Personalized GPS System

Introductory Description:

Knowing where you are is the cornerstone of getting to where you wish to be. In this technological world, global positioning systems are becoming a thriving system for exacting navigation. Developing confidence in the use of recreational GPS systems is essential for safe and enjoyable adventure. With this project I propose to build a personal handheld global positioning device. The major goal of this project will be to simplify and customize the user interface while integrating key features from competing commercial models. The application of this product will be aimed at the outdoor enthusiast who would rather spend time outdoors playing with their GPS than indoors studying a 500 page manual. The Personalized GPS (PGPS) will customize and simplify the operation of commercial handheld GPS systems while at the same time providing essential navigation functions.

Description:

This product will use an integrated single board GPS receiver module from Motorola designated the M12. This GPS receiver tracks the NAVSTAR GPS constellation of satellites. An antenna receives the satellite signals, which are tracked using 12 parallel channels. These signals are then digitally processed to obtain a full navigation solution containing position, velocity, time, and heading. The navigation solution will then be sent over a serial link to a microcontroller. This microcontroller will perform the task of handling user interface between display and keypad while manipulating standard recreational GPS functions. The block diagram on page 6 visually depicts the architecture of this project.
The PGPS will be a low power, battery operated, handheld device. Users will be able to read their location, velocity, time, altitude and heading from the LCD display once the system is powered up and tracking. Designed for use in the recreational field, this system will allow the user to store locations from a secret fishing spot to a park bench in Manhattan. Waypoints such as these will be stored with user defined names. Coordinates never visited before will be able to be entered and navigated to with a minimum of fuss from the input keypad. Optional features will include the route setting and backtracking features. Navigation to waypoints will implement flashing LED’s to direct the user in the proper direction of travel.

Benefits:

The personalized GPS system is designed for the outdoor enthusiast who likes getting lost, but not being lost. With its user-friendly interface even those of us with no technical poise will become master’s of navigation. This personalized GPS system will benefit the user with simplicity and function. Operation will be simple and to the point with a minimum of keystrokes. Navigation lights mounted on the housing will direct navigation back to stored waypoints allowing basically hands free navigation. With this GPS system, navigating in areas you’ve never been before will become second nature. If you can read the coordinates from a map and enter them in your PGPS you will be able to navigate to that location. This GPS system relates to the user a sense of technological safety without imposing on the adventure at hand. All outdoor enthusiasts will be able to enjoy their backwoods adventure in a cool and confident manner with the aid of the PGPS.
Comparison:

There are a number of commercial handheld GPS systems on the market today. Prices range anywhere from $100 to $300 depending on the manufacturer. The critical specifications of leading brands include:

- 500 Waypoint Storage
- Altitude Stored In Waypoints
- 20 Route Storage – w/Route Names (Option in the PGPS project)
- Route Backtracking (Option in the PGPS project)
- Cold Start Time – 45s
- Warm Start Time – 15s
- 20 Hour Battery Life
- Battery Save Mode
- 2 AA Batteries
- 4 Navigation Screens
- Backlit Display
- 2.5 x 1.5 Inch Screen Size
- Waterproof
- Trip Odometer
- Speed Indicator
- Arrival Alarms

These specifications were obtained from Joe Meheaffey and Jack Yeazel’s GPS review website [http://joe.mehaffey.com/]. The PGPS (Personal Global Positioning System) will aim at improving the functionality of the before mentioned specifications while maintaining simplistic operation.
**Optional Functions:**

Time permitting, two additional functions may be incorporated into the PGPS. These functions will be called Route and Backtrack. The Route function will let the user group a collection of saved or entered waypoints together as a route. For example say you wanted to map an entire hike like the Pacific Crest Trail. By saving waypoints along the hike in a route you have essentially mapped the trail. This saved route can then be used in the Backtrack function. The Backtrack function will let the user follow a route from their current location to their starting position. These optional functions would provide an extra margin of safety for the end user. If the weather changes suddenly, or visibility turns to zero, being able to navigate safely out of that environment could mean the difference between life or death.

When I fully accomplish my proposed project before the deadline the Route and Backtrack functions will be implemented. To ensure a successful project however, those functions will not be added until my proposed PGPS is one hundred percent operational.

**Project Development:**

Development of this project will hinge upon the M12’s evaluation board and accompanying software. Obviously development on a project meant for the great outdoors could prove complicated when most development takes place inside a lab. Motorola’s Winoncore12 software package bridges the gap between indoor and outdoor development. Winoncore12 allows you to record hours of GPS tracking signals for playback during lab development. All you need is a PC near a window with a good view of the horizon to log this information.

Once development moves into the lab extracting the serial data and controlling the M12 receiver becomes the job of a microcontroller. Randy Warner from Synergy Systems has
recommended two microcontrollers to research for this application. Motorola makes one and Atmel manufactures the other. Synergy Systems is a distributor for Motorola GPS receivers. Their technical support for the M12 has proven to be an essential resource for this project.

Once the microcontroller is decided upon most of the development will come from programming and digitally processing the M12 receiver data. Resources for this portion include the ETEC department’s Introl compiler, Flex debugging tools, and endless patience from the program engineer.

Components used for this project will include; Display, M12 receiver, Antenna Microcontroller, Switching Power Supply, and User Interface. Some analog signal processing circuitry may need to be added once testing commences.

Completion of this product will occur in June 2002. Research and development have already begun. Part acquisition will be completed during fall quarter. Programming and development will begin winter quarter and be finished by the end of spring quarter.

This device will be developed to operate outdoors and will not perform properly indoors. For this reason demonstration of this project will include two stages. For my general demonstration I will display the user interface, run through how it works, and run through a simple program displaying the navigation function within the lab confinements. For the technical demonstration the PGPS will be taken outside. I will mark a position near the entrance to the ETEC building called ETEC then travel across campus with another individual, “helper”. I’ll hand the PGPS over to the “helper” and have them select the GOTO ETEC command. By following the user interface the “helper“ will be guided back to the ETEC Mark previously established. This demonstration will provide adequate proof that this project has met the proposed specifications.
Figure 1.

NAVSTAR GPS SATELLITES

Antenna

M12 Receiver

68HC12 Microprocessor

Push Button User

Navigation Display
PGPS

LAT: N 48°43.0327
LON: W122°29.4722
ALT: 1077.7 ft
TIME: 16:20

Tracking Indicator
Satellite Status

User Interface
Navigation

GOTO  Menu  Light  Power