Design and Development of the GLASE Position Location Transceiver

D. Bower[1], M. L. Suen[2], K. J. McGuirk[3], S. Sriram[2], Z. Guo[2], S. S. Periyalwar[2]

[1]Technology Development Division, Waverley Ground Search & Rescue, NS.
[2]Burchill Communication Research Group,Dept. of Elec. Eng., Technical University of Nova Scotia, Halifax, NS.
[3]Applied Microelectronics Institute, Halifax, NS.

Abstract

This paper discusses the design and development of the Position Location Transceiver (PLT) unit of the Global Positioning System (GPS) in the Land Search Environment (GLASE) system. The GLASE system will provide the Waverley Ground Search and Rescue (WGSR) tactical search management team with the exact position information of searchers in the field.

1.Introduction

Search and Rescue (S&R) involves a multi-team, highly complicated operation. New technology, and information and management skills are constantly sought to optimize the S&R operation with respect to the probability of success (POS)

$$POS = POA * POD$$

where POA is the probability of area covered and POD is the probability of detection. The area covered can be maximized when accurate position of the searchers is available. The GLASE project is intended to increase the POD by providing the search team with automatic position information taking advantage of the Global Positioning System (GPS) [1].

An automatic positioning system has many benefits. It would alleviate the ground searcher from doing this task and place more concentration on searching. The command centre would readily have access to the position of any searcher and could assist the searchers if they got lost, or, in an emergency situation, the command centre could immediately dispatch aid to their location if the searchers were unable to radio for help. The intensity of a search could be increased if a clue was found in a given area, thus increasing the effectiveness of a search. These are just a few examples of the benefits of the Global Positioning System (GPS) in the Land Search Environment (GLASE) system being developed by the Waverley Ground Search and Rescue (WGSR) Technology Development Division. GLASE will provide the tactical search management team with the exact position information of searchers in the field.

This paper discusses the design and development of the Position Location Transceiver (PLT) unit of the GLASE system designed and developed by the Burchill Communication Research Group in conjunction with WGSR. Section 2 of the paper presents an overview of the Position Location Transceiver (PLT) unit of the GLASE system. Section 3 contains the conclusions.

2. The Position Location Transceiver (PLT)

The communications component of the GLASE system, namely the PLT, shown in Figure 1, consists of a Mobile GLASE Unit (MGU) carried by the search group and the Base GLASE Unit (BGU) located at the command centre. The PLT unit enables to provide the searcher and the search command centre with the location of search groups in the woods via a display unit and via data communications which is transparent to the users, respectively. Each search group will carry a Mobile GLASE Unit (MGU), which will be used for voice communication and to communicate the coordinates of the search group to the Base GLASE Unit (BGU) located at the command centre (base). Communication between the MGU and BGU takes place over a portable radio operating in the audio range.

A. Mobile Glase Unit:

The MGU carried by each independent search group is a

device that comprises of the GPS receiver, a microcontroller based Mobile GLASE Control Unit (MGCU), a display unit, a radio modem, a portable radio, and a speaker/microphone for voice communication. The prototype developed comprises of the Mobile GLASE Control Unit (MGCU) and the radio modem in one box which will be carried in the searcher's backpack, connected to a handheld display unit. The GPS receiver and the handheld radio are commercially available components.

The GPS receiver [2] is compatible with NMEA 0183 devices. The standard is electrically similar to RS232. The NMEA standard defines the output sentence format.

The portable radio [3] serves both voice and data transmission. Voice transmission has priority over data even when the data connection is already established with the base.

Data transmission is accomplished through an AFSK modem. The AFSK modem TCM3105 is capable of transmitting data at 1200 bps. The transmit signal frequency is 1200 Hz for a mark and 2400 Hz for a space.

Mobile Glase Control Unit:

The MGCU performs the functions of converting the GPS receiver output to UTM coordinates, converting the UTM data to packet format, transmission of packet data to BGU via standard (Bell 202) radio modem, response to polls to the MGU address from the BGU, and automatic data transmission with manual Push To Talk (PTT) for voice communication. The MGCU interfaces with the display unit which displays the UTM coordinates on a back lit screen. The radio modem in the MGCU interfaces with a hand held portable radio.

The micro-controller used in this design is the Intel 8344AH, part of the RUPI-44 family design for applications requiring local intelligence at remote nodes and communication capability among them. Each MGU has a specific address for identification by the base station. The base station has control over which MGU can communicate data and requires an address for each of them. The resident 8344 micro-controller on the MGCU can read a set of 8 DIP switches to determine its address. The set of 8 DIP switches allows for 256 possible addresses. The microprocessor is able to detect voice transmission. A simple method of detecting a voice transmission is to test the push-to-talk (PTT) button on the radio. The MGCU is interfaced to the GPS receiver with an RS232 compatible MAX232 chip, as the electrical interface between the GPS receiver and the 8344.

When the MGCU power is turned on, the MGCU software will run automatically. The software obtains data from the GPS receiver. The GPS data string format is

"$GPVTG,247.,T,267.,M,02.2,N04.0,K
$GPGLL,4438.30,N,06334.11,W"

The information to be extracted from this string is the latitude and the longitude. If no GPS data string arrives within a fixed period, the software will return automatically with an empty string. The software converts the GPS longitude and latitude data to the UTM easting and northing position, and displays the UTM coordinates on the LCD screen. Periodically (every minute), the latest UTM data is saved to a resident register.

The communication between the base and mobile takes place using a hand held radio at both the ends. The MGCU uses a protocol [4] to communicate with the base. The format of the packet is identical to the SDLC protocol format. The entire packet is contained within the starting and ending flags which are both identical (0 1 1 1 1 1 1 0 7E Hex). The packet format is as follows:

From Base to mobile

FLAG	ADDRESS	CONTROL	CRC	FLAG

From Mobile to Base

FLAG	ADDRESS	CONTROL	INFO	CRC	FLAG

The control field information is identical to the SDLC protocol format. The only control format used is Receive Ready (RR) from the base and Receive Ready and Receive Not Ready (RNR) from the mobile. The information field from the base to the mobile is left empty as there is no information exchange from the base to the mobile. Any information can be added without affecting other functions. The entire packet is passed through a CRC checksum generating routine which appends a 16 bit checksum to the packet.

When the base station polls the MGCU, an SIU interrupt is generated. The SIU interrupt service program will switch the radio from receive mode to transmit mode, move the data from external RAM to the transmit buffer and set the SIU transmit ready bit. If the MGCU has not been polled for more than 15 minutes, it will store the latest 15 minutes of data. The software can detect whether the

GPS receiver is unconnected (or unlocked), and outputs some messages. These messages will be displayed on the display unit and also transmitted to the base station.

Display Unit:

UTM data is conveyed to the display unit through the I^2C bus described earlier. The unit is comprised of two PCF8574 I/O expanders, switches for user interface, and a Phillips LBN211F-90 backlit display screen. The two I/O expanders provide the data bus and control signals to the LCD display.

Software routines were written to generate various display conditions, such as whole screen blinking and shifting, and writing character or string to LCD.

B. Base Glase Unit:

The BGU receives all the information transmitted to it from the MGUs, disassembles the information and displays it for the search manager. The BGU consists of a portable radio, a standard Bell 202 radio modem, a Base GLASE Control Unit (BGCU), and a speaker/microphone for voice communication. The BGCU component comprises a personal computer with software to extract UTM coordinates from packets, and allows automatic data transmission with manual Push To Talk (PTT) for voice communication. Data communication of the coordinates from the individual MGUs to the BGU occurs on request from the BGU (software originated), and is transparent to the searcher. Voice communication between the MGU and the BGU takes precedence over data communication.

The modem unit located at the BGU is the interface between the portable radio and PC. The modem board consists of a modem chip, TCM3105, a relay and support circuitry. The modem output feeds into the printer port of the PC located at the base station. The modem board is laid out with an edge card connector. This allows the board to be easily mounted on a PC's printer port.

The Base Station Control Software implements a subset of the link layer SDLC controller. The entire software is coded in 'C' except the time critical loops, which are coded in Assembly language. The menu driven software provides the user with the following choices:

- Start search
- Configure search
- Exit.

The configure search field is used to add or delete new search teams. After entering the necessary information, a search may be started. Once the 'Start search' option is selected,a timer in the bottom right hand corner of the screen begins decrementing each second. When the timer reaches the count 1, the base station starts polling the mobiles whose addresses are listed under the Team # heading during the 'configure search' operation. The keyboard is disabled during the polling. The user can monitor any mobile by typing in the station number.

To request information from the mobile, the base keys the radio, and transmits some zero pattern. This pattern is transmitted to enable PLL synchronization. The base then transmits a packet to the mobile with its address and a request for any information, and then unkeys the radio. The base waits for a predefined time for information from the mobile. If any information is received, the integrity of the data received is checked by computing the CRC check sum and verified with the one transmitted. If they match, the data packet is accepted, and the base then polls the next mobile station for data. If the CRC check sum is in error, or a frame error has occurred during reception, or if the base has timed out, the base issues a poll request again to the same mobile. This process continues until the base receives the information packet from the mobile or the maximum number of tries allotted is exhausted.

While transmitting the information to the mobile, the base uses only the supervisory frame of the protocol as there is no information exchange from the base to the mobile. To key and unkey the radio, the base writes a particular pattern to the corresponding line of the printer port.

Every mobile is polled three times (a variable) to request information from it. After every poll, the base waits for an acknowledgement from the mobile. When all the attempts have failed, the base moves on to the next mobile present in the list.

3. Conclusion

A position location transceiver unit designed and developed for the Waverley Ground Search & Rescue has been discussed in this paper. It is hoped that the prototype units developed for the WGSR will be useful in determining future steps in the automation of position location which is vital to a successful search operation.

Acknowledgement

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References

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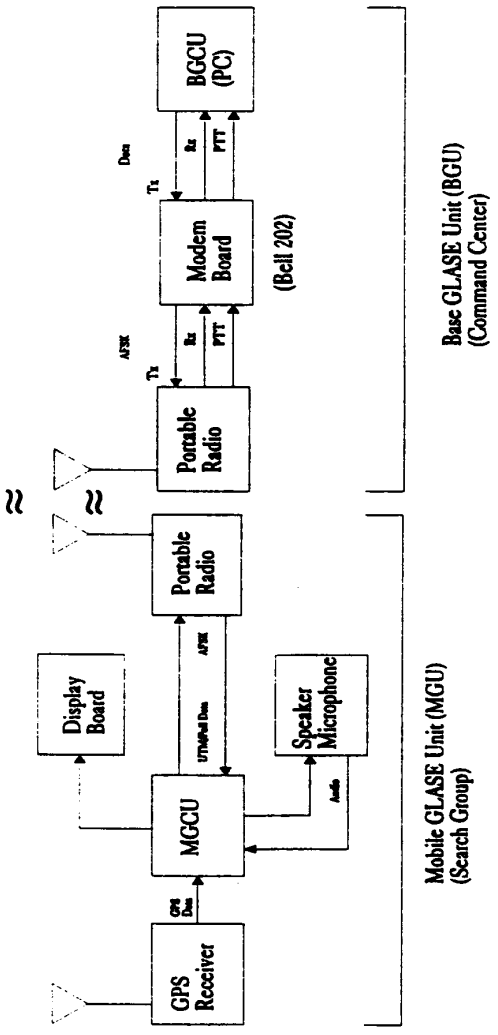

Figure 1Block Diagram of the Position Location Transceiver Unit of the GLASE System