

Feasibility study of a module for the EasyCompounder that enables the automatic filling of mini-syringes destined for eye surgery

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Topic: Developing a machine that is able to fill mini-syringes with a small dose of medicine

This thesis was commissioned by Smartcompounders, a company that aims at developing new automatization solutions for hospital and compounding pharmacies. One of the machines that Smartcompounders is developing is called the Easy Compounder, which can fill syringes, vials and pumps with different medicines. To extend the use range, multiple additional modules are under development. They desire an additional module that is able to accurately fill mini-syringes with a small dose of medicine. The thesis focusses on the feasibility of such a module as an extension of the Easy Compounder.

The research initiates with an analysis of the process that the module should replace. Therefore, a visit was made to a compounding pharmacy that fills the mini-syringes through manual operations. Two topics of concern were the working environment and the physical strain in the manual operations. To ensure the sterility of the mini-syringes, they are filled in a cleanroom. Therefore, the machine should also be usable inside this environment. Furthermore, a market research was performed, but no direct competitors were found. Together, this resulted in a list of requirements that has been used during the further development.

Through a detailed analysis of the performed steps in the filling process, the critical dimensions of the process have been evaluated. This helped to create a translation from a manual to a mechanical process. To show the possibilities and the envisioned steps, a concept was developed and presented to the compounding pharmacy. During the presentation, several concerns were voiced regarding the presence of air in the syringes. Therefore, the next step in the research became the development of a module that could prove that the module would be effective. To achieve this, a small functional model was created to discover the best settings to fill the mini-syringes.

Using the model, different velocity and acceleration trajectories for drawing up liquid have been tested and evaluated for two different types of mini-syringes. For the first type of syringes, an abundance of air was drawn into all samples independent of the settings of the module. After analysis of the syringes, it was determined that the syringe itself had to be redesigned before they could be successfully implemented. The second type of syringes showed more promising results, however, still air bubbles remained present. Multiple additions have been tested to decrease the amount of air, which showed that it was possible to get samples without air. However, the most successful solution could not be integrated into the design.

Besides, the tests highlighted shortcomings in the designed model that had to be adjusted before continuing the development of a more elaborated prototype. For each of the issues, solutions have been proposed and some have already been implemented in the model. However, before the design is continued, the results of the test phase should be evaluated by the compounding pharmacy and other experts in the field. It is expected that the results can be implemented in practise, but this is based on technical evaluations, whilst medical insights are also required.

To conclude, this Bachelor Thesis has shown that it is possible to consistently fill mini-syringes with a small dose of medicine. However, it is recommended to further develop the module and perform tests in the intended use environment. Before the module is ready for use, the results of the tests should be analysed by experts in the medical field as well. Furthermore, the model used for testing only focussed on a specific part of the final module. Therefore, the remainder of the module should still be developed and tested, preferably in the use environment.