International Journal of Research in Engineering, Science and Management
Volume-3, Issue-6, June-2020
www.ijresm.com | ISSN (Online): 2581-5792

OCR Enabled Smart Cane

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***Abstract*: The aim of Smart Cane is to make the life of visually impaired people easier, comfortable and independent. There is a need of cane which is affordable, portable and user-friendly. In this paper the smart cane has Uv sensor, Raspberry-Pi Zero, Pi-Camera, vibrator, push button switches. The presence of obstacles is detected through UV and intimated to the visually impaired people through vibrator. Thus, helps them in navigating independently. The Pi-Camera built on the Raspberry-Pi, captures the images of shop names, bus number, pedestrian crossing pattern, printed text etc. the captured image of alphanumeric characters is processed using OCR technology. The OCR process includes binarization, segmentation, feature extraction and recognition. The recognized text is converted into speech and informed to the visually impaired people through wireless head phone. In the same way template-matching technique is used for pedestrian crossing pattern detection and an alert voice message is given to the visually impaired people "Pedestrian" using wireless headphone.**

***Keywords*: Visually impaired people, Smart Cane, OCR (Optical Character recognition), Raspberry-Pi Zero W, Obstacle detection, Alphanumeric detection, Pedestrians crossing.**

1. Introduction

According to the estimations of the World Health Organization, worldwide, there are approximately 285 million visually impaired people, among them 246 million have low vision, and 39 million are blind. Vision is an essential aspect just not only to identify or detect the objects but also for dark adaptions and colour perceptions. This can also be made feel to visually impaired people, by placing sensors and for the ease life of visually impaired people without dependence and also helps them to gain employment.

Visually impaired people face numerous problems while performing daily routines and while moving through unfamiliar places. Visually impaired people rely on white canes for navigation to explore new places. White cane has limited extension, where it detects obstacles only at the position where the cane is placed. Nowadays, technology has improved in such a way that the daily routine of a common people has become ease in day to day life. Visually impaired people are one among those who are missing these available technologies in their daily life.

Now-a-days, there are many projects and researches are in progress for the benefits of visually impaired people to make their life easy and comfortable. The main objective of this project is to be safe and easier navigation while exploring new places, identification of the obstacle detection, identifying the bus number, reading the characters of shop wireless head phone.

2. System Development

Detection of obstacles is achieved by ultrasonic sensors. Specifications and functionality of UV is analyzed; thus, results are satisfying and successfully implemented the distance measurement of obstacle location using python. The shop names and bus numbers are identified by capturing an image by pi camera and processed using OCR technology and intimated to the visually impaired through audio message. Captured image is compared with the reference image using a technique of template matching, when the reference pattern image is matched with the captured image then the audio message "Pedestrian" is provided to the visually impaired people through ear phone.

3. Methodology Adopted

Functions related to UV sensor, its detection distance range, measuring angle and features were studied that suits for obstacles detection. Programs are designed using Python language. UV sensor recognizes the obstacles and measures the distance range. The system alerts through vibrator to the visually impaired. Alphanumeric characters from the captured image using Pi-Camera are identified using OCR technique and informs the audio message through wireless head phones to the visually impaired people. Pedestrian crossing pattern are captured using Pi-Camera, captured image are recognized using template-matching technique and an alert voice message is given to the visually impaired people using wireless headphone.

4. Experimental Details

The block diagram, shown in the Fig.1, depicts the major components and sequence of signal flow in Smart Cane

The functionality of Smart Cane is Obstacle Detection, Alphanumeric detection, pedestrian crossing detection.

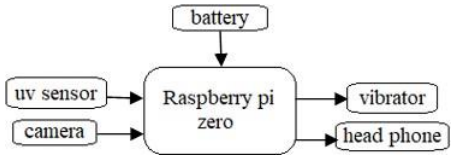

Fig. 1. Block Diagram of Smart Cane

1) Obstacle Detection

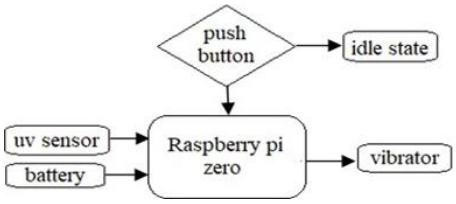

Fig. 2. Block Diagram of Obstacle detection

The identification of obstacles are achieved by using UV sensor. The UV sens or consists of four pins - trigger(TX), echo(RX), vcc and gnd. When the supply is passed to the UV, transmitter continuously generates the sonic waves, as when the obstacle gets detected in the range of 4 meters the receiver receives the echo pulses. Based on the distance travelled by the waves, distance range is calculated as given by below equation.

Distance = (high level time * ultrasonic spreading velocity in air)/2

When the push button is ON, then the UV functions otherwise the UV remains in the idle state. Detection of obstacles are determined and alerts the visually impaired people through vibrator.

2) Alphanumeric detection

Optical character recognition is also known as text recognition methodology. The basic processes of OCR are to examining the scanned text documents and further used for data processing. OCR System is a combination of hardware and software. Optical scanner or some special circuitry is used to scan the printed text images and software involves analyzing the captured image characters for further processing. OCR processes allows non-editable documents into editable one and user can search the document by characters as it is created in word document.

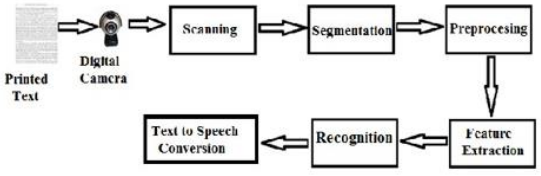

Fig. 3. OCR Block Diagram Steps involved in OCR process

- Segmentation: The image is decomposed to sub image of individual characters.
- Pre-processing: Pre-processing consists of three steps they are Skew Correction, Linearization, and Noise Removal. The skew correction is performed until it matches with the horizontal axis. The noise introduced during capturing is removed for further processing.
- Feature Extraction: The edges of the images are detected that extracts the text.
- Recognition: The individual characters are recognized.
- Text to speech conversion: Image characters are generated as voice output through speaker.

If the push button is on then the Pi-camera turns on otherwise camera remains in off state. Pi-camera captures the text from an image and it is processed using OCR technology. The alphanumeric characters from an image are identified and converted into speech. The audio message is provided to the visually impaired people through wireless head phones.

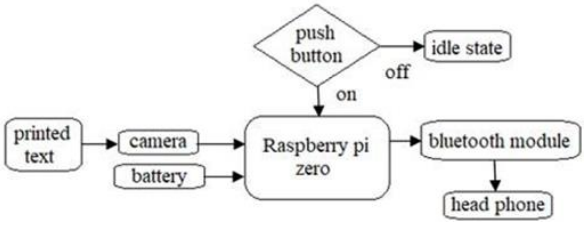

Fig. 4. Block Diagram of Alphanumeric detection

3) Pedestrian detection

Pedestrian Crossing detection is achieved by template matching technique. An image is taken as a reference image for comparing with other captured images. Template matching mainly consists of two images one is source image: The image expects to find a match with reference image and another one is template image: The image which is taken as reference image. Template matching is a technique which searches and finds the location of image that is similar to the referenced image. OpenCV package has inbuilt function cv2.matchTemplate() which supports template matching.

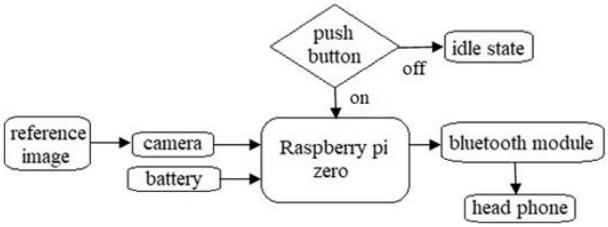

Fig. 5. Block Diagram of Zebra Crossig Detection

If the push button is on then the Pi-camera turns on otherwise camera remains in off state. Pi-camera captures the image of zebra crossing and it is processed using template matching. The source image is compared continuously until it matches with the referenced image. If the source image matches with the referenced image then the audio message “Pedestrian” is alerted to the visually impaired people through wireless headphone

4) Design of smart cane

The model of the smart cane holder has a gripper at the bottom for holding. The fore finger has a separate position at the front by considering the case of the holder which can fall due to the weight of the stick. The frontend part has a grove structure which is similar to the mechanism of the opening and

closing the water bottle cap. Any suitable stick can be attached to it and fix it with the other part. The whole body of the model is of 40mm diameter holder and 128mm length in horizontal.

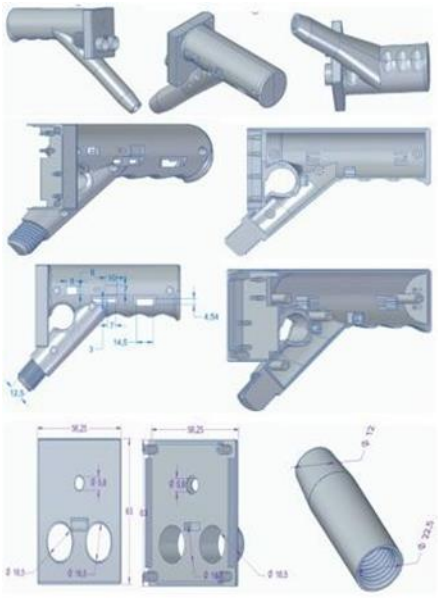

Fig. 6. Design of smart cane

5) Working of Smart Cane

Fig. 7. Smart cane

The design of the Smart Cane is shown in figure. The holder consists of three applications. For controlling these applications there are three switches/buttons. One at the thumb finger, one at the fore finger and one at middle finger. At the thumb finger, it is a switch for ON and OFF for Alphanumeric character detection. At the middle finger, it is a push button for capturing the images when the thumb finger switch is ON. At the fore finger, a push button for controlling both obstacle detection and pedestrian detection. If the fore finger button is pushed the uv sensor and the camera gets activated for processing, and when it is released it gets deactivated. The 1st preference is given to the Alphanumeric character detection, when the thumb finger switch is ON, the obstacle detection and the pedestrian detection won't work even though the button is pressed.

5. PiSugar Battery

For a portable device raspberry pi zero w is a good choice, and the solution for battery is solderless PiSugar battery. The small spring pins from the backside of pi zero is attached to the PiSugar battery module.

Thus, there is no need of USB cable to power the pi zero as shown in fig. 8.

Fig. 8. Detail view of PISugar Battery and pi zero pins

The battery has same dimension similar to pi zero board. Since direct contact of battery to the board is not good, the magnet is used to attract battery to the board to maintain the distance between the battery and board. Whenever the screw holes are needed the battery can be slided.

6. Results and Discussions

The presence of obstacles is detected using UV sensor and Raspberry-Pi Zero. The obstacle detection is measured up to maximum distance of 4m and calculated. The presence of obstacle is identified by single uv sensor and indicated by vibrator. Thus, helps in navigating independently for the visually impaired people.

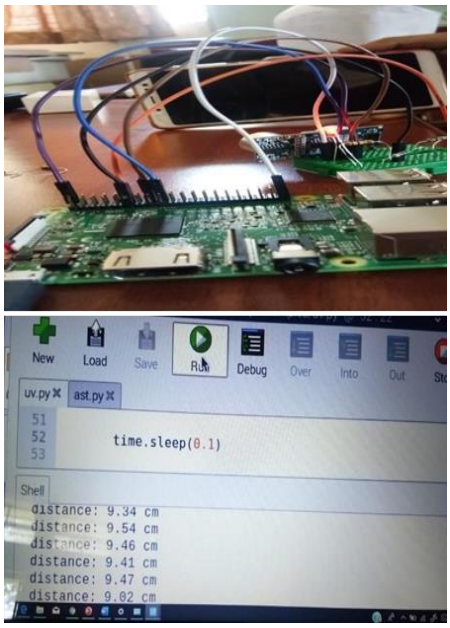

Fig. 9. Obstacle detection circuit and distance measurement readings

Pi-Camera is connected with Raspberry-Pi. The Pi-Camera captures images of shop names, bus numbers, pedestrian crossing. The alphanumeric characters in an image is processed using OCR technology. The alphanumeric characters are recognized and produces voice message. The voice message is fed to the visually impaired people through wireless head phones.

Fig. 10. Pi-Camera connected to R-Pi and alphanumeric detection

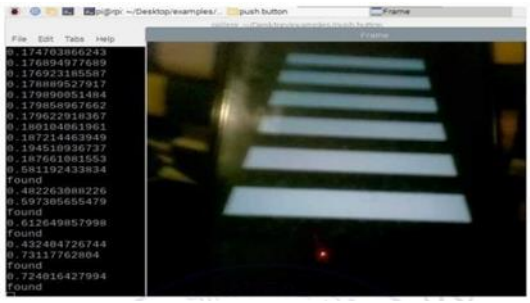

Fig. 11. Pedestrian crossing pattern detection

Pi-Camera is connected with Raspberry-Pi Zero W. The Pi-Camera captures images of pedestrian crossing pattern. Pedestrian pattern captured by the pi-camera is processed using template matching technique considering the minimum and maximum value range between -0.5 to +0.5 that is 0.5 is considered as the 100 percent accurate image, 0.25 is considered as 50 percent accurate image and an alert audio message “Pedestrian” is informed through head phone to the visually impaired people.

7. Conclusion

The obstacles are identified within the range of 4m. The presence of obstacles nearby the visually impaired people are intimated through vibrator. Thus, helps in navigation of visually impaired people. The technology of OCR and template matching is used for detection of shop names, identification of bus number and recognition of pedestrian crossing pattern. The alphanumeric characters are recognized and audio output is provided through ear phones (wired or wireless) to the visually impaired people. When the pedestrian crossing pattern is matched with the reference image then the audio output” Pedestrian” is intimated to the visually impaired people. Hence helps the visually impaired people to identify the shop names, bus number and pedestrian crossing pattern.

From the objective of obstacle detection, helps the visually impaired people easy and safer navigation while navigating in unfamiliar places. Identification of shop names, bus number and Pedestrian crossing pattern helps them in avoiding to some extent of helping hands and lead their life independently.

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