

**The A Team**

**Image Processing Tool for**

**Leidenfrost-Ratchet Systems**

**Final Report for Version 2.0**

May 8, 2014

**Authored By:**

Sanan Aamir

Romando Garcia

Anne Lam

James Rowe

Hieu Tran

Table of Contents

1. Description 2
2. Project Analysis 2-3
3. Deviations 3
4. Team Organization 3
5. Team Experience 4
6. Hypothetical 4-5
7. Reflections. 5-6

**1. Description**

The A-Team was presented with the problem of processing image sets of a droplet traveling during a Leidenfrost Ratchet Systems experiment. Our customers, Dr. Ok and Dr. Guo, requested that we improve the existing Image Processing Tool (2014) with some changes in the requirements. Our goal was to develop a new, fast, and accurate image processing application that would also be highly automated. The tool processes and analyzes a droplet moving along a ratchet surface by following the centroid position. We were successfully able to calculate the centroid, velocity, acceleration, and volume of the droplet for each image in an image set. The results are represented numerically and graphically in an Excel spreadsheet created by the tool.

**2. Project Analysis**

The final product met the basic specifications set by the customers. The tool:

* Tracks the location of the drop by following the centroid.
* Determines location of the needle and base automatically
* Does not require a base image
* Obtains volume and all required kinematics
* Outputs to Excel
* Generates plots as a function of time
* Is repeatable

The product could further be improved in the following areas:

* Processing efficiency time
* Adding frame number to the table

The only issue we found and did not resolve was the interruption/unintended stop of the tool should the user interact with the Excel spreadsheets before all the data has been loaded.

When we ran into issues, we had to pinpoint the bug, which was difficult at times due to the complexity of the data, and then reevaluate our algorithm or add functionality through thread manipulation, or software (Excel) manipulation.

Overall, we believe the project to be a success due to fairly seamless execution, better design, and more accurate processing.

**3. Deviations**

There were some deviations from the requirements and specifications and the project plan documents. The deviations are listed below:

* We dropped unit testing since our data sets could not be recreated by the testers in a manner where we could have expectations for the values and use assertions to check them.
* Microsoft Excel is now required for the project to generate graphical data automatically. Excel was not originally a requirement.
* Black/white calibration requires trial and error technique instead of user-defined calibration. This was necessary because of the algorithm we chose to process the images.

**4. Team Organization**

Our team's approach to handling issues and discussions was controlled and decentralized. James Rowe, our team leader, played a huge part in keeping the team organized and on track. More importantly, everyone on the team had equal say regarding the development and progress of the project.

Furthermore, we split the coding tasks based on functionality. We decided on two pairs of partners who would focus on a particular set of features. Anne Lam and Sanan Aamir decided to tackle the droplet-processing portion of the tool; whereas, James Rowe and Romando Garcia decided to work on the GUI, the automatic generation of the Excel spreadsheet, and multi-threading of the application.

Since we chose the waterfall process model, we had to extensively work on documentation. All five members contributed to the documentation via primary authoring or editing. Hieu Tran was chiefly in charge of drafting up the documents and bringing them up to the team for a detailed review. In addition to that, every one took part in the "big bang" testing approach of the tool.

**5. Team Experience**

Collectively, the team learned a lot. All of us enhanced our existing skills and delved into newer domains by getting out of our comfort zones. We all determined that we had learned the following:

* Communication is important both between the client and the team and also between individual team members. However, working in a team can easily lead to miscommunication. Group messaging tools, such as emails and text, are helpful in alleviating this issue.
* How to be assertive in our code choice and portray ourselves as experts in the field.
* How to write detailed documentation and keep track of our progress. Documentation also laid out the strategy for our implementation and testing phases.
* How to test the application. Going through various testing techniques helped us find defects and further refine our application.
* How to link multiple software libraries together using Component Object Model (COM). In our case we used MS Excel COM to link it to our application.
* Practical use of multi-threading. Multi-threading helped us improve the processing time and keep the GUI interactive while the processing was going on in the background. In contrast to the previous version, we had more data to process and manipulate; therefore, multi-threading was a very efficient solution to tackle this problem.

**6. Hypothetical**

Some things that we would do differently if more time were given:

* Improve processing time
* Perform more thorough testing
* Improve design of interface
* Ensure customer satisfaction

Things we would do differently if we had to start over:

* Consider an Agile process model
* Frequently communicate with the customer
* Start testing earlier
* Have necessary resources like MS Excel available for every team member beforehand

**7. Reflections**

Sanan Aamir:

*Working on this project has been an amazing experience for me. It’s been amazing because after a long time, I went out of my comfort zone and experienced different aspects of software engineering rather than just coding the solution. Moreover, working with a team has really improved my people skills, and it has taught me how to communicate with them when different issues arise. I wish we could have started testing a little earlier; however, we still managed to test most of the major components of our application. I was really impressed with how well organized our documentation is. Overall, I am really satisfied with the progress that we made.*

Romando Garcia:

*This project was beneficial in helping me understand how the Software Development Lifecycle (SDLC) works and why one model**may be more advantageous over another. Also, this experience allowed me to hone my skills in teamwork strategies, communication, and collaboration. Overall, I had the pleasure of working with a* ***one in a lifetime*** *team to develop an awesome tool.*

Anne Lam:

*I've worked on a large project with a team before, but this experience was especially rewarding due to our having our own autonomy to accomplish our set tasks. In addition, I've gained more experience on presenting and interacting with clients, both of which are invaluable and always in demand in order to contribute professional development. This problem was different to others we've been exposed to and it was fun working on it with a great set of team members.*

James Rowe:

*This project has gone incredibly well from start to finish. We joined together as a team having already worked with each other before separately in past projects. We all have excellent skills and had already known about each other’s skill sets. Following the software development processes we were learning in class, we made sure we completely understood the problem, analyzed the strengths and weaknesses of the previous project, planned out our own solutions to the complex challenges of the project, and implemented the solutions while adjusting to the inevitable hurdles that occur during implementation. Overall, it was a combination of our team’s competency and our careful planning that led to our success. I am very proud of our achievements.*

Hieu Tran:

*Working on this project has taught me how to write better documentation, which is required in the professional field. This project has taught me collaboration with teammates, planning out the project, and testing. At NCR I’ve coded, tested, and written small documentation. Now I can go back to the work field with knowledge of better documentation and planning process. Also, this has inspired me to pursue a Master’s degree in Software Engineering.*