Senior Design I
Group 23
September 17th, 2021

Initial Project Document

Pool-AID:
A Drowning Prevention System

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Section 2: Project Narrative

According to the *Stop Drowning Now* organization, there are approximately 320,000 drowning deaths worldwide on a yearly basis. With technologies developing in every aspect of the world today, it is our responsibility to make sure that technology is also used to help prevent such tragic events from happening. The leading causes of drowning, as reported by the CDC, can be traced back to lack of supervision, alcohol consumption, and neurological disorders. The ultimate purpose of the project is to notify the homeowners, lifeguards, or babysitters if anyone has accidentally entered the pool or is struggling inside the body of water. Someone once said that drowning is perfectly silent; however, our system will be designed to make drowning loud and heard until the situation receives some attention.

The motivation behind Pool-AID is to create a system that is easy to use, water resistant, and affordable for families and swimming facilities to keep their loved ones, young or old, safe. Our drowning prevention system will include a wide range of features to help minimize drowning accidents in residential and private pools. A parent will no longer have to worry about taking a nap, leaving the backdoor open, or making a quick run to the kitchen while their child is near the pool. Similarly, a lifeguard will not have to worry about taking a quick water break, checking their phone every now and then, or even chatting with a visitor in a public swimming center.

Our system will be designed to sound an alarm within seconds once any drowning activity has been noticed. This device will be floating around a pool, so it will not require any external installations. For proper usage, it will be placed inside a pool, but not completely submerged under water. It will be detecting objects weighing at least a certain amount using sonar sensors, which will be determined depending on available drowning statistics. This will be an important feature since the user will not be happy if the alarm goes off if a pool-foam noodle is thrown into the pool.

Our device will be easy to set-up as well as portable. It will be designed to provide coverage for small sized pools. This implies that a facility with a fairly large pool will need multiple devices to protect the entire area. Pool-AID can be triggered manually or automatically with its sensor-based technology. If an adult is drowning and needs assistance, they could just hit a visible button on the device. Although this feature will only be of use to a small number of people, it can also be used if the supervisor is unable to provide assistance to the victim due to physical constraints.

Another important feature our device will support is the use of solar panels for power purposes. This feature will allow the users to change the battery very rarely or charge the device. The need for a battery source is due to our device functioning in outdoor and indoor pools. With the very little sunlight available in indoor swimming facilities, having a battery source becomes necessary.

An application will be designed to display and store information of activity happening in the pool. It will include a video of the visitor for a short duration, as well as timestamps of the activity. This feature involves the use of a camera, so a waterproof camera will be needed. The application will be developed to be user friendly, so the user does not have to be tech-savvy. The application will also be able to remotely

enable or disable the alarm. If the user is having a pool party, the alarm can be deactivated to avoid causing any false alarms.

There are certain products in the market that have been marketed to prevent drowning accidents from happening. Some of the basic items that have been in use include pool fences, safety nets, and rope-lines; however, these items' efficiency levels are very limited. Moving on to modern, sensor-based devices, there are a couple of items in the market today. Examples of these modern sensor-based protective systems include, in increasing level of safety and complexity, the RJE Technologies "Safety Turtle 2.0 Pool Alarm." The PoolEye "PE23 Pool Alarm", and the Coral Detection Systems "Coral Manta 3000."

The first of these, the Safety Turtle, has a wristband that will trigger an alarm once it becomes wet. This strategy has a few flaws, in that the wristband must be worn to allow for detection, detection is only useful when the wearer does not intend to be swimming, and a wristband must be purchased for every intended user. The PE23 Pool Alarm on the other hand is a sensor that is mounted on the edge of the pool that detects any substantial waves and triggers an alarm. This system has the benefit of allowing for anyone to be tracked without the need for individual wristbands but suffers a similar issue of only being of use when nobody intends to be swimming. The final product mentioned here, the Coral Manta 3000, is the most advanced of these systems, employing an AI based drowning detection system and the usage of solar panels for 24-hour usage. This is clearly the most advanced and safe system of these offerings, but can have some drawbacks, such as needing to be installed on the side of the pool or having issues with pools of peculiar shape.

The purpose of this anti-drowning tool is to allow parents, lifeguards, and babysitters to let their guards down a little without any life-threatening consequences. The use of a device whose only job is to detect drowning activity could be much more reliable than a parent juggling between multiple tasks at once. Pool-AID will ensure the safety of their loved one and provide much needed surveillance with little to no effort from the user.

Section 3: List of Requirements Specifications:

Essential Requirements:

- Protected by a container of 10 in x 10 in x 5 in dimensions to make it waterproof
- The weight of the device will be limited to 15lbs
- Expected budget of $300 maximum
- Communication with the system should be successful up to distances of 150ft
- Battery life of hours per charge
- Have an IP64 rating
- Obtain underwater pictures of disturbances
- Buoyant
- An alarm that is loud enough to be heard within a 50ft radius
- Powered with solar energy for low battery consumption
- Backup emergency battery.

- Customizable to indoor and output pools.
- Availability of resources
- Time constraints (must be completed by April 2022)
- Manual and remote system control
- Power needed for the device of at least 5W
- Minimal false alarm rate

Software Requirements:

- Mobile application to control the systems information such as temperature and motion capture
- Send the underwater pictures in real-time to a database
- Mobile app availability for any android or IOS device.
- The pictures within the database will have a user-defined life cycle from when it was taken to save storage and have more efficient data management.
- Responsive Application.
- Notifications sent every time a picture is captured and sent to the database
- User-friendly interface
- Register each data entry in the application.
- Efficient communication between mobile application and database
- Utilization of cloud resources.
- Set up device remotely
- System configuration only accessed by admins
- Request data only if available
- No extra cost expected for software design or services

Section 4: House of Quality Diagram

The house of quality will help us determine important features desired by the target audience and the engineering design requirements. This diagram allows us to visualize the different trade-offs between the customer and engineering requirements.

The HOQ diagram is in the following page.

House of Quality Diagram

			Engineering Requirements						
			Weight	***Dimensions***	***Water-resistant***	**Power Consumption**	**Alarm Range**	**Wi-Fi Range**	**Cost**
			-	-	+	+	+	-	-
Customer Requirements	***Application***	+			-	-	++	++	+
	Feasibility	+	-		++	-		+	-
	Long battery life	+	--	--	+	++			++
	Reliability	+	-	--	++		++	+	+
	Durability	-	-	-	+		+		+
	Size	-	++	++	-	--	-	-	-
	Cost	+	-		-	+			++
	Targets for Engineering Requirements		**< 15 lbs**	**10 in x 10 in x 5 in**	**Plastic \ Silicon**	**5 V and 30 mA**	**50 ft radius**	**2.4 GHz range**	**< $ 300**

Correlation matrix	
+ +	Strong positive
+	Positive
–	Negative
– –	Strong negative
	Not correlated

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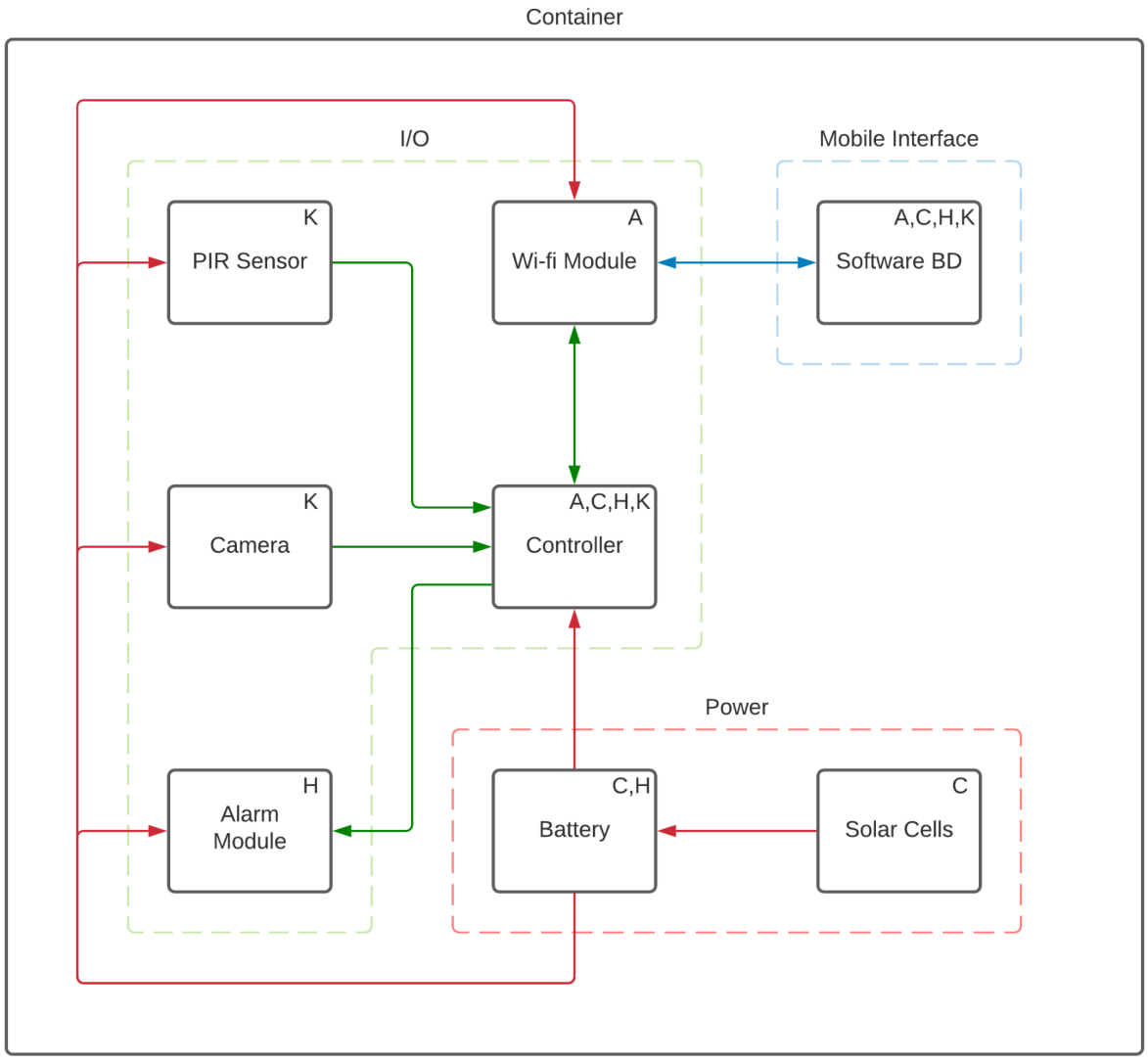
Section 5: Block Diagrams

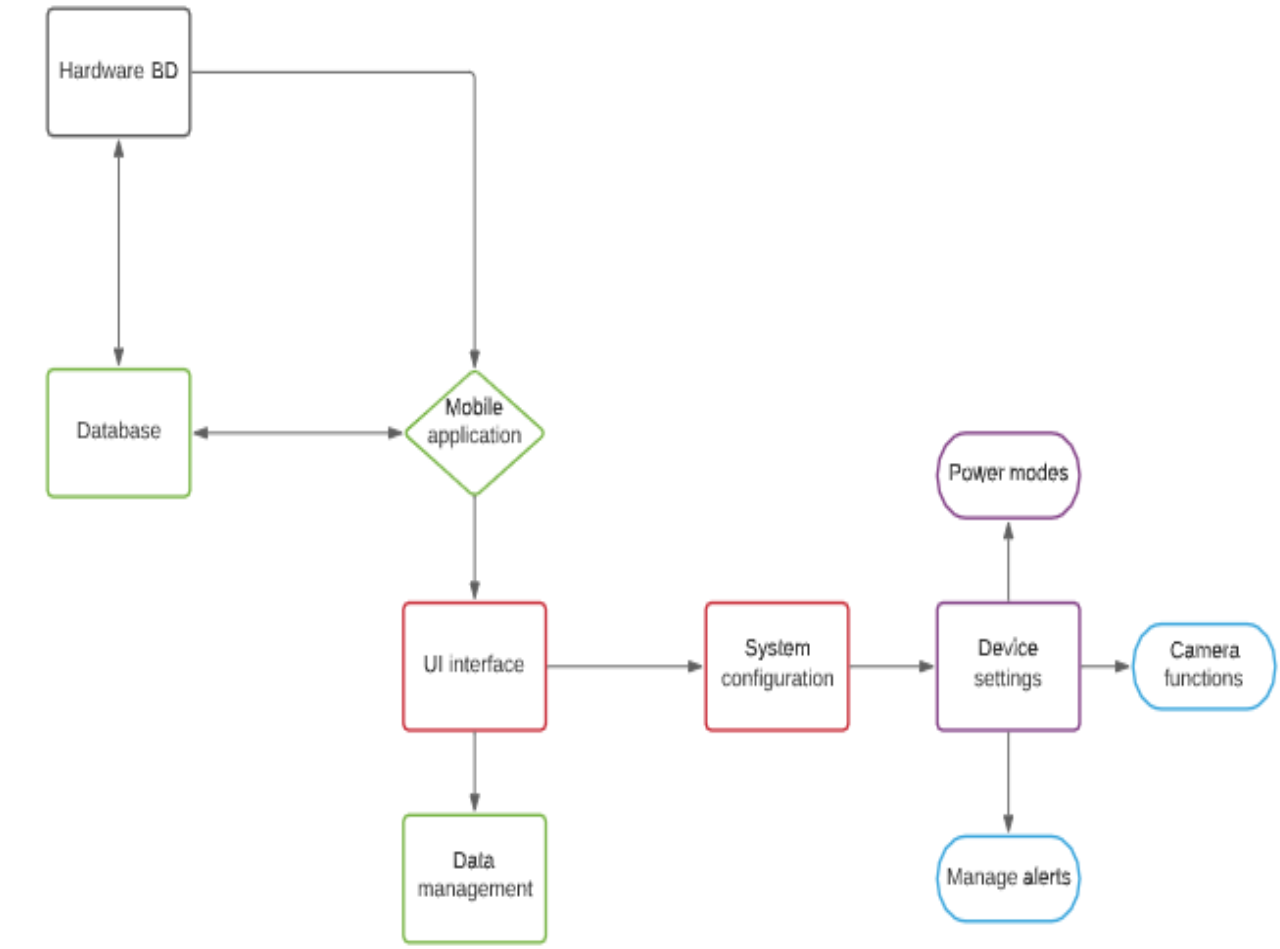
There are two block diagrams to represent the hardware design and the software breakdown of the device. Each diagram has a specific group member or members designated to take responsibility for the component and how it functions.

General Hardware Diagram



Legend:
A: Alexander Chan Vielsis
C: Chase Willert
H: Houda El Hajouji
K: Kevin Reim

General Software Diagram



Legend:
K: Kevin Reim
H: Houda El Hajouji
C: Chase Willert
A: Alexander Chan Vielsis

Section 6: Budget and Financing

Our project will be fully funded by the group members. The specific parts of the device are not expensive compared to other devices on the market. The goal is to make the device cheaper than available products without compromising the quality and efficiency levels.

Product	Vendor	Quantity	Price
Passive Infrared sensor	Digi-key	1	$ 8.95
Camera module with 0V2640	Amazon	1	$ 25.99
Wi-fi module	Mouser	1	$ 6.95
Microcontroller Board	Mouser	1	$ 25.44
Buzzer module	Adafruit	1	$ 0.95
Solar panel	Amazon	5	$ 15.00
Plastic	Amazon	3	$ 12.00
Waterproof button	Amazon	1	$ 5.00
Battery	Ebay	1	$ 10.00
Total Cost:			$110.28

Section 7: Initial Project Milestone

This design project process will begin during the Senior Design I course and carry over to a second semester. The project milestones listed below highlight the major deadlines our team will have to work with. Since this is a two term project, the first phase is mostly research and document based with very little prototyping. The second phase of the project will focus on building the device, and making sure it is fully functional.

Description	Duration	Date
Project Idea	2 weeks	8/23-9/6
Divide and Conquer 1.0	1 week	9/10-9/17
Part Research and acquisition	2 weeks	9/18-10/1
Divide and Conquer 2.0	2 weeks	9/18-10/1
Interface/test controller with PIR sensor	1 week	**
Interface/test camera with controller	1 week	**
Sensor and alarm connectivity	1 week	**
Build user interface app	4 weeks	**
Interface user interface with wireless network	1 week	**
First Draft Report	6 weeks	10/1-11/5
Further Research and Documentation	4 weeks	11/8-12/6
SDI Final Report Due	6 weeks	7-Dec
SD II Begins		
SDII: Begin Building the Device	3 weeks	TBD

Send PCB Order	2 weeks	TBD
Testing and Redesigning	4 weeks	TBD
Finalize Design	3 weeks	TBD
Presentation		TBD
Final Report		TBD

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References:

Drowning Statistics

https://www.stopdrowningnow.org/drowning-statistics/?gclid=Cj0KCQjwm9yJBhDTARIsABKIcGa9w27edfCRiDz7UfaWNmleXwI73NKN6TlPkanQLAR3xIenedg2k-IaAnNuEALw_wcB