Concept Review Pre-Read
P07306: Audible Memo Board

Senior Design I
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Introduction:

The goal of this project is to make a clip-board sized device that enables a blind person with some degree of neuropathy in their fingertips to keep track of appointments. This device should serve the same purpose a paper calendar would serve for a sighted person able to use a pen. This project calls for a design concept that can record and playback memos based on user input from a customized keyboard. The device is to include audio prompts and confirmations for button presses. The memos are to be stored with or without power applied and not erased until after the termination of the appointment at the earliest. Other specific features include automatic playback of the next several recorded appointments and volume control. Multiple concepts have been generated to meet these specifications.

Critical Specifications:

The device must do all of the following things to be useful:

The device must allow the recording of memos on a given day.

The device must allow the playback of memos for a given day.

The device must have an option to play all upcoming memos in order.

The device must be able to store a bare minimum of 64 messages each of one minute duration.

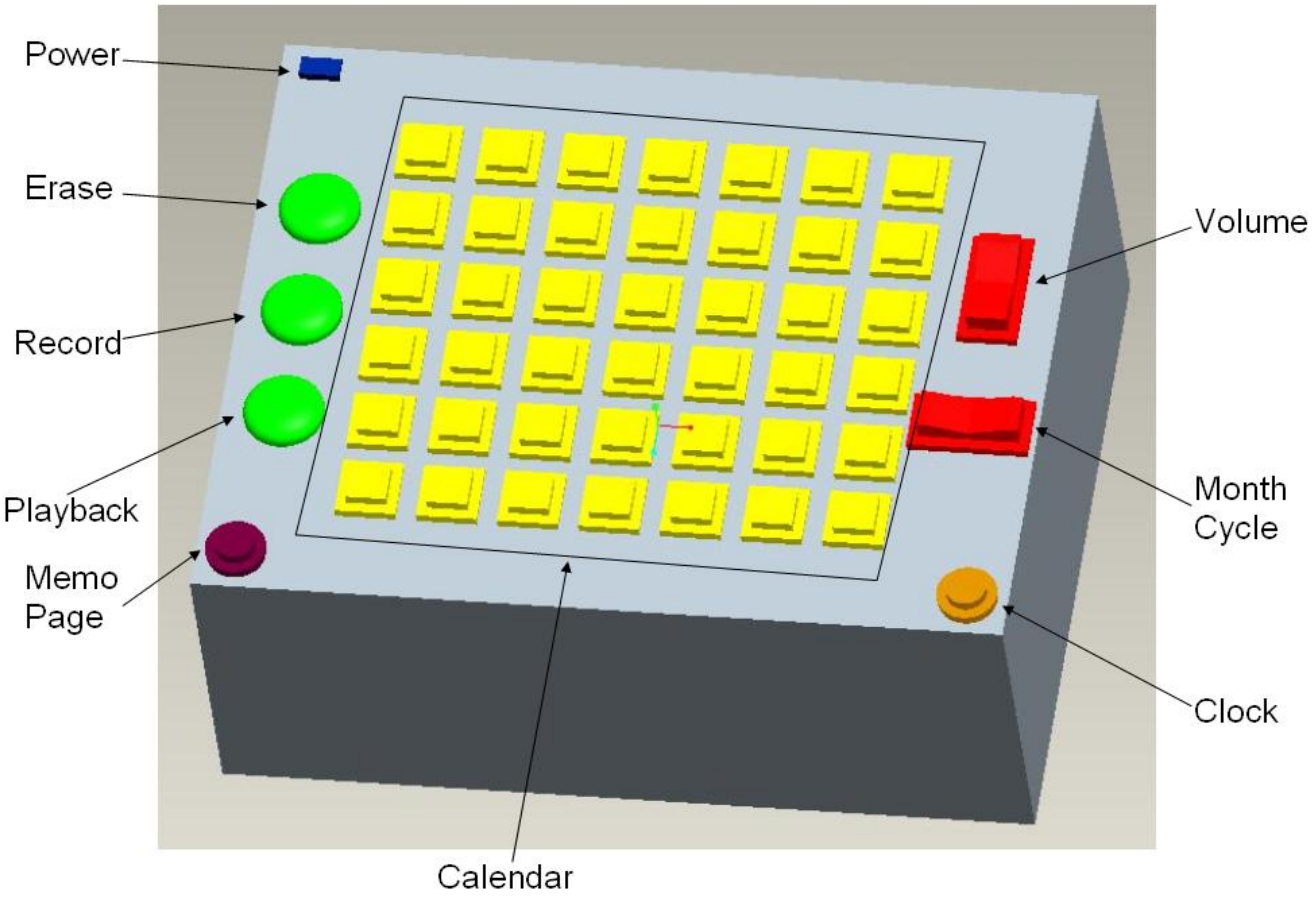
The device must have a clock that can read off the time and date.

The device must be very intuitive.

The device must retain information when turned off.

Concepts:

Full Month Calendar:



This interface uses a 6 row by 7 column arrangement of buttons to act as a calendar. Each button corresponds to a specific day and each column corresponds to a day of the week. The buttons are placed out as a normal calendar would be. When a button is pressed it says what day it is and then plays what ever messages are stored in it. Additional buttons provide methods for erasing and recording messages as well as dealing with all of the clock functions. There are also button(s) that allow the user to cycle between months. There will also be an extra "month" that allows for the recording of permanent information like phone numbers.

Two Week Calendar with Keypad:

The two week calendar is very similar to the full month calendar. It has 2 rows of 7 buttons. The top row corresponds to the current week and the bottom row corresponds to the next week. There is a keypad to allow for easy recording

of dates by entering in a specific date to access. Additional buttons provide methods for erasing and recording messages as well as dealing with all of the clock functions. There are also button(s) that allow the user to cycle between months. There will also be an extra “weeks” that allow for the recording of permanent information like phone numbers

Concept Layout Pugh Matrix

	Calendar Layout	2 Week Layou	Number Pa	2 Week Layout w/ number pa	Calendar w/ number pa
Number of days available	+	0	-	+	+
Ease of finding a date	+	0	+	+	+
Ease of entering a date	+	0	+	+	+
Number of buttons	-	0	-	+	-
Aesthetics	+	0	-	0	+
Number of presses to record	+	0	-	+	+
Ease of finding an appointmer	+	0	-	0	+
Cost	-	0	+	-	-
Ease of manufacturing	-	0	+	-	-
Functions	0	0	+	+	+
Ease of use	+	0	-	+	+
Customer Preference	+	0	-	-	-
Score	**5**	**0**	**-2**	**4**	**4**
Rank	**1**	**4**	**5**	**2**	**2**

Electrical Design Concept A:

Figure 1 shows the high-level flow of a microprocessor based record and playback concept design. The upper portion of the layout displays the recording sub circuit. The analog input speech signal is captured by a microphone and fed through an amplifier to boost the amplitude of the signal. Then a low pass filter is used for anti-aliasing to ensure that only the desired frequency range of the signal is recorded. An analog-to-digital (A/D) converter is then used to feed a digitally sampled signal into the microprocessor. The microprocessor then stores the message in a Flash memory bank. When a button is pushed on the user interface board, the microprocessor can then retrieve the appropriate message from the memory bank based on an address coordinated with the button pressed. The digital signal is fed to a digital-to-analog (D/A) converter and through a smoothing filter to produce a high quality analog signal. Finally, as the lower portion of the layout details, the playback circuitry consists of the smoothing filter, another amplifier and a speaker.

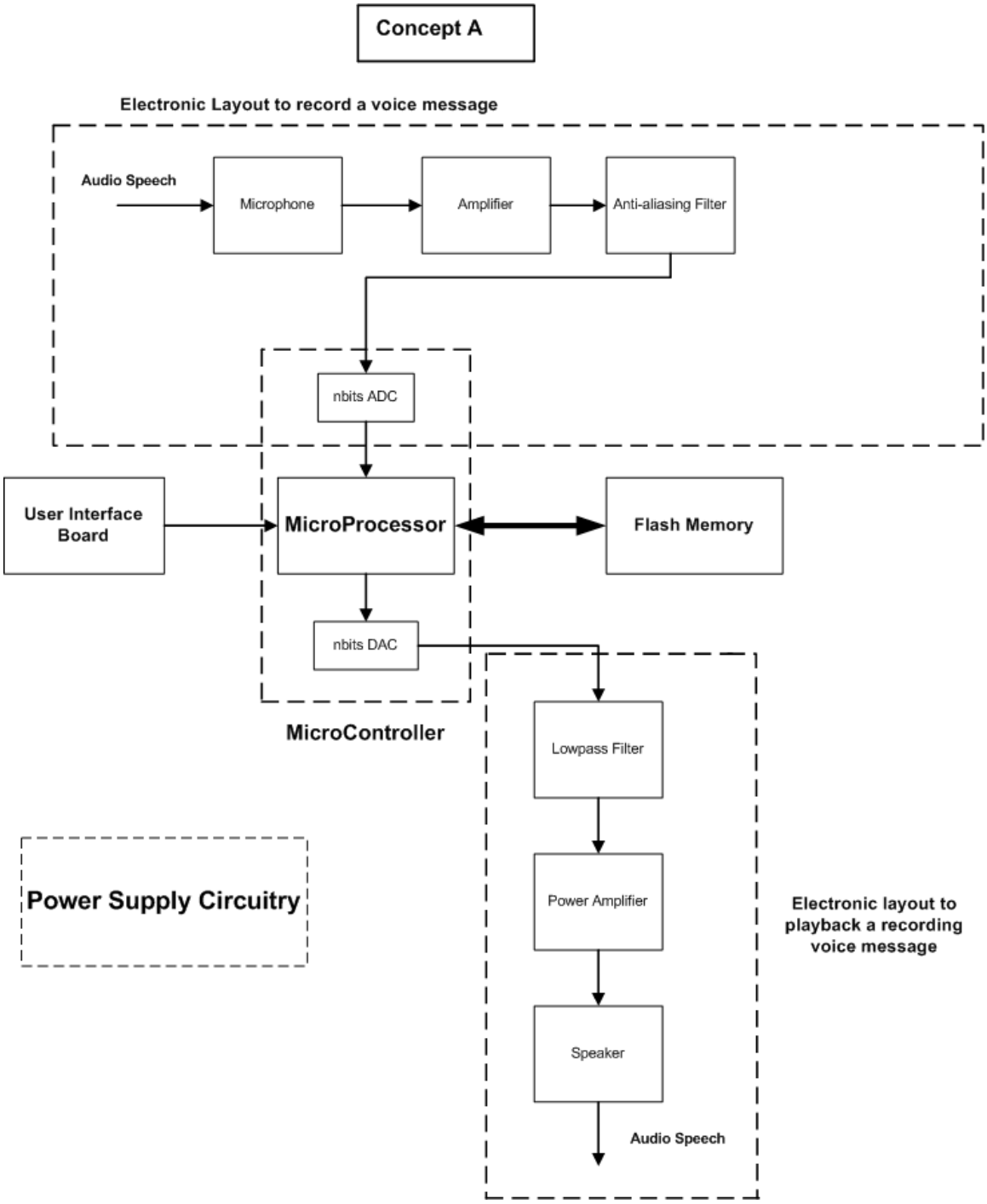


Figure 1: Concept A General Electronic Layout

Electrical Design Concept B:

This concept includes the general layout described above; however, this uses an established integrated circuit (IC) chip, ISD1000A, to provide for some of the required functions. Design features include built-in recording features that are compatible with a microprocessor. The IC incorporates the required attributes of a recording and playback system such as amplifiers, anti-aliasing

and smoothing filters, automatic gain control circuitry and fully addressable memory. The memory on the chip is electronically erasable, programmable read-only memory, EEPROM. This erasable memory is also a non-volatile memory, which retains it memory even when power is not applied. Major design issues include the small quantity of available memory on each chip. Each chip contains 128kB of EEPROM and the chips are able to be cascaded. However, the preliminary calculations indicate that the required memory to fulfill the design specifications is at least 200 MB, which translates to almost 1600 of these chips. Although this may enable bulk rate purchasing the sheer quantity of chips would overflow the containment constraints. The only viable use is shown in **Figure 2**, where 1 chip is used on the input and one chip is used on the output. The advantage gained by this is that all the necessary filters, amplifiers and signal conditioning features would already be included on the chips. However, the major disadvantage is the potential loss of quality as the signal would be sampled multiple times on the input and output.

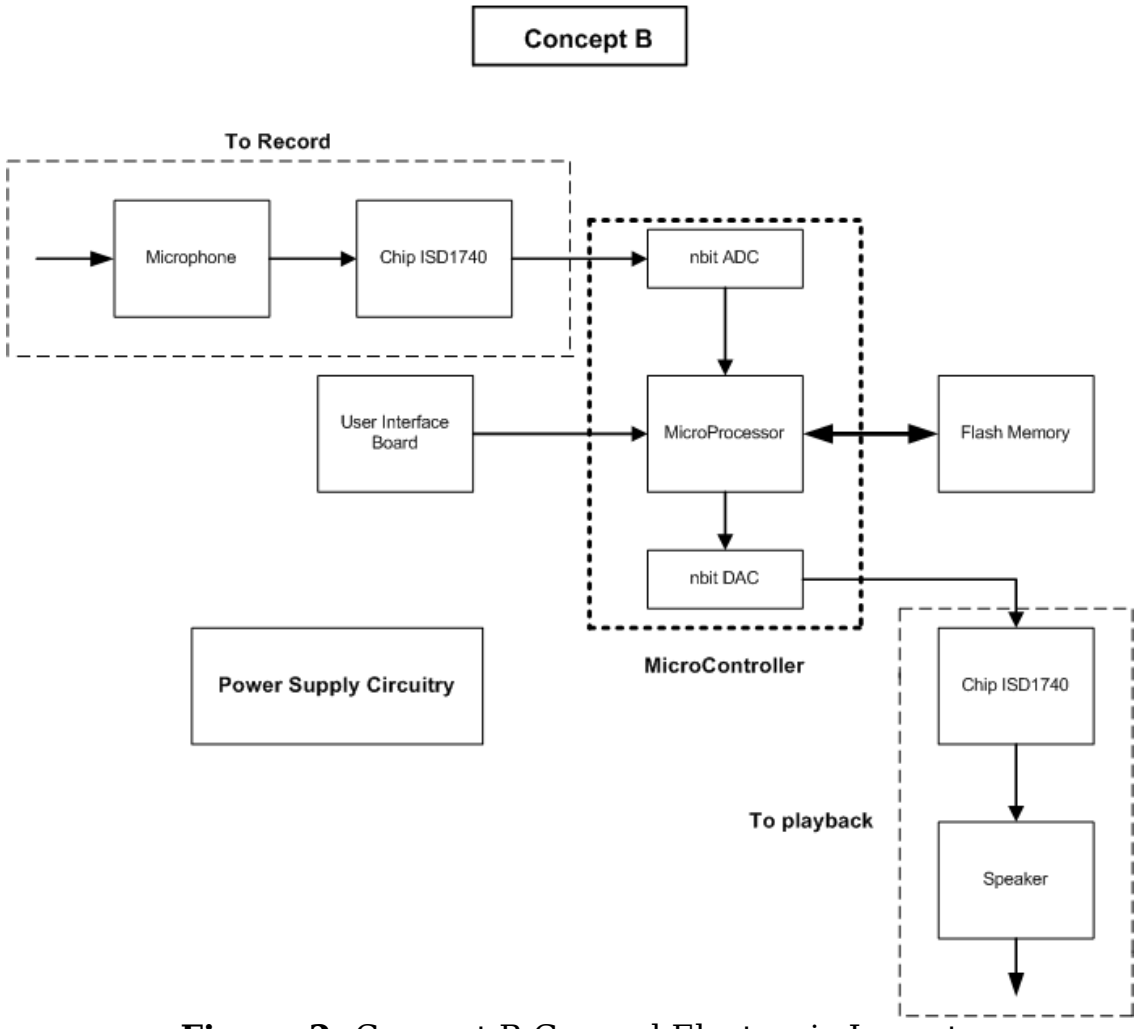
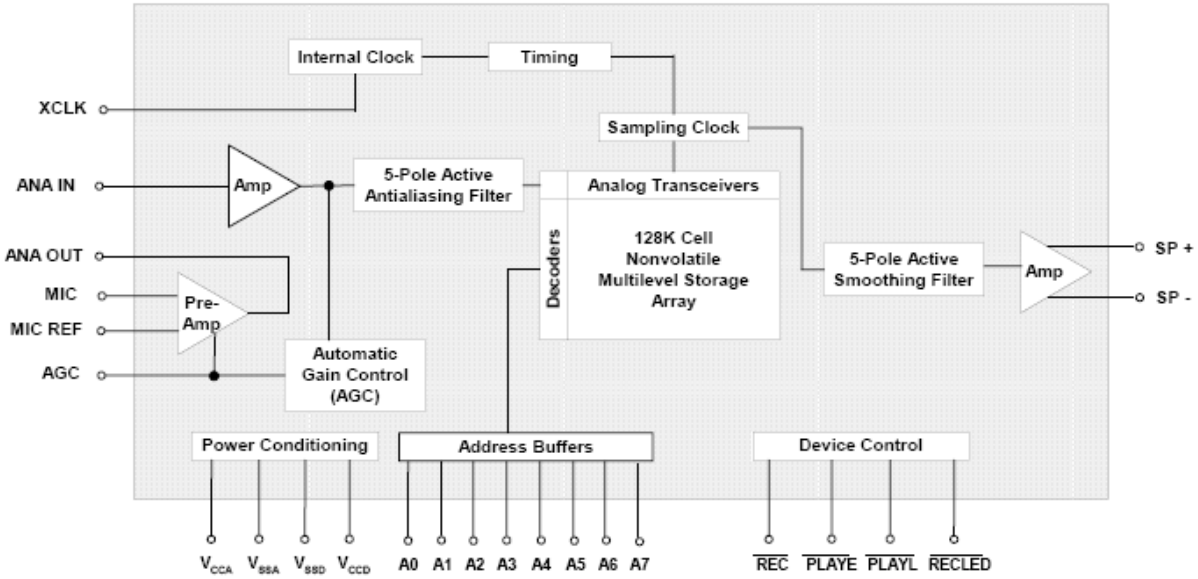


Figure 2: Concept B General Electronic Layout

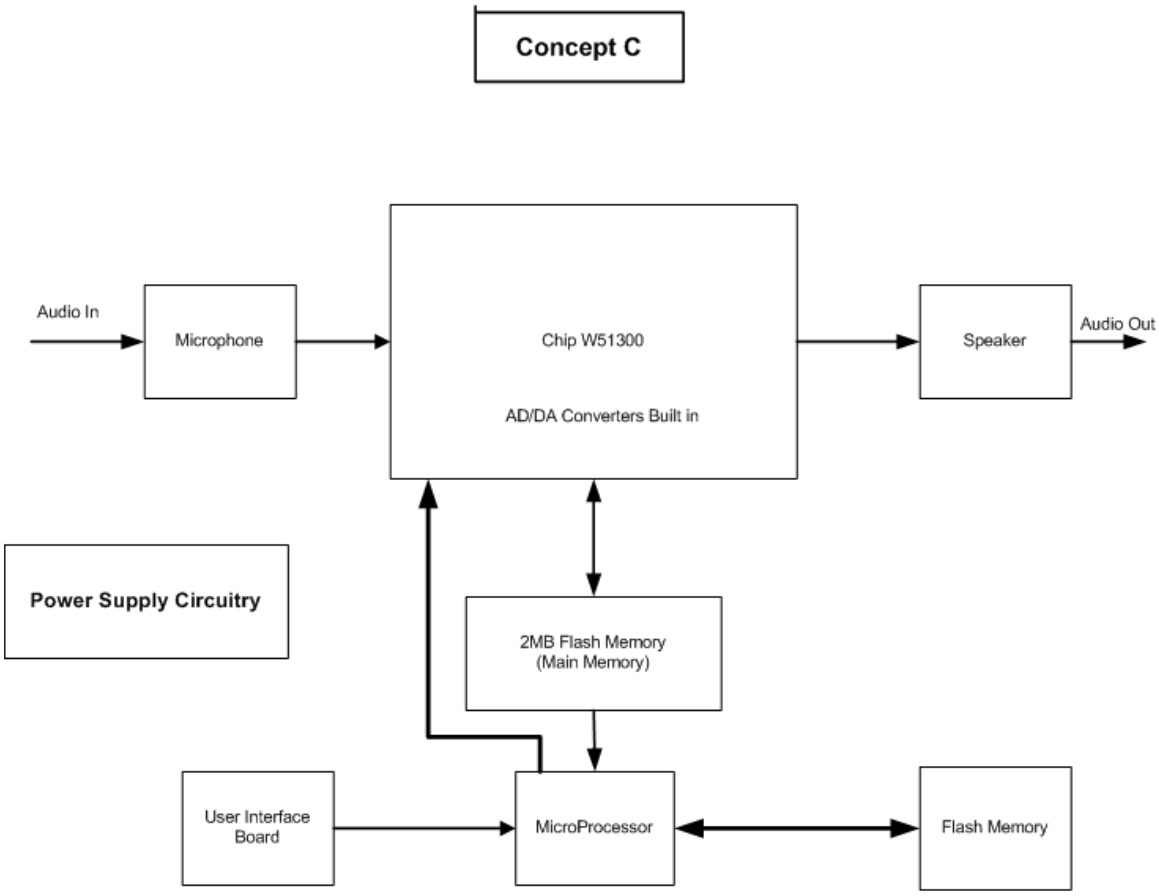


Taken from: **http://www.winbond-usa.com/mambo/content/view/150/280/** © 2007 Winbond

Figure 3: ISD1000A Chip Layout

Electrical Design Concept C:

This concept performs the same required tasks as seen in Concept A; however, an IC is again used to allow for ease of implementation. This IC, W51300, would take an input of an analog signal from a microphone and convert it to a digital signal with the ability to interface with an external flash memory bank. One constraint is that the chip itself can only directly access up to 2MB of external flash memory. However, this constraint can be overcome using a separate 2MB flash and then full memory flash banks. A microprocessor could then control the accessing of a single message from the 2MB flash and storing all the messages in the larger memory bank. **Figure 4** shows the electrical layout for this concept. **Figure 5** shows the schematic of the W51300 chip that is utilized in this concept design.



Note: please examine diagram_W51300 at last page for the electronic layout of chip W51300

Figure 4: Concept C General Electronic Layout

BLOCK DIAGRAM

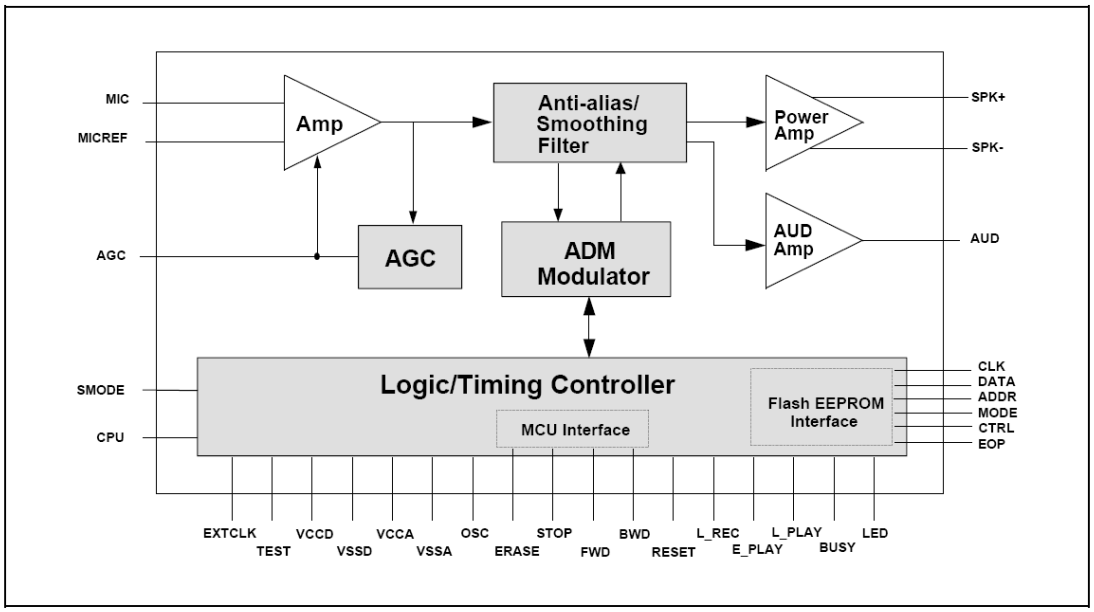


Figure 5: W51300 Schematic Layout

Electrical Design Concept D:

This concept again uses many of the same features as the former concepts. The primary difference is the use of control logic instead of a microprocessor. Most, if not all, of the required functions could potentially be satisfied using control logic. The major drawbacks of this design are the extra design effort, lower probability of fulfilling all the design specifications, and more difficult implementation. Figure 6 show the electrical layout of this concept.

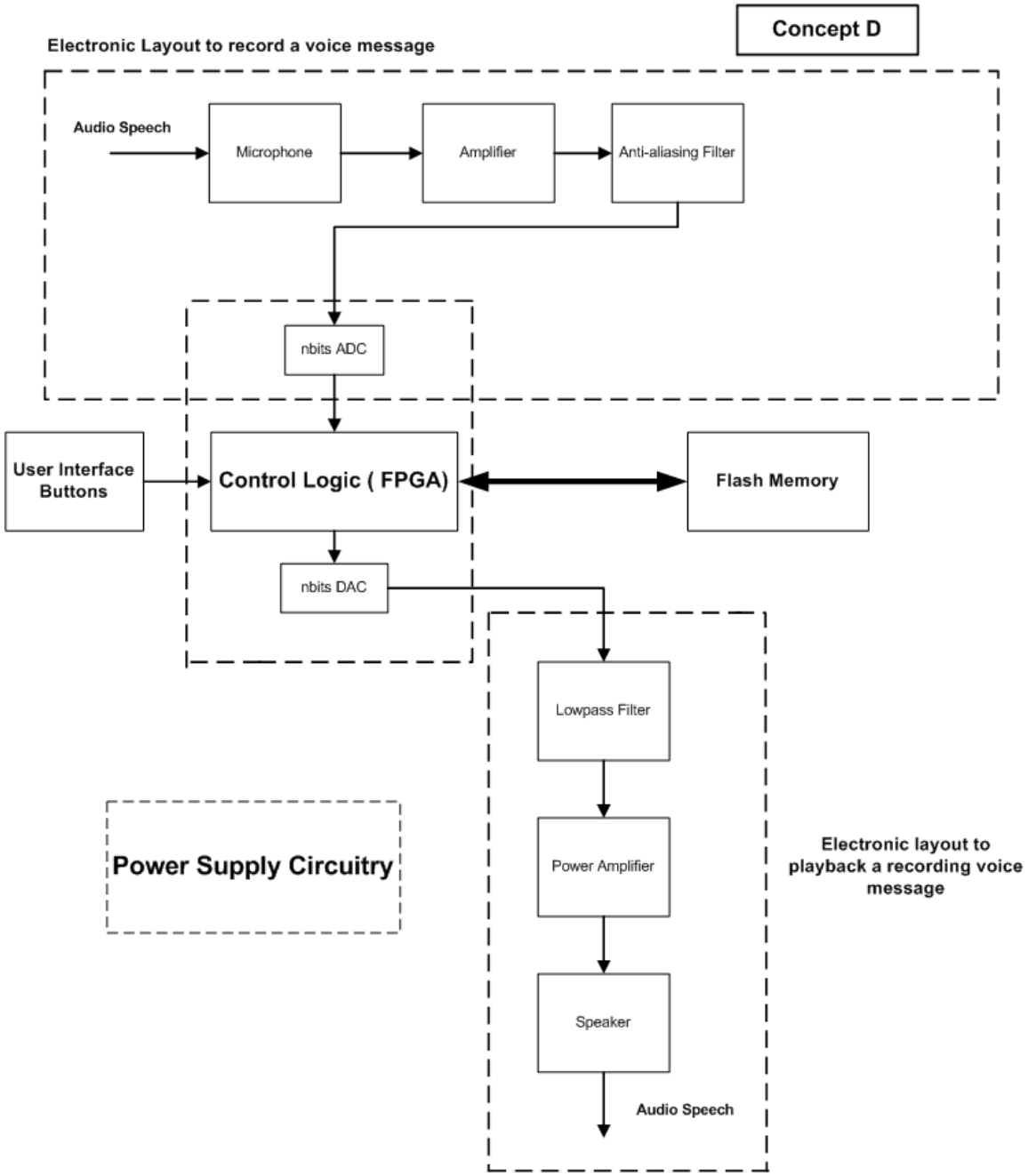


Figure 6: Concept D General Electronic Layout

Electrical Design Concept Selection:

Table 1 below shows the concept selection process used in selecting the best design. This concept scoring matrix shows the relative ranking of each concept for various criteria when compared against the reference concept, which was chosen to be Concept A. Concept A incorporates the basic features and functionality of the design specifications, and faired fairly well in the selection process. However, Concept C offers the added benefit of a much easier implementation with the W51300 IC functionality. Concept B would have also offered somewhat easier assembly due to the use of an IC to perform signal

conditioning; however, it would have also hurt the quality of the sound and may have completely disabled the design as a result. Concept D scored lowest primarily due to its dependence on extensive engineering design. The extra design for logic control would have added complexity to the overall implementation and lowered the feasibility of success. Hence, Concept C is the top priority for development and advances to the next phase of detailed design.

Concept Selection

Concept:		A		B		C		D	
Selection Criteria	Weight	Rating	Weighted Score	Rating	Weighted Score	Rating	Weighted Score	Rating	Weighted Score
feasibility of success	50%	3	1.5	2	1	3	1.5	2	1
ease of implementation	15%	3	0.45	4	0.6	5	0.75	1	0.15
estimated cost	5%	3	0.15	3	0.15	3	0.15	3	0.15
time to build	10%	3	0.3	3	0.3	3	0.3	2	0.2
Sound quality	20%	3	0.6	1	0.2	3	0.6	3	0.6
Total Score		3		2.25		3.3		2.1	
Rank		2		3		1		4	
Continue?		No		No		Develop		No	

Relative Performance	Rating
Much worse than reference	1
Worse then reference	2
Same as reference	3
Better than reference	4
Much better than reference	5

Concept A is used as the reference for selection analysis above.

Table 1: Electrical Concept Scoring Matrix

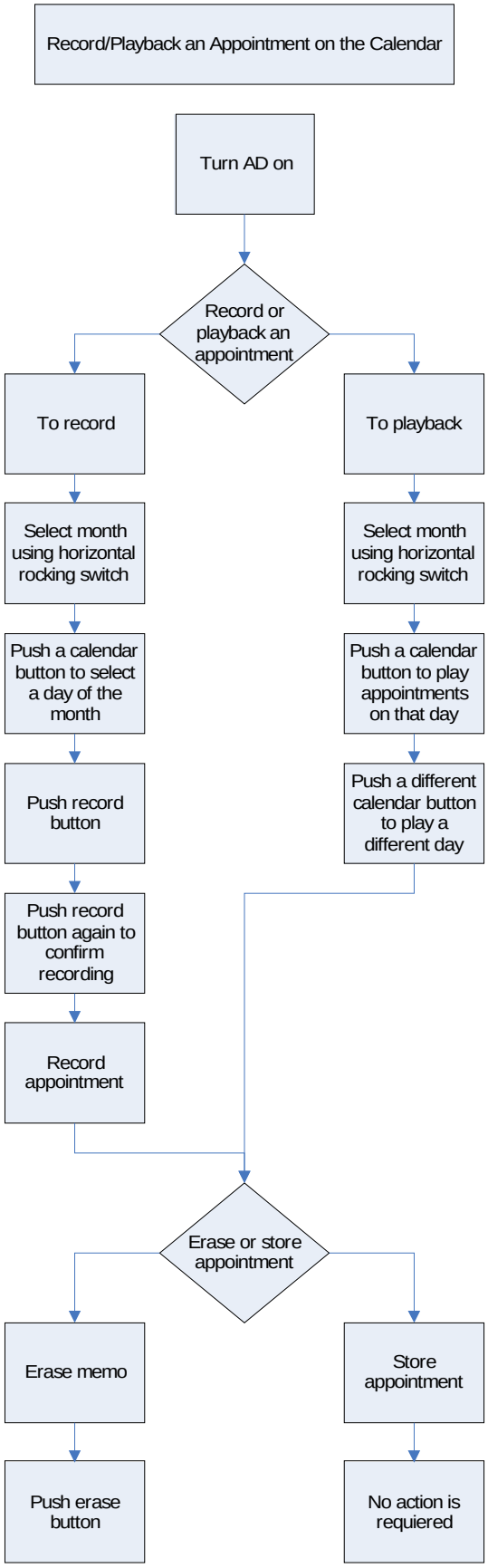
Team Challenges:

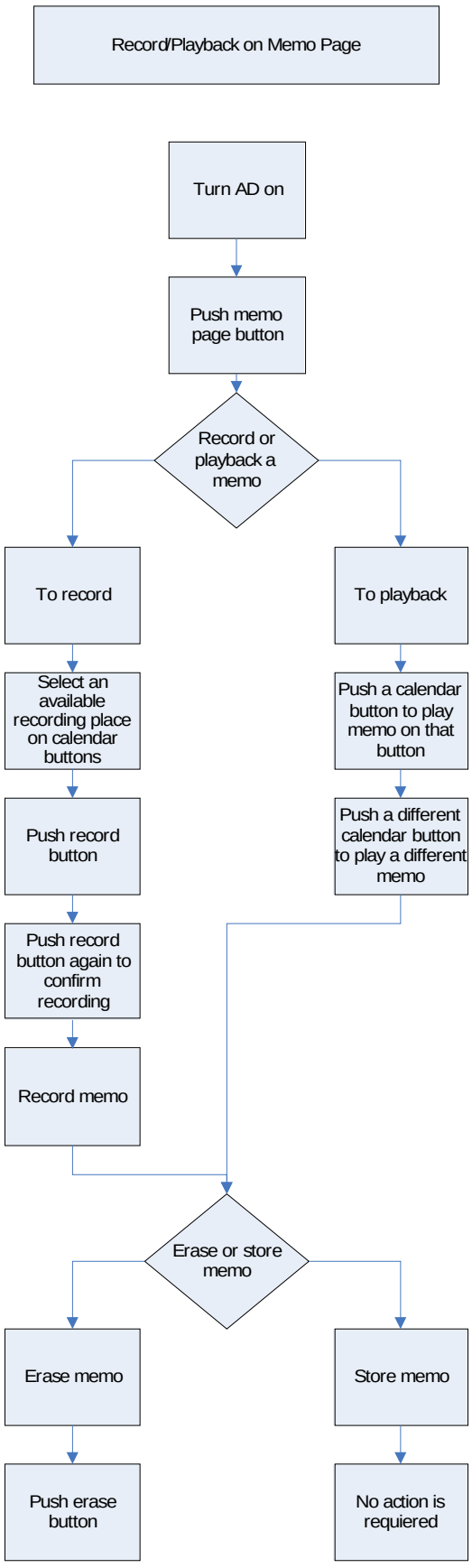
The device can use only certain types of buttons due to the neuropathy of target users. As a result, finding buttons that will meet the devices critical specifications without costing significantly more than the budget allows for seems difficult.

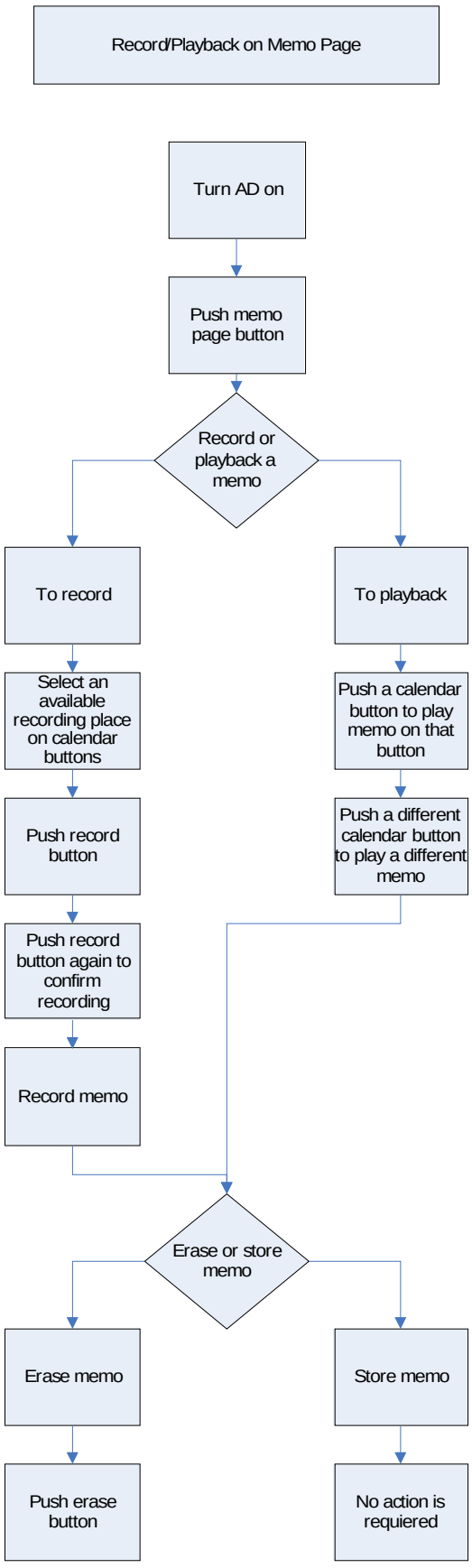
The recordings must be managed in the device's memory so that appointments can be added or removed from any day, which includes the ability to have multiple recordings for any given day.

The device needs an internal clock, which can be set to the correct time.

Use Case Flow Charts:




Record/Playback on Memo Page
Turn AD on
Push memo page button
Record or playback a memo
To record
To playback
Select an available recording place on calendar buttons
Push a calendar button to play memo on that button
Push record button
Push a different calendar button to play a different memo
Push record button again to confirm recording
Record memo
Erase or store memo
Erase memo
Store memo
Push erase button
No action is requiered


Record/Playback on Memo Page
Turn AD on
Push memo page button
Record or playback a memo
To record
To playback
Select an available recording place on calendar buttons
Push a calendar button to play memo on that button
Push record button
Push a different calendar button to play a different memo
Push record button again to confirm recording
Record memo
Erase or store memo
Erase memo
Store memo
Push erase button
No action is requiered