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Designing a Self-Regulating and Portable Heating Device for a Microfluidic Based Biosensor

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Abstract:

Paper-based biosensors are powerful microfluidic analytical devices that are potentially useful for a wide range of applications, ranging from medical diagnostics to agricultural and environmental monitoring. Molecular diagnostics have limitations because they need to send samples back to a centralized laboratory, which increases the cost and turnaround time of the test. This project aims to create a simple-to-use, low-cost, and portable heating system that would facilitate the creation of a field-deployable paper-based analytical device that can incubate the sample at elevated temperatures for conducting isothermal molecular assays. Our design aims to miniaturize a commercial water bath and will be fabricated to uniformly heat the analytical device and maintain its temperature at 60-63 ℃ over an extended period. It will maintain the temperature with a PID (proportional-integral-derivative) control mechanism that will control the amount of power through the heating element by accounting for how much the temperature is outside of a threshold and how its changes over time. This project will also determine an optimal heating element based on size and efficiency using temperature profiling. This heating system will help create a cost-effective and user-friendly point-of-care device for monitoring animal and human health.

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