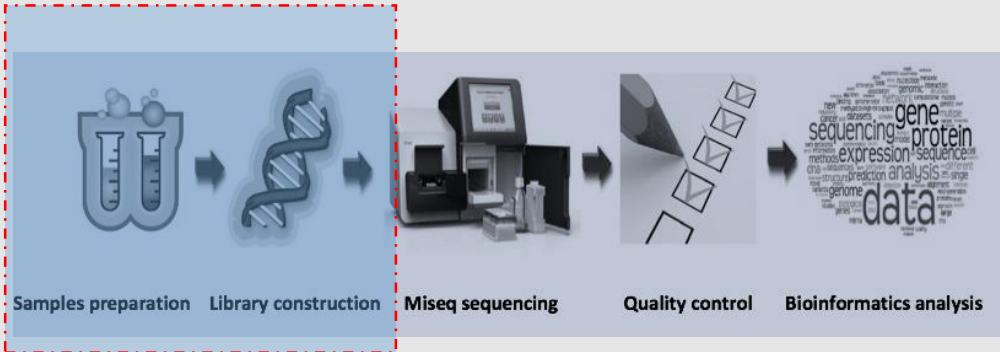




SPIN-PREP

Microfluidic automation solutions for NGS Sample Prep



Next-generation sequencing (NGS) has enabled us to extract genetic information from samples faster, more reliably, and at lower cost than ever before. Getting your DNA ready for sequencing requires the preparation of a sequencing library as well as a few other steps that depend on the type of sample and the NGS platform.

NGS Library PREP challenges

Although the cost of sequencing has significantly reduced, the challenge of library preparation remains significant for those who cannot or are not prepared to implement workflows on large-scale, expensive liquid handlers.

Key issues include:

- Manual, multi-step procedures tend to be prone to significant errors including sample loss.
- Cost-prohibitive high throughput robotic systems (USD200K+)
- High operational costs of high-throughput systems.
- Excessive waste volumes of expensive sample prep kits.
- Lack of reliable low throughput sample-prep devices

SPIN PREP: Microfluidic solutions for your NGS sample prep



Cost effective
automation

Device ~ € 10,000
Cartridge cost per run ~ € 5.

Increased
Reproducibility

Significantly reduced user-to-user and experiment-to-experiment variability due to automation.

Increased
Reliability

Significantly easier to operate than manual protocols at low throughput with ease of loading and plug and play operation.

Flexibility to optimize
protocols

Some flexibility in terms of sample/reagent volumes, incubations times, release order and number of reagents.

Portability

Small footprint (~30x30x30cm) allowing ease of portability and use in the field for on-site sample prep.

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SPIN PREP- Sample prep automation for Next Generation Sequencing

Summary

The Microsystems and Bio-interfacing group led by Dr. Rohit Mishra at the Fraunhofer Project Centre for Embedded BioAnalytical Systems at Dublin City University (FPC@DCU) is developing a microfluidic solution to automate library preparation. This technology is used for bead based nucleic acid clean-up and size selection encompassing the enzymatic steps. The system comprises a portable, low-cost instrument and consumables with a target market of low-to-medium throughput NGS users.

Background

Nucleic acid library preparation is a critical part of sample preparation for next-generation sequencing (NGS), as well as for many other applications. Low-to-medium throughput (500-15,000 sample preps/year) customers in this area are Biopharma labs, Hospital Labs, Academic and Research PIs, Sequencing Cores and Service providers pursuing both research and clinical applications of NGS.

Problem/Opportunity

There are tens of thousands of decentralised laboratories in companies, hospitals, research facilities and other point-of-use environments with low-to-medium throughput requirements. These labs need a more reliable, cost-effective and time efficient solution for implementing DNA library preparation protocols using SPRI. Current approaches include:

- Manual processing using pre-defined steps in kits, which is highly labour-intensive and error-prone;
- Robotic systems that automate handling of the kits on a large scale, which are very expensive (>USD200K) and wasteful in reagent usage for smaller throughputs;

Microfluidic products launched by NuGen (Mondrian) and Illumina (Neoprep) were withdrawn due to significant reliability issues, leaving a major gap in servicing the market for low-to-medium throughput applications. The current competition in this space (Voltrax from Oxford Nanopore and Miroculus) use the same technology as the failed Neoprep. Our market research has identified a significant commercial opportunity for a product that performs DNA library preparation including clean-up and size selection using the SPRI technology for low-to-medium throughput applications.

Solution/Innovation

Based on its extensive expertise and background IP in microfluidics, the we will develop an affordable, automated, NGS library preparation system, which delivers reproducible, high-quality outputs while minimising reagent use. DCU's patented, event-triggered dissolvable-film (DF) valve technology provides an unparalleled level of robust, multiplexed flow control which enables development of highly integrated, single-use LoaD cartridges for handling samples and reagents. This reduces complexity, footprint and cost of instrumentation, requiring only a spindle motor, temperature control and magnetic particle manipulation. This is a significant advantage over large-scale liquid handling robotics and other microfluidic technologies that employ expensive and error-prone components for pumping and valving. Pursuing a design-for-manufacture and scale-up strategy compatible with industry standard mass-manufacturing practices, FPC@DCU will deliver early prototypes that can be rapidly replicated for evaluation by early adopter customers.

USPs

- Automation of bead-based nucleic acid clean-up and size selection encompassing enzymatic end repair, A-tailing and ligation protocols.
- Fluidic control protocol that can be user customised for compatibility with widely used kits and off-the-shelf reagents.
- Minimal sample and reagent wastage while reducing inter-prep variation, leading to high reproducibility compared to manual handling for low-to-medium throughput demands.
- Competitive cost per library prep at lower sample throughput requirements due to simple LoaD instrumentation (Device cost EUR 10K, Consumable cost per prep EUR 5).
- Small footprint and seamless integration into current manual laboratory work flows by allowing the user to pipette samples and reagents into the disc cartridge and pipette out the prepared DNA solution to the next step