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Netra-A Step towards Assisting Sightless

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Abstract*—In the growing world visually impede people faces many problems in their daily life. In the world of rapidly increasing technology advancement in assistance for disabled people is also expanding. Visually disabled people face problems in detecting any obstacles or identifying the object and lifting them, many researches have been done to solve this problem faced by them which were based on IoT, Machine Learning and Deep Learning. This paper analyses various techniques used to assist the sightless.*

Keywords—Deep learning, IOT, Machine Learning, Visually Impede People.

I. INTRODUCTION

Visually challenged people face many problems in their daily life such as obstacle detection, object recognition, handling the objects and many more problems are faced. In the world of rapidly increasing technology many advancements have been done in assisting blind that help them in facing their problems, and also expanding. This paper focuses on various techniques used to assist the sightless, techniques such as use of ultrasonic sensor for object detection [1] [6] [8], Multi sensor fusion based obstacle algorithm [2], PCA and SIFT algorithm [11] [3], Use of CNN algorithm and eSpeak [4], CNNdroid for object detection [5], Human recognition [7], Use of GPS module [8], Object recognition using SIFT features-based and SURF features based [10], Use of Duplex Radio-Frequency Camera [12].

II. LITERATURE STUDY

Rohit A, et.al [1] have proposed a system that detect obstacles in front of the sightless and provide a beep sound to avoid collision. The proposed system is embedded with wearable glasses, ultrasonic sensors. The ultrasonic sensors are used to detect obstacles and to avoid collision a beep sound is provided to the sightless. The obstacles can be detected only if it is in the range of 300cm the proposed system does not detect the obstacles that is more than 300cm away, a central processing unit comprising of Arduino NANO which takes the information from the sensor about the obstacle distance and processes the information according to the coding done and sends the output through the buzzer, power supply is given to the central unit which distributes the power to different components. The ultrasonic sensors are used because ultrasound has a strong point, the energy consumption of slow wave propagating in the medium relatively far distance. Therefore, often it is used to measure the distance over a big length. At the same time, ultrasound for the object in the dark, dust, smoke, electromagnetic interference, toxic and other harsh environments have a certain ability to adapt, with a wide range of applications. The proposed system explains about ultrasonic sensors to detect obstacles in front of the user and navigate them toward the destination.

Jinqiang B, et.al [2] have proposed IOT based system for Blind people which consist of Depth Sensor for processing the depth of the objects, Ultrasonic sensor for calculating the distance, embedded CPU for processing The taken snapshot are processed with the corresponding algorithm and the guidance is provided as if the obstacles in front of the user then the system say Attention, obstacles in front of you and beep, using earphones incorporated in system. This system is fast enough for the detection and display of obstacles. Since the ultrasonic sensor can detect obstacles in the range of 0.03 m to 4.25 m, and within scanning field of 15°.Experimental results of this proposed system ensures that guiding glass can improve the travelling experience of visually impaired people.The system uses the depth image and the ultrasonic sensor to solve the problems of small and transparent object and to avoid obstacles

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Diwakar A, et.al [3] have proposedthe concept of the eye glass containing the camera for taking a snapshot of the blind surrounding. The taken snapshot is processed with the corresponding algorithm and a relevant text document of that image is retrieved. And the text document is converted to an audio file and sounded at the earphone. The algorithm used for image processing are Principal component analysis (PCA) for human face, Scale Invariant Feature Transformation (SIFT) for object and Optical Character Recognition (OCR) for text, there are multiple objects in the surrounding so after taking the snapshot the priority is given to the nearest obstruction and processed and sounded as output since that has the urgent use to be known to blind. The system provides an audio feedback to the user using text to speech, which help them to travel in outdoor environment

Nishajith A, et. al. [4] have proposed a system which is a Smart Cap and it is based on TensorFlow and text to speech synthesizer software. With a single object detection model, it is possible to classify multiple classes present within an image and also it can specify the exact position of the image (if monitor provided) with a bounding box framing the object. The system is able to detect objects which come under 90 various classes. The working of the system starts by suitably powering the Raspberry Pi processor. Thus, the web camera interfaced through one of the USB ports of pi is initialized. Real time video is captured using the NoIR camera which in turn is converted to a set of frames using python command. Pre trained object detection model 'ssd_mobilenet_v1_coco' offered by TensorFlow which is used to detect various objects present within the image. By using the text to speech converter software, eSpeak, the text documents like class label, scores etc are converted to voice output. The earphones connected to the audio jack of raspberry pi provides voice description corresponding to the objects present in the image. The system will be really helpful for the blind people in their navigation. The object detection can be developed to count the number of objects in a scene. The COCO model is used to train the SSD mobilenet which can detect only 90 classes of objects. The number of objects can be increased by training the model by ourselves. In the proposed system face detection can also be incorporated so that the blind person can easily identify his/her family members and friends.The proposed system explains implementation of Raspberry pi and TensorFlow to detect objectsusing the COCO model.

Milios A, et. al. [5] have proposed an Android Application which provide assistance to visually impaired people by providing full sets of features like light detection, color detection, object recognition, and banknote recognition .For Object detection they have created database for object classification and recognition ,for banknotes they have used CraftAR SDK for android for faster recognition of banknotes at specified positions, for color detection they have used OpenCV library for RGB color of the area where user touches on the screen the area is analyzed and output is produced .To develop the Application Android Studio IDE is used which is written in java programming language with following api's PHP and MySQL for the database, OpenCV for android, CraftAr SDK library, CNNdriod. The System has a user-friendly interface customized for blind people, where the detection results are read out loud so that the user can clearly hear them. Results showed that the application correctly detected objects, banknotes, and light levels. The system classifies the image captured and determines the class of an object using CNN algorithm.

Sujith B, et. al. [6] have proposed a smart assistive technology named Indriya, for guiding the visually impaired. The device features complete audio assistance for easy navigation, through simple button clicks. It can also detect obstacles ahead up to three meters and can differentiate between objects and humans with guaranteed 80% accuracy. The scan button in the device is used to scan for obstacles ahead. In the event of an obstacle detection, appropriate voice feedback is given to the user, mentioning the nature of obstacle (human/solid objects) and the approximate distance to them.The difference in heterogeneity and attenuation in the reflected wave is the key feature which has been used to differentiate human beings from other objects. The system also includes an android app name "Indriya App " is used to set the emergency phone numbers, and is responsible for informing location and time as voice feedback to the user. The main purpose was making the device smaller and lower in cost, by minimizing the no. of sensors used. Android and IoT support make Indriya a smart and handy device, which help them navigate independently and securely.

Joe Louis Paul I, et. al. [7] have proposed a system that helps visually impaired people in assisting them in reaching their destination which the help of audio guidance provided via earphones, the system also help them in human recognition. The face detection and recognition module uses the camera to capture the images of the face of the person in front of the user and store them in the SD card, the storage card within the microcontroller. The camera is fixed on the shirt collar of the user. The web camera has three lights that automatically switch on in the dark. It also has 16 special effects and 10 background frames. For

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efficiency purposes, the camera captures 20 images of the face and these are stored along with the person's name. This is manually done before the device can be put into practical use. If the same person comes in front of the user again then the camera captures the image and compares it with the previously stored images and if a match if found, the corresponding name of the person is read out. The image capture and processing are done with the help of OpenCV software. The system is limited to only a few destinations. However, there is scope for extending it to more locations as well as integrate it with Google Maps for better performance of GPS.

Sathya Narayanan E, et. al. [8] have proposed a system for visually challenging that helps them in detection of obstacles and avoiding them the system uses multiple ultrasonic sensors that also help in detection of the pit on the road and guide the user accordingly. The system also includes a GPS module that senses the current location of the user and the Wi-Fi Module transmits the current location to the cloud, where the user navigation history can be tracked. The guidance to the user is done using Text to speech converter module. The text to speech module intimates the user of obstacles at different heights and distances and can convey information in multiple languages. The system has an inbuilt headphone socket. The information can be provided to the user via stereophonic headphones. The system also helps the deaf one by providing a vibrator circuit that helps the deafblind people to walk through the obstacles safely. Different intensities of vibration indicate obstacles at different distances. The intensity of vibration increases as the user moves close to the obstacle.

K. Laubhan, et. al. [9] have proposed a system that consists of five ultrasonic sensors which continuously trigger serially and are positioned as left, right and front. The ultrasonic sensors detect the obstacles and compare them with the threshold. If the threshold value is crossed, then the user gets information about the position of the obstacle via the Bluetooth headset. The entire processing is done with raspberry pi. It is tested on aluminum, Plastic, and Paper and has tested that the obstacle has been detected ahead or at the sides. It selects the audio based on the ultrasonic sensor which has detected the obstacle. It successfully contributes to elimination of the walking sticks and detects if any object is present in the surrounding of the blind person using the ultrasonic sensors positioned at five different directions hence the direction of object is also known. Though it detects the position of the object, it is unable to identify which object is present before him. The system should also be able to detect which type of object is present before the user for safe and effective navigation.

HanenJabnoun, et. al. [10] have proposed a system that helps visually challenged people in object recognition with the help of video analysis and interpretation. The system eliminates the use of ultrasonic sensors for object detection instead of that systems exploit a single camera to capture images of the scene in front of the user. Various features are then extracted from those images and objects in the scene are recognized by comparing these features with those of known objects. SIFT features-based and SURF features based is used to extract the features from the image captured by the camera. The system uses a sensor that calculates the distance between the camera and the obstacle. The system is completely based on analysis of the frame captured to increase the processing speed. The first frame in the video will be matched with objects stored in the database by computing the keypoints and extracting features then making the matching between key points. The second and the rest frames will be matched first with previous frames, for example frame at time t will be matched with frame at time t-1, thus it can predict if they are the same or not. If both frames are the same, we have not to identify the object because we did it for the first one which will increase the time processing.

HanenJabnoun, et. al. [11] have proposed a system that performs object recognition for blind using SIFT feature extraction algorithm. The system is based on keypoints extraction and matching in video. A comparison between query frame and database objects is made to detect objects in each frame. For each object detected an audio file containing the information about it is activated. Hence object detection and identification are simultaneously addressed. The steps of feature extraction and addressing is processed as follow:
(I) Obtain the set of key-points of objects.A) Select a large set of images of daily objects. B) Extract the SIFT feature points of all the images within the set and obtain the SIFT descriptor for each feature point extracted from each image.

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(II) Obtain the keypoints descriptor for the first video frame. A) Extract SIFT feature points of the given image. B) Acquire SIFT descriptor for each feature point. C) Match the frame key-points with those of the objects and identify detected objects.
(III) For the next frame. A) If it contains the same objects they will not be detected. B) New objects will be detected and identified. Another method will be used in this step to identify similar and dissimilar frames for further treatments. For each object detected in video a video file is launched to notify the blind about the identity of objects.

Do-Hoon Kim, et. al. [12] have proposed a system helps visually challenged people in obstacle recognition, the system uses ultrasonic sensors for calculating distance but instead of using existing web camera for capturing image the system uses Duplex Radio-Frequency Camera for better data transport and receiving color data of the image. Front of barriers is judged using DRFC. Also, with a system that recognizes color. If some color that is not saved is detected, the system sends a warning signal. They can aware distance to the obstacle through a period of vibration. The system also includes GPS and PDA. GPS receiver receives the clock information and the latitude and longitude of satellites and calculates the present position. The GPS receiver sends this information to the PDA. The navigation map and database in PDA guide the information like current position, and environment to blind person in real time. Basically, the output information is the text style. So, the text is converted into the voice sound by TTS (Text to Speech) in PDA for blind people to understand.

III. ANALYSIS

The Table 1 given below is a summary of research papers on assisting visually challenged. It states the different techniques used for assisting sightless and also highlights their advantages and disadvantages.

TABLE 1
ANALYSIS TABLE

Sr. No.	Paper Name	Technique Used	Advantages	Disadvantages
01.	Low cost ultrasonic Smart glasses for blind.[1]	Uses ultrasonic to detect the distance. User is informed according to distance.	Navigate the user about the obstacle within 3 meters.	Only provide navigation. No object detection
02.	Only provide navigation. No object detection. [2]	Multi sensor fusion based obstacle algorithm is used.	Efficient in complicated indoor environment	It does not detect and classify the type of object
03.	HOT GLASS: Human Face, Object & Textual recognition for visually challenged people [3]	PCA and SIFT algorithm is used to detect the human face and object.	Recognize a person. Recognizes text.	It cannot detect the obstacle.
04.	SMART CAP – wearable visual guidance system for blind[4]	It uses CNN algorithm to detect the object. It uses eSpeak to convert the detected object text	Uses CNN. Detect 90 objects	Do not identify the person's face. No navigation provided

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05.	Intelligent Eye: A Mobile Application for Assisting Blind People [5]	Colorino Talking Color Identifier is a standalone device that is used to recognize colors and detect light. Object is detected using CNNdroid	It detects object, Color, light, Bank note recognition	Pedestrian guide. Reading Barcodes.
06.	Indriya - A Smart Guidance System for the Visually Impaired [6]	Use of ultrasonic sensors for object detection and help in navigation using smartphone	With accuracy of 80% differentiate whether the detected object is human or not.	Can only detect the obstacle up to three meters.
07.	Smart Eye for Visually Impaired-An aid to help the blind people [7]	GPS for navigation, OpenCv software for human face recognition	The entire features of the system can be used offline	Scope of navigation from one point to another is limited due as it customizes only for a few locations.
08.	IoT Based Smart Walking Cane for Typhlotic with Voice Assistance [8]	Multiple sensors for object detection and GPS module for determining current location of user.	The organized pattern of sensors allows you to detect the pits on the road. The system also provides a vibrator circuit so that it can be used by deafblind people.	Unable to detect the obstacles hanging at a height of 150 cm from the ground
09.	A Wearable Portable Electronic Travel Aid for Blind [6]	It just uses the ultrasonic sonic sensor and Raspberry Pi 3 module and Bluetooth module to detect the object	No walking stick is used. Wireless Bluetooth for audio guidance	Does not classify the object ahead i.e. either living or non-living.
10.	Object recognition for blind people based on features extraction [10]	SIFT and SURF algorithm	Use of both this algorithm increases the processing speed. Eliminate the drawback of ultrasonic sensors of small object detection	SIFT takes more processing time than SURF.
11.	Object Detection and Identification for Blind People in Video Scene [11]	SIFTS key points extraction and features matching for object identification	Processing speed is fast.	System does not guide the user to reach the object, it just informs the surrounding.

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12.	Obstacle Recognition System using Ultrasonic Sensor and Duplex Radio-Frequency Camera for the Visually Impaired Person [12]	Use of Duplex Radio-Frequency Camera (DRFC)	Use of DRFC increases data transport speed and helps in extracting color data of image captured.	Using the system in a populated place is difficult according to experiment.

IV. CONCLUSION

The growing world and technology help visually challenged people in making their life comfortable. Various techniques are used for helping visually challenged people to live up on their own without being dependent on others to help them. This paper tells about various techniques used for assisting sightless such as use of ultrasonic sensors, Duplex Radio-Frequency Camera for object detection. CNN, SIFT, SURF algorithm for feature extraction and object recognition. Use of ultrasonic sensors for detection of obstacles and for distance calculation. The growing technology will come up with more exciting features that will make the life of visually challenged people easier.

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