Smart Blind Stick for Assisting Visually Impaired

Akshat Tiwari[1], Vedansh Chaturvedi[2], Dr. Jyoti Vimal[3], Vaibhav Shivhare[4]
[1]*Student, Mechanical Department, Madhav Institute of Technology & Science, Gwalior (M.P)*
[2,3,4]*Assistant Professor, Mechanical Department, Madhav Institute of Technology & Science, Gwalior (M.P)*

Abstract-The aim of this project is to develop a smart blind stick that can assist visually impaired individuals in navigating their environment with greater safety and ease. The smart blind stick will be equipped with a night sensor, water sensor, and an Ultrasonic distance sensor, which will detect low levels of light, water or moisture, and obstacles in the user's path, respectively. When any of these events are detected, the smart blind stick will alert the user with an LED light or vibration motor.
The device will be powered by a rechargeable battery and controlled by a microcontroller, which will process data from the different sensors and trigger the alerts. The development of a smart blind stick with night sensor, water sensor, and obstacle sensor has the potential to greatly improve the quality of life for visually impaired individuals by providing them with an added level of safety and independence. This project showcases the use of technology to address real-world problems and demonstrates the power of engineering in creating solutions that can make a positive impact on people's lives.

I. INTRODUCTION

Visual impairment is a significant health issue affecting millions of people worldwide. It can lead to mobility difficulties, social isolation, and reduced quality of life for those affected. Globally, an estimated 40 to 45 million people are blind and 135 million have low vision [1]. Among all the age groups the older people (Above 60) are more prone to blindness. There have been many efforts to reduce the number of blind people globally including the VISION 2020 – The Right to Sight, the global initiative launched jointly by the WHO and the International Agency for the Prevention of Blindness, which was aimed to help eliminate avoidable blindness globally by the year 2020 [2].

Despite the extraordinary efforts of humanity, blindness still remains a problem for many people around the world. These issues have driven the researchers toward exploring new avenues of research across several disciplines such as assistive technologies, cognitive psychology, computer vision, sensory processing, rehabilitation and accessibility-inclusive human–computer interaction (HCI) [3]. These cutting-edge technologies are also being used in entertainment sector in order to provide a more enjoyable environment to blind people. Popular streaming websites as Netflix and Amazon Prime video have made the remarkable efforts in this sector. Viewers with disability have the potential to experience flexibility in the form of accessibility features such as captions, which provide a visual translation for people with hearing impairments, or audio descriptions (AD) which offer accessibility for people with vision impairment by describing important visual elements of a TV show, movie or performance [4].

Technological advancements in the recent years have made it possible to create hi-tech DIY solutions to assist blind people. One such solution is the development of a smart blind stick with night sensor, moisture sensor, and Ultrasonic sensor, which can aid visually impaired individuals in navigating their environment safely and confidently.

The proposed smart blind stick in this project is designed to improve the safety and independence of visually impaired individuals by providing real-time information about the environment and alerting users of potential hazards. By combining various sensors such as night, water, and obstacle sensors with a microcontroller, the device can process information and provide appropriate feedback to users. This innovative solution will enable visually impaired individuals to navigate their environment safely and with greater confidence.

Alexy Bhowmick and Shyamanta M. Hazarika in [5] compiled an extensive database of scientific research publications over the last two decades to analyse Assistive technology for the visually impaired and

blind people and came to a conclusion that The field of assistive technology, having matured significantly, will continue to gain prominence and significantly enhance the lives of visually impaired, blind, and elderly individuals in ways that were previously unimaginable. The advancement of mainstream mobile technologies, progress in computer vision processing algorithms, miniaturization of electronic devices, and breakthroughs in medical interventions are expected to propel this field further, addressing the challenges and making successful assistive technology a tangible reality.

Authors in [6] presented a new specific system based on RFID technology to help blind people find the other party in their meeting place. It was seen that the use of the proposed system and the Smart Director reduces the time taken to find the location of the visitee by 74% for the appointments of the blind people in urban areas. To overcome the mobility problem this system can also be made into a mobile application because a smartphone already has all the hardware component required in SD. The application can further be integrated with GPS service which can navigate the user to the desired location.

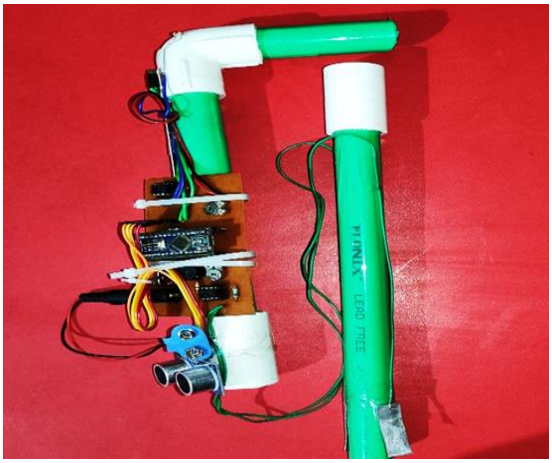

Fig 1: Smart blind stick

II. MATERIAL AND METHODS

1. Arduino Nano: In 2008, the Arduino Nano was introduced as a compact and user-friendly board, designed for use on breadboards. It is built around the ATmega328P and shares similar features and connectivity with the Arduino Uno, but in a smaller size. Featuring 30 male I/O headers arranged in a DIP-30-like configuration, the Arduino Nano can be easily programmed using the Arduino Software integrated development environment (IDE), which is compatible with all Arduino boards and can be used both online and offline. Power can be supplied to the board through a type-B mini-USB cable or a 9 V battery.
2. LDR Sensor: LDR, commonly known as a photoresistor, photocell, or photoconductor, is a unique type of resistor that demonstrates varying resistance based on the intensity of light it is exposed to. It is an electrical component that is sensitive to light and promptly alters its resistance when illuminated. The resistance of an LDR can span several orders of magnitude, with its value decreasing as the light level increases.

Fig 2: Arduino Nano

Fig 3: LDR

Fig 4: Ultrasonic distance sensor

Ultrasonic distance sensor: An ultrasonic sensor is an electronic device that measures the distance of a target object by emitting ultrasonic sound waves, and converts the reflected sound into an electrical signal. An HC-SR04 ultrasonic distance sensor actually consists of two ultrasonic transducers. One acts as a transmitter that converts the electrical signal into 40

KHz ultrasonic sound pulses. The other acts as a receiver and listens for the transmitted pulses. When the receiver receives these pulses, it produces an output pulse whose width is proportional to the distance of the object in front.

3. Buzzer: A buzzer is a device that produces beeping sound when electric current is passed through it. Whenever there is an obstacle in the way of the user the ultrasonic distance sensor will identify it and send an electric signal to buzzer which will then notify the user to stay alert.
4. Vibrator: A vibration motor creates a vibration when electric current is passed through it. It will help the user to stay alert of obstacles when they are in a noisy environment and volume of buzzer is too low to hear.
5. Other useful hardware used: 9V Battery, Power LED, Pipes (for stick), IC 555, IC 358.

III. PRINCIPLE OF OPERATION

The smart blind stick operates by using various sensors to detect obstacles, water, and low light conditions in the surrounding environment. These sensors are connected to Arduino nano that processes the information and provides appropriate feedback to the user through a buzzer and a vibration motor. Arduino nano is programmed to work in a specific way. By uploading a code one can direct Arduino nano to perform demanded task at appropriate time. This is done by Arduino Integrated Development Environment (IDE). Arduino IDE is a computer software which connects to Arduino boards to upload programs and communicate with them. For Arduino IDE to identify a board it must be first plugged in to computer via USB cable.

The obstacle sensor uses ultrasonic waves to detect obstacles in the path of the user. It sends signals to the microcontroller, which then alerts the user through vibration or sound. If the distance between the sensor and obstacle is more than 100cm, it does nothing. If the distance becomes less than 100 cm the buzzer starts alarming. As the distance decreases furthermore the volume of buzzer increases.

The water sensor detects water puddles or wet surfaces on the ground. It sends signals to the microcontroller, which alerts the user of the potential hazard.

The light sensor LDR detects low light conditions and sends signals to Arduino nano. The microcontroller then activates an LED light in order to assist the user in low light conditions.

By combining these sensors with Arduino nano, the smart blind stick provides real-time information to the user, enabling them to navigate their environment safely and with greater confidence.

Overall, the principle of operation of the smart blind stick is to detect and alert the user of potential hazards in the surrounding environment, ultimately improving the safety and independence of visually impaired individuals.

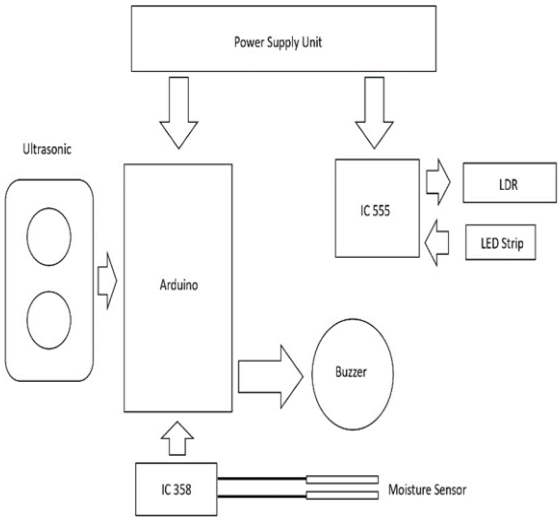

Fig 5: Block Diagram

IV. CONCLUSION

Blindness is a significant disability which has affected millions of people worldwide. Without vision life cannot be experienced at its fullest. With technological advancements in current decades, it has been made possible to assist visually impaired people in many ways. A smart Blind Stick imbedded with multiple sensors has been developed in order to help visually impaired people to navigate their way around. The smart blind stick warns the user if there is an obstacle in front, it can detect if the environment is well lit or dark. The stick starts buzzing and vibrating if the distance between it and the obstacle is equal to or less than 100 cm. This smart blind stick is suitable to use indoor as well as outdoor. Stick is equipped with a small vibrator in order to create a vibrating sensation to alert the user of obstacle. The vibrator makes it easier for user to guide their way around in loud environment when hearing the buzzer sound is quite difficult.

REFERENCE

[1] World health organisation: Up to 45 million blind people globally - and growing https://www.who.int/news/item/09-10-2003-up-to-45-million-blind-people-globally---and-growing#:~:text=Globally%2C%20an%20estimated%2040%20to,2020%3A%20The%20Right%20to%20Sight.

[2] Dandona, L., & Dandona, R. (2006). What is the global burden of visual impairment? *BMC Medicine*, *4*(1). https://doi.org/10.1186/1741-7015-4-6

[3] Khan, A. Z., & Khusro, S. (2021). An insight into smartphone-based assistive solutions for visually impaired and blind people: issues, challenges and opportunities. *Universal Access in the Information Society*, *20*(2), 265–298. https://doi.org/10.1007/s10209-020-00733-8

[4] Katie Ellis, Curtin University Netflix Closed Captions Offer an Accessible Model for the Streaming Video Industry, But What about Audio Description?

[5] Bhowmick, A., & Hazarika, S. M. (2017). An insight into assistive technology for the visually impaired and blind people: state-of-the-art and future trends. *Journal on Multimodal User Interfaces*, *11*(2), 149–172. https://doi.org/10.1007/s12193-016-0235-6

[6] Farshid Sahba, Amin Sahba, Ramin Sahba Helping Blind People in Their Meeting Locations to Find Each Other Using RFID Technology International Journal of Computer Science and Information Security (IJCSIS), Vol. 16, No. 12, December 2018