The Future Soldier

Group 4
Vincent Leone
Elliot Levy Bencheton
Asim Chaudhry
Overview

- Objective
- Proposed Solution
- Introduction
- Hardware
- Software
- Cost Estimation
- Future Plans/Improvements
- Conclusion
- Acknowledgements
Objectives

- To increase strategic coordination for military personnel by increasing the situational awareness of infantrymen and their commanding officers.
- To help coordinate emergency service efforts in the arena of complex urban environments.
Proposed Solution

- To use a combination of GPS coordinates and human dead reckoning to find the exact position of a person whether indoors or outdoors.

- To share encrypted positioning and wayfinding data between multiple individuals over Radio Frequency (RF).

- Display positioning and sensor data on an easy to use interface like Google Maps.
Introduction

- Navigational System
  - Positioning
    - GPS (primary)
      - Requires at least 4 satellites, otherwise a dead reckoning system is used as a fallback
    - Dead Reckoning (secondary)
      - Compass
      - Sonar/Switches

Way finding
- Preloaded waypoint definitions
- Heads up display LED navigation
- Piezo speaker proximity actuation
Introduction cont.

- Interface
  - 3 arm mounted push buttons for control
  - 2 foot mounted limit switches for step counting
  - Sonar step length measurement
  - Compass for angular rotation
  - Global positioning system for latitude and longitude
  - Temperature sensor for human body monitoring

- Display
  Serial LCD for displaying coordinates
  LED Heads up display for wayfinding
Communication
- RF Transmitter on user to send GPS, dead reckoning and distress signals
- RF Receiver at base where user’s position can be monitored in real time on “Google Maps”
Hardware

- Basic Stamp 2 with Board of Education
  - 16 Serial I/O pins
  - 2k EEPROM
  - 32 bytes of RAM

- GPS Module
  - Provides Current Latitude, Longitude, Altitude, Time, Compass Heading and Bearing, Speed, and Number of Satellites
  - Exact position of user outdoors
Hardware II

- **Digital Compass – HM55B**
  - Dual-Axis Magnetic Field Sensor
  - 6-bit(64 Direction) Resolution
  - Allows user to know direction of waypoint

- **LED’s for Heads Up Display**
  - 2 LED’s that points user to direction of waypoint.

- **Piezo Speaker**
  - Actuator placed in helmet for audio feedback at waypoint
Hardware III

- **RF Transmitter/Receiver**
  - 433.92 Mhz (UHF)
  - 500ft+ range based on environment
  - Allows communication between multiple Basic Stamps to send and receive position data

- **Ultra Sonic Sonar**
  - Distance measurement for step-length of user
  - Range: 2cm – 3m

- **Limit Switches for Pedometer**
  - Buttons placed on boot to count number of steps taken in Dead Reckoning mode
Hardware IV

- LM34 Temperature Sensor
  Used in conjunction with an ADC0831 Analog-Digital converter

- C-chip ATML Pic Microcontroller
  Used to offload tasks from the Basic Stamp
Hardware V

- LCD + Buttons for User Interface
  - 2 x 16 LCD display to show user position and vital information
  - 3 push buttons for different sets of data

- Emergency Shut Down Switch
  - In place for emergencies and unsafe operation conditions.
Schematic
Coding Flow Chart

GET GPS SIGNAL

IF Connected
Get temperature
Compute Distance to target
Update LCD
Send data over RF

OUTSIDE

IF Not Connected
Start Dead Reckoning
Measure each step length and compass direction
Determine translational movement
Update LCD
Send data over RF

INSIDE
IF(buttonchoice = 3) THEN GOSUB LCDHELP

'encryption
lat1 = lat1 + code
lat2 = lat2 + code
long1 = long1 + code
long2 = long2 + code
SEROUT rt_transmitter_pin, 15468, ["$GPGGA," DEC code, DEC lat1, DEC lat2, DEC long1, DEC long2,
GOSUB GETHCOMPASSANGLE
GOSUB UPDATE SPEAKER
GOSUB UPDATEGOGOGLES
RETURN

 programming
SEROUT gps_pin, 186, ["!GPS", GetLat]
SERIN gps_pin, 186, 3000, DEADRECKONING, [lat1.HIGHBYTE, lat1.LOWBYTE, lat2.HIGHBYTE, lat2.LOWBYTE
WRITE 0, Word lat1
WRITE 2, Word lat2
SEROUT gps_pin, 186, ["!GPS", GetLong]
SERIN gps_pin, 186, 3000, DEADRECKONING, [long1.HIGHBYTE, long1.LOWBYTE, long2.HIGHBYTE, long2.LOWBYTE
WRITE 4, Word long1
WRITE 6, Word long2
'DEBUG lat1.HIGHBYTE, " ", lat1.LOWBYTE, ",", lat2, " - ", long1.HIGHBYTE, " ", long1.LOWBYTE, " 
RETURN

 programming
DEADRECKONING:
'DEBUG CRSXY, 6,6, "DEADRECKONING", CR
IF(firsttime=0) THEN
   firsttime=1
   lat1=0
   lat2=0
   long1=0
   long2=0
   temperture=0
   pedometer_steps=0
   ad0=0
ENDIF

IF([IN4=0) THEN down1=0
IF([IN3=0) THEN down2=0
IF([IN4=1) AND (down1=0) THEN GOSUB right
IF([IN3=1) AND (down2=0) THEN GOSUB left
IF(ometrometer_steps >= 15) THEN GOTO MAIN
'DEBUG CRSXY, 3, 3, "getting button choice", CR
GOSUB GETBUTTONCHOICE
IF(buttonchoice = 1) THEN GOSUB LCDXXY
GOSUB GETHCOMPASSANGLE
GOSUB WAYPOINT
GOSUB GETTEMPERATURE
GOSUB RFDEADRECKON

GOSUB GETDEADRECKON
Math

Theta = \arctan \left( \frac{y}{x} \right) \quad \text{OR ATN}
D = \sqrt{dx^2 + dy^2} \quad \text{OR HYP}

Know: Latitude, Longitude, compass angle and distance travelled
# Cost of Materials

<table>
<thead>
<tr>
<th>Part</th>
<th>Amount</th>
<th>Cost/Unit</th>
<th>Price</th>
<th>Mass. Unit Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic Stamp</td>
<td>2</td>
<td>49.99</td>
<td>$99.98</td>
<td>$25.48</td>
</tr>
<tr>
<td>GPS Sensor</td>
<td>1</td>
<td>79.95</td>
<td>$79.95</td>
<td>$71.96</td>
</tr>
<tr>
<td>RF Reciever</td>
<td>1</td>
<td>39.95</td>
<td>$39.95</td>
<td>$27.97</td>
</tr>
<tr>
<td>RF Transmitter</td>
<td>1</td>
<td>29.95</td>
<td>$29.95</td>
<td>$20.07</td>
</tr>
<tr>
<td>Compass</td>
<td>1</td>
<td>29.95</td>
<td>$29.95</td>
<td>$23.96</td>
</tr>
<tr>
<td>LCD</td>
<td>1</td>
<td>29.95</td>
<td>$29.95</td>
<td>$26.96</td>
</tr>
<tr>
<td>Sonar</td>
<td>1</td>
<td>29.95</td>
<td>$29.95</td>
<td>$29.95</td>
</tr>
<tr>
<td>Temperature Probe</td>
<td>1</td>
<td>7.90</td>
<td>$7.90</td>
<td>$7.90</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td></td>
<td></td>
<td>$48.04</td>
<td>$10.13</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td><strong>$395.62</strong></td>
<td></td>
</tr>
</tbody>
</table>
Future Plans/Improvements

- Basic Stamp with more variable space and I/O pins
- More Accurate Pedometer
  - Redundant Motion Recognition
- Better Mounting
- Weather proofing
- Longer range RF transmitter
Demo
References

- Parallax – [www.parallax.com](http://www.parallax.com)
- Radio Shack – [www.radioshack.com](http://www.radioshack.com)
- Pspice Electronics Software – [www.pspice.com](http://www.pspice.com)
- Python programming language – [www.python.org](http://www.python.org)