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WEARABLE ASSISTIVE SPECTACLES FOR VISUALLY IMPAIRED PEOPLE USING RASPBBERRY PI-4

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Abstract: Individuals who are visually impaired encounter a variety of challenges in their daily lives since current assistive gadgets frequently fall short of consumer expectations in terms of cost and support structure. The number of persons who are visually impaired has increased over the years. According to WHO figures, there are around 2.2 Billion visually impaired people in the world[7]. Over 90 percent of those who are blind or visually impaired around the world are over 50 and reside in low-income areas. The majority of hangouts in the globe are now found in India. Almost 275 million of the 2.2 billion blind persons globally are from India[8]. What's terrible is that 75% among them involve cases of preventable blindness. There is a severe shortage of optometrists and donated eye in India, which makes it hard to treat corneal blindness. People with visual impairments typically rely on support from others. The support can come from living things, children, or a unique electronic item. Wearable gadgets are among the assistive technologies that are designed to be the most helpful because they don't require or require little usage of the user's hands. This article introduces a brand-new style of smart glasses with multitasking support and minimal construction costs. The concept communicates information to the user using the Raspberry Pi 4 single-board computer, a camera, an ultrasonic detector, GPS module and an earphone. People who are blind use the braille system for writing and reading requirements. The arrangement of the raised blotches, which carries the information and are actually quite delicate, is felt by the visually impaired person, thus with these effects in mind, we built our system to make it easier for persons with visual impairments to read any book. The spectacles utilise a variety of technologies, including OCR, Text to Voice Conversion, and Object Recognition, to carry out their responsibilities. Optical Character Recognition and Open CV are used to find the text in the image. Obstacle detection is performed using the ultrasonic sensor. The employed GPS module will be linked to the concerned person's Google Map, where the location will be live-fed, and the user can alert them in case of an emergency by utilising the provided buzzer.

Key words - Blind, Smart Glass,Raspberry Pi,Ultrasonic Sensor, GPS module, Google Map

I.INTRODUCTION

There are plenty of persons in our life who are afflicted by various ailments or disabilities. To make their lives simpler and better, some individuals require assistance. For those with specialised needs, there exist specialised universities and academies. There are many levels of demands, and not all circumstances necessitate unique locations or academies. Those with eyesight problems, for instance, can study with regular students if the opportunity arises. The majority of blind and visually impaired persons have never gone to school, and this is because there are few and expensive private institutions for those with special needs, or they learn at home with the help of their parents. The main goal of "Smart Glasses" is to aid the blind and persons with visual impairments by providing them with new technology that enables them to read the typed handbook. The technology in these eyewear allows them to scan any printed instruction and turn it into an audio manual. The purpose of "Smart Glasses" is to assist those people in various facets of their lives. These glasses, for instance, are quite beneficial in the sphere of education. Those who are blind or have vision problems can read, study, and learn everything from any published text or image. Someone who is blind or have vision problems are encouraged to learn and thrive in a variety of different disciplines thanks to "smart glasses." People with visual impairments report numerous challenges while attempting to read published text using current technology, including alignment, focus, accuracy, mobility, and effectiveness issues. These people require assistance to improve and simplify their lives. The major purpose of " Smart glasses " is to aid the blind, and their design makes use of a camera-based model that can be utilized by users to read text. The design is small-scale and provides a more controllable operation with little setup. It is inspired by primary investigations with visually impaired persons. These glasses are quite beneficial in the sphere of education. Those who are blind or have vision problems can read, study, and learn everything from any published text or image. People without eyes or with vision problems are encouraged to learn and thrive in many different disciplines thanks to "smart glasses."

II. SURVEY

Text detection and recognition have been a challenging issue in different computer vision fields. There are many research papers that have discussed different methods and algorithms for extracting the text from the images. Here we have designed our project based on these research papers.

The paper by TejalAdep et.al[1], aims to produce a wearable visual aid for visually challenged people in which speech commands are accepted by the user. The main function is to address the identification of objects and signs. This will help the visually disabled person to manage day- to- day exertion and navigate through his/ her surroundings. Raspberry Pi is used to apply artificial vision using python language on the Open CV platform. Muiz AhmedKhan et.al,[6] also proposed a design using Raspberry Pi 3 Model B. The design incorporates a camera and sensors for interference avoidance and advanced image processing algorithms for object discovery. The distance between the user and the interference is measured by the camera as well as ultrasonic sensors. The system includes an integrated reading adjunct, in the form of the image- to- text converter, followed by an audile feedback.

Jin Ai et.al [2] proposed a wearable visually assistive device to help them perceive images. With the help of various multimedia information processing technologies, the proposed device can first acquire image information through a depth camera, also apply an image- to- text conversion using image caption technology, and ultimately the attained text sequence is fed back to the user via voice. In this way, eyeless people are suitable to perceive the outside world, thus creating an unknown experience for them. The main technical specifications of the system are distance perception range is 0.1 m to 10m; RGB field of view (T×L×D) is 69.4 ° × 42.5 ° × 77 °; depth field of view (T×L×D) is 91.2 ° ×65.5 ° ×100.6 °; where T: transverse, L: longitudinal and D:diagonal and maximum weight is 3.05 kg.

The methodology proposed by D. Vijendra Babu et.al,[3] is a wearable device which is attached with the belt to the top wear of the person and Ultrasonic mapping is used for the exchange of Visually challenged Blind people without the help of other mortal. The Ultrasonic wave is used to discover the hurdle in anterior and back. It indicates while the hurdle is close enough. The other paper we've reviewed is by Tripti Sharma et. al,[4] for Ultrasonic Mapping where the obstacles are detected by these ultrasonic detectors and the person is cautioned either by the vibrational signals or the buzzer alarm. We've also reviewed a paper by Apostolos Meliones et.al,[5] where the smartphone application and the microelectronic external device will serve as a wearable that will help the safe out-of-door navigation and guidance of eyeless people. The external device will collect information using an ultrasonic detector and a GPS module. Its main ideal is to determine the actuality of obstacles in the path of the user and to give information, through oral instructions, about the distance at which it's located, its size and its implicit movement and to advise how it could be avoided.

III. PROBLEM IDENTIFICATION FOR BLIND

Despite the advancements in wearable devices for blind people, there are still several challenges and limitations that need to be addressed. Some of these include:

1. **Cost:** Many of these devices are quite expensive and may not be affordable for everyone.
2. **Complexity:** Some devices are difficult to use and require a steep learning curve, which can be a barrier for some individuals.
3. **Reliability:** The accuracy and reliability of these devices can be affected by various factors such as ambient light, weather, and surrounding environment.
4. **Limited availability**: Many of these devices are not widely available in all countries, and access to repair and maintenance services can also be limited.
5. **Social stigma:** Wearing assistive technology can sometimes lead to social stigma and discrimination, which can impact the user's self-esteem and confidence.
6. **Interoperability:** Some devices may not be compatible with other technologies, making it difficult to use them together.

Overall, while wearable devices for blind people have made significant progress, there is still room for improvement in terms of affordability, ease of use, and overall functionality.

3.1 BLINDNESS

According to WHO broadly at least 2.2 billion people have a near or distance visionimpairment.The International Classification of Diseases 11(2018) [7] classifies vision impairment into two groups

1.Distance vision impairment.

2. Near presenting vision impairment

Distance vision impairment

1.Mild – visual perceptivity worse than 6/12 to6/18

2. Moderate – visual perceptivity worse than 6/18 to6/60

3.Severe – visual perceptivity worse than 6/60 to3/60

4. Blindness – visual perceptivity worse than 3/60

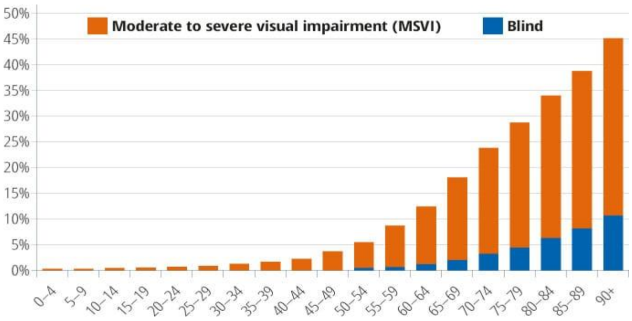
Near vision impairment

Near visual perceptivity worse than N6 orM.08 at 40 cm.

A person's experience of vision impairment varies depending upon numerous different factors. This includes for illustration, the vacuity of forestallment and treatment interventions, access to vision recovery(including assistive products similar as specs or white canes), and whether the person gests problems with inapproachable structures, transport and information.

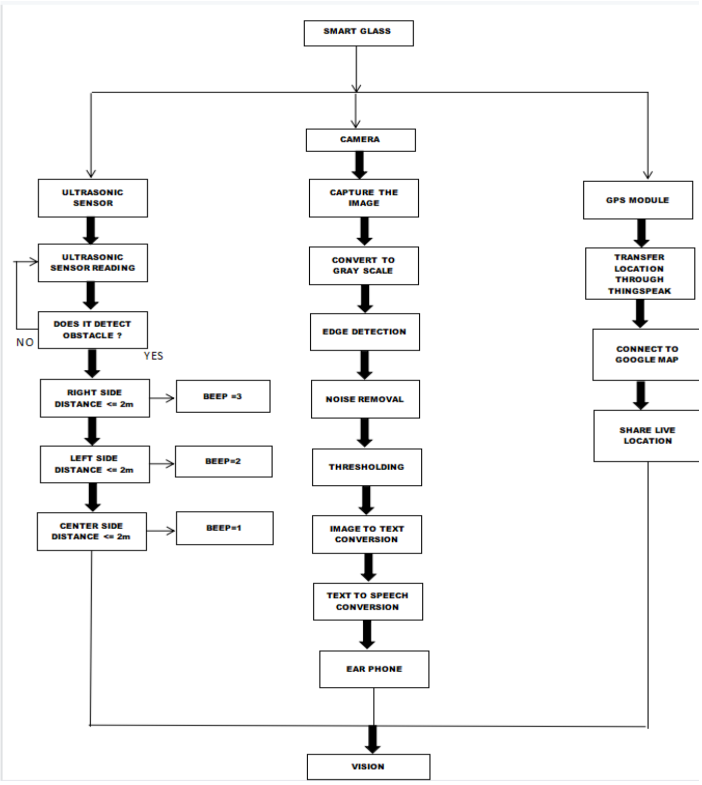
3.2 Statistics:

Blindness can affect people of all ages, but older adults (those aged 50 years and above) are most commonly affected. According to the World Health Organization [7], an estimated 65% of people who are blind are aged 50 years and older. This is due to the fact that many eye diseases, such as cataracts, age-related macular degeneration, and glaucoma, become more common as people get older. Other factors such as diabetes, which can lead to diabetic retinopathy, also contribute to the higher incidence of blindness in older adults. However, it's important to note that early detection and treatment of these eye conditions can help prevent or slow down vision loss, regardless of age. The below graph depicts the blindness rate for various age categories

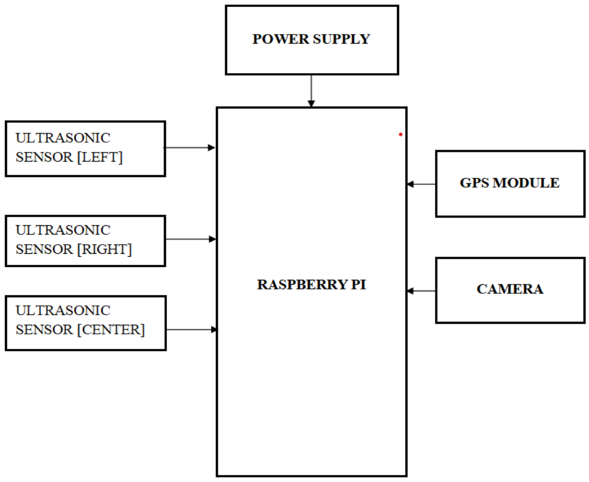


IV. PROPOSED METHODOLOGY

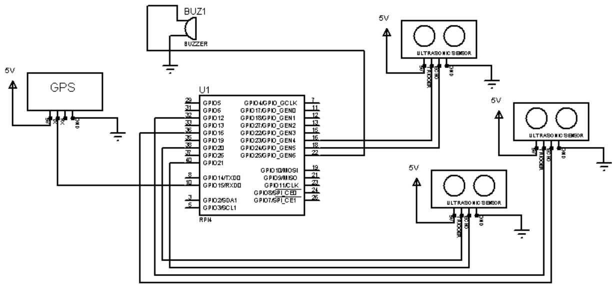
4.1 FLOW CHART:



4.2 BLOCK DIAGRAM:



4.3 CIRCUIT DIAGRAM:



4.4 METHODOLOGY:

Image acquisition:

In this step, the camera captures the images of the text. The quality of the image captured depends on the camera used. We're using the USB camera.

Pre-processing:

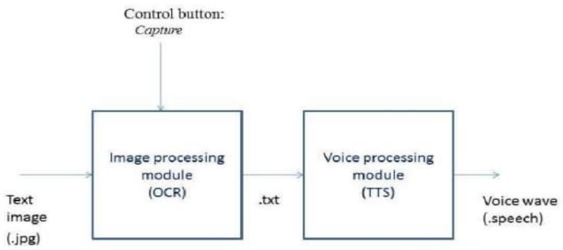
This step consists of colour to gray scale conversion, edge detection, noise removal, warping and cropping and thresholding. The image is converted to gray scale as numerous OpenCV functions bear the input parameter as a gray scale image. Noise removal is done using bilateral filter. Canny edge detection is performed on the gray scale image for better detection of the contours. The warping and cropping of the image are performed according to the contours. This enables us to descry and extract only that region which contains text and removes the unwanted background. In the end, Thresholding is done so that the image looks like a scrutinized document. This is done to allow the OCR to efficiently convert the image to text.

Image to text conversion :

The below illustration shows the flow of Text- To-Speech. The first block is the image pre-processing modules and the OCR. It converts the preprocessed image, which is in. png form, to a. txt file. We're using the Tesseract OCR.

Text to speech conversion:

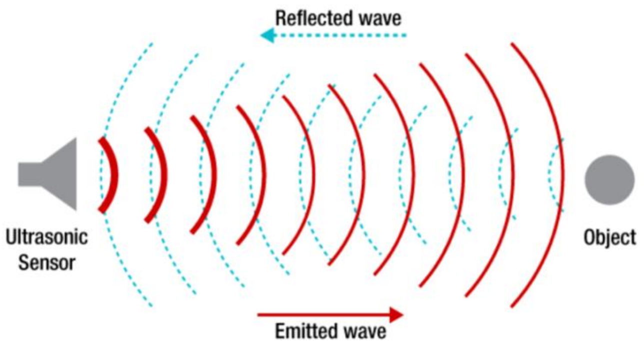
The alternate block is the voice processing module. It converts the. txt file to an audio output. Then, the text is converted to speech using a speech synthesizer called TTS.



BLOCK DIAGRAM OF TEXT-TO-SPEECH DEVICE

Obstacle detection using Ultrasonic sensor:

Ultrasonic sensors are mainly used to transmit and receive sound waves reflected from an object. When ultrasonic waves are incident on an object, a diffused reflection of the energy occurs over a wide solid angle that might be as high as 180 degrees. Thus the minute fraction of the incident energy is reflected back to the transducer in the form of echoes. The basic principle is that if the object is close to the sensor, the sound waves are reflected back quickly and if the object is far from the sensor, the sound waves take too long to reflect back. Our design is mainly based on this methodology.



Ultrasonic Testing

Real Time Object Detection:

We will use YOLOv3 real-time Object Detection algorithm trained to identify the object present before the person. Then the label of the object is identified and then converted into audio by using Text to Speech , which will be the expected output.

Interfacing with GPS module:

Using Python, we retrieve the Latitude, Longitude, and time data from the GPS module. additionally, print them on a console (terminal). Get the current location on a Google Map using this latitude and longitude. We alert the concerned person about their their location with the help of ThingSpeak.

4.5 COMPONENTS REQUIRED:

- RASPBERRY PI
- ULTRASONIC SENSOR
- GPS MODULE AND ANTENNA
- USB CAMERA
- POWER SUPPLY

4.6 SOFTWARE USED:

- Operating System : Raspbian OS
- Language : Python
- IDE : python IDE

V. CONCLUSION

When reading content that is in front of them, the user will put on their Smart glasses and hit a button. A camera module that is included within the eyewear will snap a picture of the image after a button is pressed. The text will then be identified using OCR. The text will eventually be transformed into a voice that the user will hear through headphones using TTS. The model has an 87% accuracy rate. The yolov3 algorithm is used to detect the items. By announcing the distance of the obstacle through audible prompts, the ultrasonic sensor built into the smart glasses helps to detect impediments when they are close to or approaching the user. It allows the user to escape any oncoming obstacles. The GPS receiver help in locating the user and live-feeding their location on Google Map so that when the user encounters an emergency, they can alert through the provided button. As a result, the device aids in readability, which is a crucial component of gathering information in our daily lives. For blind persons in low-profit situations, the price is fairly reasonable. The device's design enables the blind person to use it more conveniently than the blind stick, which he must carry every time he leaves his home.

VI. ACKNOWLEDGEMENTS

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