SwimView

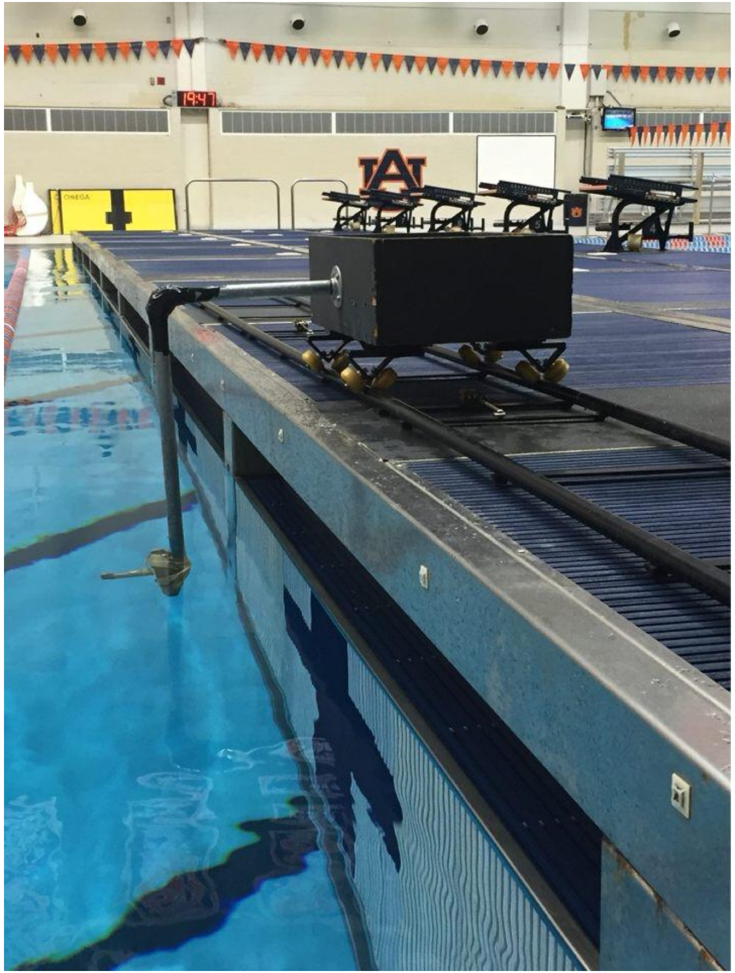
An Autonomous Camera System for the Kinesiology Department at Auburn University

Denver Atwood
Mark Ballard
Jesse Bigham
James Bowen
Kaleb Crowe
Dorian Hill
Andrew Holman
Garrett Hutchins
Brandon Leach
Jansen Phillips
Martin Wang

Andrew Holman

Introduction to the Problem

- The current system is a cart pushed along a track with an attached metal arm that extends into the pool with a video camera attached to it.
- Students have to push the cart alongside swimmers to capture underwater video.
- The video captured by the camera is not streamed live to the user.



Mark Ballard

Project Specifications

- Phase I:
  - Manually controlled system using wireless remote-controller and Raspberry Pi to drive DC motor. The speed of the motor will be variable to account for different swimmer speeds and acceleration.
  - Moves back and forth along the existing track using a belt and pulley system, which are controlled by DC motor, and using existing wheel design.
  - Attached arm with a GoPro HERO4 WiFi enabled camera that records beneath the surface of the water and provides streaming video of swimmer.
- Phase II:
  - Autonomous tracking system for following swimmers using sonar technology, which will eliminate the need for manual control.

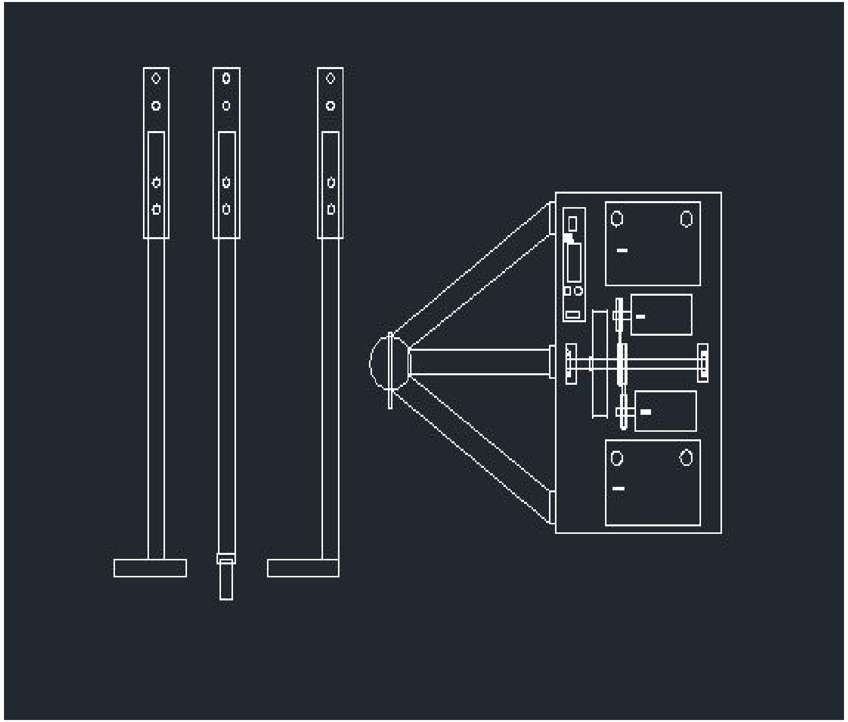
Andrew Holman

Potential Challenges

- Water Resistance
  - Pool water is ionized with chemicals, so equipment may be damaged if the circuitry is left exposed to the pool water.
  - Due to splashing and moisture, the unit on the side of the pool must be able to have adequate water protection to avoid corrosion and short circuiting.
- Weight Distribution
  - Weight of the robot must be balanced to avoid tipping or uneven strain on motors.
  - Robot must be light enough so that it can move at an adequate velocity to follow swimmers in water.
- Video Quality
  - The video quality can be affected by the movement of the robot along the track. Track must be leveled and provide a smooth enough surface for seamless motion.

Mark Ballard

CAD Design

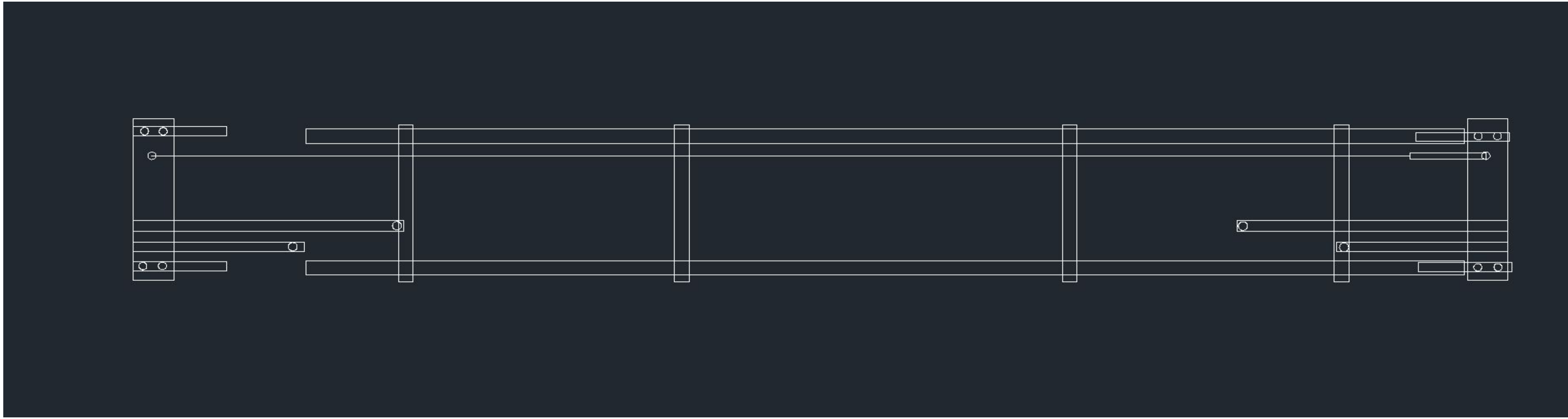


Jesse Bigham

Two 38 lb Marine AGM batteries 9.5x9x6.5
Two 12vdc motors on mounted 2.5 inches high with two 1.5 inch pulleys
One 8 inch pulley for the steel cable, will protrude 2 inches from the bottom. Box is 26.5x18x12
Additional support arms for the camera mount. Camera depth can be adjusted and arm can be removed.

CAD Design

End caps on the track



Jesse Bigham

Controller Software Design

Phase 1

- Use xboxdrv for DC motor control
- Use RaspiVid to stream video data
  - RaspiVid also has save mode
  - Could use standalone video hardware
- Detect warning & kill magnet sensors through RPi.GPIO

Phase 2

- Take input from Sonar sensor to automate driving
  - Mounting one of these in a waterproof housing might work, needs testing
- 3 presets to account for different launch style speeds (GPIO.PWM)
  - Diving block, surface dive/floor start, wall start

Alex Atwood

Video

GoPro Hero 4 Black with waterproof housing.

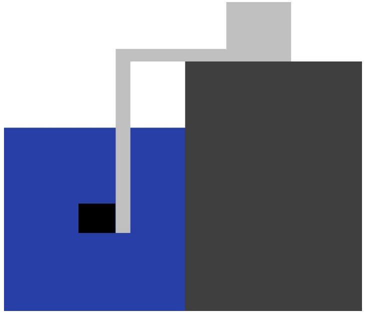
- Shoots 4k video at 30 fps, 1080p at 120 fps, and 720p at 240 fps
- Has a Wi-Fi/bluetooth app to allow video streams real time
- Has an automatic low-light mode which may be necessary for underwater filming
- Has pre-made mounts to easily attach it to the arm

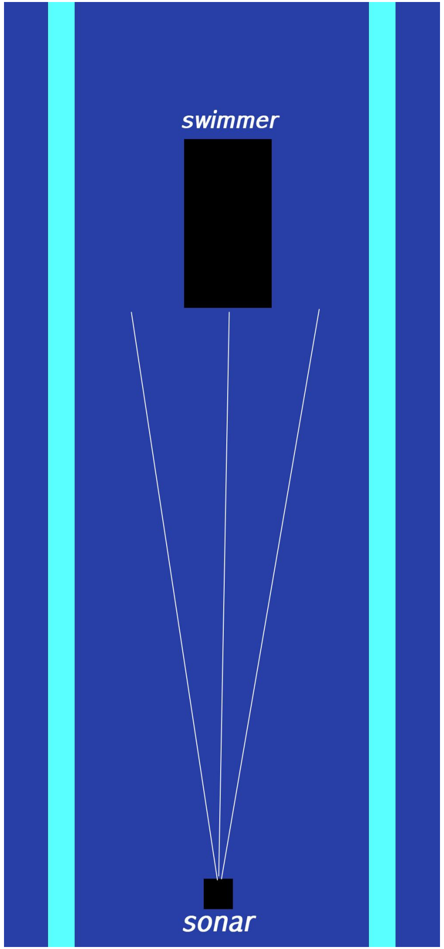
Garrett Hutchins

Tracking

For use in Phase 2

- Tracks distance from starting position
- Controls speed of chassis
    - (sample1 - sample2) / Δtime = desired speed
- Remotely fed to motor controller using raspberry pi





Jansen Phillips

Locomotion Pugh Chart

	Nomadic Wheels	Pulley System
Cost	1	1
Ease of Implementation	1	1
Reliability	-1	1
Slippage	-1	1
Space	1	1

Dorian Hill

Tracking Pugh Chart

	Video Tracking (Pattern)	RFID	Bluetooth	Manual
Cost	1	0	0	1
Ease of Implementation	1	0	0	1
Reliability	-1	1	1	0
Drag	1	0	1	1

Dorian Hill

Video Pugh Chart

	DVR	Live Stream	Uploads to Online Server
Cost	1	-1	0
Ease of Implementation	1	1	1
Reliability	1	1	1
Quality	1	1	1

Dorian Hill

Team Management

- Primary Jobs
  - Hardware jobs for the design and construction of the physical product
  - Software jobs for the design and implementation of controls and supporting software
- Secondary Jobs
  - Provide miscellaneous skills
  - Reduce critical choke points by increasing knowledge sharing

Martin Wang

Team Member	Primary Job	Secondary Job
Alex Atwood	Controls Software Programmer	Raspberry Pi Integrator
Mark Ballard	Hardware Integrator	Hardware Designer
Jesse Bigham	Hardware Designer	CAD Developer
James Bowen	Hardware Integrator	Structural Design
Kaleb Crowe	Hardware Designer	Hardware Troubleshooter
Dorian Hill	Hardware Integrator	Treasurer
Andrew Holman	Controls Software Programmer	Tracking Software Programmer
Garrett Hutchins	Video Software Programmer	Tracking Software Programmer
Brandon Leach	Hardware Designer	Hardware Troubleshooter
Jansen Phillips	Tracking Software Programmer	Video Software Programmer
Martin Wang	Controls Software Programmer	Tracking Software Programmer

Budget

Goal: Under $3,000

GoPro 4K Camera	500
Camera Arm	50
Box with Wheels	300
12 V Motor	300
2 Batteries	360
2 Bearings and Shaft	120
2 Pulleys	80

Belt and Steel Cable	55
2 Aluminum Strips	35
Ultrasonic Sensors	40
Raspberry Pi 3	35
Xbox 360 Controller	30
1 TB Hard Drive	100
Miscellaneous	300
Total	$2,305

Kaleb Crowe

Schedule

Swim View					
General Start-Up (Phase 1)					
	Start	**End**	**Duration**	**% Complete**	**Days Remaining**
Design	22-Aug	7-Nov	16	90%	16
Proposal	26-Aug	26-Aug	1	50%	1
Ordering Materials	29-Aug	12-Sep	15	0%	15
Receive All Materials	19-Sep	19-Sep	1	0%	1
Begin Project					
Cart Build Out	19-Sep	3-Oct	14	0%	14
Cable Design	19-Sep	3-Oct	14	0%	14
Arm Design	26-Sep	10-Oct	14	0%	14
Motor Assembly	3-Oct	14-Oct	11	0%	11
Software Design	26-Aug	10-Oct	44	0%	44
Controller Design	26-Aug	23-Sep	28	0%	28
General Start-Up (Phase 2)					
Tracking Device	14-Oct	25-Nov	42	0%	42
Tracking Software	14-Oct	11-Nov	21	0%	21
Tracking Motor Control	14-Oct	11-Nov	28	0%	28
Sensor Management	14-Oct	4-Nov	21	0%	21
Project Summary					
Phase 1 (Controller)	24-Aug	14-Oct	51	0%	51
Phase 2 (Tracking)	14-Oct	30-Nov	47	0%	47
Complete Project	24-Aug	30-Nov	98	0%	98
Presentation	30-Nov	30-Nov	1	0%	1

James Bowen

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.

Brandon Leach

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.

http://www.ieee.org/about/corporate/governance/p7-8.html

Brandon Leach

Disposition Agreement

The Fall 2016 Senior Design project will be donated to the Kinesiology Department at Auburn University.

All team members have signed the disposition.

Disposition Agreement

The Fall 2016 Senior Design project will be donated to the Kinesiology Department at Auburn University.

All team members have signed this disposition, and agree to comply with this decision

Date: August 24th, 2016

1. Martin Wang ______
2. Dorian Hill ______
3. Sean (Jansen) Phillips ______
4. Jesse Bigham ______
5. Brandon Leach ______
6. Kaleb Crowe ______
7. Mark Ballard ______
8. James Bowen ______
9. Andrew Holman ______
10. Garrett Hutchins ______
11. Alex Atwood ______

Conclusion

- This project will benefit the Biomechanics Lab in the Department of Kinesiology at Auburn University and its efforts to train swimmers of all different skill levels.
- All team members will gain valuable design, teamwork, and professional communication experience.
- This project will involve control software design, wireless software design, hardware design, and mechanical design.

Andrew Holman