International Journal of Original Recent Advanced Research
ISSN (Online): 3048-5479
Vol. 03, Issue 03, May 2026

MULTIFUNCTIONAL SMART STICK FOR VISUALLY IMPAIRED SAFETY AND MOBILITY ASSISTANCE

Anurodh Anand[1], Vanshika Bharti[2], Nishant Kumar[3], Prof. Priyanka Chauhan[4]

anurodhanand1@gmail.com, Vanshikabharti18@gmail.com , nishantkmrsng2002@gmail.com
Priyanka.chauhan529@gmail.com

Student, Department of Electronics and Communication Engineering, Tula's Institute, Dehradun[1,2,3]

Assistant Professor, Department of Electronics and Communication Engineering, Tula's Institute, Dehradun[4].

ABSTRACT

The multifunctional smart stick for visually impaired safety and mobility assistance is an innovative assistive technology aims to solve the day-to-day problem of visually impaired person and focuses on enhanced mobility, safety, and independence of visually impaired individuals. In this device the problem is solved by integrating modern IoT technologies and embedded system with real-time sensing and network- based communication. This smart stick is equipped with ultrasonic sensor for obstacle detection, a GPS module for real time location tracking, an accelerometer for fall detection and a Raspberry Pi as a main or central controller that manages data and communication. The device provides immediate alert through buzzers, helping them to avoid hazards in both indoor and outdoor environments. Additionally a dedicated SoS button is provided which allows user to send emergency alert with live location to caregivers. This system offers a powerful low-cost solution for the quality life and safety of visually impaired individuals and promote smart living and modern technology.

Keywords: IoT[1], Raspberry Pi[2], Ultrasonic sensor[3], Accelerometer[4], GPS tracking[5], SoS[6] .

1. INTRODUCTION

Nowadays the world is increasingly connecting to technology, and the technology is the key of ease access and independence for people with disability. In especially abled community, visually impaired individual faces challenges in navigating in familiar and non-familiar environments. Due to this the visually impaired person has to be dependent on others for their daily activity and cannot be independent for their day-to-day tasks. Traditional stick or canes offers some assistance but are not smart enough to provide smart assistance and provides limited functionality, particularly in detecting and alerting obstacle, sending emergency alert to care givers or navigating through voice assistance. With the help of advancement in technology and Internet of things (IoT), we can enhance the capability of traditional assistance systems by integrating sensors, GPS and other real-time communication features. The Internet of things (IoT) refers to interconnection of physical devices with

sensors, software, and connectivity that allows them to collect and exchange data. This technology has opened the door to a wide range of applications in healthcare, transportation, and other automation. For visually impaired person, IoT is a blessing to build a smart assistive device that can provide improved assistance, safety and navigation awareness. By connecting IoT and network-based communication this device aims to bridge the gap between traditional assistive stick limitation and provide digital support and independence to visually impaired people. This project provides the development of a multifunctional smart stick for visually impaired safety and mobility assistance, a stick that rely on various sensors and other IoT devices for smart assistance and navigation. The sensors used are ultrasonic sensors, accelerometer and an IoT device known as Raspberry Pi as central control unit. Ultrasonic sensors are used to detect obstacles, and accelerometer is used to detect the fall and triggers the SoS (can be cancelled if pressed twice within 5 sec) and send the real time location to the caregivers. In case of emergency an additional SoS button is provided which can send and emergency alert to the emergency contact or caregivers with real time co-ordinates so that they can get on time support and assistance. This adds a crucial security layer assuring not only navigation but also an emergency support tool. The entire system is housed or mounted within a lightweight UPVC stick and customised 3d printed casing ensuring ease of use and portability. This project aligns with global trends in healthcare sector and providing an affordable and scalable solution for providing a smart assistive life for the visually impaired individuals. According to WHO (World health organisation), over 285 million people globally with visual impairment, and most of them do not have access to advance assistive technology due to limited resources and high price of device. This multifunctional smart stick for visually impaired safety and mobility assistance device aims to provide cost effective, smart assistive device that bridges the gap between functionality and accessibility. It also helps visually impaired individuals to have independent life and provides confidence to them in public spaces.

OBJECTIVE

- To develop smart stick that improves mobility of visually impaired person
- To integrate ultrasonic sensor for obstacle detection
- To implement GPS tracking system using NEO-6M
- Provide emergency alert through SoS switch and sim module 900a
- To provide voice-based navigation for easy navigation using python and AI

2. LITERATURE SURVEY

1. **Smart Walking Stick for Visually Impaired People Using Ultrasonic Sensors and GPS Module**
   Authors: S. Sharma, A. Gupta, et al.
   This paper presents the development of a smart walking stick equipped with ultrasonic sensors and a GPS module to assist visually impaired individuals. The ultrasonic sensors are used to detect obstacles within a certain range and alert the user through a buzzer. The GPS module provides real-time tracking to ensure safety and location awareness. The system is cost-effective and offers basic mobility assistance but lacks remote monitoring features and web integration.
2. **Design and Implementation of a GPS-Based Blind Navigation System Using Arduino**
   Authors: M. Singh, R. Verma, et al.

The researchers proposed a GPS and GSM-based navigation system built on Arduino to help blind users travel independently. The device provides voice feedback using pre-recorded instructions and sends location details via SMS in case of emergencies. While the system offers real-time location support and emergency communication, it lacks integration with IoT platforms and has limited processing capabilities compared to Raspberry Pi.

3. **Assistive Technology for the Visually Impaired Using Machine Learning**

Authors: L. Brown, H. Zhang, et al.

This paper focuses to develop a smart IOT based cane integrating machine learning and AI. Although the primary aim is different from ultrasonic navigation, it contributes a unique approach to detecting and recognizing objects in the environment. This technology is computationally intensive and requires more robust hardware, making it suitable for future enhancements but less feasible for basic, portable applications.

4. **Real-Time Smart Navigation System for Visually Impaired Individuals**

Authors: T. Desai, N. Joshi, et al.

The authors implemented a comprehensive navigation aid using Raspberry Pi, GPS, and cloud communication. The system alerts the user via vibration motors and provides caregivers with real-time location updates through a web interface. This work closely aligns with the objectives of the current project and supports the need for integrated monitoring, real-time feedback, and caregiver connectivity. It lays a foundation for further customization and scalability in IoT-based assistive solutions.

3. Proposed System

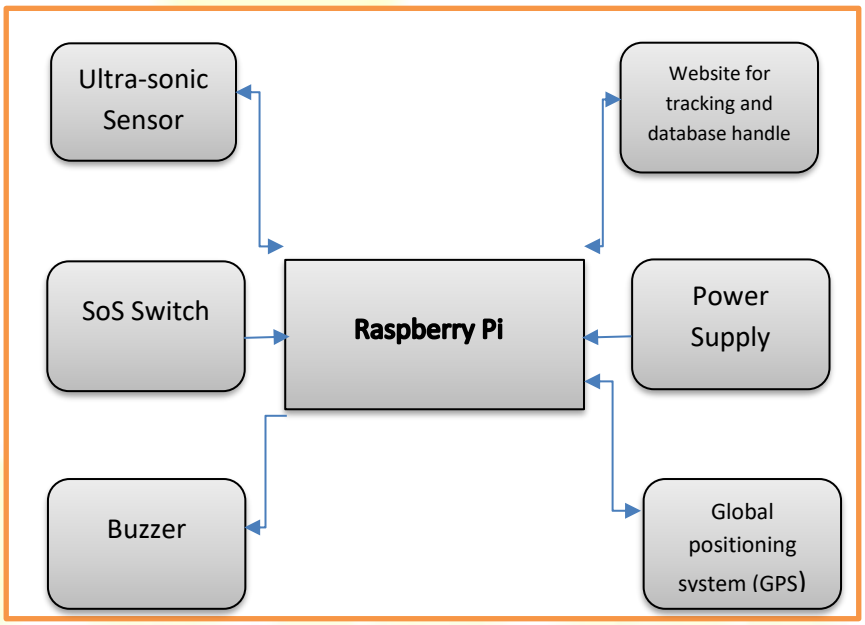


Figure 1: Proposed System

1. **System Initialization and Power Supply**

The proposed system starts operating when the power supply of 5V from a rechargeable lithium Ion Battery. This power source is chosen for its portability, reliability and sufficient current delivery to all the components. The Battery is connected to Raspberry PI using USB, providing consistent voltage. When power supply is provided in Raspberry PI it starts operating and boot the main python program.

These programs are liable for controlling the ultrasonic sensor, GPS module, SIM module and other peripherals present on the circuit.

Once this system is initialized it start active monitoring and all sensors starts working on real time data.

2. **Ultrasonic For Obstacle Detection**

This is very crucial component of our smart stick where the ultrasonic sensor (HC-SR04) works as obstacle detection module. The ultrasonic sensor is responsible for detecting obstacle like wall, Hurdles, Person or any other obstacle in forward direction. The sensor emits ultrasonic sound waves, which strike obstacles and return as Eco. The time taken for the eco to return is converted into distance using the formula

distance = (time x speed of sound)/2.

The major distance is below the pre-defined one then it indicates near-by obstacles. As soon as it detects the obstacle it sends a signal To Raspberry PI. This signal activates the Raspberry alert mechanism such as Buzzer and gives non-visual feedback which help the user to recognize obstacles and navigate accordingly or direct to change the direction. This active obstacle detection system minimizes the risk of collision and helps user for easier navigation.

3. **Real Time Location Tracking**

In this system a NEO-6M GPS module is used which continuously fetches the live location data including coordinates. This module communicates with Raspberry-PI using UART serial communication. This GPS module helps the caretaker or caregiver to know the exact coordinates of the user. This feature ensures the safety of user and provides facility to monitor

The live location of the user by the caregivers at any point of time. Hence, in case of emergency this feature becomes a vital for immediate rescue or support.

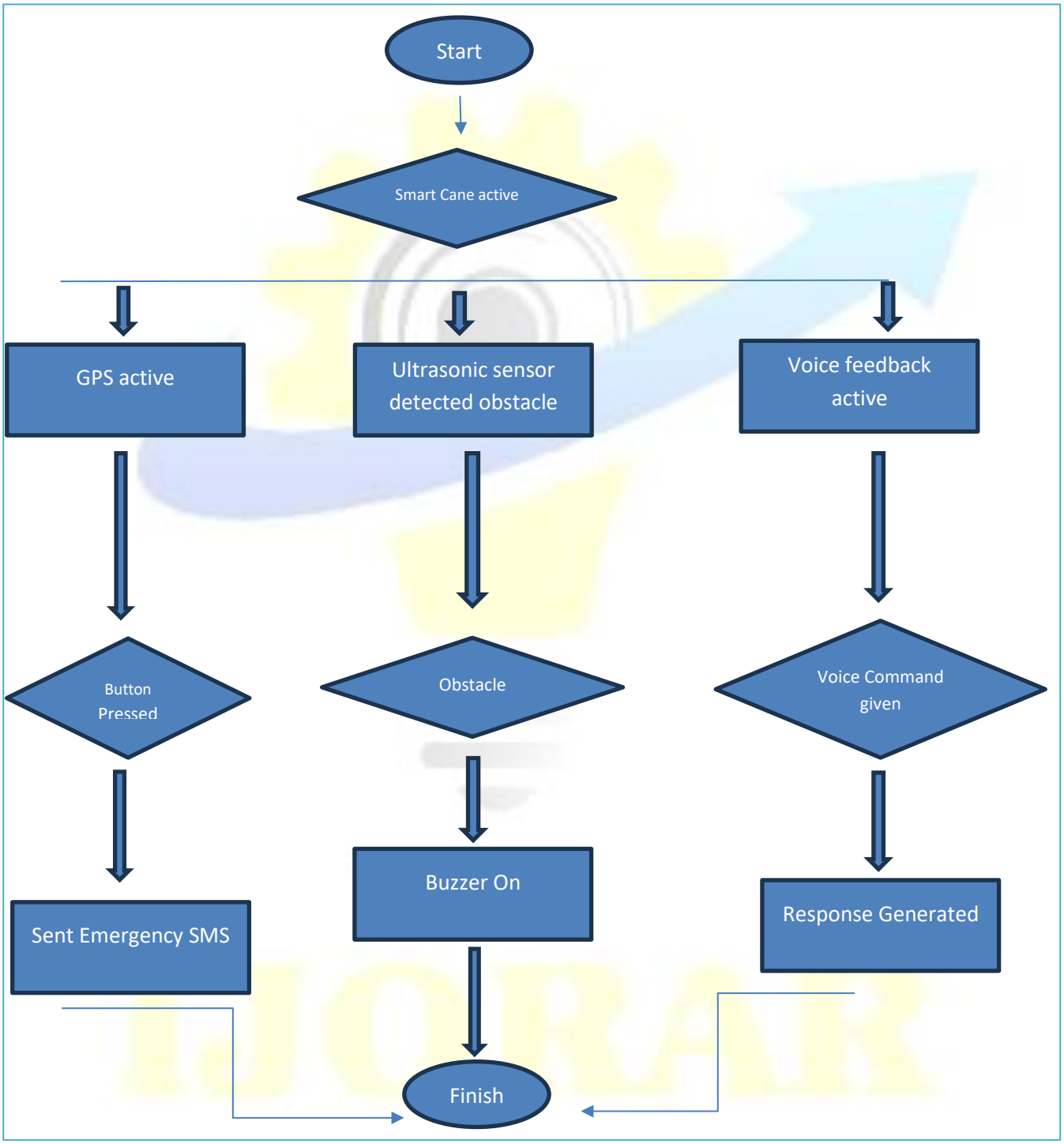
4. **SOS Emergency Switch**

SOS switch is integrated on the stick for case of emergency it provides a physical trigger for emergencies. When this switch is pressed it interrupts the whole ongoing operations and triggers an emergency protocol. The raspberry-PI treat this SoS input as high priority interrupt and immediately captures the current GPS location and send it to the caregiver whose emergency contact has been pre-defined. This feature is very critical in the situation where the user feels unsafe, is lost, needs medical support or in any emergency situation. This function has faster response time and is potentially saving life and provides trust to caregivers on the device.

5. **Control Flow Summary**

The control flow summary shows how the device works or operates when the device power is ON. The device continuously monitors nearby surroundings via ultrasonic sensor. If any obstacle found in between the threshold the ultrasonic wave, the device treats it as obstacle and triggers the buzzer for non-visual alert to the user. At the same time the GPS module fetches the data periodically and monitors the co-ordinates. In emergency the SOS function Overwrites all operation and provide immediate alert to the caregiver for immediate support to user. This system also aims to provide voice assistance to the user whenever the mic is turned ON through a push button provided on the stick. These voice feedback allows user to communicate through internet and look as per requirement. This

technological solution not only provides a smart stick but also designed to solve and address real world mobility challenges and assistance for Visually Impaired Individuals.



4. Discussion And Summary

This is the smart assistive device and integrates multiple hardware and software component and aims to provide enhanced mobility, safety, assistance to the visually impaired users through modern technology.

HARDWARE COMPONENTS:

Raspberry Pi (Central Controller): The raspberry Pi is a process control unit which acts as the main controller of the system. It processes real time data from sensors and controls output devices while doing this it also manages to communicate between hardware and software for smooth functioning and enabling remote data transmission.

Ultrasonic Sensor: The ultrasonic sensor is mounted facing forward to detect obstacle through emitting ultrasonic waves. This sensor is liable to measure distance of obstacle and trigger alert when obstacle is detected under the defined threshold range which ensures the user safety during navigation.

Buzzer: The buzzer provides immediate audible warnings whenever the ultrasonic sensor trigger alert after detecting the obstacle. This audio feedback is important for alerting users without relying on visual cues.

Power Supply: A portable 5V rechargeable Lithium-Ion battery provides the power to the system providing long lasting operations and ease of recharging to use it as daily need without power failure or frequent discharge interruptions

GPS Module: The GPS module offers to track real time location which is very essential for any emergency response. It also helps user to send real time location to the caregiver in case of emergency.

SOS Switch: The SOS switch allows user to send an immediate real time location to the caregivers or emergency contacts for immediate response whenever in case of emergency, it enhances personal safety during critical situations.

SOFTWARE COMPONENTS:

Python Programming: Nowadays python is most widely is used language, so in this stick it is a primarily language for sensor interfacing, data processing and controlling system logic on the Raspberry PI. The simplicity and extensive libraries of this language enable efficient hardware integration and operation.

SUMMARY: In multifunctional smart stick for visually impaired persons the collaborative system of Hardware and Software components works together to offer a smart, portable and user centric assistive solution to the visually impaired individuals. The combination of multiple hardware components such as ultrasonic sensor, GPS module etc. ensures independence and safety for visually impaired individual. Thia stick is scalable, usable and impactful innovation in the era of assistive technology and IOT. The system aims to provide safety navigation and assistance to the user using the technologies.

5. RESULT

The smart stick device successfully demonstrated enhance navigation and safety features for visually impaired users through its integrated hardware and software components. The ultrasonic sensor efficiently performs their task of obstacle detection within reliable range and provides timely alert whenever obstacle is detected via buzzer. The SOS button efficiently send the location coordinates to the caregivers or emergency contacts whenever pressed. This immediate feedback system and response system allows user to avoid hazards, obstacles and provides safety navigation while moving both indoors and outdoors. The device also builds confidence and provides independence to the user.

Real time GPS tracking was efficiently implemented using the NEO-6M. Caregivers were able to monitor the user current position. The voice assistive feedback was successfully implemented and was providing improved response to the user during operation. The system exhibited stable performance during continuous operation with rechargeable lithium-ion battery providing seamless power for several hours without frequent recharging. Over-all the project met its objective of improving mobility, safety and remote caregiver support for visually impaired individuals.

6. CONCLUSION

The IOT based multifunctional smart blind stick successfully integrates sensors, GPS module and real time communication technologies to enhance the mobility and independence of visual impaired individuals. By providing obstacle detection alert and remote monitoring capabilities, the device not only ensures user safety but offers trust to the caregivers.

REFERENCES

1. K. B. Prakash and K. G. Srinivasa, "Smart stick for visually impaired using Raspberry Pi," International Journal of Engineering Research & Technology (IJERT), Vol. 6, Issue 6, 2017.
2. Shruti Dhavale et al., Smart Walking Stick for Blind People, International Research Journal of Engineering and Technology (IRJET), Vol. 7, Issue 5, May 2020.
3. M. A. Hossain et al., "Smart Stick for Blind: Obstacle Detection, Artificial Vision, and Real-Time Assistance via GPS," Journal of Computer Engineering (IOSR-JCE), 2018.
4. N. Dey, A. Ashour, and S. Balas, "Smart Healthcare Monitoring Using IoT," Springer, 2017.
5. Raspberry Pi Foundation, https://www.raspberrypi.org
6. HC-SR04 Ultrasonic Sensor Datasheet, https://cdn.sparkfun.com
7. Adafruit GPS Module Guide, https://learn.adafruit.com
8. Arduino Project Hub - Smart Cane, https://create.arduino.cc/projecthub
9. K. Yelamarthi et al., "RFID and GPS-based Smart Navigation System for the Blind," IEEE Systems Journal, 2016.
10. T. George et al., ―Voice Alert System for the Blind Using Smart Stick,‖ IJCSIT, Vol. 5, Issue 2, 2014. [11]. P. Surendran et al., "Obstacle Detection and Navigation Aid for Visually Impaired People," IJRTE, 2019.
11. Python Programming Guide for Raspberry Pi, https://docs.python.org
12. Blynk IoT Platform Documentation, https://docs.blynk.io
13. ESP8266 Wi-Fi Module Reference, https://randomnerdtutorials.com
14. Zigbee Alliance – Wireless Communication, https://zigbeealliance.org
15. Kaur, R. Gill, ―An IoT Based Smart Stick for Blind Navigation,‖ International Journal of Recent Technology and Engineering (IJRTE), Vol. 8, Issue 1, May 2019.
16. "Digital Principles and System Design," R.P. Jain, McGraw Hill Education, 2016.
17. "Embedded Systems with ARM Cortex-M Microcontrollers in Assembly Language and C," Yifeng Zhu, 2017.
18. Ultrasonic Distance Sensing: Engineering Approach, ScienceDirect, 2021.
19. SOS Alert System for Emergency Situations - Implementation Guide, IEEE Explore, 2020.