Design of Smart Voice Guiding and Location Indicator System for Visually Impaired and Disabled Person: The Artificial Vision System, GSM, GPRS, GPS, Cloud Computing

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Abstract—GPS is employed to find the position of the user on the earth. This information is provided by the GPS with the help of the data it receives from the satellites. GPS based voice alert system for the blind uses the current location and gives the alert to the blind man if it was his destination area. This paper describes the concept using a microcontroller based system. The system has a dynamic user interface and is easily operable. The system is realized using a GPS module (SR-92) and a Voice Module (APR9600) interfaced with a PIC16F877 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 from the GPS receiver. The system employs a user friendly design and provides for an automatic location name announcement system.

Keywords: GSM, GPS, Ultrasonic sensor, ETA, Navigation, Audio input-output, User Interfaces, PIC microcontroller

I. INTRODUCTION

The Global Positioning System (GPS) is a U.S. space based radio navigation system that provides reliable positioning, navigation, and timing services to civilian users on a continuous worldwide basis. For anyone with a GPS receiver, the system will provide location and GPS provides accurate location and time information for an unlimited number of people in all weather, day and night, anywhere in the world. GPS based blind man device with user input interfacing (voice based) intellectually finds the current location and gives the alert to the blind man if it was his destination area. Microcontroller is the heart of the device. It stores the data of the current location which it receives from the GPS system, so that it can make use of the data stored to compare with the destination location of the user. By this it can trace out the distance from the destination and produce an alarm to alert the user in advance. This device is designed to provide a voice based announcement for the user, i.e., the user gets the voice which pronounces his destination location as and when he is about to reach the destination. Here instead of an alarm sound the blind man can directly hear the location recorded by the user itself.

II. SYSTEM DESIGN

The proposed design for smart stick distinctly consists of three units:
- The GPS Unit.
- The Obstacle Detection Unit.
- GSM Unit
- The Artificial Vision System
Basic Hardware

1. **Voice Module (APR9600)**
   APR9600 is a low-cost high performance sound record/replay IC incorporating flash analogue storage Technique. Recorded sound is retained even after power supply is removed from the module. The replayed sound exhibits high quality with a low noise level. Sampling rate for a 60 second recording period is 4.2 kHz that gives a sound record/replay bandwidth of 20Hz to 2.1 kHz.

2. **Microcontroller**
   The microcontroller used for this system is PIC16F877A. The PIC families of microcontrollers are developed by Microchip Technology Inc. Currently they are some of the most popular microcontrollers, selling over 120 million devices each year. There are basically four families of PIC microcontrollers:
   - PIC12CXXX 12/14-bit program word
   - PIC16C5X 12-bit program word
   - PIC16CXXX and PIC16FXXX 14-bit program word
   - PIC17CXXX and PIC18CXXX 16-bit program word

Basic Software

1. **Express PCB**
   This software is used for designing the circuit. Breadboards are great for prototyping equipment as it allows Great flexibility to modify a design when needed; however the final product of a project, ideally should have a Neat PCB, few cables, and survive a shake test. Not only is a proper PCB neater but it is also more durable as there are no cables which can yank loose.

2. **PIC Compiler**
   PIC compiler is software in which the machine language code is written and compiled. After compilation, the machine source code is converted into hex code which is to be dumped into the microcontroller for further Processing. PIC compiler also supports C language code.

3. **Proteus**
   Proteus is software which accepts only hex files. Once the machine code is converted into a hex code, that hex Code has to be dumped into the microcontroller and this is done by
Proteus. Proteus is a programmer which itself contains a microcontroller in it other than the one which is to be programmed. This microcontroller has a program in it written in such a way that it accepts the hex file from the PIC compiler and dumps this hex file into the microcontroller which is to be programmed.

III. OBSTACLE DETECTION UNIT

Electronic Travel Aids (ETA) has been classified in three classes:
1. Obstacle detectors
2. Environmental sensors

The first class is based on sensory or artificial vision systems. The sensory systems emit Ultrasonic or laser beams to the environment, which are reflected by the object; the system calculates the distance from the object according to the time difference between the emitted and received beam. The stereo-vision systems use the object tracking algorithms and calculate the distance by using grayscale method (voice). The proposed system uses ultrasonic sensor which basically works on the principle of the ultrasonic sound generation and alert mechanism. The system is however having a dual feedback mechanism i.e. it has an additional vibratory feedback mechanism. This enhances the overall feedback received by the blind user who receives the outputs generated in different formats of vibration i.e. high, low, medium and strong vibrations.

IV. MICROCONTROLLER

The microcontroller used in this GPS and GSM based device with user input interface can be Preferably ARM7TDMI based LPC2148 microcontroller, which is having 512KB flash memory and 8 to 40 KB of SRAM and several peripherals. The ARM7TDMI-S is a general purpose 32-bit microprocessor. Unique accelerator architecture and a 128-bit wide memory interface enable 32-bit code execution at the maximum clock rate. The GSM module and GPS will communicate using RS232 protocol with microcontroller.
V. GSM, GPS MODULES AND CLOUD COMPUTTING

The Global Positioning System (GPS) and Global System for Mobile communications (GSM) are interfaced to the microcontroller to detect the blind person location. The proposed Architecture consists of a GPS signal receiver and GSM, vibratory circuitry connected to ARM7. This complete setup will be fixed to stick. The GPS will be sending the location information to the controller continuously. The same will be routed to the GSM modem through the controller. GSM will forward this information to the pre-fed mobile nos. the user after receiving the message. If the person wants to know the location of the blind person, he has to send one message like TRACK immediately he will get the blind person location coordinates.

VI. VOICE RECORDING AND WORKING PROCEDURE

In this system, the GPS receiver and the control buttons are the input modules to the microcontroller while the Voice module and the LED indicators are the output modules to the microcontroller.
The working of the system can be divided into two phases. The first phase would involve recording of the voice in the voice module. For this, we have to switch ON the voice module by connecting the power supply (batteries). Then, using a push button and different selection buttons we record the voice. Since we are using eight selection buttons in this system we can record eight different voice messages. There is a simple process involved in recording these eight messages. For recording a message we need to press the push button, followed by the selection button. While both the buttons are pressed, we hear a beep sound from the speaker, indicating that we can release the push button. While still holding the selection button, we can record a 5sec message. When we finish recording, the selection button is released. In order to hear what we have recorded, we just need to press and hold the corresponding selection button for 1sec and the recorded message would be replayed.

The second phase deals with receiving the signal from the GPS receiver and actuating the voice module using the microcontroller. To implement this phase, we switch ON the main power supply to the microcontroller. Next, we show the GPS to the open sky for receiving the satellite signal. When the satellite signal is received by the GPS, the latitude and longitude of the current location is displayed on the LCD. If the data received from the GPS receiver is Active data then the yellow LED will glow, if the data is Void data then the red LED will glow. Active data means, when the GPS receiver gets the satellite signal it will give the current location values. Void data means if the GPS Receiver is unable to get the satellite signal it will give the previous data which may not be current location value. After getting the signal, if we want to store the present location as an alerting location for the blind person, the following procedure will do the needful –

1. Press and hold the control button
2. Press the restart button
3. Release the restart button after 1sec
4. Hold the control button until the LCD displays ‘the current location is saved’

Like this we can store 3 different locations by using the control buttons. These values will be stored into the EEPROM which is a non-volatile memory. We just have to make sure that the distance between the two locations is greater than 100 meters. After storing the location(s), we need to restart the system. Now when the blind person enters these regions (locations) with this system the voice module will announce the location names as we had recorded them with respect to the stored locations.

VII. CONTROL BUTTONS

These are used to record the voice and play the voice.
VIII. ARTIFICIAL VISION UNIT
This Unit provides the overall edge to the proposed work so far. With the variety of obstacle detection devices available and GPS emerging as a commonly preferred technology in blind navigation kit there is a need for providing overall assistance to the blind about the environmental information to make navigation more safe and secure. The unit comprises of getting the data from the environment, assembling the information and extracting the required information required by the blind user. This incorporates extracting data about the environment and providing information about the: static and dynamic objects around the blind user. The system can make use of stereo camera and processing unit, which process the data. Environmental information acquisition and image processing algorithms represent the artificial vision system. The hardware of the system is based on a pair of stereo cameras mounted on a helmet connected via connectors to a portable computer. The system speed achieves 25 frames per second due to the special Express card which allows external power supply. Actually, it runs at a rate of around 6 frames per second, working on 320x240 images, when dealing with only single dominant object. The artificial vision system is able to detect the objects which have a major importance, such as humans, cars, buildings, trees, animals and free spaces covering a range of 64º at a distance between 1 and 15m. However, the primary aim of the artificial vision system is to identify objects moving independently in the scene and to extract sufficient information from it for the cognitive feature, which will later judge if the detected object poses any danger for the visually impaired user. The objective can be achieved by implementing a series of key points: algorithms of scene segmentation, object detection, depth map and Bounding Box estimation.

All this algorithms are needed to be studied and analyzed to be practically implementable with the system. Image capturing, data analyzing and generating proper feedback are the core set of actions which are expected to be executed by this system.

IX. RESULT
The “GPS based voice alert system for the blind” is designed so as to alert the blind person through voice alerts when he enters into a particular location by announcing the location name. The locations names are prerecorded in the voice circuit and are announced when the person reaches those particular locations.

X. CONCLUSION
The system designed consists of a GPS receiver and a voice circuit which is interfaced to the microcontroller. The microcontroller is programmed in such a way that depending on the satellite information of location the predefined location name will be announced. The only major disadvantage of this system is the time taken by the GPS to receive its initial signal from the satellite, i.e., when it is switched ON. The above disadvantage can be removed by using a higher efficiency GPS receiver.

XI. FUTURE SCOPE
This project can be extended by incorporating a GSM module. We can interface this module to send messages to the near and dear ones of the Blind person regarding his/her current position. Doing so, we can track the Movement of the Blind person in a very efficient manner.

REFERENCES
