Smartphone Powered Laptop

Group 15

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Motivation

- Today's smartphones and laptops can cost anywhere from $800 - $1200 individually. But they are not interchangeable, you need both for separate tasks. Phone calls, texts, homework, projects.
- Creating a laptop that utilizes the components from the inside of a smart phone would save consumers hundreds of dollars.
- Potential breakthrough for schools in low-income areas.

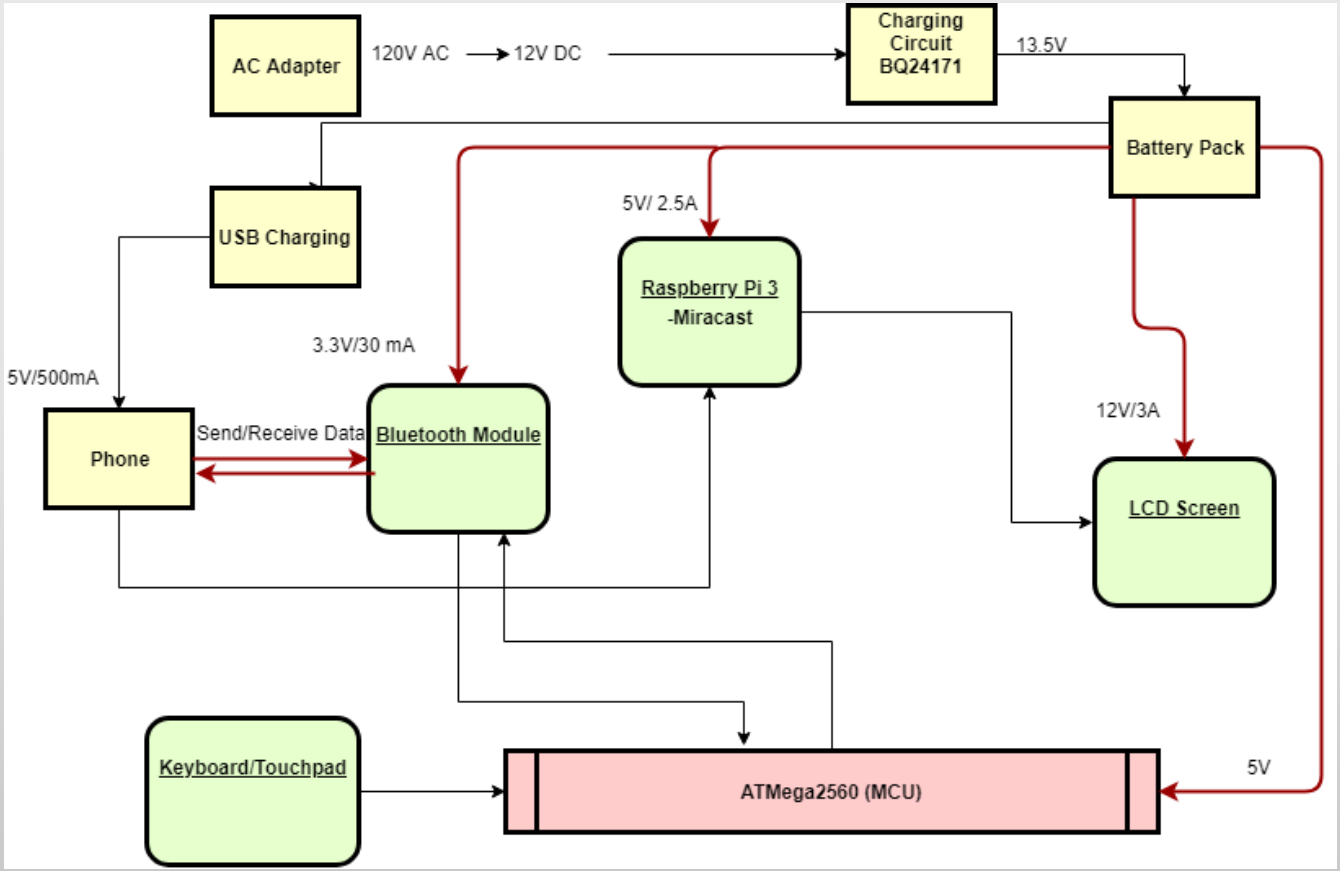
Goals and Objectives

- Create an affordable laptop (~$100 - $200)
- Successfully implement full wireless data connection (Wi-fi, Bluetooth)
- Allow users to implement with any android device

Specifications

- Wi-Fi Direct (Peer to peer communication)
- Bluetooth 2.0
- Asus G50 Laptop Keyboard
- Asus G50 synaptic Touchpad
- 15.3" LCD screen 1024x768
- 4.5v - 17v Power supply

Block Diagram



Wireless Technology Selection

Our project required implementation of both wifi and Bluetooth

Bluetooth: Version 2.0 (easier to implement into our design)

Wi-fi: MiraCast (Based on the wifi-direct standard.)

Wi-Fi Technology

- The Wi-Fi technology will help implement the screen cast from android phone to laptop LCD.
- Three technologies researched; Miracast and DLNA
- Choice: Miracast

Hardware Components

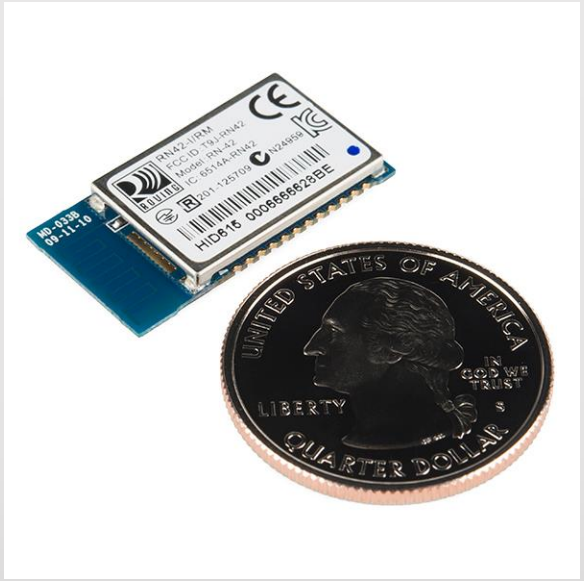
Microcontrollers

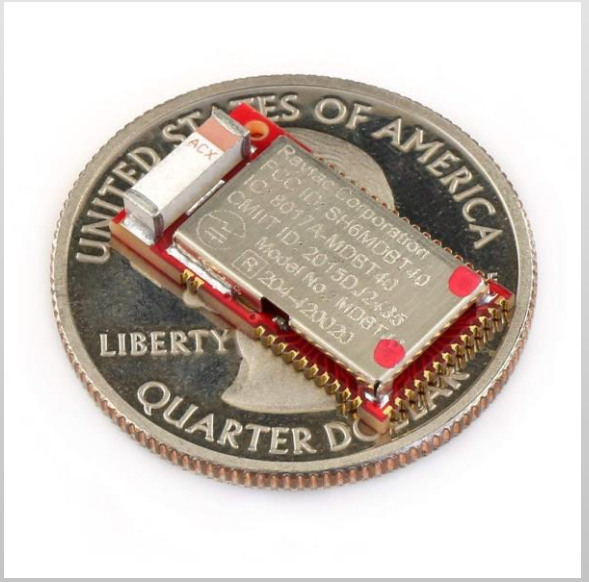
Choice: ATMEGA 2560 and BCM2387

	ATMEGA 328	ATMEGA	BCM2837
Cost	$2.15	$2.69	$30.75
Number of I/O pins	23 Pins	54 Pins	40 Pins
Manufacture			
Operating Volatage	5V	5V	2.5V-5.5V
Flash Memory	32 KB	256 KB	SD card storage

Bluetooth

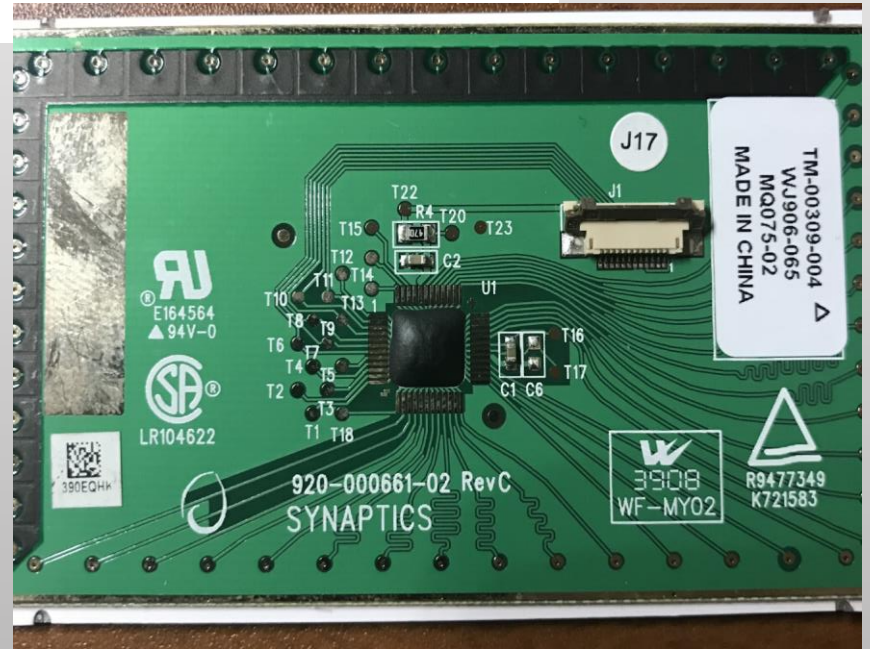
Module/ Company	**RN42 HID/** Microchip Technology	**MDBT40 /** Raytac
Bluetooth	BT 2.0	BT 4.2 LE
Range	20 m	50 m
Current Consumption	30 mA	15 mA
Flashed Firmware	Yes	No
Size (mm)	13.44 x 20 x 2	18 x 10 x 3.2
Price	$15.48	$7.95

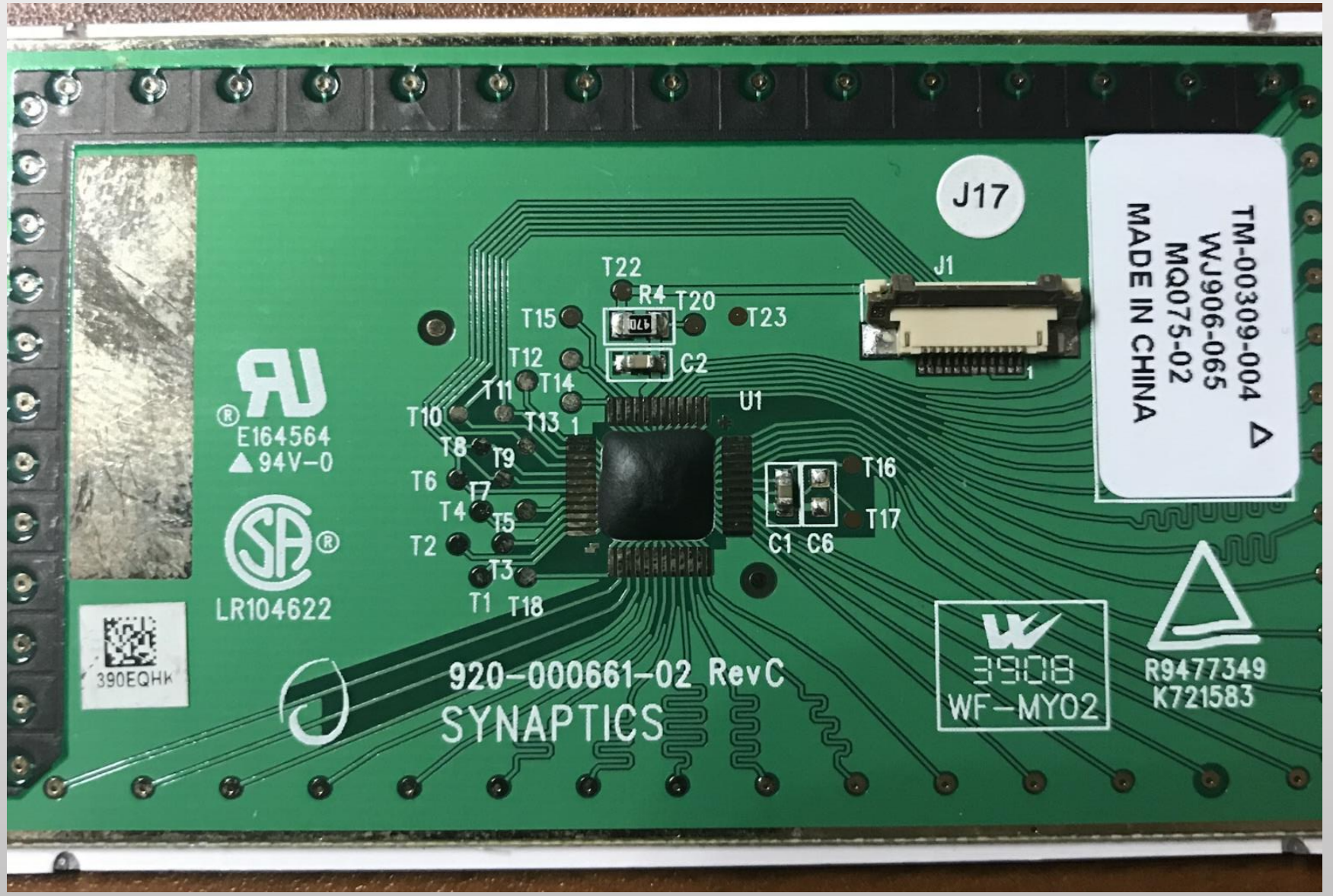




Touchpad

	TM-00309-004	Capacitie Touchpad
OEM	Yes	No
Manufacturer	Synaptics	Adafruit
Price	Free	$27.50
Size	88mm x 86mm x 14mm	




J17
J1
T22
R4
T20
T23
T15
T12
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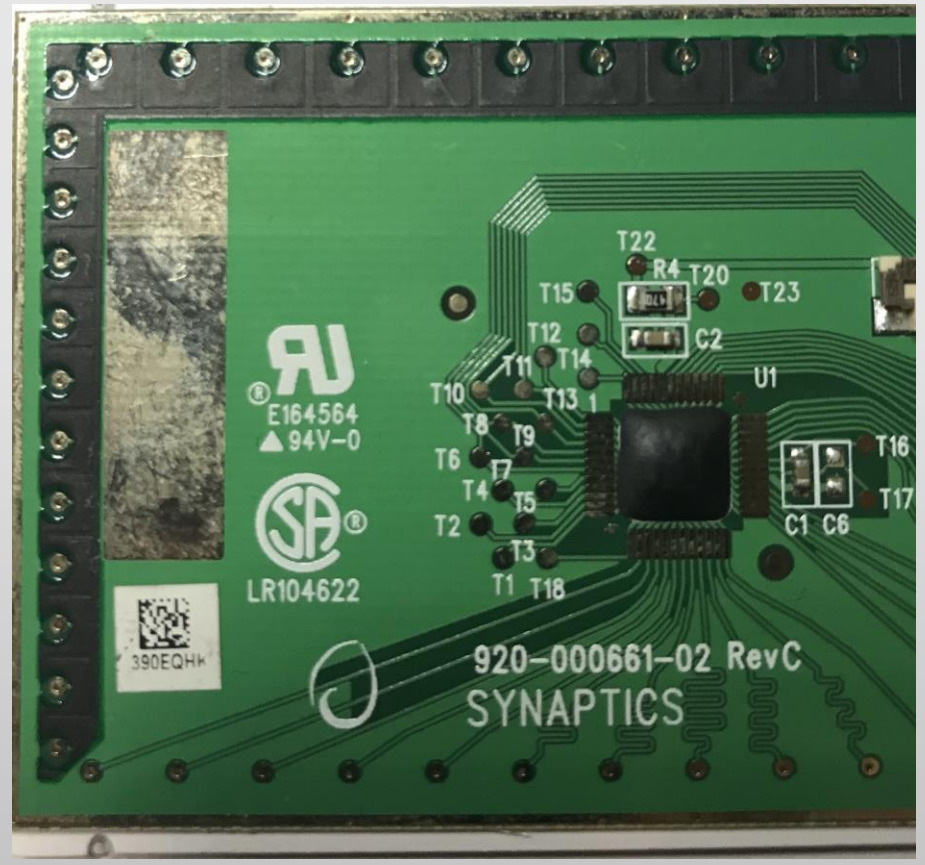
T4
T5
T2
T3
T1
T18
C2
U1
C1
C6
T16
T17
E164564
94V-0
LR104622
390EQHK
920-000661-02 RevC
SYNAPTICS
TM-00309-004
WJ906-065
MQ075-02
MADE IN CHINA
3908
WF-MY02
R9477349
K721583

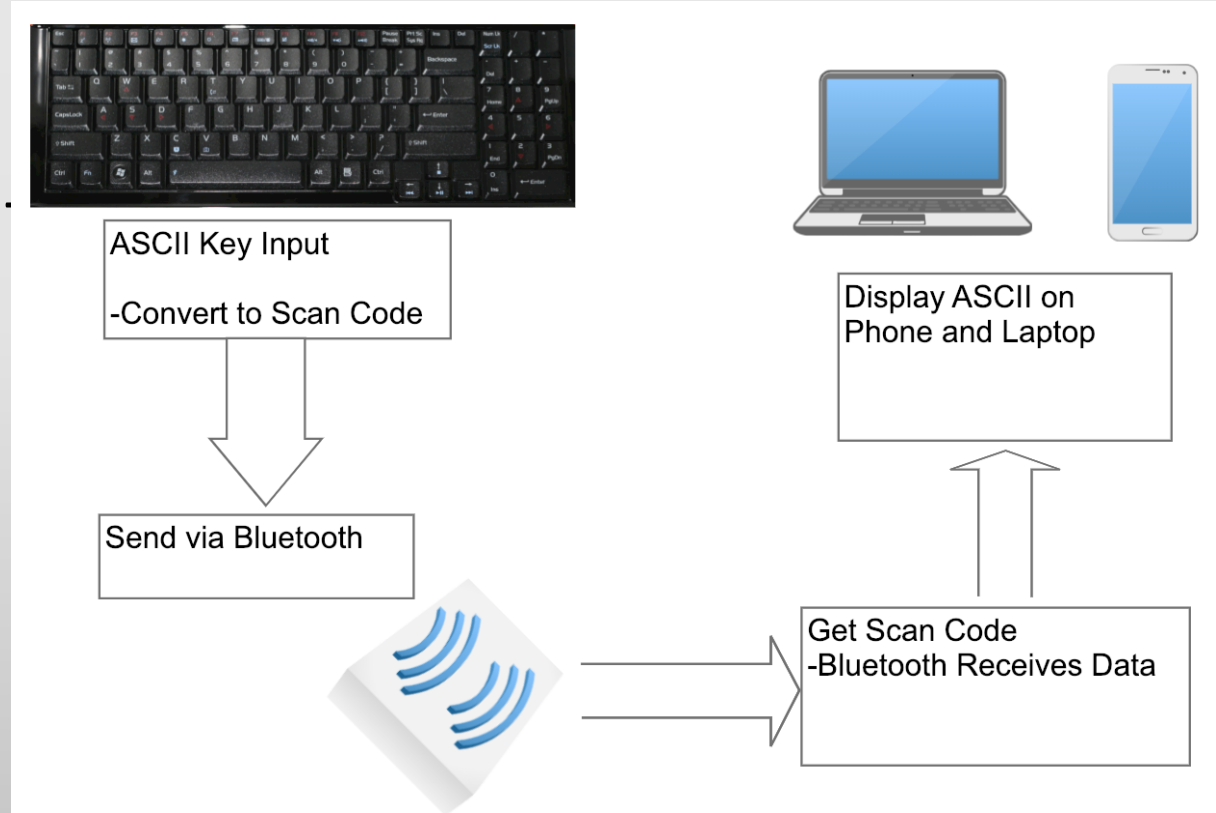
PS/2 Touchpad Electrical Interface

	Pad
5V Supply	T22
GND	Copper Pad
Data	T11
Clock	T10
Right Button	T6
Left Button	T9



Keyboard HID Interface

- Bluetooth v2.0
- Used for wireless connection
- Bluetooth v4.0+ is backwards



AC Adapter Selection

AC Adapter Name	Specifications	Price
BINZET Power Supply AC Adapter	Input: 120V AC Output: 12V/10A 120W	$19.99 - Amazon
TDK DTM65PW280D	Input: 230V AC Output: 28V/2.32A ~65W	$73.54 - Mouser
XINKAITE Wall Power Supply Adapter	Input: 120V AC Output: 12V/2A 24W	$8.98 - Amazon

- <u>Reasons for selection:</u>
- Price is cheaper than other competitors
- Output voltage is within charging IC input threshold
- Output current is within the charging IC input threshold

Battery Selection

Laptop Battery	Specifications	Price
Dell 9-Cell Lithium Ion battery pack	11.1V 7800mAh/87Wh	$69.90 - Laptopbatteryexpress
Bull-Tech 6-Cell New Laptop Battery for HP	10.8V 4350mAh/47Wh	$29.88 - Amazon
Replacement Notebook Battery for Asus G50V	11.1V 4400mAh/49Wh	$19.99 - BattDepot

<u>Reasons for Selection:</u>

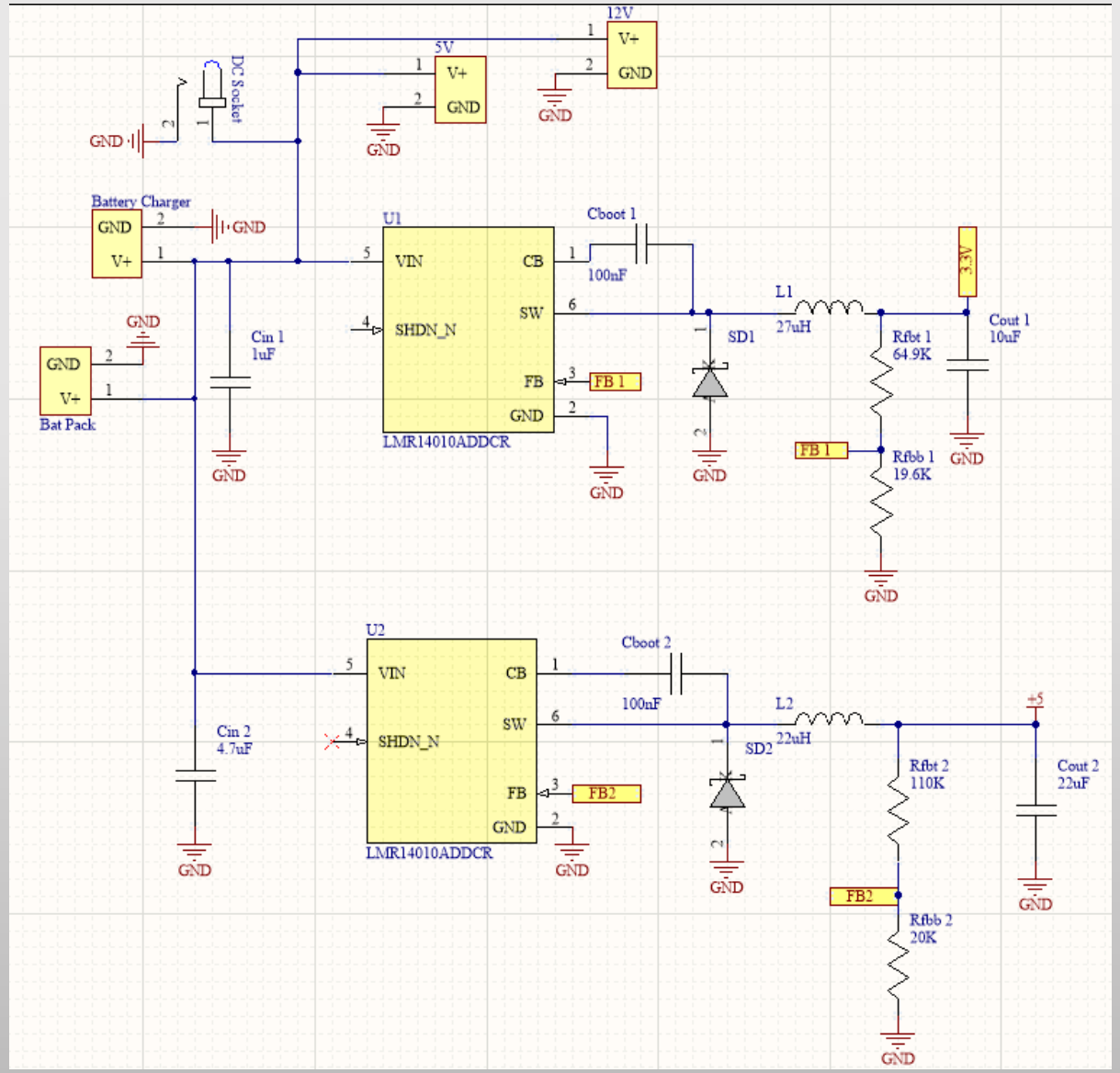
- Price is much cheaper for our type of application
- BattDepot battery was below 50% capacity when received
- Compatible Asus G50V laptop shell

Switching Regulators

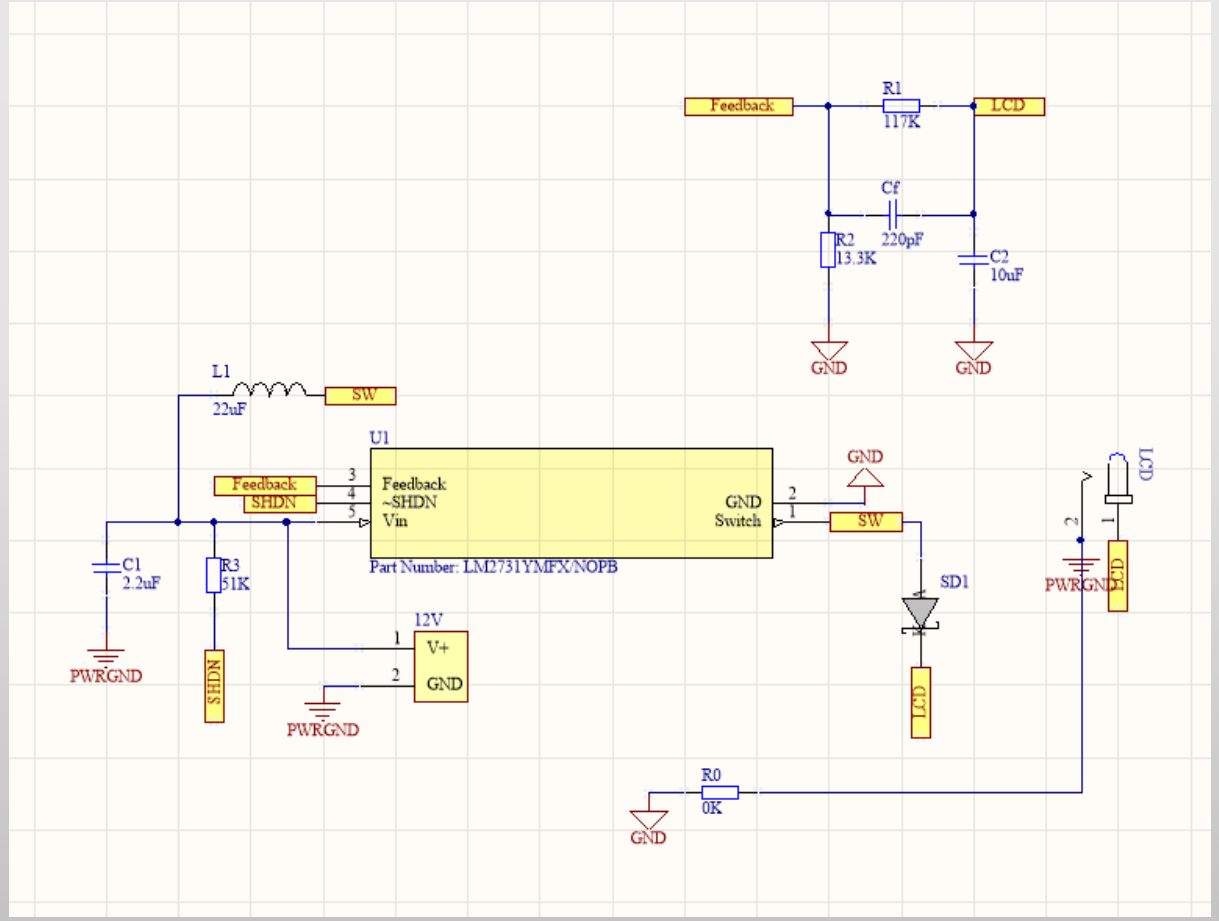
- All regulators are from TI
- Used TI webench for LMR IC

Column1	LM2731	LM2576T-5.0	LMR14010A	TPS54302
Type	Step-Up	Buck	Buck	Buck
Input Voltage	2.7 - 14V	4 - 40V	4 - 40 V	4.5 - 28V
Output Desired	12V	5V	3.3V and 5V	5V
Max Current	1.8A	3A	1A	3A
Components	9	6	7	12
Price	$1.94	$2.03	$2.76	$2.17

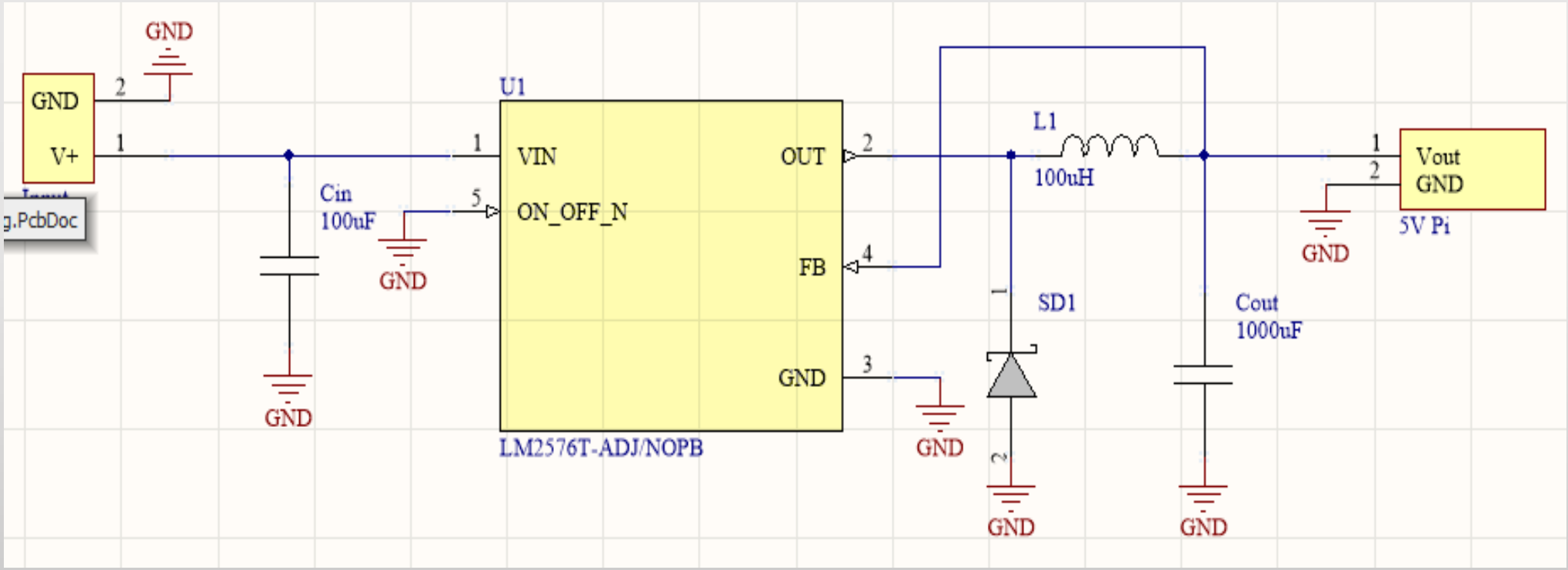
Supply to Bluetooth and Microcontroller



12V Regulator for LCD

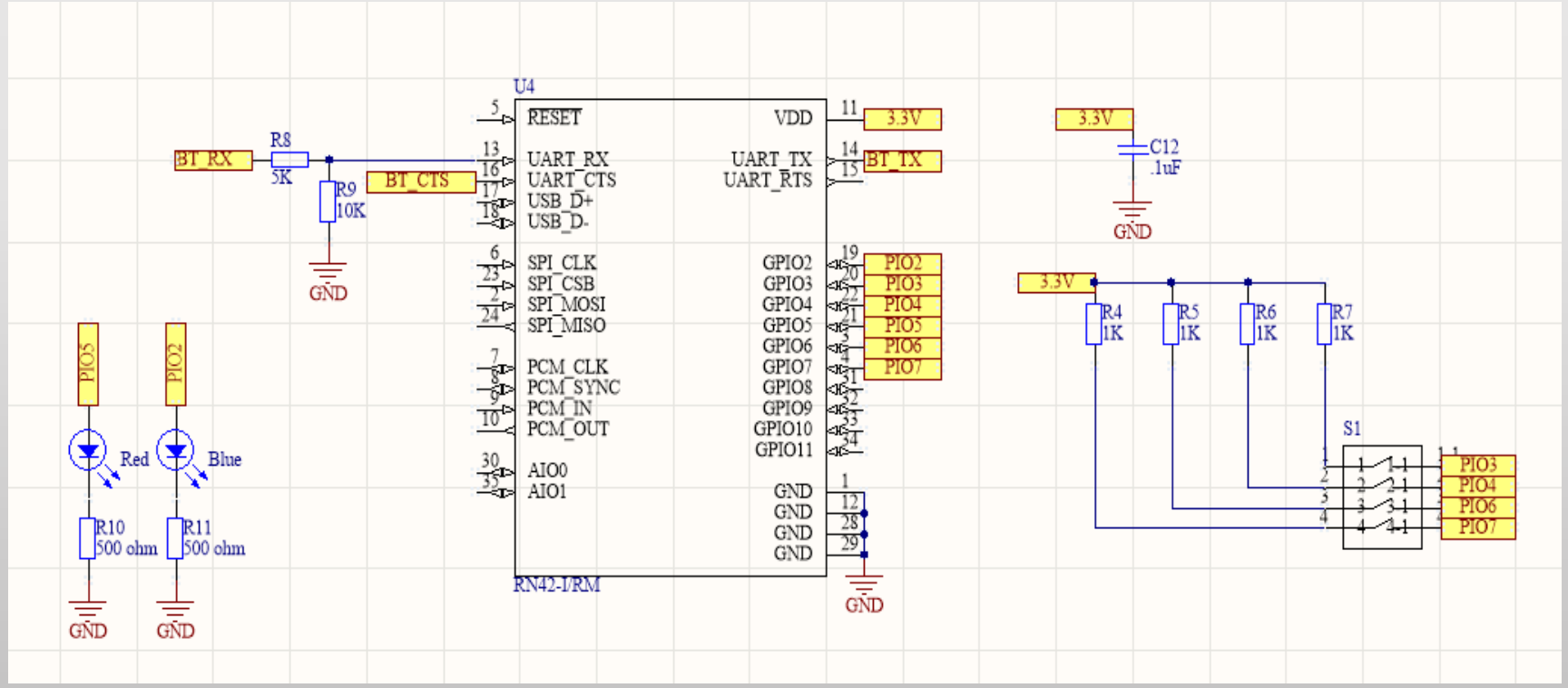


5V Regulator for Raspberry Pi

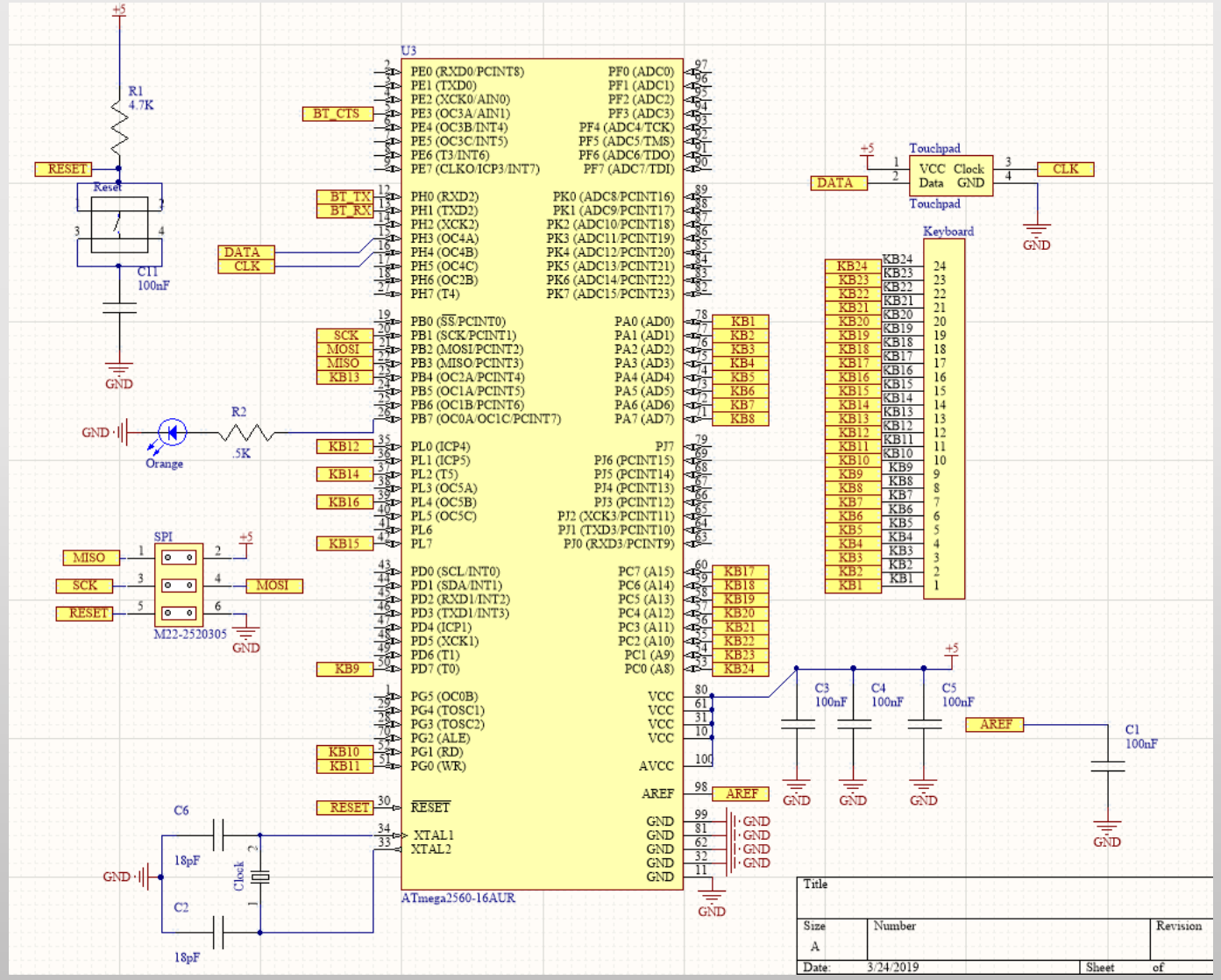


Bluetooth Schematic

- Hardware Configuration
  - i. Auto discovery
  - ii. 9600 Baud Rate
  - iii. Factory Reset
  - vi. BT Master



Microcontroller Schematic



Charging Circuit: Chip Selection

Charging IC Name	Specifications/Ratings	Price
BQ24171	Input Voltage: 4.5V - 17V Output: 13.5 V/ 0.6A - 4A	$3.61 - TI
BQ24600	Input Voltage: 5V - 28V Output: 21V/ 10A	$4.15 – Arrow
BQ25883	Input Voltage: 3.9V – 6.2V Output: 9.2V/ 2.2A	$5.61 - TI

Reasons for selection:

- Higher charging current limit to allow for faster charging
- Higher voltage ranges for output

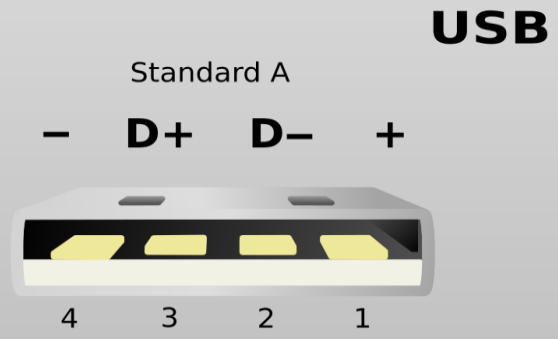
Battery Management System (BMS)

Name of BMS	Battery Voltage	Current Rating	Price
3S Balance 18560 Li Ion Battery Protection Board	11.1V to 12.6V	25A	$3.99 - Amazon
2S 18560 Charger BMS Protection Board	7.4V to 8.4V	8A	$2.12 - Amazon
3S Lithium Battery BMS Protection Board	12.6V	20A	$2.10 - Banggood

- <u>Reason for Selection:</u>
  - Our battery is 3S2P, so the BMS must be 3S.
  - Battery voltage is set to 11.1V

USB Phone Charging

USB Type	Specifications	Price
USB 2.0 Type A Port	Output: 5V/ 2.5A	$0.40 - Arrow
USB 3.0 Type A Port	Output: 5V/ 5.4A	$2.14 - Arrow



- USB 2.0 phone charging
  - Selected USB 2.0 due to its basic power transferring capabilities
  - USB 3.0 offers higher rated current at a higher price.
  - USB 3.0 offers much higher data transmission speeds, which is not needed for our application.

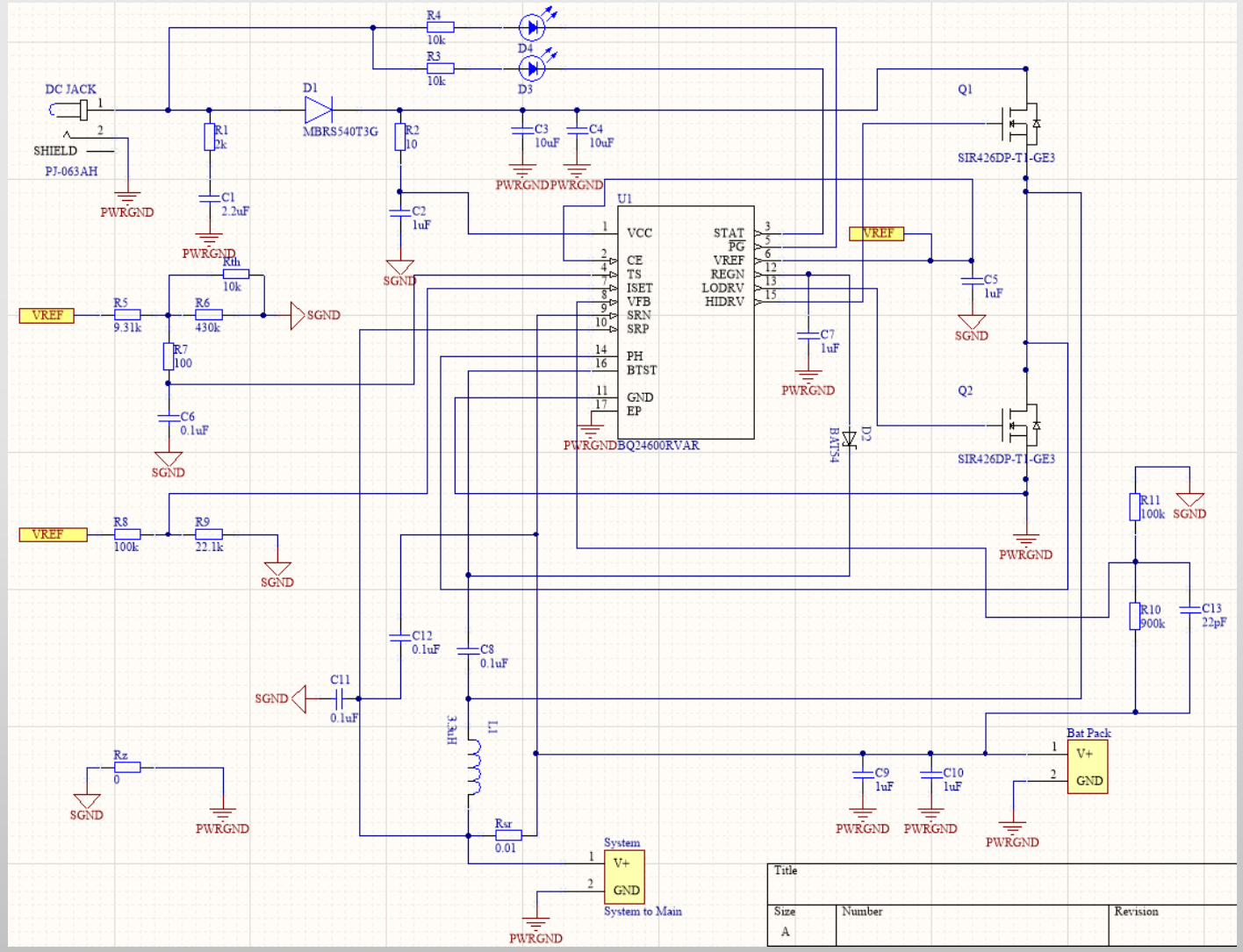
USB Phone Charging (cont.)

Name of Regulator	Specifications	Price
LM7805	Input: 7V – 30V Output: 5V/1.5A	$0.78 - Arrow
TLV767	Input: 2.5V – 13.6V Output: 0.8V – 13.6/ 1A	$1.05 - TI
TPS73801-SEP	Input: 2.2V – 20V Output: 1.21V – 20V/ 1A	$2.05

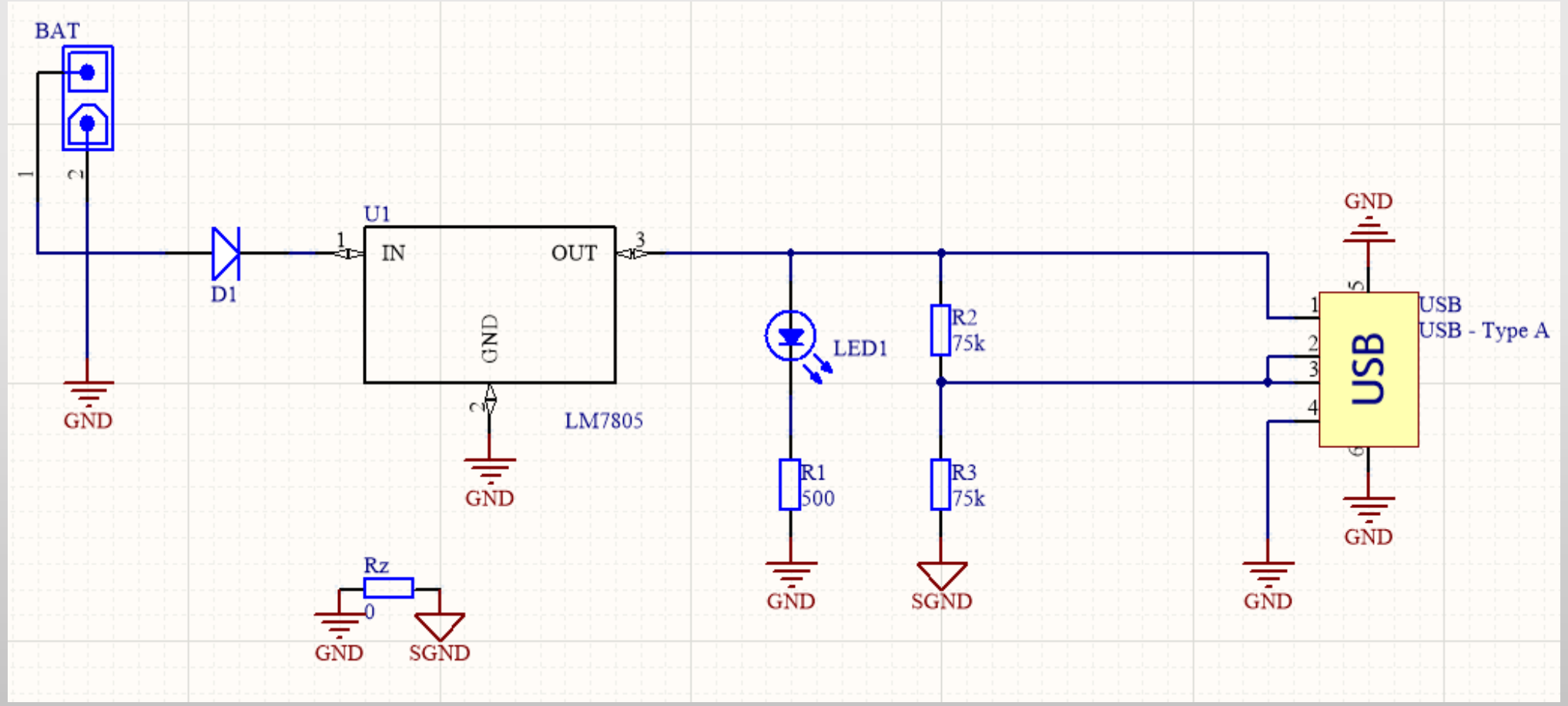
- Implementing USB 2.0 Type A charging with a voltage regulator to meet a minimum of '5V and 500mA'
  - *USB 2.0 Standard*

- Reason for Selection:
  - Broader input voltage range and is rated for a higher output current
  - Cheaper than competitors

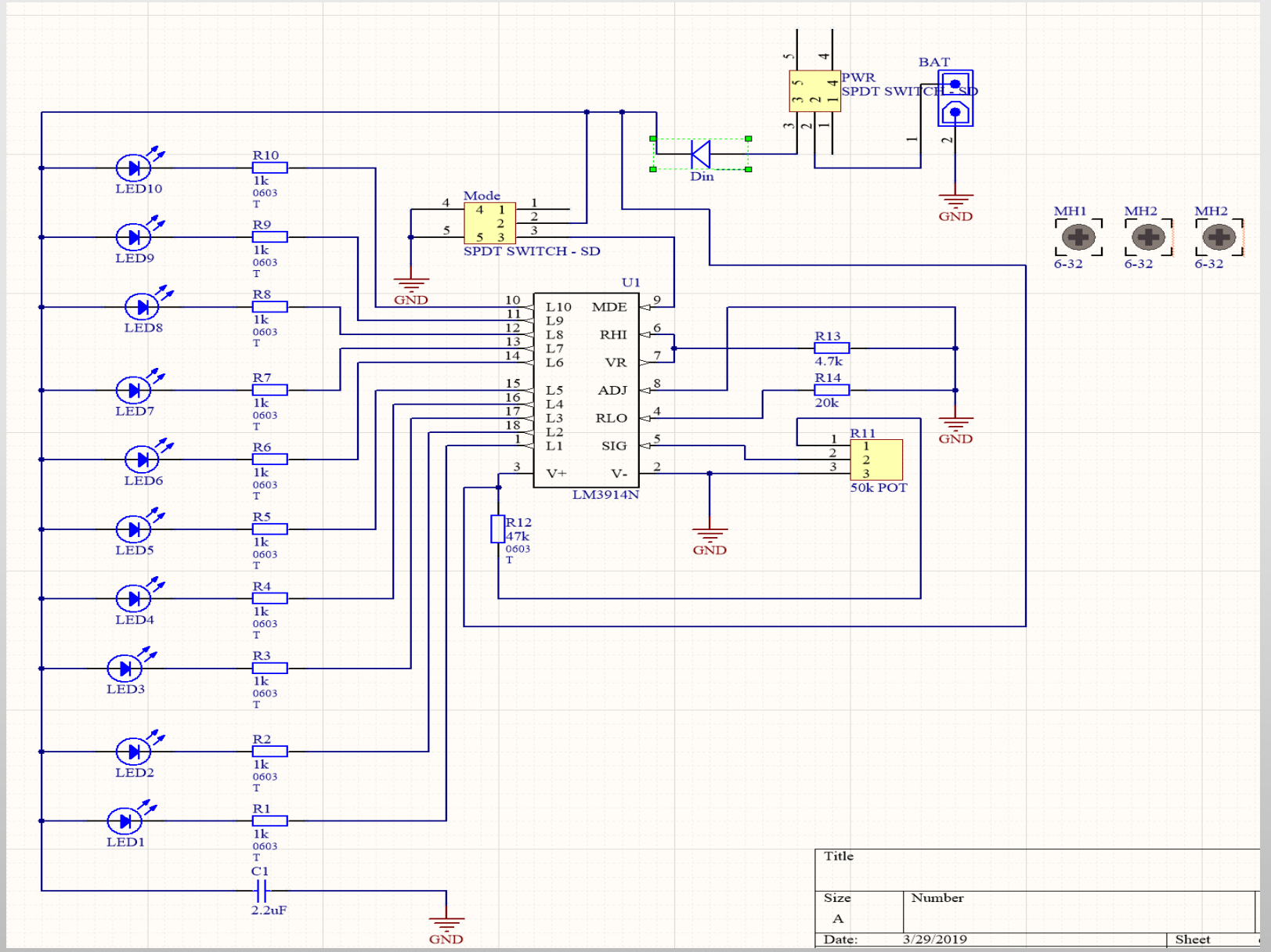
Charging Circuit Schematic



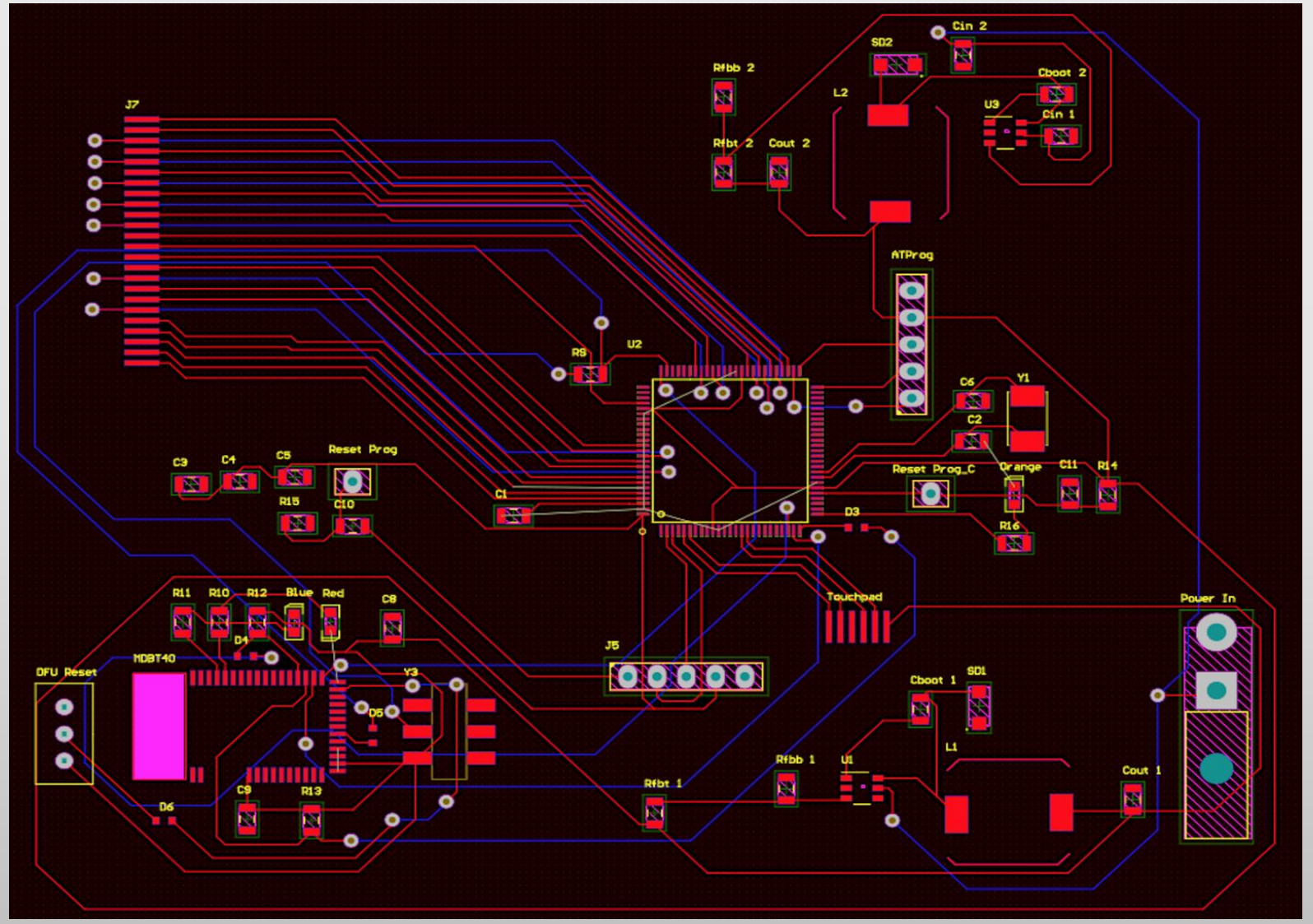
USB Charging Schematic



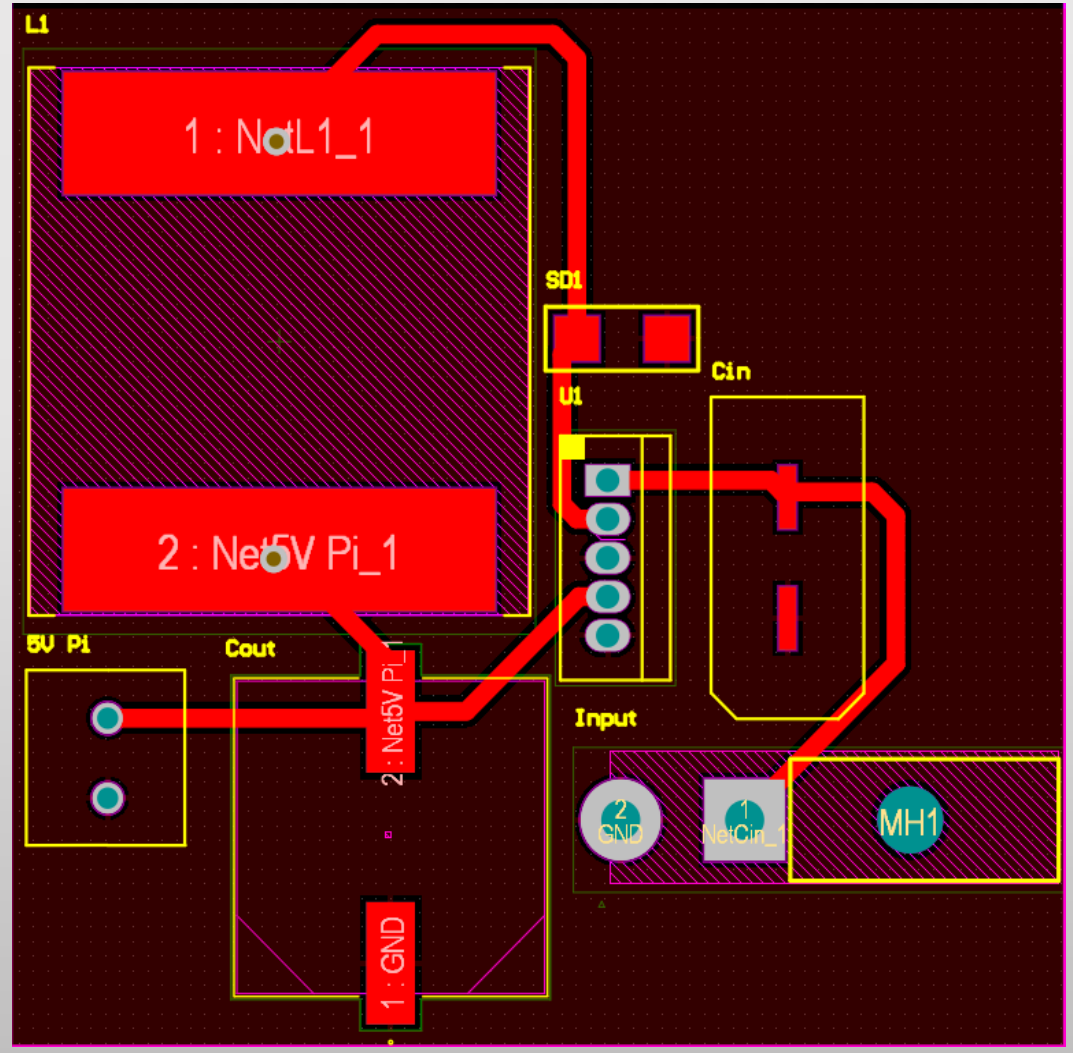
Battery Level Indicator Circuit



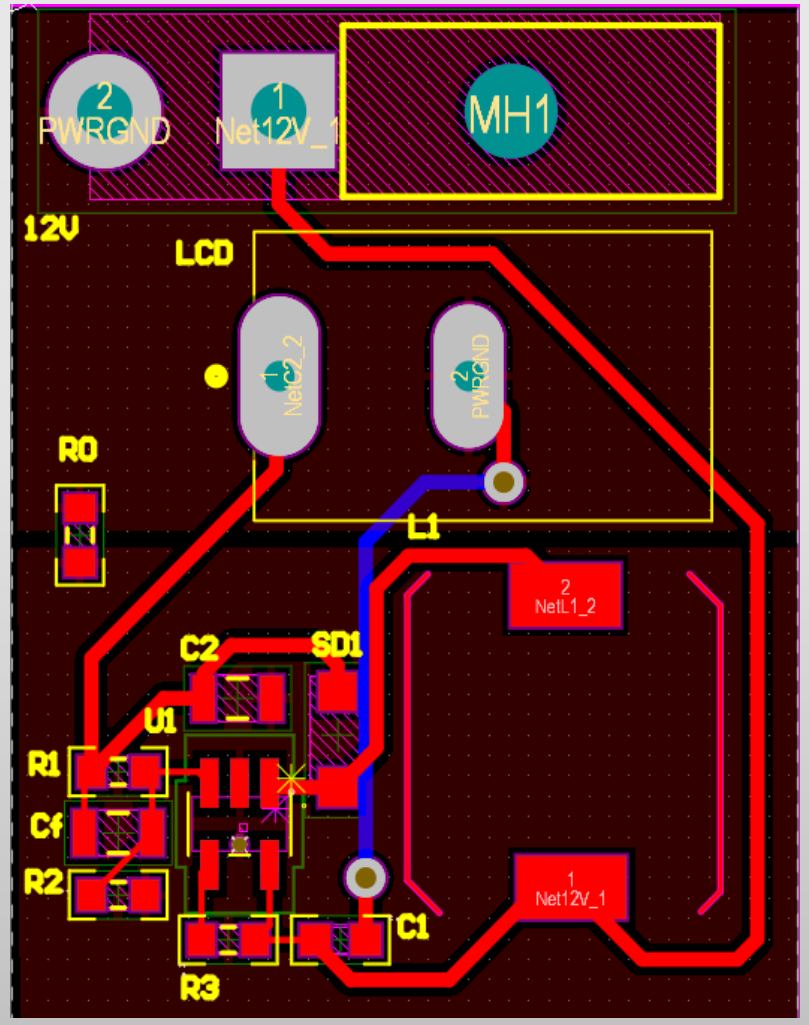
PCB Design (Initial)



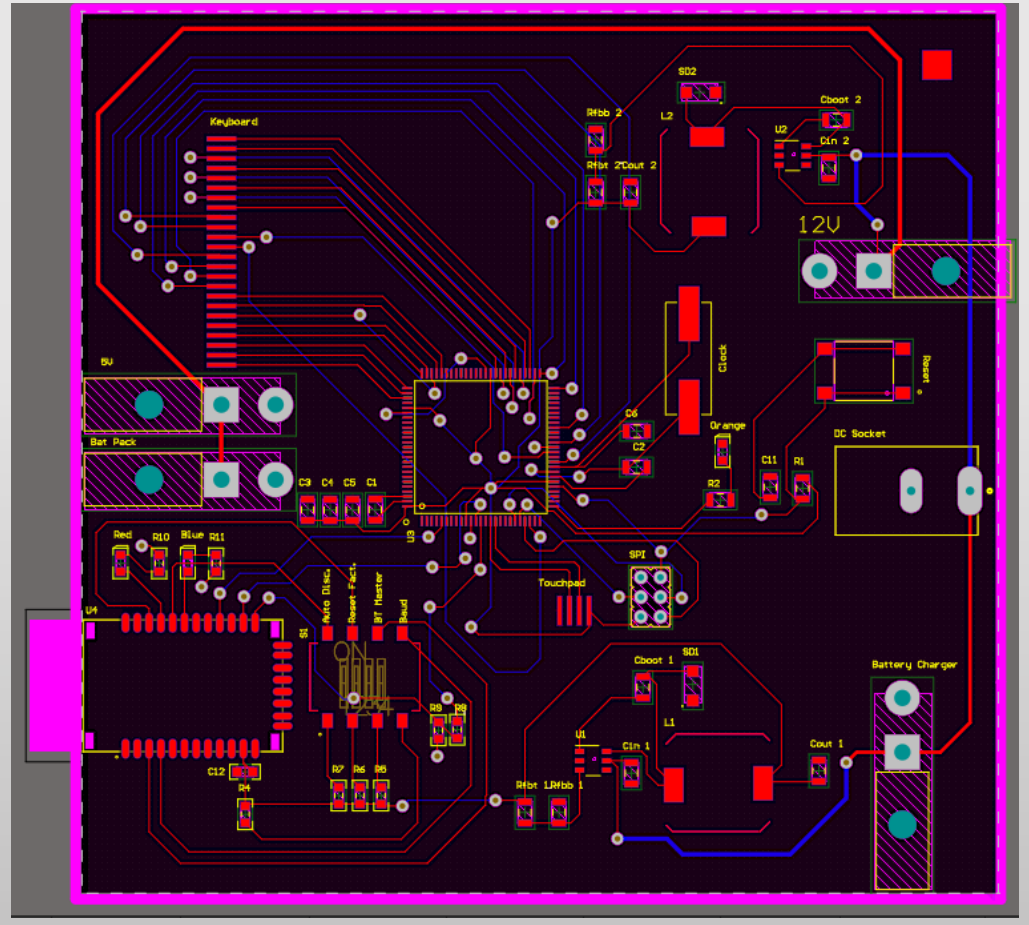
Final PCB 1 of 6
Raspberry Pi Regulator



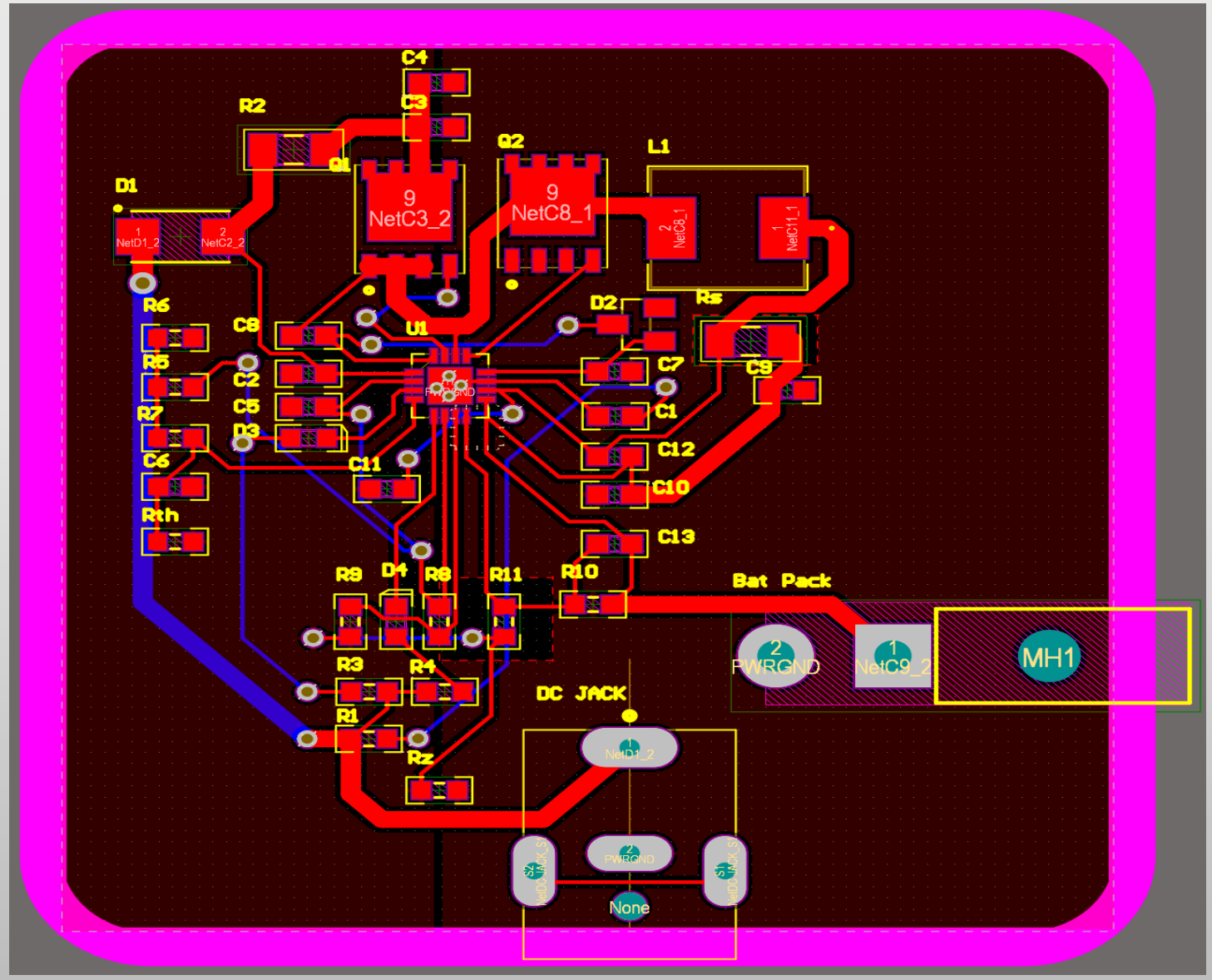
Final PCB 2 of 6
LCD Regulator



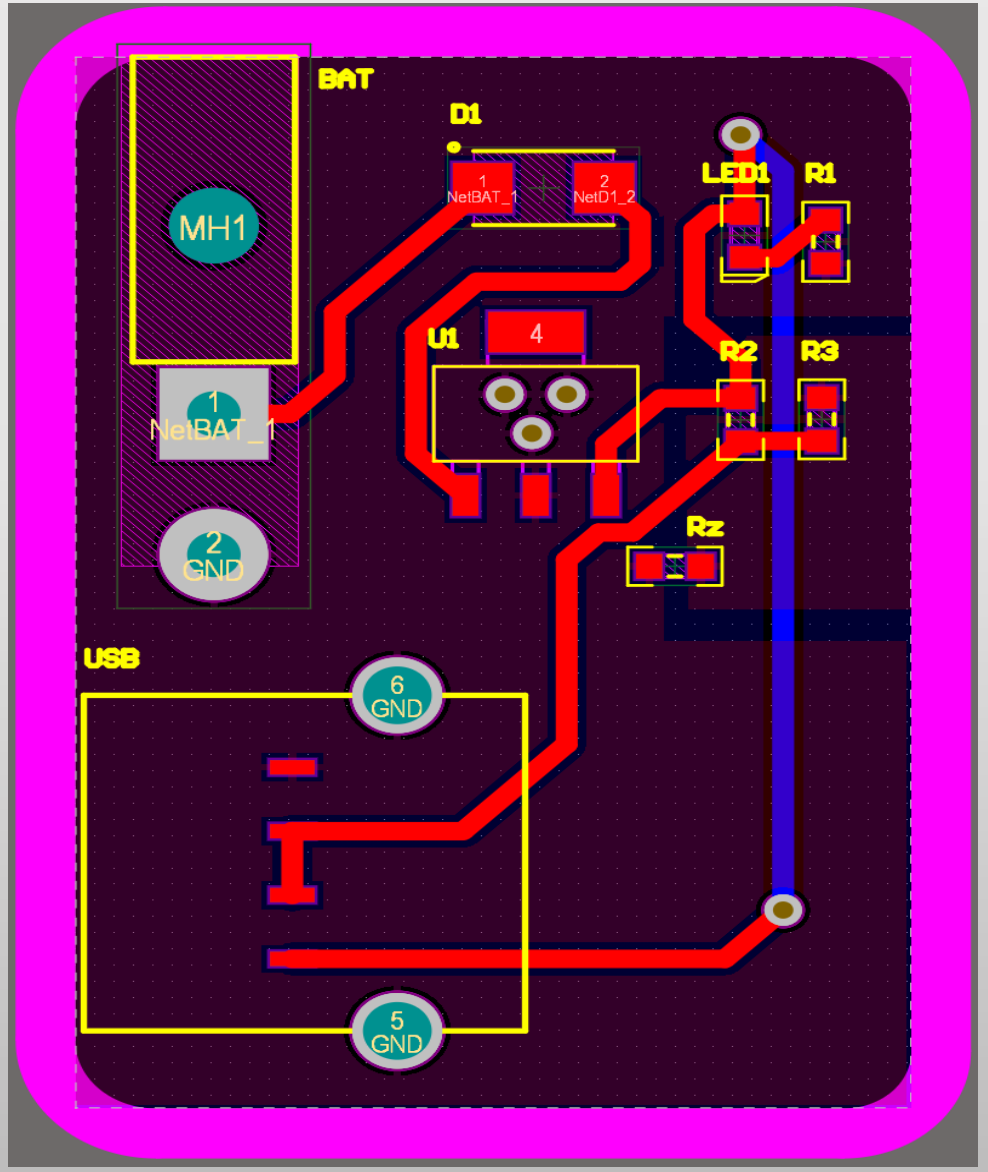
Final PCB 3 of 6
Main PCB



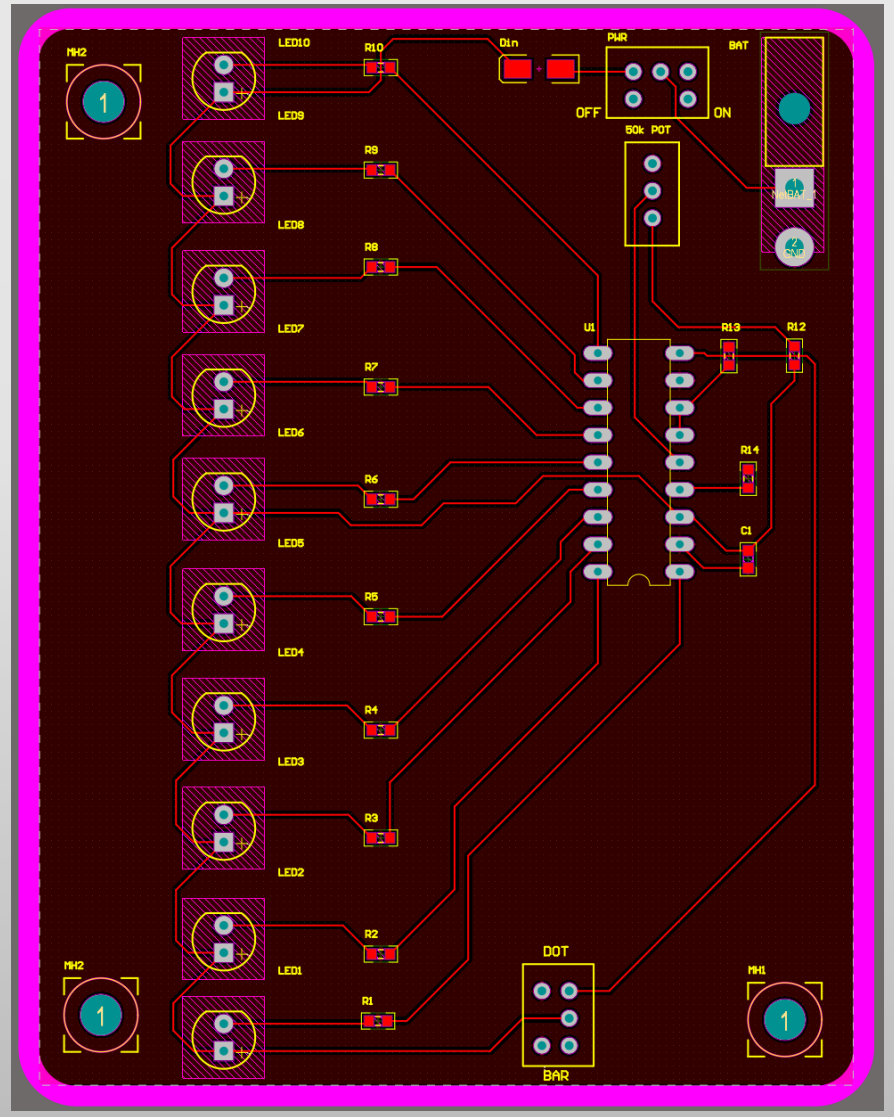
Final PCB 4 of 6
Charging Circuit



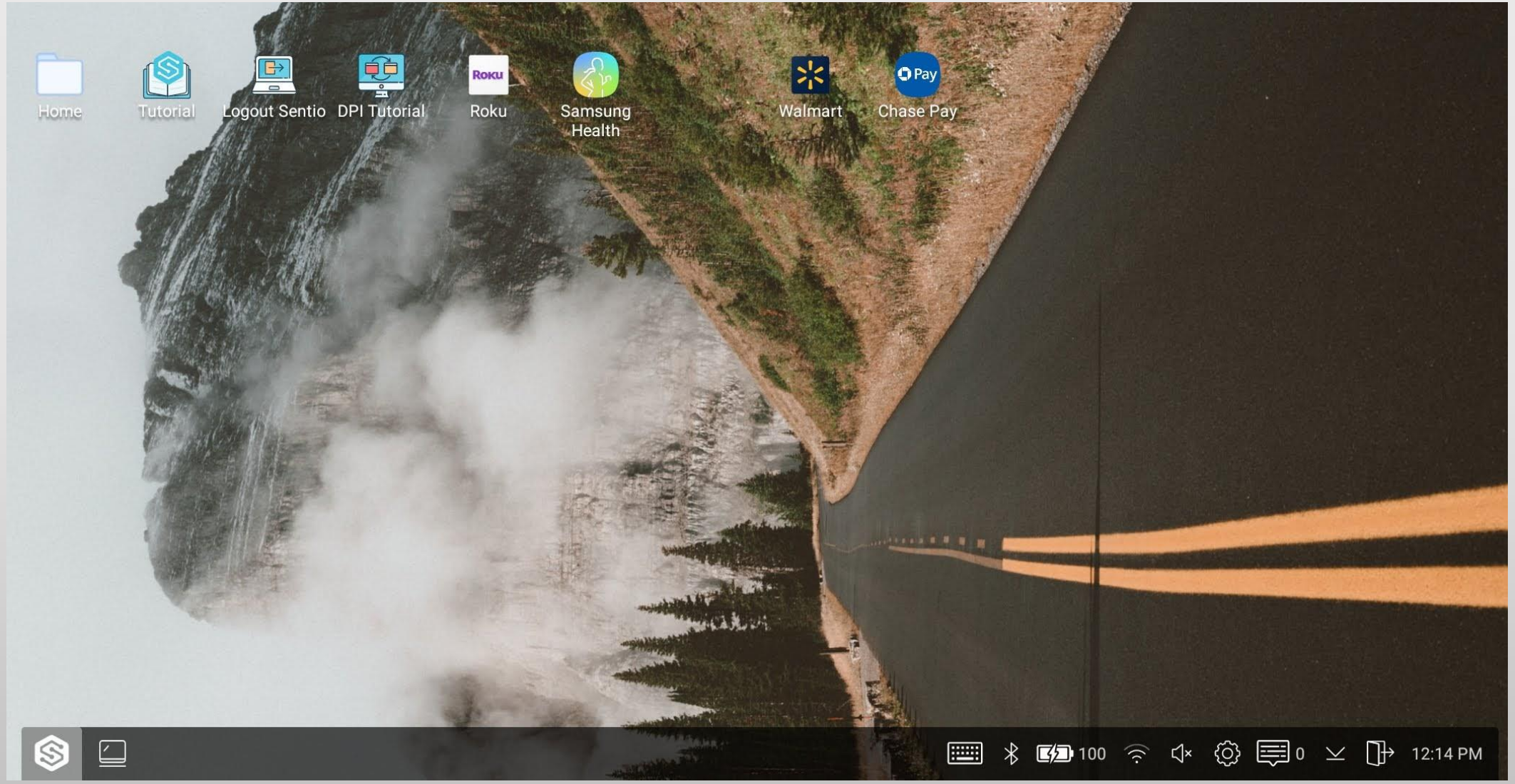
Final PCB 5 of 6
USB Phone Charging Circuit



Final PCB 6 of 6
Battery Level Indicator Circuit

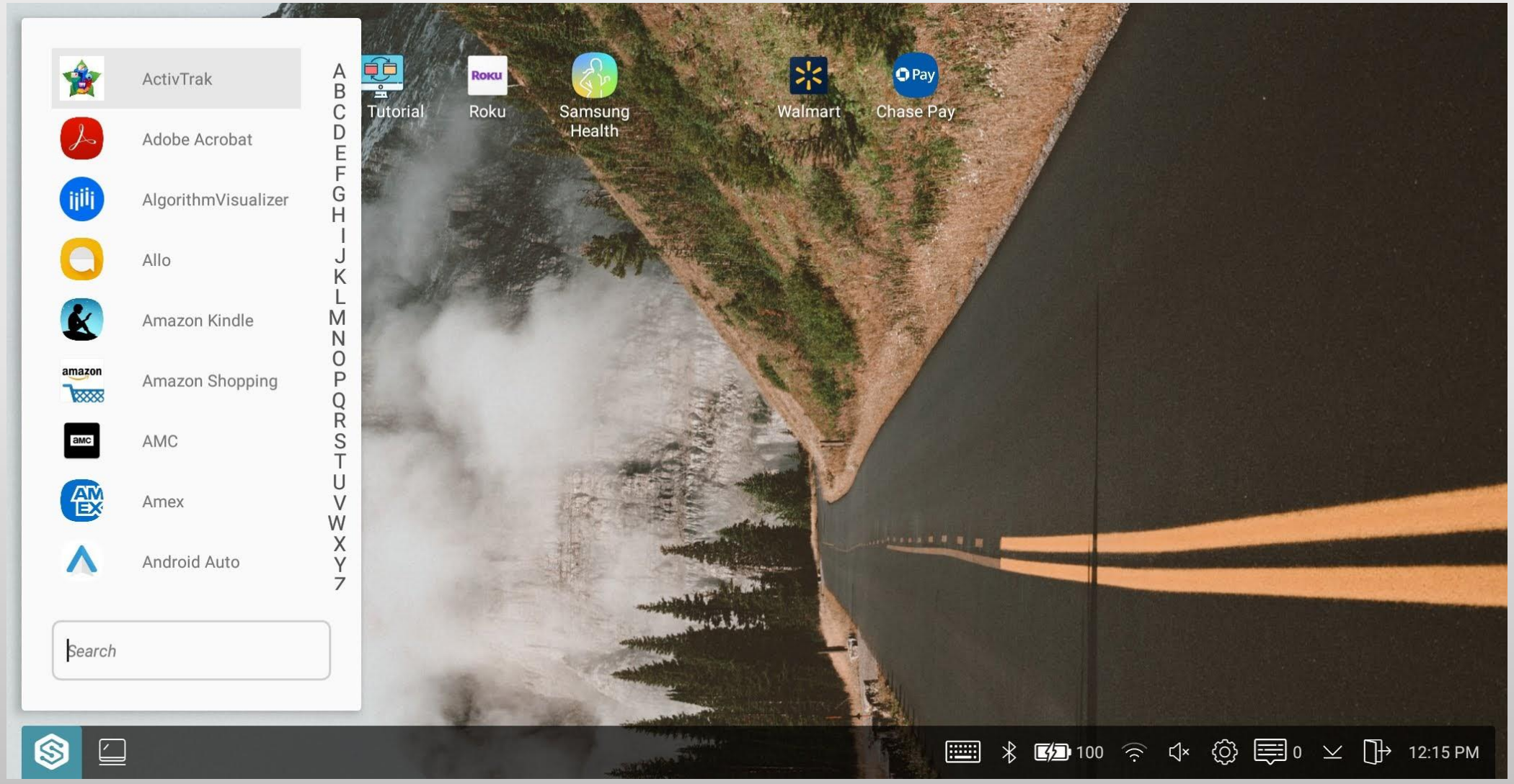


Android Application (Sentio Desktop)



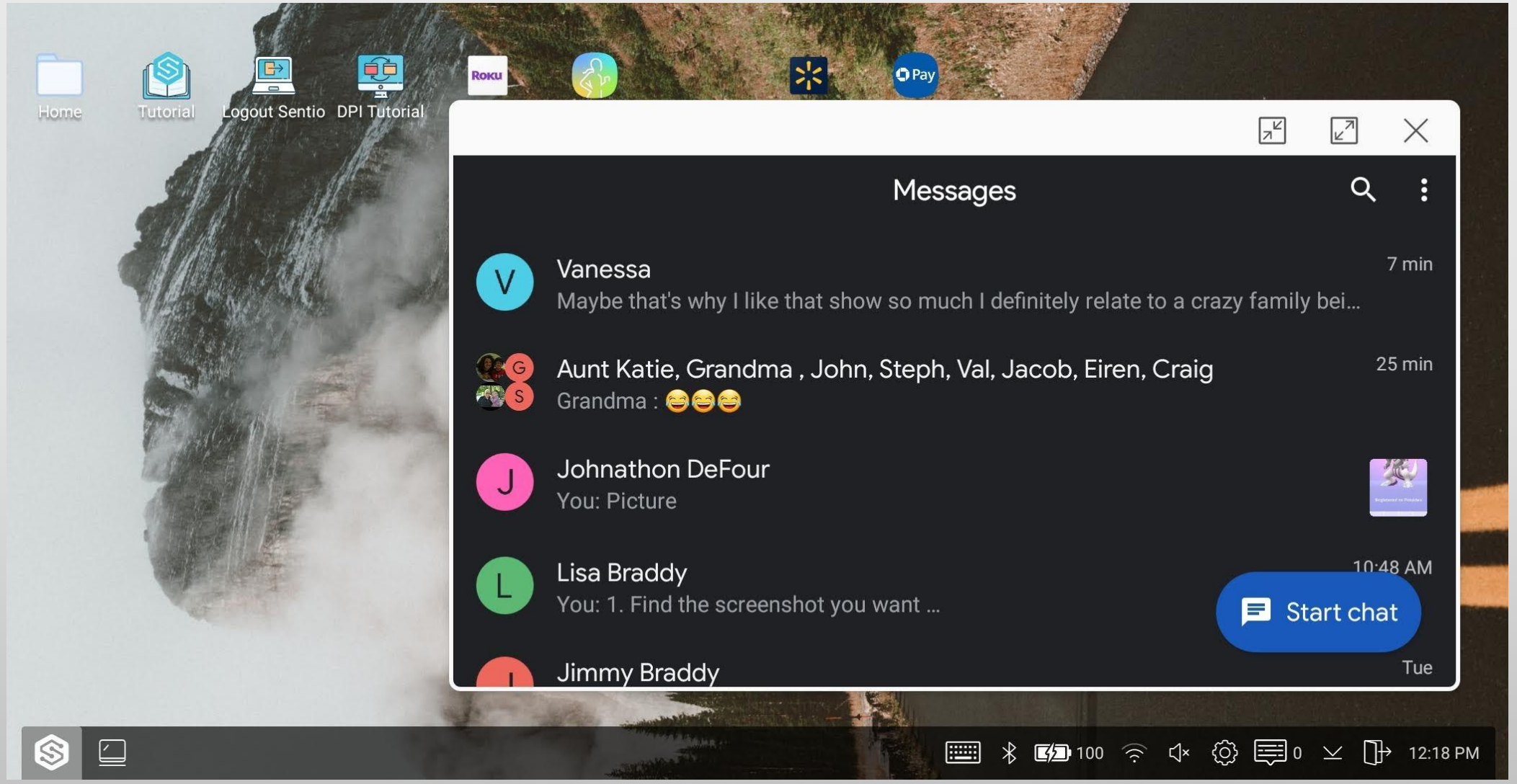
Main computer screen on android

Android Application Cont’d



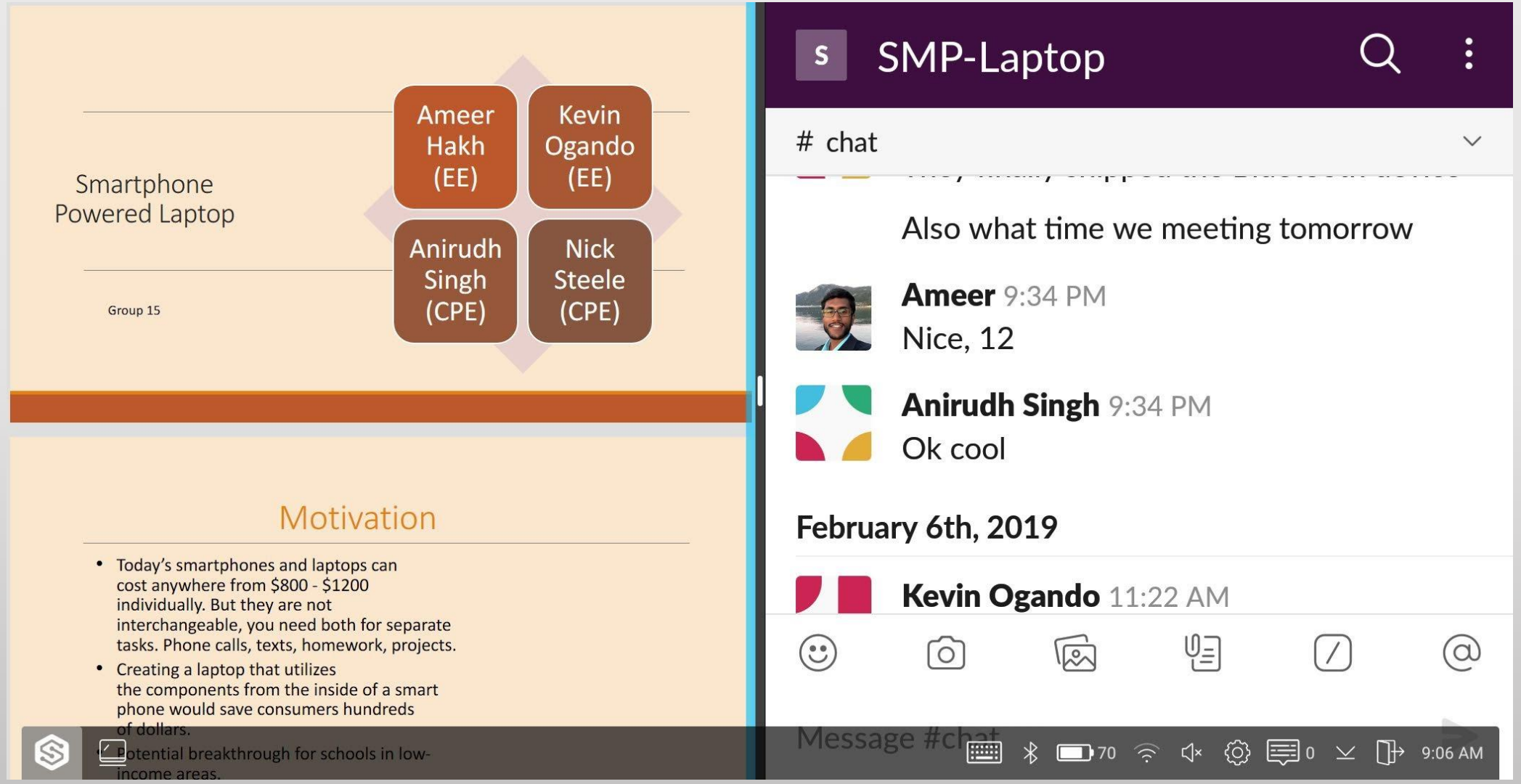
When windows button is hit

Android Application Cont’d



Stray window on screen with minimize, maximize, and close options

Android Application Cont'd



Two applications split side by side

Administrative Content

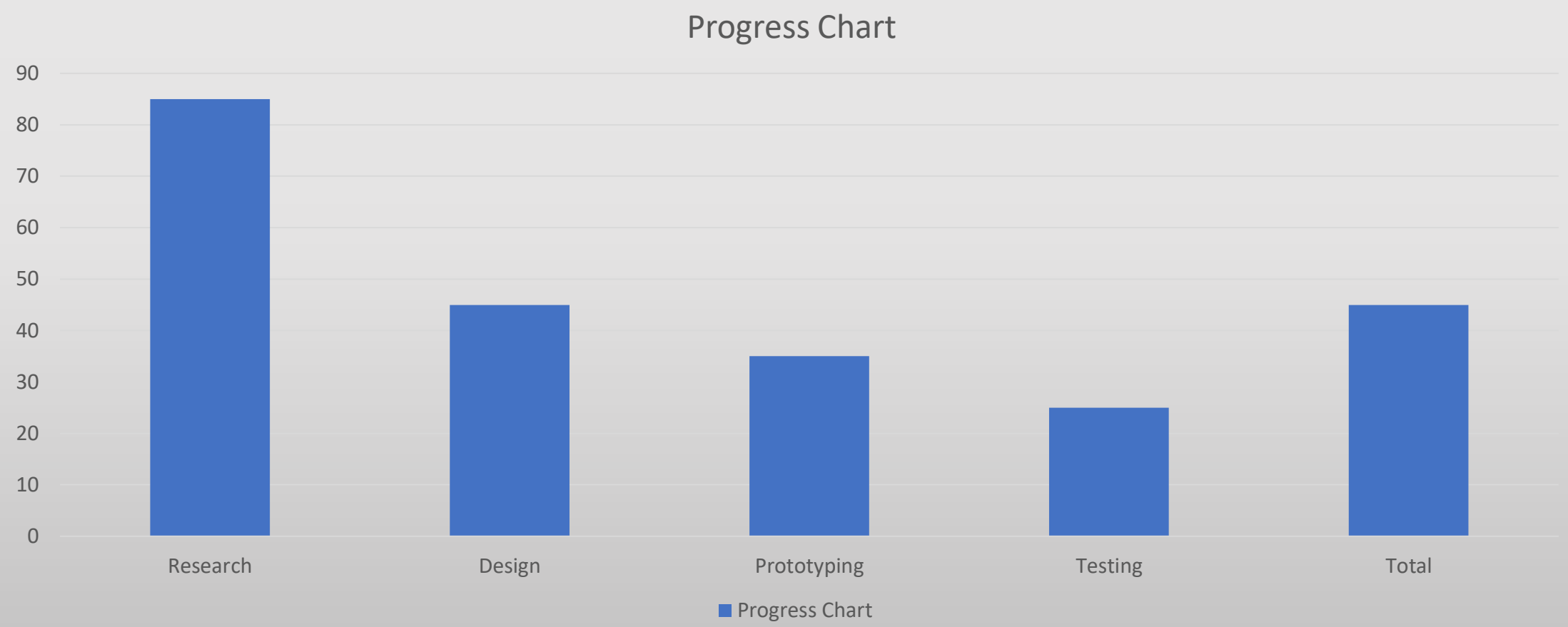
Work Distribution

	Power	PCB Design	Wi-Fi Direct	Bluetooth	Touchpad	Keyboard
Ameer	Secondary	Primary		Primary	Primary	Secondary
Kevin	Primary	Secondary			Secondary	
Anirudh			Primary			
Nick			Secondary	Secondary		Primary

Budget and Financing

.	Part Number	Unit Cost	Quantity	Total Cost
Processor	ATmega2560	$12.21	1	$12.21
	Rasperry Pi 3	$35.00	1	$35.00
	Atmega Breakout Board	$84.95	1	$84.95
BT Module	RN-42 HID	$14.38	1	$14.38
Battery	Bull-Tech 6-Cell Laptop Battery	$29.88	1	$29.88
	Charging IC - BQ24600	$4.15	2	$8.30
	Battery Management System 3s	$4.99	1	$4.99
USB	USB 2.0 Type A Port	$0.40	2	$0.80
	Voltage Regulator - LM7805CT	$0.78	1	$0.78
Touchpad	TM-00309-004	$10.00	1	$10.00
Keyboard Program Module	Teensy 3.2	$23.00	1	$23.00
Keyboard	N/A	$0.00	1	$0.00
LCD	LCD Inverter Board	INSERT HERE		#VALUE!
	LCD Screen	$0	1	$0.00
Connectors	24-Pin FPC 1mm	$4.99	1	$4.99
	24-Pin FPC Breakout Board	$5.11	1	$5.11
	6-Pin Female and Male Connector	$6.23	1	$6.23
Programmer	FTDI USB Serial Adapter	$17.19	1	$17.19
Design	PCB JLCPCB	$29.43	1	$29.43
	PCB JLCPCB - Charging	$11.41	1	$11.41
Voltage Regulator	LMR14010A	$2.59	2	$5.18
Tools	Breadboard and Wires	$9.00	1	$9.00
				$327.92

Project Progress



Design Issues

- ATMEGA 2560 was not powerful enough to stream a decent frame rate at the required resolution.
- Solution was to additionally use the BCM2387 to wirelessly stream our display via MiraCast and keep the ATMEGA 2560 for all our Bluetooth connectivity.
- Dead ground plane spots
- Charging circuit - Hard to find a circuit that matched 3.2V 3s3p

Questions?