Development of a Robotic Solution for Sustainable Cultivation

Degree programme: BSc in Micro- and Medical Technology
Specialisation: Robotics
Thesis advisor: Prof. Dr. Gabriel Gruener
Expert: Christopher Keim (Food Brewer AG)
Industrial partner: Food Brewer AG, Horgen

Food Brewer AG uses plant cell cultures to produce food and ingredients, like coffee and cacao. As they industrialise their processes, manual tasks are replaced with robotic solutions, reducing dependence on labour-intensive practices and enabling relocation to regions with stronger labour laws. This thesis proposes a novel solution for the automatic preparation of well plates, addressing a key barrier to scalable and reliable production.

Introduction

Food Brewer AG is a startup producing cacao and coffee in a laboratory environment. Unlike conventional agriculture, only the fruit or seed cells required for processing are cultivated. The resulting cell aggregates reach up to 1000 µm in diameter. To enable industrial-scale production, researchers must identify a cost-effective nutrient mixture that promotes rapid cell growth, requiring extensive testing for each cell type. These tests are conducted in standard 24-well plates filled with precise amounts of cells and nutrient solution. Currently, these plates are prepared manually (Fig. 1), a process that is slow and unreliable. Existing systems can't handle large cell aggregates without clogging, creating a critical bottleneck.

Goal

This thesis develops a device to automatically distribute cell aggregates in suspension into well plates and proposes integration into a system for fully automated test plate preparation. The aim is to overcome clogging issues caused by large cell aggregates, unmanageable with current automated solutions.

Results

Multiple concepts for evenly transferring aggregates into wells were developed, prioritizing innovation. The most viable design was manufactured as a 3D-printed prototype. Iterative optimization produced a functional system. Technical details remain undisclosed due to patent considerations.
The system distributes pure water within a ±5% accuracy margin. Performance with cell aggregates is less consistent, attributed to surface imperfections typical of 3D-printed prototypes.
A proposal for full automation has been completed and is shown in Fig. 2.

Discussion

Manual filling introduces uncertainty and delays, degrading test quality. Automating well plate preparation is essential for scaling Food Brewer's production. This thesis addresses a key bottleneck by solving a core technical problem: existing systems can't handle the size and behaviour of the aggregates. The developed solution is a first step toward removing this constraint.
Future work shall include computational fluid dynamics (CFD) analysis and fabrication using higher-precision methods (SLA or the Mantle Process) to enhance geometric accuracy and surface finish.
The system performance shall be evaluated, focusing on reliability, precision, and transfer loss. The new device shall be integrated into a robotic system to achieve full automation of plate preparation.

Bénédict Andrì Wüest
079 306 86 36
benedict.andri@gmail.com

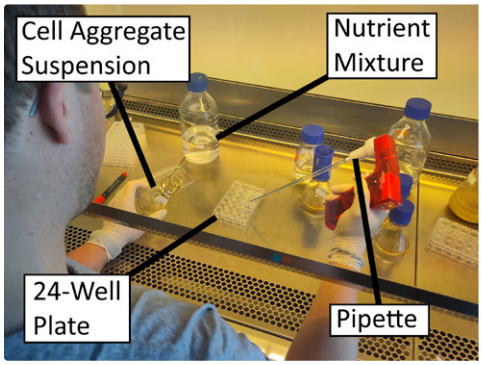

Fig. 1: Current manual process for filling well plates

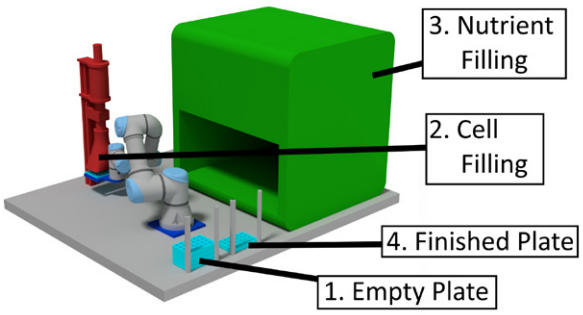

Fig. 2: Prototype concept illustrating potential automation setup