

CpE 213 Semester Project Fall 2003

Summary: For your semester project, you will design a simple, self-contained, 8051-based device that will play a short tune on request. The 8051 will be hooked to a switch and to a speaker. Whenever a user presses the button, the 8051 will play a tune that is stored in code memory. “Notes” of the tune are produced by sending a square wave of the appropriate frequency to the speaker. For example, to play the note C#, send a 554 HZ square wave (with a period of 1804 us) to the speaker. Additional information about interfacing an 8051 to a speaker can be found in section 10.5 of ISM. Your code, however, should be written in C instead of ASM.

Teams: The members of each group should work on the project together and submit a single report. Team member contribution will be evaluated in the final web-report and through a confidential evaluation the last day of the semester. Please do not share your team’s solution with other teams. You may of course share specification details to insure compatibility between devices.

Software: All code must be written in C. Use a modular design for your code. All other functions must be compiled separately from main(). Put main into one file, device independent functions into a second file (or group of files), and all device dependent functions into a third file (or group of files).

Deliverables and schedule: Points will be given for the following deliverables. Deliverables that are late will be given a lower score (15 point deduction for each day late). Delivery dates more than a week late will receive negative scores.

Project demonstration (45 points, due the week of 12/2) Prove to me that your project works. I’ll post an appointment sheet around the due date to allow you to do so. If you can’t get on my appointment list and demo to me by 5:00, I’ll give you until Tuesday night for a loss of 10 points. Grading criteria includes: does it work, is it packaged nicely, is it ‘cool’. Start debugging your whole project (software with hardware) at least a day ahead of time or you seriously risk missing your deadline. Don’t wait until the last minute to start putting your hardware together.

Short report (35 points, due 12/5). Send me a quick summary (in MS Word or Adobe PDF format) of what you did in your project, what problems you encountered, and how you got around them, via e-mail. If your project didn’t work, explain how you might get it to work. Your report should also include:

- a. **Project code.** It should be well documented so I can understand it.
- b. **Circuit Schematic.** The designed used in wiring your project.
- c. **Work effort distribution.** List each person in your group. Tell what their job was and the total percentage effort they contributed to the completion of the project.

Peer rating of team members (10 points, due 12/19). Each and every student is required to complete the peer rating form (it can be downloaded from the Blackboard website), sign and submit it at the final exam date (8:00AM, 12/19/03). **Email submissions will not be accepted.**

Project code and simulation: (10 points, due the week of 12/2) During your project demonstration, I will ask you to: show me your code, compile your code, email me a copy of your code, download the code to your device, show me your working device.

Parts: Unfortunately, neither the department nor I can buy parts for you, but the parts are not expensive. You will need the following (at least):

- AT89C1051U – May be available from Eagle Electronics for about \$5. Eagle is located on HWY 63 about a block from Walmart. You can find a datasheet for the part at <http://www.atmel.com/atmel/acrobat/doc1045.pdf>. If you want to use a different 8051, feel free.
- A small speaker – either Eagle Electronics or Radio Shack (off 10th St. in Forum Plaza).

- An inverter or a PNP transistor to power the speaker - The 8051 cannot drive it sufficiently loudly on its own. Radio Shack or Eagle Electronics should have them available.
- A battery pack to power your device - You should not use power from an external power supply – your unit should be entirely self-contained. The ATC89C1051U can run from a 2.7V to 6V power supply, which you can create by putting 2, 3, or 4 1.5V batteries in series. You should be able to find a battery pack at both Radio Shack and Eagle Electronics.
- A quartz crystal and two 30pF capacitors to provide the clock – You can probably get them from Eagle or Radio Shack. Check the data sheets to decide what frequency the crystal can/should run at.

All parts can be ordered online from <http://www.digikey.com>. Also try the HKN/Hobby Club as a local source for parts. Please be forewarned that it may be difficult to find microcontrollers of the 8051 family locally.

Downloading your code: You can download your code to your chip using the device programmer in either G10 or the senior design lab. You can find instructions for using the device programmer under the “Project” folder on Blackboard. If you use something besides the 1051, be sure to check that it is compatible with our programmers or that you have a way to program it before getting too deeply involved. Don’t ask me because the list of devices is rather long and I probably won’t know whether yours is on it.

EXTRA CREDIT: You can get a maximum of 10 extra credit points.

- (5 points) Add circuitry so the device senses when someone walks through a door and then plays a tune. (This should be easy).
- (10 points) Add circuitry and code so the user can *program* a new song in... I envision something like an extra few switches that represent keys (A-G) and an extra “program” switch. When the user hits the program switch, the unit enters program mode. Each key the user hits is stored in memory until the program switch is hit again. Thereafter, anytime the user hits the “play” switch, the 8051 will play the new song.
- (10 points) Make it *say* something... I think this will be too ridiculously difficult for anyone to actually do (at least, within the memory constraints of our device), but feel free to surprise me!