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PUBLIC SUMMARY

OPTICAL AND FLUORESCENCE ANALYSIS IN A MICROFLUIDIC-BASED PLATFORM FOR MEDICAL DIAGNOSIS

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In this project it was investigated how fluorescence and optical analysis can be incorporate into a microfluidic-based platform designed by Benchmark Electronics. Benchmark Electronics is an international company focussed manufacturing technical solutions for their partners. The platform is designed for a medical environment to enable fast, on the spot, medical diagnoses. The microfluidic platform is the first device developed by Benchmark itself, not in name for a client of them. They provide work assignments for students to corporate in the design of the device and help conceptualize the device.

The main goal of the microfluidic platform is to make medical testing more efficient, faster and cheaper. Using microfluidic chips and reagents in the device, the device can analyse the chips with samples to provide diagnoses on the desired tests. In this way, many one time-use-tests can be substituted by one device that can perform multiple tests at the same time. Next to this function, the device also enables customization in set-up for laboratory experiments to make setting up chip testing less time consuming and thereby cheaper.

Many microfluidic platforms that currently exist use fluorescence as an analysis method to enable diagnosis. For the laboratory use, the wish is established to enable optical analysis, since laboratory users have the desire to analyse the process of the reagents reacting with the sample. Therefore, the main goal of this project was to enable optical and fluorescence analysis in the microfluidic platform concept. To complete this goal, research was done about the two forms of analysis. It was investigated how fluorescence and optical analysis work and how it can be applied. The materials necessary for both methods were determined.

The wishes of potential users were investigated to determine suitable methods for the system. Desired diagnosis were established to determine the function of the device and compared with competitors. Together with the research done about the two methods of analysis, guidelines were made for the entire optical system.

With these guidelines design proposals were made for both analysis methods. In these proposal suitable materials were investigated in more detail and different set-ups have been considered. The proposals were then further optimized in size, costs and wishes of users. The two different users, doctors and laboratory staff, were considered separately, since the laboratory users have desires for more freedom in the device, while doctors do not have any benefit of this function.

To validate the proposals, interviews were done and simulations were made. This concluded that the proposals as they are designed right now are promising for the device. However, elaborate testing in practise is needed to validate this even more.

The design proposals were visualized in 3D models to conclude the project. In these models it is validated how the set-up can be integrated into the outer design of the device and how the two analysis method can be integrated together. These final models form the beginning for the next phase of the project, the detailing and testing phase, which are not in the scoop of this project.

With the current system proposal and models, a solution is given of how the optical and fluorescence analysis can be incorporated into the microfluidic platform. However, the design should be investigated into more detail to optimize the system for the specific application and it should be investigated in context with the different systems in the device to enable compatibility. This should be done when the other systems are described in more detail in a further state of the project.

For the continuation of the project, it is recommended to conduct more interviews with end users to validated the exact tests wanted in the device. This helps to determine the specific materials, like filters and sensors, needed in the device. Furthermore, it is recommended to conduct interviews with specialists on different aspects of the system. This is needed to find the most optimal materials for the application and to validate the compatibility of these materials. It should be further investigated how all materials can be mounted to each other.

The current models are proposals, which need thorough testing to validate them. It is recommended to start with simplified systems to test and complex the testing as it continues. The testing is important to validate the function of the system with the current materials and to test the accuracy of the analysis. It is important to finalize details of the system which could not be concluded yet without testing. For further development of the system, testing is an important next phase.