Fraunhofer

PROVIDING TECHNICAL SOLUTIONS FOR LABORATORY AUTOMATION

Automation of laboratory processes is important for improving a laboratory's efficiency. Fraunhofer has identified and acknowledged the need for improvements in productivity and quality of laboratory operations in clinical and research laboratories. Below are examples developed by our Fraunhofer Life Sciences Engineering group to automate the workflow in commercial laboratories and academic organizations. Each of these devices is targeted to a critical laboratory process such as blood analysis, tissue handling and nucleic acid sample preparation.

Tissue Homogenizer

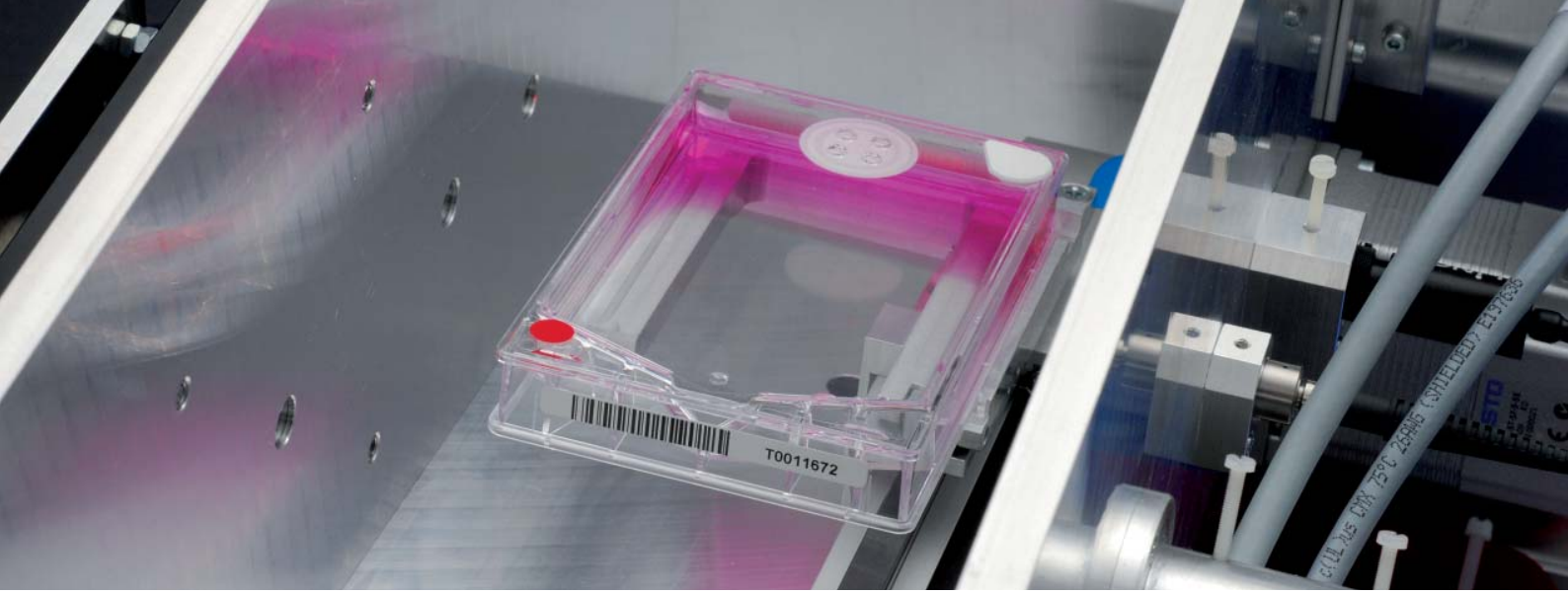
Tissue homogenization is an important process for biological sample analysis. Whether it is for analysis of food quality (components), food safety (contaminants) or for tissue-based diagnostics (autopsy, biopsy or molecular assays), the quality and speed of tissue homogenization is vital to the final quality of the results. The Fraunhofer LSE team has designed and developed an innovative and simple automated platform for simultaneous multi-sample tissue homogenization. It is based on the shearing process of a mortar and pestle tissue grinding model. An elegant mechanism allows the simultaneous processing of an array of samples with only two motors and minimal moving parts. The process can be modified by varying the speed and pressure of the operation as well as the surface geometry of the pestle. The instrument has been tested successfully in preparing sausage samples for DNA composition analysis.

Myocyte Extractor/Primer

Obtaining viable myocyte cells is a critical step in performing in vitro cardiac cell assays. Testing new drug candidates in this model heart system requires large numbers of myocytes to be produced for high throughput screening. The Fraunhofer LSE team has developed a system that utilizes pressure-based liquid infusion with volumetric feedback control. The use of a pressure-based liquid dispensing manifold results in a lower cost, easier to use and more reliable system. The four reaction chambers feature oscillating mechanical agitators and allow up to four myocyte cultures to be processed at the same time.

TriPette

Sample manipulation and liquid handling are vital for most laboratory based assays, and several platforms are currently on the market with different degrees of automation. However, most of the platforms are either too complex and/or too expensive for routine laboratory use. Our market research found the need for a simpler, cheaper and faster liquid handling solution, especially for the purification of biological macromolecules for downstream molecular analysis (e.g. DNA, RNA, and proteins). The Fraunhofer LSE team has developed a unique approach to biological liquid handling and sample preparation called the "TriPette". It is a single automated device that performs the three separate liquid-handling functions of dispensing, pipetting, and pressurizing. The innovative design uses an array of fine nozzles connected by fluidic channels to distribute flow between one source and an array of points. The instrument has proven to produce significantly faster and more accurate DNA purification from biological samples than manual methods.



Extraction of Primary Fibroblast and Keratinocytes from Human Skin Biopsies

For research in tissue engineering and regenerative medicine it is necessary to isolate primary cells from human biopsies. Primary cells are used for a broad range of applications such as basic biological research, the generation of 3D test systems for the pharmaceutical, chemical or cosmetics industries and even for clinical transplants. Due to easy access (e.g. medical waste from plastic surgery), low vascularisation in the tissue and well established cultivation methods – skin is a very common source for primary cells. The increasing demand for products that contain primary skin cells and the high quality standards of their production can only be fulfilled by using automated processes. We have developed and patented an automated process chain comprising a combination of specific mechanical and enzymatic applications to isolate fibroblasts and keratinocytes from human skin biopsies. The developed prototype automatically cuts the epidermal layer to provide enzyme access to the stratum basale and is thereby able to handle a wide range of biopsy shapes and sizes. We were able to achieve comparable or even increased cell output and viability compared to the conventional manual lab process. Depending on the needed level of automation, it is possible to combine the cutting prototype with other specialized laboratory equipment we have developed; like an automated separator of the fatty tissue or an automated multifunctional pipette which can be used to separate tissue pieces from liquid (enzyme solution, cell culture media). It is also possible to integrate these prototypes into a fully automated production environment.

Cell Cultivation Monitor

Many downstream and upstream processes involve complex cell cultivation techniques and require automatic and reliable monitoring. Besides the detection of proliferation rates and other growth conditions, a reliable sensing of contamination is essential. The Fraunhofer LSE team develops sensors and measuring devices for stand alone operation or their subsequent integration into automatic cell culture facilities. In order to reduce the risk of cross-contaminations by the transmission of pathogenic micro-organisms, the Fraunhofer LSE team focuses on the application of non-invasive optical sensor technology. By the integration of a small handling unit, the cultivation flasks are transported to the sensor array for instant measurement. In addition microscopic detection of the proliferation rate and cell morphology, the optical density and spectral distribution of the media are measured. Currently, a prototype of the device is operated in a fully automated production environment for the generation of artificial skin equivalents.

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