2. Leaking – the sealing unit for the reaction plate may be broken, which causing fluid to escape into an outer chamber; and
3. Assay spotting issues – for pre-spotted assay formats, some reaction units may not be loaded with the assay.

[0004] These sheet coating, reformatting or sample loading problems may be detected by visually checking reformatting and quality control (QC) images. Therefore, it is very important to automatically identify problems from QC images and quickly determine the root cause of failures during manufacture process. As PCR reactions may show anomalous behaviors such as sample loading problems in the images taken prior, during, or after the running of PCR for OpenArray or other array-based PCR platforms, it is desirable to automatically detect these types of failure modes in the customer facing software and make the troubleshooting step much more efficient and easier for customers.

SUMMARY

[0004a] An aspect of the present disclosure provides a system comprising a PCR system, a reaction array plate, a convolutional neural network (CNN) configured to receive a sequence of images of the reaction array plate in the PCR system; and an output of the CNN coupled to a control for the reaction array plate.

[0004b] Another aspect of the present disclosure provides a method comprising operating a PCR system on a reaction array plate; applying a sequence of images from a plurality of subarrays of the reaction array plate to a plurality of convolutional neural networks (CNNs) during operation of the PCR system on the reaction plate array; operating the CNNs to generate failure mode predictions for the reaction plate based on the sequence of images; and coupling an output of the CNNs to one or more of a setting for manufacture of the reaction array plate or to control the PCR system.

[0005] The present system utilizes a deep neural network, such as a convolutional neural network (CNN), to detect abnormalities in array plate reformatting and QC images to identify failure modes. The QC images, including both passing and failing sheets over a set period of time, are retrieved from a manufacturing data server. The data is classified based on passing or different failure modes. As each QC image may have more than one failure mode associated to one or multiple subarrays, the QC image is divided into

(for example 48) subarray images and each subarray is annotated into passing or five failure modes including: Bright Rox, Rox Spotting, Rox Stripping, Stop Point Bridging, and Reformatting error. The annotated subarray images are used to train, evaluate and test CNN model. The trained and verified model may then be used to recognize failures and their modes in array plate reformatting and QC images.

[0006] Convolutional neural networks (CNNs) are particularly well suited to classifying features in data sets modelled in two or three dimensions. This makes CNNs popular for image classification, because images can be represented in computer memories in three dimensions (two dimensions for width and height, and a third dimension for pixel features like color components and intensity). For example a color JEG image of size 480 x 480 pixels can be modelled in computer memory using an array that is 480 x 480 x 3, where each of the values of the third dimension is a red, green, or blue color component intensity for the pixel ranging from 0 to 255. Inputting this array of numbers to a trained CNN will generate outputs that describe the