Navigation for the Blind using GPS along with Portable Camera Based Real Time Monitoring

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Abstract: *This paper presents a device for the blind people that provide navigation and real time monitoring. The key idea behind the development of the device relies on providing navigation using GPS receiver with user required location names announcement and user relatives or a remote operator can provide real time assistance by monitoring the video transmitted by a RF camera. The RF camera at the user side acts as a transmission section continuously transmits video streams to RF receiver, acts as a receiving section. The RF receiver with antenna receives the video streams and displays it on the computer monitor using XGA TV box. The receiving video on the computer also contains the audio of the user. By hearing the audio of the user in the video, user relatives or a remote operator provides immediate assistance by identifying the user current staying locations and surroundings during the emergency conditions such as need of any medical help or in unsafe situations.*

Keywords: *ARM7 microcontroller, GPS Receiver, RF Receiver with antenna, Voice module, Wireless RF Camera.*

1. Introduction

According to human physiology vision plays a crucial role. More than 83% of information regarding to environment the human being gets from eye sight. Lack of mobility, orientation and independently travelling, security is the important barriers for the blind people and for partially sighted people everyday facing in their lives. Blind mobility is one of the major challenge, providing a solution for that the scientists still today are facing difficulties in order to provide assistance for the blind people using electronic navigation aids rather than using white canes, trained dogs or a human guide every time with the blind people.

The main aim of this device is blind person can travel independently to his/her desired destination locations using GPS receiver and , user relatives or a remote operator can responds immediately and provides assistance or remote guidance during emergency by monitoring the video stream.

The methodology of the device involves in recording the user required location names in the Voice module, providing navigation to required locations using GPS receiver by receiving GPS signals containing latitude and longitude values from the GPS satellites along with location name announcement from the voice module, monitoring the user from the video on the computer and provides required help.

2. Design Description

The design of the device involves required hardware components and simulation software.

The blind person carried device called as transmission section contains the hardware such as ARM 7 TDMI based LPC2148 microcontroller, SR-92 GPS receiver, APR9600 Voice module, Wireless RF camera.

In order to monitor the blind person, by his/her family relative's or a remote operator the receiving section requires the hardware such as Computer, RF receiver with antenna, XGA TV Box.

The RF camera continuously transmits user staying locations and surroundings in the form of video streams to RF receiver which was connected to PC. The transmitting video stream is a real time video stream.

The block diagram of the proposed device at the transmission section and at the receiving section is as shown in below figure 1.

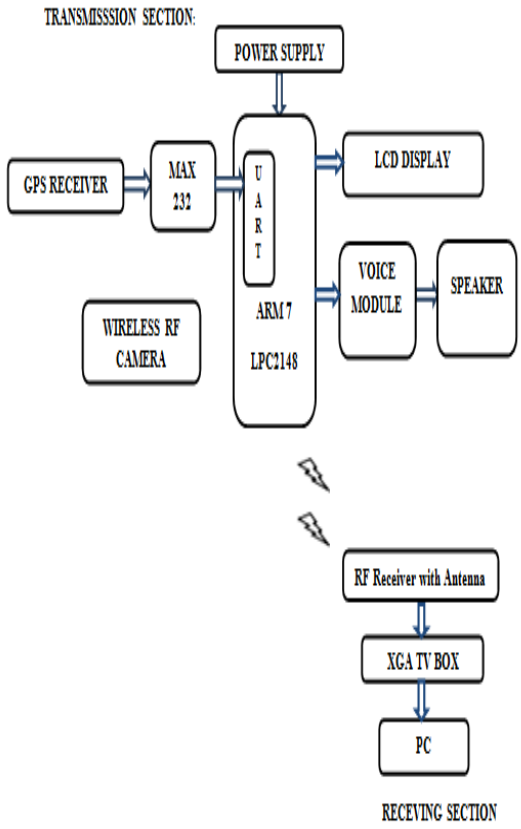

Fig 1: Block diagram of the proposed device.

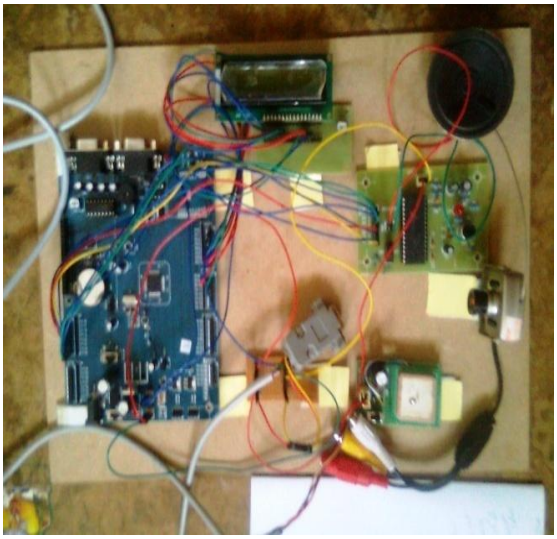

Fig 2: Transmission section contains ARM7 microcontroller, RF Camera, GPS Receiver, and Voice Module with speaker.

Fig 3: Receiving section contains PC, RF receiver with antenna, XGA TV box.

3. Hardware Description

3.1 ARM7 Microcontroller

In this proposed device ARM7 performs processing; holding, comparison process. ARM7 is a major hardware in this proposed device. ARM7 LPC2148 is a 16/32 bit TDMI-S CPU with real time and Embedded ICE logic trace support. It has the flash memory of 128KB/512KB, SRAM memory of 32KB. ARM7 LPC2148 is a 64 pin microcontroller with 2 ports as Port 0, Port 1.The Port 0 has 32 pins (Port 0.0 to Port 0.31). In Port 0 the pins P0.24, P0.26, P0.27 are not available. The Port 1 has 16 pins (Port0.16 to Port 0.31). In Port 1 the pins P1.1 to P1.15 are not available. For critical code size applications ARM 32 bit Mode changes its state to THUMB 16 bit Mode. The THUMB Mode reduces the code by more than 30% with minimal penalty.

3.2 Voice Module

APR9600 Voice module is a low cost device. Voice module provides greater performance in sound recording/playing. APR9600 IC incorporated in the voice module board has flash analogue storage. It has 8 channels as M0 to M8. Each channel stores one voice message. So that a maximum of 8 voice messages can be recorded using onboard MIC present on the voice module board. Single voice message storage duration is 60 seconds. The IC can work in two modes**:** serial access mode and parallel access mode.

1. In serial access mode, sound could be recorded in 256 segments.
2. In parallel access mode, sound could be recorded in 2, 4 or 8 segments.

TABLE 1: APR9600 has 6 message management modes.

Mode	MSEL1	MSEL2	/M8 option
Random Access 2 fixed duration messages	0	1	0 or1
Random Access 4 fixed duration messages	1	0	0 or 1
Random Access 8 fixed duration messages	1	1	1
Tape mode, Auto rewind operation	0	0	1
Tape mode, Normal operation	0	0	1
Tape mode : Replay ,Next ,Restart Operation	0	0	0

In this proposed device the operation of the voice module was in parallel / random access mode called as Random access 8 fixed duration messages mode, because it provides easy indexing to message segments and the recording or playing can be made randomly in any of the selected messages.

3.3 LCD Display

LCD is interfaced with ARM 7 MCU, GPS receiver. User required locations latitude and longitude values were displayed on the LCD and whenever the user reaches his desired location that location name is also displayed on the LCD. It also displays user currently located locations latitude and longitude values.

Fig 4: LCD displays user currently located location Latitude (9) and the Longitude (10) values, where N and E are directions.

3.4 GPS Receiver

Global positioning system is a space based satellite routing system. Now all the users using GPS network known as "NAVSTAR" which was administrated by US Department of Defense referred as "DoD". GPS has cluster of 24 satellites in earth orbit that sends accurate GPS signals and permits the GPS receivers to give data to the users such as displaying precise locations, speed and time, date data. By getting the GPS signals from 3 or more satellites among the availability of 24 GPS satellites , GPS receivers has the ability to triangulate the information and identify the user. Figure 5 below shows the how GPS receiver receives GPS signals that contains latitudes, longitudes, altitude, date and time from the GPS satellites.

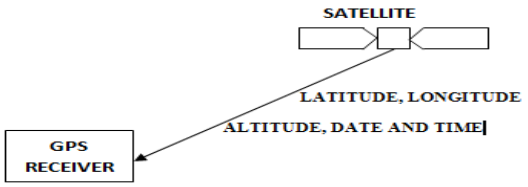

Fig 5: GPS Receiver receiving GPS signal from the GPS Satellite.

SR-92 GPS receiver is used in this proposed device which gives higher performance, by low power utilization. NMEA and SiRF are the 2 protocols maintained by the GPS by means of serial UART I/O RXA/TXA. The commonly used default protocol is NMEA protocol. The NMEA protocol gives 7 NMEA 0183 output messages such as GPGGA, GPGLL, GPGSA, GPGSV, GPRMC, GPVTG, and GPZDA. In this proposed device GPRMC NMEA output message is used.

GPRMC means Recommended Minimum Specific GNSS Data. Example of GPRMC NMEA output message is

$GPRMC,151229.487,A,3723.2475,N,12148.3416,W,0.13,309.62,120598,,,A*5F

TABLE 2: Received GPRMC NMEA output message format.

Contents	Example	Unit	Explanation
Message ID	$GPRMC		RMC protocol header
UTC Time	151229.487		hhmmss.sss hh: hour, mm: minute, ss: second
Status	A		A: Data valid, V: Data invalid
Latitude	3723.2475		ddmm.mmmm dd: degree, mm.mmmm: minute
North/South	N		N: North Latitude, S: South Latitude
Longitude	12148.3416		dddmm.mmmm dd: degree, mm.mmmm: minute
East/West	W		E: East Longitude, W: West Longitude
Speed over ground	0.13	knots	Receiver's speed
Course over ground	309.62	degrees	Receiver's direction of travel Moving clockwise starting at due north
Date	120598		ddmmyy dd: Day, mm: Month, yy: Year
Magnetic variation		degrees	This receiver does not support magnetic declination. All "course over ground" data are geodetic WGS84 directions.
Mode Indicator	A		A: Autonomous, D: D-GPS, N: Data not valid
checksum	*5F		A: Autonomous M: Manual D: DGPS S: Simulation E: Dead Reckoning N: Data Invalid
<CR><LF>			End of sentence

3.5 Wireless RF Camera With RF Receiver

In order to send video stream continuously wireless RF camera is used. For audio hearing purpose RF camera has inbuilt microphone. RF camera video transmitting frequency is ISM 2,400~ 2,483 MHZ, its transmission range is 1.2 GHZ. RF receiver video receiving frequency is ISM 2,400 ~ 2,483 MHZ. In open space the video transmission range was 100 meters.

4. Implementation

I. In the voice module user required location names need to be recorded. So 8 location voice messages was recorded using onboard MIC which was inbuilt on the Voice module board.

II. Then using SR-92 GPS receiver take user required locations GPS signals that contain latitude and longitude values displayed on the LCD connected to ARM7 and then store those received values on the ARM7. Now whenever the user of the device goes to those places for the next time with this device ARM7 holds current location latitude and longitude values. Then ARM7 MCU compares both stored and current values if both values are matched voice module gives location name announcement and LCD gives location name display.

III. If the user relatives or a remote operator wants to know where the user was currently staying in a particular location or whether the user reached his desired destination or whether the user was in safe situation, or whether the user needs any immediate assistance .This task is completed by monitoring the user on the video transmitted by the camera to PC. As the transmitted video also contains audio of the user thereby user relatives or a remote operator provides remote immediate assistance to the user.

5. Software Simulation

The software tools used for programming the proposed device are:

1. KEIL µVision IDE.
2. Flash magic 8.8 versions for ARM 7.

The KEIL µVision Integrated Development Environment (IDE) unites Project managing capability and supporting facilities such as writing and editing of the source code, debugging of written source code and complete simulation in one environment. This KEIL µVision software is an IDE (Integrated Development Environment), which integrates a text editor (used to write programs) and a compiler and IDE can translate the source code to hex files.

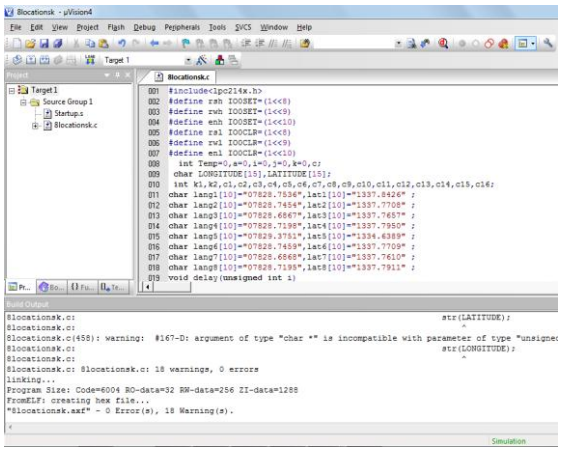

Fig 6: KEIL window.

Flash Magic is usually a tool or an application generally used to dump the source code into IC of Microcontrollers. Flash Magic is also called as an application based specific tool. Flash Magic erases part or all of the flash memory and Programs a hex file into the device.

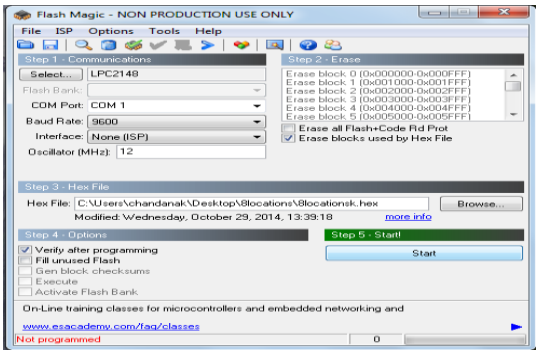

Fig 7: Flash magic window.

6. Conclusion

Earlier majority of the blind people uses white canes or trained dogs for guidance and not preferred to use electronic travelling devices. The underlying reasons for this involves devices are more costs and provides poor satisfaction to users coupled with existing electronic systems. So in this proposed system I tried to design a low cost, user friendly device for visually impaired people with highest possible precision. In this developed device I have used ARM 7 microcontroller whose processing speed is high. This device provides navigation using GPS and gives location name voice announcement and also provides remote guidance for the blind people by transmitting the video to user's relatives or a remote operator for providing real time assistance during emergency. However, there are still restrictions in the proposed system. The proposed device can't work in indoor environment because a GPS receiver receives no signals from the GPS spaced based navigation system. On the other hand, RF camera transmitted video stream was travelled to few distances at the RF receiver. Further, the users required a period of time to trust the device working in the real time situation and the users often need to learn how to use the device.

The future scope of this project is, device is designed with ZIGBEE camera whose video transmission range is more and the transmitted video stream is coded using Indeo Video 4.5 and then stacked into TCP/IP packets and transmits over the GSM network with an internet. Then two way voice communications is established between the user's relatives or a remote operator and the user, with the audio coded using Pulse Code Modulation. Both the voice messages and the GPS readouts are sending via UDP packets and use more accuracy DGPS receivers to provide navigation.

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