

A hand-held geotagged microfluidic based continuous-flow PCR device for point-of-care applications

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Abstract

Polymerase chain reaction (PCR) is one of the most extensively utilized techniques to detect nucleic acid fragments. Several approaches have been utilized to automate, integrate, and miniaturize (AIM) the PCR amplification process on a microfluidic chip using different strategies. Among them, one of the unique methods is a continuous-flow-based microfluidic PCR where the classical thermocycler is substituted by pumping the reaction sample via a microchannel that roams over the static thermal zones of PCR because of its wide benefits like fast thermal variation, dynamic flow, and low thermal mass. This work aims to develop a hand-held geotagged thermal management system for continuous-flow microfluidic PCR operation. This includes arduino, cartridge heater, k-type sensor, and IoT 8266. The temperature sensitivity of the device was $\pm 0.25^{\circ}\text{C}$. The IoT allows accessing and storage of real-time temperature values directly onto the smartphone through geotagging. The three thermal zones denaturation (94°C), annealing (60°C), and elongation (72°C) were effectively achieved on two aluminium heating blocks. A PMMA based serpentine microchannel was fabricated using CO₂ laser ablation. Further, IPA-based solvent bonding was incorporated to ensure no leakage in the microchannel. The microchannel dimensions are 30 mm(L) x 0.5 mm(W) x 0.5 mm(H) respectively. A 20 μl of total PCR sample was infused via inlet using an automated syringe pump at a stream rate of 10 $\mu\text{l}/\text{min}$ with a reaction time of 26 min. Amplification of nucleic acid template with 594-base pair (bp) fragment of the housekeeping gene was successfully executed on this thermal device validated using gel-electrophoresis.

Biography

Madhusudan B Kulkarni received the B.E. degree in Instrumentation Technology from B. V Bhoomaraddi College of Engineering and Technology (BVBCET), Hubballi, India, in 2013 and M.Tech degree in Biomedical Electronics and Industrial Instrumentation in 2016.

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