μicroDLS

Portable, Affordable, Real-Time Particle Sizing

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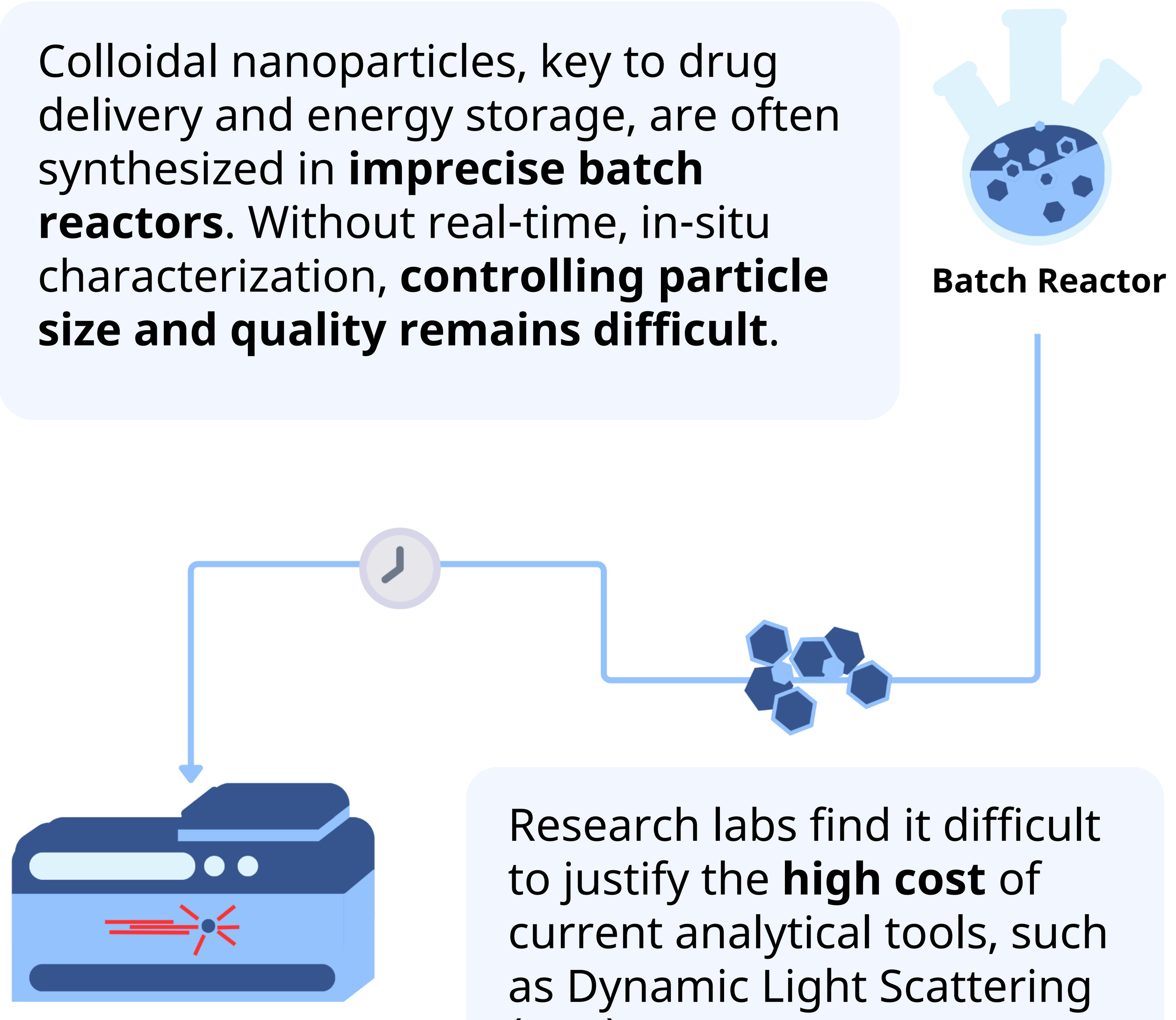
Motivation

Colloidal nanoparticles, key to drug delivery and energy storage, are often synthesized in **imprecise batch reactors**. Without real-time, in-situ characterization, **controlling particle size and quality remains difficult**.



Research labs find it difficult to justify the **high cost** of current analytical tools, such as Dynamic Light Scattering (DLS) systems, which can start at **$35k**.

Solution

Our aim is to combine **nanoparticle synthesis** with **characterization**, creating an **all-in-one platform.**

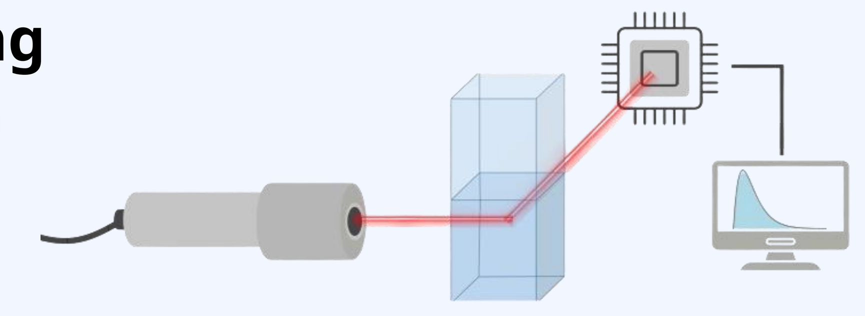
Customer Requirements

- **Particle Size Detection (20 nm – 200nm)**
- **Intuitive User Interface**
- **Fluidic Chip Compatibility**
- **Reduce Cost by 85%**
- **Portable and Lightweight Design**
- **Safety Features**

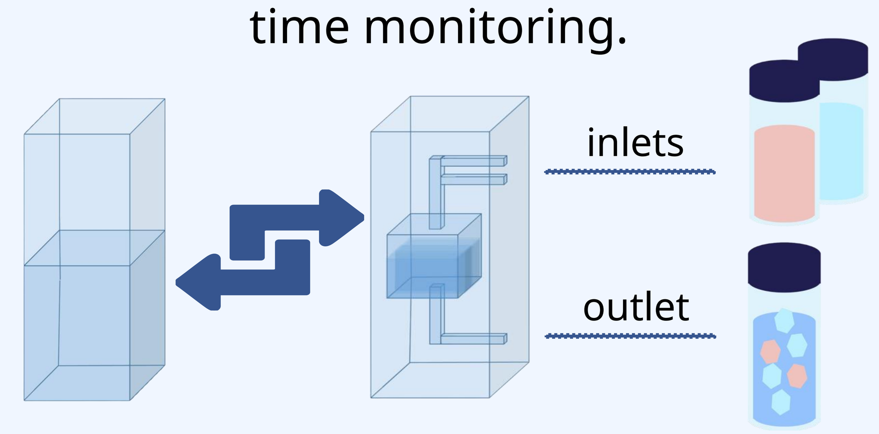
Design

Dynamic Light Scattering

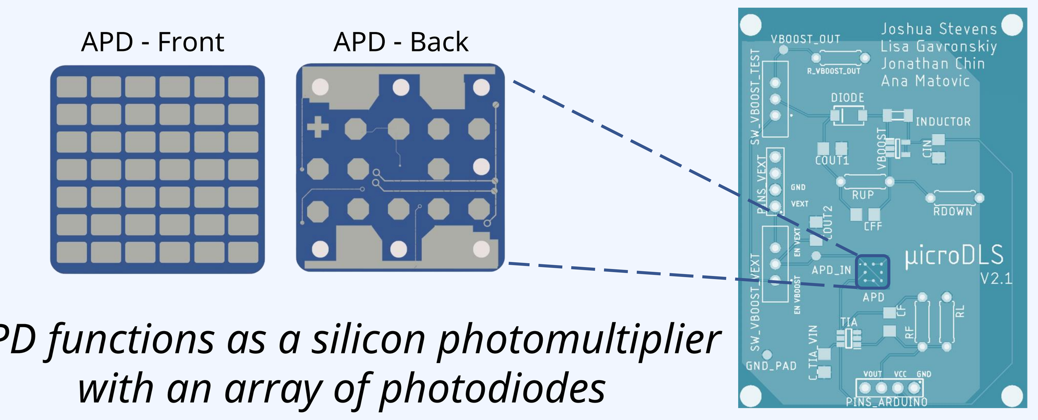
A 635 nm laser is directed at a sample, and scattered light is captured at a 90° angle to calculate particle size.



Measurements are taken from a standard DLS cuvette or a fluidic chip featuring a reaction chamber with inlets and outlets, and an integrated pumping system for real-time monitoring.

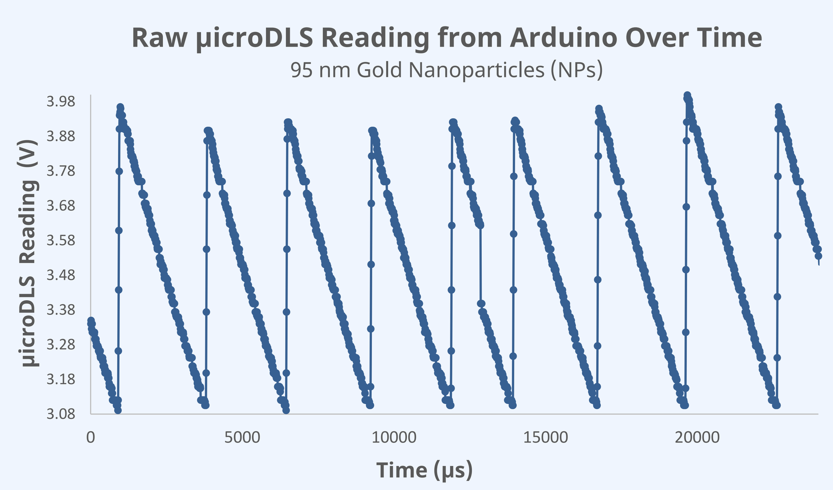


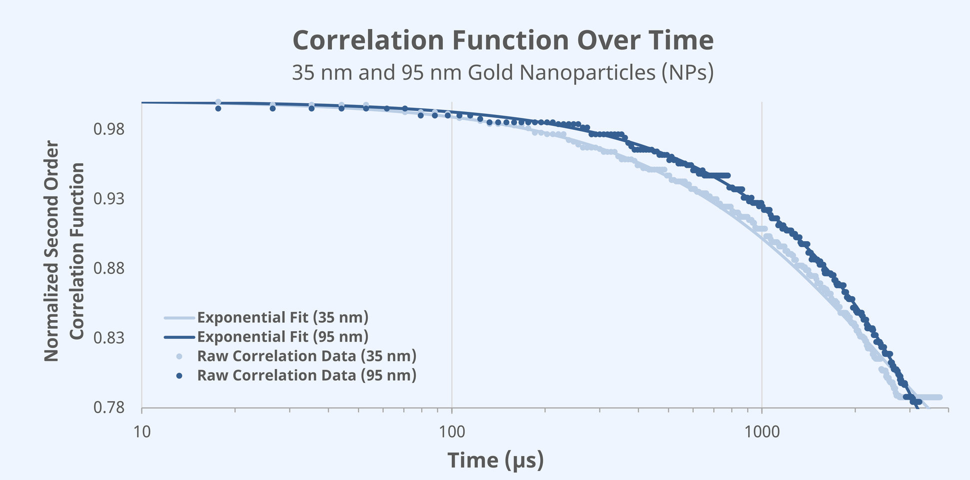
Photons are detected by generating a high voltage to operate an avalanche photodiode (APD) in reverse bias. The current is amplified into an interpretable signal for the Arduino.



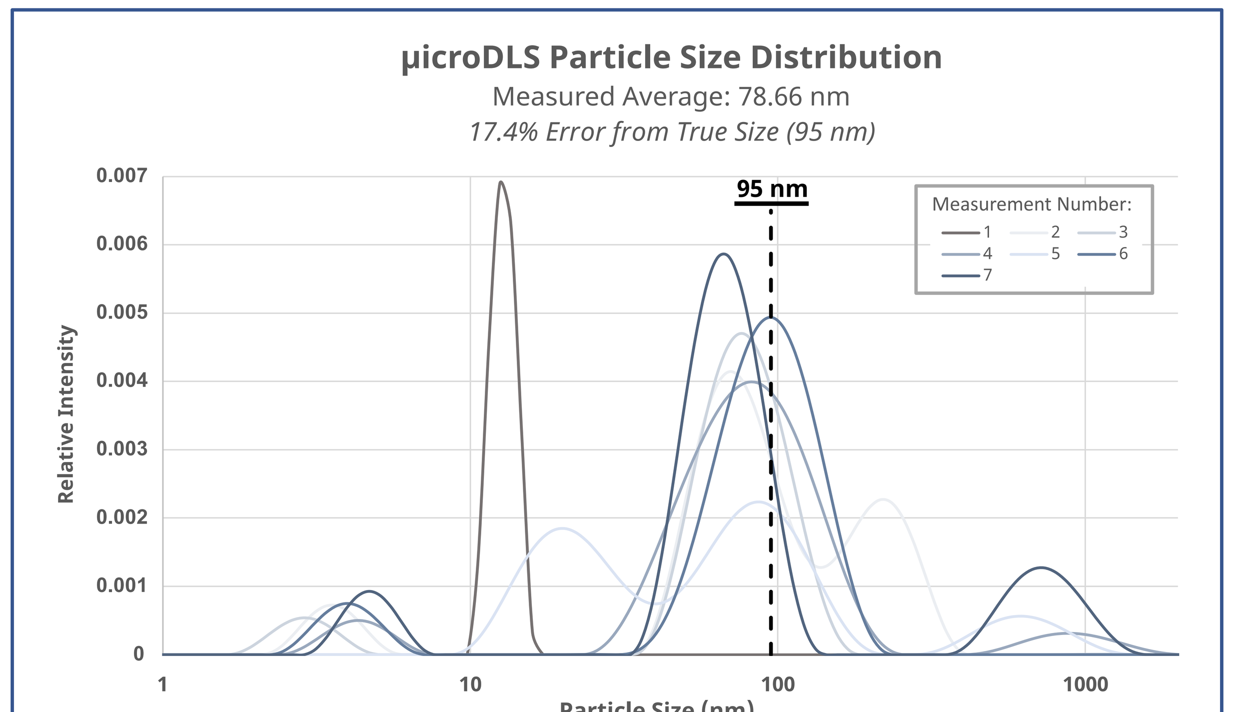
APD functions as a silicon photomultiplier with an array of photodiodes

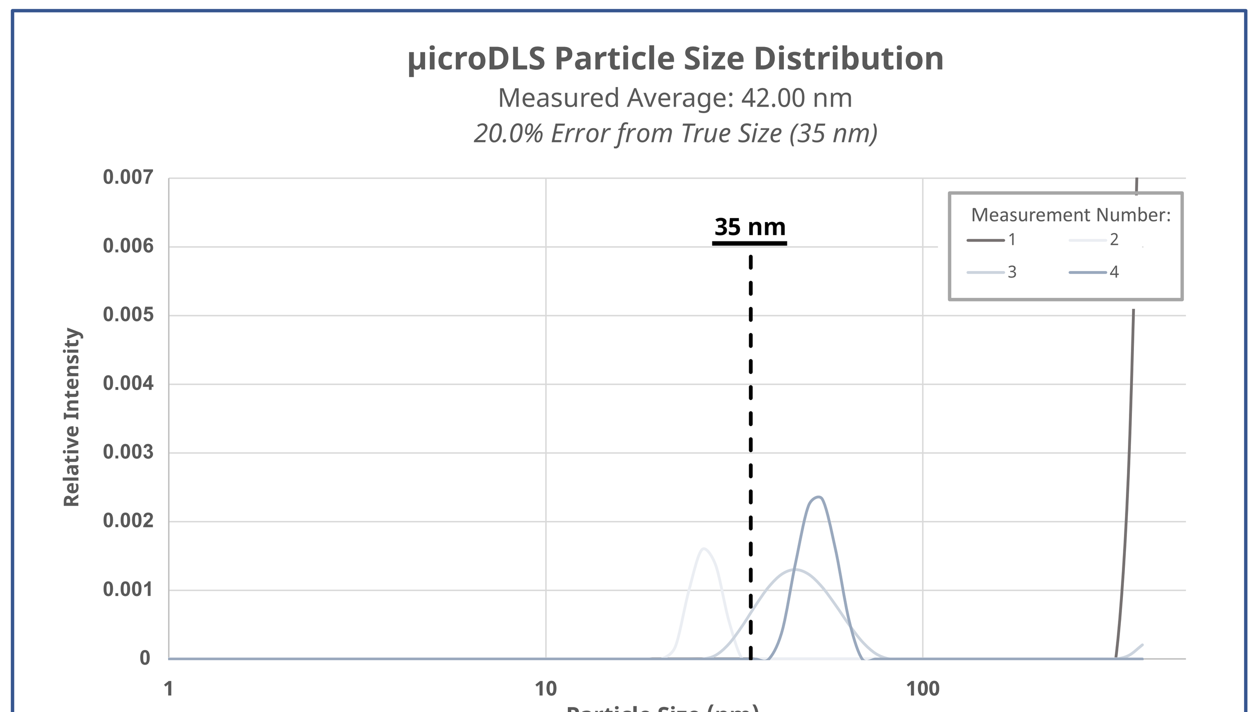
Collected data is analyzed by comparing intensity fluctuations between cycles to correlate signal variations with time. An exponential fit of the correlation function is used to determine particle size.





Results





Sequential DLS measurements of gold nanoparticle (NP) samples were conducted using the μicroDLS and compared against data from traditional DLS for validation.
Achieved successful results with an error of ≤ 20%.

Future Directions

1. Add scattering angles to measure polydispersity and zeta potential.
2. Enhance software capabilities for detailed reports.
3. Improve accuracy by increasing sampling rate and reducing noise.
4. Simplify chip integration with the device for easier user interaction.

Sustainability

Goal 7: Affordable and Clean Energy

Technical Quality
A low-cost (<$500), miniaturized DLS device enabling rapid in-situ nanoparticle size measurements during their synthesis.

Alignment with SDG
Doubling energy efficiency by 2030 relies on advanced nanomaterials. Accurate, real-time measurements are essential for nanomaterial development[2].

Sustainability
Reduction in physical footprint and low energy consumption contribute to a more sustainable lab environment, significantly decreasing material usage.

Barriers
Measurement accuracy and ease of integration is crucial for the device's adoption in research facilities.

Impact
Lowering characterization costs eliminates research barriers, supporting the development of affordable and reliable clean energy solutions.

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[2] HORIBA Scientific, "Dynamic Light Scattering in Electrochemical Energy Conversion Systems: An Overview," HORIBA Webinars. [Online]. Available: https://www.horiba.com/int/particlewebinars/dynamic-light-scattering-in-electrochemical-energy-conversion-systems-an-overview/.