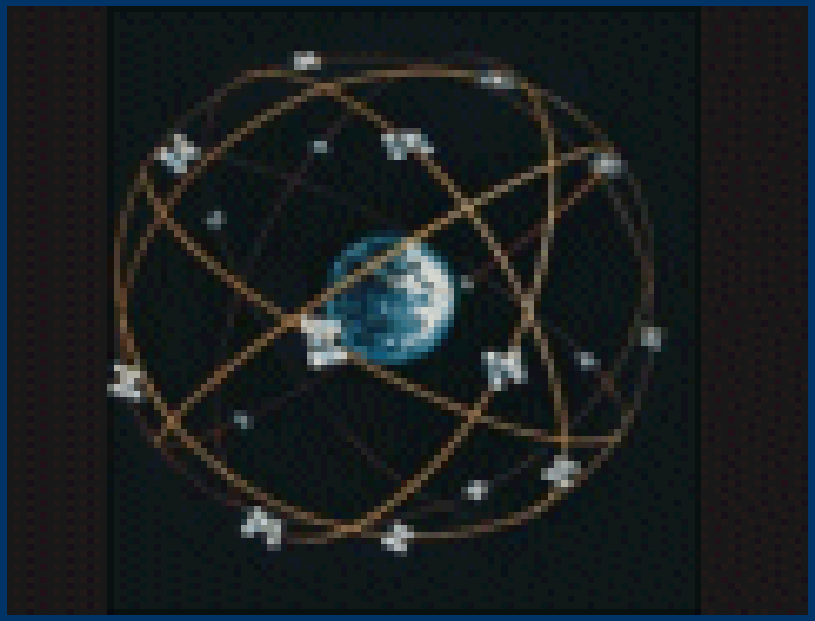
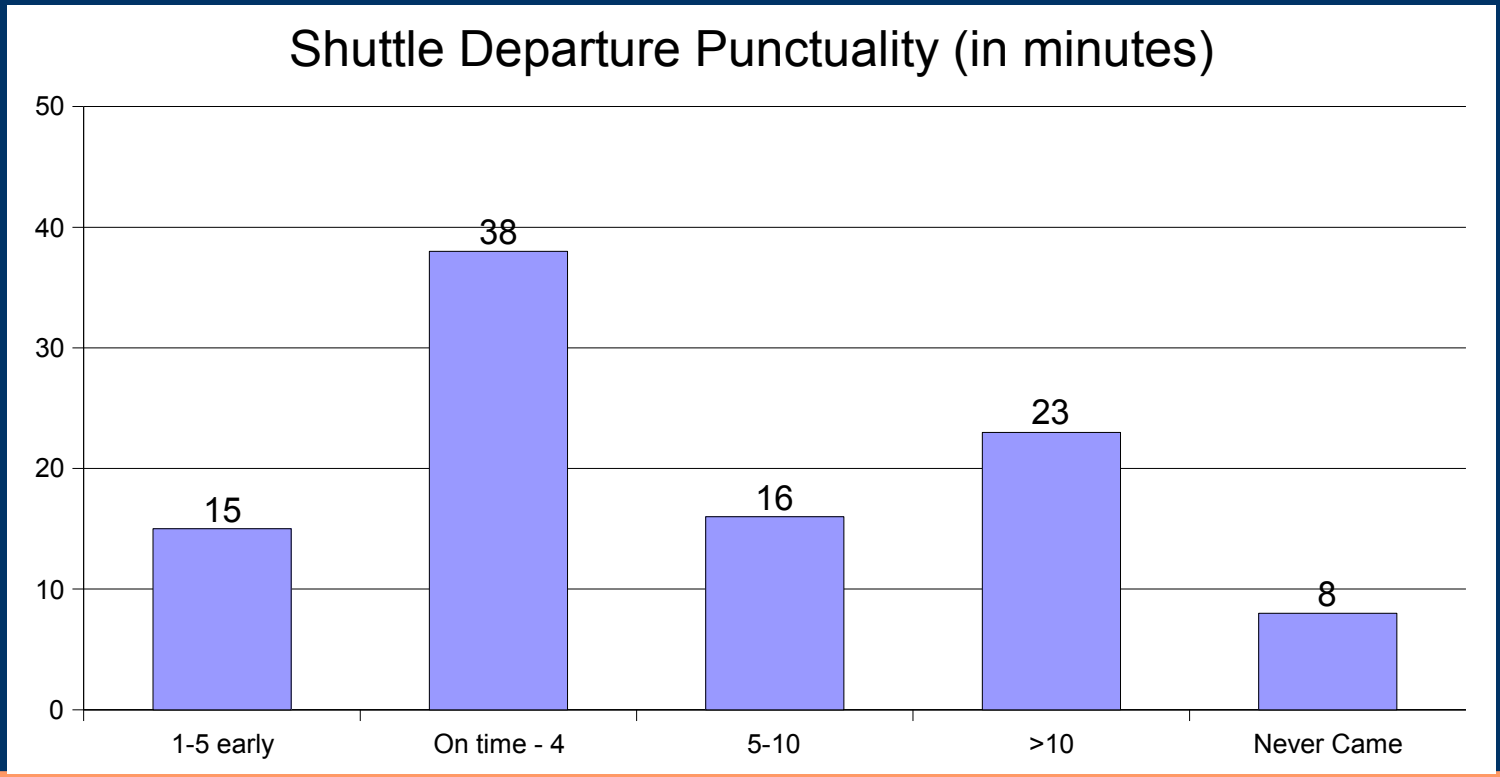
GPS Tracking System



Amany El Gouhary
Richard Wells
Anthony Thatcher

Motivation

- Shuttles up to 50 minutes late
- Drivers take breaks when running behind
- Repeatedly miss stops
- However, UTA buses are always within one or two minutes of published time. It can be done.



Project Overview

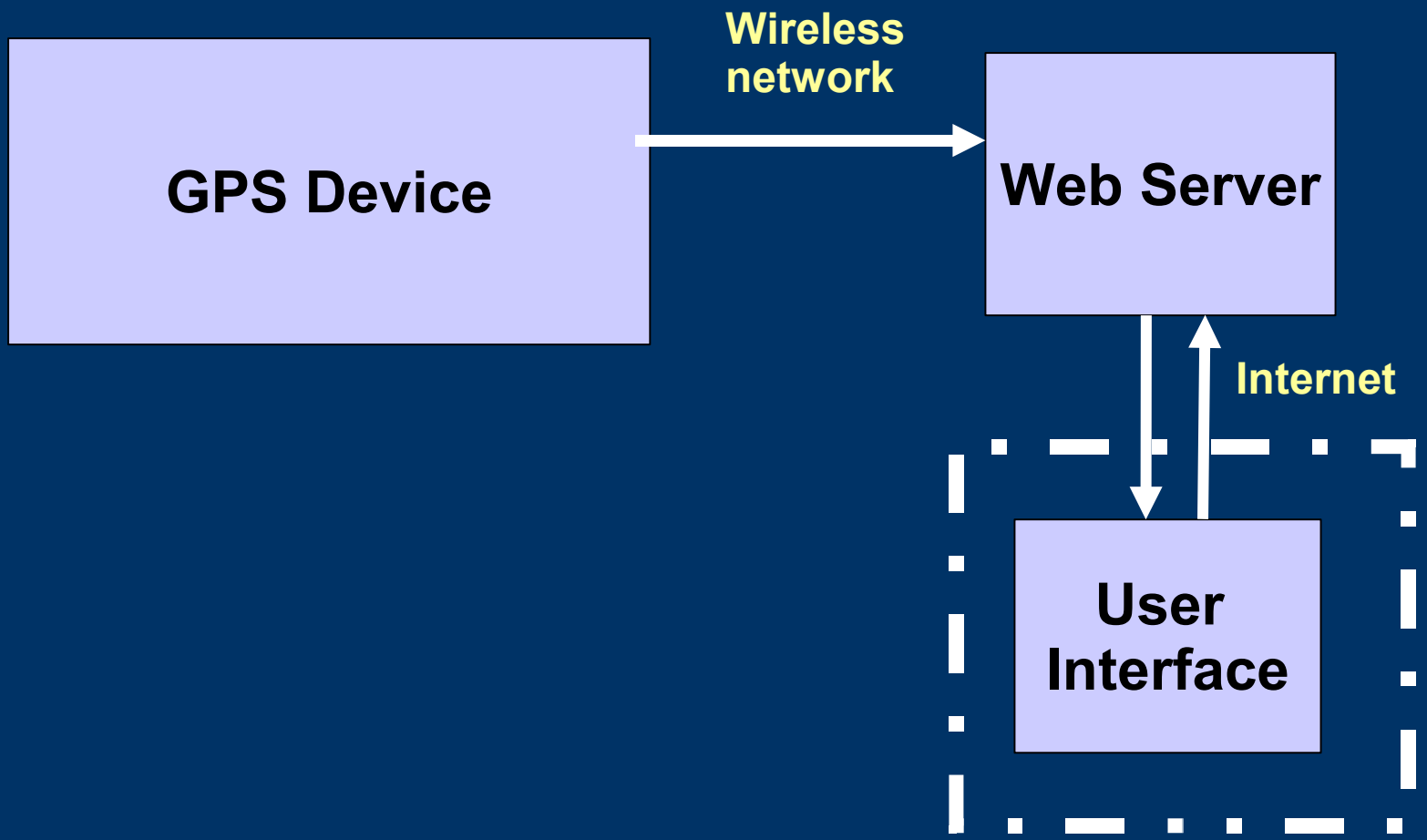
We are constructing a wireless GPS tracking device that can be tracked from the Internet. Desktop computers, laptops, PDAs, and cell phones could be used to track the device. The data available from a browser includes a scalable map of the surrounding area, latitude, longitude, speed, and altitude of the hand-held device.

Functional Description

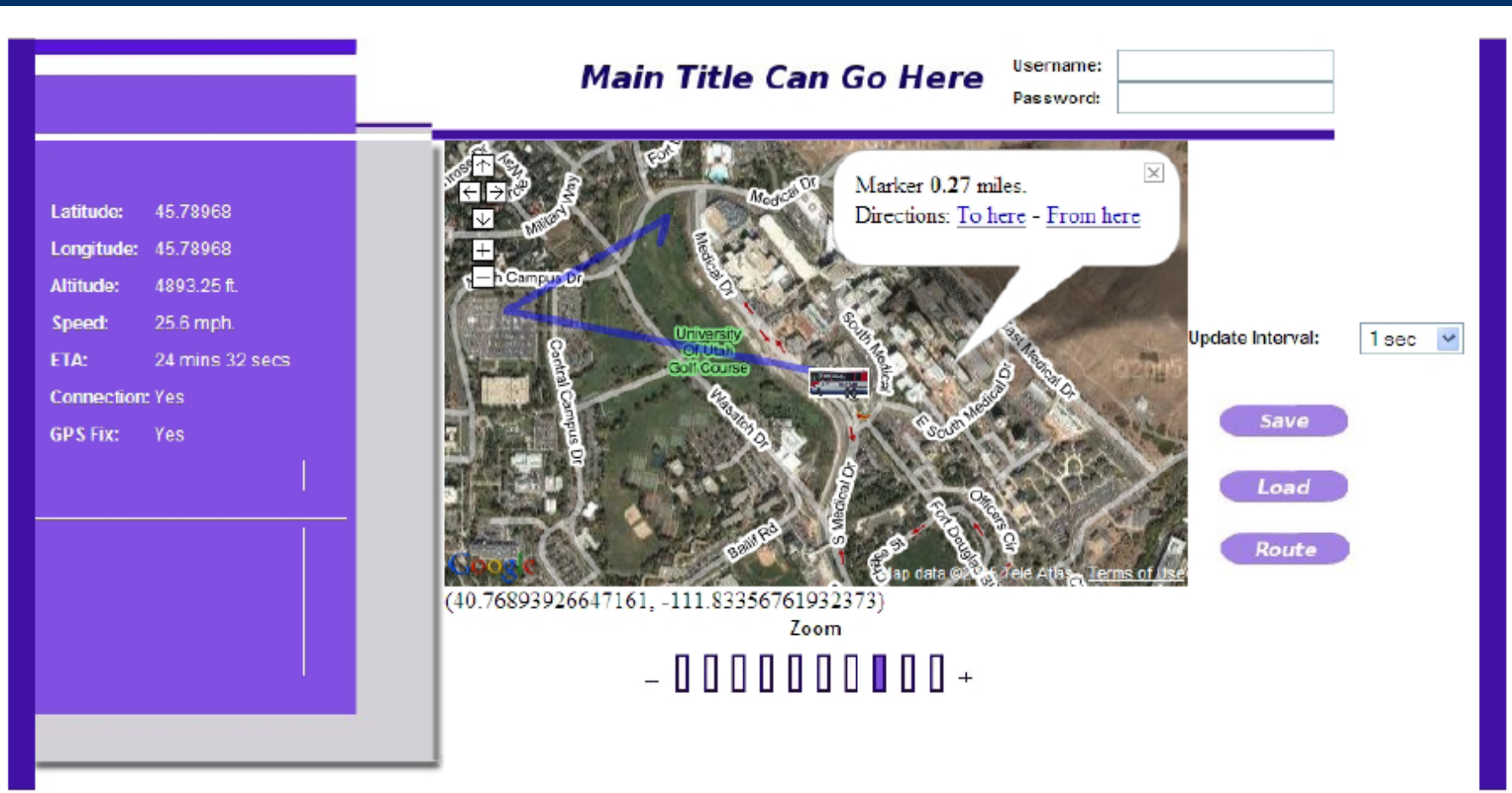
1. **The GPS device will:**
   - Calculate current latitude and longitude from GPS signals
   - Connect to the secure.utah.edu wireless network
   - Send data to the server
   - Display current latitude and longitude
   - Powered by battery or external power source

2. **The server will:**
   - Process data
   - Map our track history
   - Display the user interface

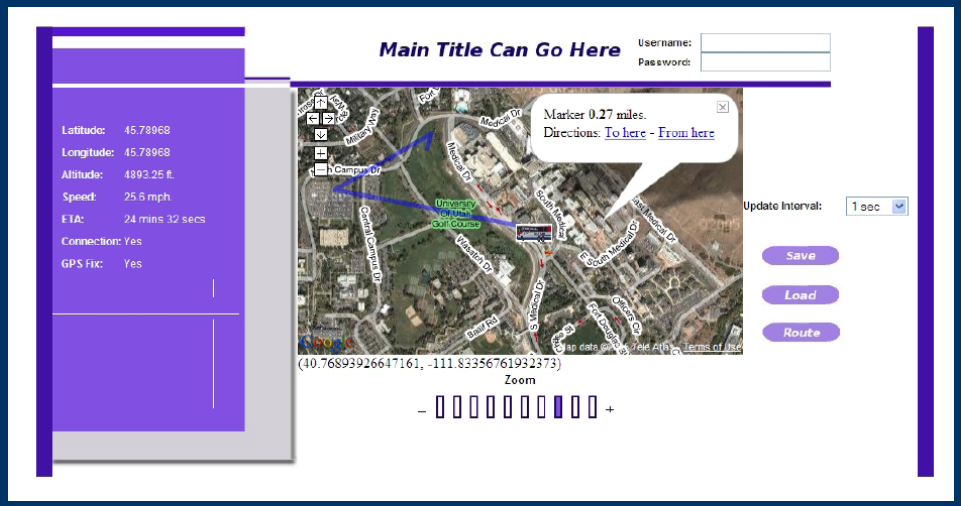
Block Diagram



User Interface Specifications

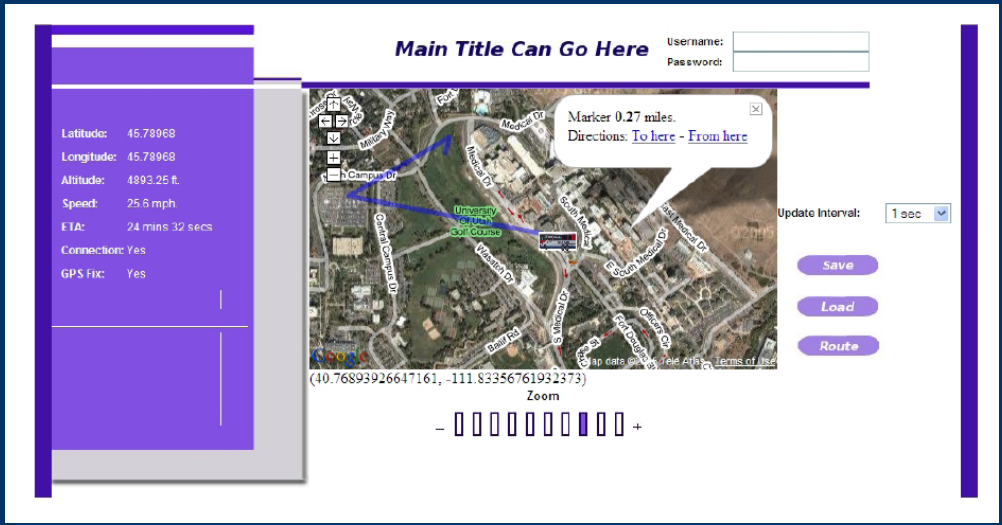


User Interface Specifications



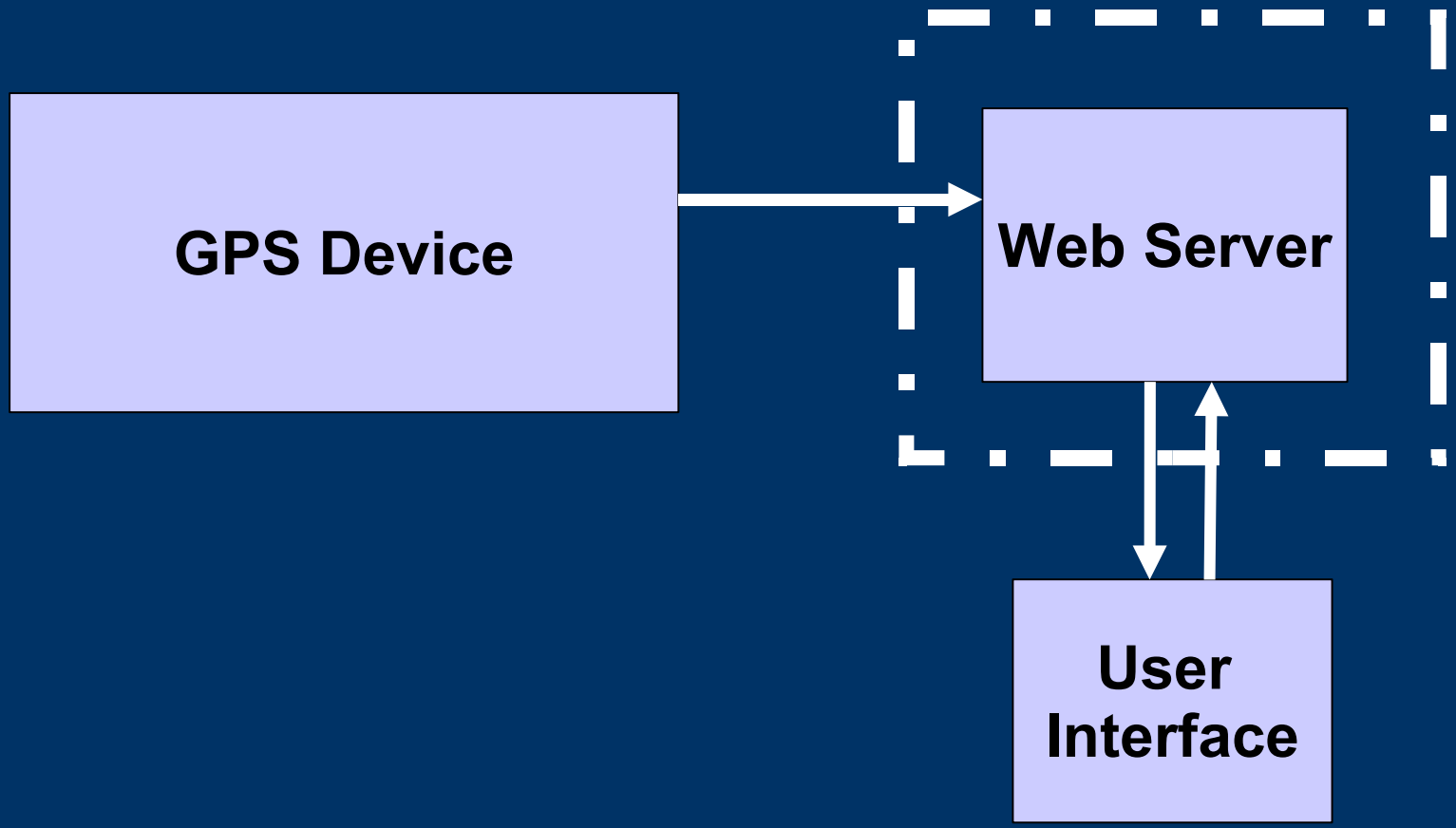
- Displays map centered on current position and past track
- Overlays track history
- Latitude
- Longitude
- Altitude
- Speed
- Status of connection with GPS device
- Directions

User Interface Extras



- Small version of user interface for PDA's, cell phones, etc.
- Estimated time of arrival of shuttle with associated shuttle route
- Sending status to cell phones using SMS

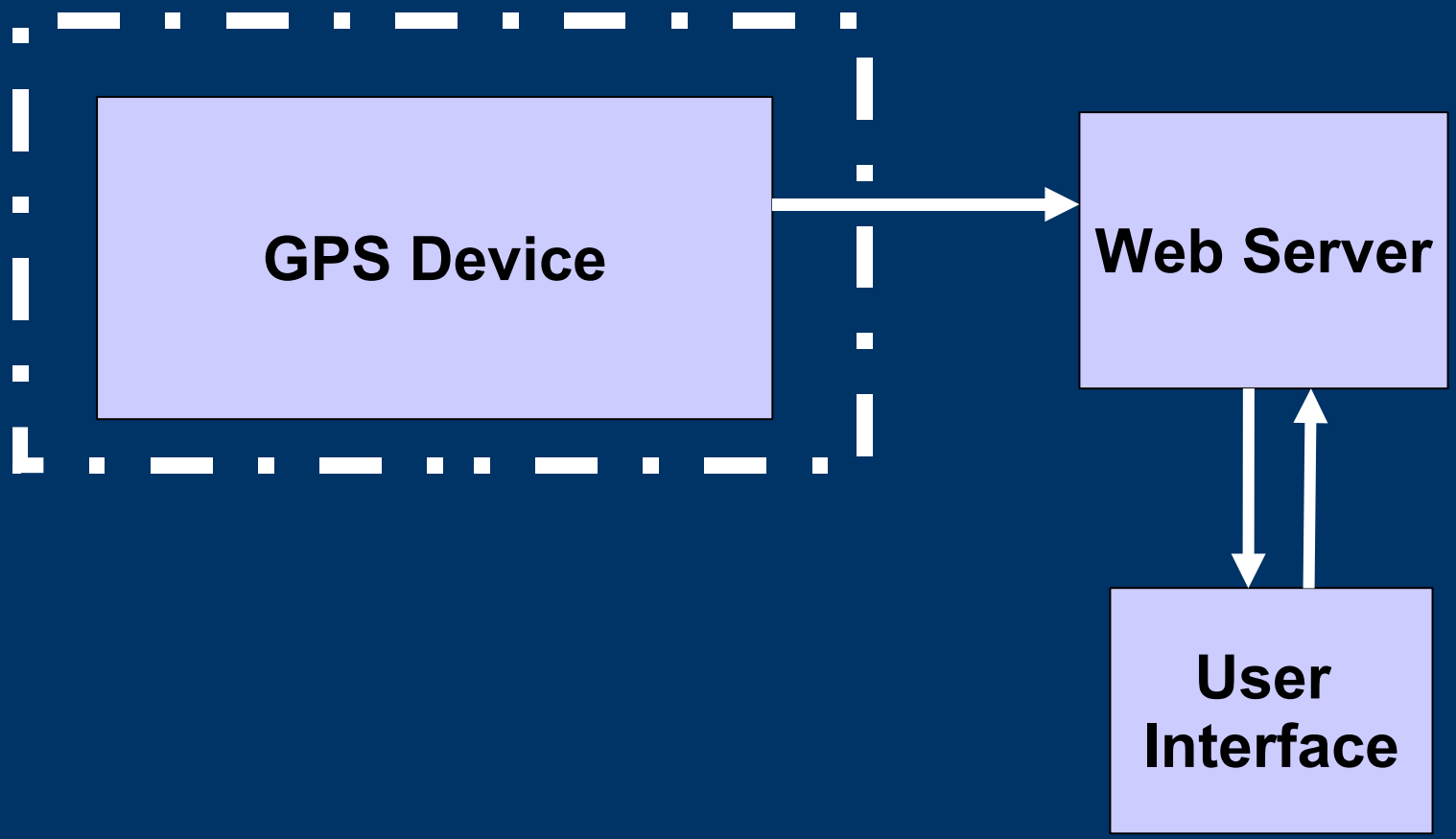
Block Diagram



Web Server Description

- *Google Maps*
  - Acquiring the Map: Google Maps has an API that allows anyone that has a registered key to download maps from their database.
  - The API can be accessed using JavaScript.
- *NMEA Parsing Software*
  - We will write software, using Java, to process the data from the hand-held device.
  - Apache, MySQL will be used to store data and serve web pages

Block Diagram



GPS Device Software

Other software

- Operating system: a stripped down version of Linux.
- Wireless authentication: hostap program

Our software

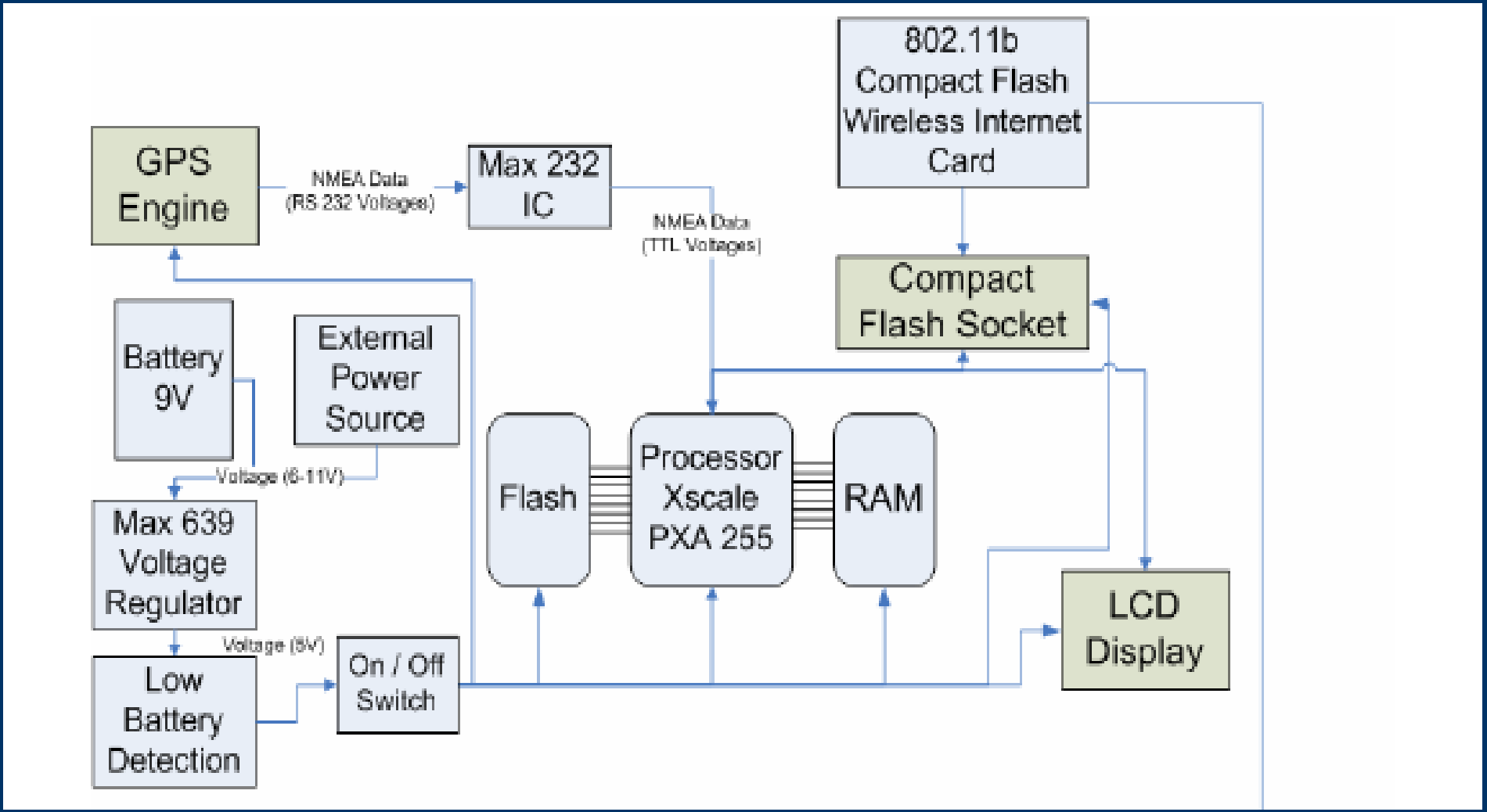
- Programming language: C
- Receives data from GPS
- Outputs latitude and longitude to the LCD
- Transfers data to the web server over the wireless connection
- Output data format: NMEA data

NMEA Data

$GPGSV,3,1,11,17,88,303,48,07,73,242,,28,54,069,,08,40,150,51*7E
$GPGSV,3,2,11,24,37,137,49,26,28,251,53,29,26,246,49,11,21,050,36*7D
$GPGSV,3,3,11,04,17,173,52,09,16,316,,27,08,148,,,,,*43
$GPGLL,4045.0634,N,11150.2367,W,095652.594,A*23
$GPGGA,095652.59,4045.0634,N,11150.2367,W,1,06,1.0,01451,M,,,,*34
$GPRMC,095652.59,A,4045.0634,N,11150.2367,W,**00.0**,000.0,190406,14.,E*74
$GPGSA,A,3,24,26,08,29,04,11,,,,,,,3.8,1.0,3.7*39

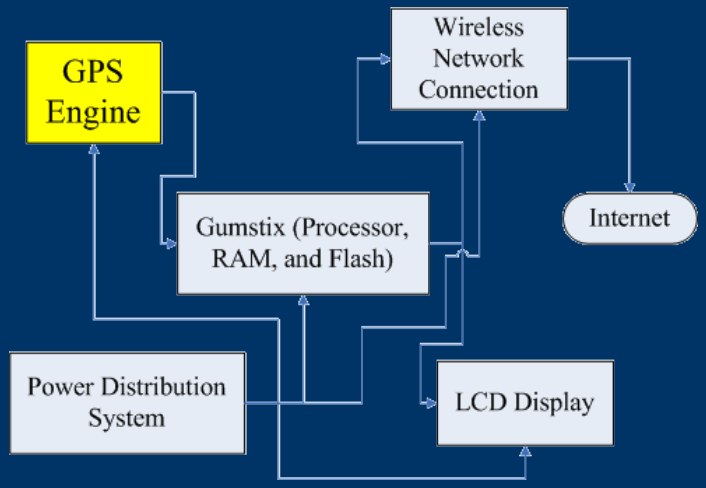
- $GPGSV - tells information about each satellite in view that you have acquired a signal from. It tells its strength and position information
- $GPGLL - gives you your latitude, longitude, and UTC of position
- $GPGGA - describes the signal fix and its quality
- $GPRMC - provides you with the speed and the date
- $GPGSA - informs you what satellites were used in the position calculation

GPS Device Hardware



Block Diagram

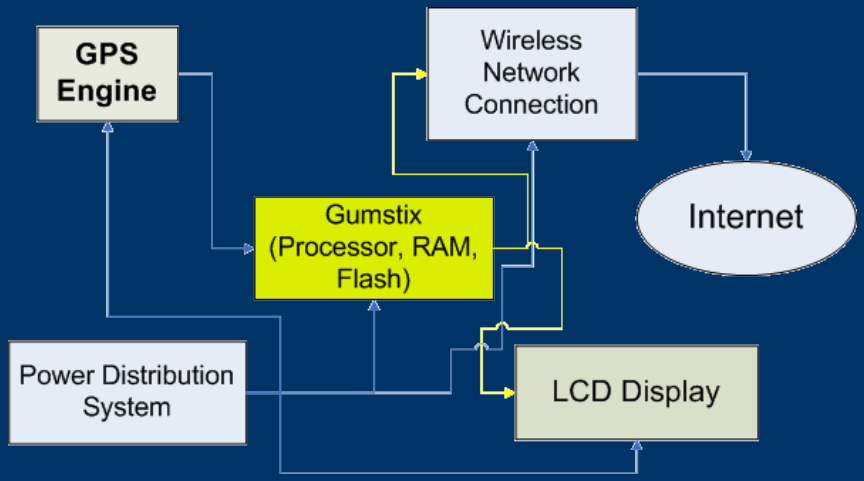
GPS

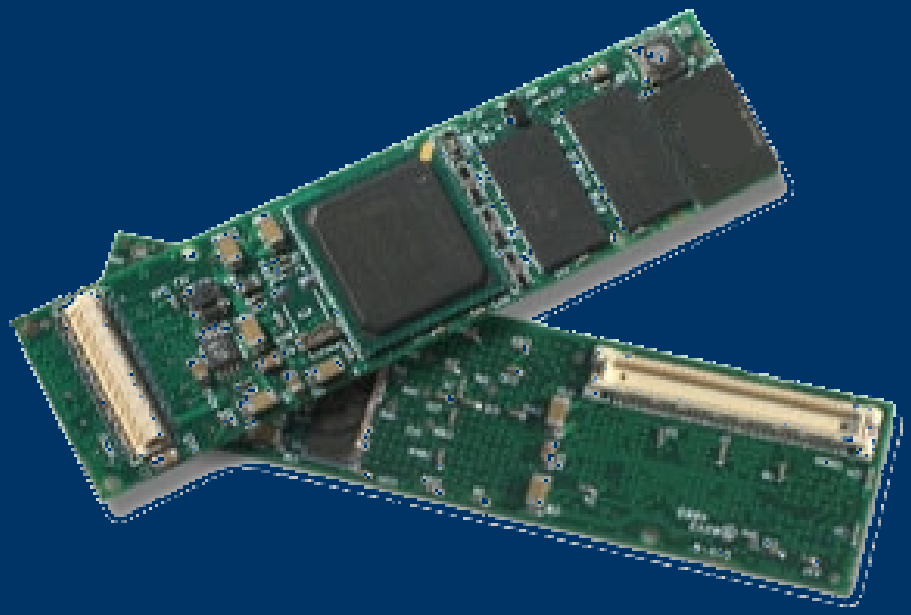


PG-11 Specifications

- 5V operation
- 71mm x 40mm x 7mm
- Low power consumption
  - 60 mA active mode
  - 26 mA trickle mode
- Outputs NMEA in decimal latitude and longitude format
- Active antenna connector (MCX, SMA) – AN-10SA from Synergy-GPS.com

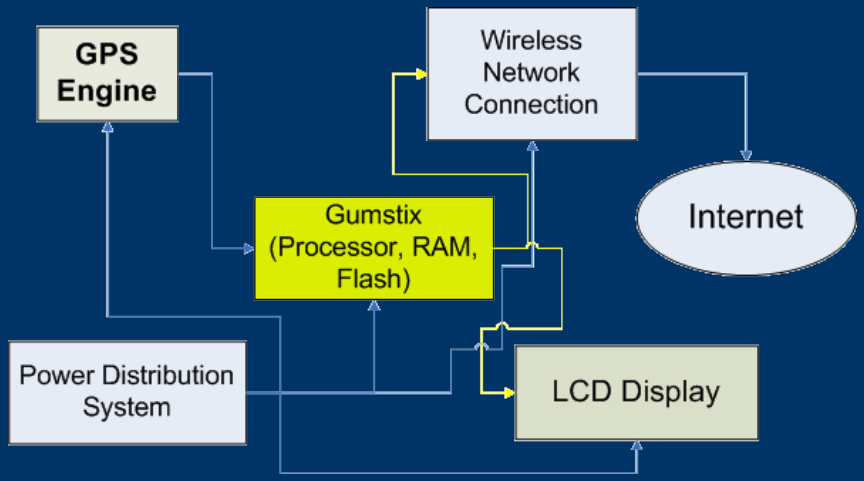
Gumstix

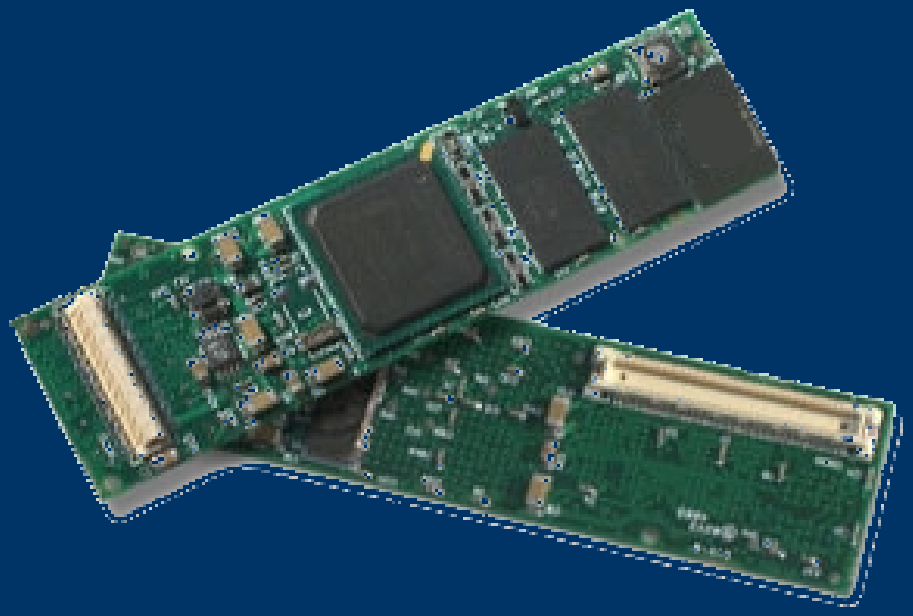




- PXA255 Xscale Processor
- 16Mb Flash for OS and program storage
- FFUART (230 Kbps)
- Integrated LCD Controller
- <250mA processing <50mA waiting for input
- Runs stripped down version of Linux for authentication

Gumstix

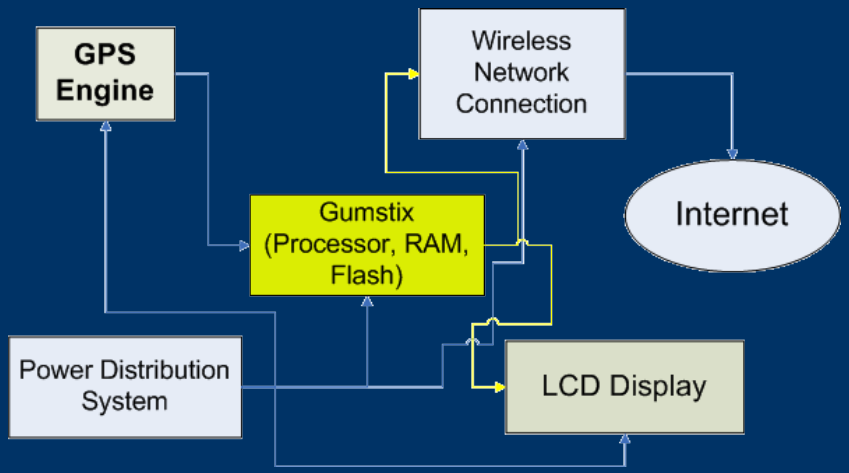


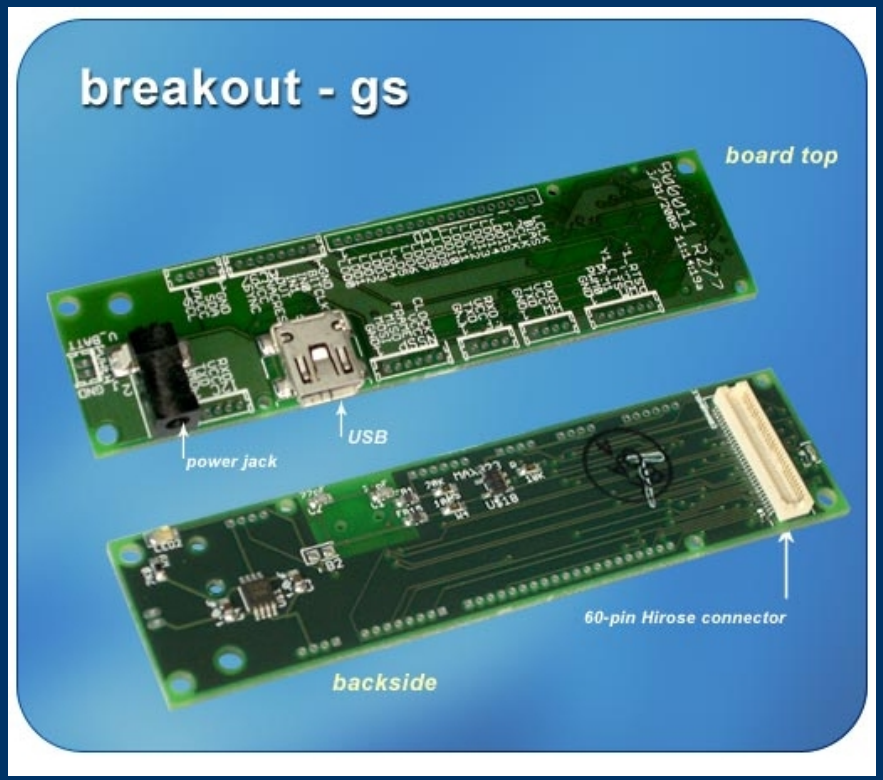


Interfaces

- Receives NMEA v2 data from the GPS
- GPS transmits RS232 levels which will be converted to TTL by a MAX232 IC
- Connects to the CFStix by its 92 pin bus header. OS does the interfacing
- LCD controller will interface with LCD display

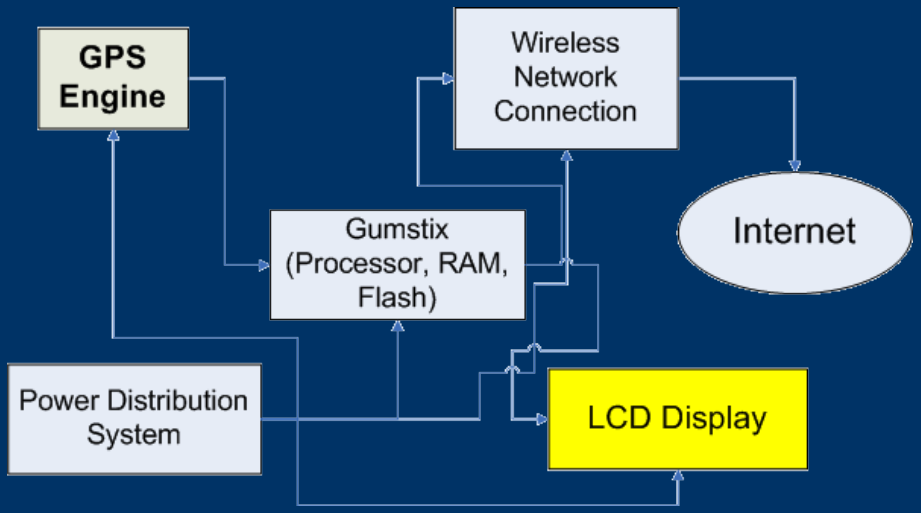
Breakout Board





- Provides access to the processor pins
- Battery connection (will also power Gumstix board)
- FFUART connection for GPS data (4 holes)
- LCD Controller (20 holes)

LCD Display



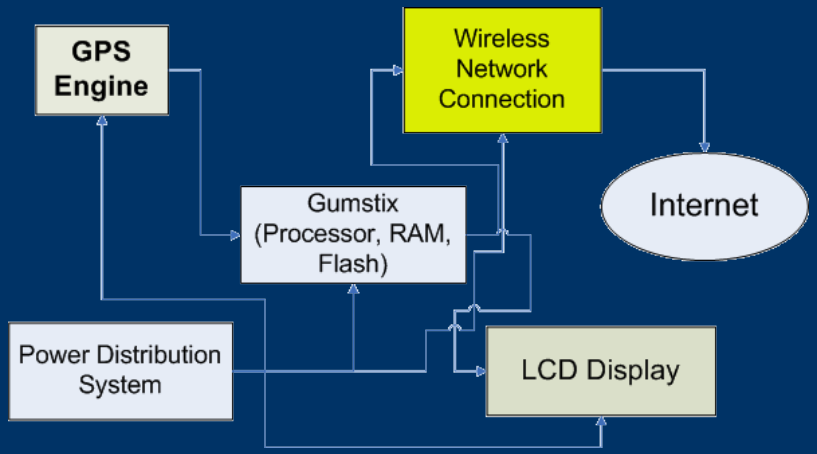
Orient Display AMC1602A-B-B6WTDW

- 2 lines by 16 characters
- HD44780 – Integrated 8 bit controller
- 16 pins – accepts ASCII on its data pins
- Small form factor
- LED backlight
- 1.2 mA power (42mA with backlight)

LCD Interface

- PXA 255 LCD Controller is designed to work with graphical LCDs.
- We are using a character LCD.
- During research we did not find that any documentation how to interface with a character LCD.
- Options -
  - Use a graphical LCD (our extra to make it a navigation system)
  - Script to “bit-bang” with the GPIO ports
  - Use GPIO ports with assembly
  - Use GPIO ports with C

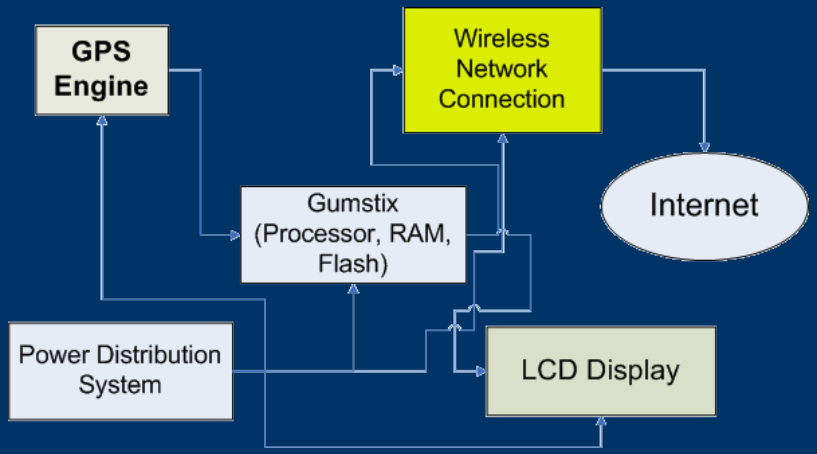
CFStix



CFStix

- Compact Flash Socket for wireless network card
- Powered from the board
- Connects via the 92 bus header connection

Wireless Network Card



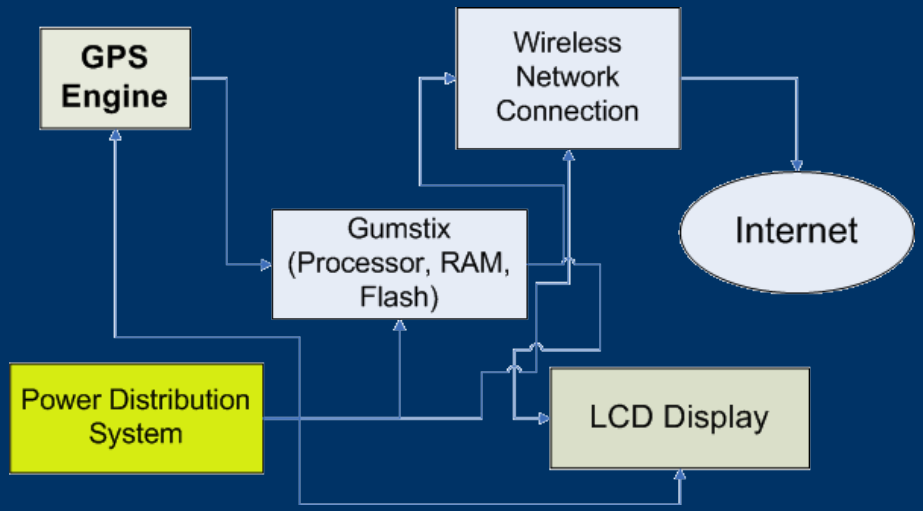
Socket Communication WL6000-320

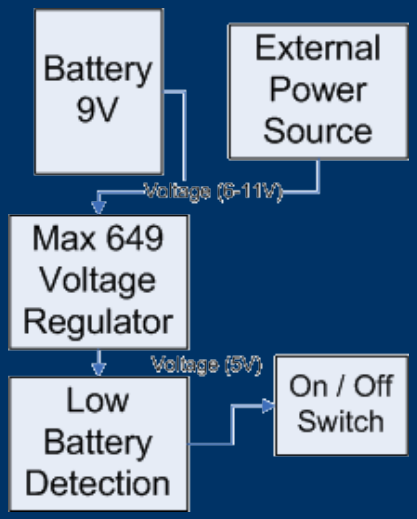
- Compact Flash Type I connection
- 170-280mA while transmitting
- <20mA idle mode
- 64 bit and 128 bit encryption
- LED link indicator
- Strip antenna
- Range: 300 feet
- Linux driver – not tested with Gumstix
- Alternatives: Belkin and Netgear
- 55mm x 42mm x 3.3mm

Campus Wireless Network

- Mandate from the Vice President that all access points broadcast insecure.utah.edu and secure.utah.edu
- The ps.utah.edu network, currently in use by the police, is now required to broadcast secure.utah.edu. It is focused on covering the roads. We have found that network will extensively increase our coverage.
- The proposed campus wireless initiative to provide access in all buildings and grounds should be completed by the end of the summer. (Hopefully)

Power Distribution System

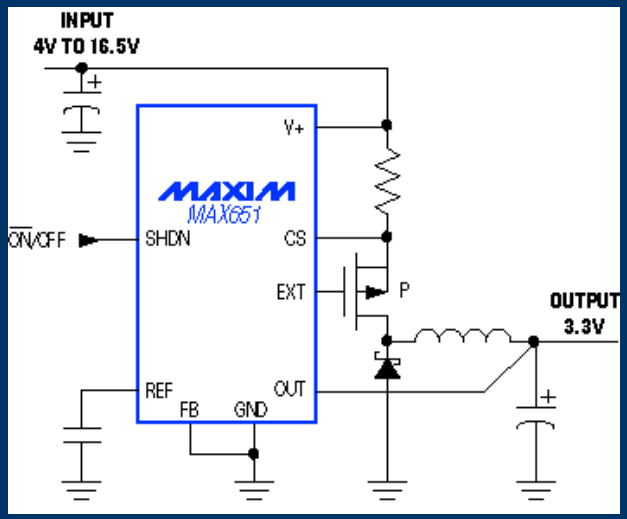




Design Criteria

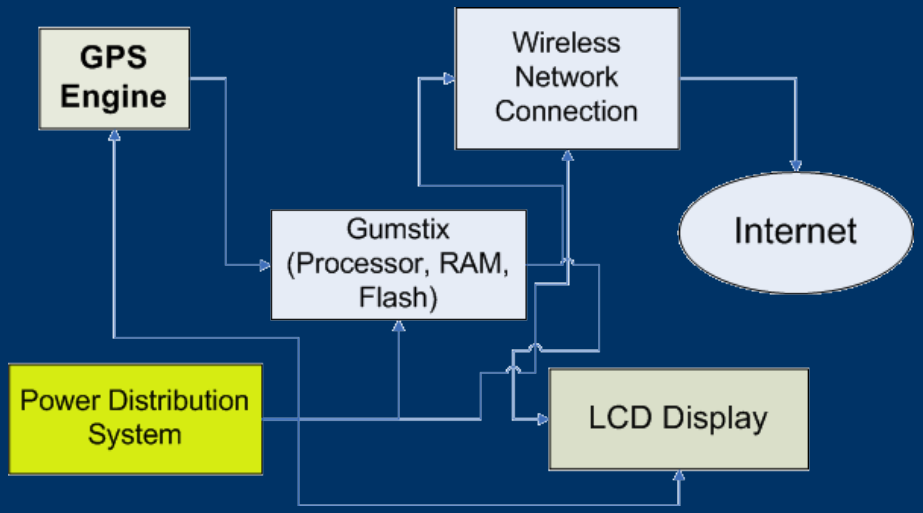
- Provides 5V
- Approximately 500mA capability
- Dual inputs
  - Battery
  - External Power Source
- Common, cheap battery
- Low battery detection

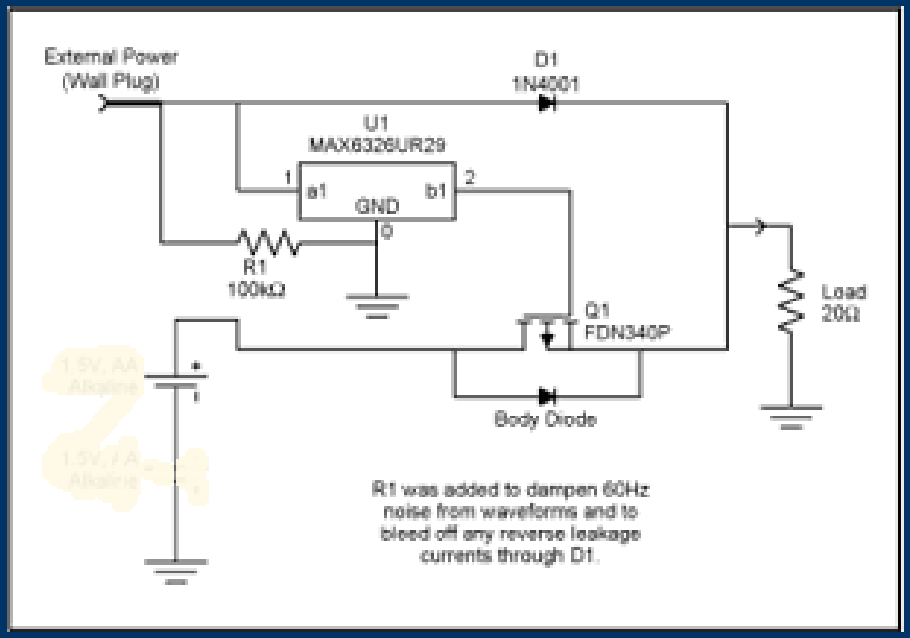
Power Distribution System Parts



- On/Off Switch
- Rechargeable 9V NiMH 150 mAh battery
- MAX649 – Voltage Regulator
- SI9430 P-channel enhancement mode MOSFET
- External power source can be between 6 and 11 volts

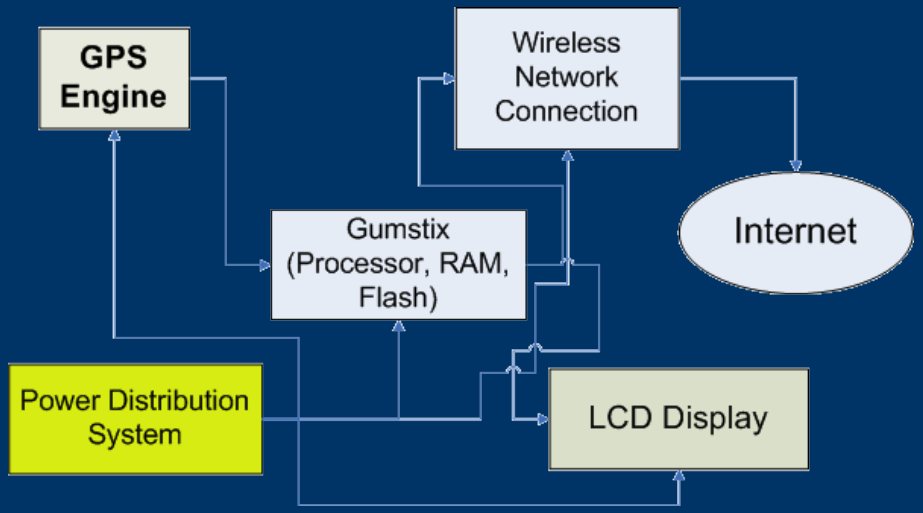
Dual Input Circuit

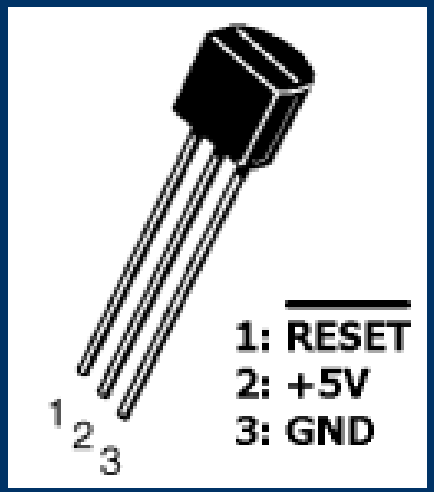




- Prefers external power
- Reduces switching noise due to contact bouncing when connecting external power
- MAX 6326 waits until external power has stabilized to switch to it.
- High efficiency - Low voltage drop so does not waste battery power

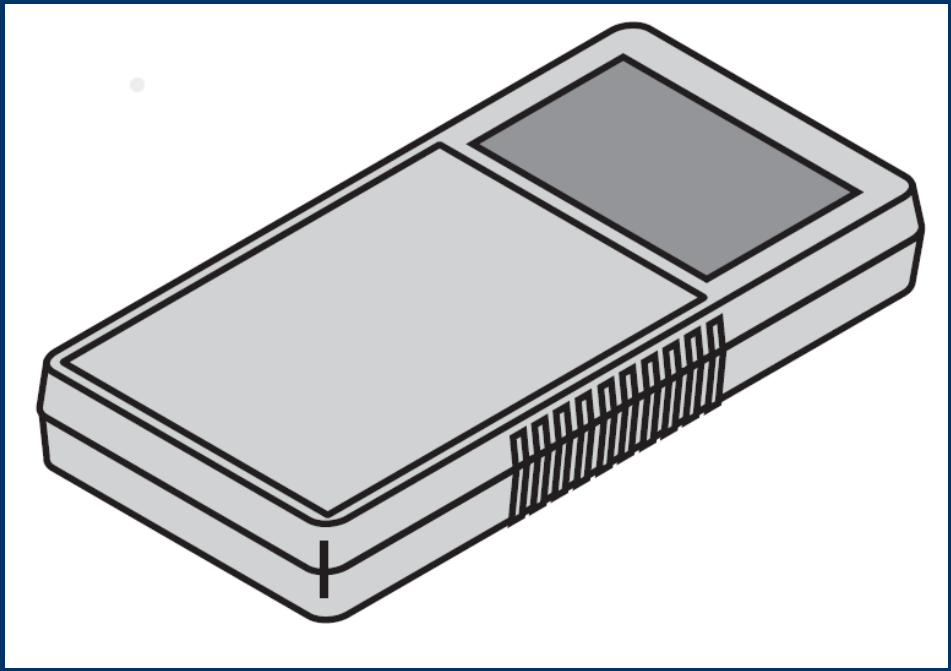
Low Battery Detection





- MC34064 undervoltage sensing circuit
- When the voltage regulator output drops below 4.6V it will indicate to the user that the battery is low. (LED)
- Also requires a not gate

Enclosure



Mouser Bud Plastic Enclosure

- 7in x 4in x 1.5in
- 9V battery compartment
- LCD cut-out is compatible with our LCD
- UL94V-O flammability rating
- Will cut out holes for power switch and low battery LED

Bill of Materials

- *GPS Engine/GPS Antenna*, GP-11, $55, Laipac Technology, Inc.
- *Gumstix Connex 400-xm*, $114, Gumstix.com
- *Breakout-gs extension board*, $27.50, Gumstix.com
- *CFStix extension board*, $25, Gumstix.com
- *Compact Flash wireless network card*, Socket Com WL6000-320, $30-$40, Ebay
- *Max 232,* $1.55, Maxim Integrated Products, Inc.
- *LCD Display,* Orient Display AMC1602A-B-B6WTDW, $15, eio.com
- *Rechargeable NiMH 9V batteries*, 150 mAh, $12.99, RadioShack
- *Lighted SPST Rocker Switch*, $3.69, RadioShack
- *Max 649 5V Voltage Regulator*, $2.07, Maxim Integrated Products, Inc.
- *Max 6326 Power Reset IC*, $0.99, Maxim Integrated Products, Inc.
- *SI9430 P Channel Enhancement Mode MOSFET*, $0.48, www.fairchildsemi.com
- *MC34064 Undervoltage Sensing Circuit*, $0.90, www.onsemi.com
- *Plastic Enclosure*, $15.10, www.mouser.com

Risks

- ***Web interface**:* Moderate risk – Not much experience
- ***Web server**:* Moderate risk – Again, not much experience
- ***GPS interfacing**:* Low risk – Informal specifications of the NMEA protocol are widely available. Also the GPS uses standard RS232 communication methods.
- ***802.11x authentication**:* Moderate Risk – Hostap to authenticate. Secure.utah.edu network has always been troublesome.
- ***Parts availability**:* High Risk – Vendors being cooperative and honest. We have identified secondary sources for parts that aren't vendor specific.
- ***Limited availability of the secure.utah.edu network**:* Moderate Risk – Not campus wide currently

Tentative Schedule, Task Assignment, and Testing

- Pre-Summer
  - Finalize all hardware and software decisions — May 1
- Phase One: Wireless Connection
  - Gumstix and wireless card installation (Amany) — July 15
  - Authentication and connection established(Anthony & Richard) — Sept. 1
  - Power Distribution System (Richard) — Sept. 15
- Phase Two: GPS
  - Integrate GPS (Anthony) — Oct. 1
  - Parse data and overlay map (Richard) — Oct. 15
  - User Interface (Amany) — Nov. 1
  - Output GPS data to LCD (Richard) — Nov. 15
- Testing and Additional functions (All) — Dec. 1
- Documentation(All) — Dec. 15

Questions?

Please visit our website at http://67.182.249.57/mediawiki/ or visit our user interface here