

**The A Team**

**Image Processing Tool for**

**Leidenfrost-Ratchet Systems**

**Test Plan Document for Version 2.0 (Final Draft)**

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Document Revision History

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| **Version Number** | **Date** | **Contributor** | **Description** |
| V1.0 | 4/12/2015 | Author: Hieu Tran  Reviewers: Rest of  A-Team | First draft of test plan |
| V2.0 | 4/28/2015 | Authors: Anne Lam and  Hieu Tran | Make revisions and add test  cases |

**1. Introduction**

This document details the test plan for the testing phase of the software development life cycle. This document sets the scope of various tests to be conducted, the activities to be completed, the general resources required, and the process to be used to test the final product before release.

1.1 Scope of Test Plan Document

The scope consists of what we intend to test and nothing more. For our purposes and our time constraints, we will concentrate on interface and system testing approaches.

1.2 Product Overview

The current purpose of the software is to efficiently track a drop of liquid and record measurements through images gathered from a high speed camera as the drop falls from an injection needle and travels along a ratchet surface. In this version, Version 2.0, we set out to also obtain net measurements as well as droplet volume, improve the user interface, and the processing time.

**2. Overview of Document**

In total, this document specifies the strategies and plans for testing the Image Processing Tool Version 2.0.

2.1 Test Strategies

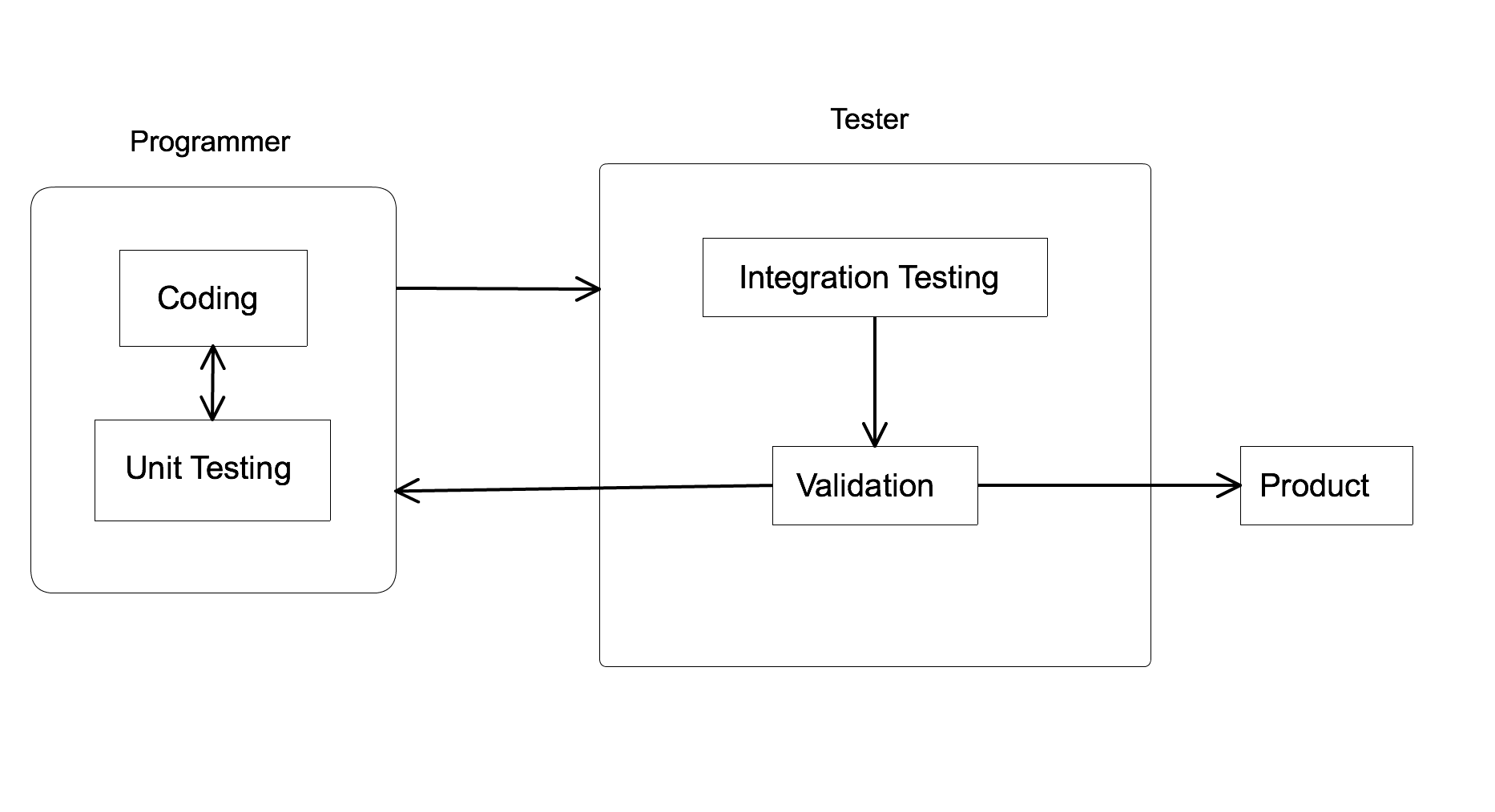
The following testing strategies will be employed in order to efficiently track issues and resolve them before release.

* **Interface Testing** – This uses the "black box" method of testing to review functionality of the user interface. Test cases are required to check every possible scenario and outcome resulting from interactions with the user interface. Hieu Tran will be responsible for interface testing.
* **System Testing –** This also uses the "black box" method of testing to check for each input the user may enter and ensure the expected results occur. Hieu Tran will primarily be responsible for system testing.

We decided against performing unit testing due to the complexity of constructing predictable data that we could assert and check for against the Tool's calculations.

2.2 The Testing Process

The flow chart in Figure 1 shows the process of the our test plan.



Ini Interface testing

Ini Integration & System testing

Figure 1. Test Plan Flow Chart

2.3 Testing Criteria

This section discusses the testing criteria for each testing strategy (unit, interface, and system) we plan to use during the testing phase of the software development cycle.

2.3.1 Interface Testing

Interface Testing is performed to evaluate whether the user interface of the Image Processing Tool passes data correctly and behaves as expected by the user. It is to verify if all the interactions between functional modules are working properly and errors are handled properly.

**Entrance Criteria** –Interface control functions and event handlers must all be established.

**Exit Criteria** – Interface testing exits when the tester verifies all interface test cases have passed and produced the correct expected output.

2.3.2 Integration Testing

“This test proves that all areas of the system interface with each other correctly and that there are no gaps in the data flow. The final integration test proves that system works as an integrated unit when all the fixes are complete. The actual testing method used for this phase will be the ‘black box’ method, (Sommerville, pg 443). ‘Bottom-up testing strategy’ will be followed throughout the integration-testing phase” (Sommerville, pg 453).

**Entrance Criteria** – At least 2 high priority modules must have passed their unit tests and been thoroughly reviewed.

**Exit Criteria –** All high priority errors from integration tests are fixed and tested.

2.3.3 System Testing

System testing is a black box testing technique performed to verify all expected inputs result in the system providing the correct output. The functionality of the Image Processing Tool will be tested from the user perspective.

**Entrance Criteria –** Entry criteria will start when the interface test phase has been completed.

**Exit Criteria –** When the tester has verified all the system test cases have passed and produced the correct expected output.

**3. Test Schedule**

For the testing phase, the following schedule will apply, with room for flexibility as needed:

Interface testing: 2 days

Integration testing: 3 days

System testing: 2 days

**4. Resources**

This section list the resources required to execute the test plan including the team members and the hardware and software requirements.

4.1 Personnel

The A-Team consists of the following team members:

Sanan Aamir – Tester/Programmer

Romando Garcia – Tester/Programmer

Anne Lam – Tester/Programmer

James Rowe – Tester/Programmer

Hieu Tran - Tester

4.2 Hardware

The testing phase will require at least one PC with the following specifications:

32 - bit architecture

at least 1GB of RAM

at least 1GHz of Processor Speed

4.3 Software

The testing phase will also require the following software:

Microsoft Visual Studio 10 or higher

Microsoft .NET 2.0 or higher

Windows 7 or higher

**5. Test Cases**

The test cases for the interface and system testing are listed in a table found in Appendix A.

**6. Glossary**

|  |  |
| --- | --- |
| **Term** | **Definition** |
| **Leidenfrost-Ratchet System** | A system involving a ratchet surface heated to a fluid's Leidenfrost point will allow a droplet of that fluid to spontaneous accelerate along that surface, even if it means traveling up slope. |
| **Droplet** | A very small drop of a liquid. |
| **Black Box** | A method of software testing that examines the functionality of an application without peering into its internal structures or workings. |
| **White Box** | A method of testing software that tests internal structures or workings of an application |
| **Unit Test** | A software testing method by units of source code, sets of one or more computer program modules together with associated control data, usage procedures, and operating procedures, are tested to determine whether they are fit for use. |

**7. References**

This document was completed with guidance from the Mavis and Scors test plan document, Test Plan Power Point slides written by Catherine Stringfellow, Professor at Midwestern State University, and a Software Engineering book written by Sommerville.

**Appendix A - Test Cases**

See detailed results in Test Report Document.

**Interface Test Cases**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Test Cases** | **Test Type** | **Step & Input** | **Expected Results** | **What is Tested** |
| **Load Button** |  |  |  |  |
| LB 011  Open File Dialog | Interface Test | Click Load Button > Show Open File Dialog | Open File Dialog Should Appear | User Interface |
| LB 021 Accept Directory .TIF | Interface Test | Find Image Directory > Open .TIF image folder | Accept .TIF Directory | Open File Dialog |
| LB 022  Accept Directory .BMP | Interface Test | Find Image Directory > Open .BMP image folder | Accept .BMP Directory | Open File Dialog |
| LB 023  Reject Single File | Interface Test | Find Image Directory > Select single file | Will not allow selection of single file | Open File Dialog |
| LB 024  Reject Other Directory Extension | Interface Test | Find Image Directory > Open other folder directory | Will show Error Dialog | Open File Dialog |
| LB 024 Reject Directory with less than 5 images | Interface Test | Find Image Directory > Open Directory with less than 5 images | Will show Error Dialog | User Interface |
| LB 031 Show Image | Interface Test | Find Directory > Click Open | Will show 5th Image in folder processed on UI | User Interface / Open File Dialog |
| LB 032  Enable Run Button | Interface Test | Find Directory > Click Open | Run Button Will Enable | User Interface |
| LB 033  Enable Calibrate Button | Interface Test | Find Directory > Click Open | Calibrate Button Will Enable | User Interface |
| **Initial User Interface** |  |  |  |  |
| UI 011 Disable Calibrate Button | Interface Test | Click Image Processing Application | Calibrate Buttons disable | User Interface |
| UI 012 Disable Run Button | Interface Test | Click Image Processing Application | Run Button is Disable | User Interface |
| UI 013  Disable Black/White Calibration Drop down | Interface Test | Click Image Processing Application | Black/White Calibration drop down is disable | User Interface |
| UI 014  Enable Load Button | Interface Test | Click Image Processing Application | Enable Load Button | User Interface |
| UI 015  Disable Frame Rate Input | Interface Test | Click Image Processing Application | Disable Frame Rate Input | User Interface |
| UI 016  Disable Base/Needle Height | Interface Test | Click Image Processing Application | Disable Base/Needle Height | User Interface |
| UI 021  Enable File Menu | Interface Test | Click Image Processing Application | Enable File Menu | User Interface |
| UI 022  Enable Image Menu | Interface Test | Click Image Processing Application | Enable Image Menu | User Interface |
| UI 023 Enable About Menu | Interface Test | Click Image Processing Application | Enable About Menu | User Interface |
| UI 024  Enable File Menu Load Button | Interface Test | Click Image Processing Application > File | Enable File Menu Load Button | User Interface |
| UI 025  Enable File Menu Quit Button | Interface Test | Click Image Processing Application > File | Enable File Menu Quit Button | User Interface |
| UI 026  Disable Image Menu Run Button | Interface Test | Click Image Processing Application > Image | Disable Image Menu Run | User Interface |
| UI 031 Resize Image Processing Form | Interface Test | Click and Drag A corner of the Form and move in and out. | Form Should be fixed | User Interface |
| **Frame Rate** |  |  |  |  |
| FR 011  Enter Frame Rate | Interface Test | Click Up or Down to select frame rate | Let User Choose Correct Frame Rate | User Interface |
| FR 012 Enter Frame Rate | Interface Test | Click Down to select negative number | Should stop at zero | User Interface |
| **Base/Needle Height** |  |  |  |  |
| BN 011 Enter Base/Needle Height | Interface Test | Enter negative number Base/Needle Height | Should not let user enter negative number | User Interface |
| BN 012 Enter Base/Needle Height | Interface Test | Enter letter for Base/Needle Height | Should not let user enter alphabetic | User Interface |
| BN 013 Enter Base/Needle Height | Interface Test | Enter positive Number for Base/Needle Height | Should let user enter positive number | User Interface |
| BN 014 Enter Base/Needle Height | Interface Test | Enter decimal bumber for Base/Needle Height | Should let user enter decimal number | User Interface |
| **Black/White Calibration** |  |  |  |  |
| BW 011 Black/White Calibration | Interface Test | Click Up or Down to select Black/White Calibration | Should let user click up or down | User Interface |
| BW 012 Black/White Calibration | Interface Test | Click Down to select negtative number for Black/White Calibration | Should stop at zero | User Interface |
| **Browse Button** |  |  |  |  |
| BB 011 | Interface Test | Click Browse Button | Save File Dialog Should Appear | User Interface |
| BB 021 | Interface Test | Click Browse Button > Enter a Name > Click Save | Names an Excel file that will be created after Running, will display file path in 'Save Destination' textbox | User Interface |
| **File Menu Strip** |  |  |  |  |
| FM 011  File Load Menu | Interface Test | Click File > Load > Show Open File Dialog | Open File Dialog Should Appear | User Interface |
| FM 021 Accept Directory | Interface Test | Find Image Directory > Open .TIF image folder | Accept .TIF Directory | Open File Dialog |
| FM 022  Accept Directory | Interface Test | Find Image Directory > Open .BMP image folder | Accept .BMP Directory | Open File Dialog |
| FM 023  Accept Directory | Interface Test | Find Image Directory > Open single file | Will not show single file | Open File Dialog |
| FM 024  Accept Directory | Interface Test | Find Image Directory > Open other folder directory | Will not allow user to select other extension | Open File Dialog |
| FM 031 Show Image | Interface Test | Find Directory > Click Open | Will show fifth Image processed on UI | User Interface / Open File Dialog |
| LB 041  Enable Calibrate Button | Interface Test | Find Directory > Click Open | Calibrate Button Will Enable | User Interface |
| LB 042  Enable Black/White Input | Interface Test | Find Directory > Click Open | Black/White Input Enable | User Interface |
| LB 043  Enable Base/Height Needle Input | Interface Test | Find Directory > Click Open | Base/Needle Height Input Enable | User Interface |
| **About Menu Strip** |  |  |  |  |
| AB 011 Show Information Form | Interface Test | Click About on the Menu Strip | Open an information regarding about the application | User Interface |
| **Image Menu Strip** |  |  |  |  |
| IM 011 Image Menu Strip | Interface Test | Click Image > Run on Menu Strip | Should run the Image Processing and open excel with data and graph | User Interface |

**Integration Test Cases**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Test Cases** | **Test Type** | **Step & Input** | **Expected Results** | **What is Tested** |
| **Run Button** |  |  |  |  |
| RB 011 Run Button | Integration Test | Click Run Button | Should open Excel software and Generate excel data | User Interface/Image Processing/Excel Data |
| RN 012  Run Button | Integration Test | Run with an Excel application currently open | Open Excel applications will close and then output Excel file will open | User Interface/Image Processing/Excel Data |
| RN 021 Run Button | Integration Test | Run > Click 'Stop' while Tool is 'Processing Images: ' or 'Calculating Drop Measurements' | Tool should allow the application to stop processing. | User Interface |
| RN 022 Run Button | Integration Test | Run > Click 'Stop' while Tool is 'Generating Spreadsheet/Data Plots' | Tool should complete Excel creation and then stop. | Excel Processing/IO |
| RN 023 Run Button | Integration Test | Run > Click 'Stop' while Tool is 'Saving Processed Images' | Tool should safely stop saving processed images. | User Interface/Excel Processing/IO |
| RN 031 Run Button | Integration Test | Run > Click 'Stop' > Click 'Run' again (at any point during processing) | Tool should just continue to as stoppable point and then restart processing all images. | Excel Processing/IO |
| RN 041 Run Button | Integration Test | Run > Click Close/Exit the application while 'Calculating Drop Measurements' | Tool should allow the application to close with no other effects. | User Interface |
| RN 042 Run Button | Integration Test | Run > Click Close/Exit the application while 'Generating Spreadsheet/Data Plots' | Tool should not allow the application to close during spreadsheet generation | Excel Processing/IO |
| RN 043 Run Button | Integration Test | Run > Click Close/Exit the application while 'Saving Processed Images' | Tool should be able to close and only some processed images will be created and saved | Image Processing/IO |

**System Test Cases**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Test Cases** | **Test Type** | **Step & Input** | **Expected Results** | **What is Tested** |
| **Black/White Calibration** |  |  |  |  |
| BW 011 Black/White Calibration Textbox | System Test | Enter Default 32 | Initial processed image will be displayed | Image Processing |
| BW 012 Black/White Calibration Textbox | System Test | Enter Higher than 32 value | More pixels from the original image will be identified as part of the experiment (displayed in black in the PictureBox) than in the Initial processed image | Image Processing |
| BW 013 Black/White Calibration Textbox | System Test | Enter Lower than 32 value | Less pixels from the original image will be identified as part of the experiment (displayed in black in the PictureBox) than in the Initial processed image | Image Processing |
| **Frame Rate** |  |  |  |  |
| FR 011 Frame Rate Textbox | System Test | Enter Default 250 | The time interval between images will be .004 seconds | Excel Data |
| FR 012 Frame Rate Textbox | System Test | Enter FPS Other than 250 | The time interval between images will be 1/FPS seconds | Excel Data |
| **Base/Needle Height** |  |  |  |  |
| BN 011 Base/Needle Height | System Test | Leave Blank | Data units will be in pixels (shown in table header) | Excel Data |
| BN 012 Base/Needle Height | System Test | Enter a value | Data units will be in centimeters (shown in table header) | Excel Data |
|  |  |  |  |  |
| **Run Button** |  |  |  |  |
| RB 011 Run Button | System Test | Click Run Button | Should open Excel software and Generate excel data | User Interface/Image Processing/Excel Data |
| RN 012  Run Button | System Test | Run with an Excel application currently open | Open Excel applications will close and then output Excel file will open | User Interface/Image Processing/Excel Data |
| RN 021 Run Button | System Test | Run > Click 'Stop' while Tool is 'Processing Images: ' or 'Calculating Drop Measurements' | Tool should allow the application to stop processing. | User Interface |
| RN 022 Run Button | System Test | Run > Click 'Stop' while Tool is 'Generating Spreadsheet/Data Plots' | Tool should complete Excel creation and then stop. | Excel Processing/IO |
| RN 023 Run Button | System Test | Run > Click 'Stop' while Tool is 'Saving Processed Images' | Tool should safely stop saving processed images. | User Interface/Excel Processing/IO |
| RN 031 Run Button | System Test | Run > Click 'Stop' > Click 'Run' again (at any point during processing) | Tool should just continue to as stoppable point and then restart processing all images. | Excel Processing/IO |
| RN 041 Run Button | System Test | Run > Click Close/Exit the application while 'Calculating Drop Measurements' | Tool should allow the application to close with no other effects. | User Interface |
| RN 042 Run Button | System Test | Run > Click Close/Exit the application while 'Generating Spreadsheet/Data Plots' | Tool should not allow the application to close during spreadsheet generation | Excel Processing/IO |
| RN 043 Run Button | System Test | Run > Click Close/Exit the application while 'Saving Processed Images' | Tool should be able to close and only some processed images will be created and saved | Image Processing/IO |