

UNIVERSITY OF CALIFORNIA AT BERKELEY
COLLEGE OF ENGINEERING
DEPARTMENT OF ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

Fall 2005 Final Project

Electronic Etch-A-Sketch

1.0 Objectives

The primary goal of this project is to familiarize EECS150 students with digital design methods and tools. The core of the paint system will take a continuous stream of input data from N64 controllers, using that to update the state of the paint cursor within the game. A separate graphics subsystem will take cursor information from the core paint engine and use it to create an NTSC compatible display, in keeping with the best traditions of home video game systems.

1.1 General Philosophy

This document is meant to describe the input/output specification for the project and its associated support hardware, as well as lay out the plan for completing this project. As with any design you will encounter in the professional world, we are merely providing a framework within which your project must fit. Unlike other college classes *we will not tell you exactly what to write or how to design your project.*

You should consider the TAs a source of direction and clarification, but it is up to you to produce a design which is fully functional on the CaLinx boards. We will attempt to help, when possible, but ultimately the burden of designing and debugging your solution lays on you.

In the end, what counts is having a well functioning, bug free, project on the Final Project Checkoff deadline of Wednesday November 30th, 2005. In an effort to stimulate those who would like to learn and do more, we will provide extra credit, should they add functionality above what is required, however all groups must finish the basic project spec first, in order to get credit. Therefore we make two recommendations: one, finish the basic project early and attempt to get checked off a week early, for extra credit and two debug your design thoroughly, otherwise it is quite likely that it will fail at the least opportune moment: final checkoff.

1.1 General Project Tips

Make sure to use top-down design methodologies in this project. We began by taking the problem of creating a paint game, and then broke it down into manageable 1-2 week checkpoints. You should follow the same: take a checkpoint and break it into manageable pieces. If you break it up well, and specify your interfaces, you should be able to split the project up between you and your partner and work more efficiently.

Document your project thoroughly, as you go. Your design review documents will help, but you should never forget to comment your code, or keep your diagrams up to date. Aside from the final project report, where you will need to turn in your

documentation, you can use it to help yourselves during the debugging process.

Finish the required features first. Do extra credit only after everything works well. Early checkoff for extra credit is worth 7%, as much as the most complex extra features. Keep this in mind. However, your project must work well to be checked off early.

2.0 Deadlines & Assignments

This section summarizes the functionality you need to demonstrate, as well as the design steps you will need to follow in order to receive full credit for the project in this course. Indicated in parenthesis in each heading is the percentage that portion of the assignment counts for.

Design reviews may only be checked off by your own TA during your lab time. Both TAs must be present. In an extremity we will allow you to get a design review checked off during your TAs office hours. The point of design reviews is to give you feedback on your design, and force you to start thinking clearly about the module you will be building before you start writing code. As such, no code will be accepted for design reviews.

2.1 Checkpoint 1: Game Controller Interface

Design Review	100% Credit	At the end of your assigned lab, week of 10/11 to 10/13.
	50% Credit	Before the start of your assigned lab, week of 10/18 to 10/20.
Checkpoint	Within the first 10 minutes of your assigned lab, week of 10/18 to 10/20.	

2.2 Checkpoint 2: LCD Interface

Design Review	100% Credit	Within the first 10 minutes of your assigned lab (i.e. 9:20A or 5:20P), week of 10/18 to 10/20.
	50% Credit	Before the start of your assigned lab, week of 10/25 to 10/27.
Checkpoint	Within the first 10 minutes of your assigned lab, week of 10/25 to 10/27.	

2.3 Checkpoint 3: Memory Interface

Design Review	100% Credit	Within the first 10 minutes of your assigned lab (i.e. 9:20A or 5:20P), week of 10/25 to 10/27.
	50% Credit	Before the start of your assigned lab, week of 11/1 to 11/3.
Checkpoint	Within the first 10 minutes of your assigned lab, week of 11/8 to 11/10.	

2.4 Checkpoint 4: Paint Engine

Design Review	Will not be collected or graded.
Checkpoint	At the time of the final project checkoff.

2.5 Final Project Checkoff

Early Final Checkoff	11/23, 10:00am
Regular Final Checkoff	11/30, 10:00am

This checkoff will be the last of your project. During the last few weeks before final checkoff on Wednesday, November 30th your job will be to design, build, test and debug your core game engine using the algorithms outlined above and in lab lecture.

The procedure for final checkoff will be as follows:

- Finish and completely debug your project
- Be sure to test with other N64 controllers
- Be sure to test on multiple CaLinx2 boards
- Be sure to test on multiple LCD monitors
- Test any multiplayer capability thoroughly against multiple other groups
- Make sure your project works perfectly after reset
- Using your group name, sign up for an early or final checkoff slot within your lab section
- Checkoff slots are 20min long
- The signup sheet will be posted next to the TA station
- **You and your partner must be present for checkoff**
- You may change checkoff slots at any time
- Please erase or cross out your name if you do not intend to get checked off at the time you signed up for.
- Submit your files to the “Project Submission Directory”
 - Make two subfolders: “Normal” and “Extra Credit”
 - The “Normal” folder should contain all the Verilog and *.edn files needed by your non-extra credit project.
 - The “Extra Credit” folder should contain all the Verilog and *.edn files needed for your extra credit project.
 - Submitting the two separately will guarantee that your Normal version will work.
- **DO NOT SUBMIT TESTBENCHES, BITFILES OR ANYTHING ELSE NON-ESSENTIAL!**
 - When in doubt, ask a TA what to submit
- Test your submitted files

- Log into a random computer
 - Copy the files to the local hard-drive
 - Create a Xilinx project
 - Synthesize your project
 - Test it on the board
- ALL SUBMISSIONS MUST BE IN BY 10am ON YOUR CHECKOFF DAY!
 - Absolutely NO late work will be accepted, no exceptions.
- If what you submit does not work, you will get a chance to perform small changes, at the cost of reduced credit.

At checkoff time:

- Show up for checkoff
- Arrive at least 20min early in case of problems.
 - If you are not there on time, your slot may go to a waiting group.
- We will program our board with your project
- You will demonstrate its features
- We will ask you a series of short questions about your design, debugging and general experience.
- BOTH PARTNERS MUST BE PRESENT

2.6 Final Project Report

After final checkoff on Wednesday November 30th, you will have one last assignment in EECS150: the final project report. This report will cover the features, design and debugging of your final project in detail. It is due on December 7th.

The report **must** be typed. Doing the diagrams in Visio is encouraged. It is available on the lab computers. You should collect your design review diagrams, draw them cleanly and use those as a basis for describing your design. This will be in addition to a significant amount of writing describing what you did and how you accomplished it.

Keep in mind that this report will be worth as much of your grade as a checkpoint! However it should be relatively easy, since you will be writing about the project you have been building over the last two months.

We will release a separate document detailing what belongs in your final project report.

2.7 Extra Credit

You may mix and match extra credit options to a maximum of 20%. Note that extra credit is in fact, extra. It can boost your grade **after the curve**. As it is extra, **do not** expect any of the TAs to help you out. Documentation for some of the extra features can be found online, either from previous semester's documents, or searched on the www. If you are in doubt as to whether your feature will receive extra credit, please see Po-kai.

2.7.1 Early Checkoff (7%)

If you are done by 10am on Wednesday November 23rd, you may submit your project, with or without other extra credit options to be checked off that day. This will provide you significant extra credit without much extra work. We highly endorse this option above having more features on the later checkoff.

If your project does not pass early checkoff, you will be asked to sign up for a regular checkoff slot. Please note, if you submitted your project for early checkoff, and for whatever reason you needed to get checked off again for regular checkoff, you will lose the 7% extra credit.

2.8.2 Blending / Fading (3%)

You will obtain 3% extra credit if your current brush color can “blend” with what is already on the canvas. I.E. if the paint canvas is already yellow and your selected color is blue, your brush stroke will be green.

2.7.3 Non-rectangular paint brushes (2%)

A non-rectangular paint brush that paints non-rectangular strokes will be worth 2% extra credit.

2.7.4 Audio (3% / 5% / 6%)

For this extra credit you can add a “crash” or “boink” sound effect which is played every time the brush strikes the wall or some boundary. If you read the BlockRAM datasheet you can learn how to load a static pattern into the SRAM on the VirtexE. This you may then play to create your sound effect clip (5%). If you generate sound waveforms instead of loading them from a wav file, it will be worth 3%. Since you are not limited by RAM, you can play the audio continuously. An idea would be a reverse Winamp visualization. Drawing different colors with the brush going in different directions will result in different tones and beats. Having both sound generation and wav files loading would be worth 6%. Make sure your audio comes out without noise and static!

2.7.5 N64 Rumble Pak (4%)

If you can demonstrate the ability to turn on and off the motor on our N64 controllers, you can obtain up to 4% extra credit. For example, you can make the controller vibrate after reset and vibrate when the paint brush hits a wall.

2.7.6 Undo (4%)

For the full 4% extra credit, you need to have at least 3 undo steps (paint strokes). No credit will be given for undoing of 1 or 2 pixels, etc.

2.7.7 Auto-paint (1% - 3%)

A randomly moving paint brush, as in our project demo solution will be worth 1%. If you are able to create an automated moving brush that draws a complex image/symbol like a car or a face, you will be able to obtain 3% extra credit.

2.7.8 Canvas magnification (3%)

This is like a “zoom in” feature. It is worth 3%. Note you should be still able to paint when zoomed in.

2.8.9 Menus, caption/text, colorwheel (0% - 5%)

An user interface can get you up to 5% extra credit. Borders and/or the

colorwheel will get 1% - 2% extra credit. To get the full 5%, you will need to be able to also display text captions.

2.7.10 Multibrush Paint (1% / 7% / 10%)

This extra credit option involves having multiple paint brushes showing up on one LCD screen. 1% extra credit will be awarded if your paint system can handle two controllers plugged in the same controller and simultaneously paint.

Significantly more credit will be awarded if this multi-brush setup is done over the network. If the brush information is successfully obtained through the Ethernet from another Calinx board, you can receive up to 7% extra credit. If the brush information is relayed wirelessly, you can receive up to 10% extra credit. See Po-kai if you intend to do the Ethernet or wireless networking options.

2.8.11 Added Game Play (0% - 5%)

If you add additional gameplay, you can get up to 5% extra credit for each game up to 10% total in for this category. Examples include paint puzzles, paint race, snake, pong, etc.