

# Project Title: DiveIQ – Advanced Analytical Insights into Dive Performance for Competitive Swimming

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**Signature:**

**Objective:** DiveIQ is a cutting-edge, AI-driven performance analysis system designed for the precision evaluation of competitive diving form. This project aims to equip athletes and coaches with high-fidelity insights to enhance technique and minimize performance inefficiencies in short-distance events like 50m and 100m swims. By using high-resolution biomechanical assessments and predictive modeling, DiveIQ identifies, analyzes, and visualizes critical parameters of a dive sequence.

## Project Components

1. **Latent Response Time Analytics:** Employing high-speed video capture and edge-detection algorithms to quantify latent reaction times from initiation to launch, allowing for the precise measurement of an athlete's responsiveness and quickness at the dive's onset.
2. **Takeoff Angle Kinetics Analysis:** Utilizing gyroscopic data and motion capture technology to calculate optimal angular velocity at the moment of takeoff, providing detailed feedback on initial trajectory alignment based on the athlete's body posture and launch dynamics.
3. **Velocity Vector Profiling:** This module employs Doppler-based speed sensors and real-time motion interpolation techniques to compute instantaneous takeoff speed. Advanced algorithms further analyze speed vectors to isolate the impact of force exertion and gravitational pull on dive trajectory.
4. **Hydro-Angular Alignment Assessment:** Using skeletal tracking systems, DiveIQ evaluates body position at the exact moment of water entry. By cross-referencing these positions with dynamic posture models, the system suggests micro-adjustments for optimal alignment and reduced water resistance.
5. **Hydrodynamic Entry Angle Calculation:** Leverages sonar imaging and angular displacement sensors to assess the athlete's entry angle relative to water surface normal. This parameter is crucial to ensuring minimal splash and maximum streamline efficiency upon entry.
6. **Aqua-Contact Distance Quantification:** Calculates the linear distance from the takeoff point to the first point of water contact. DiveIQ's spatial mapping algorithms offer pinpoint accuracy, allowing athletes to refine jump length for optimal positioning and timing.
7. **Dive Data Archival and Retrieval System:** DiveIQ integrates with cloud storage to manage historical dive data in a structured, indexed format. The system employs a no-SQL database schema to facilitate quick retrieval, comparison, and data mining for longitudinal performance trends.

8. **Performance Trajectory Visualization:** Advanced machine learning algorithms analyze past dive data to generate performance improvement charts. Using regression models, the system highlights areas of growth and potential decline, visualized in time-series graphs and color-coded heatmaps.
9. **Ideal Dive Model Benchmarking:** Utilizing machine learning algorithms trained on professional dive data, DiveIQ generates an 'ideal dive model' for comparison. This benchmarking feature allows athletes to quantitatively assess their dive mechanics against a statistically optimized standard.
10. **Hydrodynamic Disruption Quantification (Splash Level Metric):** Quantifies splash intensity on a 0-5 scale using image processing and depth sensing, employing algorithms that factor in splash height, width, and persistence to gauge water disruption levels and entry precision.
11. **Airtime Duration Estimation:** Uses motion sensors and inertial measurement units (IMUs) to calculate the time between takeoff and water contact, providing insights into airtime consistency. This metric is pivotal for optimizing body positioning throughout the dive.

## Technologies Utilized

- **Computer Vision with OpenCV:** For real-time video analysis and movement tracking.
- **Inertial Measurement Units (IMUs):** For detailed tracking of angular momentum and body dynamics.
- **Neural Network Predictive Models:** Trained on dive performance data for ideal form benchmarking and performance comparison.
- **Cloud-based Big Data Storage Solutions (e.g., AWS, Google Cloud):** For storing extensive video and sensor data with efficient retrieval systems.
- **GraphQL API Integration:** To support data requests and retrieval operations across platforms for user-friendly data accessibility.
- **Augmented Visualization Tools** (e.g., Plotly, D3.js): For performance graphing and interactive dive data visualization, enabling a more nuanced understanding of individual dive metrics.

**Conclusion:** DiveIQ provides an unparalleled blend of technical precision and accessible insight, empowering coaches and athletes to make data-driven adjustments. The project integrates sophisticated technologies to make real-time, feedback-oriented training possible, establishing a benchmark in the field of competitive dive analytics.