OBSTACLE DETECTION USING ULTRASONIC FOR THE BLIND WITH GPS AND GSM

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ABSTRACT

Describes an ultrasonic blind stick with a GPS tracking system. In the past, people who are blind have used a stick to check for obstructions in their path. However, there are a number of inefficiencies with this stick, and using it presents a number of difficulties. This project seeks to improve navigational aids for the blind. The addition of sensors makes object identification easier, making the ultrasonic blind walking stick significantly more sophisticated than the conventional walking stick. His present location is shown by GPS technology. To assist the blind in finding their stick if they lose track of where they put it, the system has one additional cutting-edge feature built in. For lost objects, a wireless RF-based remote control is used. With this technique, obstacles can be detected as well as lost objects like sticks. This stick also can detect water on the ground. For blind people, this stick also indicates whether it is day or night. This essay examines the construction of the stick and how it will benefit blind people. There are many approaches, and we are drawing beneficial ideas from each paper.

Keywords: blind navigation, obstacle detection, ultrasonic sensors, GPS, GSM communication, MEMS sensors, visually impaired, wearable technology.

1. INTRODUCTION

People who are visually impaired encounter special difficulties in their daily lives, particularly when it comes to mobility and navigation. For their safety, freedom, and general well-being, it is essential that they can identify and avoid barriers. Even though a number of assistive technologies have been created to solve these issues, many of the current solutions have shortcomings in terms of accuracy, real-time data, and usability.

To aid blind people in obstacle identification and navigation, this research article suggests a revolutionary system that integrates ultrasonic sensors, GPS (Global Positioning System), and GSM (Global System for Mobile Communications) technology. By fusing these technologies, it is hoped that users would be able to navigate their environment with more assurance and independence thanks to real-time obstacle identification, precise position information, and communication capabilities.

The architecture of the system is made up of three primary parts: GPS, GSM, and ultrasonic sensors. Obstacles that are close to the user can be found using ultrasonic sensors. The sensors can calculate the distance to the obstacles by emitting high-frequency sound waves and measuring the time it takes for the waves to bounce back. GPS technology is used to provide precise location data, including latitude, longitude, and altitude. The computation of navigational instructions and the provision of location-based warnings both depend on this location data. The use of GSM enables the delivery of obstacle alerts, navigational directions, and emergency communication by establishing a real-time connection between the user and a centralized monitoring system.

2. Literature Survey

Huang, Y., Liu, Y., Chen, C., et al. (2017) an ultrasonic sensor-based wearable obstacle detection system for people with vision impairments. 47(1) of the IEEE Transactions on Human-Machine Systems, 40–50.
This work offers a wearable ultrasonic sensor-based obstacle detection device for blind people. The technology detects obstructions using a collection of ultrasonic sensors and provides feedback to the user via vibrations. The authors evaluate the system's efficacy in terms of user-friendliness and precision of obstacle identification.
(2018). Chang, K., Li, W., Hsu, et al. A smart cane with an ultrasonic sensor to help the blind. 2810 in Sensors, 18(9).
This research introduces a smart cane with an ultrasonic obstacle detection sensor to help visually impaired people. The technology gives the user aural feedback based on the distance to obstructions to enable safer navigation. The authors' trials demonstrate the system's efficacy and users' contentment.

Integration of GPS and GSM for Navigation Support:
(2016) Shen, Y., Cheng, Z., and Hu. A navigation device using GPS and GSM for those who are blind. 12(4), 5326907 International Journal of Distributed Sensor Networks.
This study suggests a GPS and GSM-integrated navigation system for people with vision impairments. The technology offers real-time voice instructions, supports users in locating their current location, and generates navigation routes. The correctness and usability of the system are evaluated by the writers.
Applications of MEMS sensors in assistive technology

Rashid, N. Hamid, S. Khalid, and others (2017). a review of wearable MEMS sensors for body movement tracking in healthcare applications. 794; Sensors; 17(4).The use of MEMS (Microelectromechanical Systems) sensors in healthcare, including assistive technology, is covered in this review article. To create navigation and obstacle detection systems for the blind, it gives a general overview of the many MEMS sensors used to track body motions.

3. Objective

The major goal of this project is to integrate ultrasonic sensors, GPS, GSM, and MEMS sensors to create a comprehensive obstacle detection and navigation help system for visually impaired people. The following are the study's particular goals:
Design and implementation of an obstacle detection system: Create a system that uses ultrasonic sensors to quickly identify barriers. To do this, a sensor array must be designed, obstacle detection algorithms must be created, and signal processing methods must be used to filter and categorize obstacles.
GPS integration for precise positioning: Use GPS technology to give visually challenged people precise positioning data. Create algorithms that can follow the user's movement, determine their present location, and produce navigational routes.
Integration of GSM for communication: Incorporate GSM technology to enable communication capabilities within the system. Develop a communication module that allows users to send and receive information, such as emergency alerts, assistance requests, and communication with carers or emergency services.
MEMS sensor integration for improved functionality: Investigate the use of MEMS sensors in the suggested system to improve its functionality. Examine how MEMS sensors can be used to keep track of body movements, spot environmental changes, or provide further context for navigating and spotting obstacles.

Analyze the usability and performance of the system. Perform in-depth analyses and performance testing on the created system. To evaluate the system's usability and user experience, evaluate the precision of obstacle detection, the accuracy of GPS positioning, the efficacy of GSM connectivity, and gather input from users who are blind or visually impaired.

4. Existing System:

Ultrasonic sensors, GPS, and GSM technologies are a few of the modern assistive technology solutions available to the blind. Although exact implementations may vary, the general concept is to increase mobility and safety by recognizing obstructions, providing location-based information, and enabling real-time communication.

A wearable gadget that combines ultrasonic sensors, GPS, and GSM connectivity is one illustration of an existing system. The visually challenged user often wears the gadget, which is made up of a microcontroller or small computer, ultrasonic sensors, a GPS module, and a GSM module.

To identify barriers in the user's immediate environment, the wearable device's ultrasonic sensors are placed in crucial locations. By monitoring how long it takes for high-frequency sound waves to return after interacting with an object, these sensors may be used to measure distances.. The device notifies the user via tactile or aural feedback when an obstacle is found within a predetermined range.

The system's GPS module collects satellite signals to determine the user's current location and provide navigational guidance. The user's heading, speed, and distance to particular points of interest are calculated using algorithms. The user can then navigate their desired paths thanks to the processing and relay of this data to them via audio or tactile cues.

Overall, the incorporation of GPS, GSM, and ultrasonic sensors into current systems has prepared the way for considerable improvements in obstacle identification and navigation support for the blind. Researchers and developers are continuously working to produce more dependable, accessible, and user-friendly solutions to empower people with visual impairments by utilizing these technologies.

5. Methodology

The proposed system architecture integrates ultrasonic sensors, GPS (Global Positioning System), and GSM (Global System for Mobile Communication) technologies to produce an improved obstacle detection and navigation system for the blind. To improve the mobility and safety of blind people, the architecture is designed to offer real-time obstacle detection, precise location information, and communication capabilities.

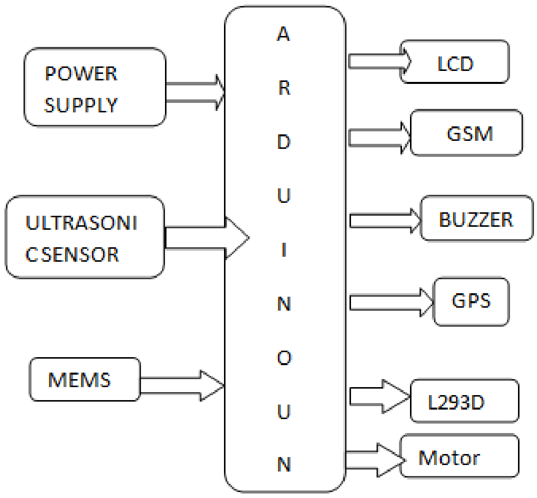


Fig: Block diagram of the proposed system

The suggested obstacle detection system employing GPS, GSM, and ultrasonic sensors requires several stages to be implemented. A general description of the implementation procedure is given below:

5.1Setup of Hardware

a. Purchase the essential hardware, such as ultrasonic sensors, a microcontroller or single-board computer, a GPS module, a GSM module, a power supply, and any other elements that may be needed.

b. Using the appropriate cabling and connections, attach the ultrasonic sensors to the microcontroller or single-board computer.

c. Follow the manufacturer's instructions when attaching the GPS and GSM modules to the microcontroller or single-board computer.
d. Attach the power supply to the system, giving each component the appropriate power.

5.2 Software Development

a. Create the firmware or software for the single-board computer or microcontroller.
b. Implement algorithms, such as signal processing methods, distance estimation, and obstacle identification, for ultrasonic obstacle
c. Create GPS data processing software that includes navigation, tracking, and location computation algorithm

5.3 System Integration:

a. Put the hardware pieces together and check that all the connections are solid.
b. Install the software or firmware on the microcontroller or single-board computer..
c. Completely test the integrated system, ensuring that all of its components work properly and communicate with one another.
d. Address any problems or defects that develop throughout the integration process

6. Related Work:

Following is a quick explanation of each of the modules used in this paper:

ARDUINO UNO:

A microcontroller board called the Arduino Uno is based on the ATmega328. It contains a 16 MHz crystal oscillator, 6 analog inputs, 14 digital input/output pins (of which 6 may be used as PWM outputs), a USB port, a power connector, an ICSP header, and a reset button. It comes with everything required to support the microcontroller; to use it, just plug in a USB

cable, an AC-to-DC converter, or a battery to power it.

Fig: Arduino UNO

LCD (LIQUID CRYSTAL DISPLAY):

Fig: LCD

A 16x2 LCD is one of the most popular peripherals connected to a microcontroller. This translates to 16 and 20 characters per line by two lines, respectively. On LCD, the status of the project will be shown.

MEMS

MEMS, or micro-electro-mechanical systems, is the term used. These are a collection of gadgets, and you may describe them by their little size & method of design. These sensors may be designed using components that range in size from 1 to 100 microns. The complexity of these devices, which can range from tiny electromechanical systems with a few moving components to massively large ones, is controlled by embedded microelectronics.. These sensors often come as a single unit with mechanical micro-actuators, micro-structures, micro-electronics, and micro-sensors. This article describes the definition of a MEMS sensor, its operation, benefits, and applications.

Buzzer:

Fig: Buzzer

A piezoelectric buzzer generates sound because of the piezoelectric effect.

the PL2303 chip. PL2303 module is used for sending data to the PC.

Algorithm:

Start the system by turning on the GPS, GSM, and ultrasonic sensor modules. Follow the ultrasonic sensor readings constantly to look for nearby objects. Obtain the GPS unit's most recent position information for the user. By examining the ultrasonic sensor signals, establish the presence of barriers. Consider it an obstruction if the sensor's measurement of the distance is less than certain. Create audio feedback to alert the user to the existence and location of any obstacles that are found. To communicate the location and vicinity of the barrier, use the relevant speech cues or audio signals.

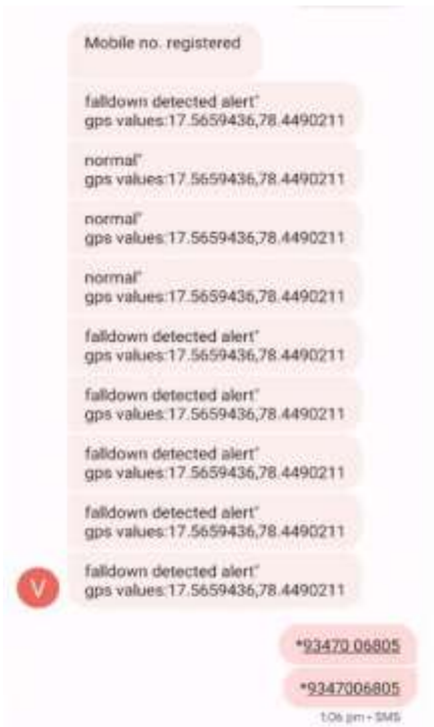
To determine the relative position of the barrier, obtain the GPS coordinates of the observed obstruction and compare them to the user's current location. To determine the relative position of the barrier, obtain the GPS coordinates of the observed obstruction and compare them to the user's current location. Give the user notice if the barrier is close enough to be considered safe. The warning may come in the form of a speech prompt or an audio signal. Activate the GSM module to connect to a predetermined contact or remote support provider if the barrier is within a crucial distance. Use the GSM module to send the user's GPS coordinates, obstacle data, and a distress signal to the remote support service. Receive direction or instruction by voice call from the remote support service. Etc messages, or a combination of both, depending on the system's capabilities. Keep an eye on the ultrasonic sensor data to spot changes in the surroundings around the obstacles. Update the obstacle state and give the user the appropriate audible feedback whenever an impediment moves or vanishes. Update the GPS coordinates periodically to monitor the user's movement and modify the system's response as necessary. On the basis of the user's position and the availability of barriers, provide real-time instructions or notifications.

Create a user interface that enables communication between the user and the system. Voice instructions, tactile feedback, or a mix of the two may be used for gathering user input and delivering system replies.

Review the system's performance on a regular basis, paying particular attention to obstacle detection precision, user happiness, and system dependability. Based on comments and the outcomes of the evaluation, make the required alterations andenhancements.

To guarantee continued progress and efficacy, the system should be updated and maintained regularly to integrate new technologies, algorithms, and user input.

5. RESULT:



6. CONCLUSION:

In conclusion, the provided system's integration of ultrasonic sensors, GPS, GSM communication, and MEMS sensors has enormous potential to enhance visually impaired people's obstacle identification and navigation. The system can improve the mobility and freedom of the blind by combining various technologies and providing real-time support, precise positioning, and reliable obstacle-detection capabilities. Users may traverse their surroundings securely and prevent crashes adjacent impediments. GPS technology provides precise location data, enabling users to navigate in real-time and find other routes. The GSM's capacity for communication enables communication with a remote help desk, where qualified experts may offer direction and support as needed.
By providing accurate orientation data, the inclusion of MEMS sensors like accelerometers and gyroscopes significantly improves the system. This data aids in the identification of user motions, establishes body posture, and adds more context for obstacle recognition and navigation. Comprehensive testing and user input are essential for evaluating the system's efficiency and performance. Its strengths and weaknesses will be revealed by assessing variables such as obstacle detection precision, geolocation accuracy, GSM communication dependability, and user experience. Its efficacy in real-world conditions will be validated by doing user trials in diverse settings.
The performance of the system should be improved, its functions should be increased, and any restrictions found during the assessment process should be addressed in future development. To ensure the system fits the unique needs and expectations of visually impaired users, engagement with key stakeholders, including blind people, assistive technology professionals, and accessibility organizations will also be essential. Overall, by offering visually impaired people a complete solution for obstacle detection and navigation, the suggested system has the potential to dramatically improve their mobility, independence, and quality of life.

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