cart
- Marshall CV200-MB camera
- Xbox controller
- Live-stream and Recording capability

Our Objectives

- Make system completely autonomous
  - Develop camera tracking system
  - Develop autonomous controls system
  - Hardware Integration

•Fix slipping of cable/pulley drive system

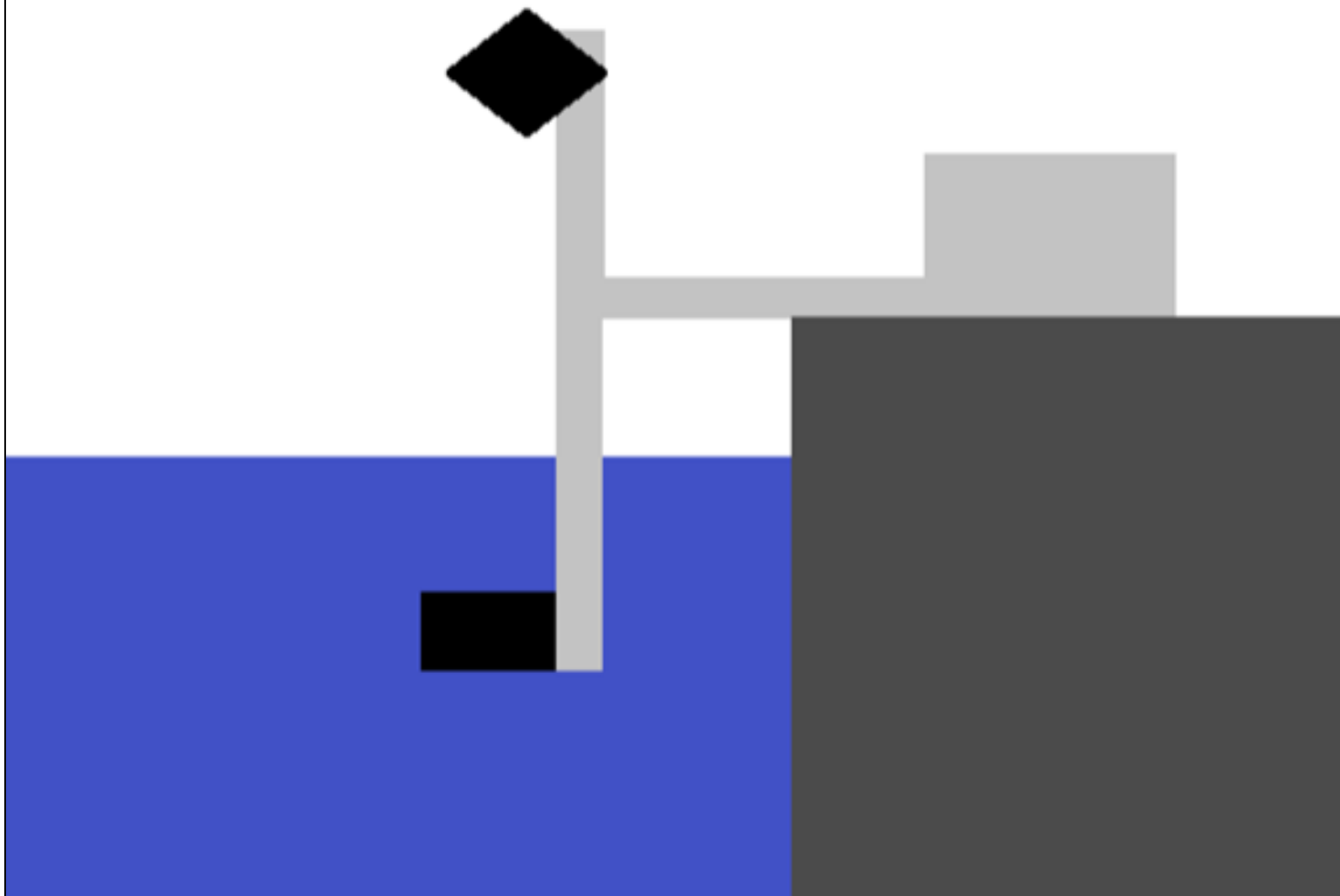


Image Tracking Hardware

- Raspberry Pi 3
  - 1.2 GHz Quad-Core ARM
  - 1GB DDR2 RAM
  - 5V, 2.5A
- Raspberry Picamera
  - 8 Megapixels
  - 1080p/720p
  - 640 x 480
- PVC arm

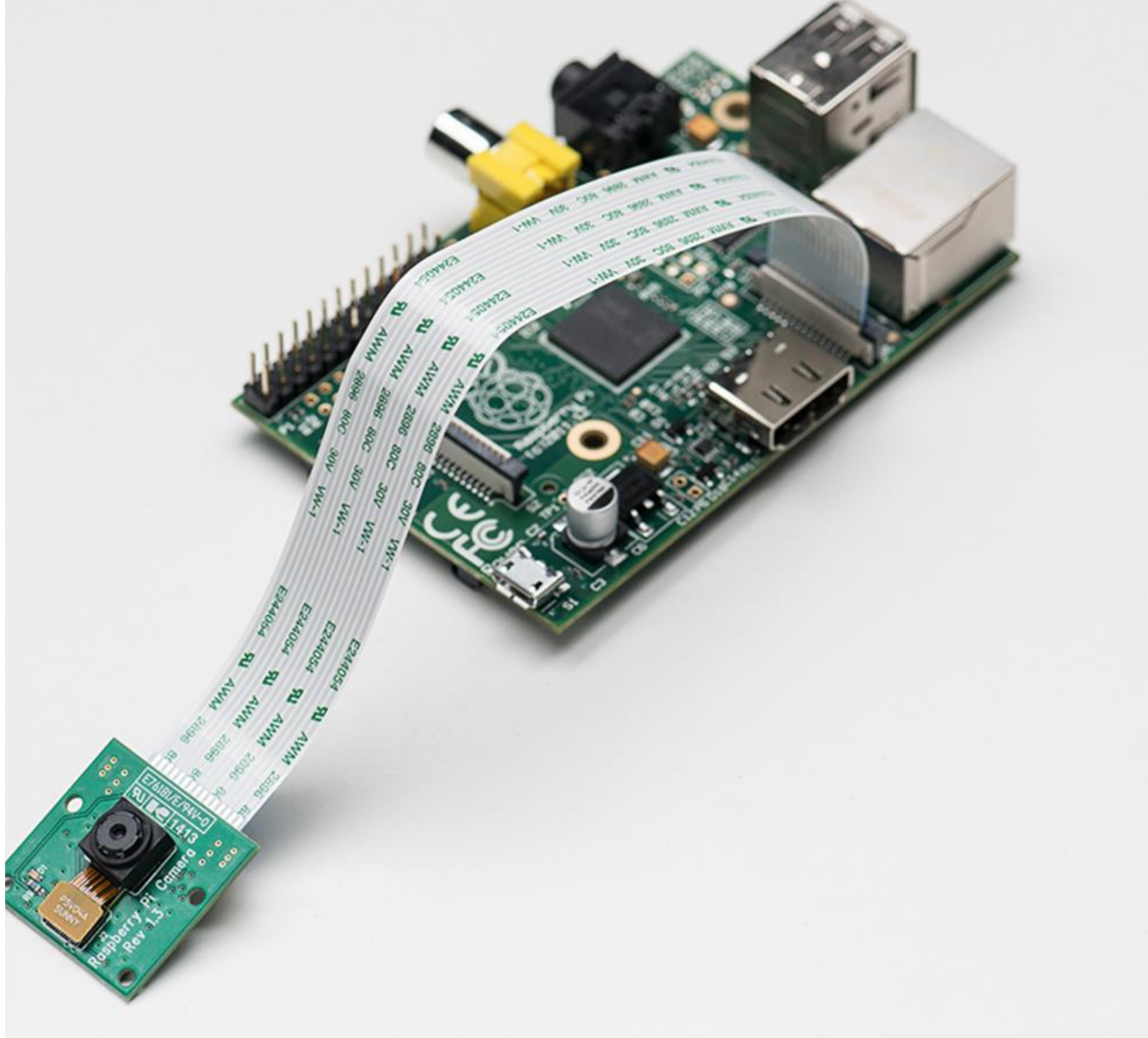
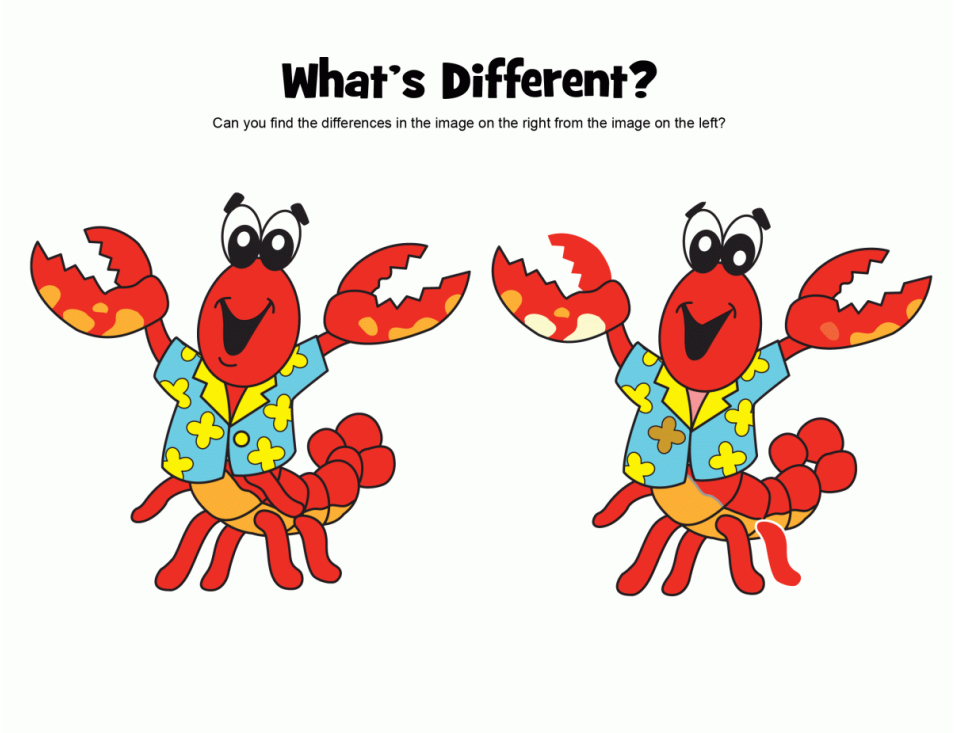


Image Tracking Software

- Python
- OpenCV

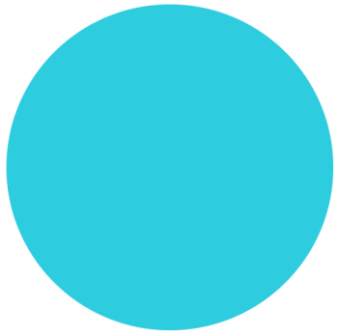
The Basic Idea

- Track Swimmer's Movement
- Sequential Images
- Estimate speed



Approach 1: Markers

- Solid Colored
  - Red
  - Yellow
  - Pink
  - White
- Simple Shapes

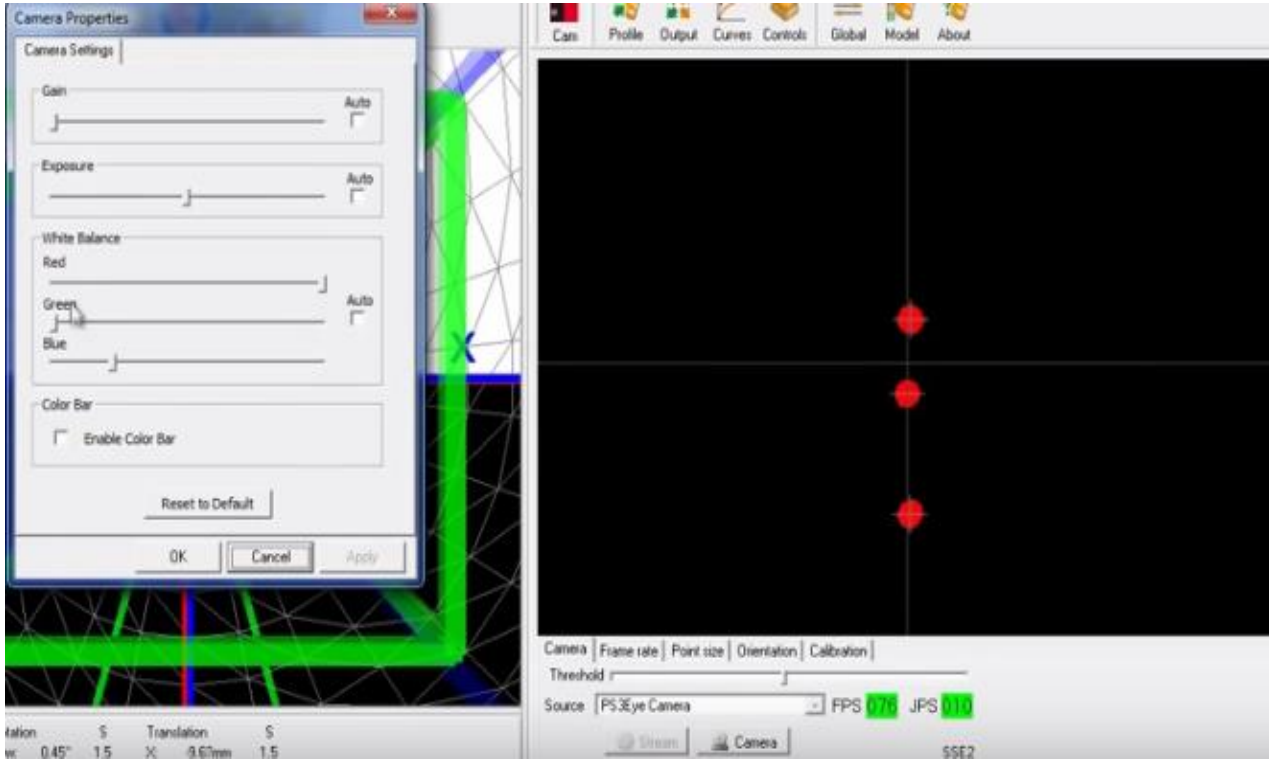


Approach 2: No Markers

- Compares pixels of two frames
- Tracks which pixels have changed
- Background is not static

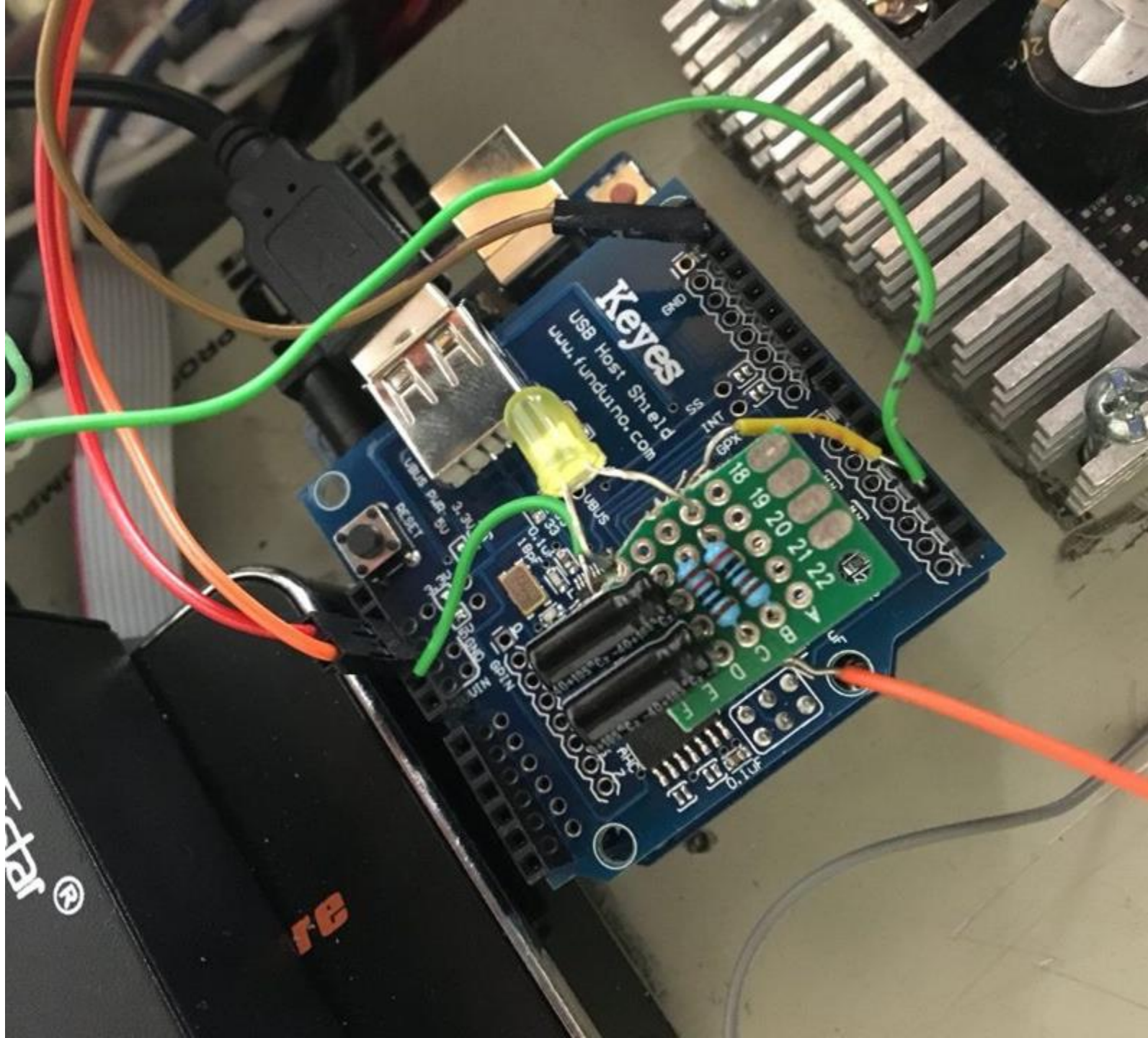
Approach 3: IR LED

- LED clipped onto swimmer
- Modify camera to sense infrared
- Water may obstruct light



Control System

- Automatic Control
  - Raspberry Pi 3 to Arduino
    - Serial Communication
  - Arduino to Sabertooth
    - Analog Signal
- Manual Control
  - Xbox Controller to Arduino
    - Radio Communication
  - Arduino to Sabertooth
    - Analog Signal



Team Responsibilities

- Software
  - Data collection
  - Image processing
  - Controls
- Hardware
  - Mounting new arm/camera
  - Integrating new microcontroller

Team Member	Primary Responsibility	Secondary Responsibility
Harrison Burch	Controls	Image Processing
Demetris Coleman	Image Processing	Controls
Avion Foreman	Controls	Hardware Integration
Jungihn Kim	Hardware Integration	Image Processing
Dustin Spencer	Image Processing	Controls
William Stewart	Controls	Project Management
Nick Thompson	Project Management	Hardware Integration
Dr. Robert Dean	Technical Advisor	
Dr. Wendi Weimer	Kinesiology Department Liaison	

Proposed Budget

Item	Price
Raspberry Pi Camera Module	$24.78
Adafruit Flex Cable (2m)	$7.97
Raspberry Pi Camera Case	$8.49
Rubber	$10.00
PVC Pipe	$50.00
extension cord	$70.00
Raspberry Pi Camera Lens	$30.00
Safety Seal for Ext Cord	$15.00
Colored Athletic Tape	$20
Overhead	$58.54
	$270.00

Timeline

Phase	Week No.	Wednesday Date	Objective
Proposal	1	11-Jan	Organizational Development
	2	18-Jan	Requirement Gathering
	3	25-Jan	Final Proposal
Phase One	4	1-Feb	Data Acquisition
	5	8-Feb	Data Acquisition
	6	22-Feb	Algorithm Development
	7	1-Mar	Image Processing Code
	8	8-Mar	Image Processing Code
	9	15-Mar	Spring Break
	10	22-Mar	Control Process Development
Phase Two	11	29-Mar	Hardware Integration
	12	5-Apr	Hardware Integration
	13	12-Apr	System Testing
	14	19-Apr	System Testing
	15	26-Apr	Presentation Development
	16	28-Apr	Senior Design Fair

Data Acquisition

- Recording of swimmers
- Full length of the pool including entry and turn-around
- Four Main Strokes:
  - Freestyle
  - Butterfly
  - Breaststroke
  - Backstroke
- Allow for testing of tracking and control algorithms

Algorithm Development (Image Processing)

- Swimmer Identification
  - Color histogram
  - Edge detection
  - Optical flow analysis

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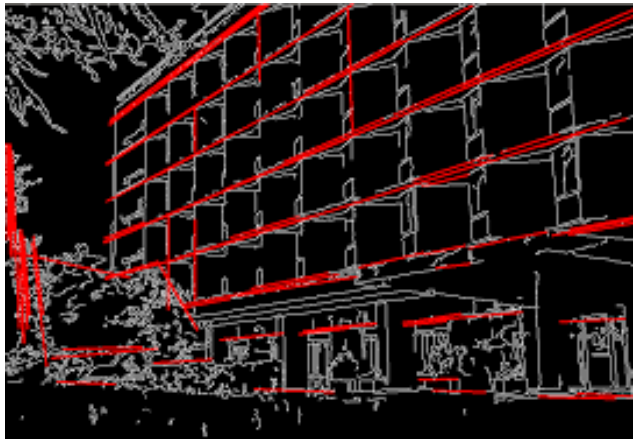
- Movement Modeling
  - Monitor successive frames
  - Match to one of six scenarios
  - Issue control signals

Becomes
This ⇒



Algorithm Development (Control System)

- Raspberry Pi to Arduino
  - Protocol development (in progress)
  - Control signals via serial communication
  - Initiated by image processing

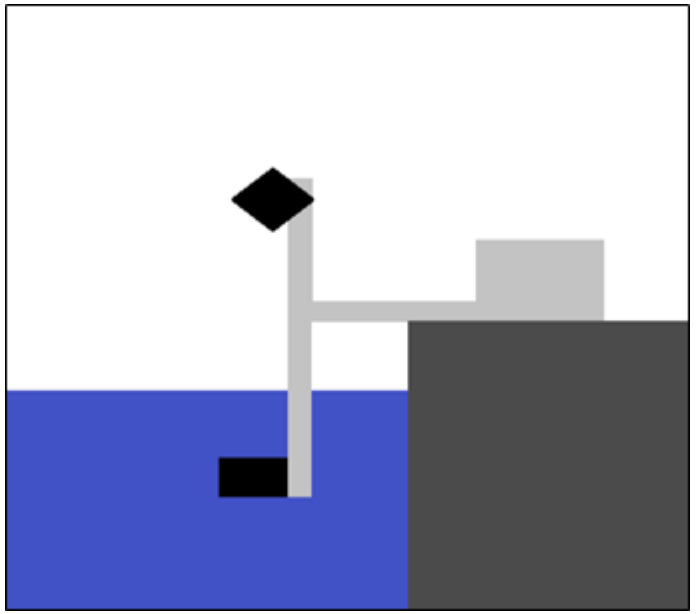
- Arduino to Sabertooth
  - Analyze current system (in progress)
  - Update code to mimic while in automatic mode

Software Development and Testing

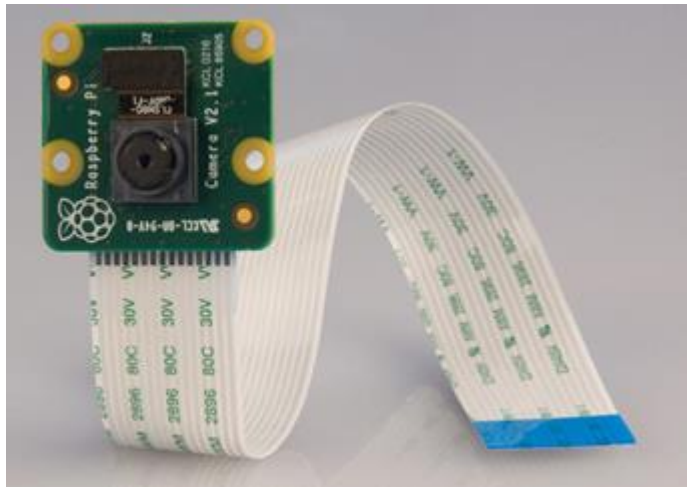
- Test algorithms using swimmer footage
  - Which methods work best?
- Issue controls signals
  - From Raspberry Pi to replica of Arduino/Sabertooth
- Monitor and measure outputs of Pi and both Arduinos

Hardware Integration (Raspberry Picamera)

- Mounting
  - Above water
  - PVC pipe onto previous camera mount
  - 45 degree angle towards water



- Electrical Connection
  - 2m Ribbon cable to Pi 3



Hardware Integration (Raspberry Pi 3)

- Mounting
  - Fit within chassis
  - Minimize length of signal cables
  - Use existing routing paths
- Power
  - 5V supply
  - 2.5A current draw
- Signal
  - Picamera to Pi: ribbon cable
  - Pi to Arduino: serial communication

Complete System Testing

- Software/Hardware
  - Interaction between camera tracking and autonomous control system
- Functionality
  - Monitor view of swimmer’s strokes
  - Stability of pulley system
- Usability
  - Manual controller to autonomous control switch
  - Video recording and live-stream features

IEEE Code of Ethics and Safety Codes

- All design decisions will be made in accordance with the IEEE Code of Ethics and the National Electric Safety Code (NESC).
- Accept responsibility in making decisions for the well being of the swimmers, workers, and public while product is in use.
- Avoid any conflicts of interest, be honest and realistic in claims or estimates, and reject bribery in all its forms.
- Improve the understanding of technology and to undertake tasks after full disclosure of pertinent limitations in training or experience.
- Seek, accept, and offer honest criticism of technical work received from colleagues and advisors and to credit properly the contributions of others.

IEEE Code of Ethics and Safety Codes

- Treat all persons involved fairly and not engage in discriminatory behavior.
- Assist colleagues in their professional development and support them in following the code of ethics.
- Abide by all NESC regulations of wiring near water.
- Handle batteries with extreme care

Conclusion

- This project will be a majority of software design with some hardware integration.
- Everyone will gain valuable experience in teamwork and technical skills.
- The project will be used by the Auburn University Kinesiology Department to observe swimmer’s mechanics.

Disposition

- The Spring 2017 Senior Design project will be donated to the Kinesiology Department at Auburn University

Disposition Agreement

The Spring 2017 SwimTrack design project is being sponsored by the Kinesiology Department Auburn University. All parts and equipment will be given to their department at the end of th semester. All team members have signed this disposition, and agree to comply with this decision.

Date: January 23rd, 2017

1. Nicholas Thompson
2. Avion Foreman
3. Dustin Spencer
4. Jungihn Kim
5. Demetris Coleman
6. William Stewart
7. Harrison Burch