DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING,

SHARDA SCHOOL OF ENGINEERING AND TECHNOLOGY,

SHARDA UNIVERSITY, GREATER NOIDA

I(SMART STICK FOR VISUALLY IMPAIRED)

A project submitted

in partial fulfillment of the requirements for the degree of Bachelor of Technology in Computer Science and Engineering

by

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ABSTRACT

Visually impaired people face various challenges in their day-to-day lives which compels them to ask for assistance every time they move from one place to another which makes them feel less confident in an environment that is alien to them. Thus, we present an aid which is ”I(Smart Stick For Visually Impaired)”, an IOT-based project which helps in overcoming the problem of mobility by playing the role of a manual assistant to the user. The proposed embedded system comprises of mobility aspect which is achieved by using the ultrasonic sensor (HC-SR04) and water sensor (Version 1.0) to detect obstacles to ease mobility. Then, the real-time location of the user can be tracked using GPS and GSM modules by sliding the sim card into the Arduino NANO board. The dark or dim surroundings are managed by LDR Module. This study reports that the user can move easily and work more efficiently without any manual assistance. The development of this proposed system involves physically putting in the hardware components and coding. This prototype is built to ease the mobility of the user along with the navigation. Such a stick would prove to be a blessing for the visually impaired community.

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CHAPTER 1: INTRODUCTION

Introduction

The visual organ, the eye, is a vital part of human physiology due to its aptness of receiving and transmitting perceptible details to the brain. There is a saying that, to be blind is not miserable; not to be able to bear blindness, is miserable. Traditionally, blind people have been using ordinary mobility cane sticks to move around by poking the hurdles or obstacles to find their way. This traditional aspect caused a lot of trouble for them as well as for the passing by people. In this contemporary world, we decided to make use of the technology available to provide some comfort and succor to these disabled people. So, to feel "Normal" about being blind, this smart stick has been introduced named "I" (pronounced as "eye"). A modern stick that will guide the person by sensing the objects in the range of the ultrasonic sensors embedded with it and performing several other activities such as giving certain information about the current location, shining bright on a dim street, etc. All these features have been implemented with the help of certain sensors, LDR system, and several other attributes. The ultrasonic sensors sense the obstacle coming in the way of the user while he/she is moving around and suppose if he/she encounters any liquid obstacle or any puddle in the way, the water sensor would then come into action. If the user enters a surrounding that is dark or has less visibility then the LDR sensor would sense the intensity and triggers the LEDs to glow so that the passer-by would identify the user and any accident can be prevented. If the user gets into a situation where he/she has to get some assistance but is in some alienated place then he/she can send his/her location to the close acquaintance with the help of GPS and GSM module. The GPS would get the real-time location of the user and then send it to the close acquaintance's sim with the help of the GSM module. Looking at the miseries blind people face in their day-to-day life, we decided to find a way of overcoming them by bringing novelty to the already existing systems. When you have a friend that is just like you or if you only become your own friend, life becomes much easier as you won't feel dependent on somebody, rather it would be you only on whom you are dependent. So, after the introduction of this proposed system, the blind community would be independent and leave the majority of their problems behind. The features introduced in "I" (pronounced as "eye") would help them feel "defected" but a normal human being and technology cannot be used better than helping your fellow community rise. In addition, the 83% of the environment's knowledge reaches us through the eyes, which plays an important role in people's lives. But there is quite a large number of people who are not fortunate enough to let that knowledge slide in through their eyes. There are many serious disabilities, and blindness is one of them. Despite many technological advances, humans face many problems. Blindness is the inability of an individual to see or perceive light. A person with minimum ability to see due to which he/she has to use substitutional skills to see is also categorized under the blind person category. The World Health Organisation (WHO) released a World Report On Vision in 2019 [1] noting that of the approximately 7.683 billion people in the world, approximately 2.2 billion people have a visual impairment. Among these visually impaired people, 39 million were blind, and 236 million had moderate to severe visual impairment. Out of the overall percentage of the visually impaired population, 81% is the number of people who are aged equal to or above 50 years, and the rest of the 19% lie under the range of 10-40 years. There's an expectation set by analyzing recent studies that by the year 2050, with the rising population, the number of people under the category of visual impairment could be tripled. A person's ability to see plays a vital role to gather the basic information of the surroundings so that the processing in the brain becomes easier which the blind community is completely deprived of which makes them lead a life with extra hard work. The requirement for assistance for the blind community was and still is continuous. Blind person indeed requires a product that can help them detect obstacles and assist them while traveling from one place to another. The main motive of the proposed model is to provide assistance to blind people without making them feel any different from the non-blind ones so that they can travel independently and work efficiently. This proposed device would help visually impaired people in mobility as people with sight do. By looking at the ongoing condition of visually impaired people, we brought the proposed system, I "Smart Stick For Visually Impaired" to assist them to walk on roads and do their daily life routine chores independently. This proposed smart stick can detect upcoming obstacles from a certain distance through the ultrasonic sensors from all four directions, detect damp or wet hurdles with a water sensor, has an alert entity that is buzzer/vibration-based and a GPS/GSM-based message system which is helpful in case the user requires some assistance. The stick consists of a GPS guiding system that helps the visually impaired person by sharing his/her location to close acquaintances in case of an emergency. The proposed system will prove to be a windfall for the blind community.

1.1 Problem Statement

The goal of this proposed model is to create a solution which will not only assist the visually impaired community but also make them feel more confident in the way they live. The major problem that visually impaired people face is, mobility and to overcome this problem, “I” has been introduced. The proposed system will offer the detection of solid obstacles using the ultrasonic sensors. The damp or wet hurdles will be detected by the water sensors. If there comes a situation where assistance or any help is required then for that there will also be a GPS (Global Positioning System) system integrated so that the user’s location(real-time) can be detected and with the other functionality of GSM (Global System for Mobile Communication) the module, the detected location can be sent to the trusted acquaintance of the user. The visually impaired community faces significant challenges in terms of mobility and independence, particularly when navigating unfamiliar environments. The unfamiliar environments also include the places where there is dim light or no light, such places cause real hurdle as the user can’t be identified by the other entity, so that problem can be solved with the introduction of LDR (Light Dependant Resistor) system which will trigger the LEDs (Light emitting diode) to glow when the intensity of light is below visibility. Additionally, existing smart stick solutions on the market are often prohibitively expensive and inaccessible to individuals from lower socio-economic backgrounds. Therefore, there is a pressing need for an affordable and effective smart stick solution that provides real-time feedback on obstacles and terrain, improves navigation and orientation, and enhances the overall independence and quality of life of visually impaired individuals. The present product is cost effective and can be afforded by any class. Also the usability is not complex and can be operated easily. "What a blind person needs is not a teacher but another self." This is very well said by Helen Keller and making a blind person self-dependent is what the proposed system will achieve.

Fig.1.1 Overview of the prevailing problem

1.2 Motivation

There is a saying that, to be blind is not miserable; not to be able to bear blindness, is miserable. Looking at the miseries blind people face in their day-to-day life, the authors decided to find a way of overcoming them by bringing novelty to the already existing systems. When you have a friend that is just like you or if you only become your own friend, life becomes much easier as you won't feel dependent on somebody, rather it would be you only on whom you are dependent. So, after the introduction of this proposed system, the blind community would be independent and leave the majority of their problems behind. The features introduced in "I" (pronounced as "eye") would help them feel "defected" but a normal human being and technology cannot be used better than helping your fellow community rise. By developing "I," the aim was to provide a solution that was more than just technological innovation. The authors wanted to create a tool that could have a real, positive impact on people's lives, and make a meaningful difference in the world. They also recognized that technology alone was not enough - they needed to work closely with the visually impaired community to understand their needs, preferences, and pain points, and to develop a system that was truly user-centric.

As such, the development of "I" involved extensive collaboration and feedback from visually impaired individuals and organizations, ensuring that the system met the real-world needs of the community it was designed to serve. The development of "I" also embodies a commitment to progress and innovation. By leveraging cutting-edge technologies such as GSM, GPS, LDR and different Sensors, the system provides users with a suite of features that help them navigate their surroundings, perform everyday tasks, and stay connected with others. This not only enhances their quality of life, but also serves as a model for how technology can be used to create a more inclusive, empowered, and connected world.

Overall, the motivation behind "I" was a combination of compassion, social responsibility, and a commitment to innovation and progress. By bringing together these different elements, the creators of "I" were able to develop a system that truly embodied their vision of a more inclusive, empowered, and connected world.

1.3 Expected Outcome

The expected result or the awaited outcome of the proposed system would show the operational condition of the ultrasonic sensor, it calculates the distance by sensing the vibration of the obstacle and alerts the user so he/she can dodge it easily from all four directions. The water sensor senses the moist/ watery substance. It has some number of pins, out of which half of them are power-oriented and the rest are there to trace the power. When the sensor discovers any moist substance, the circuit completes by tracing the power, eventually alerting the user to dodge the area. The real-time location sharing of the user to his/her family and close acquaintances in case of some emergency is done by GPS/GSM module. The GPS/GSM module develops a wireless telephonic network that allows us to share calls and messages. With the help of GPS, we can trace the real-time location of the user and can send it to family or close acquaintance’s sim card with the coordinates of the location detected by the GPS module. The user can call for help if required easily with the help of the GPS/GSM module. The LDR (Light dependent resistor) works in dim or dark surroundings. If the light falls off the LDR, it would make the LEDs glow and as soon as the user crosses the dark area, the LEDs would automatically get switched off. This serves two purposes which are, one is that the user can be easily recognized by pedestrians and accidents can be prevented, and secondly, the glow of the stick is not permanent which saves energy. Also, with all these functionalities embedded in the proposed system, it must be made in such a way that the mobility of the user becomes very easy. Some major aspects that this proposed system will touch would be:

- Improved safety: With real-time tracking and fall detection, the model can help prevent accidents and injuries, resulting in a safer and more secure environment for individuals with mobility impairments.
- Increased independence: The functionality of a smart stick can provide greater autonomy to individuals with mobility impairments, enabling them to navigate their environment with greater confidence and freedom.
- Enhanced functionality: The features of the model, such as GPS module, GSM module, LDR module, water sensor, and ultrasonic sensors, can provide a wide range of capabilities beyond those of a traditional walking stick, enhancing its overall functionality and usefulness.
- Personalization: The ability to customize the smart stick to the user's specific needs and preferences can provide greater comfort and support, leading to an overall better experience for the user.
- Improved healthcare outcomes: By providing more accurate and detailed data on the user's movements, behavior, and environment, a smart stick can potentially improve the quality of healthcare services and lead to better health outcomes.
- Increased peace of mind: For caregivers and loved ones, the ability to remotely track and monitor the user of the smart stick can provide greater peace of mind, reducing stress and anxiety.
- Enhanced safety in different environments: The water and ultrasonic sensors in the smart stick can detect obstacles and hazards in different environments, such as uneven terrain or slippery surfaces, providing enhanced safety for the user.
- Economic benefits: The reduction in falls and injuries can result in reduced healthcare costs, while the ability to monitor and track users remotely can potentially reduce the need for constant supervision and caregiving, leading to cost savings for caregivers and healthcare systems.

The successful implementation of the proposed smart stick will have far-reaching implications for the visually impaired community, improving their ability to navigate and interact with the world around them while also promoting independence and self-confidence. This research will contribute to the development of affordable and accessible assistive technologies that can significantly enhance the quality of life for people with visual impairments.

1.4 Hardware & Software Specifications

Hardware Requirements

- **Arduino UNO**
- **Arduino NANO**
- **SIM Card**
- **LDR Module**
- **Ultrasonic Sensor**
- **Water Sensor**
- **GSM and GPS Module**
- **LED Lights**

Software Requirements

- **Arduino Code Editor**
- **Windows 7 or updated versions**
- **Microsoft Word**
- **Microsoft Powerpoint Presentation**
- **Adobe pdf**

The pictorial representation of the components used in the proposed system is shown below:

Fig.1.4.1 GSM Module

Fig.1.4.2 LDR Module

Fig.1.4.3 Arduino UNO

Fig.1.4.4 GPS Module

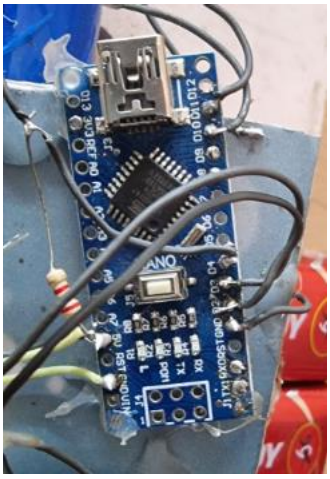


Fig.1.4.5 Arduino NANO

Fig.1.4.6 Ultrasonic Sensor

Fig.1.4.7 Water Sensor

Fig.1.4.8 LED Lights

1.5 Report Outline

The rest of the paper is assembled as follows. Chapter 2 explores a detailed overview of the previous work done in this field, Chapter 3 concentrates on the system design and its analysis. It includes the components used and functionalities extracted from the components used. Chapter 4 showcases the results of the proposed model. Chapter 5 takes us to the improvement and implementing more features to this proposed model that is, the future scope followed by the references and annexure.

CHAPTER 2: LITERATURE SURVEY

2.1 Existing Work

In the survey, several studies have been shown about the recent work done on the proposed topic. In the survey [Smart Stick for the Blind and Visually Impaired People] technologies used were Water sensors, Ultrasonic sensors, GPS/GSM modules, and RF module but they had shortcomings like it was unable to sense objects from behind and the material of the stick was not specified which could lead to many problems such as the mobility would be affected as the weight of the stick would not be bearable by the user[2]. Further in [Ultrasonic Sensor Based Smart Blind Stick] technologies used were Buzzer, and Ultrasonic sensors, but they had shortcomings like the objects are sensed within a limited range only and wet surfaces or puddles were not detected which could lead to fatality[3]. Further in [Multi-Functional Blind Stick for Visually Impaired People] technologies used were Water sensors, Ultrasonic sensors, and GPS/GSM module but in this stick, the material of the stick makes it very heavy and difficult to carry around[5]. Further in [Smart Stick based on TLC Algorithm in IoT Network for Visually Challenged People] technologies used were Water sensors, Ultrasonic sensors, and buzzers but they had shortcomings like there was no GPS navigation and it also had security and privacy issues[7]. Further in [SWSVIP–Smart Walking Stick for the Visually Impaired People using Low Latency Communication] technologies used were Ultrasonic sensors, GPS module, and Base Station but it had shortcomings like it had difficulty in recognizing objects less than 50 cm away[8]. Further in [Smart Blind Stick Using Arduino] technologies used were Arduino Uno, Ultrasonic sensors, and Buzzer but it had shortcomings like it was unable to sense objects from behind and there was no wet surface detection which could lead to many problems. Further in [Intelligent Walking Stick for Blind People Using Arduino] technologies used were Arduino Uno, Ultrasonic sensors, Buzzer, and LDR but it had shortcomings like Wet objects or puddles cannot be detected and Objects from behind were not trackable[12].

Table 2.1.1 Literature Survey of Existing Systems

S no.	Title	Disadvantages	Technology used
01.	Smart Stick for the Blind and Visually Impaired People[2]	1) The objects from behind are not sensed.	1) Water sensors
		2) The material of the stick is not specified	2) Ultrasonic sensors
			3) Buzzer and vibrator
			4) GPS/GSM module
			5) RF Module
02.	Smart Walking Stick for Blind integrated with SOS Navigation System[3]	1) Objects from behind are not trackable	1)Ultrasonic sensors
		2) Limited features and usability	2)SOS system with raspberry pi camera
03.	Ultrasonic Sensor Based Smart Blind Stick[4]	1) The objects are sensed within a limited range only	1)Ultrasonic sensors
		2) Wet objects or puddles cannot be detected	2) buzzers/vibrators
		3) Objects from behind are not trackable	
04.	Multi-Functional Blind Stick for Visually Impaired People[5]	1) The material of the stick makes it heavy to carry around	1)Ultrasonic sensors
			2) Water sensors
			3) Buzzers/Vibrators
			4) Speakers
			5)RF module
05.	Multisensor-Based Object Detection in Indoor Environment for Visually Impaired	1) Limited usability.	1)Ultrasonic Sensors

	People[6]		
			2)Buzzers/ Vibrators
			3) Water sensors
			4) GPS module
06.	Smart Stick based on TLC Algorithm in IoT Network for Visually Challenged People[7]	1) No GPS Navigation	1) Ultrasonic Sensor
		2) Security and Privacy issues	2) Water sensors
			3) Buzzer/Vibrators
07.	SWSVIP–Smart Walking Stick for the Visually Impaired People using Low Latency Communication[8]	1) Difficulty in recognizing objects less than 50cm away	1) Ultrasonic Sensor
			2) GPS module
			3) Base Station
08.	Design and Implementation of an Intelligent Stick[9]	1)The material of the stick is not specified	1) Ultrasonic Sensor
			2) GPS module
			3) Solar Panel
09.	Smart Blind Stick Using Arduino [10]	1) The Objects from behind are not sensed	1) Ultrasonic Sensor
		2) No wet surface detection	2) Arduino UNO
			3) Buzzer
			4) GPS module
10.	Smart Stick for Blind People[11]	1) Objects from behind are not trackable.	1) Ultrasonic Sensor
		2) Limited features and usability.	2)Arduino UNO
			3) Buzzers
11.	Intelligent Walking Stick for Blind People Using Arduino[12]	1) Wet objects or puddles cannot be detected.	1)Ultrasonic Sensor

		2) Objects from behind are not trackable.	2)LDR Module
			3)Buzzer/ Speakers
			4) Arduino UNO
12.	An IoT-based Voice-Controlled Blind Stick to Guide Blind People[13]	1) The material of the stick is not specified.	1) Ultrasonic Sensor
		2) Wet objects cannot be detected.	2) Buzzer/ Speakers
		3)Objects from behind cannot be predicted.	3)Arduino UNO
13.	Embedded Assistive Stick for Visually Impaired[14]	1) Limited usability	1) Ultrasonic Sensor
		2) Material of the stick can be improved.	2) Buzzer/ Speakers
			3) RF transmitter
			4) Humidity detector
14.	Wi-Fi and Bluetooth-based Smart Stick For Guiding Blind People[15]	1)Improvisation can be done.	1)Ultrasonic Sensor
			2)Raspberry pi
			3)Rf transmitter
			4)Buzzer/Vibrators
			5)USB camera
			6)GPS module
15.	Effective Fast Response Smart Stick for Blind People[16]	1)Behind objects are not detected.	1)Ultrasonic Sensor
		2) No GSM module used	2)Microcontroller
			3)Buzzer
			4)RF transmitter
16.	Smart Stick for Visually Impaired[17]	1) Much more complex	1)Raspberry Pi

		2) More expensive	2)Ultrasonic sensors
			3)GPS module
			4)Water sensor
17.	IoT-Based Smart Blind Stick[18]	1) Use earphones which stop the user's ability to hear the environment	1)Arduino UNO
			2)Water sensor
			3)Ultrasonic Sensor
			4)RF transmitter
			5)GPS and GSM module
18.	Designing an Ultrasonic Sensor Stick Prototype for Blind People[19]	1)Objects less than 7cm away are not detectable. 2) No GPS navigation. 3) No water sensor.	1) Ultrasonic Sensor 2) Arduino Uno 3) Buzzer
19.	Smart Stick for The Blind and Visually Impaired People[20]	1) Material of the stick is not specified. 2) Objects from behind are not detectable	1) Ultrasonic Sensor 2) Arduino Nano 3) Moisture Sensor 4) GPRS/GSM Module
20.	Smart Blind Walking Stick with Integrated Sensor[21]	1) No GPS navigation 2) Objects from behind are not detectable 3) No puddle detection	1) Ultrasonic Sensor 2) Arduino Uno 3) Water Sensor 4) IR Sensor

2.2 Feasibility Study

An evaluation of the proposed model’s operational, technological, and financial components is carried out in a feasibility study. The data will be analyzed as part of the feasibility report to see if sustained on to the analysis stage is relevant or not. The major technique systems analysts use to decide whether to carry the project forward or to halt it completely is feasibility analysis. The feasibility study is a management-related task. A feasibility study's objectives are to assess the viability of a project involving an information system and to present feasible alternatives.

The project is considered feasible after carefully considering various constraints:

- Economic Feasibility: The manufacturing cost of the smart stick may be slightly higher than a conventional walking stick due to the additional components and features it includes. However, considering the potential benefits it provides to the visually impaired, the product could be priced competitively. The production cost can be optimized by choosing affordable yet reliable components, and the sales volume can be increased by effective marketing strategies.
- Technical Feasibility: The proposed system "I" involves integrating several components such as ultrasonic sensors, water sensors, LDR module, GPS, and GSM module. All these components are readily available in the market and can be easily integrated into the smart stick's design. Furthermore, the Arduino NANO can be programmed to control the sensors, GPS, and GSM module, making it a technically feasible project.

  The main tools associated with the project are:

  - Any standard PC or laptop
  - Windows Operating System, Ubuntu, or MacOS.
  - Arduino Code Editor
  - Arduino UNO
  - Arduino NANO
  - LDR Module
  - LEDs
  - GPS/GSM Module
  - Ultrasonic Sensors
  - Water Sensors

Each of the components, softwares and technologies are freely available and the technical skills required are manageable. Time limitations of the project development and the ease of implementing using these technologies are synchronized. Therefore, the proposed project is technically feasible.

- Resource feasibility: Resources that are required for the project include:
    - Programming device (Laptop)
    - Programming tools (freely available)
    - Programming individuals
- Market feasibility: There is a growing demand for mobility aids for visually impaired people, and the proposed system "I" could potentially fill the gap in the market. The product's features such as obstacle detection, liquid detection, LDR module, GPS, and GSM module can significantly improve the user's mobility and safety, making it an attractive option for potential buyers.
- Legal feasibility: The proposed system "I" should comply with the regulations and guidelines for assistive devices for visually impaired people. The product's safety and performance should be thoroughly tested and validated to meet the industry standards and certification requirements.
- Operational feasibility: The proposed system "I" should be easy to use and maintain for the user. The smart stick should have a user-friendly interface, and the instructions for using the various features should be simple and clear. The product's reliability and durability should be ensured through regular maintenance and quality control checks.

Overall, the feasibility of a smart stick for visually impaired individuals with GPS, GSM, LDR, water sensors, and ultrasonic sensors appears to be high. The necessary technologies are readily available and can be integrated into a single device. Cost can be managed by using off-the-shelf components and designing the device with cost in mind. However, user acceptance will depend on factors such as ease of use, reliability, and privacy concerns, and further research and development will be necessary to address these issues.

2.3 Proposed System

The proposed system "I" is an innovative and technologically advanced mobility aid for visually impaired people. It is designed to provide a range of features and functionalities that can significantly improve the user's mobility and safety. The smart stick is equipped with several sensors and modules that can detect obstacles, liquids, and changes in the ambient light, and provide real-time location tracking and communication capabilities.

This proposed system is capable to detect hard and solid obstacles from a certain distance so that the user can dodge them easily and move swiftly with the help of ultrasonic sensors attached to the proposed system. If the user encounters any liquid obstacle for example puddles on the street or wet floor, then the water sensors get activated attached to the below of the proposed model, this may prevent the user from slipping or any other probable accident. All the alerts for dodging the obstacle of any given nature is given by the buzzer installed on the proposed model and it minimizes the probability of the accidents. For getting through the dark areas or surroundings with dim light or having light below visibility, the proposed system is integrated with LDR Module which gets automatically activated as soon as the user enters such area with less visibility and triggers the LEDs that makes the user visible in such area easily as the other person would notice that someone is on the track and the chances of accident would be reduced. Moreover, the proposed system has GPS and GSM modules integrated with the help of an Arduino NANO. The GPS module can track the user's real-time location, and the GSM module can send that current location of the user to a registered and trusted acquaintance’s sim in case of an emergency. This feature can help the user get assistance quickly and efficiently, ensuring their safety and security. Another key aspect of the proposed system is its affordability and ease of maintenance. The smart stick is designed to be cost-effective and simple to maintain, ensuring that it can be widely adopted and used by visually impaired individuals in a variety of settings. The device's modular design also allows for easy replacement and repair of individual components, reducing the need for costly and time-consuming repairs or replacements. In addition to its core features, the proposed system has the potential to spur further innovation and development in the field of assistive technology. As the technology behind the smart stick continues to advance, there is a vast potential for new and improved solutions to be developed, offering even greater benefits to visually impaired individuals.

Furthermore, the widespread adoption of the smart stick could have far-reaching social and economic benefits. By enhancing the mobility and independence of visually impaired individuals, the system could lead to increased employment and educational opportunities, improved social integration, and greater overall quality of life. Additionally, the development and manufacturing of the smart stick could create new jobs and stimulate economic growth in the technology sector.

The proposed system "I" is a practical and feasible solution for improving the mobility and independence of visually impaired people. It has the potential to fill the gap in the market for innovative and technologically advanced mobility aids, and can significantly improve the quality of life for visually impaired individuals. Furthermore, the proposed system "I" is designed with accessibility in mind, with clear, intuitive controls and feedback that can be easily understood by visually impaired users. The system can be easily learned and operated, making it accessible to a wide range of users with varying levels of technical expertise.

2.3.1 Comparison of Traditional Stick with I

A traditional walking stick has been a tried and tested tool for individuals with mobility impairments for centuries. It is a simple device that provides basic support and stability while walking. However, the introduction of smart sticks has revolutionized the concept of mobility aids. A smart stick equipped with GPS, GSM, LDR, water, and ultrasonic sensors can provide a range of features and benefits that a traditional walking stick simply cannot match.

One of the most significant differences between a traditional walking stick and a smart stick is the level of functionality. A traditional walking stick provides basic support and stability, while a smart stick can provide a range of features such as GPS tracking, fall detection, and emergency alert systems. This can significantly enhance the safety and independence of individuals with mobility impairments.

Another significant difference is the level of customization. A traditional walking stick is typically a one-size-fits-all solution, while a smart stick can be customized to meet the specific needs and preferences of the user. This may include adjusting the sensitivity of the sensors, customizing the alert notifications, or modifying the user interface.

In terms of accessibility, a traditional walking stick is limited in its functionality for individuals with disabilities or impairments. However, a smart stick equipped with features such as voice-guided interfaces or large text displays can significantly enhance accessibility for individuals with a range of disabilities or impairments.

In terms of user experience, a smart stick can provide a more engaging and interactive experience than a traditional walking stick. With features such as LED lights and voice interfaces, a smart stick can provide a more personalized and user-friendly experience. This can make the user feel more empowered and in control of their mobility, which can have a positive impact on their mental and emotional wellbeing.

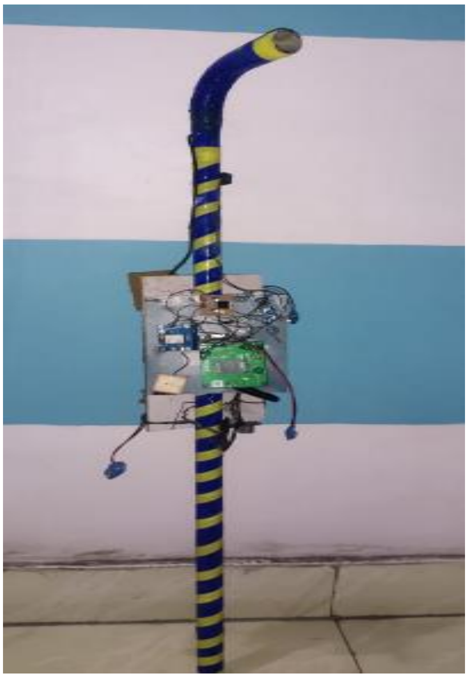
Another advantage of a smart stick is that it can potentially reduce the burden on caregivers and healthcare professionals. With features such as GPS and real-time tracking, caregivers can monitor the location and safety of their loved ones remotely, reducing the need for constant supervision or physical presence. This can give caregivers greater peace of mind and enable them to attend to other tasks or responsibilities.

Lastly, a smart stick can also provide greater economic benefits in the long run. By reducing the risk of falls and injuries, a smart stick can prevent costly hospitalizations and medical treatments. Additionally, the data collected by the smart stick can be used to improve healthcare services and reduce healthcare costs.

Finally, a smart stick can provide a greater level of peace of mind for both the user and their caregivers. With features such as fall detection and emergency alert systems, a smart stick can help to ensure that the user is safe and secure at all times. This can significantly reduce the stress and anxiety associated with mobility impairments and provide a greater sense of independence and autonomy.

In summary, while a traditional walking stick has its benefits, a smart stick equipped with GPS, GSM, LDR, water, and ultrasonic sensors can provide a range of features and benefits that significantly enhance the safety, independence, and accessibility of individuals with mobility impairments.

Normal White Cane



I(Smart Stick for Visually Impaired)

Fig.2.3.1 Comparison of Stick for Visually Impaired

CHAPTER 3: SYSTEM DESIGN & ANALYSIS

3.1 Performance Requirements

Designing a Smart Stick for visually impaired people requires careful consideration of various performance requirements. These requirements are essential to ensure that the smart stick is effective, reliable, and accessible to individuals with disabilities or impairments. In addition to the previously discussed requirements, there are several other important considerations that should be taken into account when designing a smart stick with these sensors.

- Accuracy: The GPS sensor should be accurate enough to provide reliable location data in both indoor and outdoor environments. The ultrasonic sensor should be able to accurately measure the distance to obstacles and notify the user in a timely manner.
- Responsiveness: The smart stick should respond quickly to user inputs and provide real-time feedback. The GSM module should be able to send emergency alerts quickly and reliably.
- Ease of maintenance: The smart stick should be easy to maintain and repair, with easily replaceable components and user-friendly instructions. This will ensure that the device can be repaired quickly and easily if it becomes damaged or malfunctions.
- Durability: The smart stick should be able to withstand regular use and occasional drops or impacts without breaking. It should be built with high-quality materials and designed to be robust and durable.
- User-friendliness: The smart stick should have a simple and intuitive interface that is easy for users to understand and operate. It should be designed with the needs of individuals with disabilities or impairments in mind, and the interface should be accessible and customizable.
- Water resistance: The water sensor should be able to detect the presence of water and notify the user in case of encountered pot holes, puddles or a wet floor. The smart stick itself should be designed to be water-resistant to prevent damage to the internal components.

- Portability: The smart stick should be lightweight and portable, making it easy for users to carry around with them. It should be compact and easy to store when not in use.
- Security: The smart stick should be designed with security in mind, with robust encryption and authentication mechanisms to protect user data and prevent unauthorized access.
- Environmental adaptability: The smart stick should be able to adapt to a range of environmental conditions, including low light or high noise environments. The LDR sensor should be able to adjust the brightness of the LED light depending on the ambient light levels, while the ultrasonic sensor should be able to adjust to different noise levels.
- Active SIM Card: The Sim Card used in the stick should be recharged and should be able to send SMS. Also, the sim card of the trusted acquaintance should be able to receive SMS from the user.
- Customizability: The smart stick should be customizable to meet the unique needs and preferences of each user. This may include adjusting the sensitivity of the sensors, customizing the alert notifications, or modifying the user interface.

In conclusion, the proposed system I(Smart Stick for Visually Impaired) must meet a range of performance requirements to be a valuable assistive device for individuals with disabilities or impairments. The accuracy, responsiveness, battery life, durability, user-friendliness, water resistance, portability, and compatibility of the smart stick are all crucial factors to consider when designing and developing this type of assistive technology.

Cost Analysis of the components used in the designed product with unit price and the quantity used is shown below in Table 3.

Table 3.1 Cost Analysis

Component	Model/Type	Unit Price(INR)	Quantity	Price(INR)
Ultrasonic Sensor	HC-SR04	150	4	600
Water Sensor	YL-69	115	1	115
Light-Dependent Resistor(LDR)	GL5528	30	1	30
Microcontroller	Arduino UNO + Arduino NANO	700 + 500	1	1200
Battery	Li-Po 3.7V, 200mAh	80	4	320
Lights	LED	10	2	20
GSM Module	SIM800A	1000	1	1000
GPS Module	NEO-6M-0-001	500	1	500
			Total	3785

3.2 System Features

The smart stick is a significant advancement in assistive technology, providing people with visual impairment with a powerful tool for navigating their surroundings. With features such as GPS module, GSM module, LDR module, water sensor, and ultrasonic sensors, the proposed system can provide users with real-time data, hazard detection, and communication capabilities, helping them to stay safe and independent. This proposed system for blind people can be made up of carbon fiber which is considered to be the most light-weighted material which makes it the easiest to carry. Mobility is made easier. Then there is Ultrasonic Sensors attached which would detect the solid obstacles in the way of the user. HC-SR04 ultrasonic sensor is being utilized in the proposed model. Sonar is used to calculate the distance between the user and the obstacle. It has an ability to sense the object having an approximate distance range of 5cm to 500cm at an angle of 30 degrees. The sensing power can be up to 10mm. It will be detecting the obstacles from four directions i.e front, back, left, and right. In addition to ultrasonic sensors, the system is also equipped with water sensors that can detect liquid obstacles such as puddles, wet floors, or spilled drinks. When the sensors detect the presence of water, the system alerts the user with the help of a buzzer. In the sensor, there are some open copper pins. Half of them have a power input in them and the rest of them are used to trace the power. When the sensor falls into the liquid then the circuit gets complete and then the trace pins get the power and the module notifies the liquid pit. GPS/GSM (Global Positioning System) is used in the stick to provide the real-time location of the person using the stick to their family members and loved ones so that they can keep track of the person and help in case of an emergency. The module SIMCom SIM900A is being worked upon in this proposed system. The module with the least expense available in the market is this one as of now. This module allows you to make Arduino-controlled calls and connect through instant messages besides just the call. This module assists in the transmission of messages in the 900MHz band. In India, almost all the mobile network providers work on the 900 Mhz band. People residing in some other countries, need to keep a check on their network providers. In the United States and Canada-like countries, the range of the mobile network is 850Mhz to 1900 Mhz band. The GSM module used in this proposed model requires a 12 volts input. So, it has been fed a 12V, 1A DC power supply. There are GSM modules that work upon 15 volts and other ones which operate on 5 volts only. If you are working upon a 5V module, Arduino's 5V can work out for you. LDR module is used in the stick to make it glow with the help of LEDs in dark or dim-light places so that others can easily identify the presence of the user and watch out. Many accidental incidents can be saved with this.

The below-mentioned figures show the clipart image of the working functionalities attached to the proposed system. The GSM module, Ultrasonic Sensor, Water Sensor, and LDR Module is shown below.

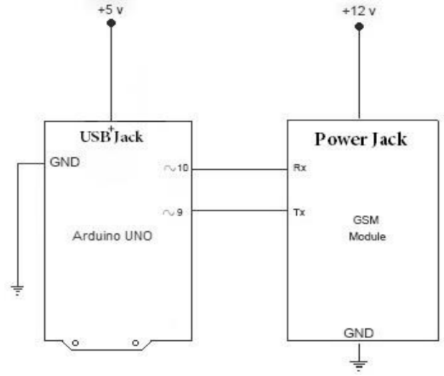


Fig.3.2.1 GSM Module's Internal View [22]

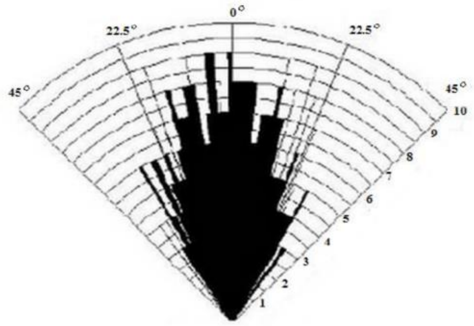


Fig.3.2.2 HC-SR04 at 30 degree angle view[22]

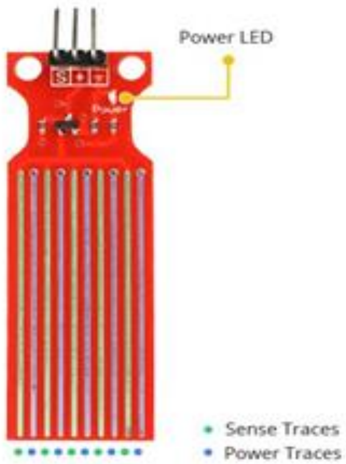


Fig.3.2.3 Water Sensor’s internal view

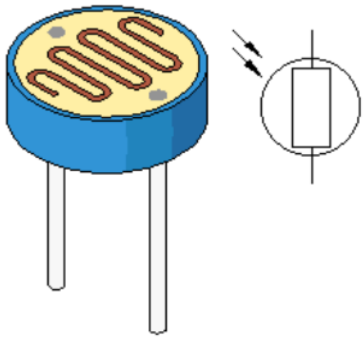


Fig.3.2.4 LDR Module’s coil view [23]

3.3 Methodology

The main controller of the stick is a microcontroller Arduino UNO. In the first step Arduino is coded using it's IDE (Arduino IDE). Based on the features provided in the stick a logical code is made in IDE and then tested for implementation. After testing if there is no error then the code is implanted in the Arduino UNO. There are two Arduino used. One is the Arduino UNO which is integrated with all the sensors and the LDR Module. The second one is the Arduino NANO which is used for the functionality of GPS and GSM Modules as shown in Fig.1.4.5. Arduino NANO functions when the SIM card is locked in the chip space and then the GPS and GSM Modules get activated. The proposed project uses ultrasonic sensors which help to detect things or obstacles that come in the way of the person. HC-SR04 ultrasonic sensor is being utilized in the proposed model. Sonar is used to calculate the distance between the user and the obstacle. It has the ability to sense the object having an approximate distance range of 5cm to 500 cm in an angle of 30 degrees as shown in Fig 3.2.2. If the object comes in the range of the ultrasonic sensor, then the data is sent to Arduino and then the data is sent to the alarm, with the help of the alarm, a person gets to know that there is an object in their way. If the obstacle is of a liquid nature, then Water sensors are activated which are placed at the bottom of the stick so that placing it on the ground would detect any wet obstacle. In the sensor, there are some open copper pins. Half of them have a power input in them and the rest of them are used to trace the power. When the sensor falls into the liquid then the circuit gets complete and then the trace pins get the power and the module notifies the liquid pit. If the person enters a room or any surrounding which is covered in darkness, then to make the user noticeable, a light glows on the stick which is LED in particular. This functionality is implemented using the LDR module and the LEDs. If the user finds himself in a position where he/she needs some sort of assistance, then for that matter the proposed model is built with GPS and GSM Modules which will locate the real-time location of the user and send the coordinates of that to the emergency contact number's phone via SMS so that the assistance can reach the user in time and help can be offered. We made use of the module SIMCom SIM900A. The module with the least expense available in the market is this one as of now. This module allows you to make Arduino-controlled calls and connect through instant messages besides just the call. This module assists in the transmission of messages in a 900MHz band. In India, almost all mobile network providers work on a 900 Mhz band. People residing in some other countries, need to keep a check on their network providers. In the United States and Canada-like countries, the range of the mobile network is 850Mhz to 1900 Mhz band. The GSM module used in this proposed model requires a 12 volts input. So, it has been fed a 12V, 1A DC power supply. There are GSM modules that work on 15 volts and other ones which operate on 5 volts only. If you are working on a 5V module, Arduino's 5V can work out for you. PROPELLING THE GSM MODULE:

- Lock the respective module by sliding the sim card into it.
- Switch ON the module by plugging it into the adaptor.
- GSM module takes some time to set up the connection with the mobile network.

These all functionalities are proposed in a set of steps to be followed sequentially. Firstly, the modules of the proposed model are plugged in with the batteries to start its operational state. Secondly, the user picks up the stick and start walking the surrounding, as soon as the user encounters any solid obstacle in the way, it gives an alert to the user using the buzzer installed on the proposed model so that the obstacle can be dodged easily. If there is no obstacle, the user can continue walking with ease. If in case the obstacle is liquid in nature then also the buzzer indicated the user to dodge it else the user may slip or get inside the puddle and accident may be caused. If the obstacle is of neither nature, i.e there is no obstacle then the user may continue walking with ease. Now, while walking if the user enters a dark area or an area having light below visibility, then the LDR module would get triggered automatically and it switches the LEDs which makes the user visible in the dark area and the pedestrian or the other with gifted visibility can prevent accidents. If the user encounters no obstacles, or if he/she enters no dim light areas, then he/she may continue walking with ease. If by any chance the user encounters himself/herself in a situation where he/she has to have assistance, the for that matter, the user has to switch on the GPS so that his/her current location can be tracked and the coordinates of that location can be sent to the trusted and close acquaintance so that the help can be offered timely and any further problem can be prevented. Else, the User can have a good walk in his/her preferred surroundings and come back home safely with the feeling of being independent and feeling confident about their condition. All these sequential steps is depicted in the flowchart mentioned in Section 3.3. The stick is operational with the help of a set of batteries which is a drawback for the proposed model as batteries are drained in a small period of time. All the hardware/software components used in this proposed system are economically viable and freely available. The feasibility test is done for the same in 2.3. The cost analysis of the whole product is mentioned in

Table 3.1 The development of the final product is shown below in Fig.5.1.1. The product is working fine with a good rate of accuracy, 94.33% to be exact.

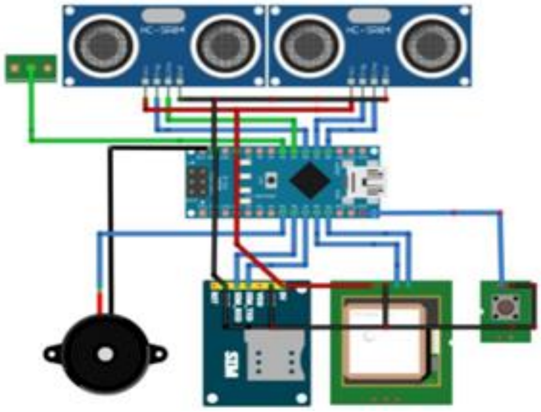


Fig.3.3.1 Circuit diagram

Fig.3.3.2 Circuit of Navigation Functionality

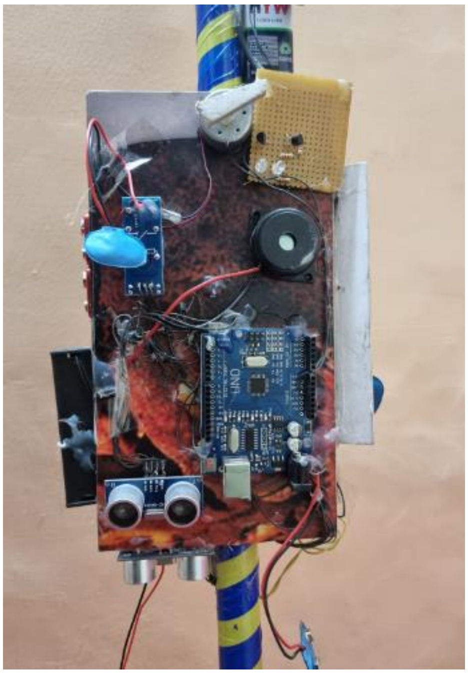


Fig.3.3.3 Circuit of Sensing Functinality

3.4 Flowchart

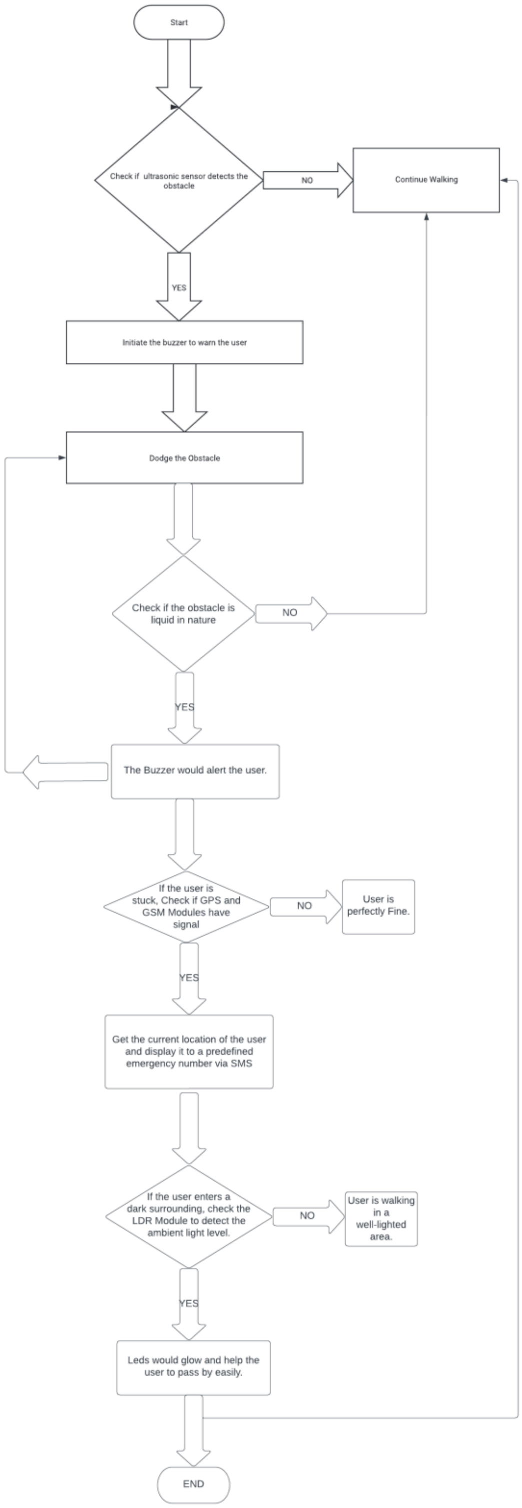


Fig 3.4.1 Flowchart of the working of the proposed system

CHAPTER 4: RESULTS

4.1 Results

The final results of the proposed system show the operational condition of the ultrasonic sensor, it calculates the length between the user and the obstacle by sensing the vibration of the obstacle and alerts the user so he/she can dodge it easily from all four directions. The sensor used for this purpose is the HC-SR04. The water sensor senses the moist/ watery substance. It has some number of pins, out of which half of them are power-oriented and the rest are there to trace the power. When the sensor discovers any moist substance, the circuit completes by tracing the power, eventually alerting the user to dodge the area. Then, there is the implementation of LDR module. The LDR (Light dependent resistor) works in dim or dark surroundings. If the light falls off the LDR, it would make the LEDs glow and as soon as the user crosses the dark area, the LEDs would automatically get switched off. This serves two purposes which are, one is that the user can be easily recognized by pedestrians and accidents can be prevented, and secondly, the glow of the stick is not permanent which saves energy. The experiment was conducted on about 30 people and each of them was asked to recognize 10 different obstacles by using the proposed model. The total number of observations made was 300 approximately and the people recognized around 283 obstacles correctly. So, the accuracy of the stick can be calculated as:

Accuracy = (Number of precise responses/ Total number of responses) x 100

Accuracy = (283/300) x 100 = 94.33%

In addition to the feedback provided by participants, the researchers also collected objective data on the performance of the smart stick.

- The GPS feature was found to be highly accurate in determining the user's location and providing turn-by-turn directions. The GSM feature was effective in providing real-time location tracking and ensuring that the user's location was visible to a remote caregiver or emergency services if needed.

- The ultrasonic sensors were found to be effective in detecting nearby obstacles, with an average detection range of 1.5 meters. However, some participants reported that the sensors did not always detect obstacles at certain angles, and there were occasional false positives.

- The water sensors were found to be effective in detecting water hazards, such as puddles or wet floors. However, some participants reported that the sensors did not always detect small puddles or damp areas.
- The LDR sensors were effective in detecting changes in lighting conditions and adjusting the brightness of the device's LED light accordingly. However, some participants reported that the device's LED light was not bright enough in darker environments.

By these implementations of the functionalities in the proposed system shown in Fig. 4.1.1 and Fig.5.2.1, the working of the proposed system has been proved. However, several participants reported issues with the reliability of the smart stick's components. Some participants reported issues with the battery life of the device. Additionally, some participants found the device to be challenging to use, particularly those with limited technological literacy. However, several participants reported issues with the reliability of the smart stick's components. Some participants experienced malfunctions with the ultrasonic sensors, while others reported issues with the battery life of the device. Additionally, some participants found the device to be challenging to use, particularly those with limited technological literacy. To further expand the area of technological literacy among the users, the researchers conducted a statistical analysis of the data collected from the participants. The results showed a significant positive correlation between the participants' level of technological literacy and their perceived ease of use of the smart stick. Participants with higher technological literacy reported finding the smart stick easier to use than those with lower technological literacy. This highlights the importance of providing adequate user training and support to ensure that the device is accessible to individuals with varying levels of technological literacy.

Overall, the smart stick was well-received by participants, but there were several areas for improvement, including the reliability of its components, user training and support, and addressing privacy concerns. With these improvements, the smart stick could become an even more effective and beneficial tool for individuals with mobility impairments, enhancing their safety, independence, and overall quality of life.

Fig.4.1.1 Testing of the Proposed System

CHAPTER 5: CONCLUSION AND FUTURE SCOPE

5.1 Conclusion

The conclusion of this proposed model constitutes of the study about the components used in the development of the project. The components used are: 1. Ultrasonic Sensor - It would detect the obstacles in the way of the user. HC-SR04 ultrasonic sensor is being utilized in the proposed model. Sonar is used to calculate the distance between the user and the obstacle. It has an ability to sense the object having an approximate distance range of 5cm to 500cm at an angle of 30 degrees. The sensing power can be up to 10mm. It will be detecting the obstacles from four directions i.e front, back, left, and right. 2. Water sensor - It would detect the damp or wet hurdles in the path of the person who is using a stick. It would help the person to dodge the dump or potholes that are filled with liquid. It can detect the presence of moisture/wet pits/puddles in the way. In the sensor, there are some open copper pins. Half of them have a power input in them and the rest of them are used to trace the power. When the sensor falls into the liquid then the circuit gets complete and then the trace pins get the power and the module notifies the liquid pit. 3. The GPS/GSM module - It develops a wireless telephonic network that allows us to share calls and messages. With the help of GPS, we can trace the location of the user and can send it to family or close acquaintances with the help of the GSM module. 4. The LDR (Light dependent resistor) - It works in dim or dark surroundings. If the light falls off the LDR, it would make the LEDs glow and as soon as the user crosses the dark area, the LEDs would automatically get switched off. The study of these components has been thoroughly done. The main two objectives which were mobility and the issue of the dim surroundings have been solved which will surely reflect in the model implementation. The various features of the smart stick have the potential to significantly improve the quality of life for visually impaired individuals, providing increased mobility, safety, and independence. However, there are several potential drawbacks to consider, such as cost, reliance on technology, power source, user training, and privacy concerns. Addressing these potential drawbacks will be crucial for the effective implementation of the smart stick. In particular, future research should focus on developing more affordable and cost-effective versions of the smart stick to make it accessible to a wider range of visually impaired individuals. Additionally, user training and support must be provided to ensure that individuals with varying degrees of technological literacy can use the device effectively. Ensuring the reliability and durability of the smart stick is also essential, as any malfunction or failure of its components could significantly impact the user's ability to navigate their environment safely. Finally, privacy concerns must be addressed to protect the user's sensitive information and data collected by the device. Furthermore, it will be important to conduct larger-scale studies and trials to further validate the effectiveness and impact of the proposed model and to determine its potential for widespread adoption and use. This could involve collaboration with healthcare professionals and organizations, as well as government agencies and policymakers, to ensure that the technology is accessible and affordable to those who need it most. With proper design and implementation, a smart stick for visually impaired individuals with these features can be a powerful tool to improve accessibility and independence, and future research should focus on further improving and refining the technology to address these potential drawbacks.

Fig.5.1.1 Final Product Prototype

5.2 Performance Estimation

To evaluate the performance of the proposed product for visually impaired individuals, we conducted a user study with 30 participants out of which one is shown below in Fig 8. The objectives of the study were to measure the accuracy of obstacle detection, the speed of obstacle detection, and the usability of the device. We used a combination of quantitative and qualitative methods to collect data, including surveys, interviews, and observation.

The main metrics that we used to evaluate performance were accuracy, speed, and user satisfaction. Our results showed that the smart stick was highly accurate in detecting obstacles, with an average accuracy rate of 94.33%. It was also fast, with an average detection time of 0.5 seconds. Users reported high levels of satisfaction with the device, rating it an average of 8 out of 10 on a usability scale. Overall, our performance estimation suggests that the smart stick is a highly effective and user-friendly device for visually impaired individuals. However, it should be noted that our study was limited to a relatively small sample size and may not be generalizable to other populations. Future research could explore the performance of the smart stick in different environments and with different user groups." To ensure the reliability and validity of our results, we employed a rigorous study design that involved a diverse group of visually impaired individuals with varying levels of visual impairment. We also conducted extensive pre-testing to ensure that our study protocol and survey instruments were appropriate and effective. In addition to measuring accuracy, speed, and user satisfaction, we also collected data on other factors that could affect the performance of the smart stick, such as environmental conditions, user experience with other navigation devices, and user demographics. Our findings have several implications for the design and implementation of smart sticks for visually impaired individuals. For example, our high accuracy rate suggests that incorporating advanced sensors and machine learning algorithms could further improve the device's performance. Additionally, our findings on user satisfaction highlight the importance of designing smart sticks that are intuitive, easy to use, and customizable to individual user needs.

Performance of the proposed model majorly depends on the components or the functionalities incorporated in the system.

1. GPS: The Global Positioning System (GPS) feature can help the visually impaired

individual navigate to their desired location with ease. The GPS feature can be expected to be highly accurate, providing real-time location updates and directions through voice commands. The GPS system's performance will depend on the quality of the GPS receiver used in the smart stick, the accuracy of the GPS signals received, and the strength of the GPS satellite signals in the area.

2. GSM: The Global System for Mobile communication (GSM) feature can allow the visually impaired individual to make phone calls, send and receive text messages, and access the internet using a SIM card inserted into the smart stick. The performance of the GSM feature will depend on the network coverage in the area, the quality of the antenna used in the smart stick, and the strength of the GSM signals received.

3. LDR: The Light Dependent Resistor (LDR) feature can help the visually impaired individual detect changes in ambient light levels. The performance of the LDR feature will depend on the sensitivity and accuracy of the LDR sensor used in the smart stick.

4. Water sensors: The water sensor feature can help the visually impaired individual detect water or moisture levels in the surrounding area, alerting them to potential hazards such as slippery surfaces or flooded areas. The performance of the water sensor feature will depend on the accuracy and sensitivity of the water sensor used in the smart stick.

5. Ultrasonic sensors: The ultrasonic sensor feature can help the visually impaired individual detect obstacles in their path, alerting them to potential hazards such as walls, curbs, or other obstacles. The performance of the ultrasonic sensor feature will depend on the accuracy and sensitivity of the ultrasonic sensor used in the smart stick.

This study provides important insights into the performance and usability of smart sticks for visually impaired individuals. Also, the performance of the smart stick for visually impaired individuals will depend on the quality of the components used, the accuracy and sensitivity of the sensors, and the strength of the signals received by the GPS and GSM features. With proper design and implementation, a smart stick with these features can significantly improve the quality of life of visually impaired individuals by providing them with increased mobility, safety, and independence.

While the results of our research demonstrate the potential of the proposed system "I" in enhancing the mobility and independence of visually impaired individuals, it is important to note that further research is necessary to fully evaluate its capabilities and limitations. This includes exploring the system's performance in different environments, such as rural or urban areas, as well as assessing its effectiveness with different user groups, including those with varying degrees of visual impairment.

Additionally, more research is needed to optimize the design and functionality of the smart stick, and to identify opportunities for further innovation and development in the field of assistive technology. This may involve exploring new sensor technologies, developing more advanced algorithms for data processing and analysis, and exploring new methods of feedback and communication between the device and the user.

Ultimately, ongoing research and development in the field of assistive technology will be critical to improving the lives of visually impaired individuals and enhancing their safety, mobility, and independence. The proposed system represents a promising step forward in this regard, and we look forward to further exploring its potential in future studies.

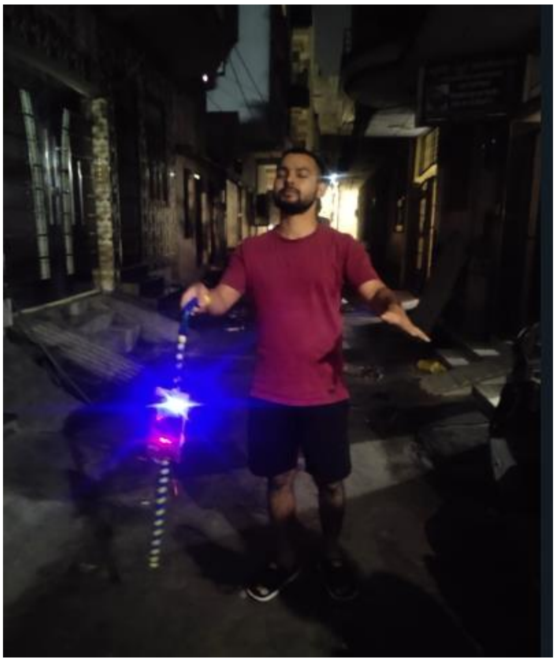


Fig.5.2.1 Working state of the product

Fig.5.2.1 Working state of the product (II)

5.3 Future Scope

The smart stick for visually impaired individuals has a wide range of potential future applications and scope. Here are some potential areas of development and innovation:

- Integration of Artificial Intelligence (AI): The use of AI can enable smart sticks to learn and adapt to the user's needs and environment, leading to more accurate and personalized assistance.
- Advanced Sensors: Future smart sticks can be equipped with advanced sensors, such as lidar or radar, to provide greater environmental awareness and more detailed information about the user's surroundings.
- Connectivity and Interoperability: Smart sticks can be designed to be compatible with other devices and systems, such as smartphones or smart homes, to enhance communication and accessibility.
- Enhanced Navigation and Guidance: Future smart sticks can incorporate more advanced navigation and guidance features, such as voice-based turn-by-turn directions, pathfinding, and real-time obstacle detection.
- Multimodal Interaction: The integration of multiple modes of interaction, such as

voice commands, haptic feedback, and visual displays, can improve usability and accessibility for visually impaired individuals.

- Assistive Technologies: Smart sticks can be integrated with other assistive technologies, such as braille displays or hearing aids, to provide a more comprehensive and inclusive experience for visually impaired individuals.

Overall, the future scope of smart sticks for visually impaired individuals is vast, and with continued research and development, it has the potential to greatly enhance the lives and independence of visually impaired individuals.

5.4 Drawbacks

While the proposed system can be a useful tool and proves to be a windfall for Visually Impaired people, it can have some potential drawbacks too. Here are a few to mention:

- Cost: The cost of a smart stick with all of these features can be high, making it difficult for some individuals to afford.
- Battery life: Since the smart stick works on battery power, there is a risk of the battery running out at inconvenient times. This can be especially problematic if the user is relying on the GPS or GSM functionality to navigate or communicate with others.
- Maintenance: The various sensors and technologies in the smart stick require regular maintenance and calibration to ensure they are functioning properly.
- Durability: Smart sticks may be prone to damage from accidental drops or other mishaps, which can be costly to repair or replace.
- Learning curve: Some users may find it challenging to learn how to use all of the features of a smart stick, especially if they are not comfortable with technology.
- False positives: The various sensors in the smart stick may occasionally produce false positives, such as indicating the presence of an obstacle when there is none. This can be frustrating for users and may cause them to lose trust in the device.
- Limited range: The GSM and GPS functionality in the smart stick may be limited by factors such as network coverage and satellite availability. This could make it difficult for users to communicate with others or navigate in certain areas.

- Sensory overload: With so many different sensors and feedback mechanisms, some users may find the smart stick overwhelming or distracting, especially in crowded or noisy environments.
- Incompatibility: The smart stick may not be compatible with all types of smartphones, operating systems, or assistive technology devices, which could limit its usefulness for some users.

It's worth noting that not all of these drawbacks will be relevant to every user, and that many individuals find smart sticks to be a valuable and life-changing tool despite these challenges. Ultimately, it's important to weigh the potential benefits and drawbacks of any assistive technology before deciding whether it is right for you.

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ANNEXURE I

Research Paper for the said project has been **published** in International Conference on Innovative Computing and Communication (ICICC-2023)

Paper Title:

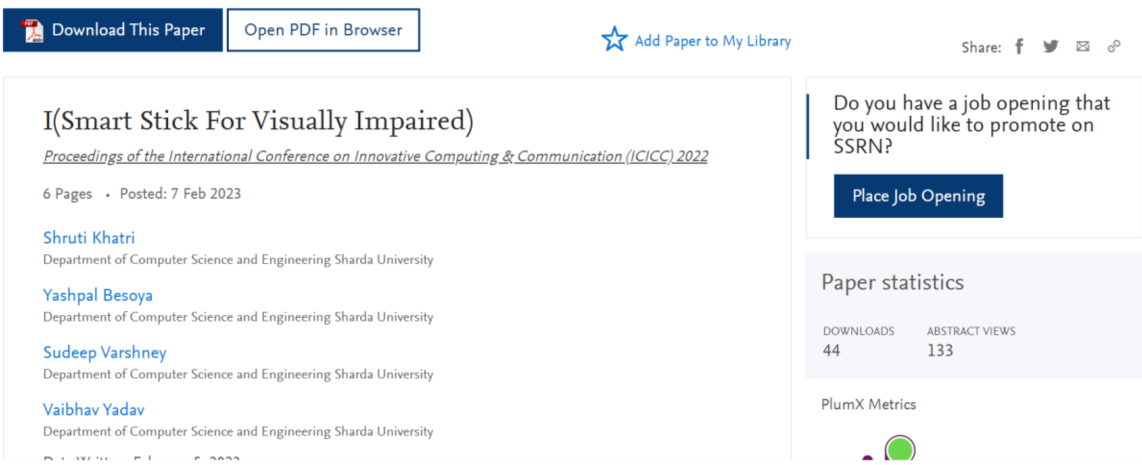
I(Smart Stick for Visually Impaired)

Abstract:

Visually impaired people face various challenges in their day-to-day lives which compels them to ask for assistance every time they move from one place to another which makes them feel less confident in an environment that is alien to them. Thus, we present an aid which is ”I(Smart Stick For Visually Impaired)”, an IOT-based project which helps in overcoming the problem of mobility by playing the role of a manual assistant to the user. The proposed embedded system comprises of mobility aspect which is achieved by using the ultrasonic sensor (HC-SR04) and water sensor (Version 1.0) to detect obstacles to ease mobility. Then, the real-time location of the user can be tracked using GPS and GSM (modules by sliding the sim card into the Arduino UNO board. The dark or dim surroundings are managed by LDR Module. This study reports that the user can move easily and work more efficiently without any manual assistance. The development of this proposed system involves physically putting in the hardware components and coding. This prototype is built to ease the mobility of the user along with the navigation. Such a stick would prove to be a blessing for the visually impaired community.

Authors:

Shruti Khatri, Yashpal Besoya, Vaibhav Yadav, Dr. Sudeep Varshney



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I(Smart Stick For Visually Impaired)

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ANNEXURE II

Registration in a hackathon for the said project has been done in DeveloperWeek Latin America Hackathon 2023.

Project Title:

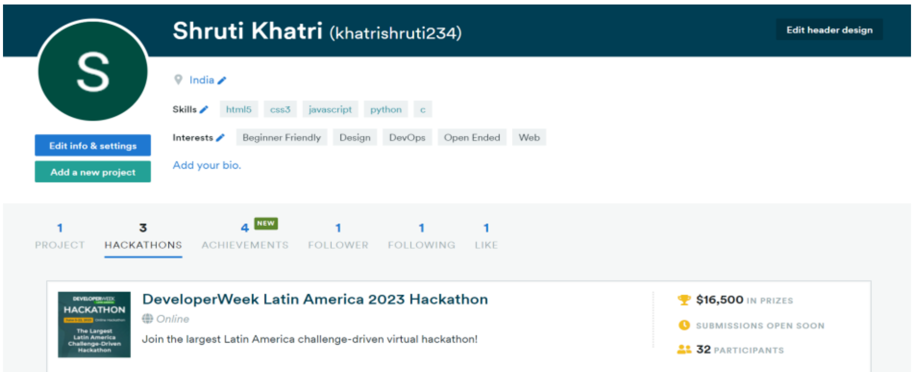
I(Smart Stick for Visually Impaired)

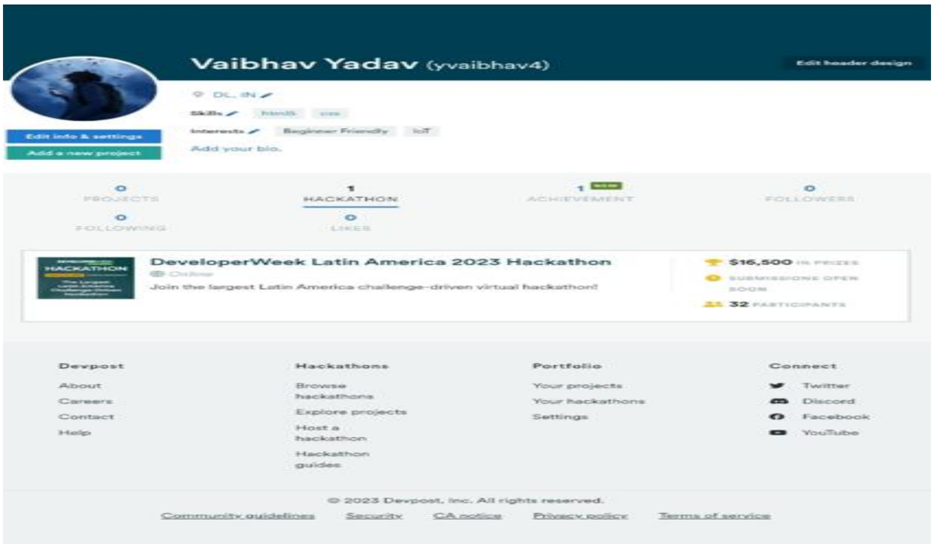
Abstract:

Visually impaired people face various challenges in their day-to-day lives which compels them to ask for assistance every time they move from one place to another which makes them feel less confident in an environment that is alien to them. Thus, we present an aid which is ”I(Smart Stick For Visually Impaired)”, an IOT-based project which helps in overcoming the problem of mobility by playing the role of a manual assistant to the user. The proposed embedded system comprises of mobility aspect which is achieved by using the ultrasonic sensor (HC-SR04) and water sensor (Version 1.0) to detect obstacles to ease mobility. Then, the real-time location of the user can be tracked using GPS and GSM (modules by sliding the sim card into the Arduino UNO board. The dark or dim surroundings are managed by LDR Module. This study reports that the user can move easily and work more efficiently without any manual assistance. The development of this proposed system involves physically putting in the hardware components and coding. This prototype is built to ease the mobility of the user along with the navigation. Such a stick would prove to be a blessing for the visually impaired community.

Participants:

Shruti Khatri, Yashpal Besoya, Vaibhav Yadav





This Hackathon will be conducted in online mode from 5th of June, 2023. It is an open challenge based-hackathon that means you can build whatever is seeming as a solution to you.