Conceptual design of a microfluidic-based platform for medical diagnosis

David de Groot
10-07-2020

Bachelor Thesis Industrial Design Engineering,
University of Twente, The Netherlands

Benchmark Electronics Almelo, The Netherlands
examination date 16-07-2020

Benchmark

Introduction

Benchmark Electronics offers customers R&D, high-tech manufacturing, and design engineering services. Among other solutions, Benchmark combines expertise from both engineering and advanced manufacturing to provide a state-of-the-art microfluidic diagnostics platform.

The goal of this platform is to be as versatile as possible, for example by being compatible with various test-cartridges. The platform is suitable for both research purposes and for use in the medical sector.

This aim of this assignment was to concretise the **functions** of the platform, the **system** and its components, a **preliminary requirements** specification, **user interactions**, and most importantly establish a **design language**. For this thesis I spent twelve weeks working for Benchmark Electronics in Almelo. The results are to be used for marketing purposes, and for the continued development of the platform.

Microfluidics

The functionality of the platform is based on microfluidics. Microfluidics is the technology of manipulating very small amounts of liquid (internal volumes less than 100 µL) on a microfluidic chip. This technology allows for complete chemical processes to be embedded onto one microfluidic chip, in the form of a so-called lab-on-chip (LOC).

LOC analytics has various benefits compared to traditional analytical chemistry, such as faster chemical analysis, parallel experiments, lower risk of contamination, lower reagent consumption, and lower operator skill requirements. This makes LOC technology very suitable to be used in point-of-care diagnosis devices.

Based on this research, the system architecture of the platform was concretised, along with a detailed requirement specification. Important next are what use-situations exist for the platform. For this, POC and laboratory-use were recognised as the most important.

The future of point-of-care diagnostics

In a point-of-care setting, the device will be used by a medical professional like a GP or physician to carry out a medical assay for a patient. Instead of sending the sample to a medical laboratory with a long throughput time, the medical professional can carry out the test in-practice, which leads to better healthcare. For this use-case, tests are proprietary and predefined.

In the laboratory use-case, the platform will be used for the development of new microfluidic chips, complex diagnostics, and drug development. For this use-case, important is the ability to monitor reactions closely and accurately, and to be able to carry out a large variety of tests.

Final design

The final device features a glossy white HDPE body with a black glass panel facing the user. Embedded within the glass are the display, fingerprint-scanner, capacitive ON-button, and the reagent slide. Slightly lower, embedded in the body of the device, is the cover behind which the reagents are stored. Through here, the operator can exchange and refill reagent reservoirs. The side of the device features an interface for modular expansions, such as a module for extra reagent storage.

The device is relatively small, with a footprint of only 23x35 cm and a total hight of 40 cm. It is estimated to weigh under 8 kg.

Benchmark Electronics
Lelyweg 10 | 7602 EA | Almelo, The Netherlands
+31 (0) 546 535 111 | www.bench.com