Ultrasonic Glasses for The Blind

Asst Prof. V S G N Raju, Qurrat Ul Ain, Vanshika Addu
Email: vsgnraju@gmail.com 20311a04am@sreenidhi.edu.in, 20311a04bg@sreenidhi.edu.in
Sreenidhi Institute of Science and Technology, Hyderabad

Abstract : Ultrasonic glasses for the blind are a kind of wearable technology that helps the vision impaired and the blind navigate their environment more easily. The glasses' built-in ultrasonic sensors generate high-frequency sound waves, which reverberate off nearby objects before returning to the wearer's spectacles. After the items are identified by the glasses equipped with cameras, the data is transformed into audible waves. Once the audio signals have been digitally transformed, they are processed and analysed by a microcontroller. The user gets aural or tactile cues, depending on the signals received, to warn them of potential hazards. The visually impaired or those with other vision impairments now have much more flexibility and confidence to explore their environments without fear because to ultrasonic glasses, which have greatly changed their mobility. In the event of an accident or fall, the sound warning system can utilize a phone to notify individuals around so they can get assistance. Technological advancements have the ability to greatly enhancement of the quality of life for individuals who are visually impaired through facilitating access to previously inaccessible environments.

Keywords: Object Detection, Object Recognition, Fall Detection, Image Processing, Google Text-to-Speech

I.INTRODUCTION

Because poor vision limits their ability to participate in many activities, those who are visually impaired face substantial obstacles when it comes to mobility. They rely on their recollections of past explorations or employ blind tactics for navigation. An obstacle sensor module, a power supply, an output device (such a buzzer component), and eyewear are the basic components of a mobility assistance. The processing unit gets its power from the power source and is attached to an output device and an obstacle-detecting module. An ultrasonic sensor that can detect impediments has a 30-degree field of view, or up to 5-6 meters in the direction the user is going. When the sensor senses an obstruction, the gadget will compose a voice message and send it to the user's headphones. Thanks to this innovation, people with visual impairments may be able to go about their daily lives with greater independence and confidence. Creating smart glasses that the visually handicapped can use to navigate independently is the main objective of this project. Its creation using the Android OS and feedback based on Android makes it very trustworthy by alerting users to any problems. The adoption of ultrasonic glasses has completely changed the way visually impaired people walk, giving them the confidence to explore their environment without fear. People who are visually impaired may have a much better quality of life if this technology allows them to access places that would otherwise be inaccessible to them. Raspberry Pi, hardware, goggles, analog, and virtual assistant. Almost everyone carries a smartphone these days. The sensors, buzzers, and voice assistant integrated into the glass are all powered by an Arduino microcontroller. The glass will notify the user and the voice assistant when they are going to face an impending danger. Wands are mechanical obstacle detectors that are compact, lightweight, and have a limited range. To shield the head from nearby hazards, the gadget is both rigid and has a relatively limited range. Wearable software like this can assist users or patients cut down on the number of times doctors have to visit their homes. Expenses for running the business are therefore cut. Quickly obtain the most current vital sign data with an app that syncs with all medical devices. Even at faster speeds, your data is still private and safe. You may streamline your job and speed up the delivery of future outcomes or outputs by using this portable technology. Our current focus is on developing a dependable technology that allows visually impaired persons to move normally without excessive power consumption. The formula for the speed of sound in air is derived from this velocity. Multiplying the speed of sound in a given medium by its travel time yields the distance that sound travels.

To accomplish a certain purpose, an embedded system combines computer hardware, software, and perhaps supplementary mechanical and/or other parts. Consider the microwave oven as an example. Though tens of millions of them are used every day, few people realize that a processor and software are used to make their lunch or dinner An individual's machine, however, is not designed to perform a particular activity, but it is capable of performing a broad variety of them. Some people use the phrase "general-purpose computer" to make this difference more clear

Embedded systems are often found as subsystems within larger systems. Numerous embedded systems are found in contemporary vehicles, such as trucks and cars. Three interconnected systems: one regulates the anti-lock brakes, another keeps an eye on the emissions, and a third shows all of that information on the dashboard. Although it is not always necessary, a communication network may occasionally link these embedded systems.

The fact that multiple embedded systems make up a general-purpose computer should not be misunderstood. Everything from the keyboard and mouse to the video card, modem, hard drive, floppy drive, and sound card in my computer has is own embedded system. Each of these devices is purpose-built, has its own central processing unit (CPU), and runs its own software. The modem may, for example, send and receive digital data via analogue phone lines. All the other devices are similarly summarized in just one line.

If the architecture of an embedded system is good, the user could not even notice the presence of a central processing unit (CPU) and software. A microwave oven, video recorder, alarm clock are all subject to the same rule. Making a similar device without the central processing unit and software may even be possible in some cases. One possible solution would be to replace the combination with an integrated circuit that performs the same functions in hardware. However, there is a lot of leeway in design when using this form of hard-cooling. Redesigning a piece of specialized hardware is more complicated and costly than changing a few lines of code.

II.LITERATURE SURVEY

Dunai Dunai, L.; Chillarón Pérez, M.; Peris-Fajarnés, G.; Lengua Lengua, I. Euro banknote recognition system for blind people:

This research details developing a handheld device that can read Euro banknotes for the visually impaired. A device that fits into sunglasses has made it possible for those who are blind or visually handicapped to handle Euro bills unaided. This is particularly helpful when people receive their money back after making a purchase. One little computer, a camera, and a Pi NoIR (No Infrared Filter) are the main components, with additional infrared light dispersed throughout. In order to detect banknotes, we use the updated Viola and Jones algorithms; to determine their worth, we use the Speed Up Robust Features (SURF) method. Detecting banknotes has an accuracy rate of 84% and recognizing their value has an accuracy rate of 97.5%.

The authors of this work are Lee, J., Ahn, J., and Lee, K.Y., and they provide a method allowing visually challenged people to recognize banknotes using a Raspberry Pi.

Hsan Habib | Md. Milon Islam A Hybrid Approach to Staircase Detection for the Benefit of the Visually Impaired
The eyes and other visual organs are fundamental to human physiology because of the complex information they can relay to the brain. But there are certain people who can't see anything around them. These people typically require assistance getting around and deal with the many challenges that come with being vision impaired. In order to help users navigate their surroundings, this research constructs a hybrid system that can detect stairs and the ground using an ultrasonic sensor in conjunction with a pre-trained model. The recommended hardware consists of include a buzzer, an ultrasonic sensor, an R-GBD camera attached on a walking stick, and a raspberry pi. The first phase of the detection approach is to capture images of the steps using an RGB-D camera. These images are subsequently compared with photographs of training templates. Applying our strategy to many staircase images taken in varying lighting and noise levels allowed us to get an average accuracy of 98.73%. This study will be very helpful has limited eyesight or no vision at all.

Mohammad Marufur Rahman Obstacle and Fall Detection to Guide the Visually Impaired People with Real Time Monitoring.

This study presents a wearable electronic gadget that can monitor a person's current location in real-time, allowing those who are visually impaired to walk around independently without assistance. Objects in the user's path, surfaces with imperfections, and moving parts can all be detected by the system. Also, the system notifies the user's guardian when the decline occurs suddenly. An ultrasonic sensor, an accelerometer, a data transmission device, a microprocessor, a motion sensor that detects both visible and invisible light, and a smartphone app make up the system. A Bluetooth module allows the microcontroller to communicate with the user's smartphone. To aid the user in navigating effectively, the software on the smartphone creates auditory instructions. So that they can keep a watch on their loved ones, the app also updates the user's location and alerts guardians when the user trips or is in danger. The designed system achieved an accuracy of around 98.34% at a user-to-barrier distance of 50 cm. Users may navigate the system extremely effectively and efficiently by using accurate voice directions. In the end, the proposed method will be more comfortable and safer for the visually impaired and their caregivers.

III. PROPOSED SYSTEM

Existing System:

Costly and difficult to maintain, the existing system is run on huge hardware with a basic controller for communication. There may be communication issues with the present system because it depends on several components for control.

Proposed System:

In spite of these limitations, the project is designed to discover the optimal solution. Every object is recognized by putting a camera panel that measures object distance. that they can know what it is before they get there.

This is where image processing technology come into play, extracting text from photos. By using sensors, the pinpoint accuracy is enhanced.

The project is built on the Raspberry Pi, which provides complete functionality and control. The project involves controlling a battery. A voltage regulator is used to control the voltage.

IV. FUNCTIONAL REQUIREMENTS

1 RASPBERRY PI BOARD:
Bcm2837 Features

The BCM2837 controller on a Raspberry Pi 4 board makes the ARM11 central processing unit (CPU) unit compatible. Many previous versions of the Raspberry Pi, including the 2 and 4, feature this Broadcom chip. The BCM2837 and the BCM2836 are functionally and structurally equivalent; in fact, they are indistinguishable. The sole significant change is that the ARMv7 quad-core cluster has been replaced by the ARM Cortex A53 (ARMv8) quad-core cluster. With its 1.2GHz ARM processors, the device is about half the speed of the Raspberry Pi 2. The Video core IV operates at a frequency of 400 MHz.

2 Operating System In SD Card

The Raspberry Pi doesn't come with any operating system or internal storage, so you'll need to get an SD card that already has Linux installed on it.

3 Power Supply

At its input, the circuit receives electricity from the controlled source. After the transformer decreases the 230V input from the mains supply to 12V a.c., the rectifier receives this reduced voltage. The output of the rectifier is a DC voltage that pulses. The rectifier's output voltage is filtered to eliminate any remaining a.c components, resulting in a pure d.c voltage voltage conditioner in order to generate a clean, steady DC voltage.

4 Web Camera

For robotic tasks, a camera is a must-have. Keeping an eye on a room from afar is what the camera is all about. This experiment made use of a life cam vx-800 USB camera. As soon as the user clicks the video button on the loaded webpage, the video from the appropriate room will begin streaming into the webpage. For this, we employ a MJPG streamer.

5 Speaker

While computer speakers—sometimes called multimedia speakers—are most commonly used with computers, they may also be connected to other audio devices like MP3 players. Most of these speakers have amplifiers already built in, so you'll need to find a way to power them up. You may use a USB port, an AC adapter, or the mains power outlet. One typical signal input connection is the 3.5 mm jack connector, which is lime green in colour according to the PC 99 standard. On rare occasions, RCA connections are also utilized.

6 Buzzer

Beepers and buzzers are examples of mechanical, electromechanical, and piezoelectric audio signaling devices. Timers, alarm systems, and devices that detect human input, including computer keystrokes and mouse clicks, often make use of buzzers and beepers.

7 Ultrasonic Sensor

The distance to an object may be determined by sensors by measuring the time it takes to send a signal and receive an echo. This technology (annemometer) can measure

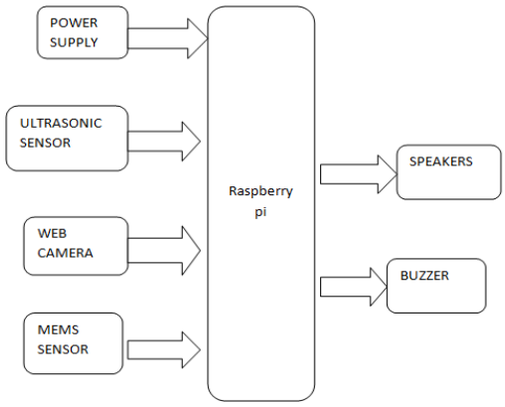
the level of a tank, the direction and speed of the wind, and the speed of air or water. A gadget that tracks direction and speed uses many detectors to determine speed in relation to water-or air-borne particle distances. The sensor finds the depth to the fluid's surface to calculate the tank's volume of liquid. Some other uses include sonar, medical ultrasonography, non-destructive testing, humidifiers, and burglar alarms.

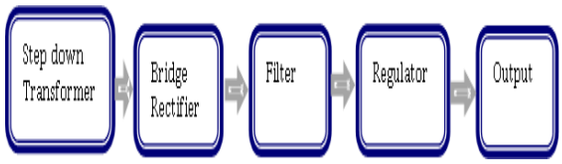
Ultrasonic systems generate sound waves with a frequency greater than 18,000 hertz by use of transducers. When it hears an echo, the transducer converts the sound waves back into usable electrical energy.

8 Mems Sensor

They are known as micro-electro-mechanical systems. This category of gadgets is easily identifiable by its small size and futuristic design. These sensors are made with components as tiny as 100 micro-meters. The devices range in size from basic constructions to intricate electromechanical systems with integrated micro-electronic control of several moving elements. as addition to mechanical micro-actuators, microstructures, and microelectronics, these sensors are frequently offered as bundles with other types of microsensors.

V. DESGIN OF THE PRODUCT





• A Raspberry Pi (Model B or B+ would work)
• SD Card: Our recommendation is a class 4 SD card with 8 GB of storage space.
• A screen and connector cables
o Any display device that supports HDMI or DVI can be used by the Pi.
o Get one with an HDMI port for the best picture quality; older gadgets may work with other types of connections.
• Computer input devices · Any standard USB mouse and keyboard should work with your Raspberry Pi.
• Power source: A micro USB power source with 5V can be used to power your Raspberry Pi. Your Pi can behave erratically if the power source you use does not generate 5V.

• Access to the internet to install software updates or add new features, you need to link your Raspberry Pi to the internet using either an Ethernet wire or a WiFi adapter.
• Audio o The Raspberry Pi is compatible with 3.5mm audio devices, so you may listen to music with your headphones, speakers, or earbuds.

VI. INSTALLATION AND SETUP TOOLS

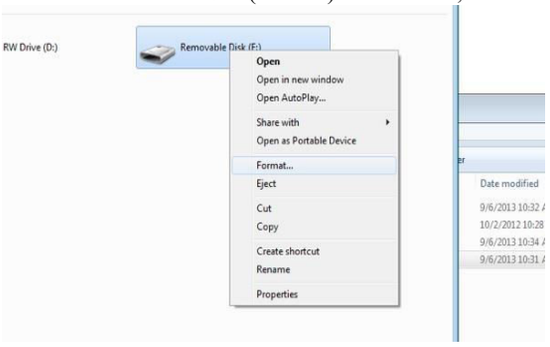
INSTALLING RASBIAN DEBIAN WHEEZY OPERATING SYSTEM USING WINDOWS

The most recent Raspbian zip archive. This may be downloaded from the following URL: http://www.raspberrypi.org/downloads.
After downloading, extract the image file from the "RASPBIAN Debian Wheezy.zip" file.
It is important to verify the assigned drive letter after formatting the SD card and inserting it into the reader. You can quickly identify the drive letter (like G:) in Windows Explorer by looking at the left column. You may use a cheap SD converter in either your device's USB port or the SD card slot.
The Source-forge Project website is where you may get Win32DiskImager, which is also available as a zip file. A USB drive will allow you to execute it afterwards. Get Win32DiskImager from http://sourceforge.net/files/latest/download.
Extract the executable file from the zip package, and then launch the Win32DiskImager program. In certain cases, you'll need administrative access in order to do this. Using the context menu that appears when you right-click on the file, select "Run as administrator." The photo file that was extracted should now be available for your selection.

You have to select the drive letter of the SD card in the device box. If you don't choose the correct drive, all of your data will be permanently deleted from the computer's hard disk. Try using a cheap SD adaptor linked via USB if the disk appears in Win32DiskImager but your computer's SD card port doesn't identify it. Once you're ready to start writing, hit "Write" and then be patient. As soon as you take the SD card out of the imager, turn it off.

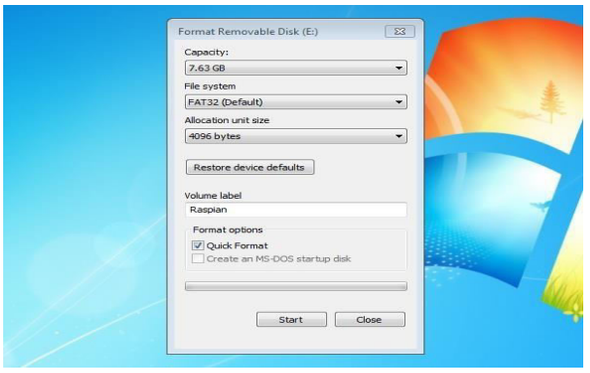
FORMAT THE SD CARD

To access the SD card disk, open Windows Explorer. Next, access the context-sensitive menu by using the secondary mouse button. Press Format in the menu. Once you've confirmed that FAT32 (Default) is selected, click Start.



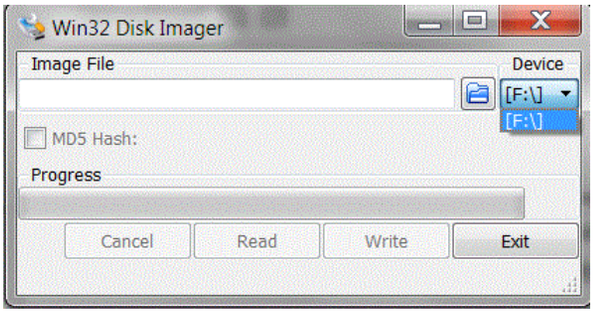
Selecting an SD card to format

Upon completion of the format, you will be notified that your SD card is ready for the next stage. This should happen shortly.

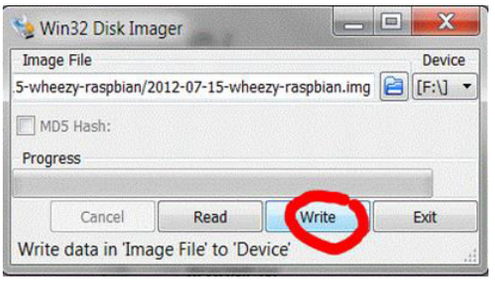


USING WIN32DISKIMAGER

After swapping out the SD card, launch Win32DiskImager again. In this example, I'll choose F: as the destination drive, but you may choose any drive you like.
.
To proceed with copying the.img file to the SD card, click the folder icon and then choose it from the list. After selecting the.img file, choose Write next to transfer the operating system to the card.

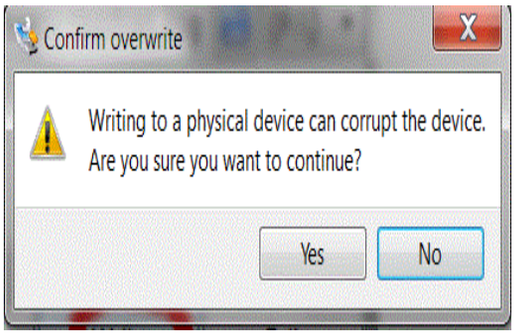


1. Write OS image from .img file to SD card

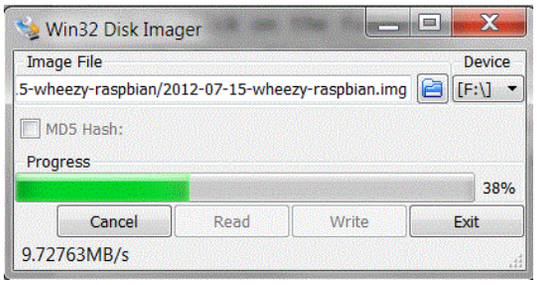


2.Write OS image from .img file to SD card

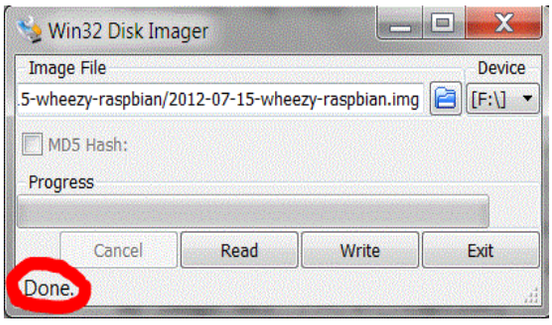
3. ***Check device and confirm***.



4. ***Progress indicator***



5. Finished



PLUGGING IN YOUR RASPBERRY PI

1. Insert your SD card into the Raspberry Pi's SD card port; there's just one way to do this.
2. After that, find the Raspberry Pi's USB ports and insert your USB keyboard and mouse. If you want to use a certain input on your TV or monitor, such as HDMI 1, DVI, etc., you need to switch it on first. 3. After that, link your Raspberry Pi to your TV or monitor using the HDMI wire.
4. Attach an Ethernet cable to the Ethernet port that is adjacent to the USB ports if you want to link your Raspberry Pi to the internet. Disregard this step if you do not require an internet connection.
5. After you're certain that all the necessary wires and SD card have been inserted, plug in the micro USB power source. Your Raspberry Pi will be powered on and booted up when you do this.
6. For the first time, you'll need to configure your Raspberry Pi SD card and choose an operating system.

LOGGING INTO YOUR RASPBERRY PI

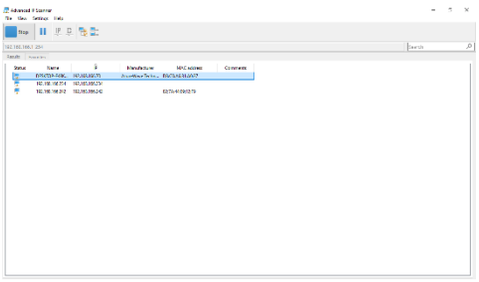
1. Upon successful booting of your Raspberry Pi, a login prompt will be shown. If you're using Raspbian, the default login credentials are pi and raspberry. When you enter in the password, you won't see any text display.
2. The command line prompt pi@raspberrypi~$ will appear when you have successfully signed in.
3. Press the Enter key on your keyboard to launch the graphical user interface.

VII. SYSTEM IMPLEMENTATION

Steps Performed to establish connection:

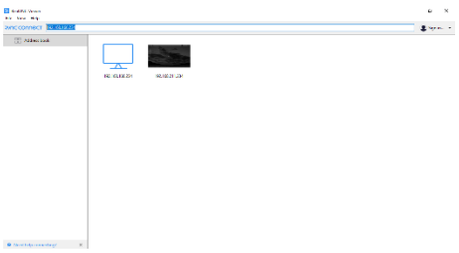
1. Advanced IP Scanner

Used to search for the number of connecting devices and their IP Address

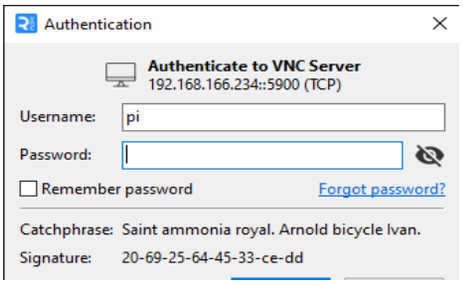


2. Real VNC Viewer

Used to connect to the raspberry Pi by searching it's IP Address.

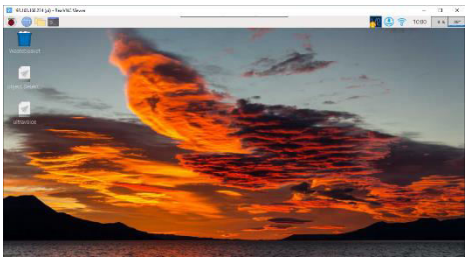


3.Pi



Connecting to Pi

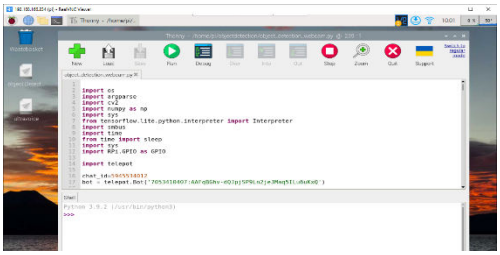
4.



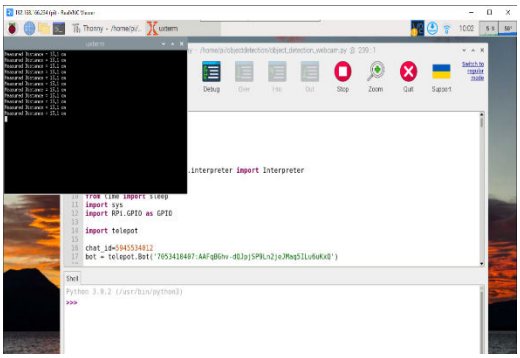
Type the Program in

Go to Programming →Thonny →Open Program

4.

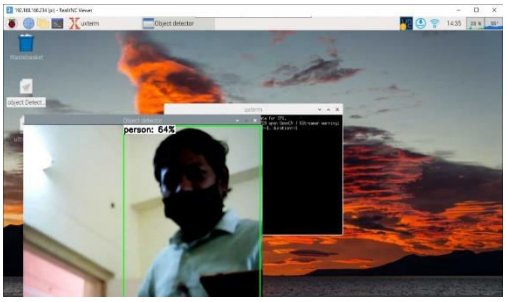


6. Distance Detection



Uxterm shows how far the object is. Upon clicking the ultra-voice, you can find the exact range of the object from the worn glasses. It is measured in centi-meters. You can check the varying distance by moving the object towards or away from the ultrasonic sensor.

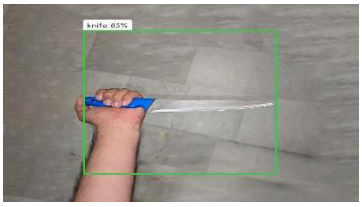
7. Object Detection

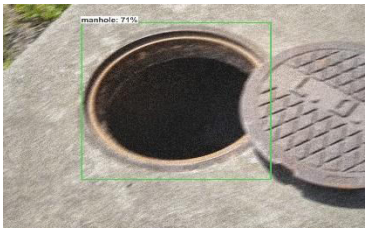


On clicking Object Detect, you can see how the objects are identified with the help of the camera using the principle of image processing. It also shows the percentage of match with such object stored.

VIII. RESULTS AND DISCUSSION

Helps in the seeing of day to day objects as well as sends an alert in case of a fall. Any dangerous objects can also be identified. Ultrasonic glasses for the blind are a kind of wearable technology that helps the vision impaired and the blind navigate their environment more easily. The glasses' built-in ultrasonic sensors generate high-frequency sound waves, which reverberate off nearby objects before returning to the wearer's spectacles. After the items are identified by the glasses equipped with cameras, the data is transformed into audible waves. Once the audio signals have been digitally transformed, they are processed and analysed by a microcontroller. The user gets aural or tactile cues, depending on the signals received, to warn them of potential hazards. The visually impaired or those with other vision impairments now have much more flexibility and confidence to explore their environments without fear because to ultrasonic glasses, which have greatly changed their mobility. In the event of an accident or fall, the sound warning system can utilize a phone to notify individuals around so they can get assistance. Technological advancements have the ability to greatly enhancement of the quality of life for individuals who are visually impaired through facilitating access to previously inaccessible environments.





Telegram Alert and Mems Sensor

The Mems sensor when tilted or when the distance detected by the ultrasonic sensor from the floor/ground decreases, a fall will be detected. This is done by sending an immediate Alert along with a buzzing sound which is activated with 1 second delay.

The alert message along with the image is sent to the telegram app, so that it is noticed at once that the blind person has fallen.

REFERENCES

1. Steinmetz, J.D.; Bourne, R.R.; Briant, P.S.; Flaxman, S.R.; Taylor, H.R.; Jonas, J.B.; Abdoli, A.A.; Abrha, W.A.; Abualhasan, A.; Abu-Gharbieh, E.G.; et al. Causes of blindness and vision impairment in 2020 and trends over 30 years, and prevalence of avoidable blindness in relation to VISION 2020: The Right to Sight: An analysis for the Global Burden of Disease Study. *Lancet Glob. Health* **2021**, *9*, e144–e160. [Google Scholar] [CrossRef]

2. Dunai Dunai, L.; Chillarón Pérez, M.; Peris-Fajarnés, G.; Lengua Lengua, I. Euro banknote recognition system for blind people. *Sensors* **2017**, *17*, 184. [Google Scholar] [CrossRef] [PubMed][Green Version]

3. Lee, J.; Ahn, J.; Lee, K.Y. Development of a raspberry Pi-based banknote recognition system for the visually impaired. *J. Soc. E-Bus. Stud.* **2018**, *23*, 21–31. [Google Scholar]

4. Patrycja, B.-A.; Osiński, D.; Wierzchoń, M.; Konieczny, J. Visual Echolocation Concept for the Colorophone Sensory Substitution Device Using Virtual Reality. *Sensors* **2021**, *21*, 237. [Google Scholar]

5. Chang, W.-J.; Chen, L.-B.; Sie, C.-Y.; Yang, C.-H. An artificial intelligence edge computing-based assistive system for visually impaired pedestrian safety at zebra crossings. *IEEE Trans. Consum. Electron.* **2020**, *67*, 3–11. [Google Scholar] [CrossRef]

6. Yu, S.; Lee, H.; Kim, J. Street crossing aid using light-weight CNNs for the visually impaired. In Proceedings of the IEEE/CVF International Conference on Computer Vision Workshops, Seoul, Korea, 27–28 October 2019. [Google Scholar]

7. Yuksel, B.F.; Fazli, P.; Mathur, U.; Bisht, V.; Kim, S.J.; Lee, J.J.; Jin, S.J.; Siu, Y.-T.; Miele, J.A.; Yoon, I. Human-in-the-Loop Machine Learning to Increase Video Accessibility for Visually Impaired and Blind Users. In Proceedings of the 2020 ACM Designing Interactive Systems Conference, Eindhoven, The Netherlands, 6–10 July 2020. [Google Scholar]

8. Liu, X.; Carrington, P.; Chen, X.A.; Pavel, A. What Makes Videos Accessible to Blind and Visually Impaired People? In Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems, Yokohama, Japan, 8–13 May 2021. [Google Scholar]

9. Spagnol, S.; Hoffmann, R.; Martínez, M.H.; Unnthorsson, R. Blind wayfinding with physically-based liquid sounds. *Int. J. Hum.-Comput. Stud.* **2018**, *115*, 9–19. [Google Scholar] [CrossRef][Green Version]

10. Skulimowski, P.; Owczarek, M.; Radecki, A.; Bujacz, M.; Rzeszotarski, D.; Strumillo, P. Interactive sonification of U-depth images in a navigation aid for the visually impaired. *J. Multimodal User Interfaces* **2019**, *13*, 219–230. [Google Scholar] [CrossRef][Green Version]

11. Zhao, Y.; Wu, S.; Reynolds, L.; Azenkot, S. A face recognition application for people with visual impairments: Understanding use beyond the lab. In Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems, Montreal, QC, Canada, 21–26 April 2018. [Google Scholar]

Author name: 1. Qurrat Ul Ain 2. Vanshika Addu

Designation: B.Tech

Department: Electronics and Communication

College: Sreenidhi Institute of Science and Technology

Email: 20311a04am@sreenidhi.edu.in

20311a04bg@sreenidhi.edu.in