CloneSelect™ Imager

Description of the Automation API

Contents

Theory of Operation

Manual Mode

The CloneSelect Imager takes images of cell culture microplates and generates confluence data for each well. When the instrument is used by a human operator in manual mode, they operate the instrument by running processes in the software. There are two processes available that image a well plate. One is named "Image Plate", the other is named "Microscope mode". Microscope mode is a point-and-click way for the user to look at a well plate without saving the result, so will not be discussed further.

Image Plate mode prompts the user for the well plate type and then asks them for the wells they want to image. It next allows the user to adjust the focus, brightness and alignment of the images. Finally, the wells are imaged and the results displayed.

Whilst it is possible for the user to save the process configuration to a file so that they can load it later, in practice this is not used on the CloneSelect Imager. The saved processes do not contain brightness, focus and alignment settings.

Automated Mode

To run the instrument from external software, it is first necessary to start the CloneSelect Imager software as normal, then start the "Automation Process" from the start screen. When this process runs, it opens the automation server and waits for an automation client to connect. It is not possible for the user to operate the software whilst it is in this state. The automation client can use the functions in the automation interface to control the instrument. When the automation client has completed its task, it disconnects from the automation server. At this point, the user is able to close the automation process in the CloneSelect Imager software and begin using manual processes again.

Communication with the automation sever is via a SOAP protocol. Details of the automation API and a sample application that illustrates its use are available once an order has been placed.

Please note that the Automation Process is an optional extra and is not included in the standard CloneSelect Imager package.

Remote Results Viewing

An optional component of the CloneSelect Imager system is the Remote Data Viewer. This is a software program that can be installed on any PC, and used to view the results of plates scanned on the CloneSelect Imager. The results can be on the CloneSelect Imager PC and shared using Windows® network folder sharing, on a Network server, on a CD or DVD, or copied to the local PC and viewed from there.

The Remote Data Viewer is especially useful when used in conjunction with the CloneSelect Imager that is fed by an automatic arm, since then it can be used on a remote PC to view recent results whilst the CloneSelect Imager itself is in use.

Programmatic Interface

The CloneSelect Imager automation mechanism uses a SOAP interface to communicate with automation clients. The CloneSelect Imager software is written using Microsoft® .NET™ 3.5 framework. The SOAP interface does not use IIS, but instead uses a self contained web server. When the automation server starts, it opens a URL based on the computer name (it uses the .NET Environment.MachineName property). The port it opens is always 8080. This yields URLs in the form http://name:8080

We have created a sample application to demonstrate use of the automation interface. You can either modify it to communicate with your own software, or simply examine it to understand how to use the SOAP interface and then write your own application.

Automatic Functions

The automation interface for the CloneSelect Imager contains the following functions:

- bool Connect()
- bool Disconnect()
- bool Initialise()
- string GetStatus()
- string GetHolderStatus()
- string[] GetAvailablePipelines()
- bool SetImagingPipeline(string sPipeline)
- string GetCurrentImagingPipeline()
- bool RunImagingAutomated(string sSourceWellplate, bool bAutoFocus, bool bReadBarcodes, bool bFastScan, bool bEnhanceImages, string sExpectedBarcode)
- bool RunImagingAutomatedSelectedWells(string sSourceWellplate, bool bAutoFocus, bool bReadBarcodes, bool bFastScan, string sWellList, bool bEnhanceImages, string sExpectedBarcode)
- string [] GetResults()

The GetStatus function can return one of the following states:

- Waiting
- LoadingPlate
- Barcoding
- AutoFocusing
- Imaging
- EjectingPlate
- Errored
- FatalError

The GetHolderStatus function can return one of the following states:

- Ejected
- InsideEmpty
- InsideLoaded
- Unknown

Initial communication with the instrument should be established by the Connect function. This

will return True if connection was successfully made. If the instrument is busy when connection was attempted False is returned. If the listening process has not been started on the instrument an exception may be thrown.

Once connection has been established with the instrument, the instrument requires initializing. This is done by calling the initialize function. The initialize function blocks while the instrument is placed in to a known state. This will place the plate holder in the Ejected state and set the instrument to the Waiting state. The instrument is now in the required state to have a microplate loaded.

Once a microplate is loaded and the loading device is clear, the RunImagingAutomated or RunImagingAutomatedSelectedWells function can now be called. The parameters used by these functions are as follows:

RunImagingAutomated (images all wells)

Parameter	Description
string sSourceWellplate	The type of plate to be imaged e.g. "Greiner 96 well"
bool bAutoFocus	If the instrument should try to find a focus level automatically or if it should use the stored value for the microplate type.
bool bReadBarcodes	See 'Reading Barcodes' Section.
bool bFastScan	If only a centre section of each well should be imaged (True) or the complete well should be imaged (False).
bool bEnhanceImages	If the captured images should be enhanced for visualization. In manual imaging this is True by default.
string sExpectedBarcode	See 'Reading Barcodes' Section.

RunImagingAutomatedSelectedWells (same as RunImagingAutomated plus)

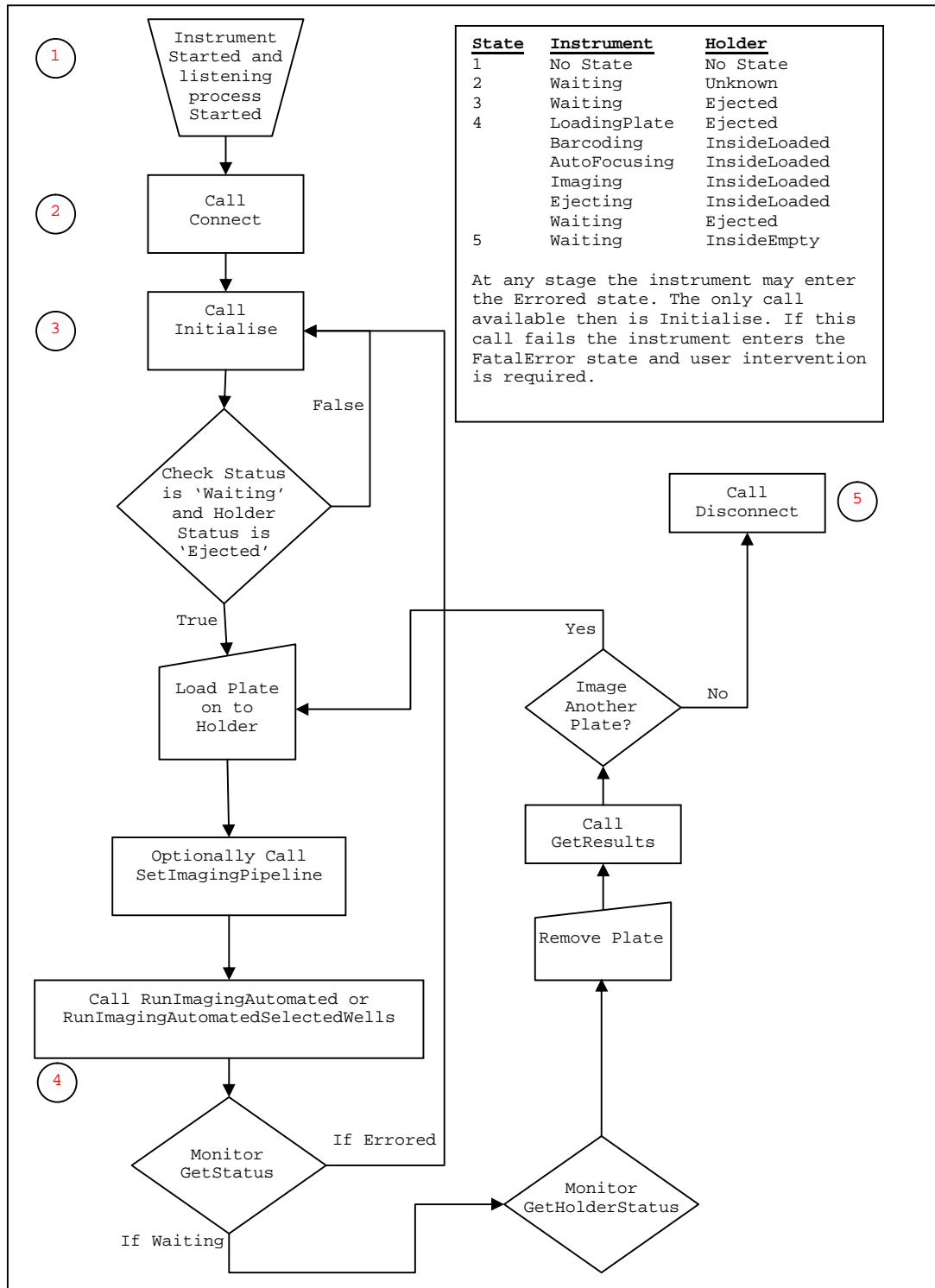| Parameter	Description
string sWellList	A comma separated list of wells to be imaged e.g. "A1, B1, C1, D1"

Both the RunImagingAutomated and RunImagingAutomatedSelectedWells do not block when called. They return if the functions have been started correctly by the way of boolean. Both Imaging tasks will take in the region of 1-8 minutes to complete and in this time their progress can be monitored by the GetStatus function. On completion the status will be set to Waiting.

Once the Waiting state has been reported the results can be retrieved by calling the GetResults function. This returns a string array. Each item in the array is a well and confluence pair separated by a comma. E.g. "A1, 56.19" meaning well A1 has a confluence of 56.19%. The only exception to this is when there are no results to return. In this case the first item in the string array will be set to "No Results".

The plate can be removed from the instrument when the Waiting state is set and the plate holder status is set to Ejected. At this point another microplate could be loaded and the RunImagingAutomated or RunImagingAutomatedSelectedWells function called to image that plate or if there are no more plates in the batch, the Disconnect function can be called. This will cause the plate holder to be returned to the safe position back within the instrument.

Instrument State and Flow

State	Instrument	Holder
1	No State	No State
2	Waiting	Unknown
3	Waiting	Ejected
4	LoadingPlate	Ejected
	Barcoding	InsideLoaded
	AutoFocusing	InsideLoaded
	Imaging	InsideLoaded
	Ejecting	InsideLoaded
	Waiting	Ejected
5	Waiting	InsideEmpty

At any stage the instrument may enter the Errored state. The only call available then is Initialise. If this call fails the instrument enters the FatalError state and user intervention is required.

① Instrument Started and listening process Started

② Call Connect

③ Call Initialise

Check Status is 'Waiting' and Holder Status is 'Ejected' — False / True

Load Plate on to Holder

Optionally Call SetImagingPipeline

Call RunImagingAutomated or RunImagingAutomatedSelectedWells

④ Monitor GetStatus — If Errored / If Waiting

Monitor GetHolderStatus

Remove Plate

Call GetResults

Image Another Plate? — Yes / No

⑤ Call Disconnect

Reading Barcodes

Both RunImagingAutomated and RunImagingAutomatedSelectedWells functions allow the way in which barcodes are used to be specified. This is controlled by the bReadBarcodes and sExpectedBarcode properties. The following table shows the how changes to these properties effects the method of barcoding that is used.

bReadBarcodes	sExpectedBarcode	Result
false	Length = 0	Barcodes are not scanned. A random barcode is automatically generated for the plate.
false	Length > 0	Barcodes are not scanned. The value of sExpectedBarcode is assigned to the plate.
true	Length = 0	Barcodes are scanned. The read barcode is assigned to the plate. An error is raised if no barcode was found.
true	Length > 0	Barcodes are scanned. The read barcode is checked against the value of sExpectedBarcode. If the barcodes do not match an error is raised. An error is raised if no barcode was found.

Selecting An Image Pipeline

After the call to Initialise is made and before the call to RunImagingAutomated or RunImagingAutomatedSelectedWells (See the diagram under the Instrument State and Flow section.), a pipeline to be used can be selected. This is achieved by calling the SetImagingPipeline function with the name of the pipeline to be used passed as a parameter. An array of the available pipelines can be found by calling the GetAvailablePipelines function and the currently selected pipeline can be found by making a call to the GetCurrentImagingPipelineFunction. It is advised that an imaging pipeline is set at the start of each session of plates.

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Revised June 2011