Adapty Floaty Project Proposal

Team #1 (Leon Cheng and Daniel Hong)

Problem Statement & Idea:

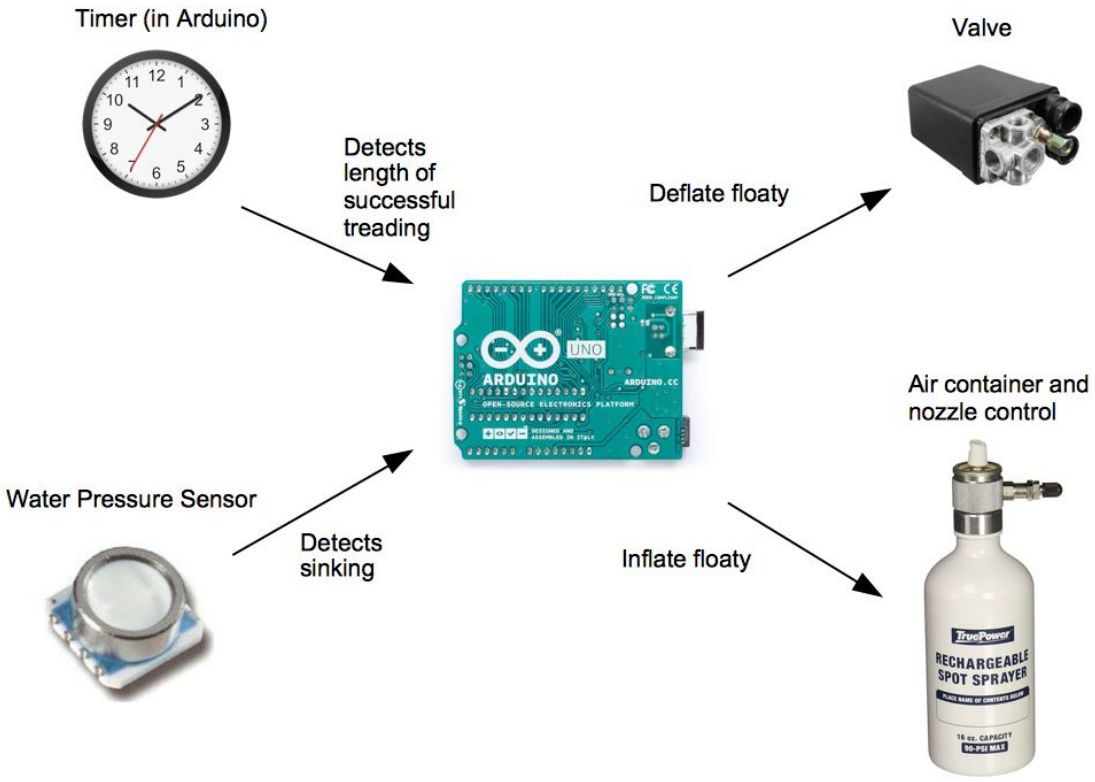
Learning how to swim can be quite challenging.

Our Adapty Floaty © adjusts to your skill level, supporting you with as much buoyancy as you need.

The idea is to detect how well the user is treading water and then inflating/deflating the floaty to aid the person learn to tread.

System Block Diagram

Here's what we plan to use for sensors and actuators:



Sensing

Detecting Sinking

We need to detect if the person is sinking.

List all the sensors that would allow you to sense the user performance:

There are several options that we thought of:

1. **Water Pressure Sensor:** This sensor would detect how deep the floaty is underwater; would be the most reliable way to measure water depth.
2. **Water Detection Sensor:** Detect if it touches water. Can be attached to a person's head and detect if it goes underwater. But this is not fine tuned readings because it only allows detection of above surface or below surface.
3. **Ultrasound Sensor:** This sensor would detect how deep the floaty is underwater by using ultrasound to detect how far from the surface.
4. **Camera Sensor:** This sensor would sit outside the pool and watch for the person to start sinking. May not be reliable if the person is only slightly below the surface of the water and the sensor still sees the person.
5. **Stick Sensor:** This sensor would attach to the user and read how deep the person is based on the water level of the stick. This would be reliable in reading the water pressure, but also cumbersome since it would need to stick out of the water as well.

Which sensor from the list do you plan to use?

Water pressure sensor.

Why is this sensor a better choice than the other options from above?

We decided that the water pressure sensor is the most logical sensor to use since it should provide the most accuracy in measuring the person's ability to tread, which is extremely important since it can be dangerous if we do not accurately sense the person is sinking.

Detecting Treading

We need to detect if the person is treading successfully.

List all the sensors that would allow you to sense the user performance:

1. **Time Sensor:** Will keep track of how the long the person is treading successfully, and after a certain time will increase the difficulty level. Time is always consistent so this would give perfect accuracy.

2. **Camera Sensor:** This sensor would sit outside the pool and watch the person's treading form to determine if they are treading properly using machine learning. Accuracy would be heavily dependent on how good the machine learning model it.
3. **Body Stress Level Sensor:** Would be attached to the person's blood flow or heart. If the person is under high duress, increase buoyancy. If the person is doing very well, decrease buoyancy.

Which sensor from the list do you plan to use?

Time sensor.

Why is this sensor a better choice than the other options from above?

It is cheap and reliable.

Actuation

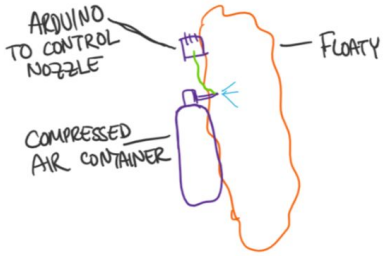
Adjusting the Buoyancy (Inflation)

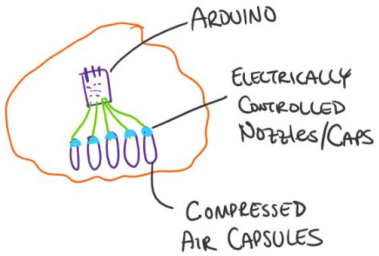
We need a way to inflate the floaty

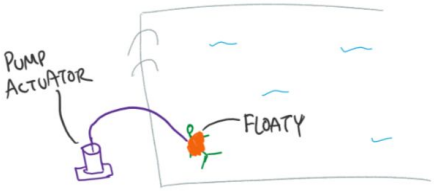
List all the actuation methods that would allow you to adapt the physical tool:

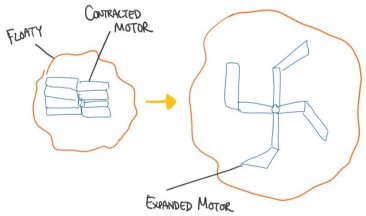
To raise and lower the basket, we could use the following:

1. **Compressed air container and nozzle control:** Have the user wear a container of compressed air on their back. Allow for fine tuned release of compressed air to inflate floaty. Hopefully also obtain the equipment to refill air container to reuse for repeated testing.
2. **Small Capsules of Compressed Air:** Each capsule holds an amount of compressed air, which can be released to inflate a floaty. Multiple small capsules are used for incrementally adding more air. However, this allows for less fine-tuned control. Also may be difficult to refill small capsules with compressed air.A possible advantage is that everything may be able to be encased inside the floaty.
3. **Pump actuator:** Place on the side of the pool and pumps air to the floaty through a long tube. Would be easy and reliable, but very cumbersome and would restrict movement in the pool. If the person accidentally pulls the actuator into the water, it may break. Can be used indefinitely because it does not need refilling like compressed air.
4. **Motor inside of a floaty:** Take advantage of archimedes' principle (displacing more volume of water results in more buoyancy). Put a skeleton structure inside a floaty, which can expand and take up more space. But this may be unusually shaped to fit inside a floaty. Also may be difficult to cause a floaty to expand in this way or may cause tears in the floaty.









Which actuation method from the list do you plan to use?

Compressed air container and nozzle control.

Why is this actuation method a better choice than the other options from above?

It allows for the most fine-tuned control. It is not very cumbersome and should also allow retesting.

Adjusting the Buoyancy (Deflation)

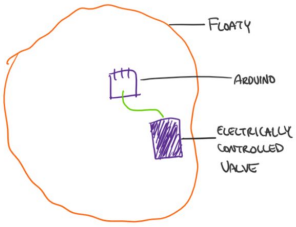
We need a way to deflate the floaty

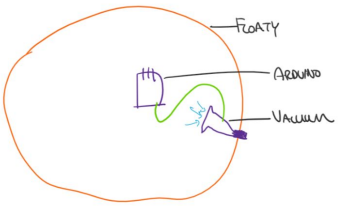
List all the actuation methods that would allow you to adapt the physical tool:

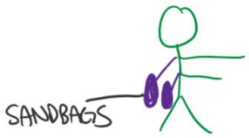
Making a hoop that changes size will likely be a challenge.

Here are some thoughts on how we can do it:

1. **Have a valve on the floaty:** The valve would simply open for a short amount of time to release air from the floaty. Easiest solution and very reliable. Similar to how a balloon automatically deflates itself and shrinks to its initial smaller shape.
2. **Vacuum:** Have a vacuum attached to the floaty to suck out just the right amount of air. Would provide the most accurate way of releasing the right amount of air, but may be difficult to attach properly.
3. **Adding sandbags:** In order to make it more difficult (since the swimmer is at this point doing very well), add heavy sandbags to make it heavier.







Which actuation method from the list do you plan to use?

The valve.

Why is this actuation method a better choice than the other options from above?

As long as the valve can close quickly, it should be the easiest way to deflate the floaty without adding too many electronics (which is important since more electronics means more water-proofing)

Order Sheet

Item	Price	Website	Description
1) Sensors:			
Water pressure sensor	$22.39	https://www.mouser.com/ProductDetail/Measurement-Specialties/325540009-50?qs=6mErgoZBfVK3N6P%252bVoqNPA%3D%3D&gclid=Cj0KCQjw_7HdBRDPARIsAN_ItcIxNKi0UPhJzsTzwgEPZ64-0AwySTrYwKCS6sKzV9Bx-UuDEkw2K2QaAvefEALw_wcB	Detects water pressure/depth for detecting sinking
Time sensor	free	In Arduino	For detecting treading mastery level
2) Actuators:			
Compressed air container and nozzle control	$19.86	https://www.amazon.com/Gino-Development-03-0828-Refillable-Multipurpose/dp/B009IY6IHS/ref=asc_df_B009IY6IHS/?tag=hyprod-20&linkCode=df0&hvadid=1981	For adding air to the floaty

		07334619&hvpos=1o1&hvnetw=g&hvrand=10942124645772590793&hvpone=&hvptwo=&hvqmt=&hvdev=c&hvdvcmdl=&hvlocint=&hvlocphy=9002000&hvtargid=pla-319250115722&psc=1	
Valve	$9.38 (2x)	https://www.banggood.com/Heavy-Duty-Air-Compressor-Pressure-Switch-Control-Valve-90-120PSI-p-917569.html?gmcCountry=US&currency=USD&createTmp=1&utm_source=googleshopping&utm_medium=cpc_elc&utm_content=2zou&utm_campaign=pla-all2-us-pc&gclid=Cj0KCQjw_7HdBRDPARIsAN_ltcIcNCcLE6_EcU3qgnZ7iwkYN57KWp7Aa9eXUV03E-IvCEIiHKgav6IaAhxyEALw_wcB&cur_warehouse=CN	For releasing air from the floaty
3) Other electronic components:			
None			
4) Other mechanical components:			
Floaty	$8.99	https://www.amazon.com/Airhead-Type-Keyhole-Adult-Orange/dp/B0001YW09E/ref=sr_1_12?s=boating-water-sports&ie=UTF8&qid=1538112050&sr=1-12&keywords=life%2Bvest&th=1&psc=1	Base floaty
Tubes	$5.69	https://www.amazon.com/Penn-Plax-Aquariums-Flexible-Standard/dp/B0002563MW/ref=sr_1_5?ie=UTF8&qid=1538093349&sr=8-5&keywords=air+tube	Connect compressed air to foaty
Waterproofing material	free	Get it from the lab	To keep electronics waterproof, especially for connecting points between objects underwater
Back straps	$16.78	https://www.amazon.com/Mueller-Lumbar-Support-Removable-Regular/dp/B00267SFKC/ref=sr_1_6_a_it?ie=UTF8&qid=1538093386&sr=8-6&keywords=back+strap	For the compressed air

Motor for nozzle control	$3.55	https://www.miniinthebox.com/en/p/130-miniature-dc-motors-small-motor-small-four-wheel-motor-5pcs_p2808842.html?currency=USD&litb_from=paid_adwords_shopping&country_code=us&utm_source=google_shopping&utm_medium=cpc&adword_mt=&adword_ct=202532451501&adword_kw=&adword_pos=1o9&adword_pl=&adword_net=g&adword_tar=&adw_src_id=33249133621_866623160_43913316455_pla-327802935816&gclid=Cj0KCQjw_7HdBRDPARIsAN_ltcKyuO0DhFyF_mdNh8-fKRki4L1sa2Gq3iLSHrrMGmsUfoPArCIR1fcaAnkPEALw_wcB	

Milestone Plan

For every milestone, we will ask you to upload a video to gradebook showing the demo deliverable you described.

You will be able to change your demo-deliverable up to 1 week before it is due (e.g. you can change the description of your Oct. 19 deliverable until Oct. 12, but not afterwards, so think hard of what you can actually get done in a week in a team of two).

We will watch the video and compare it to your milestone description. If it matches, you get all the points, if it doesn't you don't get the points.

E.g. if you have one (#1) todo, you get either 100% or 0% on the todo. If that's all you had for the week, it's pretty high risk. If you have #1 + #2 todos, you still get 100% or 0% on each todo, but now the risk is mitigated (e.g. you get one done and one doesn't work, you get 50% in total for the week). Thus, more detailed milestones help.

Milestone	**Requirements**	**What we will implement during the week (max. #4 separate todos per week):**	**What we will show in the video to demonstrate that it actually works:**
Oct 5 (#1)	first sensor wired up	We will wire up the water pressure and write the raw data to the Arduino Serial Monitor. - Sensor fully wired to Arduino - Sensor outputs accurate water level readings - Write Arduino code that works to	We will put the sensor in a glass of water and show that we are getting the readings

		read in pressure data	
Oct 12 (#2)	first actuator wired up	We will wire up the nozzle to inflate the floaty - Attach tube to floaty in a waterproof/sealed manner - Manually control nozzle to release air into floaty - Actuator fully wired to Arduino - Use correct Arduino code to move the nozzle to control air release	We will show the floaty inflating
Oct 19 (#3)	Second actuator wired up	We will wire up the valve to release air from the floaty - Actuator fully wired to Arduino - Valve moves open and closed, manually - Valve moves open and closed, according to correct Arduino code	We will show the floaty deflating
Oct 26 (#4)	First sensor-actuator connection	We will have the nozzle automatically inflate the floaty if the water pressure sensor signals sinking - Write correct Arduino code to detect "sinking" - Write correct Arduino code to cause floaty to inflate when "sinking" is detected - Compressed air nozzle control works correctly to inflate the floaty when arduino tells it to	We will show the floaty automatically inflating
Nov 2 (#5) midterm presentation	Second sensor-actuator connection	We will have the timer deflate the floaty automatically if the water pressure sensor does not signal sinking after a specified amount of time - Correct Arduino code to detect time/duration to use to decide when the swimmer has reached competency - Valve works correctly to deflate the floaty when the arduino tells it to - Do some testing to make sure that "sinking" is detected	We will show the floaty automatically deflating

		correctly (under unusual swimming conditions) and resets the timer	
Nov 9	no deliverable necessary, veteran's day	----------	----------
Nov 16 (#6)	Connect everything	Attach things to the back strap and make sure everything is waterproof - Attach everything so that nothing falls off with shaking - Attach on to a human to make sure it is not too restrictive of swimming condition - Place underwater to make sure electronics are not touched by the water - Place underwater and turn functions on to make sure there are no leaks	We will show a person wearing the product
Nov 23	no deliverable, thanksgiving	----------	----------
Nov 30 (#7)	user study results	Ran the user study and made graphs to show the results. Took photos for prototype and captured video material for video. - Run user study on participant and record data - Run study with differing conditions, ex: sinking, swimming well - Make graphs to analyze results	Show the graphs and videos
Dec 5	final presen-tations #1	Cut and exported final video and made presentation for class today.	Present our project
Dec 7	(no class)	Created final website with photos and video.	Show website
Dec 12	final presen-tations #2	Cleaned up code.	Give final presentation