

Anna, Astha, Colin, Caden, Evan

4 Testing

Testing is an **extremely** important component of most projects, whether it involves a circuit, a process, power system, or software.

The testing plan should connect the requirements and the design to the adopting test strategy and instruments. In this overarching introduction, given an overview of the testing strategy. Emphasize any unique challenges to testing for your system/design.

4.1 UNIT TESTING

What units are being tested? How? Tools?

- 3D Printer – Running test prints using software and code we created/improved
- Flow Control – Using Fluigent’s software OxyGEN and ink to run standard test cycle
- LED Board - The current LED board has been in talks to be upgraded; the board (current or new) will need to be tested with the current Arduino and hardware systems.

4.2 INTERFACE TESTING

What are the interfaces in your design? Discuss how the composition of two or more units (interfaces) are being tested. Tools?

- Two units that will be interfaced include the 3D printer and the flow control system. The Fluigent system comes with an interface module that you upload the software from OxyGEN to the module, which then controls the piping and air compressor to move certain liquids/substances. These liquids will then be fed to the 3D printer that will print the DNA strand. We will test the effectiveness of our software/code by uploading it to the interface module and seeing if our hardware components behave accordingly. We will start by testing it with ink.
- Another interface will be the LED board / OLED board with the Arduino, necessary control software, and the other current hardware systems and components. This will be a larger interface as there will be multiple software components and hardware parts.

4.3 INTEGRATION TESTING

What are the critical integration paths in your design? Justification for criticality may come from your requirements. How will they be tested? Tools?

- Integration of Units
 - Integration of Units is critical to our project as one of our requirements was combining systems designed by the prior year’s team. We will test this by utilizing the above listed interfaces such as the integration of the Arduino, software, LED board, and the flow control system.

4.4 SYSTEM TESTING

Describe system level testing strategy. What set of unit tests, interface tests, and integration tests suffice for system level testing? This should be closely tied to the requirements. Tools?

- System testing is the process in which the team evaluates how the various components of an application interact together in the full, integrated system. We will probably use performance/usability tests on each unit to make sure they perform well under stress and are functional. We will start using usability tests on the prior team's work to see if changes need to be made before we begin whole system integration. This will give us a chance to improve individual units like the code and perform regression testing to make sure our changes do their intended purpose. We can then start with smaller integration tests to confirm pieces work together, like the code to run the flow control system integrates well with the pressurized piping.

4.5 REGRESSION TESTING

How are you ensuring that any new additions do not break the old functionality? What implemented critical features do you need to ensure they do not break? Is it driven by requirements? Tools?

- As mentioned above, this is where regression testing becomes prevalent. Regression testing evaluates the functionality of pre-existing systems, then again tests the functionality of those systems with modifications or changes. One idea we have to track changes is to begin leaving comments in the code that dictates changes, and the purpose of old sections, and maintain general notes and thought processes behind new additions. The documentation will allow us to follow the code and debug more efficiently should something break.

4.6 ACCEPTANCE TESTING

How will you demonstrate that the design requirements, both functional and non-functional are being met? How would you involve your client in the acceptance testing?

- Fortunately, our client is also our advisor for the project. Professor Lu will be with us for every testing stage prior to acceptance testing and therefore should be easy to involve. We don't believe that we will complete the project, we can simply improve what was given to us and pass it on to the next team as this is a multi-year investment. Based on this observation, acceptance testing for this project might take the form of beta testing or integration testing, since the prior team never got to integrate units.

4.7 SECURITY TESTING (IF APPLICABLE)

- N/A

4.8 RESULTS

What are the results of your testing? How do they ensure compliance with the requirements? Include figures and tables to explain your testing process better. A summary narrative concluding that your design is as intended is useful.

- We haven't performed any integration testing, but we have some preliminary results from unit testing. We discovered that the pressurized piping of the flow control system tends to clog/kink. We believe that this is because some of the lines are too taut and therefore crease and clog.