Track Mate is designed to fulfill the needs of an athlete on the go. With its on-board GPS, Track Mate will be able to provide to the LCD display information such as distance traveled, average speed, and roughly the number of calories burned. By setting calorie or distance goals beforehand, it will also be able to give feedback on progress and inform the user when he or she has met his or her targets.

Audio feedback will be conveniently combined with Track Mate's secondary function: MP3 playback. Songs will be preloaded onto any SD card, which when inserted will allow the user to construct a playlist or set to shuffle. Basic MP3 player functionality such as play, pause, skip and volume control will be included as well.
Microprocessor: LPC2478

- ARM7 processor with 2 external clocks
- 512 kb on chip flash program memory
- LCD Controller with TFT support
- SD card memory interface
- SPI interface controller for audio decoding and LCD display
- RS-232 peripheral interface for GPS and programming the processor
Micron Technologies MT48LC8M16A2P-7E:G TR

- 32MB x 4 Architecture
- 54 pin (400 mil) TSOP package
- 166 MHz Clock
- PC133 Data Rate
SD Card Reader

- Sparkfun PRT-11362
- 4-bit data bus
- Communicates with CPU SD/MMC interface.
- Is a Mixed type Edge Connector. It contains surface mount and through hole padstacks.
PMB-648 GPS Module

- 20 parallel satellite-tracking channels
- Power: 3.3V DC @ 65mA
- Output: NMEA string
- Communications: RS-232 asynchronous serial @ 4800 bps
- Cold start: 42s (average)
- Hot start: 1s (minimum)
- Berg connector used to connect GPS module to processor
VS1011e MP3 Audio Codec Chip

- SOIC-28 Chip
- SPI interface, multiplexed with display
- Operates with a single, off-chip, 12.88MHz clock
- 5 KiB Instruction RAM for user code and data
- 32-bit instruction words and 16-bit data words
- On-chip stereo DAC
- Shares 3.3V supply for digital operations
- Dedicated 2.8V supply for analog operations
- 4 GPIO Pins unused
Audio Decoding (cont)
Specifications: TFT LCD Display

- Embedded 4-wire Resistive Touch Panel Control
- Power: Digital 3.3V Power supply and a 19.2V for Backlight
- SPI Interface shared with the Audio Decoder
- GPIO Pin to select which device is currently using the SPI interface
- 24-Bit RGB Interface
- 19V AC Adapter will be used to power Backlight
- Molex-51296-5494 connector will be used to mount LCD to the PCB
- Reset switch will be tied to a master reset DIP switch
**Touchscreen Connector**

- Required Power: 3V Digital @ 6mA
- Two interrupt pins to communicate with the processor
  - /INT - Interrupt from touch panel to processor
  - /Wake - Interrupt from processor to touch panel
- I2C interface to transfer data to registers on the processor
- 5 groups of onboard registers to hold 12-bit X and Y position as well as an event flag and touch ID.
- Molex_52271-0617 connector used to mount to the PCB
10-pin DIP Switch

- Standard 2.54mm X 7.62mm DIP centers
- Operating temperature: -55°C - 85°C
- Used for testing purposes throughout the board such as controlling/invoking various features while debugging
Audio Output Jack

- Operating temperature: -25°C - 85°C
- Maximum input current: 1A
- Used for the output of the MP3 decoder to any standard male headphone jack
Voltage Regulators

- Voltage Regulator 6V to 3.3V @ 500mA(max)
  - GPS
  - Processor
  - SDRAM
  - LCD
  - RS-232 Level Shifter
  - Audio Decoder

- Voltage Regulator 6V to 2.8V @ 250mA(max)
  - Audio Decoder (Analog)

- Voltage Regulator 6V to 3V @ 100mA(max)
  - Touchscreen
The NMEA data string that is sent to the microprocessor from the GPS module will have to be parsed to pull out the necessary information such as latitude, longitude and altitude. This data will then have to be sent to the LCD to be displayed. This information will also have to be used in the calculation of speed, distance and average calories burned which will also have to be displayed on the LCD screen.

Software will have to be developed to take in real time data and compute different values that will be shown on the LCD display. The touch screen, depending on where it is touched, will store that value in a certain register that will be readable by the processor. Depending on that value different functions will be accommodated through C code.

The SDRAM will be used to quickly access data on the SD card, particularly to the audio decoder. All basic functionality of an MP3 player will be coded using C for example: play, pause, skip, stop, volume adjust, menu display, etc. The RS-232 level shifter and connector will allow us to put code on the processor.
Upon booting up the LCD will display a home screen with the following options:
Software Structure (cont)

- Pressing the GPS Screen button from the Home screen brings up the following display:
Pressing the MP3 Screen button from the Home screen brings up the following display:
Pressing the Options button from the home screen brings up the following display:
Test Plan

- Just about every pin we are using on the processor will have a test pin header attached.
- LED's will be used to test power supplies as well as the reset state of the processor and the invalid state of the RS-232 Level Shifter.
- A 10-pin DIP switch will be used to manually reset individual devices as well we being used to implement a master reset for all the peripherals.
# Bill of Materials

<table>
<thead>
<tr>
<th>Ref. Des</th>
<th>Part Number</th>
<th>Side</th>
<th>Description</th>
<th>Vendor</th>
<th>Unit Price</th>
<th>Quantity</th>
<th>Ordered/Received</th>
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<tr>
<td>CPU</td>
<td>LPC2478</td>
<td>Top</td>
<td>Processor</td>
<td>NXP</td>
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<td>IC7</td>
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<td>RS 232 Level</td>
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<td>LCD/Touchscreen Display</td>
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<td>IC8</td>
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<td>Touchscreen Connector</td>
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<td>IC2</td>
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<td>VS1011e</td>
<td>Top</td>
<td>Audio Decoder</td>
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<td>Y1</td>
<td>Ask Prof</td>
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<td>Crystal Processor</td>
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<tr>
<td>Y2</td>
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<td>CRYSTAL 12.288 MHZ 20PP</td>
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<td>IC4</td>
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<td>SD Card Reader</td>
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<td>IC5</td>
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<td>SDRAM Voltage Regulator 6V to 3.3V @ 500mA(max)</td>
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<td>VR1</td>
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<td>VR2</td>
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<td>DIP</td>
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<td>10-Pin DIP Switch</td>
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<tr>
<td>C1-C2</td>
<td>445-4657-1-ND C0603C0G1E180J</td>
<td>Top</td>
<td>18F Capacitor</td>
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<td>C5-C40, C47, C50</td>
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<td>.1uf Bypass Cap</td>
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<td>13pF Capacitor for RTC crystal</td>
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### Bill of Materials (cont)

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<tr>
<th>Part Description</th>
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<tr>
<td>445-1780-1-ND C0603G0G1H330J 33pF Capacitor for Audio Decoder</td>
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<tr>
<td>445-8465-ND FK20X7S1H106K 10uF Capacitor for Audio Decoder output and power supplies</td>
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<td>10nF capacitor for audio decoder output</td>
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<td>Pullup Resistor LCD (100K)</td>
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<td>Audio Decoder Resistor 1M Ohm</td>
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<tr>
<td>100k Ohm Pull-up, pull-down resistors</td>
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<td>At least 20, ordering 50</td>
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<td>Audio Decoder 20 Ohm</td>
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<tr>
<td>Test LEDs</td>
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<td>Resistors for LEDs (100 ohm)</td>
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<td>Audio Output</td>
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Questions or comments?