Abstract

Lab-on-Chip (LoC) systems are microfluidics-based analysis platforms that allow the integration of automated complex molecular biological procedures on a single chip. The development of LoC systems has recently gained a spectacular interest in healthcare technologies to provide them as a Point-of-Care (PoC) diagnostic tools. A new LoC system called Vivalytic developed by Bosch Healthcare Solutions GmbH is already established to provide an accurate and fast diagnosis result for respiratory infections and sexually transmitted diseases based on a technique called polymerase chain reaction (PCR). The development and implementation of new diagnostic tests for the Vivalytic system require the use of the quantitative polymerase chain reaction (qPCR). As a consequence, a new data analysis module needs to be developed for the system to evaluate the outcome of the newly implemented qPCR method.
In this thesis, a unique data analysis module is designed primarily to work for the Vivalytic system. The module is designed to fulfill its function through a consecutive steps process forming together a pipeline. The developed pipeline is capable of loading the input fluorescence images, automatically segment the region of interest, select the area of interest inside the fluorescence region, acquire the average intensity values, plot the initial curve, correct, classify and fit the curve, as well as output the quantitive threshold cycle measure. Moreover, the designed pipeline is implemented inside a graphical user interface to present it as an interactive windows tool for the user to work on. Additionally, a model for the qPCR reaction is proposed and compared with a real qPCR reaction output, and the pipeline design is evaluated based on artificial images generated from the model and real qPCR images from the system. The evaluation showed the robustness of the designed pipeline in a correctly classifying the qPCR curve and in overcoming the noise generated by the bubbles.