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Smart Blind Stick

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ABSTRACT :

The Smart Blind Stick capstone project represents a groundbreaking application of technology in addressing a pressing societal issue. This innovative device harnesses the power of advanced sensors, GPS technology, and real-time data processing to assist visually impaired individuals in navigating their surroundings with greater independence and safety. By utilizing ultrasonic sensors, the stick detects obstacles in the user's path and conveys this information through audible beep alerts, thereby preventing collisions and enhancing mobility. The integration of GPS enables location tracking feature, offering a seamless and efficient way for users to reach their desired destinations. The positive impact of this project on society is profound, as it empowers visually impaired individuals to access and participate more fully in their communities, fostering inclusivity and improving their overall quality of life. Moreover, the Smart Blind Stick serves as an exemplar of how technology can be harnessed to create transformative solutions that address real-world challenges, ultimately promoting social equity and accessibility for all.

Keywords: Smart blind stick, Ultrasonic sensors, GPS technology, Visually impaired assistance, Obstacle detection.

1. Introduction :

In our ever-evolving world of smart gadgets, there's a simple yet revolutionary invention that can make a difference in the lives of visually impaired individuals "The Smart Blind Stick". This interactive device is all about providing a helping hand to those who face challenges when navigating their surroundings due to visual impairments.

It is an interactive device which mainly aims at helping the blind to navigate easily and in a safer manner. Unlike a conventional white cane, which primarily relies on touch and feel to detect obstacles, a Smart Blind Stick incorporates advanced sensors, electronics, and connectivity features to provide more comprehensive and real-time assistance to the user.

The Smart Blind Stick is more than just a mobility aid; It is a symbol of empowerment. It combines sensors, connectivity, and user-friendly design to assist users in detecting obstacles, finding their way, and provide additional navigation assistance to blind. In doing so, it transcends the boundaries of disability, breaking down barriers and enabling individuals to explore the world with greater confidence.

Figure 1: Schematic Diagram of Smart Blind Stick [1]

1.1. Define User based problem

In the case of visually impaired individuals and blind people, the main problem comes with navigating their ways on street, foot paths, roads and even at home. Due to this, they face many problems in everyday life and they have to be dependent on traditional white cane stick which lacks many features and does not prove to be a smart way of assisting the blind. So, considering the user-based problem we have decided to make a Smart Blind Stick which not only helps the blind in navigating their way but also detects the obstacles surrounding them and even comes with features of 'real time location tracking' which increases the value of this project.

By building a Smart Blind Stick, considering the needs of blind people we can achieve objectives of providing sense of independence to visually impaired individuals and provide them features of obstacle detection, navigation assistance and real time location tracking which ultimately will help the blind person improve the quality of their life.

1.2. Problem Definition

It is society-based problem and requires attention for addressing the issue of mobility and safety for visually impaired individuals through the development of an smart blind stick. This innovative device aims to enhance the independence and quality of life for the visually impaired by incorporating cutting-edge technologies such as ultrasonic sensors and GPS navigation.
The primary problem statement revolves around the need to create a highly efficient and reliable smart blind stick that not only detects obstacles and provides real-time navigational assistance but also integrates seamlessly into the daily lives of visually impaired individuals. This report will delve into the design, development, and evaluation of such a device to empower individuals with visual impairments, fostering their autonomy and safety while navigating their surroundings.

2. Literature survey :

A survey by WHO (World Health Organization) carried out in 2011 estimates that in the world, about 1% of the human population is visually impaired (about 70 million people) and amongst them, about 10% are fully blind (about 7 million people) and 90% (about 63 million people) with low vision. The problem with blind people is how to navigate way to wherever they go. Such people need assistance from others. This study proposes a new technique for designing a smart stick to help visually impaired people that will provide them navigation.

The conventional and archaic navigation aids for persons with visual impairments are the walking cane (also called white cane or stick) and guide dogs which are characterized by many imperfections. we can modify this cane with some electronics components and sensors.

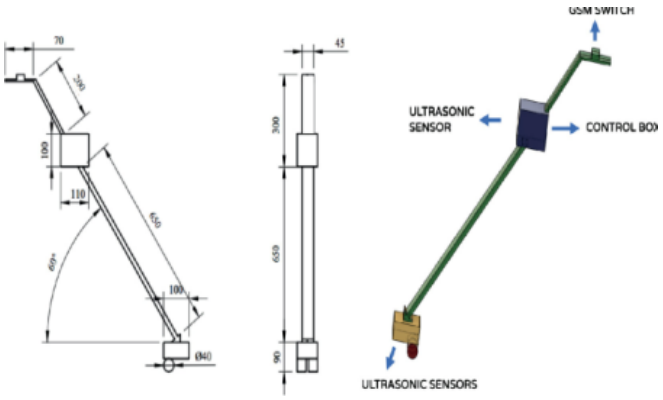


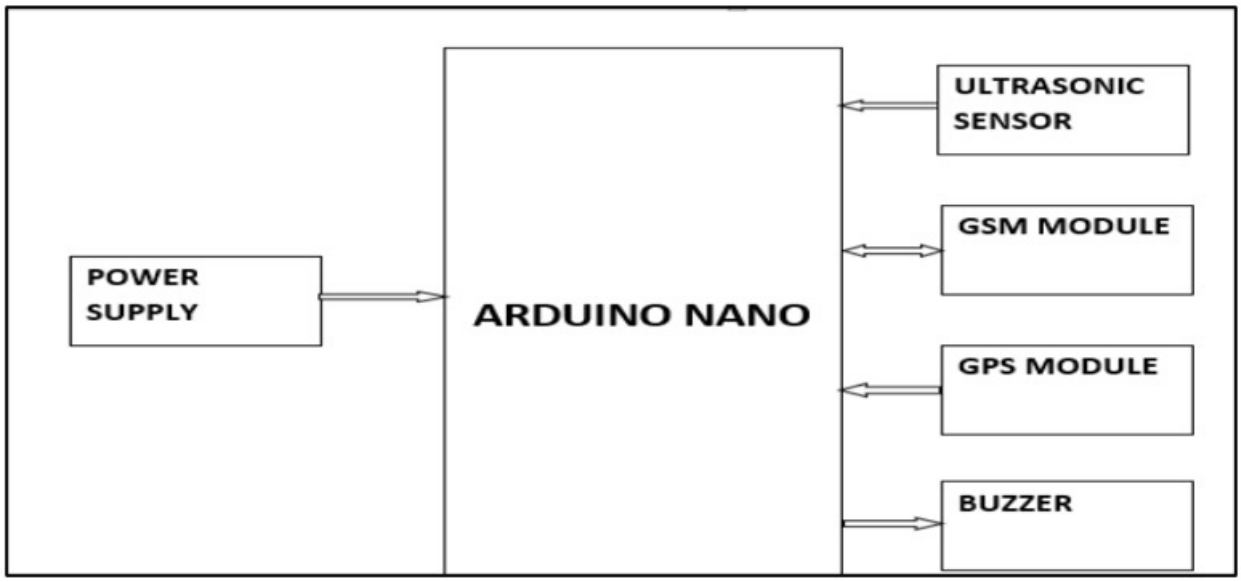
Figure 2: Design of Smart Blind Stick [2]

A smart blind stick is for the visually impaired people which will detect obstacles with the use of ultrasonic sensors. GPS and GSM module helps them to navigate and reach his/her destination and also gives information to his/her guardian where he/she is located. The blind person can also send emergency message at times of risk, to his guardian through GSM module.

This is achieved through implementation of design for visually impaired, thus eliminating the problems associated with the existing solutions. This makes it know the exact location, altitude at any given moments and current orientation of obstacles. This magic wand is preloaded with map information of street, position of potential obstacles and landmark, doorways, staircase and dangerous obstacles. The performance and functionality are also improved.
The idea behind the design of the stick was to keep it structurally similar i.e., their light weight and easy to handle. This smart blind stick uses

ultrasonic sensors to detect obstacles, holes, pits, etc. The user is notified about the same in the form of beeping alerts.
The Smart Blind Stick is equipped with ultrasonic sensors for object detection and a buzzer for beep alerts in case of obstacle being detected. It contains Neo 6mv2 GPS module which is used to determine the geographical location of (latitude, longitude and altitude) and this information is sent to the care taker of blind person via SIM 800 GSM module which allows the stick to connect to cellular networks for the purpose of sharing this information.

3. Block Diagram :



An Arduino nano has been used for the main controlling system. Ultrasonic sensor has been used for sensing the object. GSM module (SIM) is used for sending SMS. Buzzer used for creating automatic alarm in case of obstacle being detected. GPS module is used for real time location tracking.

The ultrasonic sensors emit sound scopes with frequency (>20KHZ) which is inaudible to human ears. The microcontroller then processes this data and calculates if the obstacles is close enough. If the obstacle is not close the circuit does nothing. If the obstacle is close, microcontroller sent a signal to sound a buzzer. It also detects and sounds a different buzzer.

correct embedded program (code) in the memory of micro controller we can give specific instructions to it to perform accordingly. This will help to decrease the latency and provide short time response in the output making it perfect fit for the blind person. The smart blind stick using GPS-GSM modules and ultrasonic sensors will aid the blind immediately as the object is detected by the ultrasonic sensors.

4. Hardware Description :

4.1. Arduino Nano

Arduino is an open-source microcontroller board. The Arduino Nano is a small, complete, and breadboard-friendly board based on the ATmega328P. The microcontroller on the board is programmed using Arduino software. The boards are equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards or breadboards and other circuit. The Microcontrollers are typically programmed using a dialect of features from programming language C & C++. Arduino project provides an integrated development environment (IDE) bases on the processing language project.

Figure 4.1 Arduino Nano Microcontroller Board

The Arduino Nano serves as the central control unit in the smart blind stick project. It plays a pivotal role in orchestrating the various functions and features of the smart stick. The Arduino Nano is responsible for processing data from sensors and modules, making real-time decisions based on the input received, and providing valuable feedback to the user.

Using its microcontroller, the Arduino Nano executes a programmed algorithm for obstacle detection, GPS data interpretation, and communication with the GSM module. It interfaces with ultrasonic sensors to detect obstacles in the user's path and triggers appropriate feedback mechanisms, such as beeping alerts. Additionally, it processes GPS coordinates to enable accurate location tracking, aiding the visually impaired user in navigation.

Through its robust programming capabilities and versatility, the Arduino Nano ensures that the smart blind stick functions as an effective aid, enhancing the user's safety and independence while navigating through various environments.

4.2. GPS module

GPS (Global positioning System) is a satellite navigation system used to determine the ground position of an object. GPS technology was first used by the United state military in 1960s and expanded into civilian use over the next few decades. Today, GPS receiver are included in many commercial products, such as automobiles, Smartphone, exercise watches etc. The navigation messages are broadcast at a rate of 50 bits per second.

The NEO-6M V2 GPS module is a crucial component of the smart blind stick, offering accurate and reliable positioning data for visually impaired individuals. This specific GPS module is known for its compact size, low power consumption, and high performance.

Figure 4.2 Neo6mv2 GPS Module

In the smart blind stick project, the NEO-6M V2 GPS module to determine the user's precise geographic coordinates in real-time. It provides latitude and longitude information, which is relayed to the Arduino Nano for processing.

The NEO-6M V2's capabilities help the visually impaired user understand their exact location, ensuring they can navigate safely and independently. It is particularly well-suited for this application due to its balance of accuracy and power efficiency, ensuring the smart blind stick remains lightweight and functional while providing the essential location data needed to assist the user in their travels.

Moreover, the NEO-6M V2 offers excellent sensitivity and tracking performance, which is invaluable when navigating through crowded or complex landscapes. These attributes make it a valuable asset in the smart blind stick, as it empowers visually impaired individuals to confidently traverse various terrains, be it urban city streets, parks, or rural paths, with accurate and up-to-date location information.

4.3. GSM Module

GSM (Global system for mobile communication) is a digital mobile telephony system that is widely used all over the world. A GSM module requires a SIM (Subscriber's identity module) card to be operated and operated over a network range subscribed by the network operated. It can be connected to a Arduino through cable. GSM is a mobile communication modem; It is open and digital cellular technology used for transmitting mobile voice and data services operated at the 850 to 1900MHz frequency band. GSM system developed a digital system using Time division multiple access (TDMA) technique for communication purposed.

Figure 4.3 SIM 800 GSM Module

The SIM800 GSM module is a pivotal component in the smart blind stick project, facilitating crucial communication functionalities. It is designed to work with various mobile networks, enabling the smart stick to establish voice and data connections. The SIM800 module's versatility and compatibility ensure that the visually impaired user can stay connected and request assistance in case of emergencies. When triggered, the GSM module can send SMS messages to predefined contacts, or transmit the user's location data to emergency services, providing an added layer of safety and peace of mind.

The SIM800 GSM module empowers the smart blind stick with real-time communication capabilities, ensuring that the user can reach out for help or convey their location whenever needed. This feature is especially critical for visually impaired individuals, as it allows them to contact friends, family, or caregivers quickly. The SIM800's support for SMS which ensures that users can easily request assistance or report their location, enhancing their ability to navigate confidently and securely in a variety of environments. The SIM800 module can transmit the user's location data to a designated contact or emergency service, offering an extra layer of safety and support to the visually impaired user during their travels.

4.4. Ultrasonic Sensors

An ultrasonic sensor is a device that can measure the distance to an object by using sound waves. It measures distance by sending out a sound wave at a specific frequency and listening for that sound wave to bounce back.

The ultrasonic transmitter an ultrasonic wave this wave travel in air and when it gets object by any material it gets reflected back toward the sensor this reflected wave is observed by ultrasonic receiver module. It operated in frequency in 40 Hz. It can measure the distance 2 cm to 80 cm.

Figure 4.4 HC-SR04 Ultrasonic Sensors

The HC-SR04 ultrasonic sensor is a fundamental component of the smart blind stick project, primarily serving as the obstacle detection mechanism. This sensor operates on the principle of sound wave reflection and is reliable and precise in detecting obstacles in the user's path.

In the smart blind stick, the HC-SR04 sensor emits high-frequency ultrasonic waves in a cone shaped pattern. These waves bounce off objects in the environment, and the sensor measures the time it takes for the waves to return. By calculating the time of transmission and reception, the sensor can determine the distance to the nearest obstacle accurately.

The HC-SR04 is strategically placed on the smart blind stick at different angles to cover a broad field of view. When an obstacle is detected within a specified range, the sensor sends this information to the Arduino Nano. The Arduino Nano then triggers the buzzer, enabling the visually impaired user to navigate safely and avoid collisions with objects in their path. The HC-SR04's precision and rapid response make it an indispensable tool in enhancing the user's mobility and safety while using the smart blind stick.

5. Future Directions :

- GPS Integration: Incorporating GPS for better navigation and autonomy.

- Object Training: Enhancing the stick's ability to recognize a wider array of objects for improved safety.
- Face Detection: Implementing face detection technology for more personalized interaction.
- Vibration Modules: Adding vibration feedback for users who are also hearing-impaired.
- IoT Enhancements: Utilizing IoT platforms for effective tracking and data analysis.

The Smart Blind Stick has the potential to significantly improve the quality of life for visually impaired individuals, and ongoing development will likely address current challenges while expanding its capabilities.

Conclusion :

In conclusion, the Smart Blind Stick project represents a significant advancement in assistive technology for visually impaired individuals, integrating cutting-edge features such as GPS tracking, GSM communication, ultrasonic obstacle detection, and Arduino-based control. By combining these technologies into a single device, the project aims to enhance the safety, mobility, and independence of blind individuals, empowering them to navigate their surroundings with confidence and ease. Through rigorous testing and refinement, the Smart Blind Stick demonstrates its potential to positively impact the lives of visually impaired individuals, offering a reliable and comprehensive solution for mobility assistance that addresses critical challenges faced by this community.

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