

# BULB by SONOS

## Initial Design Review

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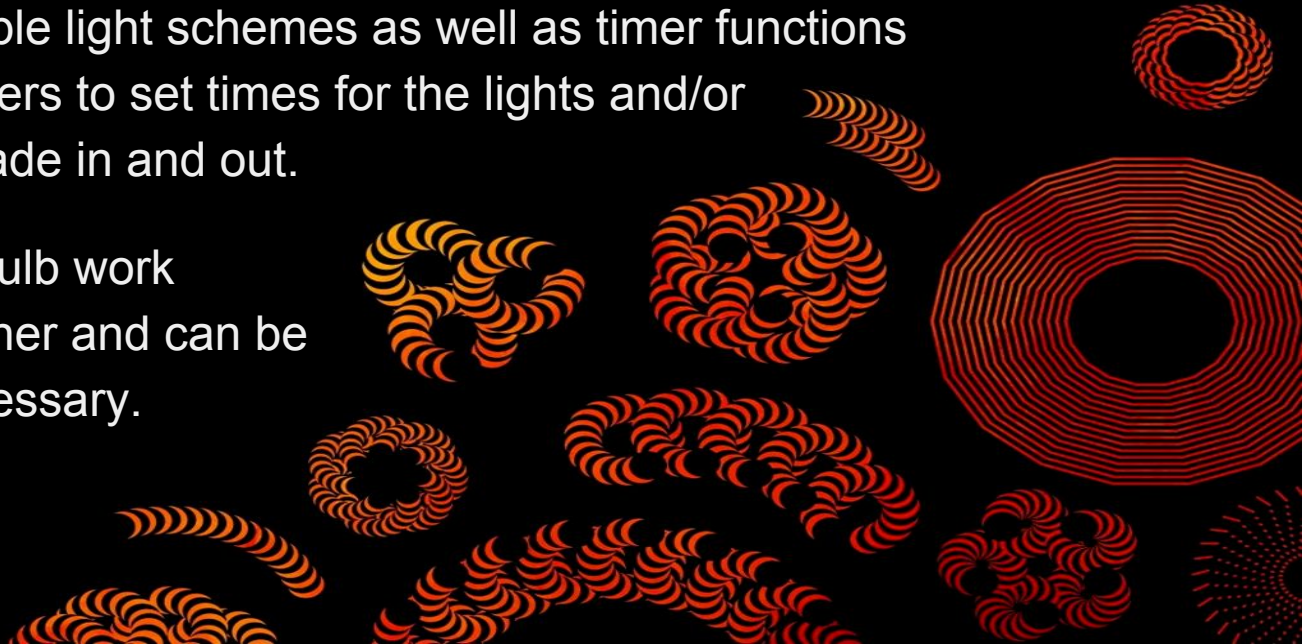
Professor John  
Johnson

CE Capstone Fall 2012



# Project Description

- A light bulb speaker that screws directly into a 6-inch recessed light fixture and is connected to WiFi in order to control audio and lighting.
- BULB comes with multiple light schemes as well as timer functions (alarm/sleep) allowing users to set times for the lights and/or music to turn on, off, or fade in and out.
- The speaker and light bulb work independently of each other and can be used one at a time if necessary.

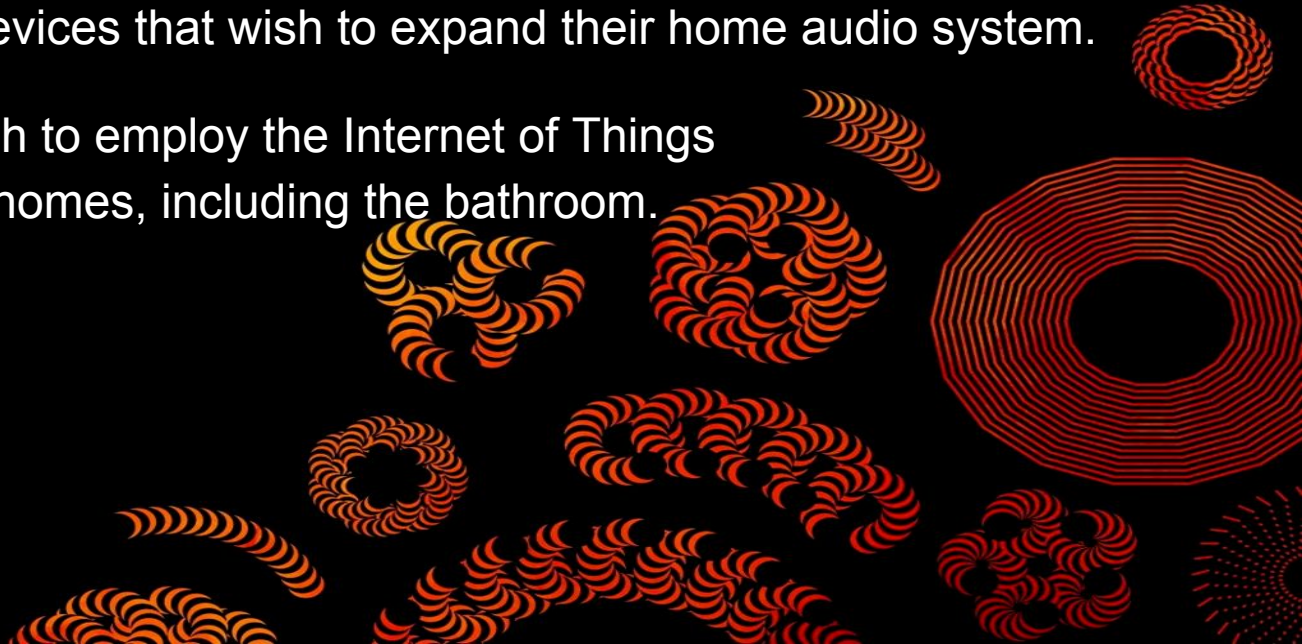


# Application

For music enthusiasts looking for a discreet way to enjoy both a musical and lighting experience.

For owners of SONOS devices that wish to expand their home audio system.

For homeowners that wish to employ the Internet of Things in various rooms of their homes, including the bathroom.



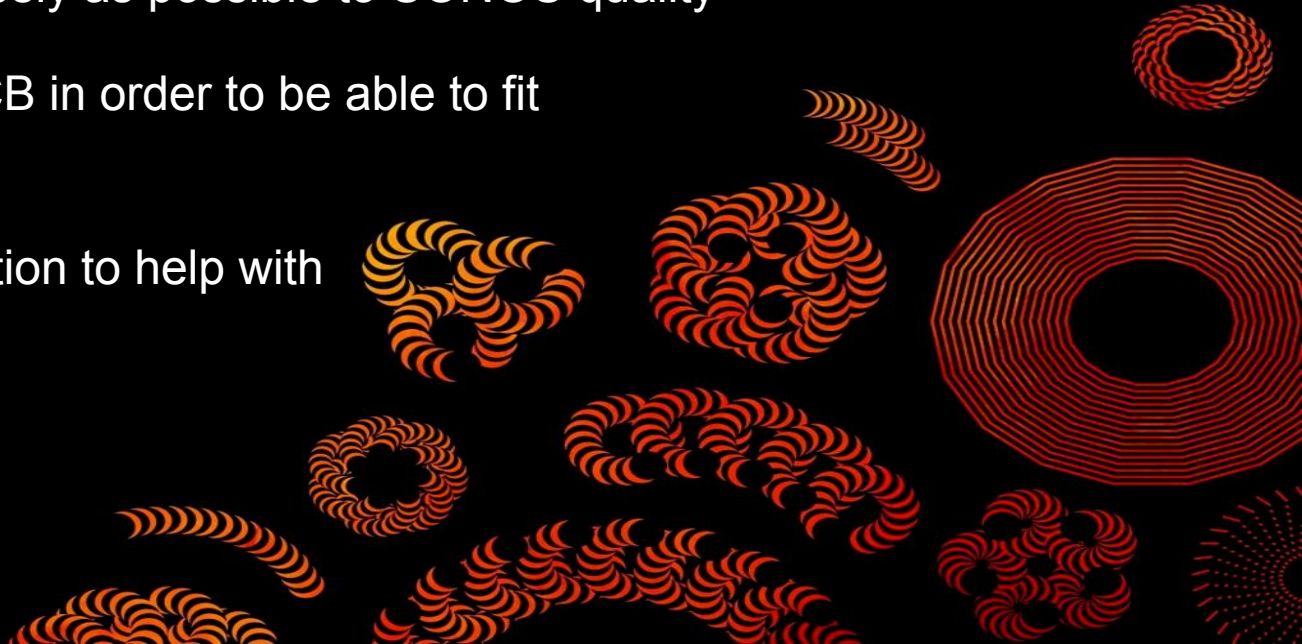
# Initial Specs

- Fits flush in a 6 inch recessed lighting fixture
- Ring of RGB LED lights surrounding speaker
  - wide light distribution, dimmability, and color control.
  - replaceable LED ring
- Wifi Module
  - Communicate via 802.11 a/b/g/n
  - WPA2 and WPA2 Enterprise
- Android controller app
  - Music and Lighting Control

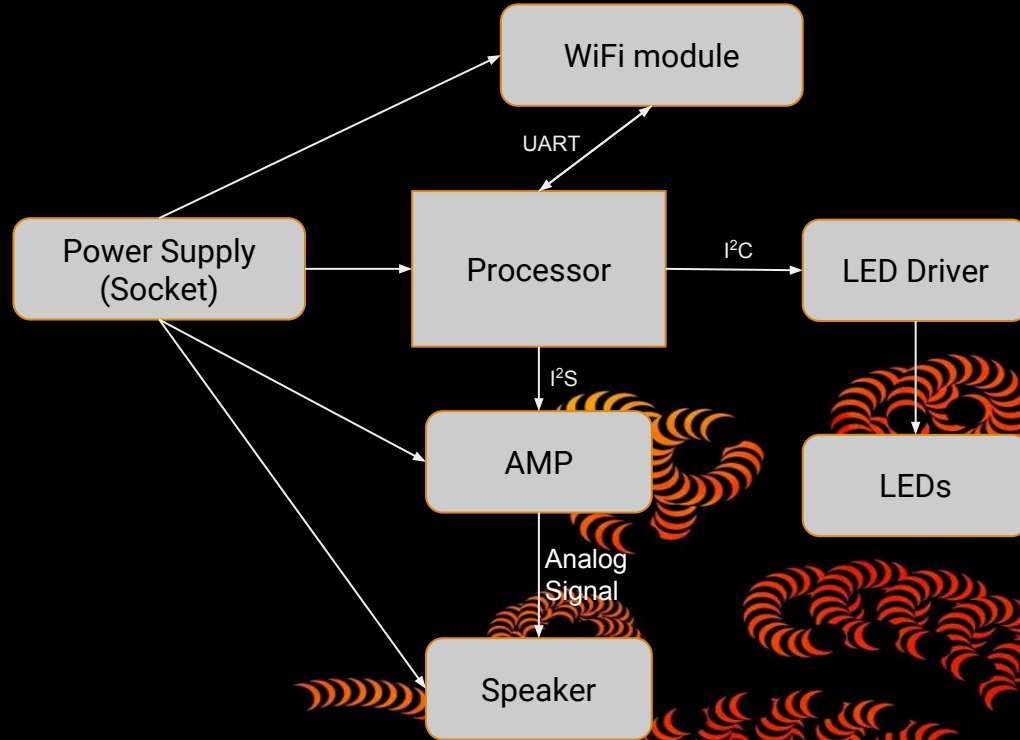


# Initial Specs (II)

- PLAY: 1 Amplifier and Speaker
  - Plays music selected from Android controller app
  - Plays music as closely as possible to SONOS quality
- Minimize footprint of PCB in order to be able to fit design constraints.
- Optimize power dissipation to help with ME's thermal issues.



# Block Diagram



# Subsystem Responsibilities

**Nicolas Soberanes (Fearless Leader)** - Lead on PCB layout, Firmware Support

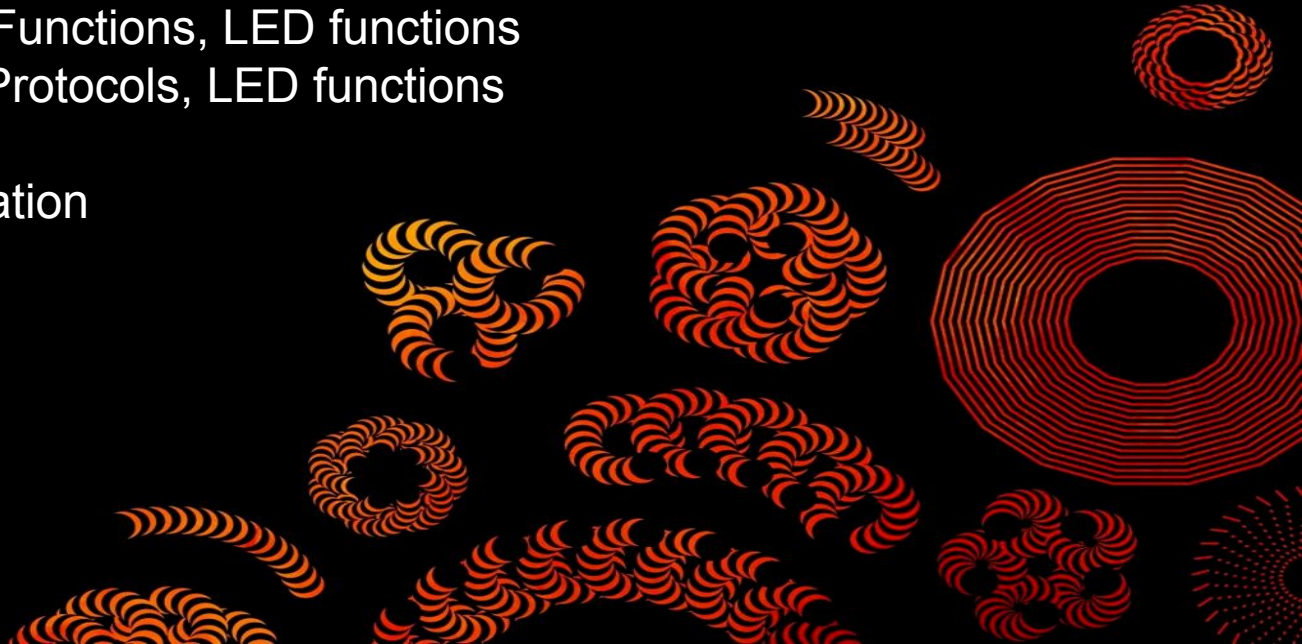
**Eric Jin** - Software/Firmware Integration

**Jose Maun Jr.** - Software/Firmware Integration

**Randy Picchini** - Timer Functions, LED functions

**Zaira Tomayeva** - WiFi Protocols, LED functions

**All** - PCB Layout, Verification



# Development Plan (Bi-Weekly)

Week of 10/26

- Parts of prototype ordered

Week of 11/9

- Power amplifiers built-Use Play 1 amplifiers, review amplifier design interface
- Work on layout

Week of 11/23

- More complete BOM
- Power supply circuit built- use Play 1 power supply
- Review design interface with SONOS
- Finish schematic of PCB
- Start PCB layout
- LED circuit built

Week of 12/2

- Functioning dev-board prototype (hand-wired interface)
- WiFi dev. board interfaced with CPU
- LED interface completed
- Interfaced with Play 1 audio amp
- Interface with Play 1 power supply
- PCB layout for first prototype





# Preliminary Bill of Materials

Quantity	Part Name	Unit Cost	Total Cost
1	Processor	\$12.92	\$12.92
1	WiFi Module	\$89.00	\$89.00
3	LED Driver, tentative	\$2.44	\$2.44
1	Power Supply PLAY:1	\$0.00	\$0.00
1	Amplifier PLAY:1	\$0.00	\$0.00
1	Transducer PLAY:1	\$0.00	\$0.00
4	LEDs, tentative	\$15.31	\$61.24
		<b>Total</b>	<b>\$170.48</b>

# Parts: Processor

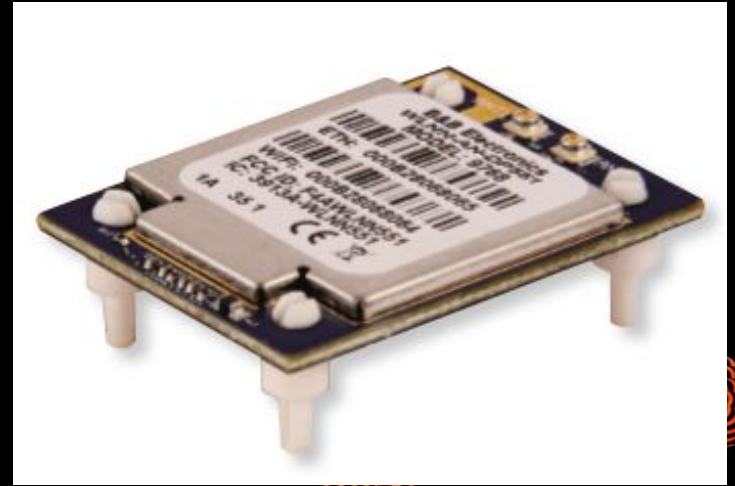
## - NXP LPC4088

- Operating speed: 120MHz
- Power supply: 3.3V
- Internal Memory: 512kB Flash,  
96kB RAM,  
4kB EEPROM
- Serial interfaces: I2S, I2C, SPI,  
UART, USB, CAN,  
Ethernet interfaces



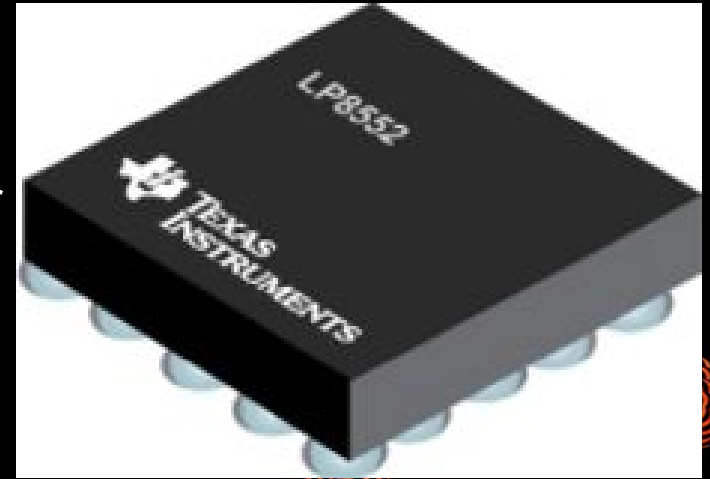
# Parts: Wi-Fi Module

- WLNN-SE-DP551 Series
  - 802.11 a/b/g/n Wi-Fi
  - 2.4 GHz Operation
  - Serial Interface: UART
  - TCP/IP stack included
  - Firmware included
  - Power Supply Reqs
    - 3.3 VDC, 650 mA (MAX)
    - Shared with processor



# Parts: LED Driver

- LP8552 High-Frequency LED Backlight Driver
  - Serial Interface: I<sup>2</sup>C
  - 6 output channels
  - 350mA constant current output
  - 2.7-V to 22-V Input Voltage Range



# Critical Elements

- Wifi Communication
- Bright LED lighting
- Decent sound Quality
- Fit in recessed lighting



Fin.

