Component Analysis (Spring 2020)

Team: 8
Project: AudioBeamer
Creation Date: 1/29/2020
Last Modified: 1/31/2020

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Assignment Evaluation:

Item	Score (0-5)	Weight	Points	Notes
Assignment-Specific Items				
Analysis of Component 1		x2		
Analysis of Component 2		x2		
Analysis of Component 3		x2		
Bill of Materials		x6		
Writing-Specific Items				
Spelling and Grammar		x2		
Formatting and Citations		x1		
Figures and Graphs		x2		
Technical Writing Style		x3		
Total Score				

5: Excellent 4: Good 3: Acceptable 2: Poor 1: Very Poor 0: Not attempted

General Comments:
Relevant overall comments about the paper will be included here

1.0 Component Analysis:

Microcontroller

MSP430FR5994
This microcontroller has a designated DSP processor (marketed as LEA module) and interfacing with SPI, UART, and I2C. Importantly, this microcontroller has a native library for DSP processing which will make designing FIR & IIR filters less complex. Another key factor is the low supply current of this MCU which is vital to our battery powered project. We chose TI's proprietary architecture over similar STM Cortex M0 MCUs because TI has better performance benchmarks (FFT performance) when compared to a similar Cortex M0+ MCU at similar current supply which is vital to help us achieve our real time audio processing goal.

1.1 Analysis of Component 1: Audio Codec

Audio Codec: Used as an external bridge to handle all digital-analog & analog-digital conversion in 16-bit & 44.1kHz sampling rate to maintain standard professional audio quality.

This chip uses I2S which is used to communicate on 2 channels with the MCU. The MSP430 does not have native I2S support but this can be achieved with reasonable complexity by using SPI with a 5-bit counter. There is ample official documentation on this topic which should make this device relatively understandable to implement.

Part Number	Sampling Size	Sampling Rate	Supply Current (Vdd = 3V)	Communication Protocol
TLV320AIC26	Up to 32bit	Up to 48 kHz	13.6 mA typ.	SPI and I2S
PCM3008	16-bit	Up to 48 kHz	17mA max, 13mA typ.	I2S
PCM3002	16/20-bit	Up to 48kHz	24mA max, 18mA typ.	I2S & SPI
TLV320AIC23 BPW	Up to 32-bit	Up to 92kHz	18mA max, 16mA typ.	I2S & SPI

The ideal audio codec for our project would be the TLV320AIC23B. //PCM3002
Several factors were taken into consideration.
The TLV320AIC26 was seriously considered for its low power consumption at 3V. However, it had many additional features (mic & recording support) that our project does not need and thus

it physically takes up extra space on the PCB as well as increasing interfacing complexity. The PCM3008 was an excellent choice for us and had every feature we needed with no added complexity. However, the TLV320AIC23BPW had a lower power consumption while allowing customizability via SPI which will help in noise reduction & tweaking gain levels. Furthermore, the PCM3002 is very similar to the TLV320AIC23BPW but has a slightly higher supply current.

Our core requirement for the audio codec are:

- At least 16-bit resolution on the ADC & DAC
- Stereo input & output
- Compatible with left-justified I2S
- Capable of 44.1kHz sampling rate

1.1 Analysis of Component 2: PMIC (Power Management IC)

PMIC (Power Management Integrated Circuit) is being used to accurately measure the charge capacity, voltage levels & temperature of an external battery and deliver this information to our MCU using I2C.

Part Number	**Maximum Current Draw**	**Supported Battery Technologies**	**Package**	**Communication Protocol**
STC3115	100uA	Lithium Cells	DFN	I2C
STC3100	100uA	Single Cell Li-ion	Surface Mount	I2C
MAX6777	10uA	Li-ion, NiCd, NiMH, Alkaline	Surface Mount	None

The STC3100 PMIC is an ideal choice for our project.
The factor that drove our component choice for the PMIC is mainly getting accurate battery SOC (state of charge) in a digital format so that we can use this information to display charge levels to the end user. One important feature required is compatibility with Li-ion cell which our team is considering using as a power supply. Another contributing factor was the package of the IC. We chose the STC3100 due to its easy to use surface mount package. Additionally, the STC3115 has features which may be deemed unnecessary to our project (GPIO pins, Alarms).
The MAX6777 initially seemed preferable due to its extremely low current draw, as well as its small size. However, this IC only provides an output through an Alarm pin that is asserted when the battery levels falls below a certain charge capacity. This is too vague and would only tell our end user when the battery is near the end of its charge cycle.

1.1 Analysis of Component 3: Bluetooth chip/module

We plan to interface the Bluetooth chip to our DSP chip through UART, all chips listed below have that capability. We also tried to find chips with BLE and that would mean support for Bluetooth 4.0 and above. Our priority is to find chips that consume less power as our project is battery driven. After looking through several candidates, the efficiency and the compatibility with CCS made us chose the **CC2650** made by Texas Instruments.

Component	Current consumption (mA)	BLE
NRF52832	5.4	Yes
NRF51822	10.5	Yes
CC2650	5.9mA ~ 6.1	Yes
DA14583/ DA14580	3.7	Yes
CSR1010	20	Yes
HC-05 module	-	No
HC-06 module	-	No

Some additional notes about some candidates are listed below:

NRF51822 (current consumption ~10.5mA)
This Bluetooth chip uses an ARM cortex M0. This chip seems to be more power hungry than its it's cousin (nRF52832). Rigado BMD-200 the module version can be considered as well.

CC2650 (current receiving 5.9mA ~ 6.1mA)
Made by Texas Instruments, employs ARM cortex M3. Advantages include being able to program it in the same code composer environment. CC2650MODA the module version can be considered as well.

DA1458x(3/0) (current receiving: 3.7mA)
This chip is made by Dialog semiconductors and is the most power efficient chip in the bunch.

HC-05 module
UART interface with programmable baud rate. Includes antenna. Does not seem to support BLE. Data sheet also seems to be not well made.

HC-06 module
Can work at the low voltage (3.1V~4.2V). Does not seem to support BLE. Data sheet also seems to be not well made.

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