Motivational Mp3 player

Group #7

Adam Browning

Neil Jacildo

Brian Wirth

Introduction

Create an MP3 Player which:

- Helps monitor workout progress
- Customizes the workout experience
- Provides user with information of their heart rate
- Interactively play with music

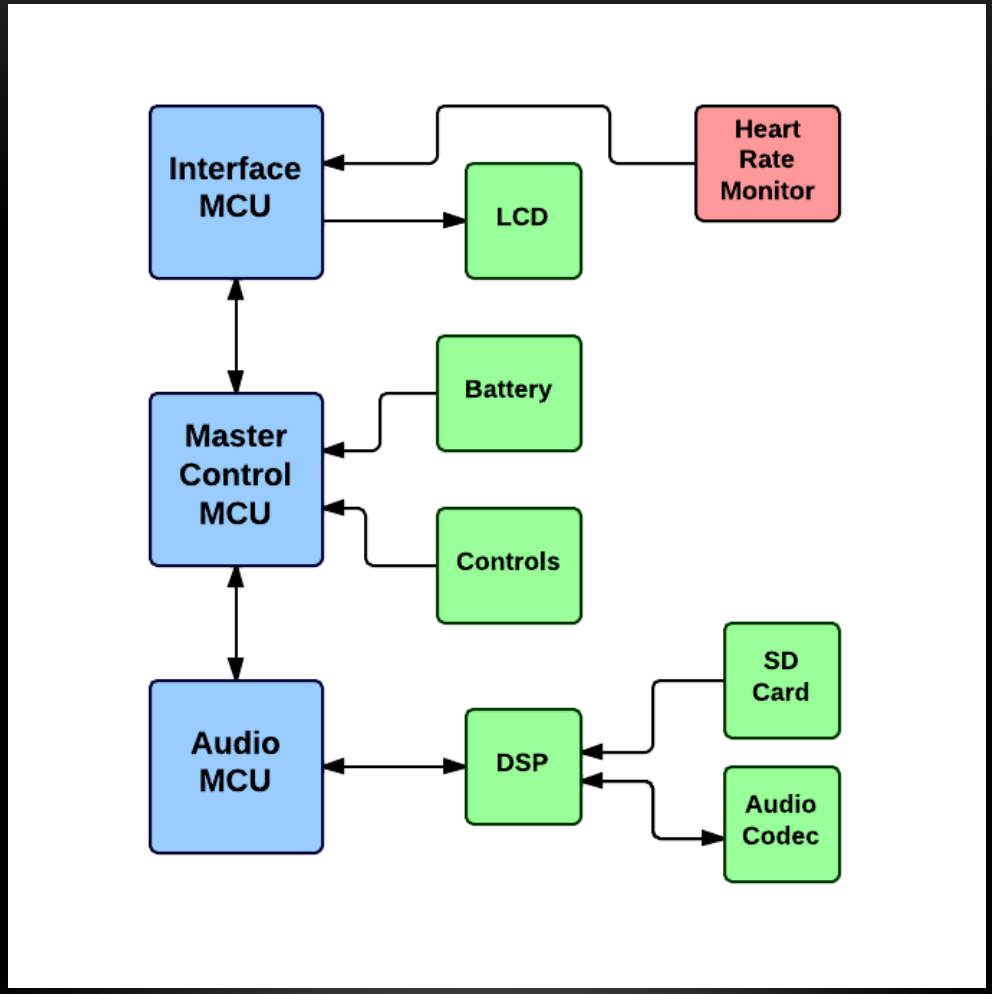
SPECIFICATIONS

Battery Life	6 Hours
Dimensions	5.5 in x 2.75 in x 0.7 inc
Weight	5 oz
Flash Memory Size	16 GB
Supported Digital Audio Standards	MP3, WMA, WAV
ID3 Tag Support	Yes
Headphones	Wired
Sound Output Mode	Stereo
Connectivity	Wired
System Display	LCD
Display Diagonal Size	2.5 in.

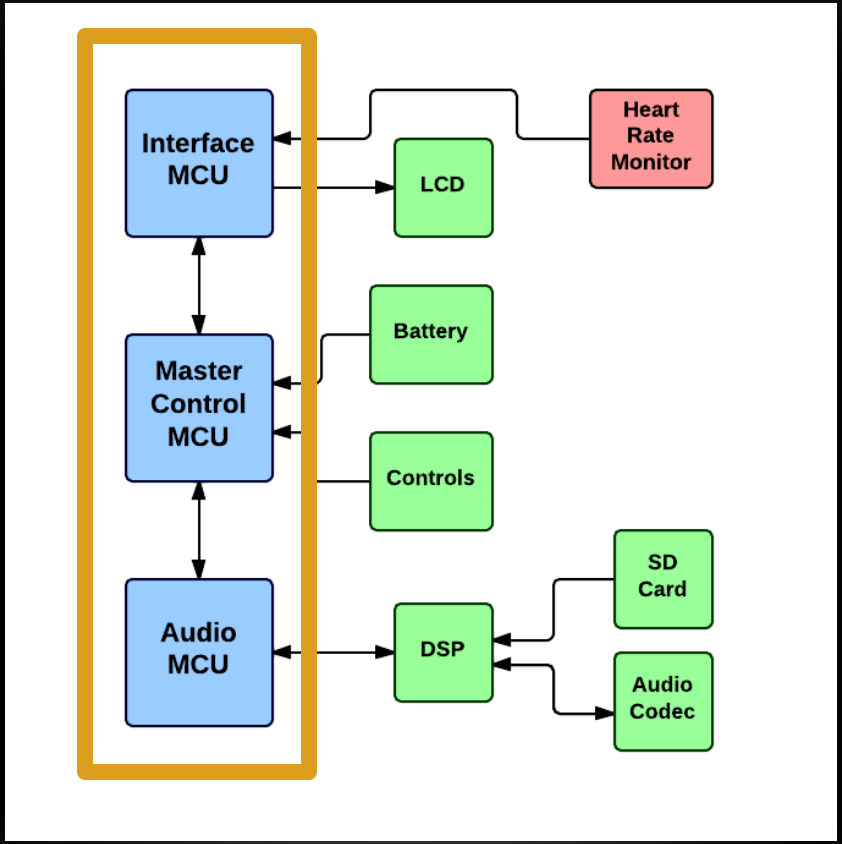
REQUIREMENTS

- Audio Playback
- Mode Select
  - Dynamic Tempo-Change
  - Anaerobic Exercising
  - Basic Playback
- EKG
- User Interface

Overview


Interface MCU
LCD
Heart Rate Monitor
Battery
Master Control MCU
Controls
SD Card
Audio MCU
DSP
Audio Codec

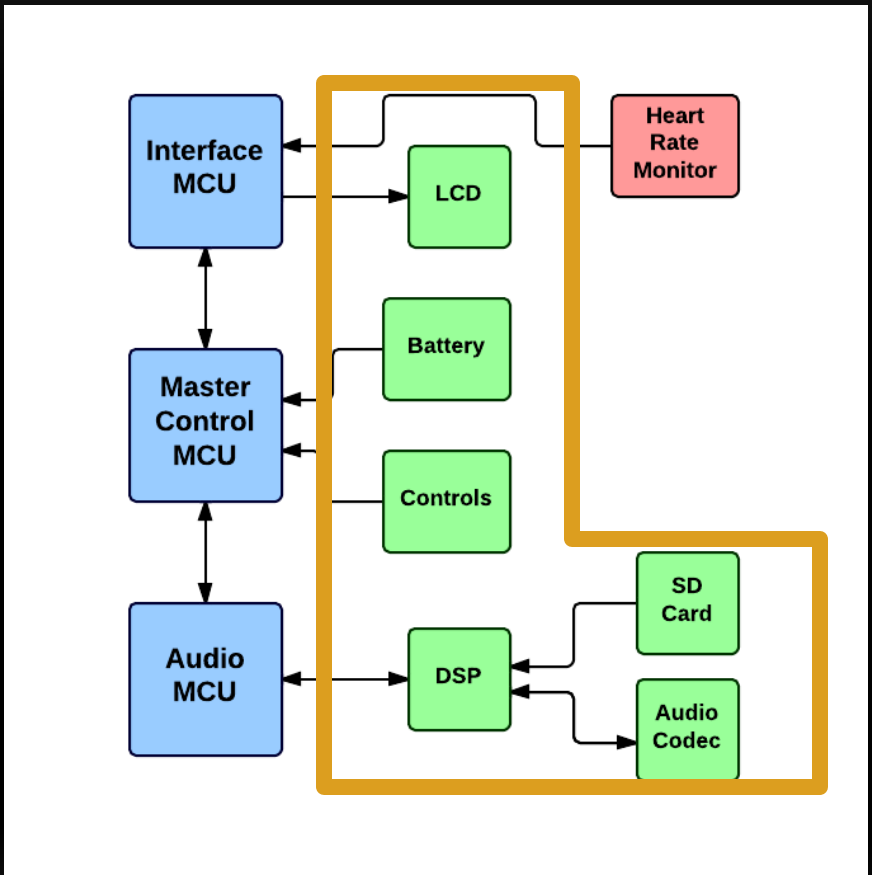
MICROCONTROLLER



MICROCONTROLLER

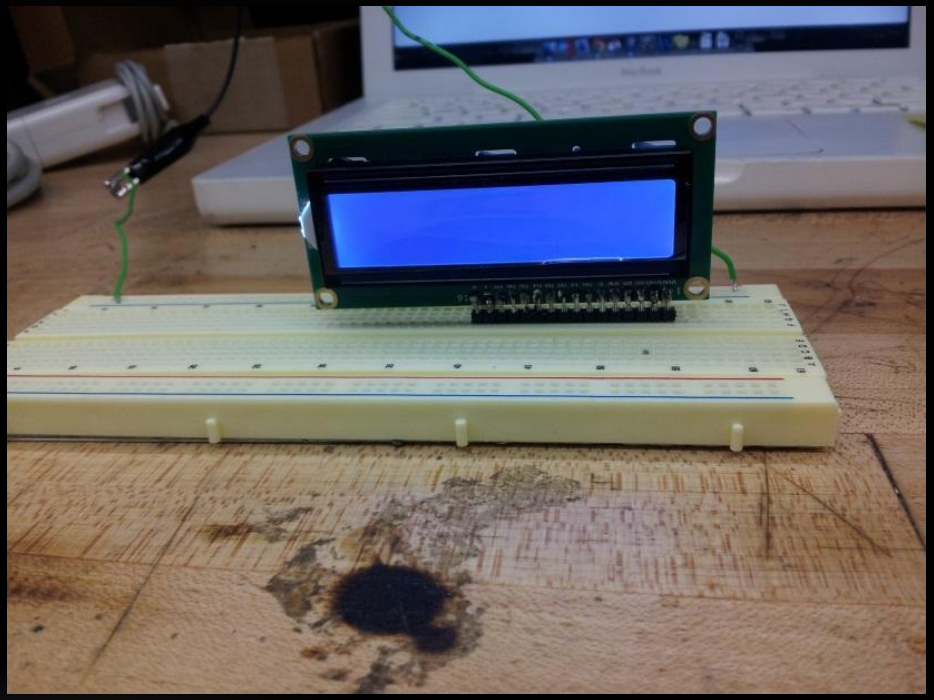
	MSP430G2553	MSP430G2452	PIC18LF2550
Frequency	16MHz	16MHz	48MHz
Flash Memory	16KB	8KB	32KB
SRAM	0.5kB	0.25kB	2kB
GPIO	24	16	24
Comm Interface	USCI: SPI & I2C	USI: SPI & I2C	SPI & I2C
ADC	10bit / 8 channels	10bit / 8 channels	10 bit / 10 channels
Voltage	1.8 - 3.6V	1.8 - 3.6V	2 - 5.5V
Pricing	$2.43	$2.43	$5.38

Peripherals



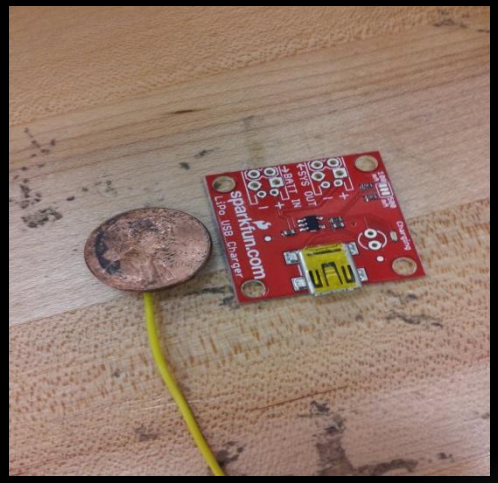
DISPLAY

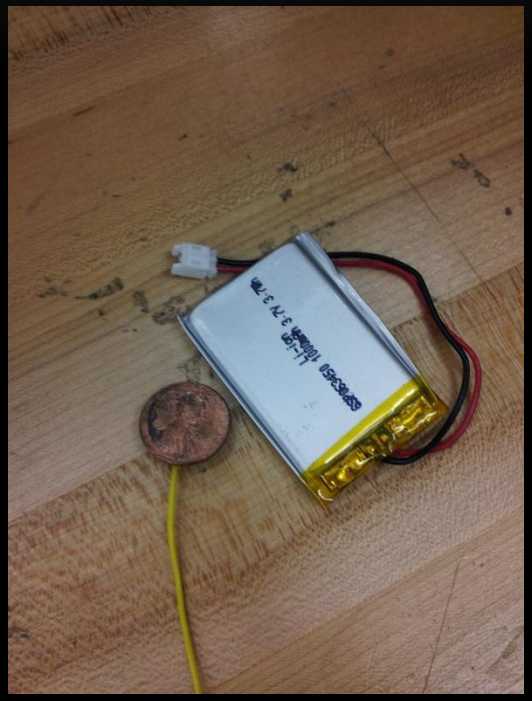
- Liquid Crystal
- 16 x 2 Characters
- 3.3v
- Parallel Interface



Power Supply

- Lithium Polymer USB Charger and Battery
- 3.7V Cell
- 850mAh LiPo Battery
- Highest Energy Density In Production



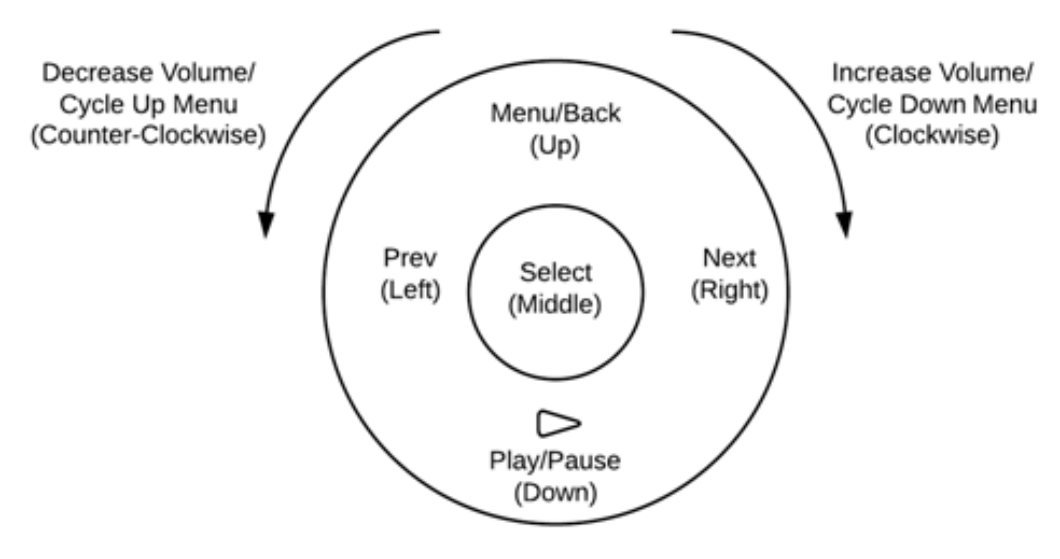


CONTROLS

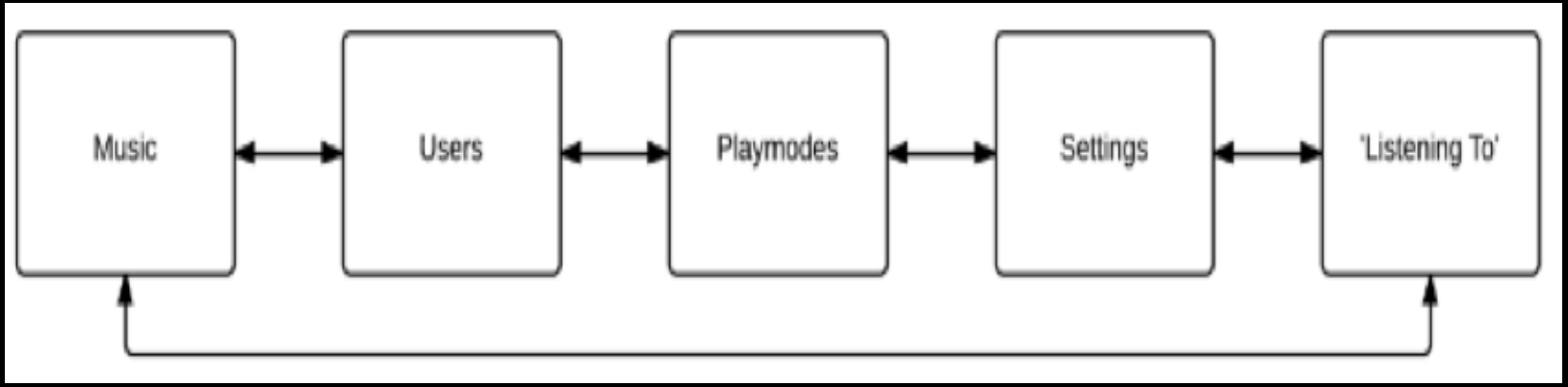
MSP430 Capacitive Touch Boosterpack

- Low powered control system
- Natural feel
- Tons of included libraries

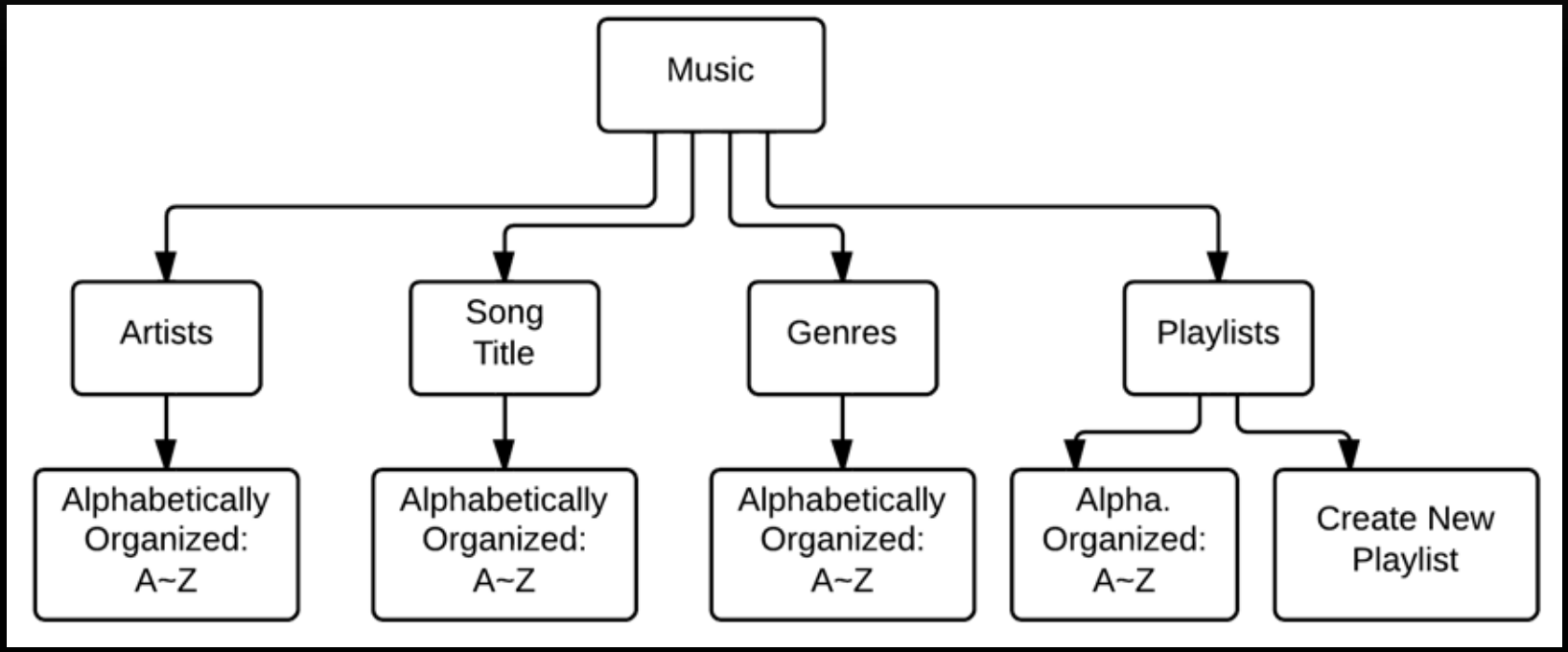
CONTROLS


Decrease Volume/
Cycle Up Menu
(Counter-Clockwise)
Increase Volume/
Cycle Down Menu
(Clockwise)
Menu/Back
(Up)
Prev
(Left)
Select
(Middle)
Next
(Right)
Play/Pause
(Down)

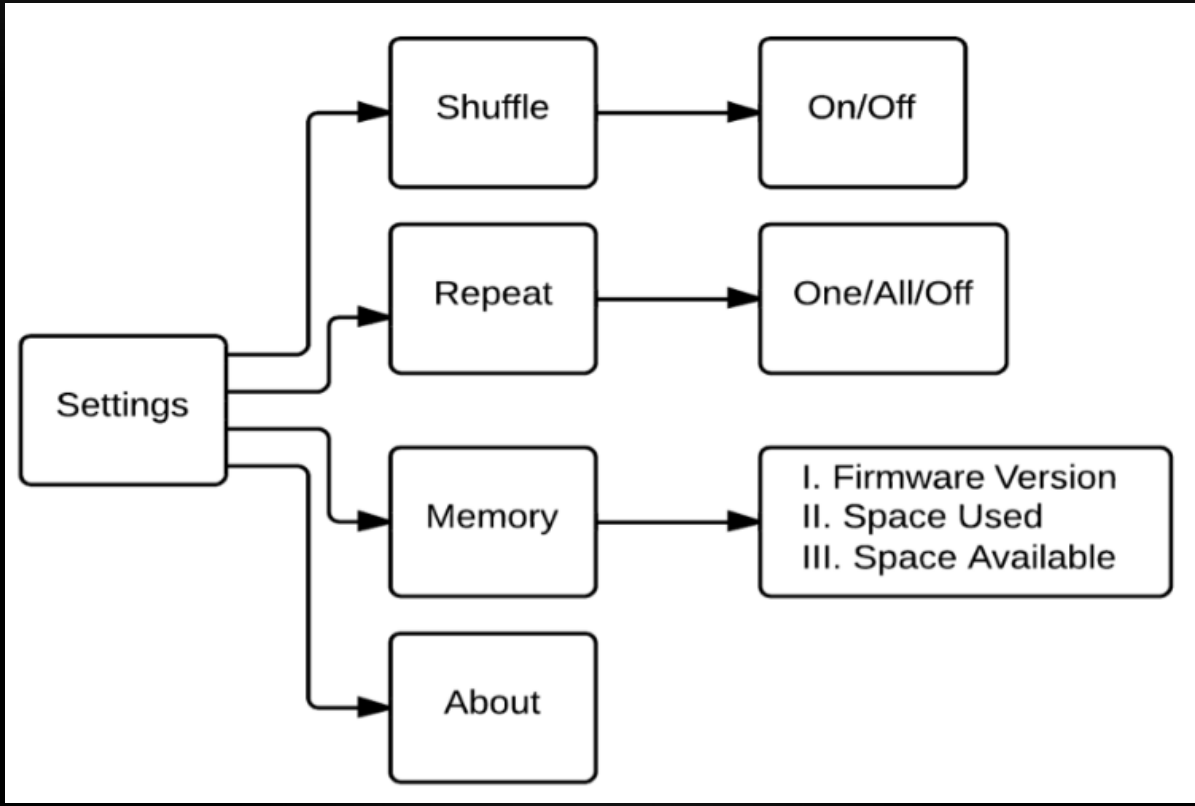
Menu overview



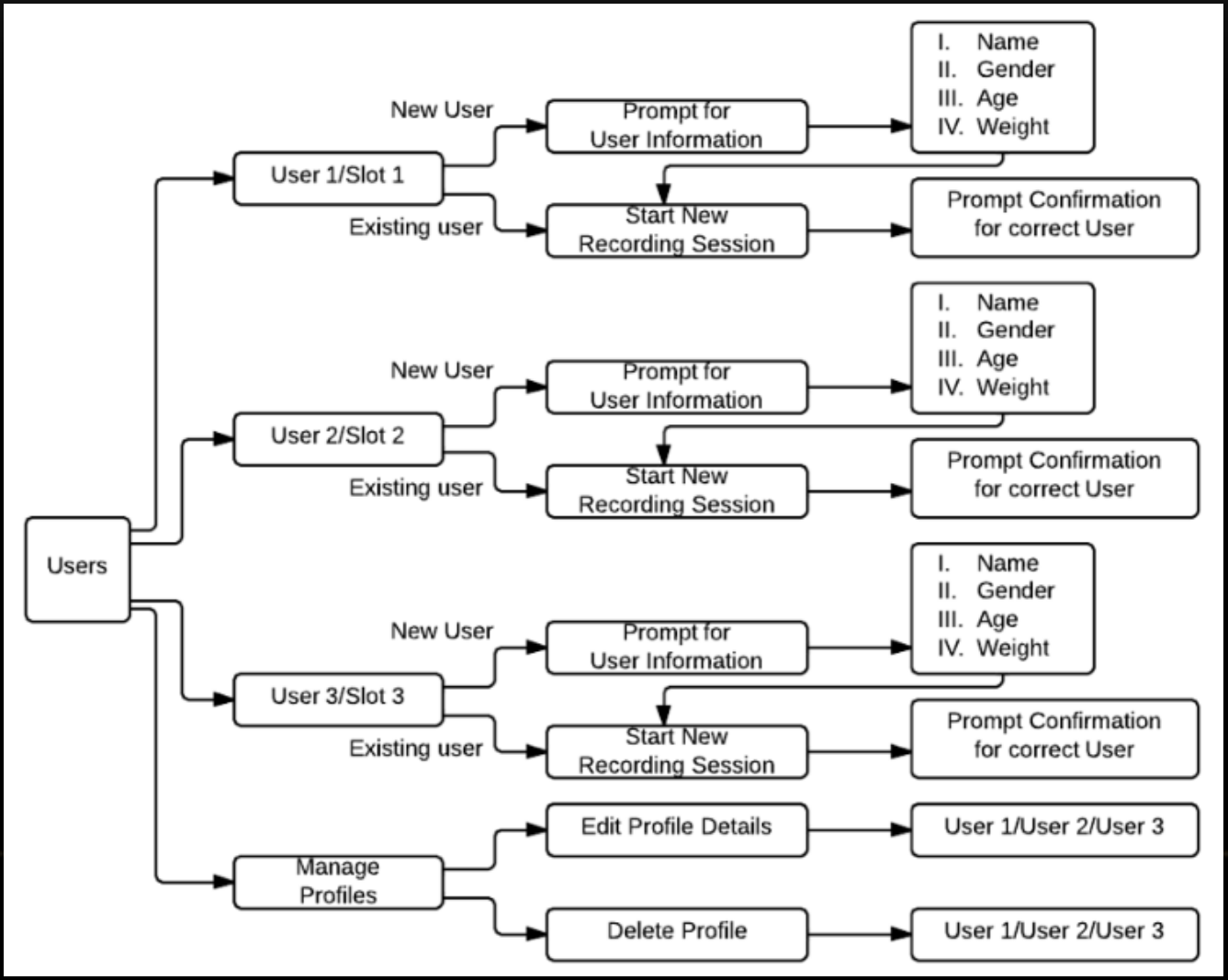
Menu


Music
Artists
Song Title
Genres
Playlists
Alphabetically Organized: A~Z
Alphabetically Organized: A~Z
Alphabetically Organized: A~Z
Alpha. Organized: A~Z
Create New Playlist

Menu

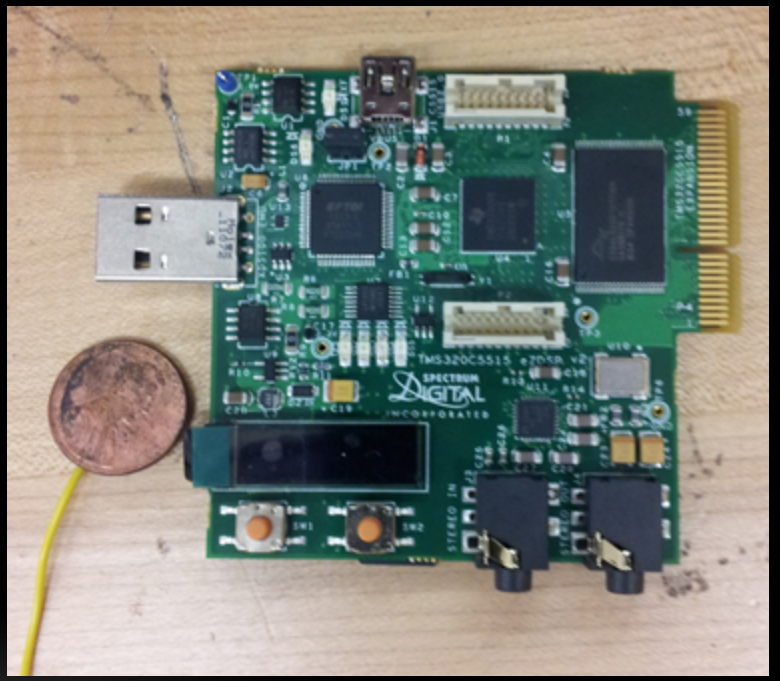

Settings
Shuffle
On/Off
Repeat
One/All/Off
Memory
I. Firmware Version
II. Space Used
III. Space Available
About

MENU


Users
User 1/Slot 1
User 2/Slot 2
User 3/Slot 3
Manage Profiles
New User
Existing user
Prompt for User Information
Start New Recording Session
I. Name
II. Gender
III. Age
IV. Weight
Prompt Confirmation for correct User
Edit Profile Details
Delete Profile
User 1/User 2/User 3

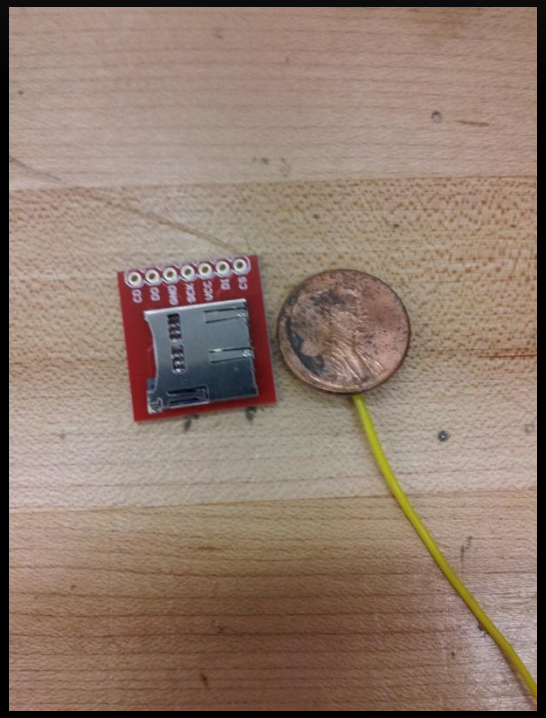
DSP

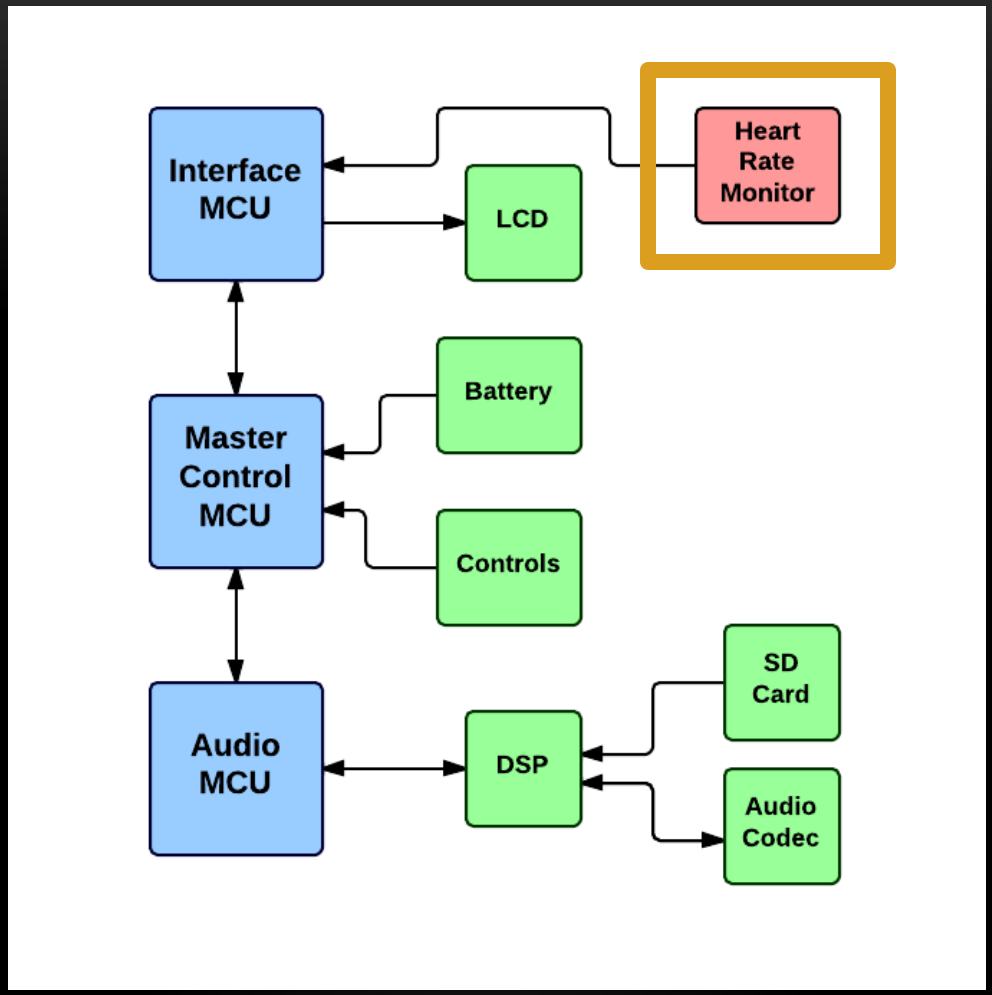
- Low Power System



SD - Memory

- Various Sizes of Data Storage Available
  - E.g. 2GB to 32GB
- SD Protocol Compatible
- Supports SPI Mode
- Up to 50 MB/sec Data Transfer Rate
- 2.7V to 3.6V Supply Voltage
- 250mS Power-Up Time
- 10uA Output Leakage Current




Interface MCU
LCD
Heart Rate Monitor
Battery
Master Control MCU
Controls
Audio MCU
DSP
SD Card
Audio Codec

ELECTROCARDIOGRAPH

EKG/ECG

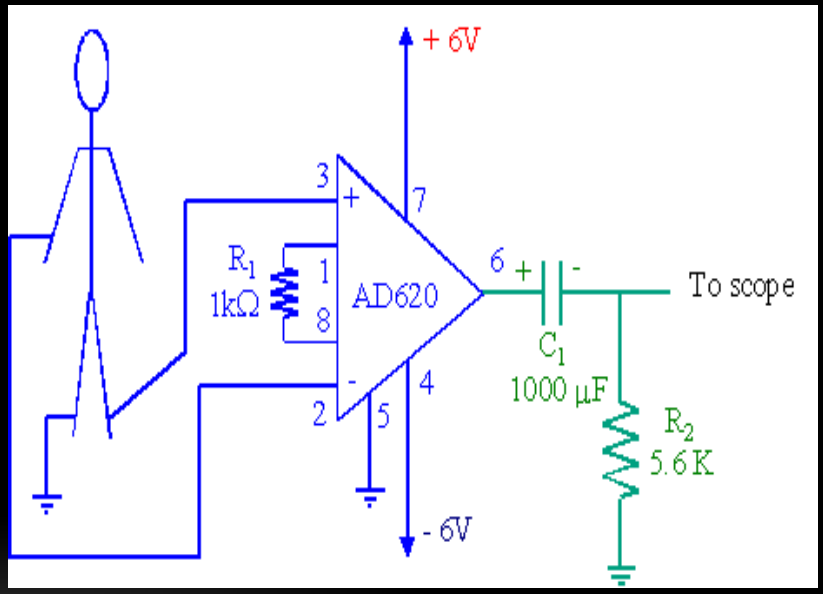
- Medical Device
- Measures Potential Difference
- Amplifies/Filters
- Average person is around 10mV

"A test of a patient's heartbeat that involves placing leads, or detectors, on the patient's chest to record electrical impulses in the heart. This test will produce a strip, or picture record of the heart's electrical functioning."

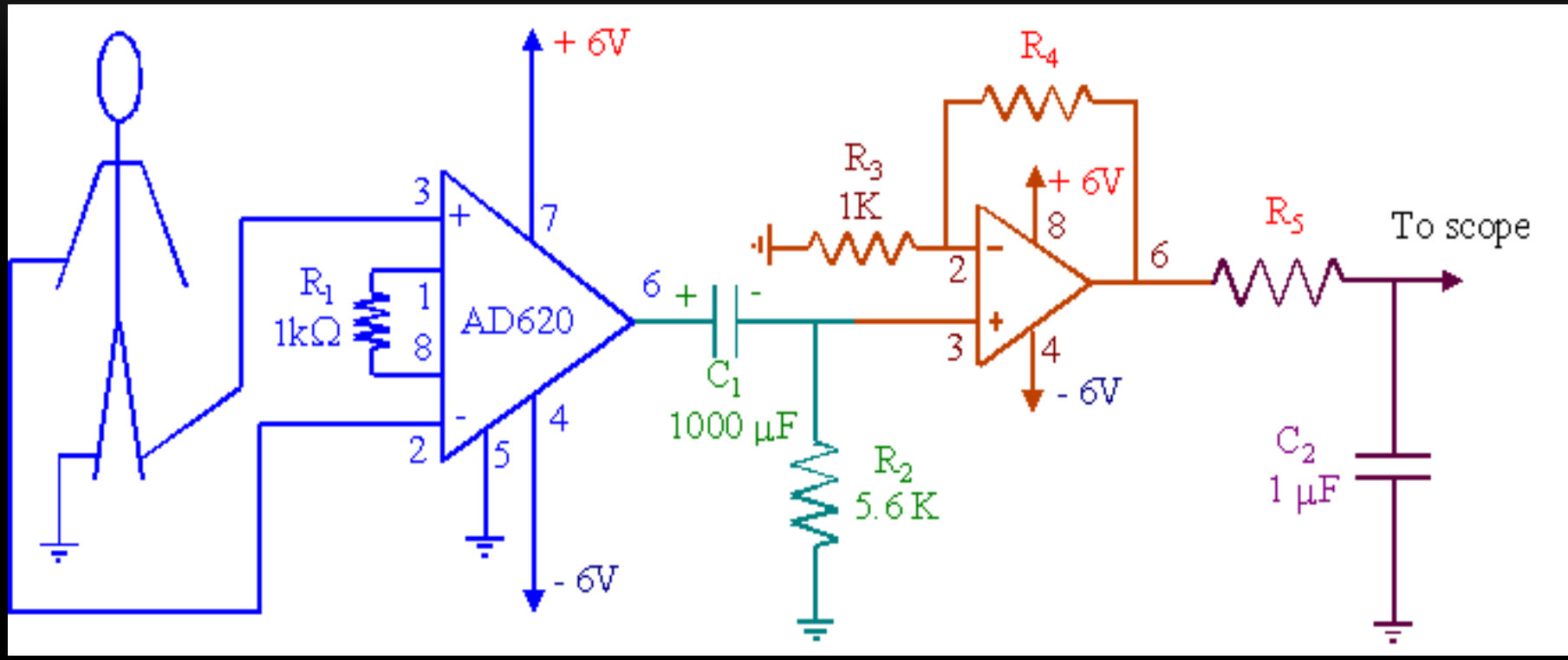
EKG

Criteria

- Small Compact Circuit
- Reliable
- Low-Power
- Robust

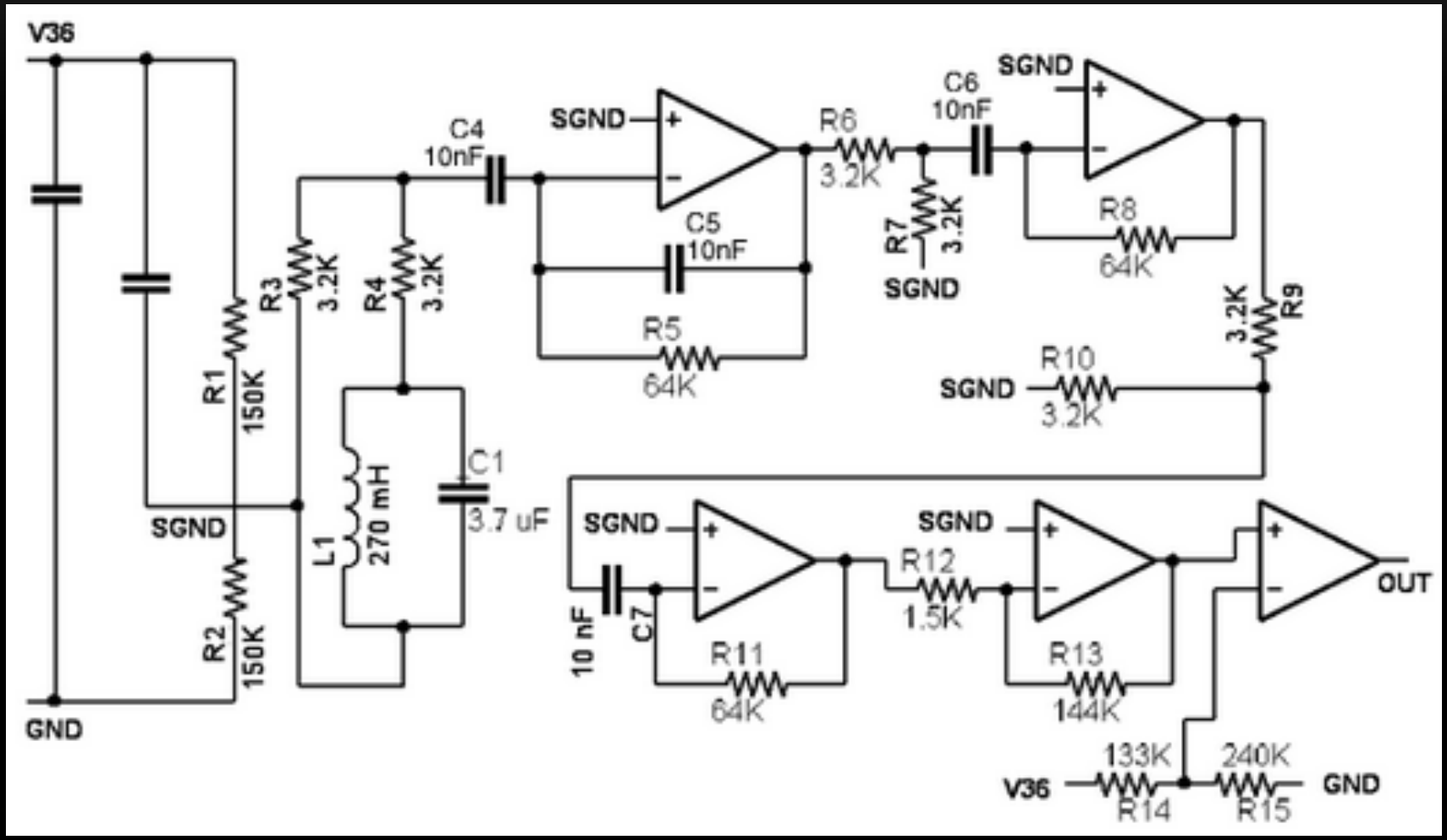


EKG

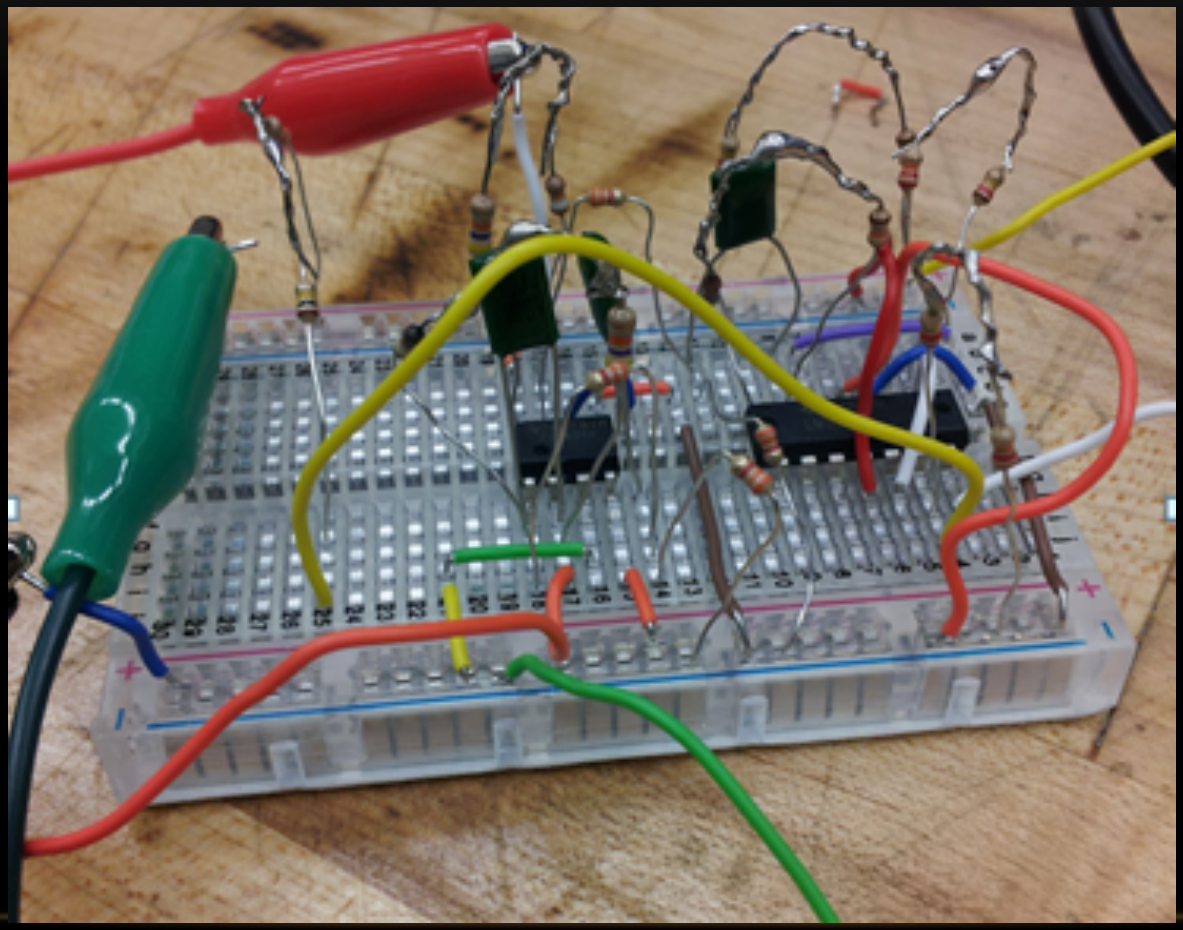


- Filters 60 Hz Power Line Noise
- Custom Amplification

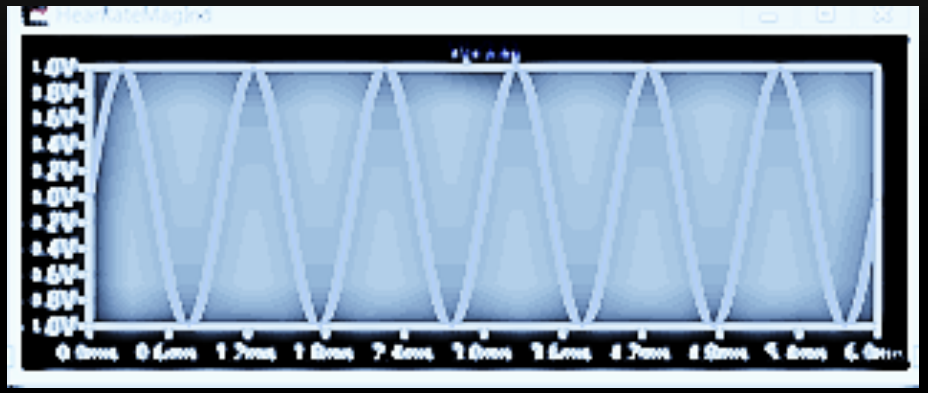
EKG


V36
GND
R1
150K
R2
150K
SGND
R3
3.2K
R4
3.2K
L1
270 mH
C1
3.7 uF
C4
10nF
SGND
C5
10nF
R5
64K
R6
3.2K
R7
3.2K
SGND
C6
10nF
SGND
R8
64K
3.2K
R9
R10
SGND
3.2K
SGND
10 nF
C7
R11
64K
SGND
R12
1.5K
R13
144K
OUT
V36
133K
R14
240K
R15
GND

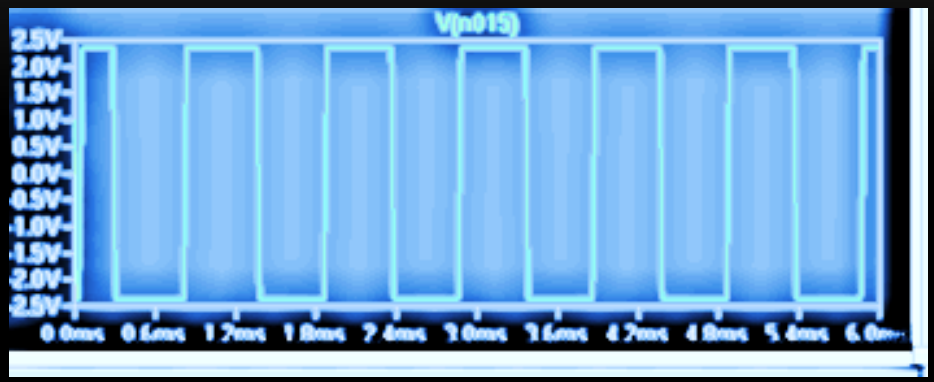
EKG



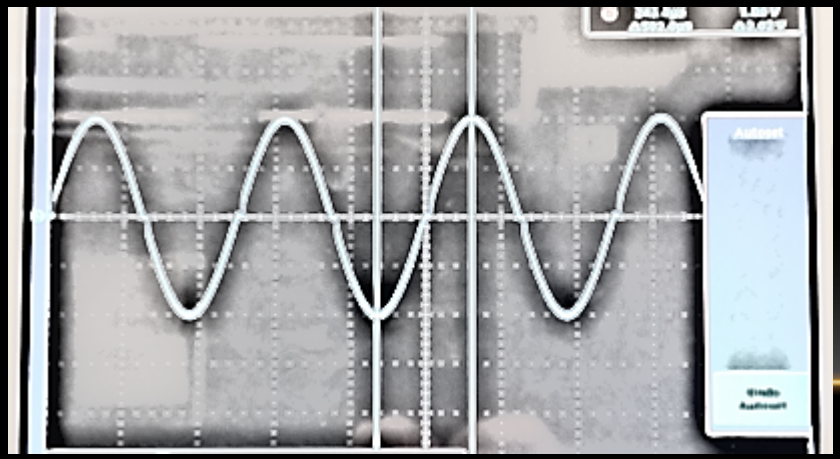
EKG



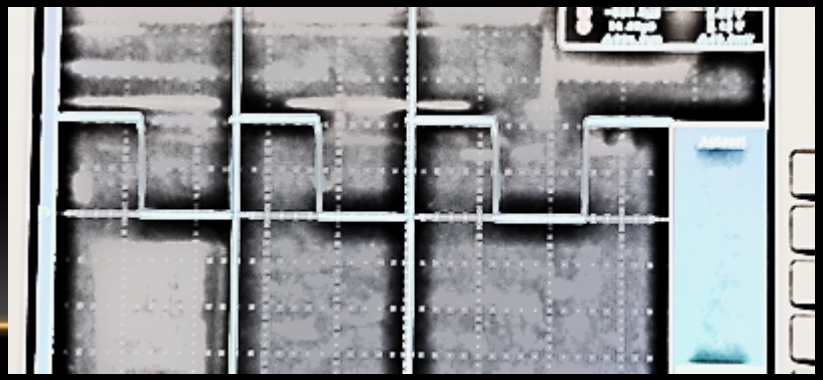
Simulation Input (1Vpp/1kHz)



Simulation Output (2.4Vpp/1kHz)



Sinusoidal Input (1Vpp/1kHz)

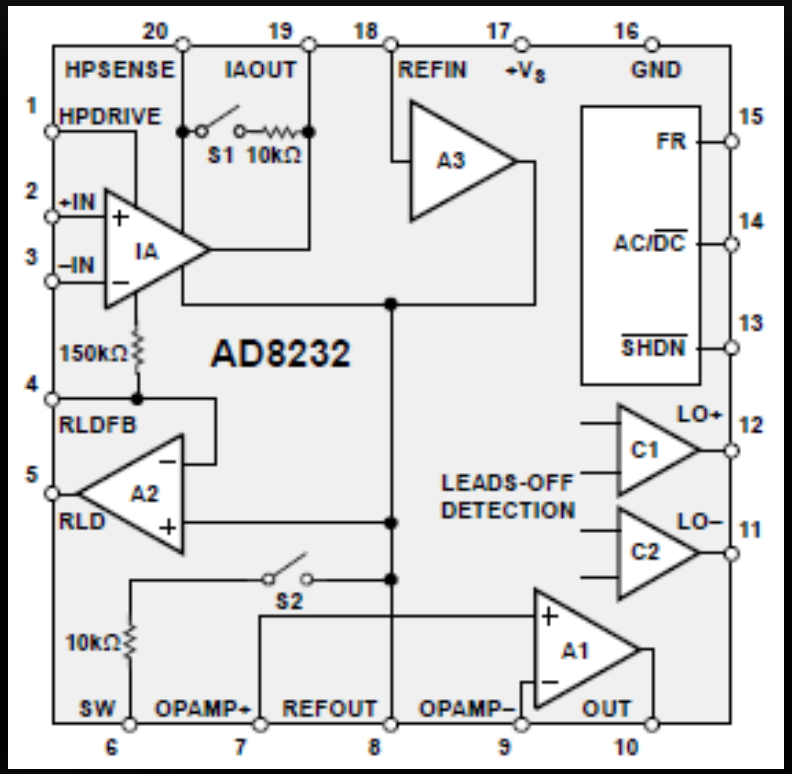


Square Wave Output (2.1Vpp/1kHz)

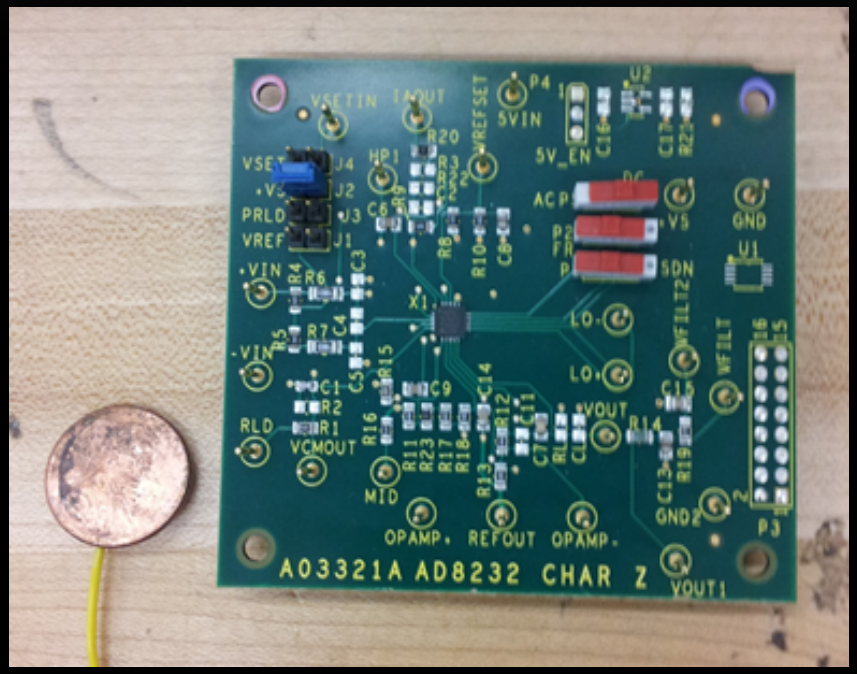
EKG

- Solutions Too Inaccurate
- Too Much Noise
- Really Meant for Patients that are Not in Motion

- New Solution
- AD8232 by Analog Devices



HEART RATE MONITOR



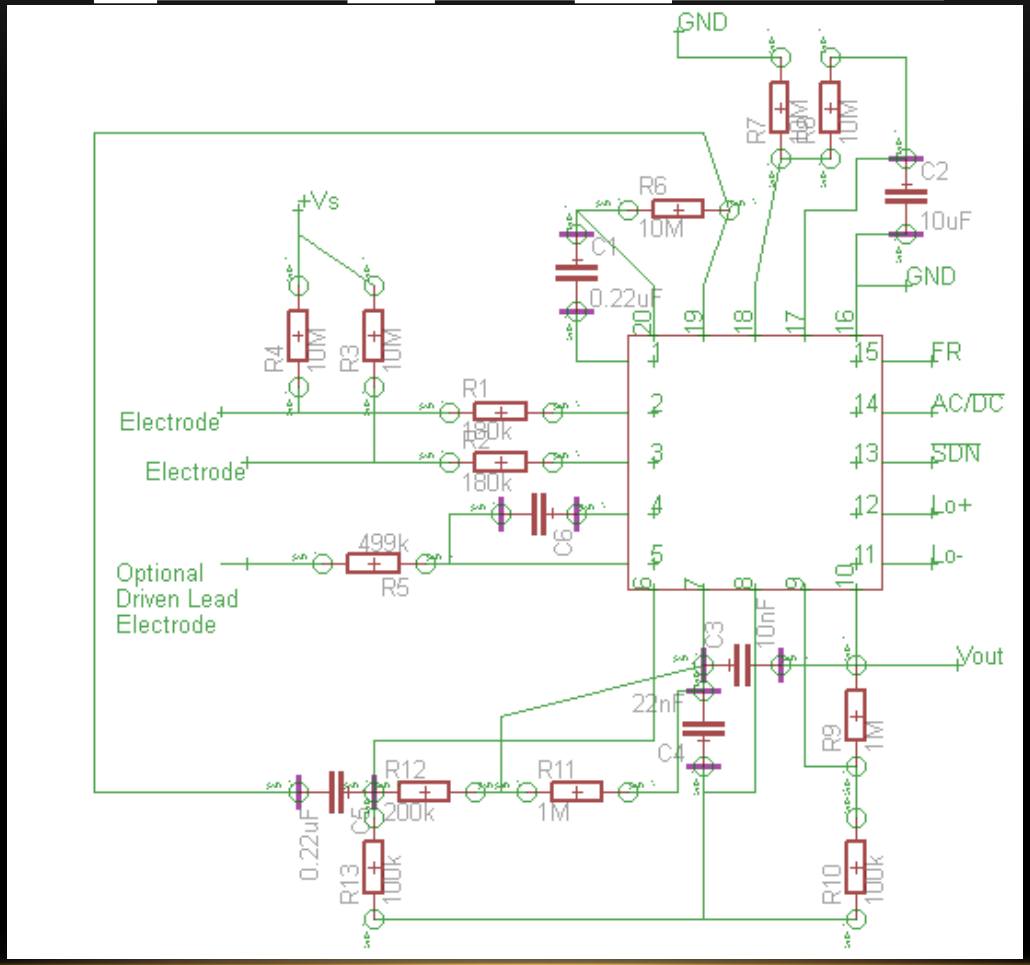
Heart Rate Monitor

- High-Pass Filter:
  - $f_c = \frac{100}{2\pi R9C6} = \frac{100}{2\pi(10M\Omega)(0.22\mu F)}$ = 7.23Hz
  - $f_c = \frac{1}{2\pi R11C9} = \frac{1}{2\pi(100k\Omega)(0.22\mu F)}$ = 7.23Hz
  - Total Roll-off of 40dB/dec
  - 6dB Attenuation at Corner Frequency

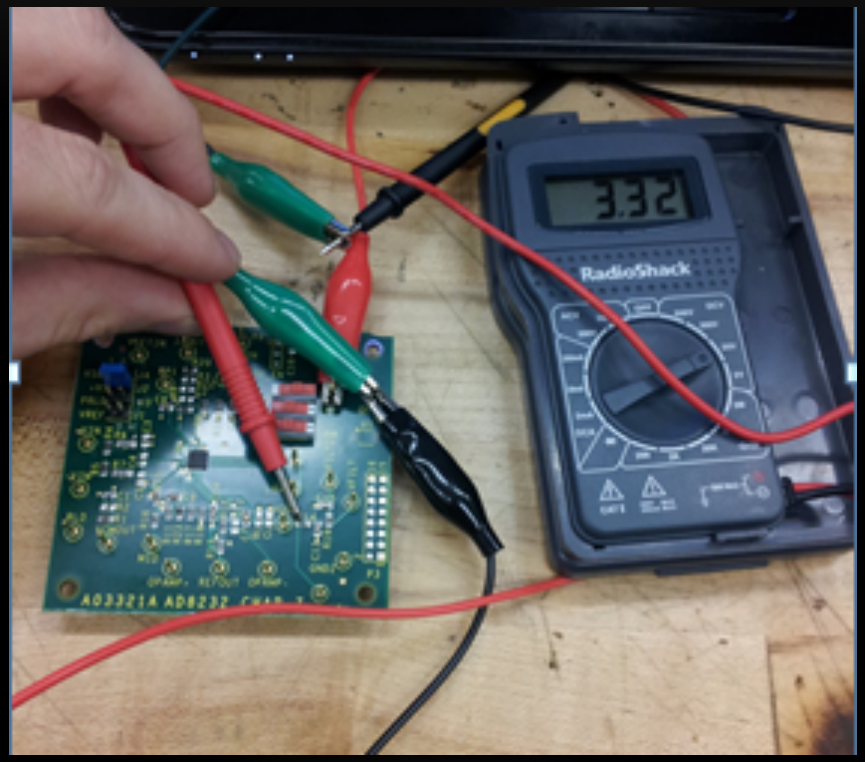
Heart Rate Monitor

- Low-Pass Filter
  - $f_c = \frac{1}{2\pi\sqrt{R18C14R17C7}} = \frac{1}{2\pi\sqrt{(1M\Omega)(22nF)(200k\Omega)(10nF)}} =$ 24Hz
  - $G = 1 + \frac{R12}{R13} = 1 + \frac{1M\Omega}{100k\Omega} = 11$
  - $R12 + R13 = 1.1M\Omega > 50k\Omega$
  - Saves Power

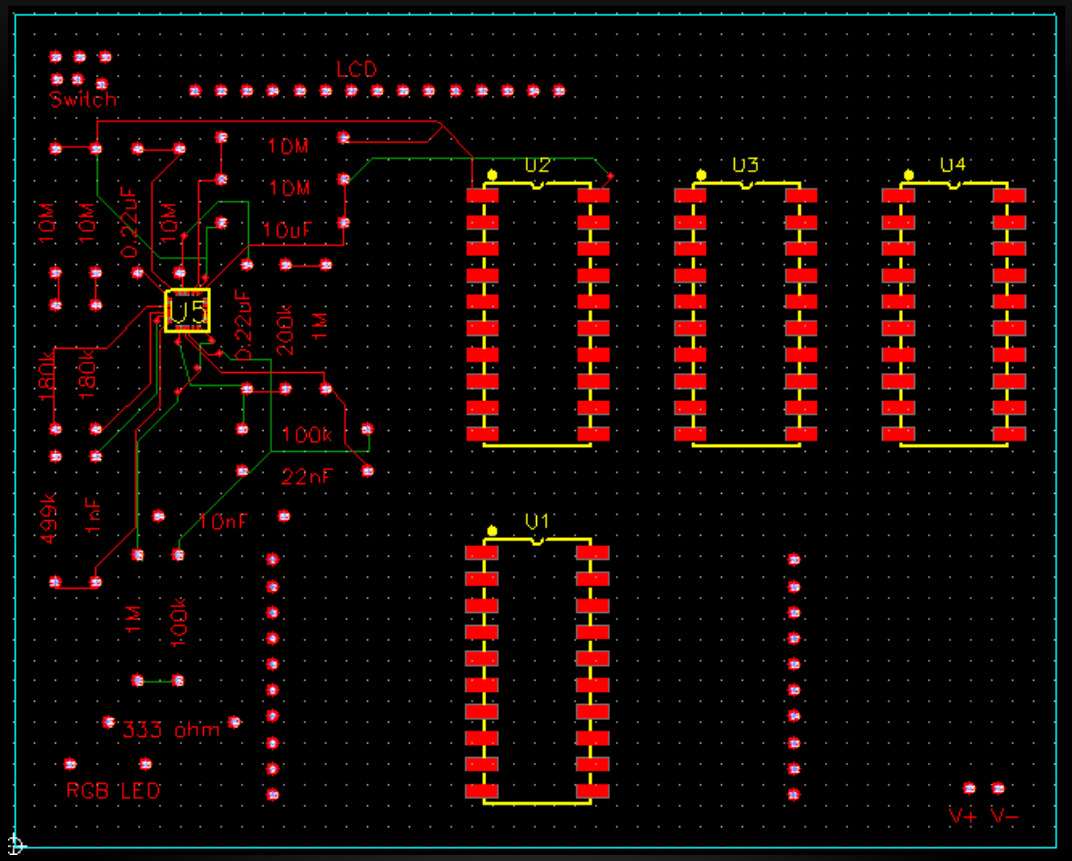
HEART RATE MONITOR



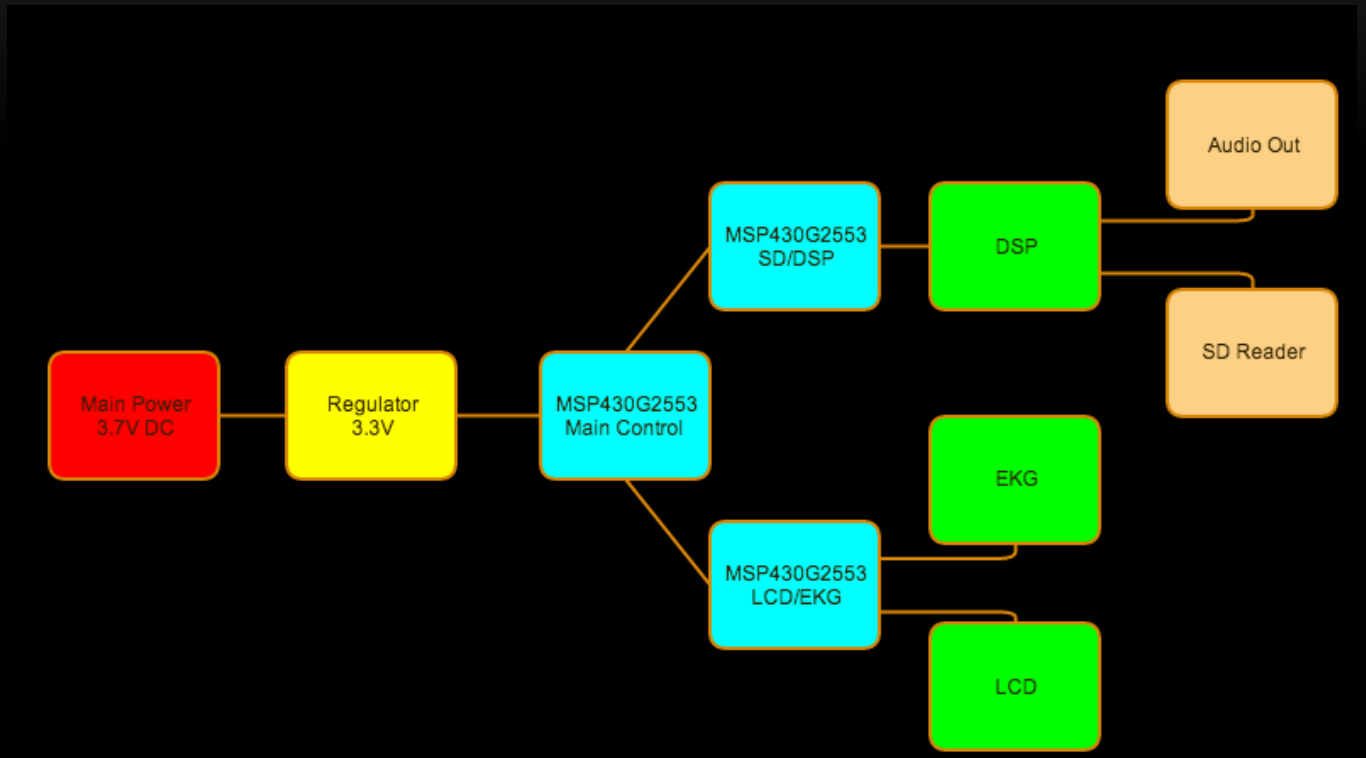
Heart Rate Monitor



PCB Layout


LCD
Switch
10M
10M
10M
10M
10uF
0.22uF
0.22uF
U5
200k
1M
180k
180k
100k
22nF
499k
1nF
10nF
1M
100k
333 ohm
RGB LED
U1
U2
U3
U4
V+
V-

POWER


Main Power
3.7V DC
Regulator
3.3V
MSP430G2553
Main Control
MSP430G2553
SD/DSP
DSP
Audio Out
SD Reader
MSP430G2553
LCD/EKG
EKG
LCD

Distribution of Work

	Adam	Brian	Neil
EKG	X		
Power Supply	X		
PCB Design	X		
Display		X	
Controls		X	X
Audio Decoding		X	X
SD Memory			X

Progress

BUDGET

Product		
Part		**Price**
DSP TMSC5515	Samples	$0
MSP430G2452	Samples	$0
MSP430G2553	Samples	$0
Audio Jack		$2
Leads		$6
LCD Display		$8
Heart Rate Sensor		$8
opamps		$9
SD card		$10
SD card reader		$10
Battery		$25
PCB		$36
Misc		
capactiors		$5
resistor		$10
Breadboard		$15
wire		$30
Solder		$30

Eval boards		
TI LaunchPad	Free	$0
Capaticve Touch	Free	$0
Audio Booster Pack		$35
AD8232		$50
USB DSP C5515		$80
Product cost		$204
Dev cost		$165
Grand total		$369
Initial Budget		$350
Over/Under		$19

Questions