Pool Safety Alarm

TEAM: 56

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Introduction/Background

Problem Statement:
Drowning is the leading cause of unintentional death globally, with residential pools being high-risk zones. Current solutions like pool fencing or covers are often ineffective, highlighting the need for an active safety device.

Project Goal:
Design a pool safety alarm that detects unusual water movements, triggers immediate alerts, and ensures reliable safety in residential and commercial pools.
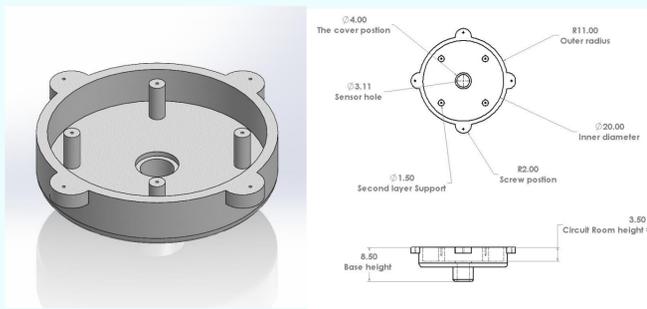
Constraints:
• Suitable for private and commercial pools.
Weather Resistance: Must withstand outdoor conditions.

Target Specifications:
Response Time: < 1 second
Battery Life: > 1 month
Audible (75–90 dB)
Coverage Area: ≥ 24 m²
Setup Time: ≤ 15 seconds

3D Design

Base part: The part takes most of the electrical components inside. Also, it will carry the support that will hold the second floor to have more area for the components there is a small cylindrical shape that extends from the bottom side of the base, this place will be the location of the sensor that will be under the water to detect the signals.
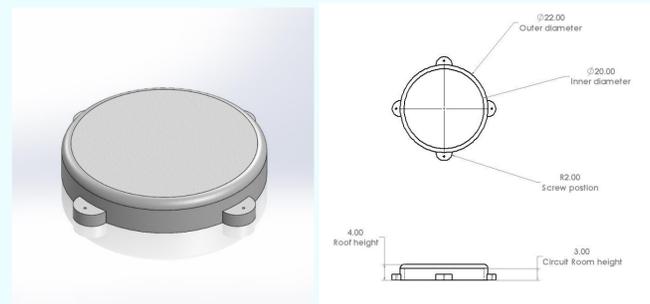
Roof part: The part that will match the base to close the device, and its dimension is similar to the base part.

Electrical Circuit
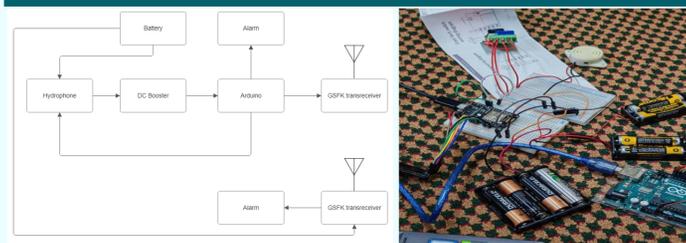
Battery: Provides power to the entire circuit, **Hydrophone**: **The YH-3000** Miniature Hydrophone was selected due to its suitability for deep-sea operations
DC Booster: Boosts the voltage from the battery to a level required for the hydrophone and other components to operate efficiently.
Arduino (Microcontroller): Acts as the brain of the system.
Alarm: This alarm consists of a loud buzzer and visual LED indicators that alert users when an emergency is detected.
GFSK Transceiver (Transmitter and Receiver):
1. **Transmitter**: Sends signals wirelessly to the receiver module when an alarm is triggered.
2. **Receiver**: Receives signals from the transmitter and activates an alarm remotely, ensuring alerts can be heard or seen at a distance.

Detecting false Alarms

Minimizing false alarms was achieved using Quality Control Charts:

X-bar Chart: Monitored the average response time to ensure consistency in detecting genuine emergencies.

R-bar Chart: Assessed variability in alarm triggers to differentiate normal pool activity from real emergencies**.**

Prototype

The complete **chassis** of the device

Testing/Validation

Response Time: Verified to be <1 second.

Durability: Waterproof PETG material withstands pool conditions.

Coverage Area: Validated for 6x4 m² detection.

Sound: Noticeable sound

Setup Time: Successfully installed within 15 seconds.

Calculations

Floating Analysis Equation:

Mass = 1050 g

Volume = 1801.66 cm3

g=9.81m/s2 (acceleration due to gravity)

ρw ≈1000 kg/m3

(Density of water) $W = m \times g$

$W = 1.05 \times 9.81 = 10.3N$

$Fb = \rho w \times g \times V$

$Fb = 1000 \times 9.81 \times 0.00180166$

$Fb = 17.67N$

• Since $W > Fb \rightarrow 10.3N < 17.76N$ **the device will float.**

Conclusions

The Pool Safety Alarm system enhances pool safety by Providing real-time detection of unauthorized or accidental entry.

Combining ease of use, affordability, and reliability. Offering a modular, scalable design adaptable to diverse user needs.

Future Recommendation

• **Advanced Sensors:** Add AI-powered or thermal imaging sensors to improve accuracy and reduce false alarms.

• **Solar Power:** Integrate solar charging to enhance battery life and sustainability.

• **Mobile App**: Create an app for remote monitoring, control, and real-time alerts.