ECE 477 DESIGN REVIEW TEAM 3 – SPRING 2015

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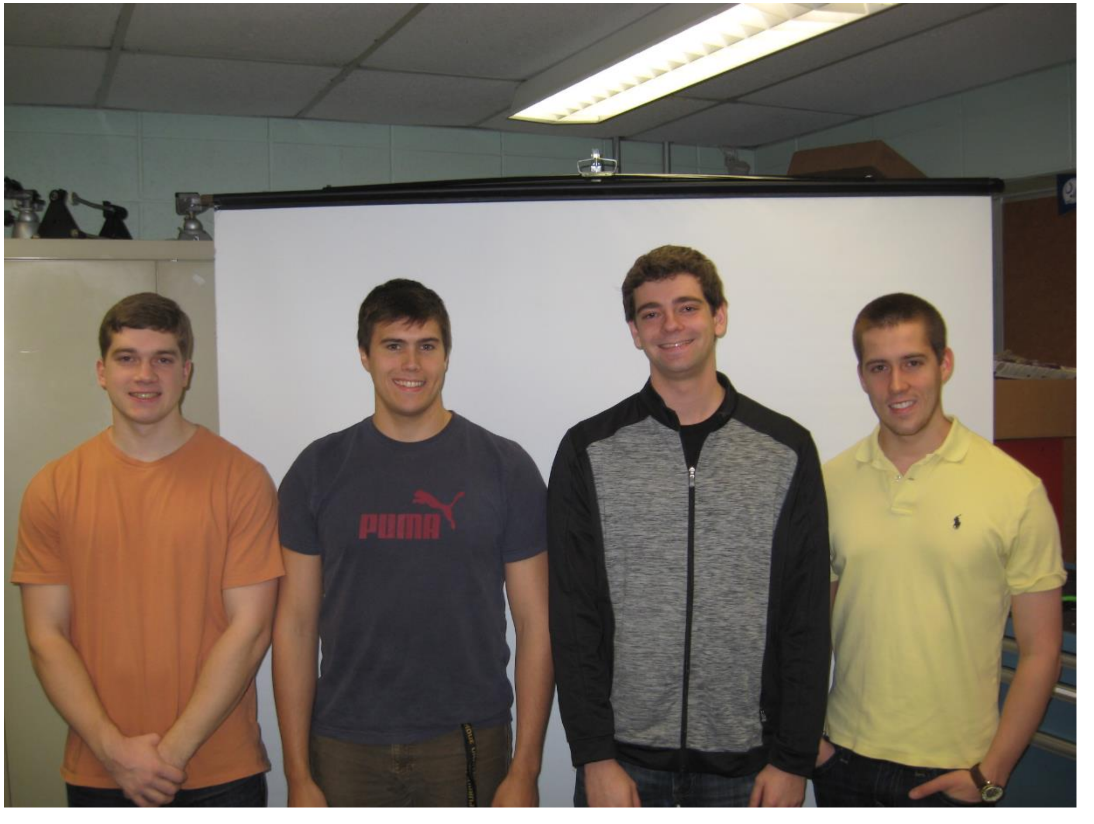


OUTLINE

- Project overview
- Project-specific success criteria
- Block diagram
- Component selection rationale
- Schematic and theory of operation
- PCB layout
- Packaging design
- Software design/development status
- Project completion timeline
- Questions / discussion

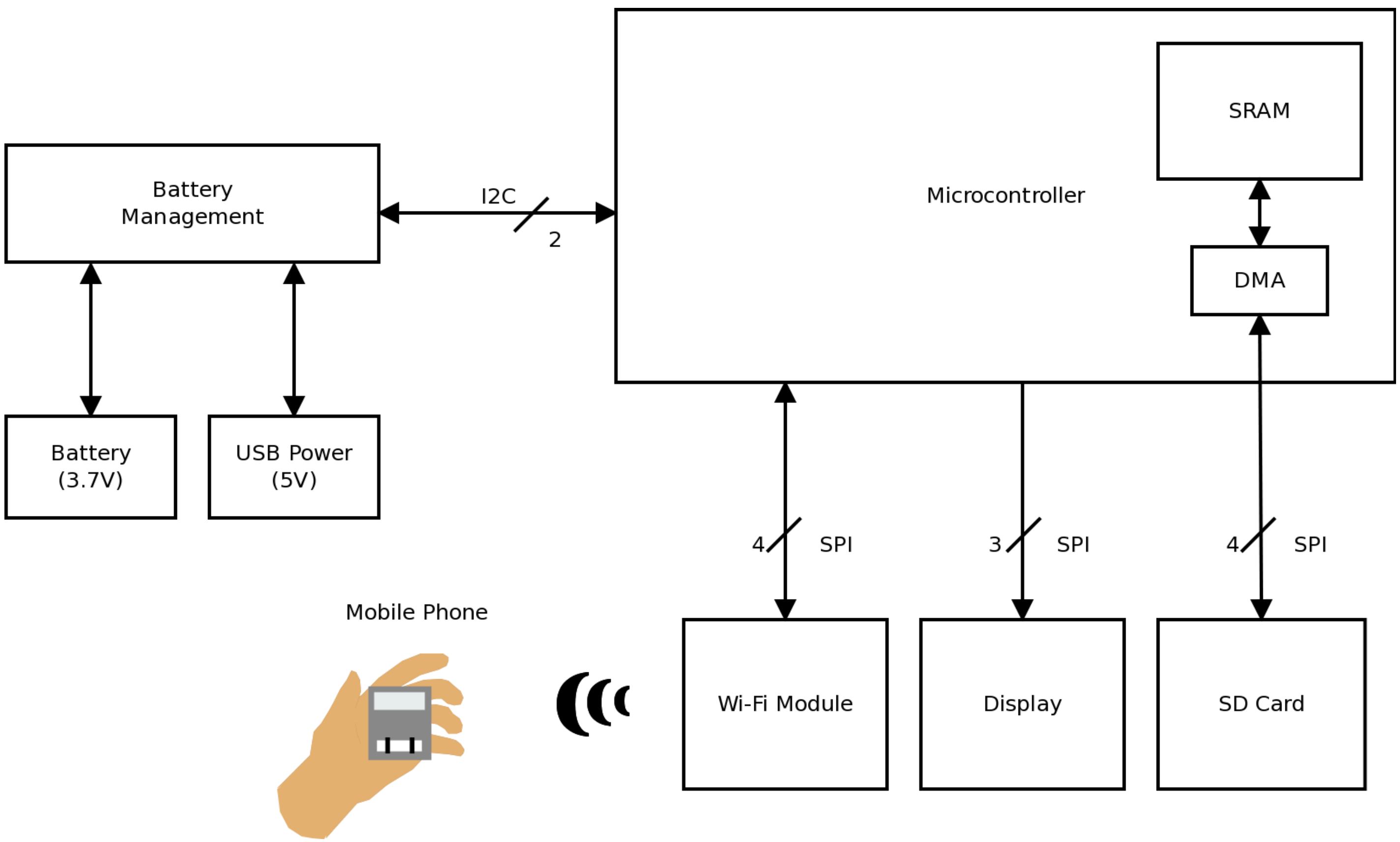
PROJECT OVERVIEW

- Stratus provides additional storage for mobile devices
- The storage is accessed from a Wi-Fi hotspot
- Data is stored on Stratus via a micro SD card
- System status is presented via a graphical display
- Stratus is powered by a lithium polymer battery chargeable by a USB cable

PROJECT-SPECIFIC SUCCESS CRITERIA

- An ability to stream information from Stratus to an external device using Wi-Fi.
- An ability to charge and manage a battery system, and inform the microcontroller of remaining charge.
- An ability to read and write data to a SD card unit connected to Stratus.
- An ability to browse and select files to stream from Stratus via a mobile app.
- An ability to display information such as battery life, Wi-Fi connection status, and name of current file being accessed to the user via a graphics display connected to Stratus.

BLOCK DIAGRAM



COMPONENT SELECTION RATIONALE: MICROCONTROLLER

- Texas Instruments TM4C123GH6PM (Tiva C Series)
  - 32-bit ARM Cortex M4
  - 80 MHz max system clock
  - 4 SPI channels
  - 32 DMA channels
  - 256 KB flash, 32 KB SRAM

- Atmel ATSAME70J19 (SAM E Series)
  - 32-bit ARM Cortex M7
  - 300 MHz max system clock
  - 3 SPI channels
  - 24 DMA channels
  - 512 KB flash, 256 KB SRAM

COMPONENT SELECTION RATIONALE: WI-FI VS. BLUETOOTH

Wi-Fi

+ Higher throughput
+ More open
- Power Consumption
- Extra software for configuration as both an access-point or not

Bluetooth

+ Low-power
- Low throughput

COMPONENT SELECTION RATIONALE: WI-FI MODULE

TI CC3100

+ Creates a Wi-Fi hotspot

- Module has pins on bottom

TI CC3000

+ small module with antenna

- Can't create a Wi-Fi hotspot

TI CC3200

+ Has built-in ARM processor

+ Creates Wi-Fi hotpot

- Requires an OS

- Not hand solderable

COMPONENT SELECTION RATIONALE: DISPLAY

Sharp LS013B4DN04 LCD E-Paper hybrid

1.35” screen

+ Low power consumption

+ No external circuit needed

- More complex software

RePaper E-Paper display

1.3” screen

+ Low power consumption

+ Simple software interface

- Requires large external circuit

- Requires 3.3V and 5.0V

COMPONENT SELECTION RATIONALE: BATTERY

Constraints:

- Maximum size, must fit inside packaging
- Minimum capacity, aiming for six hours of heavy usage (heavy = 370 mA approx.)

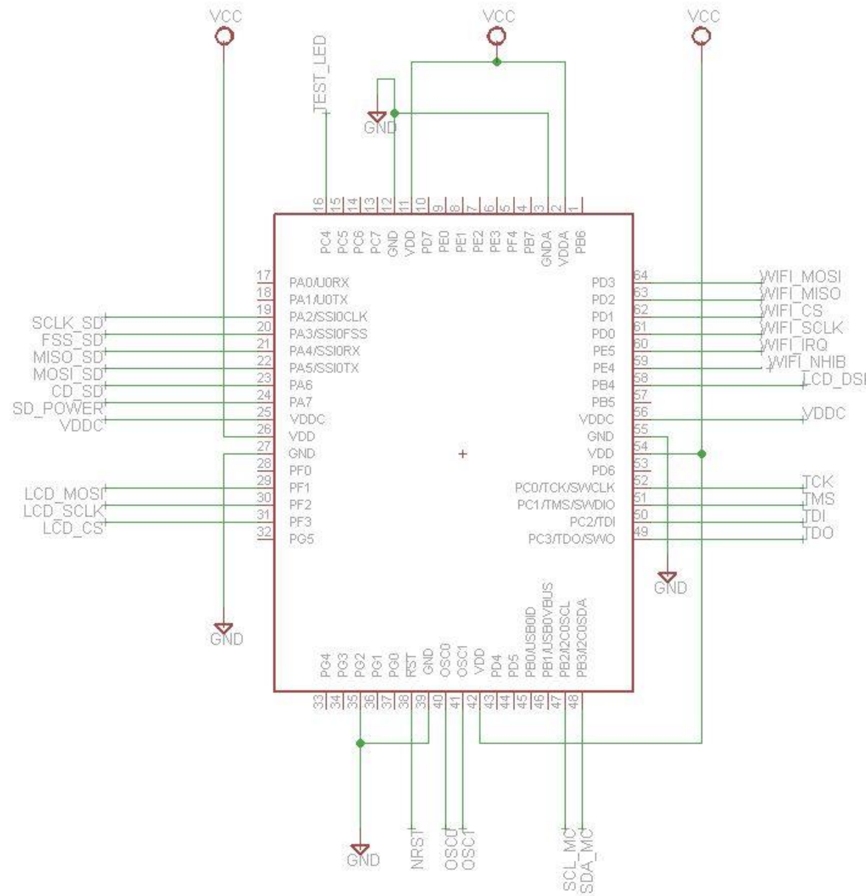
Decision:

- Polymer Lithium Ion Battery 2000 mAh

SCHEMATIC/THEORY OF OPERATION : MICROCONTROLLER

Microcontroller

- System Clock
  - Internal PLL to achieve 40 MHz
  - 16 MHz External (for boot-up)
- Serial connections
  - Battery Monitor (I2C)
  - SD Card (SPI)
  - Wi-Fi module (SPI)
  - LCD (SPI)



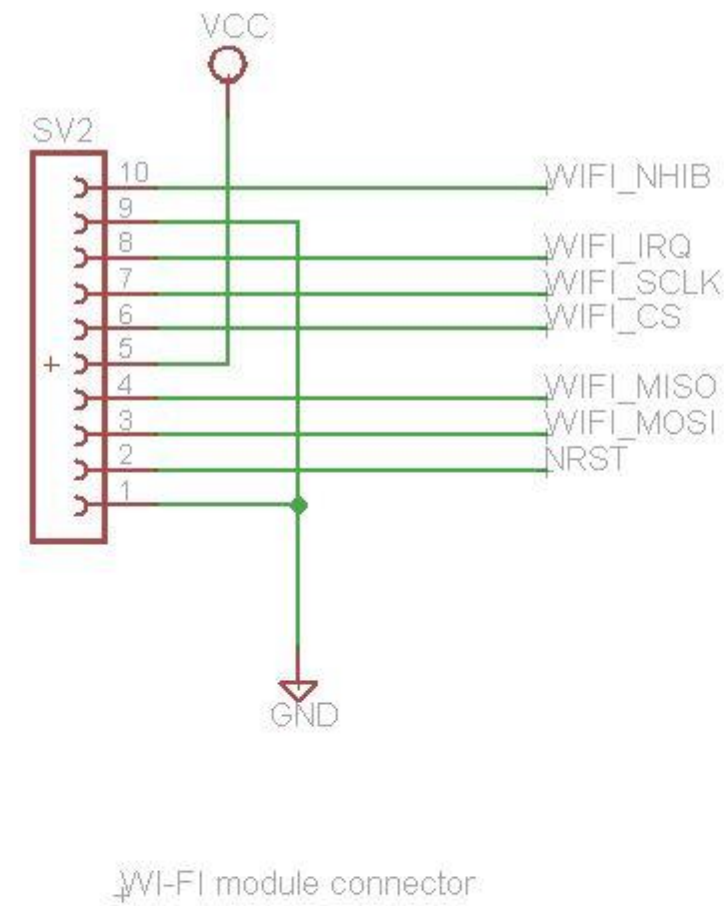
SCHEMATIC/THEORY OF OPERATION : WI-FI

Wi-Fi Module

- External module
- 20 MHz max SPI CLK

Designing our own module

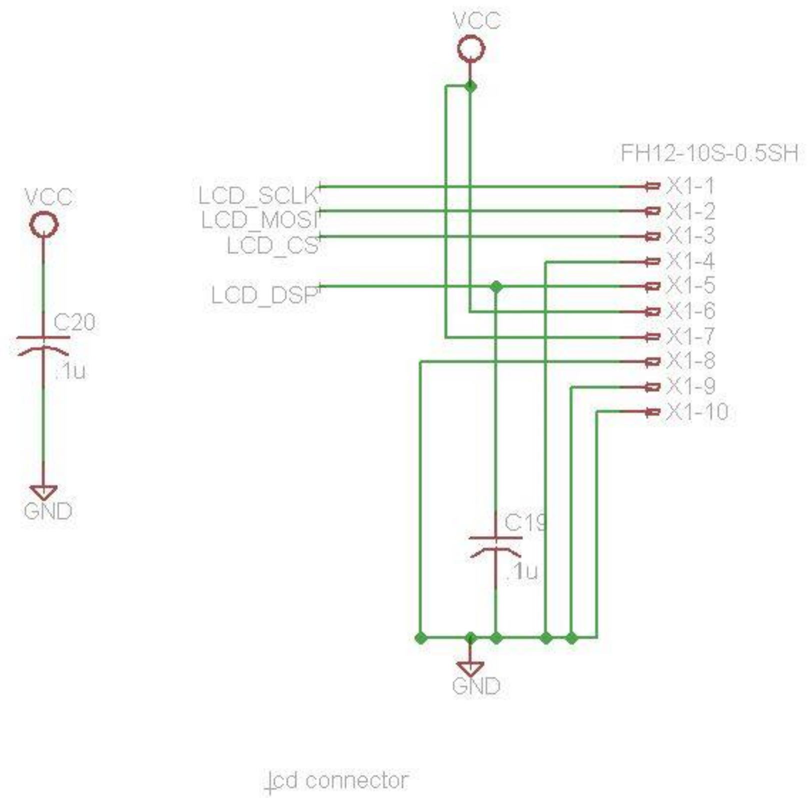
- Solderablility
- Antenna design



SCHEMATIC/THEORY OF OPERATION : LCD

LCD/E-paper Hybrid Screen

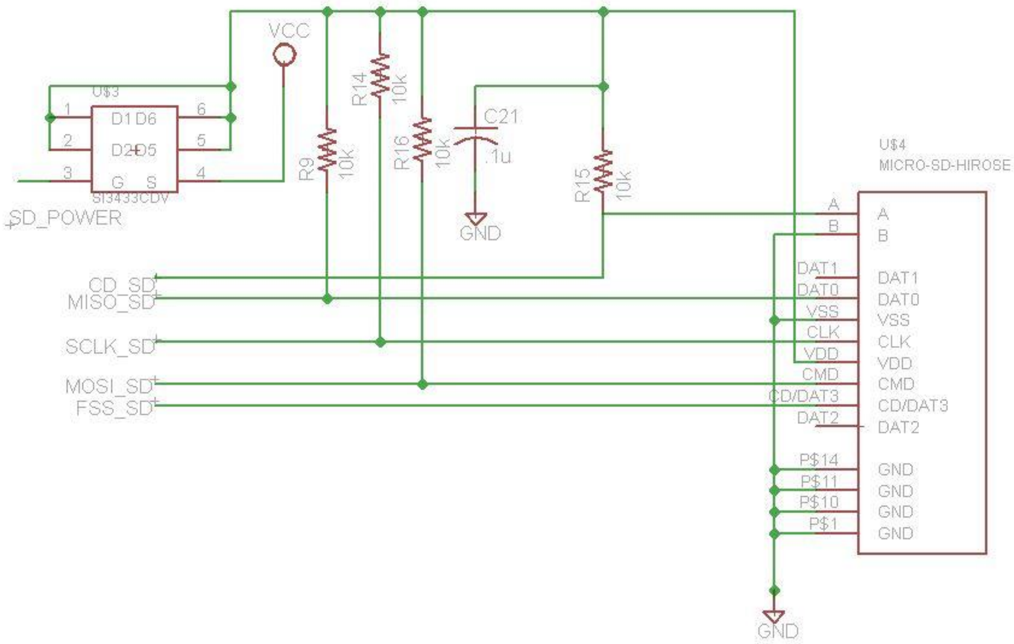
- Interfaces with SPI at 1Mbps
- Setup so VCOM signal is set using SPI



SCHEMATIC/THEORY OF OPERATION : SD CARD

SD Card

- Interfaces with SPI at ~20-25 Mbps
- Pull-Up resistors for idle (Hi-Z) lines → SD requires idle to be high
- Power MOSFET for software control of hard-reset
- Chip-Detect signal

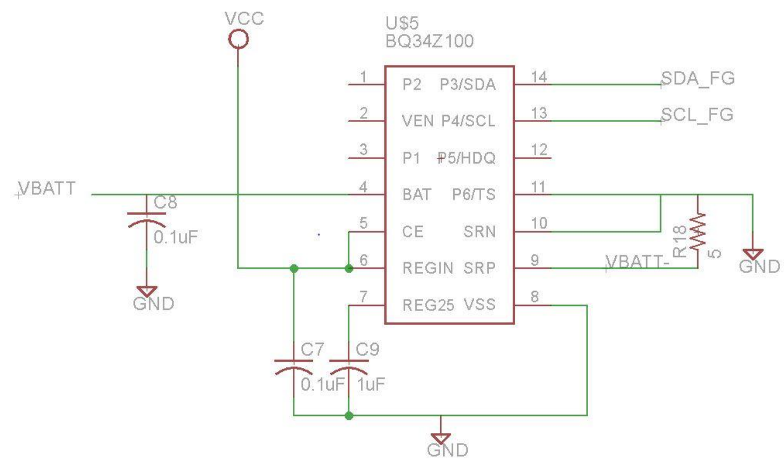


micro SD card connector

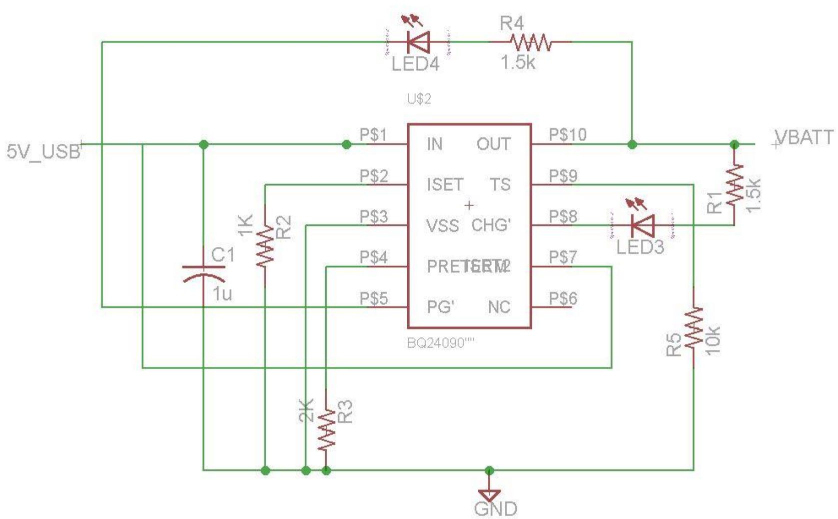
SCHEMATIC/THEORY OF OPERATION: POWER

Power Management

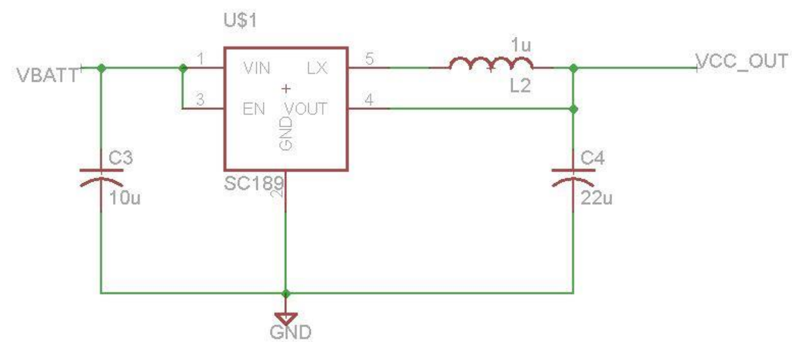
- 5V USB charging
- 3.7V battery
- 3.3 V data bus



Fuel Gauge

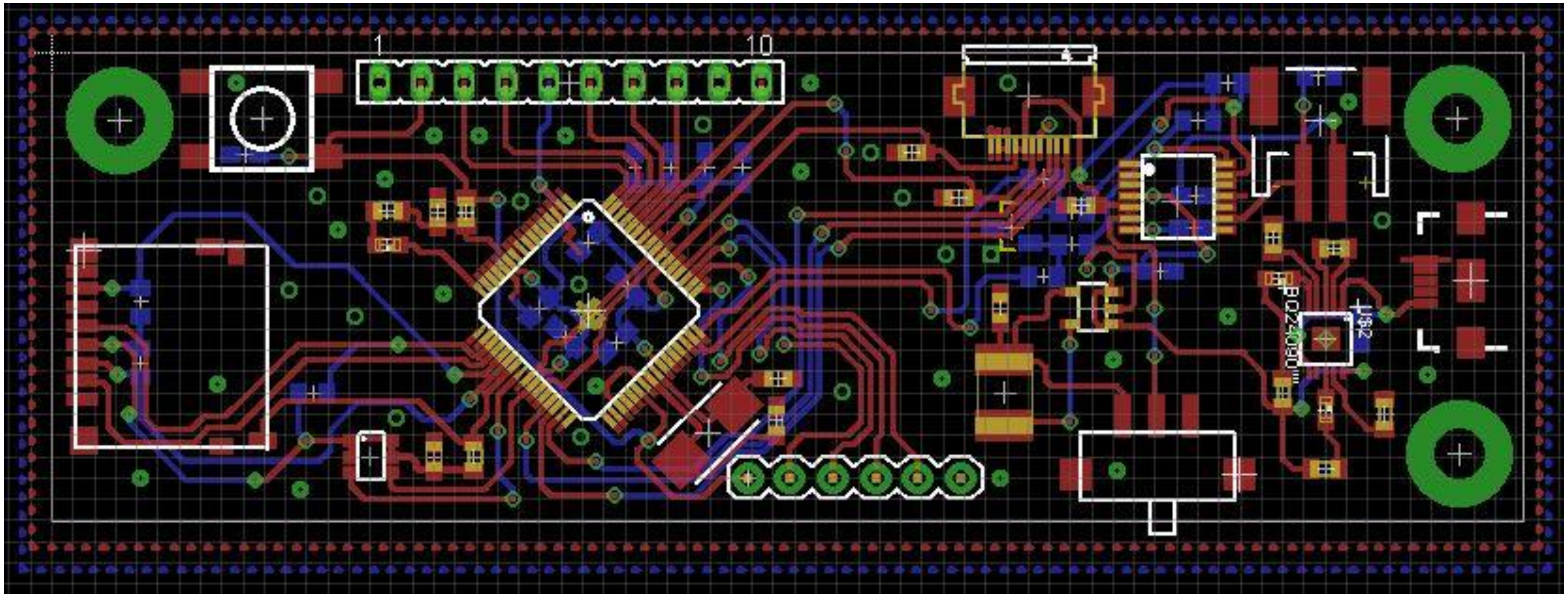


LiPo Battery Charger



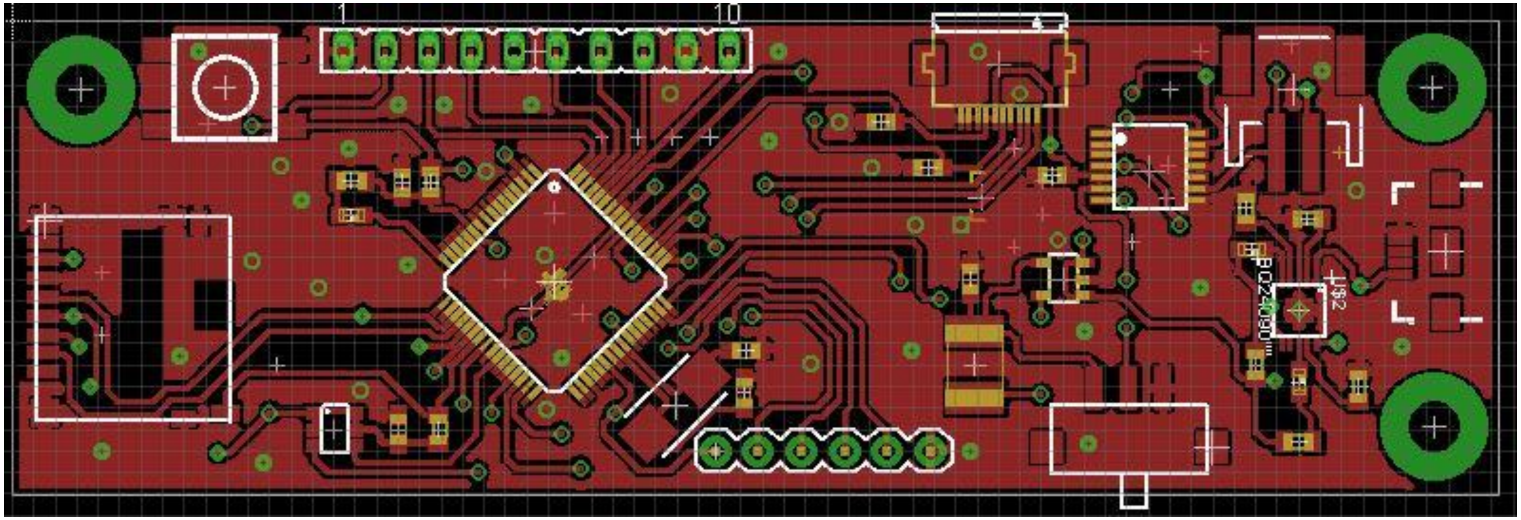
Buck converter 3.7V to 3.3V

PCB LAYOUT

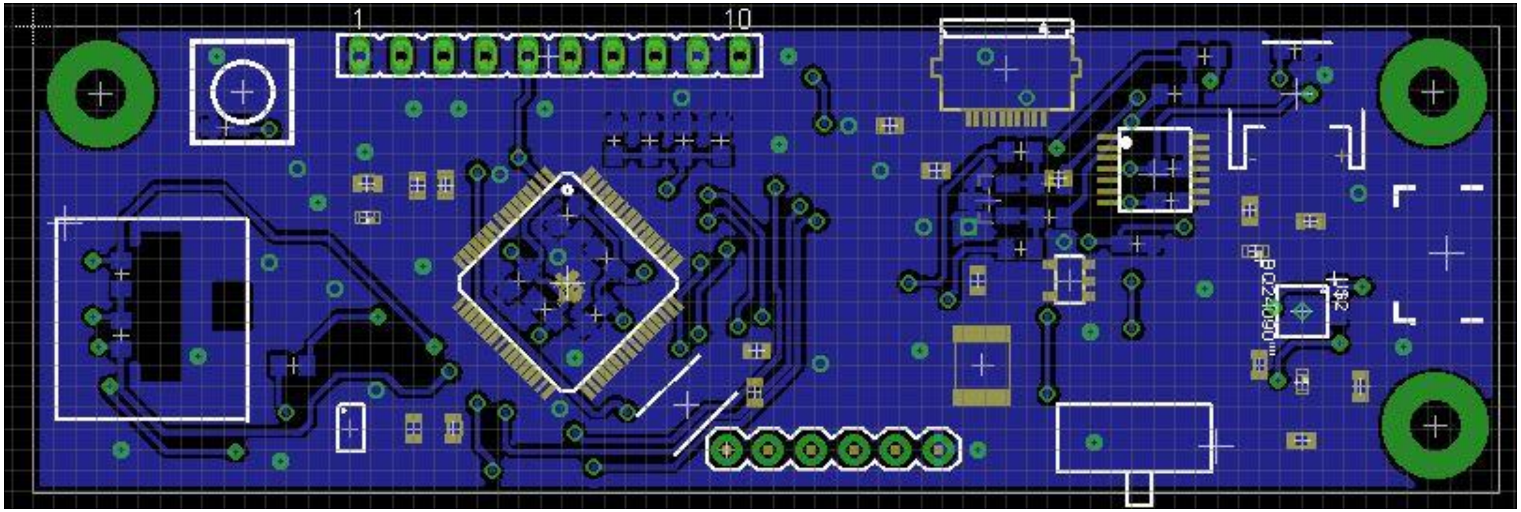


PCB LAYOUT

Top:

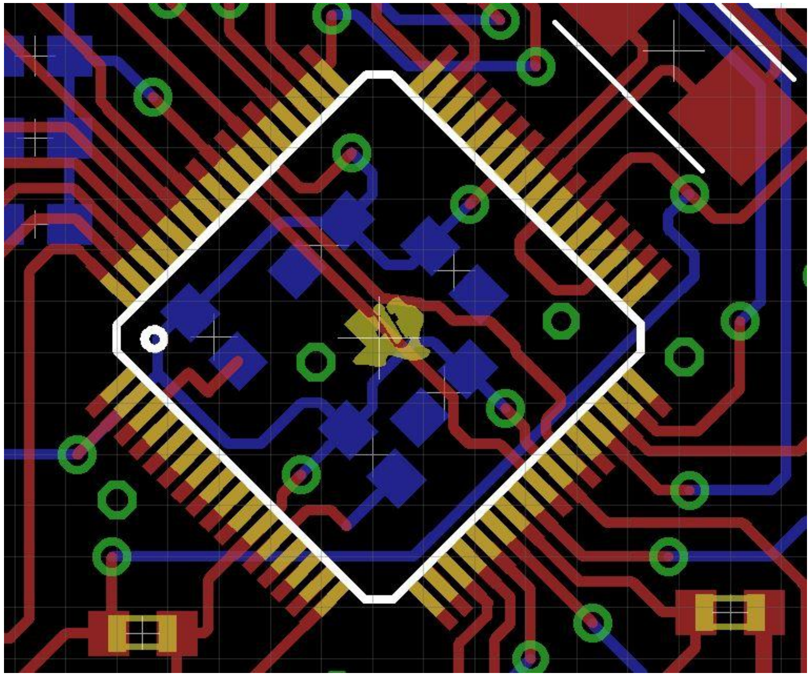


Bottom:

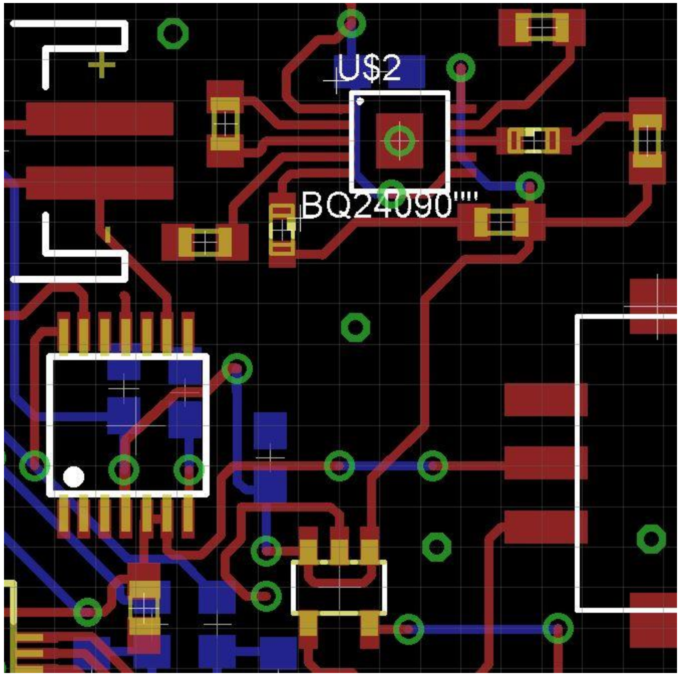


PCB LAYOUT

Microcontroller:



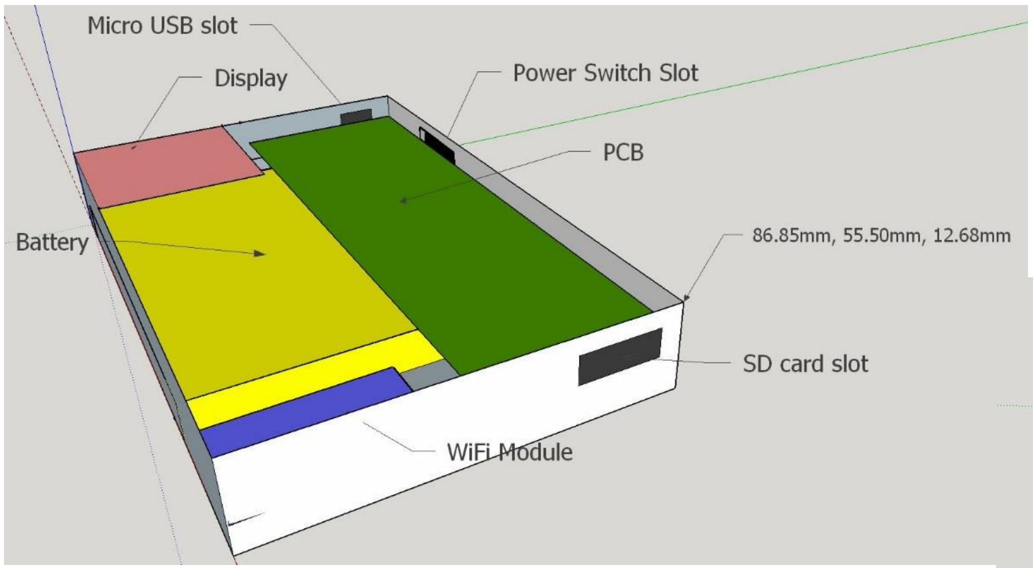
Battery:

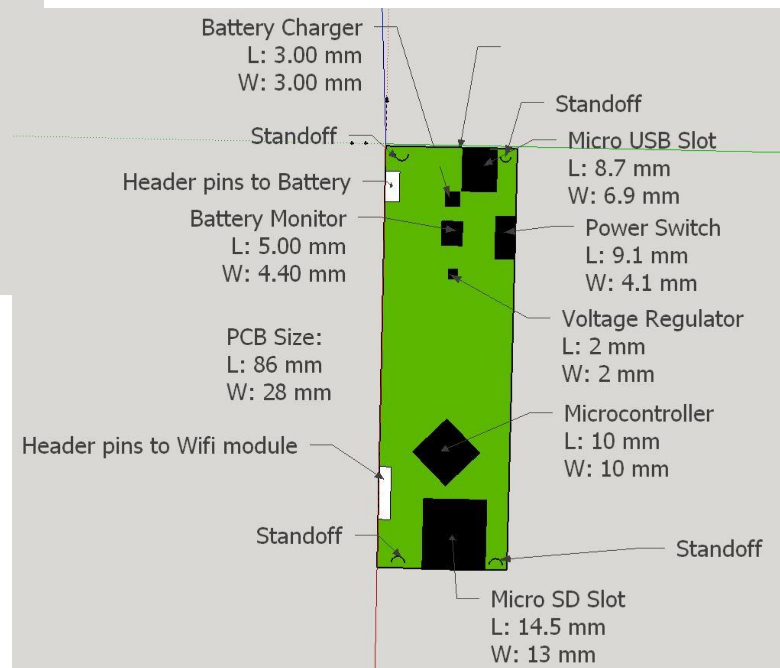


PACKAGING DESIGN

- Dimensions: 90 x 57 x 13 (mm)
- Two 3D printed plastic pieces will be screwed together, one top and one bottom with sides
- Insulation will be added inside to aid in securing components.
- Battery Dimensions: 5.8 x 54 x 60 (mm)
- PCB Dimensions: 86 x 28 (mm)

PACKAGING DESIGN





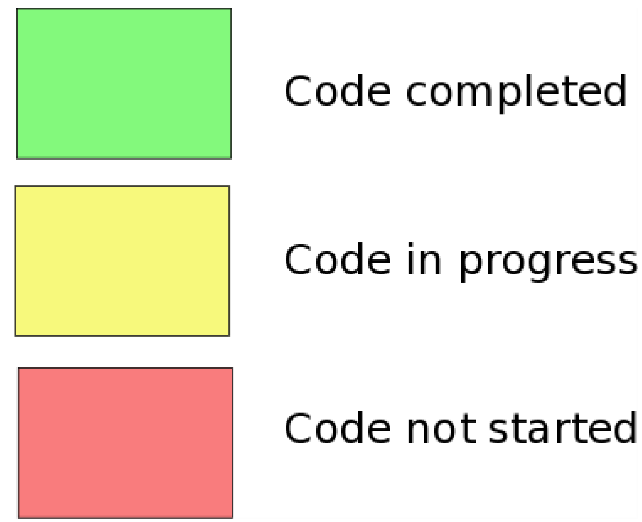
SOFTWARE DEVELOPMENT STATUS

Embedded

- Embedded Initializations
- System Status Interrupts
- Wi-Fi Interface
- DMA Controller Interrupts
- Main Control Loop

iOS Development

- Using Python TCP server to act as Stratus
- Can request and receive music library
- Can request, receive, and play a song
- User Interface is 75% complete



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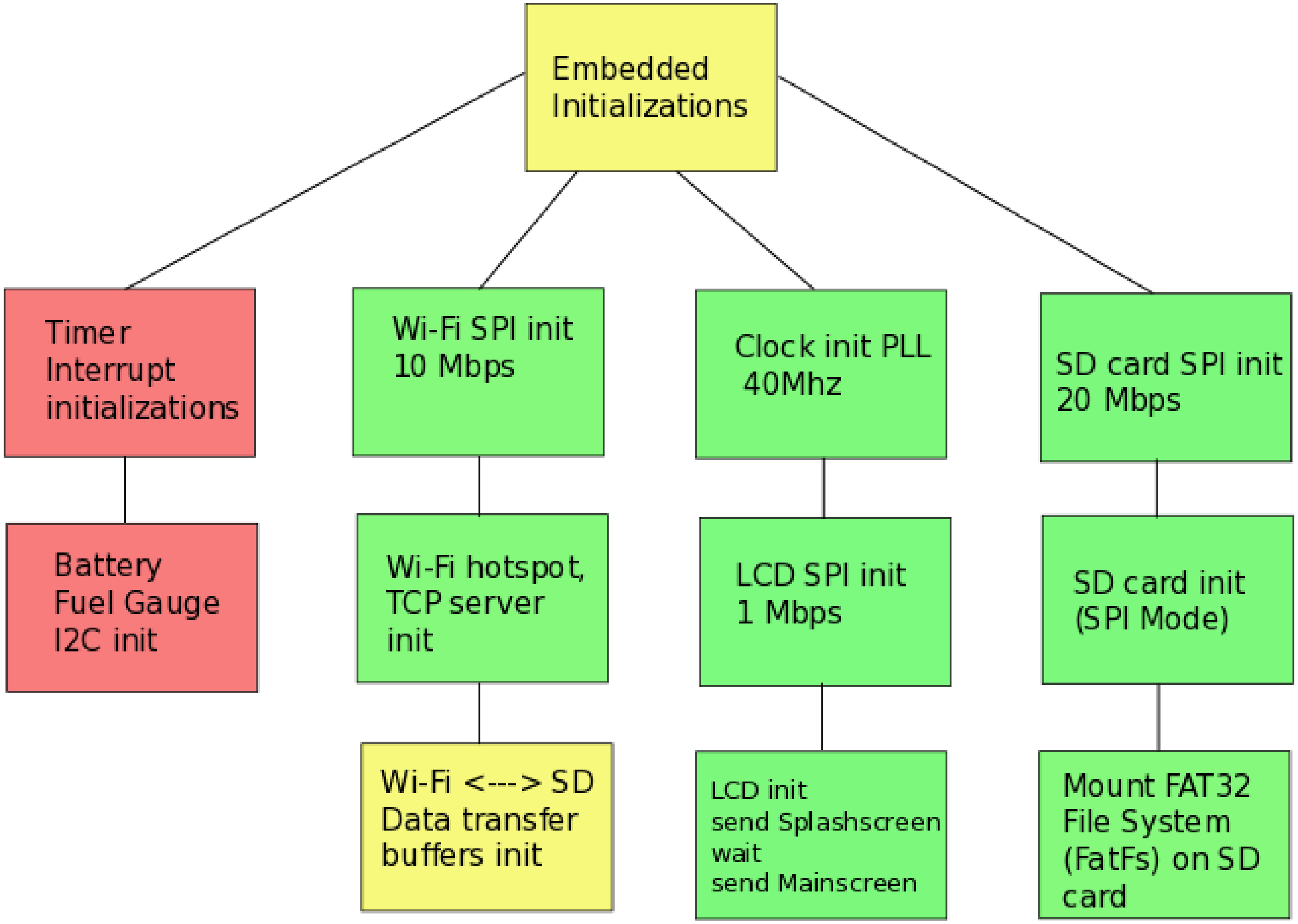

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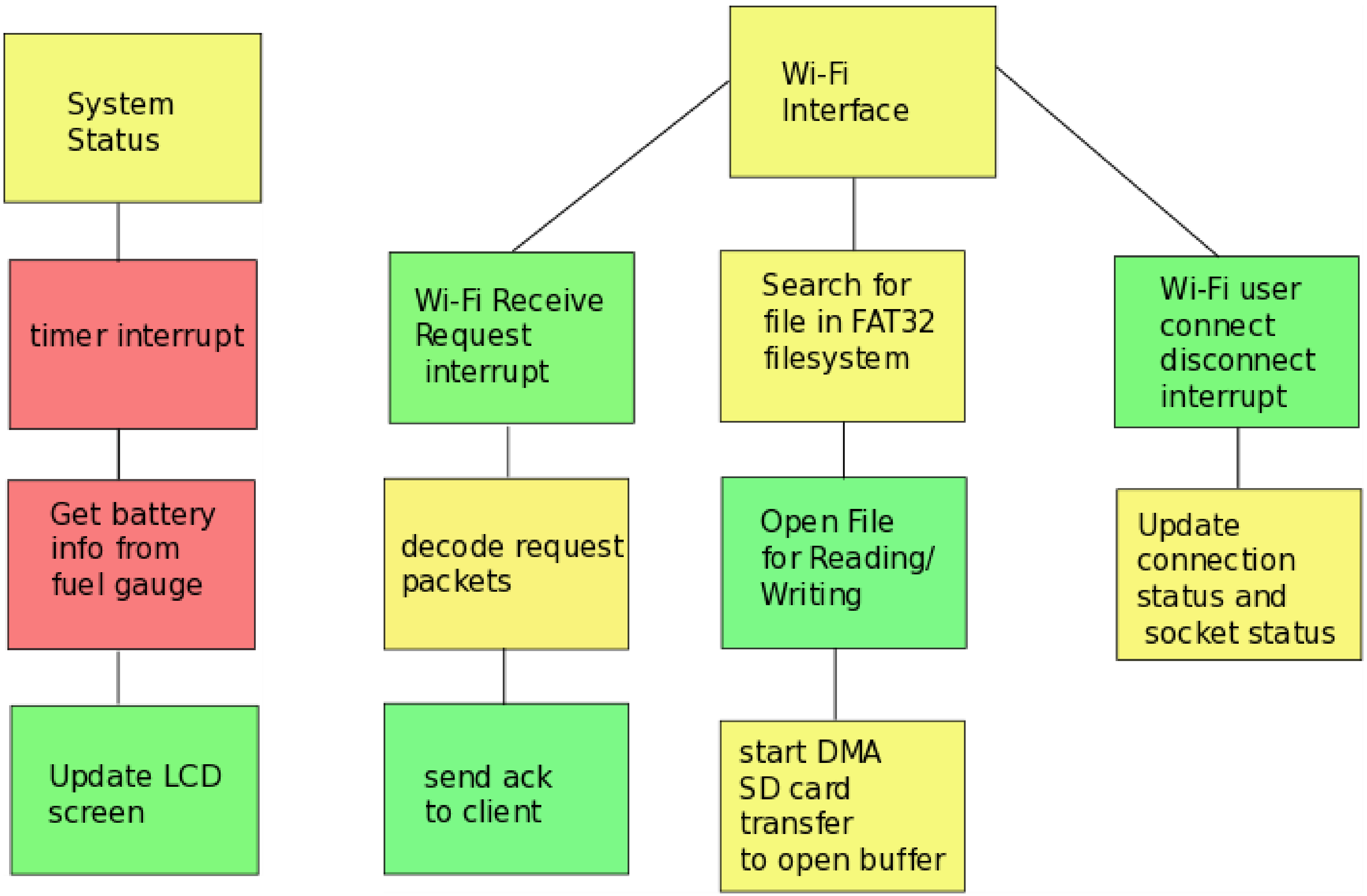

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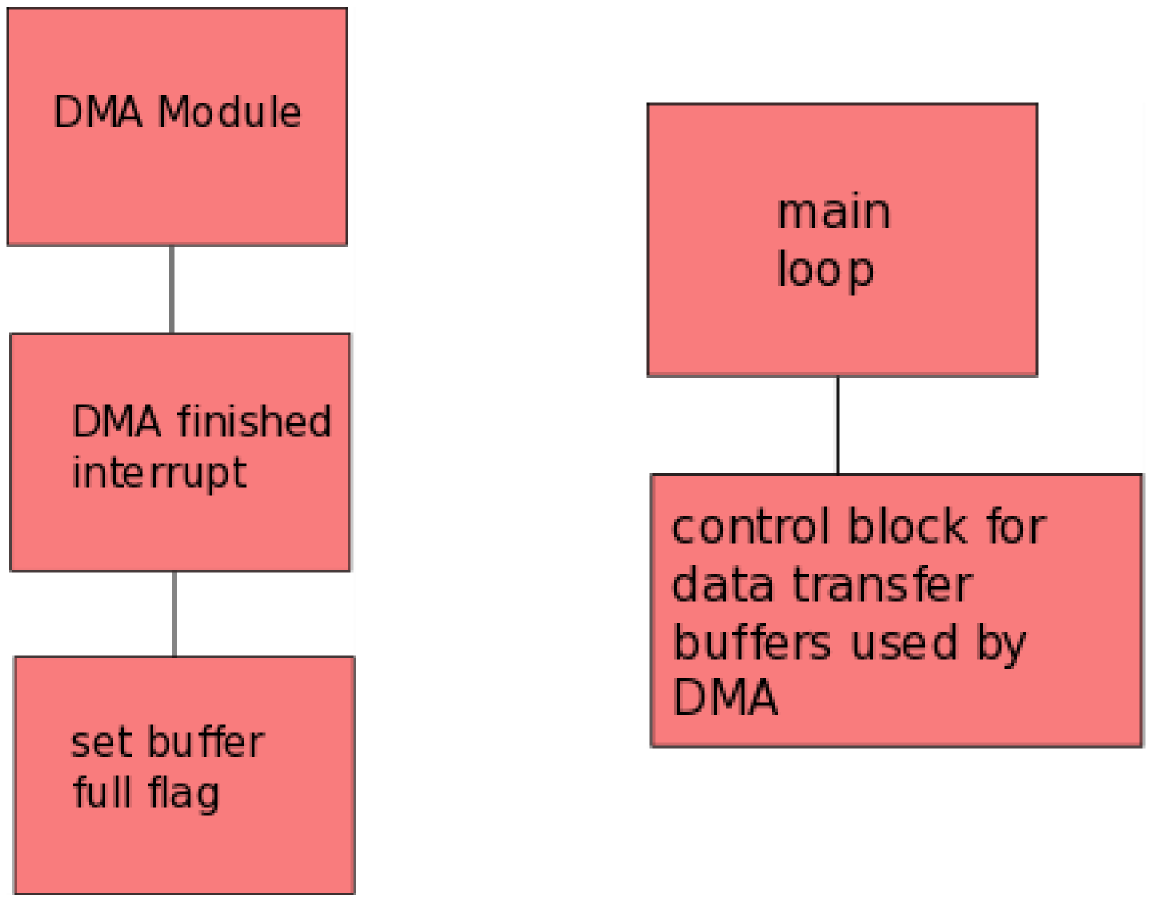

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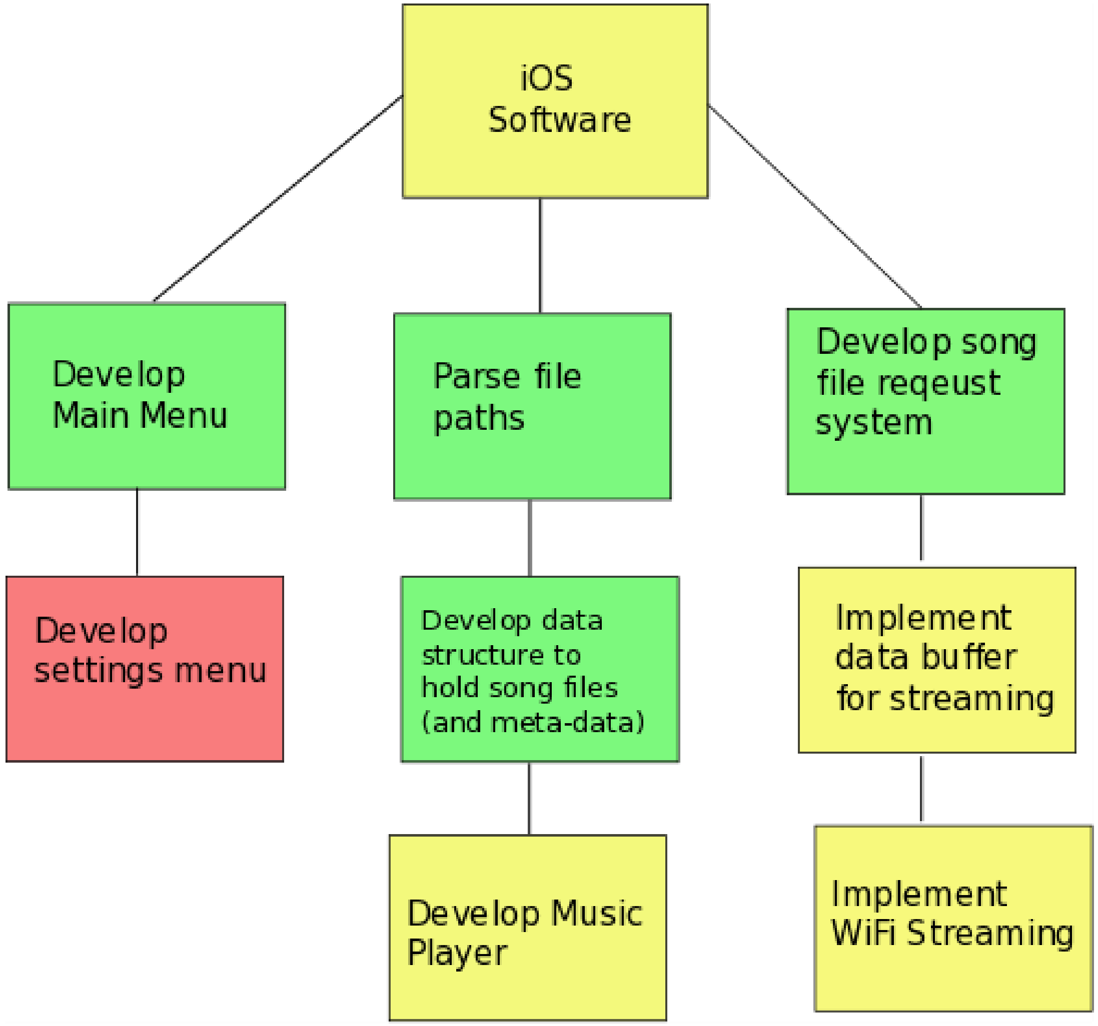

PROJECT COMPLETION TIMELINE

Week 8:	finalize board
Week 9:	finish embedded initializations, finish iOS application, design own Wi-Fi module, battery communication
Week 10:	spring break
Week 11:	solder PCB components, Wi-Fi module interface, optimize file access (DMA)
Week 12:	integrate all software components
Week 13:	3D print packaging, continue integration & testing
Week 14:	continue integration & testing
Week 15:	testing
Week 16:	showcase week

QUESTIONS?