Design and Implementation of a Low-Cost Electrospinning Setup for Nanofibers Fabrication ★

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Abstract. This paper presents an advanced electrospinning device designed for novel nanomaterials production, focusing on its innovative software architecture and open-source approach. The system, built around an Arduino Mega microcontroller, utilizes FreeRTOS for efficient task management and real-time control (see. Figure 1). Developed using PlatformIO, the entire codebase is hosted in an open GitHub repository, promoting collaboration and customization. Key hardware features include a high-voltage source with precise output measurement, an LCD interface for parameter adjustment, and accurate motor control for the syringe pump. The implementation of GitHub Actions ensures cross-device compatibility and streamlines the development process. Custom-written code enhances voltage reading and motor control, adapting to various research requirements. This open-source, real-time operating system-based approach represents a significant advancement in electrospinning technology, potentially accelerating the development of new nanomaterials with tailored properties for applications in tissue engineering, filtration, energy storage etc.

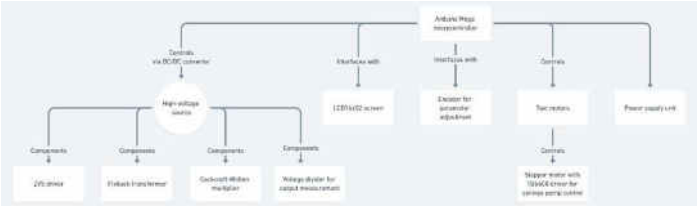

Fig.1. Schematic representation of the custom electrospinning setup

This open-source electrospinning device represents a significant advancement in accessible materials research. Its key advantages include:

- Cost-effectiveness: Utilizing readily available components reduces overall expenses.
- Reproducibility: Open-source nature and GitHub integration ensure easy replication across labs.
- Customizability: FreeRTOS implementation allows for flexible adaptation to various research needs.
- Real-time control: Precise parameter adjustment enhances experimental accuracy.

Compared to commercial alternatives, the elaborated device offers comparable performance at a fraction of the cost. The open-source approach also encourages collaborative improvement, potentially accelerating innovation in nanofiber production.

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References

[1] C. Creciunel, Development of an electrospinning device for nanofiber production, *The Technical Scientific Conference of Undergraduate, Master, PhD students*, Vol. I, Tehnica-UTM, 2024, pp. 444-448.

[2] Y. Yan, X. Liu, J. Yan, C. Guan, J. Wang, Electrospun Nanofibers for New Generation Flexible Energy Storage, Energy & Environmental Materials, 4(4), (2021), pp. 502-521.

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