GPS based Voice Enable Roaming Assistant for the Blind

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Abstract— There are millions of vision impaired people around the world who are facing difficulties in carrying out their day to day activities involving roaming toward a certain destination. There are many ways by which they can be guided safely and efficiently toward a predefined location. The goal of this paper is to design a suitable, user-friendly and cost-effective system that helps a blind person in roaming around. Global Positioning System (GPS) is a space-based satellite navigation system that provides location and time information in all weather conditions, anywhere on or near the Earth. GPS based voice alert system collect the positioning information from GPS receiver and gives the positioning information to blind people by using voice. This goal is done by using a microcontroller-based system. The system has a dynamic user interface and is easily operable. The system is realized using a GPS module (SIMCOM 458c) and a Voice Module (ISD 1760) interfaced with an ATmega 128 microcontroller. The working of the system incorporates two stages; first, the location-based audio recording stage and second, the navigation of the blind person using the signal received from the GPS receiver. The system employs a user-friendly design and provides an automatic location detection mechanism and location name announcement system.

Index Terms— GPS, Navigation, Roaming Assistant, Audio recording and playback, User Interfaces, ATmega 128 microcontroller

1 INTRODUCTION

Global Positioning System (GPS) is a U.S. space-based radio navigation system that provides reliable positioning, navigation, and timing services to civilian users worldwide on a continuous worldwide basis [1], [2], [3], [4], [5], [6]. For anyone with a GPS receiver, the system will provide location and time [1], [2], [3], [4], [5], [6]. GPS provides accurate location and time information for an unlimited number of people in all weather, day and night, anywhere in the world [1], [2], [3]. GPS based location detection with voice-based location announcement system intellectually and accurately finds its correct location and correspondingly notifies a blind person if it was on the route toward reaching his current destination [3], [4]. A microcontroller coordinates the activities of GPS receiver and the automated triggering of the playback mechanism of the respective predefined voice message upon receiving location information from the receiver [3], [4].

Microcontroller acts as the heart of the device. It stores the data of the current location received from the GPS system and compares it with the one stored in the memory to check whether the blind person is on the right track or, not [3], [4], [5]. GPS module is the main component of this project that connects with the satellite using GPS antenna, collects location data and sends received data to the microcontroller by using Tx pin of it[3] [4], [5]. The microcontroller then compares the received data with the pre-specified one. Depending on the result of the comparison, it activates the playback circuit and displays the position information as well.

2 SYSTEM REQUREMENTS

2.1 Hardware

2.1.1 Voice Module (ISD 1760)

ISD1760 [7] ChipCorder Series is a high quality, fully integrated, single-chip multi-message voice record and playback device which is a very suitable hardware component for different kind of electronic systems. Here users can define the duration of the message in the range from 26 seconds to 120 seconds on the basis of a particular device and also with the help of an external resistor user can adjust the sampling frequency of each device from 4 kHz to 12 kHz. The Operating voltage range of this module is from 2.4 V to 5.5V.

2.1.1.1 Features

Integrated message management systems for single-chip, push-button applications

REC: Level-trigger for recording

PLAY: Edge-trigger for individual message or level-trigger for looping playback sequentially

ERASE: Edge-triggered erase for first or last message or level-triggered erase for all messages

FWD: Edge-trigger to advance to the next message or fast message scan during the playback

VOL: 8 Levels output volume control

RDY INT: Ready or busy status indication

RESET: Return to the default state

ISD1760 goes through automatic power-down after each operation cycle.

Selectable sampling frequency can be controlled by an external oscillator resistor

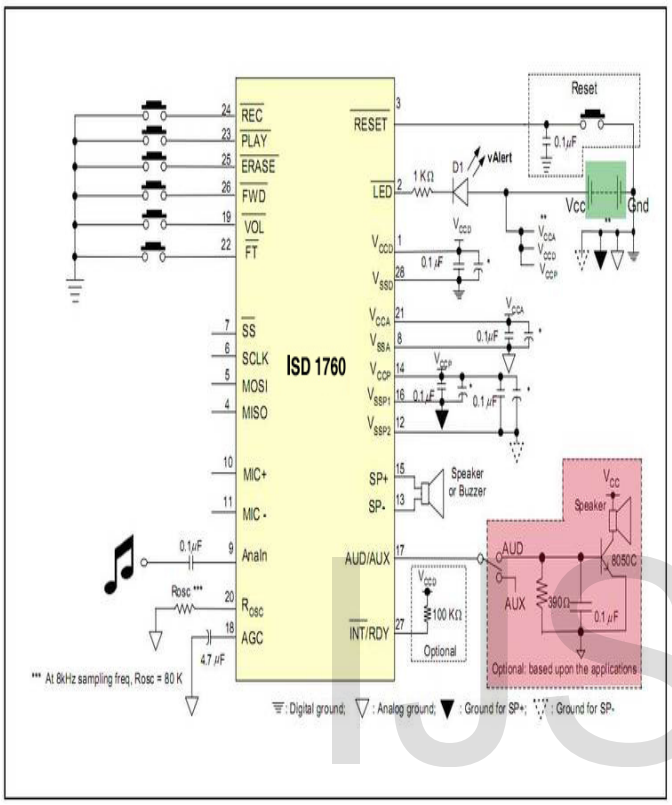

Figure 1: Circuit diagram of Voice Module (ISD 1760)

The value of the oscillator resistor can manipulate the duration of the recording time, depending on the sampling frequency selected.

Following table shows the sampling frequency and the corresponding resistor values.

Sampling Frequency	12 kHz	8 kHz	6.4 kHz	5.3 kHz	4 kHz
Oscillator Resistor Value	53 kΩ	80 kΩ	100 kΩ	120 kΩ	160 kΩ

Table1: Selectable oscillator resistor values

A wide range of message duration can be achieved ranging from 20s to 480s based on the sampling frequency chosen as tabulated below.

Sampling Frequency	**Duration of Voice Message**
12 kHz	40 seconds
8 kHz	60 seconds
6.4 kHz	75 seconds
5.3 kHz	90 seconds
4 kHz	120 seconds

Table2: Selectable message duration

2.1.2 Microcontroller

Microcontroller ATmega128 [7] coordinates the overall operation of the project. The Atmel® AVR ATmega128 is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the ATmega128 achieves throughputs approaching 1MIPS per MHz allowing the system designer to optimize power consumption versus processing speed.

The ATmega128 contains 128 kbytes On-chip In-System Reprogrammable Flash memory for program storage. Since all AVR instructions are 16 or 32 bits wide, the Flash is organized as 64K x 16. For software security, the Flash Program memory space is divided into two sections, Boot Program section and Application Program section.

2.1.2.1 Features of ATmega128

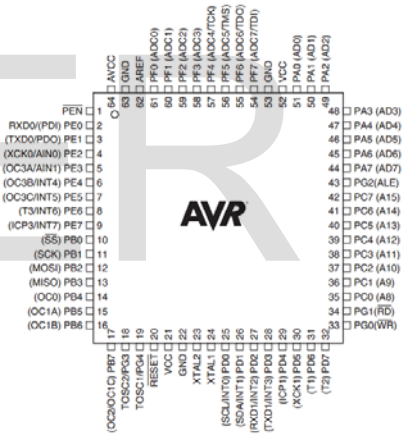

Figure 2: Pin diagram of ATmega128 Microcontroller

• High-performance, Low-power Atmel®AVR®8-bit Microcontroller

• Advanced RISC Architecture
– 133 Powerful Instructions – Most Single Clock Cycle Execution
– 32 x 8 General Purpose Working Registers + Peripheral Control Registers
– Fully Static Operation
– Up to 16 MIPS Throughput at 16 MHz
– On-chip 2-cycle Multiplier

• High Endurance Non-volatile Memory segments
– 128kbytes of In-System Self-programmable Flash program memory
– 4kbytes EEPROM
– 4kbytes Internal SRAM
– Write/Erase cycles: 10,000 Flash/100,000 EEPROM

– Data retention: 20 years at 85°C/100 years at 25°C
– Optional Boot Code Section with Independent Lock Bits
In-System Programming by On-chip Boot Program

2.1.3 Power supply unit

A battery acts as the power supply unit to the microcontroller, GPS module, voice IC and LCD display. The level of voltage is fixed at 5V by LM7805 regulated IC as required by the microcontroller and the LCD display to operate [7]. GSM part requires 4.2V to become active whereas, GPS part needs 3.3V and playback circuit needs 2.45 to 5.5 V to operate [7].

2.1.4 Miscellaneous items

■ An LCD display is incorporated in the project for better user interface. Its primary use is to display the latitude and longitude of the current location although displaying location information is of no help for a blind person.

■ Two different colored LED's are used to indicate the type of data received from the GPS receiver.

■ A Speaker is incorporated for announcing the already recorded message in the voice module.

2.2 Software

2.2.1 Proteus Virtual System Modeling (VSM)

PROTEUS combines advanced schematic capture, mixed mode SPICE simulation, PCB layout and auto routing to make a complete electronic design system [8].
PROTEUS product range also includes revolutionary VSM technology, which allows simulating micro-controller based design with all the supportive electronic components [4].

2.2.1.1 Product Features

• ISIS Schematic Capture which is an easy to use yet an extremely powerful tool for entering design requirements
• PROSPICE Mixed mode SPICE Simulation industry standard SPICE3F5 simulator upgradable to unique virtual system modeling technology
• ARES PCB Layout
• Modern Graphical User Interface (GUI) standardized across all modules
• Runs on Windows 98/ME/2000/XP or, later version
• Technical Support directly offered from the author
• Rated best overall products

3 Block Diagram

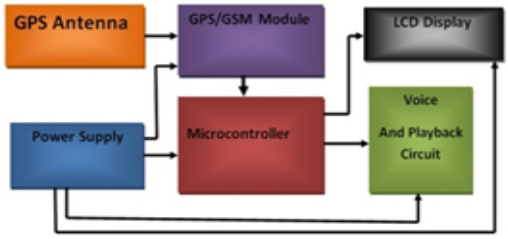

Figure 3: Block diagram of the complete system

Figure 3 depicts the block diagram of the project. The GPS module receives location data from the satellite in the coordinate system and is sent to the microcontroller. A microcontroller always monitors or receives location data from the GPS module and detects or, tries to match the received location data with the predefined location information for the current route as stored in the memory. If a perfect matching is found, a corresponding voice message will be played back by the voice playback circuit.

4 Simulation of the Project in Proteus

The program we adopted for simulation is Proteus VSM release 7.10 sp2. It is possible to simulate complete microcontroller based system and thus helps a developer to develop the software without access to a physical prototype. This is a real advantage for developing a top quality design. To understand various developing features, a step by step guidance will be very helpful.

Firstly, necessary components namely ATmega128 microcontroller, Simcom 548C, 7805 voltage regulator, capacitor, resistor, transistor, LCD display, voice IC etc. are placed in the schematic layout in a systematic order. The library browser is used to browse for the components. Finally, a complete layout is designed as depicted in Figure 4.

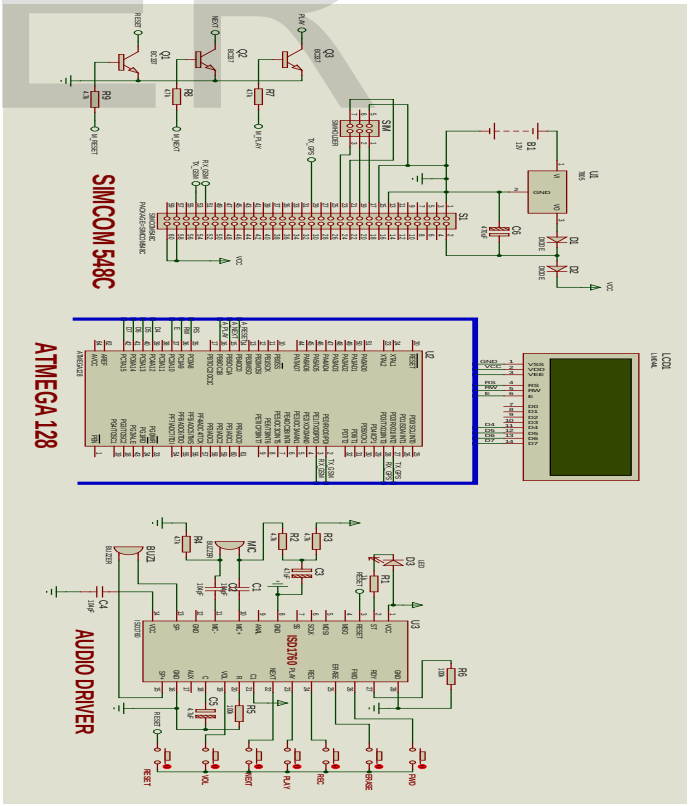

Figure 4: Complete Schematic Layout of the project in PROTEUS

5 Flow chart (the working princple)

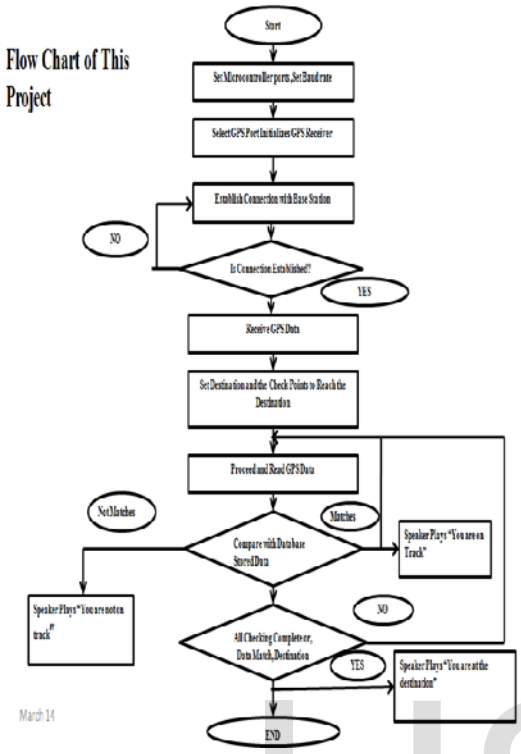

Figure 5: Flow chart of the project

In Figure 5, the flow chart of the project is shown. When the system is powering up, it initializes input and output ports of the microcontroller. When location data is received by the GPS module and then sent to the microcontroller, it is compared with predefined data as stored previously in the database; if any matching occurs with predefined data, the microcontroller activates its respective ports and directs the voice module to play respective voice messages and displays corresponding preset messages as well. If location data does not match with any predefined data, the system comes back to its initial state and the process will continue.

6 Result

The GPS-based voice alert system plays recorded voice when a blind person follows the destination path toward reaching a target location. The location name in terms of voice and text message is prerecorded in the voice circuit and the microcontroller's memory. So when a blind person reaches a position on his route, voice circuit plays back the voice message and the LCD display shows the location name with latitude and longitude.

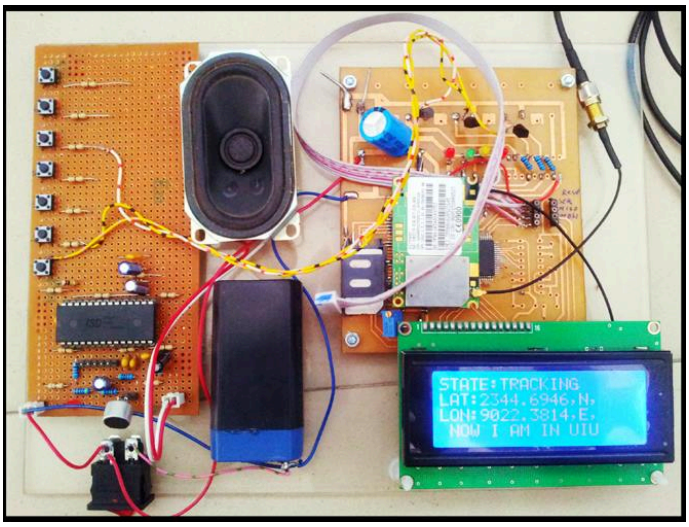

Figure 6: Complete hardware circuit of the project

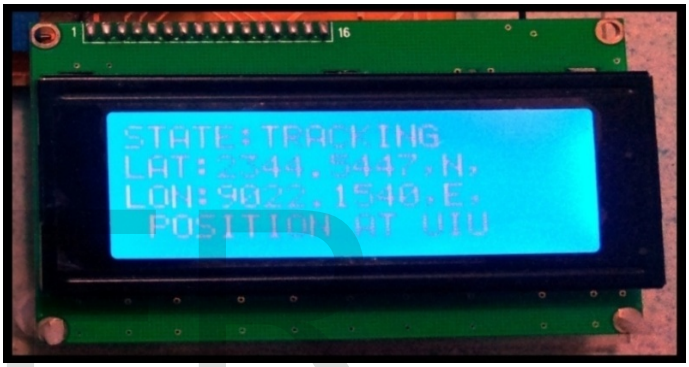

Figure7: Displaying location with Latitude and Longitude

7 Conclusion

The complete project divided into three parts; the GPS part provides positioning information, voice and playback section records and plays the voice and microcontroller act as the overall coordinator programmed in such a way that depending on the satellite information it triggers the playing of different voice messages which are predefined by the user.

8 Future scope

This project can be extended by using GSM. When a GSM module is used, it may communicate with the blind person's near and dear ones sending messages and thus provides with the roaming person's current location on the route to the destination. Also using sonar technology, the blind person can safely move through his/her destination path.
If the person feels any obstacle, sonar message alerts the person about the presence of the obstacle.

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