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<u>Minor Project Report (EC-4608)</u>

Group Number: 23

Project Title

Smart Glasses for Blind people

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Table of Contents

1. <u>Introduction</u>

The Smart glasses for blind people project is a revolutionary new technology designed to help visually impaired people read books and other printed materials. The glasses capture video of the text, takes photos, extracts text from images and reads the text aloud to the user. The aim of this project is to provide practical and easy tools for visually impaired people to enjoy reading and improve their quality of life. Traditional reading methods such as Braille can be difficult and time consuming for the visually impaired. These Smart Glasses for the visually impaired aims to eliminate these problems by providing users with a good reading and problem solving experience.

The glasses offer a hands-free experience, allowing users to move around easily while reading. This program uses the latest technology, including advanced image recognition and text-to-speech software, to provide users with a unique reading experience. The glasses are designed to be lightweight and comfortable. This report will provide an overview of the Smart Glasses for Blind People project, including its design and functionality. It will also discuss the potential impact of this technology on the lives of visually impaired individuals and the future of assistive technology.

2. <u>Objective</u>

The objective of a project report on smart vision glasses for the blind would be to provide a detailed analysis of the development and implementation of this technology. It describes the functionality, design, and technical aspects of the smart vision glasses, as well as their potential impact on the lives of visually impaired individuals.

It provides an introduction to the project and its purpose, including the need for assistive technology for visually impaired individuals. This report highlights the features and benefits of the smart vision glasses, including their ability to recognize text and provide audio feedback to the user.

Additionally, It also discuss the processes involved in the making of the smart vision glasses.

Overall, the objective of the project report is to provide a comprehensive understanding of the potential impact of smart vision glasses for the blind and to assess the potential for their widespread adoption in the assistive technology market.

3. Block diagram

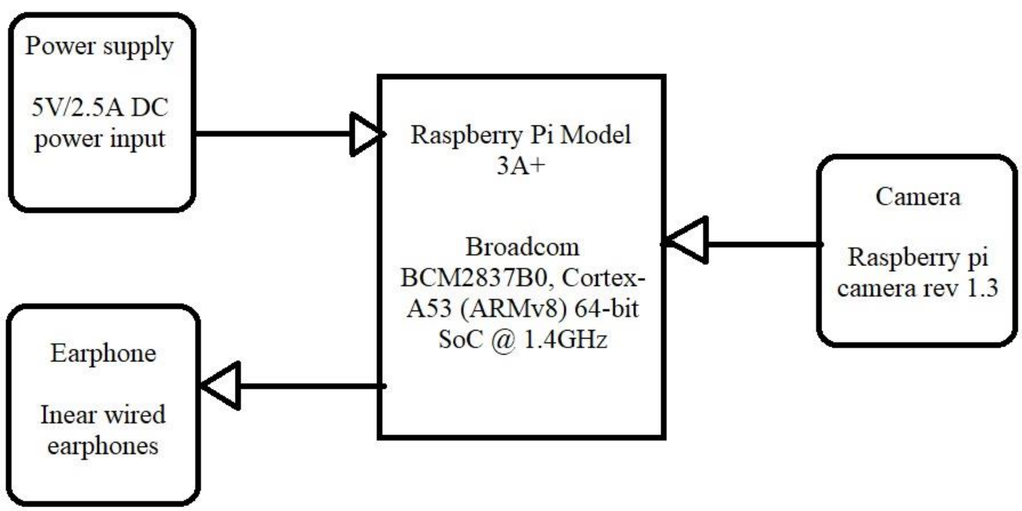

Figure 1 : Block diagram of the project

4. **Circuit Diagram**

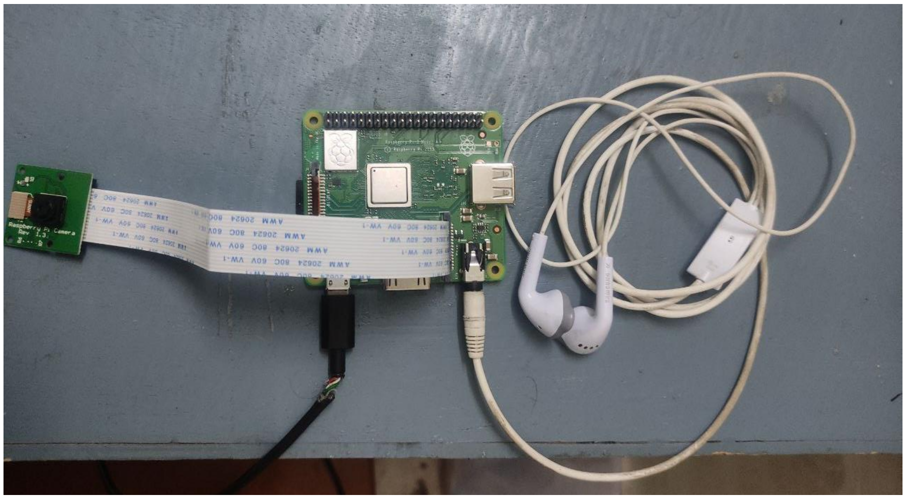

Figure 2: Circuit picture

The Raspberry Pi 3 Model A+ is provided power through USB type b cable. The supply should be of 5V/2A. The camera is connected to the Raspberry Pi using a 15cm flex cable to the Raspberry Pi's CSI port. The flex cable can be bought at different lengths. The earphones are connected through 3.5mm audio jack.

The circuitry of the SmartVision glasses includes a high-definition camera mounted on the front of the glasses. This camera capture images of the wearer's surroundings, which are then processed by a computer vision algorithm. The algorithm text and converts this information into audio feedback using text-to-speech technology.

5. <u>Components</u>

a. Raspberry pi Model 3A+

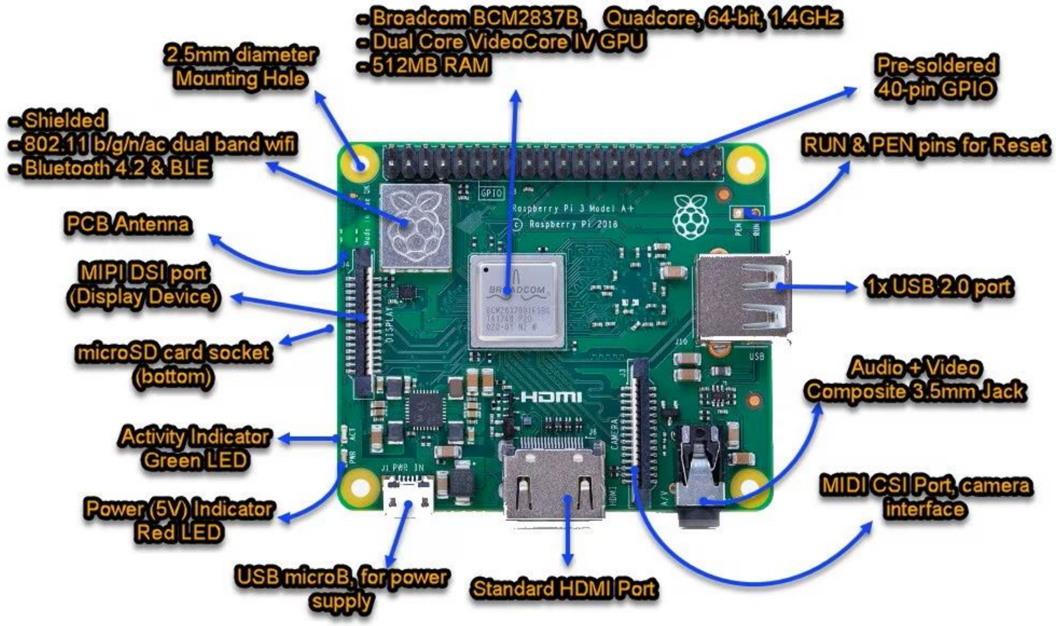

Figure 3: Raspberry pi 3A+

The Raspberry Pi 3 Model A+ is the latest product in the Raspberry Pi 3 range. It boasts a 64-bit quad core processor running at 1.4 GHz, dual-band 2.4 GHz and 5 GHz wireless LAN, and Bluetooth 4.2/BLE.

The Pi 3A+ has the same 40 pin GPIO header and mounting holes, so any standard HATS and mounting plates that work with the 3B+ will work with this version as well. Any software or operating systems compatible with the 3B+ should also be compatible with the 3A+.

The Raspberry Pi 3 Model A+ has the same mechanical footprint as the Raspberry Pi 1 Model A+.

Technical Specifications:

- Processor: Broadcom BCM2837B0, Cortex-A5364-bit SoC @1.4 GHz
- Memory: 512MB LPDDR2 SDRAM
- Connectivity: 2.4 GHz and 5 GHz IEE 802.11.b/g/n/ac wireless LAN, Bluetooth 4.2/BLE
- 1 × USB 2.0 port
- Access: Extended 40-pin GPIO header
- Video & sound: 1 × full size HDMI
- MIPI DSI display port
- MIPI CSI camera port
- 4 pole stereo output and composite video port
- Multimedia: H.264, MPEG-4 decode (1080p30); H.264 encode (1080p30);
- OpenGL ES 1.1, 2.0 graphics
- SD card support: Micro SD format for loading operating system and data storage
- Input power: 5 V/2.5 A DC via micro USB connector
- 5 V DC via GPIO header
- Environment: Operating temperature, 0–50°C

GPIO stands for General Purpose Input Output. The Raspberry Pi has two rows of GPIO pins, which are connections between the Raspberry Pi, and the real world. Output pins are like switches that the Raspberry Pi can turn on or off (like turning on/off a LED light). But it can also send a signal to another device. The Raspberry Pi 3A+ board contains a single 40-pin expansion header labeled as 'J8' providing access to 28 GPIO pins.

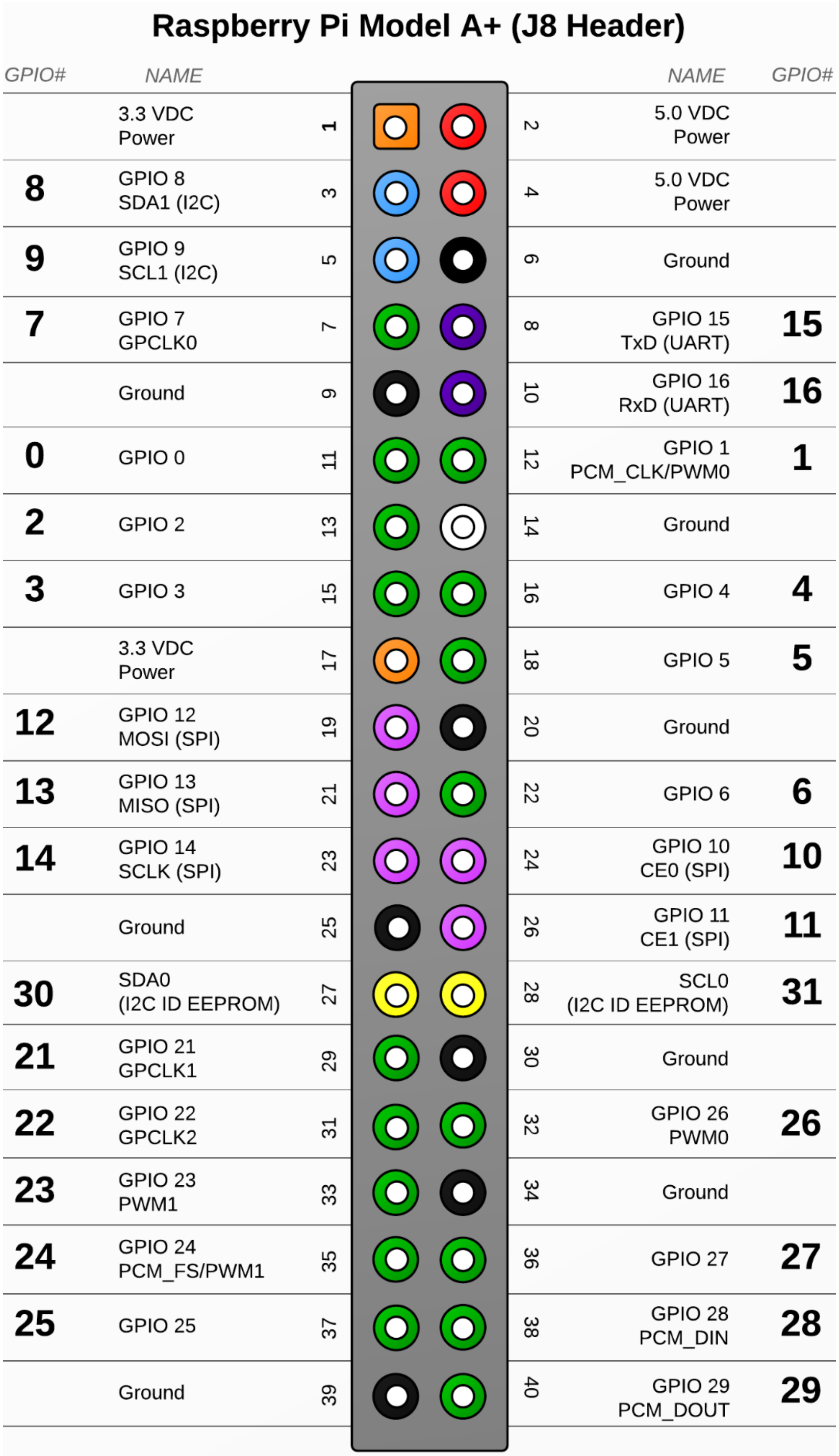

Figure 4 : GPIO pins of raspberry pi

b. Camera

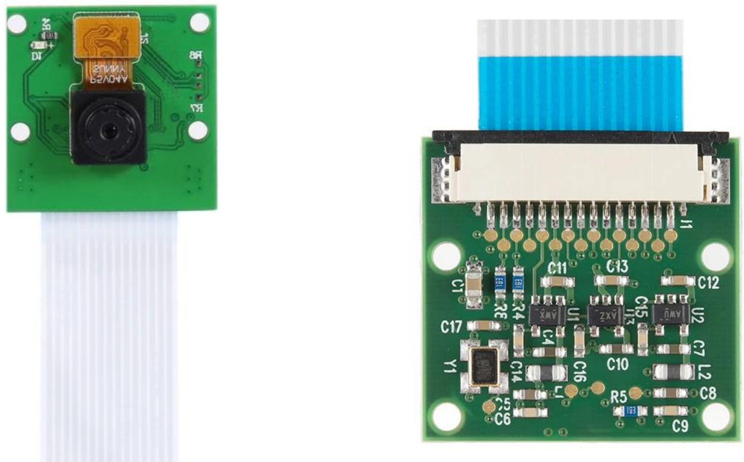

Figure 5 : Camera module

The 5MP Raspberry Pi 3/4 Model B Camera Module Rev 1.3 with Cable equips flexible cable for attaching with Raspberry Pi 3 +.
The 5MP camera module is perfect for sma ll Raspberry Pi projects which have very little space allowance just boot up the latest version of Raspbian and you are good to go.

Technical specifications

- Resolution: 5 MP
- Interface Type: CSI(Camera Serial Interface)
- Dimensions: 25x23x8 (LxWxH) mm
- Supported Video Formats: 1080p @ 30fps, 720p @ 60fps and 640x480p 60/90 video

c. Power Supply

The Power supply cable should be of good quality to give the raspberry pi a constant power. Bad cables can show low power warning.

Figure 6 : Charger

It should only be connected to an external power supply rated at 5 V/2.5 A DC.
We can use a regular USB type B charger to power the raspberry pi. We could take input from power bank also.

It can be also powered through GPO pins.

d. Earphones

Figure 7 : Earphones

The audio output is taken from the Audio Video composite 3.5mm jack. The earphones/headphones with 3.5mm headphone plug can be used to hear the audio output.

e. Glasses

Figure 8: Glasses

Any wearable glasses can be taken to mount the setup on it. Black glasses can be preferably used to signify the usage by blind people.

6. Results & Conclusion

The image processing method includes the image capturing and image to text conversion. A. Image processing method. The image processing is done with the optical character recognition method. The optical character recognition is a method that captures or scans the images and has an ability to convert the image into readable or text format which can be processed further. The image captured with OCR can be of any resolution.

The image processing method includes capturing of static image with the help of camera. The camera works as an eye for the raspberry-pi. The camera can be connected to the raspberry-pi with the help of Cable. We have used a raspberry pi camera to capture the image. After the successful connection the image is captured with the help of tesseract OCR software. We are using tesseract OCR which is raspberry pi compatible and can understand primarily English language.

The teserract-ocr is library and is open source. The Tesseract-ocr is command line OCR which captures the image on the press of button. The image can be saved in .jpeg or .png format. With the help of tesseract OCR library of python, the captured image is converted to the text format in the raspberry pi and saved with the same name as an image. The converted text is provided to python espeak which converts the text to the voice format.

In this step, the inbuilt camera captures the images of the text. The quality of the image captured depends on the camera used. We are using the Raspberry Pi's camera which 5MP camera with a resolution of 2592x1944.

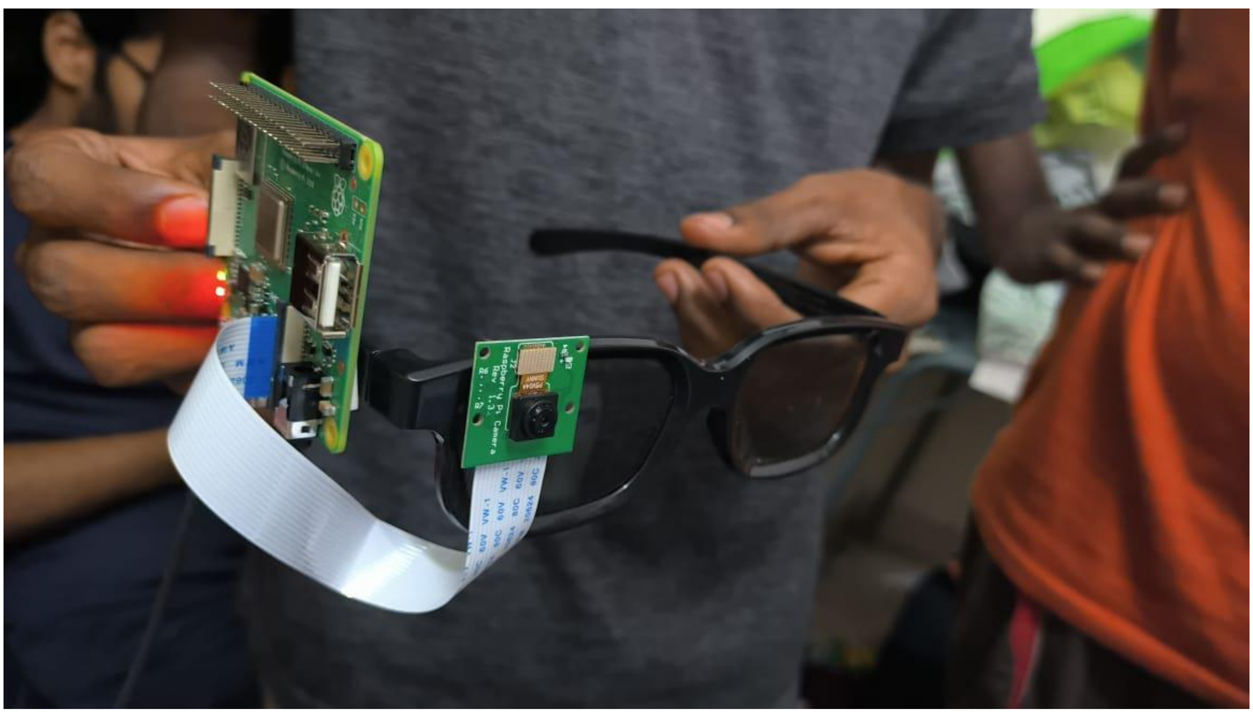

Figure 9 : Final prototype

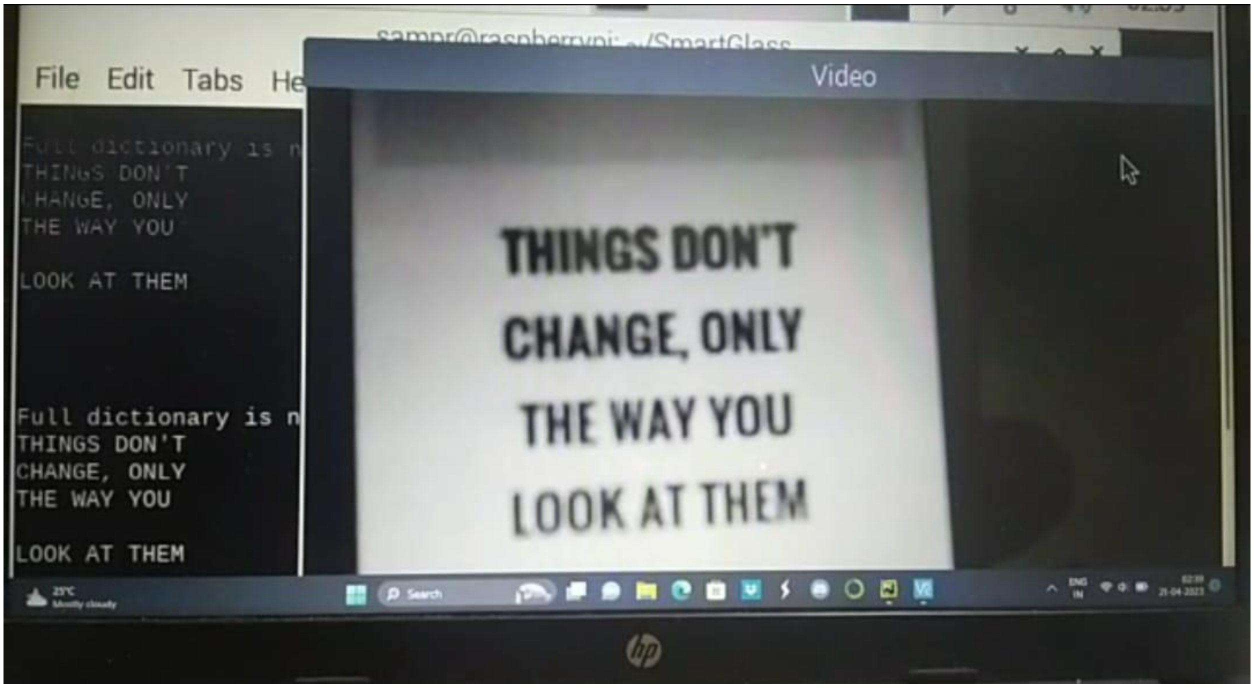

Figure 10

The following figures shows the running model on the raspberry pi results, figure 10 is the final figure sent to the OCR and final text output that is sent to the earpiece. Figure 9 shows the final prototype.

Visually impaired people are those who are either totally blind or having a very low vision that is legally considered as blindness. The number of the visually impaired people has increased in the recent decades and the difficulties they face in their everyday life are becoming more and more serious with the new technologies, buildings, population and so on.

This project is intended to help this type of people to widen their scope of independence by giving them a description of the live scenes delivered in an audio format using an earpiece. The project is implemented using OpenCV python as a main software program, and the single board computer the raspberry pi 3a+as a platform.

The project is also using the raspberry pi camera to capture real time videos and an earpiece to voice out the descriptions. The implementation of one mode in the education scope is presented in this report, which is reading mode utilizing the text recognition techniques.

7. <u>Future scope and advancement</u>

The future scope and development of Smart Vision Glasses for the blind are vast and promising. Here are some potential areas of development and advancement:

1. Improved Technology:
   The Smart Vision Glasses can be further enhanced with improved technology, including more advanced image recognition algorithms and text-to-speech software, to provide a more accurate and seamless reading experience for users.
2. Integration with Smart Devices:
   The glasses can be integrated with smart devices and applications, such as smartphones and tablets, to allow for easier access to information and improved functionality.
3. Enhanced Mobility:
   The Smart Vision Glasses can be made more mobile with the addition of GPS technology, allowing users to easily navigate and explore new environments.
4. Increased Accessibility:
   The glasses can be made more accessible to a wider range of visually impaired individuals, including those with more severe visual impairments.
5. International Adaptation:
   The technology can be adapted for different languages, cultures, and countries to enable more people worldwide to benefit from the Smart Vision Glasses.
6. Cost Reduction:
   The cost of the glasses can be reduced through the use of more affordable components, making them more accessible to individuals with limited financial resources.

While the Smart Vision Glasses are primarily designed to assist visually impaired individuals in reading and accessing printed materials, they can also be used to help individuals with mobility issues. The glasses can be equipped with GPS technology to provide navigation assistance, helping users to move around more confidently and safely.

Additionally, the glasses can be integrated with smart devices and applications to provide real-time information about transportation options and accessibility features in their local area. This can help visually impaired individuals with mobility issues to plan their routes more effectively and navigate public transportation more easily.

Overall, while the primary focus of the Smart Vision Glasses is on reading and accessing printed materials, they have the potential to assist visually impaired individuals with a range of mobility issues as well.

Overall, the future scope of Smart Vision Glasses for the blind is bright, with the potential to revolutionize the lives of visually impaired individuals by providing them with greater access to information and increased independence.

8. Code

a. Setting up the device

First we have to setup the raspberry pi, for that we can use desktop setup through HDMI input from raspberry pi. Since we didn’t have a desktop setup, we followed the headless setup. Raspberry pi headless setup is to connect it to our laptop through SSH and Wi-fi.

We have to first load our operating system into an SD card through raspberry pi imager. In our case we used Raspberry pi OS (32 bit) which comes with desktop environment as recommended by the imager. Before writing the OS onto SD card we have to set some options. Using advanced options, set up your username and password for raspberry pi (which is useful for us to login). Also enable the SSH and give your Wi-fi credentials. Then write the OS onto raspberry pi.

Now eject the SD card and put it in the SD card slot of the raspberry pi. Now also attach camera to the camera slot provided. Then give the power to the raspberry pi. Make sure the laptop and raspberry pi are connected to the same Wi-fi network. Then raspberry pi will boot and automatically connect to the Wi-fi. Now access the raspberry pi through SSH from the laptop terminal using following commands.

```
ssh <username>@<ipadress_of_raspberrypi>
```

Now enter the password to connect through ssh

```
sudo raspi-config
```

Through arrow keys select Interfacing options. Use the arrow keys to select VNC and press Enter. You will be prompted to enable VNC Server. Select Yes and press Enter. Use the arrow keys to select Ok and then Finish, to return to the terminal. Now install any VNC viewer software. Here we are using Real VNC viewer. We can now setup the virtual desktop through VNC viewer.

b. Programme Used

Now for the program we need to install the following modules and libraries, through the following commands.

```
sudo apt install tesseract-OCR
```

```
sudo apt install espeak
```

Now create a directory to store our program files

```
mkdir SmartGlasses
```

Now access the directory using

```
cd SmartGlasses
```

```
ls
```

```
pip install pytesseract

pip install python-espeak

pip install opencv-contrib-python

pip install numpy==1.8.0
```

Now create a python file and copy the following code in it and name the file as app.py

```
import cv2

import numpy as np

import time

from espeak import espeak

import datetime

import pytesseract

img_cv=
cv2.imread(r'/home/pi/pytesseract/tests/data/test.png')

previous ="unkno"

video_capture = cv2.VideoCapture(0)

process_this_frame = True


while True:

    # Grab a single frame of video

    ret, frame = video_capture.read(
```

```
  # Resize frame of video to 1/4 size for faster face recognition processing
    small_frame = cv2.resize(frame, (0, 0), fx=0.25, fy=0.25)


    # Convert the image from BGR color (which OpenCV uses) to RGB color (which face_recognition uses)
    rgb_small_frame = small_frame[:, :, ::-1]


    # Only process every other frame of video to save time
    if process_this_frame:

cv2.imwrite('/home/pi/pytesseract/tests/data/test.png', frame)
        img_cv= cv2.imread(r'/home/pi/pytesseract/tests/data/test.png')


        img_rgb = cv2.cvtColor(img_cv, cv2.COLOR_BGR2RGB)
        print(pytesseract.image_to_string(img_rgb))
        espeak.set_voice("En")
        espeak.synth("Hey hello ")
        espeak.synth(pytesseract.image_to_string(img_rgb))
        # Find all the faces and face encodings in the current frame of video
        cv2.imshow('Video', frame)
```

```python
    # Hit 'q' on the keyboard to quit!
    if cv2.waitKey(1) & 0xFF == ord('q'):
        break

# Release handle to the webcam
video_capture.release()
bus.close()
cv2.destroyAllWindows()
```

Now run the code using command

```
Python app.py
```

9. References

[1] Raspberry pi documentations https://www.raspberrypi.com/documentation/

[2] Setting up ssh connection to raspberry pi https://raspberrytips.com/ssh-guide-raspberry-pi/

[3] B, Anitha & M, Jyothi & R, Pooja & N, Sahana. (2021). Smart Glass for Visually Challenged Peoples to Read the Books using Raspberry Pi. International Journal of Advanced Research in Science, Communication and Technology. 258-262. 10.48175/IJARSCT-1842.