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# An Innovative IOT Based Assistive Device for the Blind and Deaf Mute

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**Abstract:** ***This paper presents an innovative personal assistive device designed for the blind and deaf mute. The device utilizes an ESP32 camera module to recognize objects and convey the information via a refreshable braille display. Through the use of IOT and ultrasonic technology, this device enhances the independence of visually impaired individuals by accurately detecting objects and distances. This new assistive tool bridges the gap left by conventional aids, offering a reliable solution for everyday navigation and communication.***

**Keywords:** Assistive technology, IOT, Blindness, Braille device, Object recognition

## 1. Introduction

Written in Lancet Global health by 2050, blindness will increase from 36 million to 115 million around the world. And regions with the highest number of blind people are reported in the South Asia region and the Africa region. And complete blindness cannot be cured by wearing glasses or lenses. People with complete blindness find it very difficult to do their day-to-day activities. This is because of the lack of proper functioning of the eye, which is important in life. For activities like recognizing friends, crossing roads, and finding objects. The white cane currently on the market for the blind has many shortcomings. A smart cane has been introduced to the market by upgrading the cane, but it is not possible to identify the objects in front of the cane. Deaf mute individuals recognize each other through hand signals by touching another person's hand. Deaf – mute is often due to genetic mutations that are common in some families, and the extreme explosions caused by these conditions cause blindness and deafness in soldiers as well. Therefore, deaf-mutes are more likely to be helpless in society than people with only blindness.

A personal assistive device for the blind can be used as a solution for not only blind people, but also deaf-mute people. The device detects the distance of objects and conveys this information in a manner understandable to a blind person. The ESP-32 camera module can train a system to recognize objects using image processing technology. When the objects are recognized, then the recognized label name is printed on a refreshable brail display.

People who are currently blind read books and obtain information using the braille system, so the blind person can easily identify the information provided by this technical device using the same methodology as well. Braille is a method used for reading and providing information to blind individuals. It is a common method not only in Sri Lanka, but in every country. This technique consists of six small dots in which blind people place their index fingers on the dots and read the letters. The data from this device is transmitted to a refreshable braille board, then the blind user can read the letters by placing his index finger on the braille board. And the bored will refresh letter by letter with a small-time delay. This device was developed using IOT technology and ultrasonic technology and is far more useful than the smart white stick currently on the market.

This article aims to introduce and evaluate a personal assistive device developed for blind and deaf mute individuals, incorporating IOT technologies and braille systems for enhanced object recognition and distance detection. The significance of this device lies in its ability to provide blind and deaf mute individuals with an innovative, reliable solution for real-time object recognition and distance detection, addressing the limitations of existing assistive technologies

## 2. Methodology

### *a) Block diagram*

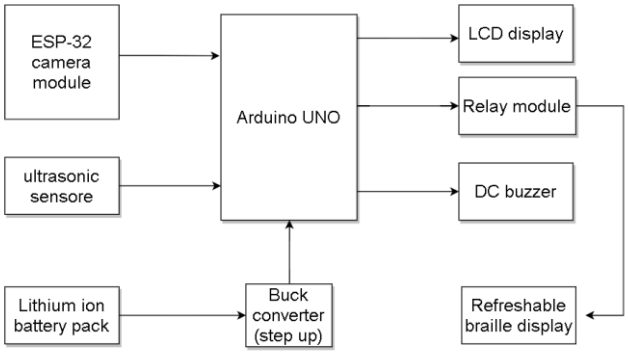


**Figure 1:** Block Diagram

The Arduino Uno board serves as the system's primary processing element. This is where braille conversion and distance measurement take place. The ESP32 camera sends the recognized name labels over serial connection at a 115200 baud rate, while the ultrasonic sensor sends the distance measurements.

Once the Arduino board receives the recognized name labels, it converts the characters to ascii, which is comparable to the braille system. While letters are printing on the refreshable braille board, the LCD display indicates which letters are now printing. Ultrasonic sensors detect adjacent impediments and communicate their presence to the Arduino board. A DC buzzer will sound to alert the user[1]

### *b) Flow chart*

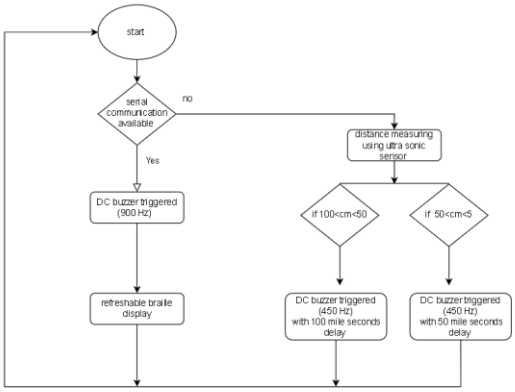


**Figure 2:** Flowchart

Esp32 camera will recognized the objects and send the recognized name label via the serial communication. Then the DC buzzer will be triggered with a 900H z frequency because of that user can get a slight idea about the direction where the recognized objects are located. Then the blind user can read the letters by placing his index finger on the braille board. And the bored will refresh letter by letter with a small-time delay. If the serial communication unavailable, it means there are no recognizable objects nearby to user then the distance measuring system is turned on with ultra-sonic sensor. if the nearby obstacle is in a range of 100cm DC buzzer will trigger 450Hz with a normal time delay (100-mile seconds). if the objects are in range of 50 cm DC buzzer will trigger with small time delay (50-mile seconds) so the user can be aware of the obstacle distance that the user nearby.

### *c) System Design*

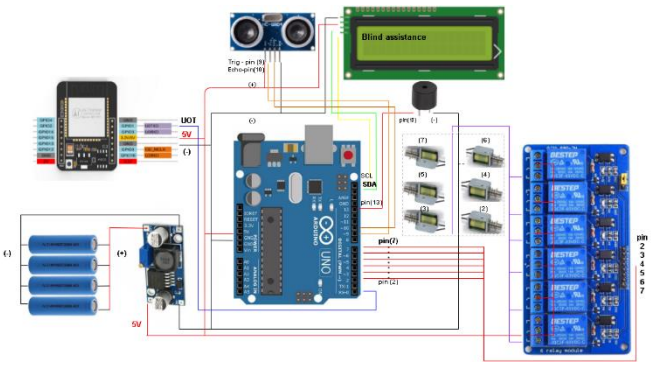


**Figure 3**: System Design

The ESP32 camera module recognizes objects using IOT technologies. The recognized name label will broadcast via the ESP-32 module's UOT pin, and the transmitted name label will be received by the Arduino Uno's RX pin. Braille conversion is accomplished using an Arduino Uno board and received name labels are converted to braille using Ascii conversion. The HC-SR04 ultrasonic sensor is used to measure distance, and the data collected by the sensor is processed on the Arduino Uno board.

This system can be divided into three main topics,

1. Object recognition
2. Braille conversion
3. Distance measuring

#### *1) Object recognition*

Object recognizing system is based on ESP-32 camera with help of google teachable machine learning, Teachable Machine is a web-based graphical user interface tool for rapidly developing unique machine learning classification models without the need for specialist technical expertise. It was intended to assist students, instructors, designers, and others in learning about machine learning by allowing them to create and use their own classification models.

The ESP32-CAM is a high-performance microcontroller with an integrated OV2640 video camera and micro SD card slot. It is affordable and simple to use, making it ideal for IOT devices that require complex functionality such as image tracking, video streaming and recognition.

#### *2) Braille conversion*

The Arduino UNO Rev3 board is used to power the braille converting mechanism. The data received from the ESP-32 board will be converted to ascii, which is similar to the braille method currently used by blind people. This approach entails blind people placing their index fingers on six little dots and reading the letters. Six dots are displayed using miniature push pull solenoids, which are represented by Arduino 2-7 pins

#### *3) Distance measuring*

The HC-SR04 ultrasonic sensor is primarily used to calculate the distance between two objects. It obtains precise distance measurements by the use of non-contact technology - a technique that avoids physical touch between the sensor and the object. The transmitter and receiver are the sensor's two primary components. The transmitter converts electrical signals to ultrasonic waves, while the receiver converts those ultrasonic waves back to electrical signals. Ultrasonic waves are nothing more than sound signals that can be detected and presented on the receiving end

## 3. Conclusion

This study introduces a novel assistive device that combines object recognition and distance detection for blind and deaf mute individuals. Through IOT and braille integration, the device significantly enhances the user's ability to navigate their surroundings safely and independently. The findings indicate that this technology addresses the limitations of existing tools, offering a promising solution for visually and hearing-impaired individuals.

## References

[1] Pawluk, D.T.V., Adams, R.J. and Kitada, R. (2015). Designing Haptic Assistive Technology for Individuals Who Are Blind or Visually Impaired. *IEEE Transactions on Haptics*, 8(3), pp.258–278. doi:https://doi.org/10.1109/toh.2015.2471300.

## Author Profile

**Lasanda Manupiya** received the B.Eng. degree in Electrical and Electronic Engineering in 2022 and the M.Sc. degree in Electronics Engineering in 2024. During his studies, he developed a strong interest in low voltage systems, biomedical systems, and new innovations in technology. After completing his B.Eng., he worked as a Service Engineer at a

biomedical company, where he gained practical experience in troubleshooting medical devices, maintaining equipment, implementing system upgrades.