Ultrasonic Smart Glasses With Facial Recognition

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Abstract

The visually impaired face various challenges in their daily life and this project aims to develop a computerized tool to bring some simplicity and ease to their lives. In this project, we will be working on making a prototype of a Smart Ultrasonic Eyeglass that will not only help the visually impaired to detect obstacles but it will also help them to identify whether they're being encountered by known or unknown people. This will be facilitated with the help of a face detection feature built with python codes and flashed into the raspberry pi. The ultrasonic sensor will help to detect the distance between the wearer and the obstacle or a person in their vicinity and alert the sensor via vibration or via a voice message sent through the earphones to the user attached to the glasses. We will create an intelligent system using python that will capture images using a mini camera and analyse the face of the person in front of the user and verify it with the previously stored data on the Raspberry pi. If the data matches, it identifies and lets the user know that he/she is familiar with the person in front of him else alerts him that the face is unfamiliar. With this system, we aim to design and implement a real time object recognition using blind glass and solve the day-to-day problems faced by the visually challenged people.

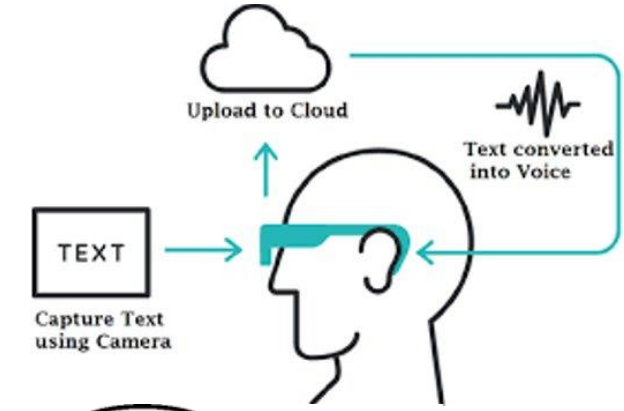
INTRODUCTION

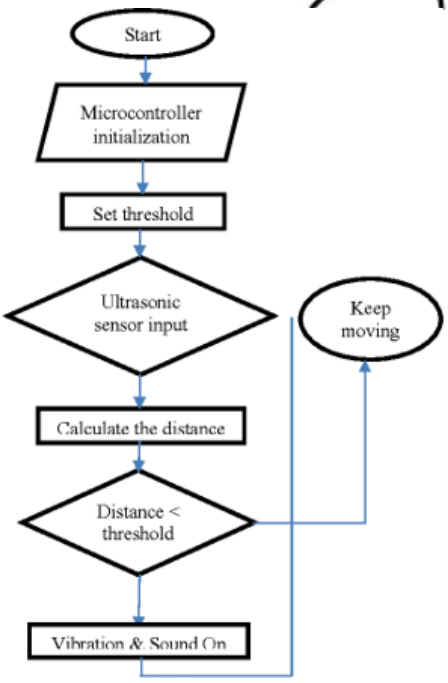
Visually impaired people are facing various challenges in their day-to-day life. They are having a hard time moving around and finding things. It is hard for them to do everyday work. The objective of this project is to make their life easy by designing and implementing a real time object recognising glasses. The intelligent system just like human eye recognises the object in front of the user and conveys it to them. The glasses also detect the obstacles in front of the user and says at what direction the obstacle is and makes it easy for the user to manoeuvre. This makes the life of visually impaired easy and they can live a normal life.

Proposed Design

The proposed design of the project includes a mini camera attached to the spectacles for acquiring the images and visuals from the surroundings, an ultrasonic sensor to detect distance between obstacles and the wearer, a Raspberry pi Data Acquisition System for performing and executing operations such as face recognition, data fusion, image processing etc, and spectacles onto which all of these will be built.

Block Diagram and Flowchart





LITERATURE SURVEY

1. Voscal vision for visually impaired [The International Journal of Issn: 2319 – 1813 Isbn: 2319-1805 Engineering and Science(Ijes)-01-07||2013 by Shrilekha Banger, Preetam Narkhede Rajashree Parajape.] - This project is a vision substitute system designed to assist blind people for autonomous navigation.
2. Microsoft COCO Common Objects in Context- A project by Tsung-Yi Lin, Michael Maire, Serge Belongie, Lubomir Bourdev, Ross Girshick, James Hays, Pietro Perona, Deva Ramanan, C. Lawrence Zitnick, Piotr Dollár which was submitted on 1 May 2014 (v1) and last revised 21 Feb 2015 (this version, v3): They present a new dataset with the goal of advancing the stateof-the-art in object recognition
3. A Japanese company (Keisuke Shimakage) designed the Oton Glass- These smart glasses are designed to help dyslexic to read. The camera will capture pictures of words that the user wants to read and reads the words for the user via the earpiece.
4. Anushree Harsur in her study she had mentioned about the use of ultrasonic sensor to help the blind people to know the obstacles before them.
5. Bharathi has done a research based on obstacle avoidance system in which a ultrasonic sensor is placed in cane which detects the obstacle in the ground level. In eyeglass method, an ultrasonic sensor is used which detects obstacle above the head up to certain angle.
6. Sharma in his study he had mentioned a lead of idea of setting the ultrasonic sensor at 30-degree angle on a suitable blind stick to sense if there is a hole or staircase in front of the blind at about 30 cm distance to avoid a person from falling
7. Mohamed Fezari in his study he had mentioned about a navigation aid for blind and visually impaired people which is based on a microcontroller with synthetic speech output that is portable and gives information to the user about urban walking routes.
8. Students of university of messina had done a research on electromagnetic sensor to assist the autonomous walking of visually impaired and blind. Their idea consists in applying a microwave radar on the traditional white cane making aware the user about the presence of an obstacle in a wider and safer range. Compared to the already existing electronic travel aids devices, the proposed system exhibits better performance, noise tolerance, and reduced dimensions.
9. Students of Beihang University had done a research to help the blind people sense the obstacle in an indoor environment they have used a pair of wearable optical see-through glasses for the ease of use of blind people's daily walks.

Components

RASPBERRY PI 4

Several generations of Raspberry Pis have been released. The first generation (Raspberry Pi Model B) was released in February 2012, followed by the simpler and cheaper Model A. In 2014, the Foundation released a board with an improved design, Raspberry Pi Model B+. These first-generation boards feature ARM11 processors, are approximately credit-card sized and represent the standard *mainline* form-factor. Improved A+ and B+ models were released a year later.
Then Raspberry Pi 2 was released and initially featured a 900 MHz 32-bit quad-core ARM Cortex-A7 processor with 1 GB RAM.A Raspberry Pi Zero with smaller size and reduced input/output (I/O) and general-purpose input/output (GPIO) capabilities was released. On 28 February 2017, the Raspberry Pi Zero W was launched, a version of the Zero with Wi-Fi and Bluetooth capabilities. Raspberry Pi 3 Model B was released with a 1.2 GHz 64-bit quad core ARM Cortex-A53 processor, on-board 802.11n Wi-fi, Bluetooth and USB boot capabilities. Then the Raspberry Pi 3 Model B+ was launched with a faster 1.4 GHz processor, a three-times faster gigabit Ethernet (throughput limited to ca. 300 Mbit/s by the internal USB 2.0 connection), and 2.4 / 5 GHz dual-band 802.11ac Wi-Fi (100 Mbit/s). Other features are Power over Ethernet (PoE) (with the add-on PoE HAT), USB boot and network boot (an S card is no longer required)). Raspberry Pi 4 Model B was released in June 2019 with a 1.5 GHz 64-bit quad core ARM Cortex-A72 processor, on-board 802.11ac Wi-Fi, Bluetooth 5, full gigabit Ethernet (throughput not limited), two USB 2.0 ports, two USB 3.0 ports, and dual-monitor support via a pair of micro-HDMI (HDMI Type D) ports for up to 4K resolution. The Pi 4 is also powered via a USB-C port, enabling additional power to be provided to downstream peripherals, when used with an appropriate PSU. Raspberry Pi 400 features a custom board that is derived from the existing Raspberry Pi 4, specifically remodeled with a keyboard attached. Raspberry Pi Pico was released in January 2021. The Pico has 264 KB of RAM and 2 MB of flash memory. It is programmable in MicroPython, CircuitPython, and C. Rather than perform the role of general-purpose computer, it is designed for physical computing, similar in concept to an Arduino.
We will be using Raspberry pi 4 which is an open-source platform which we use for coding our application and one can get a lot of related information so you can customize the system depending on the need.

ULTRASONIC SENSOR

Ultrasonic sensing is one of the best ways to sense proximity and detect levels with high reliability. Ultrasonic transducers are used in systems which evaluate targets by interpreting the reflected signals. For example, by measuring the time between sending a signal and receiving an echo the distance of an object can be calculated. For presence detection, ultrasonic sensors detect objects regardless of the color, surface, or material (unless the material is very soft like wool, as it would absorb sound.) To detect transparent and other items where optical technologies may fail, ultrasonic sensors are a reliable choice.

MINI CAMERA

A webcam is a video camera that feeds or streams an image or video in real time to or through a computer to a computer network. The maximum resolution of a webcam is also lower than most handheld video cameras, as higher resolutions would be reduced during transmission. The lower resolution enables webcams to be relatively inexpensive compared to most video cameras, but the effect is adequate for acquiring visuals from surroundings. This will be used to capture images of people and objects so that the AI system installed can detect if it is a known face or unknown face or object.

PYTHON CODE

Python is an interpreted, object-oriented, high-level programming language with dynamic semantics. Its high-level built in data structures, combined with dynamic typing and dynamic binding, make it very attractive for Rapid Application Development, as well as for use as a scripting or glue language to connect existing components together. Two separate codes will be required one to tell the distance of obstacles ahead and other for face recognition.

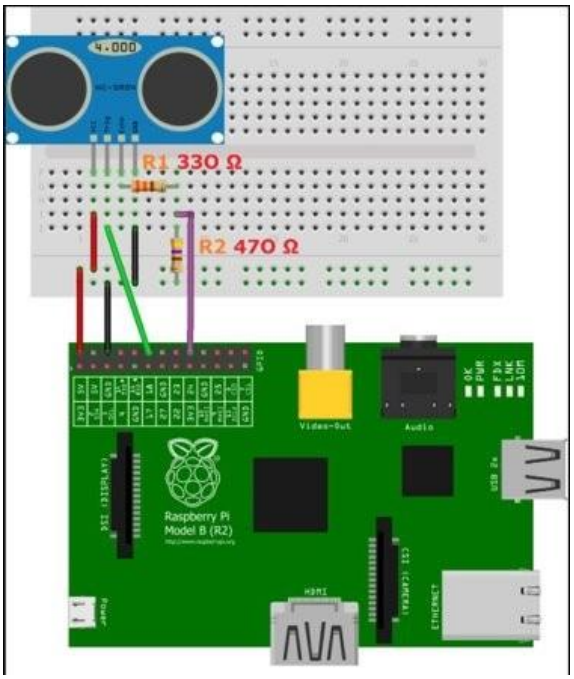
Other Components:

5Volts batter to power the Pi, a glass to work on, earphones to alert the user and wires for connection.

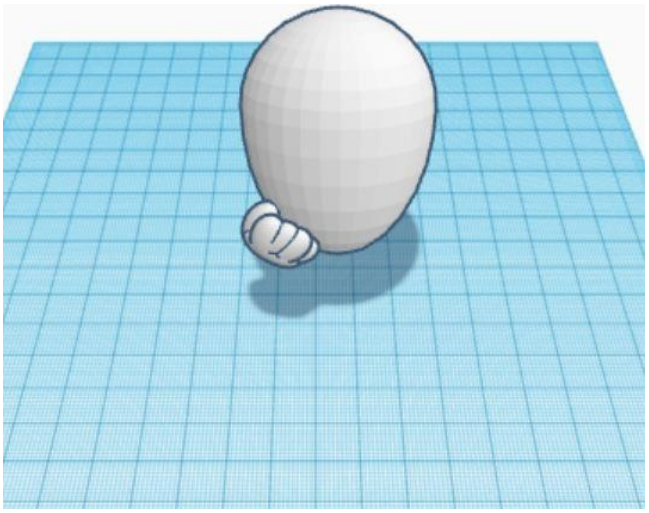
Setup

Python supports modules and packages, which encourages program modularity and code reuse. We need to install all the required packages in Raspberry Pi terminal. The major libraries and modules that we need are espeak, opencv, dlib and face recognition library for Python 3. We would require two separate codes- one to calculate the distance between the user and the object and the second code to recognize facial features.

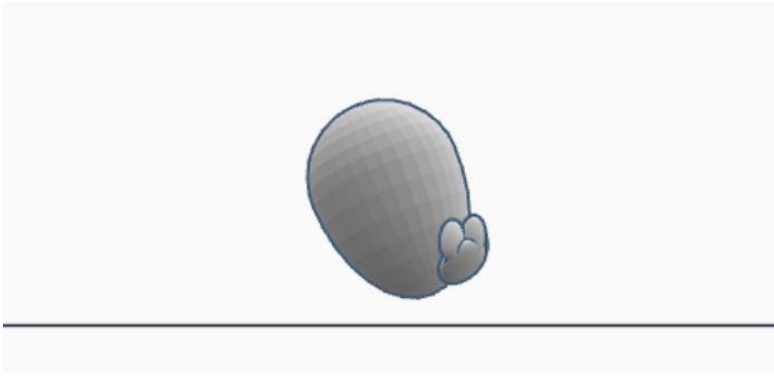
Setup Representation



Raspberry Pi integrated with Ultrasonic Sensor



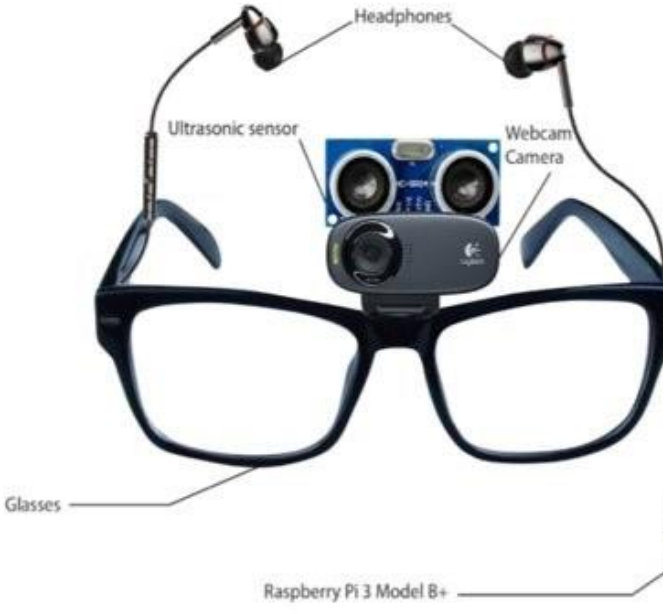
3D Face Recognition Front View



3D Face Recognition Side View

Result

The final product will a pair of smart glasses with a mini webcam for acquiring surrounding information attached to it, along with ultrasonic sensors integrated with raspberry pi for distance detection and earphones attached to the stems of glasses for giving alerts and information to the wearer.



Conclusion and Future Scope

- We have presented a design of a pair of smart eyeglasses with a mini web camera to acquire visual information from the surroundings, an ultrasonic sensor to determine safe distance between the wearer and the obstacle and Raspberry pi data acquisition system to which the sensor is integrated. The Raspberry Pi works efficiently to interpret the distance and identify images captured by the web cam. The system design, working mechanism and principles were discussed in the paper. This new concept is expected to improve the visually impaired peoples' lives despite their economic situations.

The future scope of this project can be extended to various fields such as:

- Adding GPS in the glasses which will tell directions to visually impaired people.
- Could make the glass compact and lightweight.
- Could make the glasses read texts and read it to its user. This makes it easy for visually impaired students in their studies.
- Could implement an AI like Alexa which gives answers to the user for the enquired questions.

ACKNOWLEDGMENT

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REFERENCES

[1]. M. R. Miah and M. S. Hussain, "A Unique Smart Eye Glass for Visually Impaired People," *2018 International Conference on Advancement in Electrical and Electronic Engineering (ICAEEE)*, 2018, pp. 1-4, doi: 10.1109/ICAEEE.2018.8643011.

[2]. Feng Lan, Guangtao Zhai and Wei Lin, "Lightweight smart glass system with audio aid for visually impaired people", *TENCON IEEE Region 10 Conference*, 2015.

[3]. A. Valberg, Light Vision Color (Wiley, Chichester, 2005). 36-5 M. Juttner, Physiological Optics, in T. G. Brown (Ed.), the Optics Encyclopedia (Willey-VCH, Berlin, 2004), Vol. 4, P. 2511.

[4]. D. A. Atchison, A. Joblin and G. Smith, Influence of the Stiles-Crawford effect apodization on spatial visual performance JOSA A 15, 2545 (1998).

[5]. A. J. Rentschler, R. A. Cooper, B. Blasch and M. L. Boninger, "Intelligent walkers for the elderly: Performance and safety testing of VA-PAMAID robotic walker", *Journal of Rehabilitation Research and Development*, vol. 40, no. 5, pp. 423-432, 2003.

[6]. A. Carullo and M. Parvis, "An ultrasonic sensor for distance measurement in automotive applications", *IEEE Sensors Journal*, vol. 1, no. 2, pp. 143, 2001.

[7]. W. Lotmar ,Theoretical eye model with asperics , JOSA 61 1522 (1971). [12] E. R. Villegas, L. Carretero and A. Fimia , Le Grand eye for the study of ocular chromatic aberration, Ophthal. Physiol. Opt. 16, 528 (1996).

[8]. Yadav, E.P., Mittal, E.A. and Yadav, H., 2018, February. IoT: Challenges and Issues in Indian Perspective. In 2018 3rd International Conference on Internet of Things: Smart Innovation and Usages (IoT-SIU) (pp. 1-5). IEEE.

[9]. Paolo Bellavista, Alessandro Zanni, Towards Better Scalability for IoT-Cloud Interactions via Combined Exploitation of MQTT and CoAP, IEEE 2nd International Forum on Research and Technologies for Society and Industry.

[10]. bHuang T. (1996-11-19). Vandoni, Carlo, E, ed. Computer Vision: Evolution and Promise (PDF). 19th CERN School of Computing. Geneva: CERN. pp. 21–25. ISBN 978-9290830955. doi:10.5170/CERN-1996-008.21. [16] bMilanSonka; Vaclav Hlavac; Roger Boyle (2008). Image Processing, Analysis, and Machine Vision. Thomson. ISBN 0-495-08252-X.

[11]. Dana H. Ballard; Christopher M. Brown (1982). Computer Vision. Prentice Hall. ISBN 0-13-165316-4

[12]. N. Molton, S. Se, J.M. Brady, D. Lee, P. Probert, “A stereo vision-based aid for the visually impaired", Department of Engineering Science, University of Oxford, Oxford, OX1 3PJ, U.K. 1998 Elsevier Science B.V, Received 1 November 1996; revised 3 September 1997; accepted 22 September 1997.

[13]. Farrah Wong; R. Nagarajan, Sazali Yaacob, “Application of Stereovision in a. Navigation Aid for Blind People”, Artificial Intelligence Research Group School of Engineering and Information Technology University, Malaysia, ICICS-PCM 2003. Singapore.

[14]. Supreeth K Rao1, Arpitha Prasad B1, Anushree R Shetty1, Chinmai1, R. Bhakthavathsalam2, Rajeshwari Hegde1, “Stereo Acoustic Perception Based on Real Time Video Acquisition for Navigational Assistance”, Natarajan Meghanathan, et al (Eds): SIPM, FCST, ITCA, WSE, ACSIT, CS & IT 06, pp. 97–108, 2012. © CS & IT-CSCP 2012.

[15]. Tim Morris (2004). Computer Vision and Image Processing. Palgrave Macmillan. ISBN 0-333-99451-5.

[16]. Bernd Jähne; Horst Haußecker (2000). Computer Vision and Applications, A Guide for Students and Practitioners. Academic Press. ISBN 0-13-085198-1.

[17]. Volodymyr Ivanchenko, James Coughlan, William Gerrey and Huiying Shen, Computer Vision-Based Clear Path Guidance for Blind Wheelchair Users, Proceedings of the 10th international ACM SIGACCESS conference on Computers and accessibility, Pages 291-292, ISBN: 978-1-59593- 976-0, 2008.

[18]. David A. Forsyth; Jean Ponce (2003). Computer Vision, A Modern Approach. Prentice Hall. ISBN 0-13-085198-1.

[19]. D. Marr, ``Vision: A Computational Investigation into the Human Representation and Processing of Visual Information’’, Freeman, San Francisco (1982).

[20]. Barcodes Ender Tekin and James M. Coughlan, A Mobile Phone Application. Enabling Visually Impaired Users to Find and Read Product, ICCHP'10 Proceedings of the 12th international conference on Computers helping people with special needs, Pages 290-295, ISBN:3-642-14099-8 978-3-642-14099-0, 2010.

[21]. L. Roberts, ``Machine perception of 3D solids", Chapter 9 in J.T.Tippett,etal. (eds), Optical and Electro Optical Information Processing, MIT Press, pp. 159-197 (1965).

[22]. http://www.bmva.org/visionoverview The British Machine Vision Association and Society for Pattern Recognition Retrieved February 20, 2017

[23]. Y.Aloimonos (ed.), Special Issue on Purposive and Qualitive Active Vision, CVGIP B: Image Understanding, Vol. 56(1992).

[24]. Joseph Redmon and Anelia Angelova, Real-Time Grasp Detection Using Convolutional Neural Net- works (ICRA), 2015

[25]. Boris Schauertey, Manel Martinezy, Angela Constantinescuz and Rainer. Stiefelhagen, An Assistive Vision System for the Blind that Helps Find Lost Things, ICCHP'12 Proceedings of the 13th international conference on Computers Helping People with Special Needs - Volume Part II, Pages 566-572, ISBN: 978-3-642-31533-6, 2012.