

Singularity Software
Milestone 5

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By signing below, I approve the contents of the following document.

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1 Executive Summary

This document is the fifth and final in a series of milestone documents that will accompany the planning of the Siftables Emulator. The Emulator project is an application that will allow developers of Sifteo applications to test the features of Sifteo Cubes — miniature computers that interact and communicate when used in tandem — in a virtual programming environment. There is currently an emulator from Sifteo, Inc. that comes as part of the Software Development Kit (SDK) for the Cubes. However, Singularity intends to come up with a more natural interface than the one currently provided in that application.

This milestone reports on the usability study that was conducted to compare the interfaces of Sifteo Inc.’s Siftulator and Singularity’s Siftables Emulator. After elaborating the methods and findings of that study, it goes on to show the original prototype used therein as well as a second prototype that has been adjusted based on feedback therefrom.

2 Introduction

Developers of applications for the Sifteo Cubes currently must test programs they create for the platform within the emulator provided by Sifteo. While this emulator covers all the functionality of the Sifteo Cubes, it presents a user interface that Singularity Software believes could be more naturally implemented. As such, Singularity Software will provide, in the form of the Siftables Emulator, a new software-based emulator for the Sifteo Cubes that will allow developers to more naturally interact with the platform.

Milestone 5 elaborates on the usability study that compared the proposed Siftables Emulator design to the Siftulator’s design before presenting original and feedback-based interface designs for the Siftables Emulator. It follows Milestones 2, 3, and 4, which defined a change control plan, coding standards, and test cases and laid the foundation and elaborated the requirements of the Siftables Emulator specification based on the high-level design created in Milestone 1.

3 Project Background

The Siftables Emulator is being developed by Singularity Software as part of the Junior Project sequence of classes at Rose-Hulman Institute of Technology. When projects were solicited for the sequence, clients Tim Ekl and Eric Stokes (both Rose-Hulman alumni) submitted a request for an emulator for Sifteo Cubes, a new platform intended for “intelligent play.” After Singularity was chosen for the project, we met with Mr. Ekl to determine the three primary features of the Emulator: a Workspace where 1-6 Cubes could mimic the manipulations possible with physical Cubes, an Application Programming Interface (API) to program those virtual Cubes, and a set of example games designed to show off the first two features. Singularity’s Emulator is intended to build on the foundation of Sifteo, Inc.’s existing emulator by creating a more fluid and natural user interface.

4 Usability Report

4.1 Process

A basic prototype of the Siftables Emulator was developed using Flash in order to conduct the usability test. The prototype, which modeled the basic functionality intended for the final emulator, was then compared to the current Sifteo emulator, the Siftulator. The tests were conducted using CSSE students and faculty as subjects as they were found to be the best representation of the post-development use demographic.

Participants in the study were first presented with an informed consent form and a pre-test questionnaire containing inquiries for personal criteria. Upon completion of these two documents, the user was then taken into the testing area and briefly given a basic set of verbal instructions by one of the team members. After the team member finished dictating the instructions and departed, the participant was asked to begin the study by watching a short video demonstrating the capabilities of the Sifteo Cubes. Singularity Software felt that this was the most efficient way to acquaint users with the product, a necessary task for them to be able to accurately judge the performance of an emulator.

Upon completion of the video, participants were asked to complete a series of simple tasks in the current Siftulator platform. Because of the nature of this product and its lack of a help file, a list of action commands was located on the table next to the user. If they could not intuitively determine the correct way to complete a task, participants were told that this sheet could be used to help them. Users were then asked to switch to Siftables Emulator prototype and reminded that this product was in no way based on the software which they had just used. They were then asked to complete a similar set of tasks using the prototype. In the event that the user became stuck and was unable to complete their task at any time on either emulator, help was offered. This help was kept to a minimum degree, often consisting solely of asking the user a question to help them cogitate in a different fashion.

At the conclusion of the technical portion of the study, participants were thanked for their time and assistance and asked to complete a posttest questionnaire. This questionnaire was designed to allow each user to express his or her opinion about the various aspects of both projects and suggest possible improvements to the interface of the Siftables Emulator prototype.

4.2 Analysis

The results from the usability study can be found primarily in the usability report generated by the Ovo software.

Additionally, a pre-test questionnaire and a post-test questionnaire were distributed to each participant to collect data regarding their overall experience as well as their prior knowledge of the product and similar systems. The informed consent form, pre-test questionnaire, and post-test questionnaire are all included as appendices at the end of this document. The results of the questionnaires are shown in the table following this section.

4.2.1 Pre-Test Results

1. All of the participants reported that they had never heard of Sifteo nor their product, so they had no previous experience working with the product, which provided a clean slate on which to base our findings.
2. All of the participants but one reported having never programmed for an embedded system before. This question does not directly reflect in any of the results, but it indicates that the emulator is still accessible to first-time programmers for embedded systems.
3. On average the participants felt somewhere between comfortable and uncomfortable using new software without documentation. Considering that is the exact median of the possible values, these results are expected.
4. With documentation, all participants felt at least somewhat comfortable, and all but one reported feeling very comfortable using new software. Because the participants chosen were all from or had experience in the field of computer science/engineering or software engineering, this is expected.
5. Similar results were found with the participants' comfort level with using an API.
6. Half of the participants had used an emulator before, and half had not, indicating that our results would accurately depict the user experience on both ends of the spectrum.

4.2.2 Study Results

Results from the usability study with the six participants are available in the usability report. Overall, the times associated with the tasks for Singularity's emulator were significantly lower than those associated with the tasks for Sifteo's emulator.

One notable difference was in the "Load program" task. Using Sifteo's emulator, a user has to open a separate program loader, and navigating to the "Play" functionality is not intuitive. Additionally, there is not much immediate feedback regarding the success of loading a program. On the other hand, in Singularity's emulator, loading a program was literally as easy as the click of a button, making the task much more straightforward.

4.2.3 Post-Test Results

1. All but one participant strongly agreed that the main screen of the emulator was accessible. The other participant agreed that the main screen was accessible but did not strongly agree, indicating that the layout works well for efficient use.
2. All but two participants strongly agreed, and the other two agreed, that the commands were in easy-to-find locations, reinforcing that the layout of the main screen was well-designed.
3. Moving a Cube was not as straightforward, with the users on average agreeing that it was easy, and one participant strongly disagreeing. Because the moving functionality was not fully implemented in the prototype but participants found it

easy to use in Sifteo's emulator, we can ensure that the functionality will be easy to use because we plan on implementing movement in the same way.

4. Organizing Cubes on the screen on average was determined to be halfway between agreeing and strongly agreeing. Because only one Cube was present in the emulator, some found it less intuitive because they did not receive visual feedback, which is understandable and does not heavily indicate any lack of usability in the product.
5. Manipulating a cube on average was indicated to be fairly intuitive, but not all functionality was straightforward or immediately obvious. As the study indicated, shaking and tilting took considerably longer than the other manipulations, due to the icons used as those who found it fairly unintuitive reported on their questionnaire.
6. On average the participants agreed that Singularity's emulator was easier to use than Sifteo's. The participants who found Sifteo's emulator easier to use made extensive use of the help sheet provided, so they were able to complete the actions more quickly.

Gender	Major	Class	Pre1	Pre2	Pre3	Pre4	Pre5	Pre6	Post1	Post2	Post3	Post4	Post5	Post6
F	CS	S	A	No	1	4	4	No	4	4	1	2	3	3
F	CE	F	A	No	1	3	4	Yes	3	4	3	4	3	4
M	SE/CS/MA	S	A	No	3	4	3	Yes	4	4	4	4	3	2
M	SE	J	A	No	4	4	4	Yes	4	3	4	4	4	2
M	CSSE	Fac	A	No	3	4	4	No	4	3	2.5	2.5	3	4
M	CPE	J	A	Yes	3	4	4	No	4	4	4	4	4	4
Average					2.5	3.8	3.8		3.8	3.7	3.1	3.4	3.3	3.2

4.3 Findings

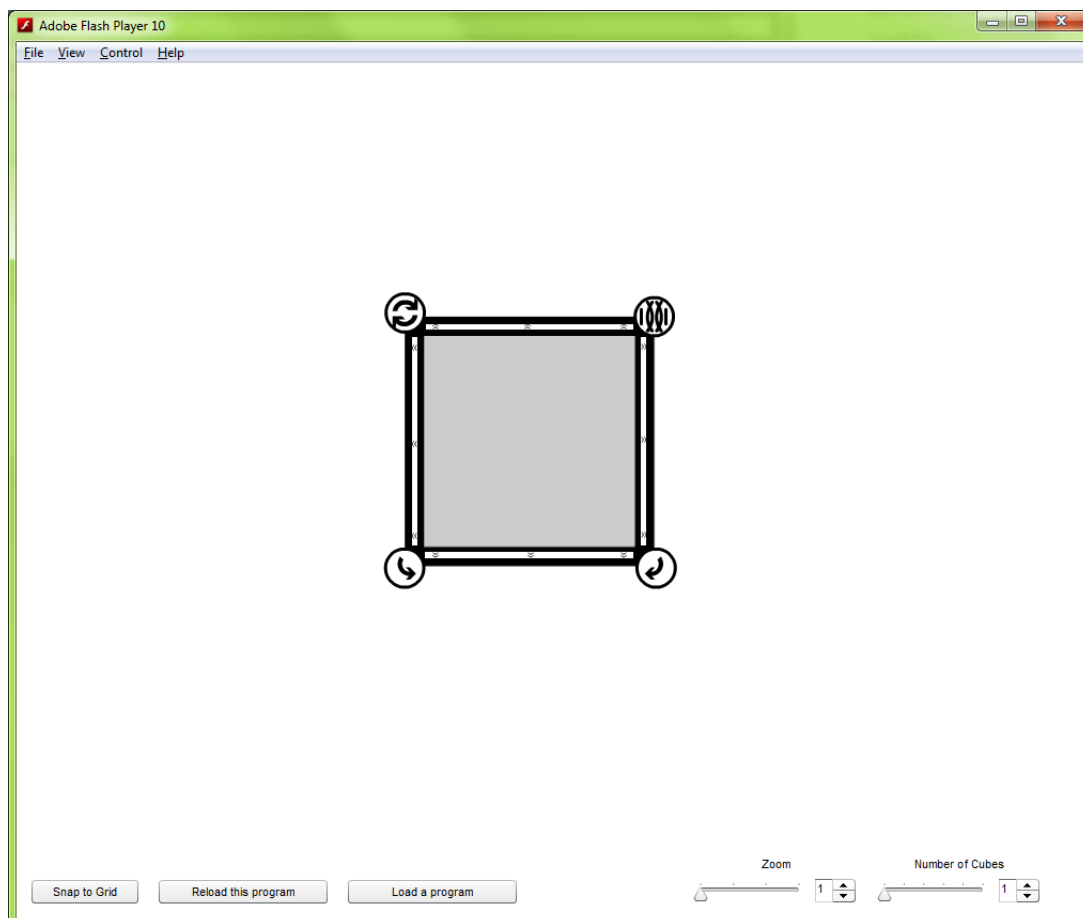
Based on the post-test results, our emulator was regarded as having an accessible layout and fairly intuitive controls. All the users at least agreed that the commands were in easy-to-find locations and that the main screen looked accessible.

One aspect that the users saw that could be improved is in manipulating the Cube. While rotating and flipping were not an issue for most users, they found tilting and shaking to be more difficult to comprehend. For this reason, we made the edges of the Cube bolder to help inform the user where to grab the Cube for tilting and also changed the shake icon to be more recognizable. However, since most of the users first instinct to shake the Cube was to drag it with the mouse, the shake icon is temporary and we plan to implement mouse control for the shake command in the future.

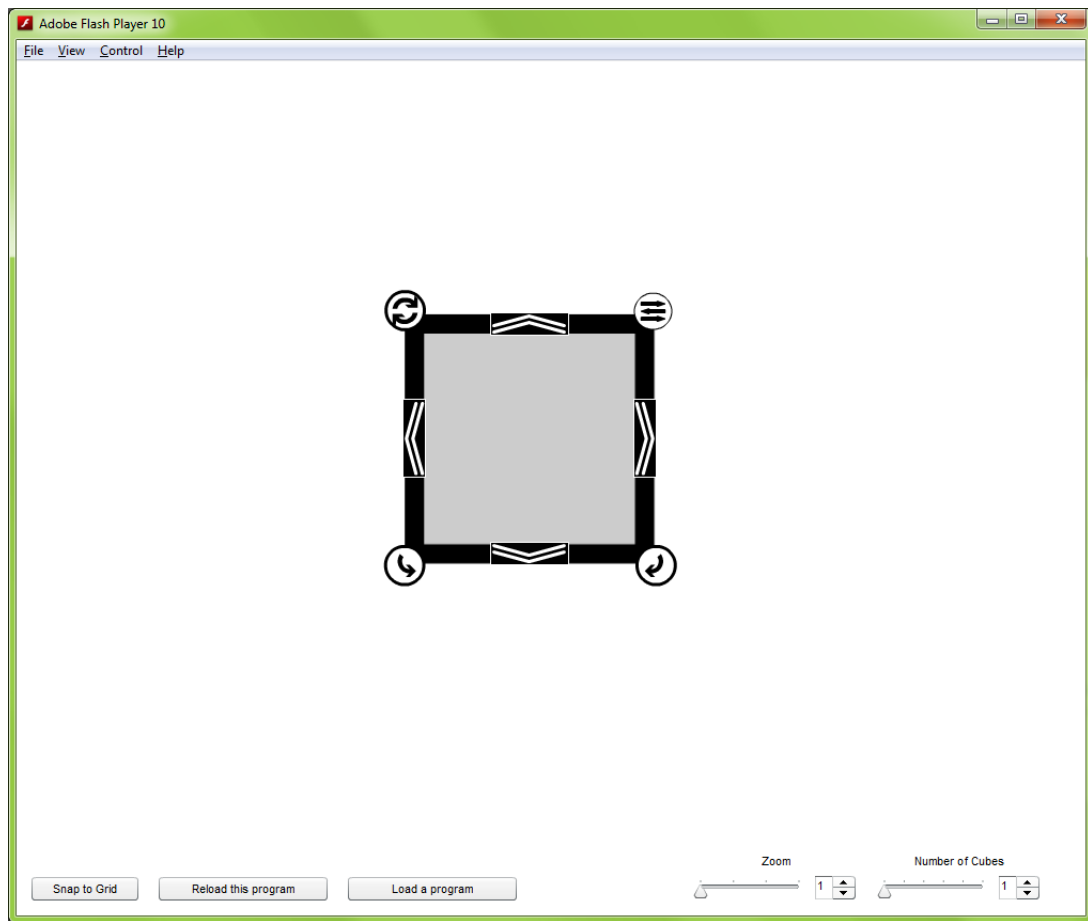
The users, on average, completed the designated tasks quicker and with less help in comparison to Sifteos emulator. Overall, the emulator was conceived as an improvement over Sifteos emulator by outperforming it in various tasks such as adding/removing cubes, loading programs, and controls.

5 Interaction Architecture

6 Initial Interface Design



7 Revised Interface Design



A Features

Feature	Description	Status	Priority	Risk	Reason
Individual, virtual Sifteo Cube	A virtual representation of a single Sifteo cube	Approved	Critical	Low	Replicates physical Sifteo Cube
Buttons to manipulate each virtual Cube	Buttons on the virtual Cube will allow the user to flip and tilt it	Approved	Critical	Medium	Replaces physical actions where said actions would be impractical with a mouse
Workspace where multiple cubes can be emulated	Multiple cubes will be displayed on a workspace that replicates the free-form nature of physical Sifteo Cubes	Approved	Critical	Low	Replicates multiple Sifteo Cubes in a natural, free-form environment
Interactions between Cubes	The Cubes present on the workspace will communicate when they are neighbored	Approved	Critical	Low	Cubes can simulate the interactions possible with physical Cubes
Load programs into the Cubes	The user will load his own and example programs into the emulators Cubes	Approved	Critical	Medium	The ability to program programs for the emulator is dependent on a common interface
Snap Cubes to invisible grid	The Cubes will snap into an invisible grid when a button is clicked	Proposed	Useful	Medium	Increases productivity by allowing a quick reset if the Cubes are in disarray
Zoom Workspace	The Workspace will zoom to the level of an individual Cube or the whole space	Proposed	Useful	Low	Inspecting individual Cubes allows for precise checks of program Graphical User Interfaces (GUIs)

Informed Consent

You are invited to participate in a study conducted by Singularity Software. We hope to learn the ways in which our software (the Siftables Emulator) is more or less easy-to-use than (Sifteo cube developer) Sifteo Inc.'s Siftulator. You were selected as a possible participant in this study because of your familiarity with software development and the process it entails.

If you decide to participate, we will ask you to complete a series of tasks within both emulators and then to report on your experience. This will take no more than 30 minutes and will only be conducted once. There are no risks inherent in your study participation.

Any personally-identifiable information that is obtained in connection with this study will remain confidential and will be disclosed only with your advance permission. Should the data be published — either for the purpose of obtaining course credit in CSSE 371 or for other puproses — no personally-identifiable information will be disclosed. Your participation in this usability study is voluntary. By completing the survey, you are voluntarily agreeing to participate. You are free to skip any particular question you do not wish to answer for any reason.

If you have any questions at any point during the study or thereafter, please contact any member of the Singularity Software project team: Alex Mullans at mullanaaj@rose-hulman.edu, Ruben Rodriguez at rodrigrd@rose-hulman.edu, Ethan Veatch at veatchje@rose-hulman.edu, or Kurtis Zimmerman at zimmerka@rose-hulman.edu.

If you have any questions about your rights as a research subject or if you feel you've been placed at risk, you may contact the Institutional Reviewer, Robert Throne, by mail at CM 114, by phone at (812) 877-8414, or by email at throne@rose-hulman.edu.

Date

Signature

Signature of Investigator

Pre-test Questionnaire

Please complete the following questionnaire prior to participating in the usability study carried out by Singularity Software. Your honest answers are important to the success of the analysis of the results of this study. Thank you.

Name: _____

Gender: ☐ Male ☐ Female

Major: _____

Class: ☐ Freshman ☐ Sophomore ☐ Junior ☐ Senior ☐ Graduate

How familiar are you with the Sifteo Cubes?

- ☐ I have never heard of Sifteo Cubes.
- ☐ I have heard of Sifteo Cubes, but I have never used them.
- ☐ I have used them, but I know nothing about programming them.
- ☐ I have used and programmed for them.

Have you ever programmed for an embedded system before?

- ☐ Yes
- ☐ No

How comfortable are you with using a new software program without documentation?

☐ ☐ ☐ ☐

Very uncomfortable Somewhat uncomfortable Somewhat comfortable Very comfortable

How comfortable are you with using a new software program with documentation?

☐ ☐ ☐ ☐

Very uncomfortable Somewhat uncomfortable Somewhat comfortable Very comfortable

How comfortable are you with using an API?

☐ ☐ ☐ ☐

Very uncomfortable Somewhat uncomfortable Somewhat comfortable Very comfortable

Have you ever worked with an emulator (for mobile device e.g. iPhone programming) before?

- ☐ Yes
- ☐ No

Post-test Questionnaire

Please complete the following questionnaire prior to departing the Siftables Emulator usability study. There are no right answers, and your honest answers are important to the success of the analysis of this study. Thank you for your time.

Name: _____

Please indicate your feelings regarding the emulator you used during the study.

Statement	Strongly agree	Agree	Disagree	Strongly disagree
The overall layout of the main screen is accessible.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Commands (i.e. snap to grid) are in useful, easy-to-find locations.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Moving a Cube is easy and straightforward.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Organizing the Cubes on the screen is easy.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Manipulating a Cube (flipping, rotating, etc.) is intuitive.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Singularity's Siftables Emulator is easier to use than Sifteo, Inc.'s Siftulator.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please make specific comments about your answers below. Feel free to provide any additional suggestions as well.

References

1. Sifteo Inc. Online: <http://www.sifteo.com>
2. Tim Ekl. Client Meeting. 25 October 2011 2:30 p.m.
3. Milestone 1. Singularity Software. Online: <https://github.com/alexmullans/Siftables-Emulator/blob/master/docs/pdfs/m1.pdf>
4. Milestone 2. Singularity Software. Online: <https://github.com/alexmullans/Siftables-Emulator/blob/master/docs/pdfs/m2.pdf>
5. Milestone 3. Singularity Software. Online: <https://github.com/alexmullans/Siftables-Emulator/blob/master/docs/pdfs/m3.pdf>
6. Milestone 4. Singularity Software. Online: <https://github.com/alexmullans/Siftables-Emulator/blob/master/docs/pdfs/m4.pdf>