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Smart Vision System for Visually Impaired People

Dr. P. Mangayarkarasi[1], Muhammad Shahbaz Khan[2], Sunil K A[3], Pramod Sencha N[4]

[1]Associate Professor, Department of Information Science and Engineering, New Horizon College of Engineering (Affiliated to VTU), Bangalore, India
[2,3,4]Department of Information Science and Engineering, New Horizon College of Engineering(Affiliated to VTU), Bangalore, India

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Abstract - *Visually Impaired people face a lot of challenges in their daily lives. To overcome the difficulty of the visually impaired group this paper presents a Smart Vision system which provides assistance to visually impaired people efficiently and easily. Some of the existing systems such as white cane, guide dogs or even the recently developed solutions aim to provide only limited functionality. The main objective of the present work is to develop a low cost, reliable, portable, user friendly solution for visually impaired people. The product would serve as an assistive friend for the visually impaired user providing features like voicing out the current date & time, current weather, top 10 news headlines for the day, OCR, color detection and also provides obstacle detection feature with the help of ultrasonic sensors. The experimental results show that the Smart Vision System can effectively improve the user's experience. Thus, it serves as a consumer device for helping the visually impaired people.*

Key Words: **Current date and time, Current Weather, News headlines, Obstacle detection, OCR.**

1. INTRODUCTION

According to WHO (World Health Organization), the estimated number of people visually impaired in the world is 285 million, out of which 39 million are blind and 246 million are having low vision[1]. The visually impaired people face a lot of difficulty in perceiving and interacting with the surroundings but there are some navigation systems or tools available for visually impaired individuals. Traditionally, most of them rely on cane (walking stick) swaying in front while walking to avoid obstacle. However, they cannot perceive any information written on boards or any important indication.

The proposed prototype includes functionalities such as news headlines, unread emails, dominant color detection, current date and time, current location, weather information and calculator. It also includes ultrasonic sensors, camera which is used for multiple functionalities. The ultrasonic sensors are placed on the hat or glass which detects objects and notify the user with a beep sound through an earphone when the user is very close to the object[1][2]. The camera is used for OCR (optical character recognition) which extracts text from images taken by the camera on the press of a button on remote by the user. The processing unit used is Raspberry pi which processes the above functionalities. The details of the above functionalities are discussed in the proposed system.

2. LITERATURE SURVEY

Over the past few years a lot of efforts have been made to help the visually impaired people using the technology. One such attempt is "Low cost ultrasonic smart glasses for blind" [2] where the main focus is on obstacle detection. It includes ultrasonic sensors. The control unit controls the ultrasonic sensors and get the information of the obstacle present in front of the man and processes the information and sends the output through the buzzer accordingly. The idea that can be seen in [1] is a device in the shape of a pair of eyeglasses. It uses a multi-sensor fusion based obstacle avoiding algorithm which utilizes both the depth sensor and ultrasonic sensor to solve the problems of detecting small obstacles, and transparent obstacles. In [4] it can be observed that it consists of a video camera on the frame itself as well as a computer processing unit precise enough to get fit in the pocket and the software that provides images of objects close by to transparent displays on the eyepieces. The major limitation of this device is that it is not at all suitable for completely blind people. It is recommended only for people with low vision or night blindness. In [3] it includes ultrasonic sensors and output feedback through pulse vibration motors which are placed on the blind man's head. When the person gets closer to the object, the intensity and frequency of the vibration are increased. The limitation is the use of vibration motor which is irritating for the blind person.

3. RELATED TECHNOLOGY

3.1 Geocoder

Central to this technological revolution is the process of geocoding, which essentially translates text-based information about locations (address, zip code, names of localities or even countries) into numerical geographic coordinates (e.g. longitude and latitude). Geocoding uses spatially explicit reference dataset (e.g., digital road network) to identify the location that best matches the input address, essentially by comparing and interpolating the address to the range of addresses for each segment of the reference dataset. Each segment contains the locations of the street center and the range of addresses between the street intersections.

3.2 Date time module in python

Datetime module supplies classes to work with date and time. These classes provide a number of functions to deal with dates, times and time intervals. Date and datetime are an object in Python, so when you manipulate them, you are actually manipulating objects and not string or timestamps. In this project it gives the current date and time to user using this method.

3.3 SMTP & POP protocol

SMTP ("Simple Mail Transfer Protocol") is used for sending and delivering from a client to a server via port 25: it's the outgoing server. On the contrary, POP ("Post Office Protocol") allows the user to pick up the message and download it into his own inbox: it's the incoming server. Here the user is notified with the mails received to him to his mail id.

3.4 API

API stands for Application Programming Interface. An API is a software intermediary that allows two applications to talk to each other. In other words, an API is the messenger that delivers your request to the provider that you're requesting it from and then delivers the response back to you. Here the API helps in giving the signal to the user in the form of sound and speech after detecting from the sensors and camera module used for this product development.

3.5 Tesseract

Python-tesseract is an optical character recognition (OCR) tool for python. That is, it will recognize and "read" the text embedded in images. Python-tesseract is a wrapper for Google's Tesseract-OCR Engine. In this project it helps the user to detect the texts in the image and making the user more precise about his moment and surrounding.

3.6 GTTS

gTTS (Google Text-to-Speech), a Python library and CLI tool to interface with Google Translate's text-to-speech API. Writes spoken mp3 data to a file, a file-like object (bytestring) for further audio manipulation, or stdout. Here the camera module reads the text displayed in front of it and it converts them to the speech with the help of GTTS by which the user is helped in reading the text in front him.

3.7 Open weather API

The service allows you to regularly download current weather and forecast data in JSON format. This helps the user in identifying the weather and temperature around the user.

3.8 Open CV

OpenCV is a cross-platform library using which we can develop real-time computer vision applications. It mainly focuses on image processing, video capture and analysis including features like face detection and object detection. It's the main thing which backs this project by providing all the necessary libraries to this project.

4. PROPOSED SYSTEM

Smart vision glasses give the visually impaired person with the following capabilities:

4.1 Voice the text content present in a picture

The webcam is used to take a picture of the document or any object containing text. The picture is taken and tesseract ocr module is used to extract the text from the image and the extracted text is stored into a text document. The gTTS is used to convert the text to speech format. The speech is then played to the visually impaired person.

4.2 Voice out the current date and time

The smart vision system uses the datetime module to get the current date and time and it is stored into a text document. The text document that is generated is later given as an input to the gTTS (google text to speech module) which converts the text to speech and the speech output is stored into a .mp3 file and the .mp3 file is played out as the output to the visually impaired person via an earphone.

4.3 Voice out the current location

The smart vision system uses the ip address for knowing the current location, region and the country. The shell command curl ipinfo is used to get the current location, region and the country. The result is stored into a text document and the text document is given as an input to the gTTS which converts the text into .mp3 file. The .mp3 file is played back to the visually impaired person.

4.4 Voice out the current weather

The smart vision system uses the OpenWeatherMap API to get the current temperature and the weather description for the day. The result is stored into a text document and this document is given to gTTS which converts the result into speech format. The speech result is then played to the visually impaired person.

4.5 Voice out the unread emails

The smart vision system has the capability to read out the new emails arrived to the person's email. The vision system uses the imap module to connect the SMTP server over the

SSL. Using already feed in user credentials we login to the mail server and get the unread messages and store it into a text file. Using gTTS the text file is converted into a speech format and the .mp3 file is played out to the visually impaired person.

4.6 Voice out the top 10 headlines for the day

The smart vision system uses the News API to get the top 10 news headlines for the day. The result is stored into a text document and the text document is given as an input to the gTTS. The gTTS converts it into the .mp3 file which is played to the visually impaired person.

4.7 Calculator function

The smart vision system provides the calculator functionality to the visually impaired person. The calculator function gets the input numbers from the user through the hand held remote. The associated python program executes and produces a result text document. The resultant text document is given to gTTS module which does the text to speech conversion and produces a .mp3 file for the output of calculation. This output .mp3 file is played to the visually impaired person through the audio output device.

4.8 Voice out the dominant color in an image

The smart vision system gets the image from the webcam hosted on the device for which the dominant color has to be found out. The image is then analyzed by a python program which uses the Color Thief library for getting the dominant colour in the image. The dominant colour output is placed in a text document and this text document is given to the gTTS module. The gTTS module converts the text to speech and produces an .mp3 file. The mp3 file is played to the visually impaired person.

5. ARCHITECTURE

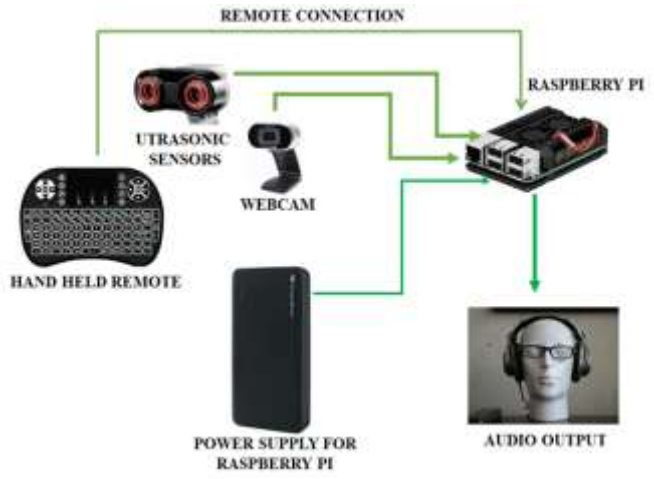

Fig -1: Architecture of Smart Vision System

The main processing unit used is Raspberry pi. It is a credit card size computer. It includes all the programs for the above functionalities which are executed when the user selects the option from the hand held remote. The model includes a webcam which is used to capture an image and send it to Raspberry pi for processing it. The main functionalities which require an image are OCR (optical Character Recognition) and dominant color detection. All other features are executed on raspberry pi and provide the user with the latest results in speech format.

6. RESULTS AND DISCUSSION

The performance of the proposed system has found to be effective. The ultrasonic sensors can detect the obstacle in the range 2cm to 400cm and alert the user with a beep sound via an earphone. With the press of a button, the user can perform various functionalities. The user can perceive any written information with the press of a button also voice out the current date and time, current weather, current location, unread emails, news headlines, calculator, dominant colour. The proposed model is easy to wear and use and can be used as a portable model for visually impaired people.

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BIOGRAPHIES

Dr. P.Mangayarkarasi M.Tech[CSE]., PhD[CSE] is Associate Professor of the Department of Information Science and Engineering, New Horizon College of Engineering, (Autonomous Institution, NAAC A grade, NBA- Accredited Institution, ISO Certified), Bangalore. She has an excellent track record in the fields of academic, research and Quality Assurance. She is author of over 10+ scholarly research/ review papers, 06+ reputed and peer reviewed Journal

Scopus/SCI/UGC/IEEE/ACM/Springer/Thomson Reuters) papers with good Citation index and h-index. She has won several research paper awards in different National and International conferences and symposiums. She filed around 03 patents. She is Member in 07+ leading professional Societies and Forums. She is reviewer and editorial board member/ Advisory board for 07 reputed/ UGC approved International/ National Journals and has published 2 Technical books in the field of Computer Science. Her current research interests include Data Mining, Machine Learning, Data Science and Analytics, Learning Systems, Algorithm Design for emerging Medical Image and Video, data analysis and Advanced Network and Cyber Security. She is guiding PG & PhD Scholars in the fields of Computer and Information Science and Engineering.

Mr. Muhammad Shahbaz Khan
Pursuing B.E in Information Science and Engineering from New Horizon College of Engineering(Affiliated to VTU) Bangalore, Karnataka, India

Mr. Sunil K A
Pursuing B.E in Information Science and Engineering from New Horizon College of Engineering(Affiliated to VTU) Bangalore, Karnataka, India

Mr. Pramod Sencha N
Pursuing B.E in Information Science and Engineering from New Horizon College of Engineering(Affiliated to VTU) Bangalore, Karnataka, India