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Smart Navigation Device for Blind People using Image Processing

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Abstract:- There are many thousands of blind people in the world, who frequently require palms. The white cane has been a well-known component of blind people's navigation for decades, and efforts have since been made to improve it by incorporating new sensors. Blind people arerelatively comfortable because they can pinpoint where things are, but in the outside world, matters are moving, posing a hazard to them without the necessary assistance. The mission to develop a sound navigation and range system for blind people. Here, real-time obstacle identification has been accomplished using ultrasonic sensors. To be able to create a safe pathfor navigation to a destination, image processing in real-time is used for providing the blind person's perception of the size and distance of the obstacle utilizing raspberry pi for object detection. The suggested method makes use of a camera for recording video sequence of surroundings, which it subsequently processes using a vocal input from a person who is visually impaired. It takes the location data while moving in the (GPS) module for outdoor use andtransportedtothe cloud.

Keywords: Smart Navigation, Image Processing, Blind people, raspberry pi object detection

1. Introduction

The Worldwide Health Organization estimates that 285,000,000 individuals globally are having poor eye sight. Severe vision loss affects over 246 million individuals. Blind people are those who have severe vision loss that cannot be treated with regular procedures like wearing glasses. A blind individual is unable to move without assistance since they are unable to observe any obstacles. Additionally, whenwalking or moving, visionless folks utilize orienting tool made of ivory. The conventional white cane cannot provide a blind person with any information about their surrounds or environment. Nature has given us vision as a gift that enables us to experience the world directly. A sighted person needs to use their visual sense to navigate an unfamiliar environment and help them get to their destination safely. In addition, it can limit a person's privilege and the kinds of jobs they can take on, which can result in inability to support oneself financially and unemployment. Person with visual impairment is exactly similar to everyone else, but are blind. These people's guarded behavior has an effect on their life. According to figures from the Worldwide Health Organization, 82% of the 385,000,000 persons with reduction of vision who are blind are 50 years of age or older. Of these, 39million people are blind. Creating a system that allows blind individuals to navigate like sighted peopleis a trending topic these days. With various machine learning techniques. This study develops a novel internet of things (IoT)-based blind navigation system. In addition to providing guidance, this will alsolet the blind view their

environmentas naturally possible, for as by identifying objects on their left. Additionally, a blind person can use the internet to search for information and obtain the location of any individual within 5 meters. The speech recognition module enables intelligent system interaction forblind users who can effortlessly converse using formal Language. A stereo camera withfive MPs isutilized which is the substitute for the blind person's eyes, and range measurement equipment to both identify obstructions on a head the sightless people and gauge their separation..

2. Literature Survey

It is imperative to create a guidance system and for blind which is completely operational. S.R. Alwiand M.N. Ahmad's study [2] looks on the daily requirements of blind individuals who reside in urban areas. In order to cross highways and avoid collisions, vision challenged patients require a transportable guidance system, according to the findings of a walking stick and black glasses. A intelligent system which can identify information and translate it into voice is suggested by R. Ani et al. [3]. The method here is just concerned with English. MandeShen and Hansheng Lei's research paper suggests creatingan embedded system which extracts information out of a textbook. This approach that produces from amixofimage processingmethods,OCRandaText-To-Speechmodule. The camera includes a component for message. While in study of K. Dhivya et al. [4], the camera module takes pictures oftextual content, which is subsequently analyzed prior to being transmitted to the OCR unit. The content then is transformed to voice via the Text-To-Speech module. The difficulty inside this investigation seems to be in identifying the phrase in its circumstances. Since RNN can encode patterns of any size and has a better possibility of properly forecasting the desired phrase than that of a neural network using convolution, it is the subject of the research presented by S. Zamanetal. in [5] and Soh and Moses in[6]. This approach works well for getting accurate descriptions. Gathering, pre-processing, delineation, and edge detection are all steps in the multi-step OCR process[7]. Sivan and Darsan's [8] contextual long term care, digital technology, & hyper technologies are divided into many sections for data gathering, management, recognition, and speech conversion before being sent to a cell device. According to Setiadi et al. [9] and Sarakhman et al. [10], neural pathways can be used to aid blind individuals. LiDAR was employed byi nvestigators in addition to two webcams to identify the passenger route. The user can first take a picture using the digicam before receiving information on the three vocal styles. [11] provides a successful method that utilizes voice analysis for patients, the aged, and people who have impairments using in expensive, simple Internet of things application. AidSVM and the DTW method were employed to improve this technique

3. Proposed Work

This proposed model’s basic design is given below. The Navigation device for blind people consists ofa Box-shaped device wherein the object detection is done by optical sensor Pi camera, it might record photographs instantaneously. Power is given to this device by using rechargeable battery. Imagecaptured by the camera is processed by using Image processing and Open CV. The pictures would be transferred towards the cloud, where they will be used to fill the model and produce a speech response. To turn on the digicam at first, the client must switch the gadget on. When the blind person is travelling in the roads, it can be used to identify what type of object is present in front of them, at whatdistance it is situated. Distance is calculated by using Raspberry PI 3 webcam. The standard setting forthe picture description technique will be put into effect. Impaired people cannot distinguish objects.When a person is walking on the road, the device is trained to provide information about the traffic signs, it can detect and identify what type of object is present in front of them. Additional feature of object classification can be done by providing different type of sounds for each object. This navigation is passed to the user in the form of voice. User needs to connect headphones where they can hear the navigations. GPS Module is placed to provide Real time Tracking of the User. Emergency button is embedded which can be pressed when needed and information about the location is passed on to the family members

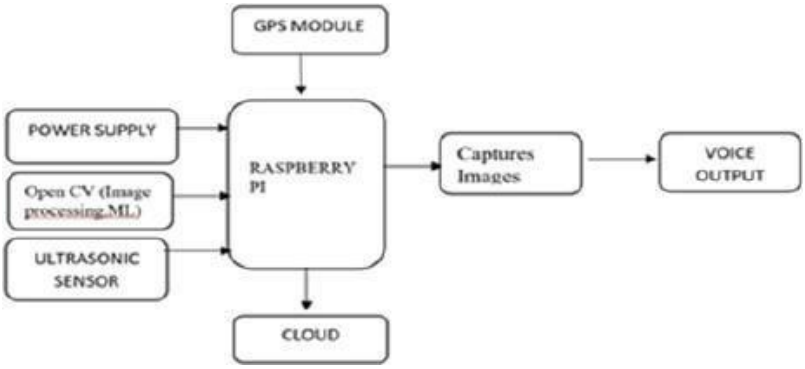

Figure.1 Schematic Diagramof the Proposed System

3.1. Dataset

With more than 330 000 pictures and 270 000 tags, the Common object in context collection is usedby the suggested method. Modern neural networks also have thorough knowledge of the COCO dataset, one that has uses including object identification, localization, and interpretation. Its adaptability and variety of scenario types for diverse reasons make it ideal for training and evaluatingvision - based systems. A sizable object identification, picture fragmentation, and annotation database called Microsoft COCO. The COCO collection is often used by ML and vision - based experts for awide range of machine learning projects. As a result, the database may be used to train models on entity detection as well as identification.

3.2. Distance Measurement

The proximity component is split into two sections: first employs an ultra - sonic detector to gauge separation, and the other employs a digicam linked to the unit to measure physical separation. The next two data components are explained

3.3. Measuring distance with an ultrasonic sensor

The device employ edanultra-sonic sensor to find obstructions. Two sensors are used in ultra –sonic (hc-sr04), where one acts as a translator to send electrical sound into ultrasonic sound. The first is a receiver that checks forth signals, and the other the trigger pin is activated when the transmitted pulses has atleast 5 to 10 S (10microseconds) pass during the surge [13]. It is known as object reflection whenever the trigger pin is high, which causes the sensor to yield an eight-cycle sonic burst at 40 kHzand then sets the echo pin to high until the burst returns, and that the connection between the pulse duration and the separation between the object and sensor. The impacts of sound are illustrated in Figure 2 where the trigger pin (top in Figure 2) sends out impulses to discover items, if located, thereturn wave is received by the echo pin (bottom on in Figure 2). Using two vibrations, determine the separation from the item and sound travels at a pace of 340 m/s. The speed S of a distance D with time T is state din (1):

$S = V * T$

The ultrasonic gives precise and reliable measurements from 2 inches to 450 inches, which have an accuracy of about 2 millimeters and are focused at less than 15 degrees

Fig2.Ultrasonic distance device transmitting and receiving ultra sound wavepatterns

3.4. Person Distance Measurement

The CMOS digital camera is utilized in this system which is an instrument used for distance measurements, the algorithm and camera employed by this system serve as a blind person's simulated sights. The following describes the monitoring method. Focal length f is the measurement of the separation between the CMOS and the position of the lens. At first, the object's height is h and the distance between the lens and the object is d. This material's height was captured by the CMOS camera at an elevation of Θ1. The material's new height in CMOS is b at an elevation of Θ2 as it approaches the video camera and d-m will be the space seen between item and the camera. The ultimate position expression after the aforementioned algorithm is:

$d=m/(1-a/b)$

Figure3 depict show the aforementioned programmer uses a CMOS imaging sensor to determine depth. The device's sensor captures pictures in real-time and, using the aforementioned algorithm, provides the distance an individual stands to the camera

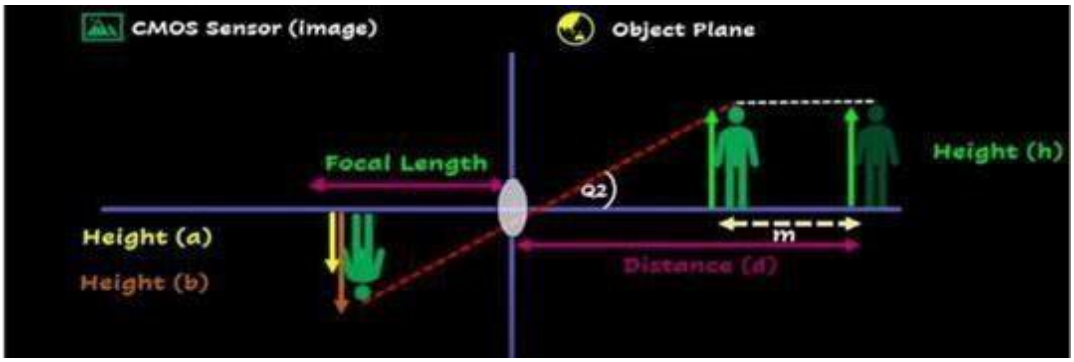

Fig3. How well the CMOS device senses the focal distance from the camera to the subject

4. Scanning and Ranging

The system makes use of discovery and identification of objects techniques to be able to travel while recognizing the details from the item discovery and identification of objects algorithm is used by the system to classify and identify the object in the environment-sourced image. Real-time object identification for both interior and outdoor objects is covered in this section. The architecture of the system employs the dark net as a foundation to identify items. You only look once method has strong scalability in comparison to other deep learning techniques. The system incorporates a section for identification as well as detection, which is divided into two sections called object both recognition and identification to be able to adequately offer a navigational aid for impaired people. The programmer uses the You only look once multilayer perceptron with a structure, which are utilized to provide instantaneous object recognition, to detect objects. You only look once is a program that is uses owingto its quickness, improved precision and strong studying potential. There are other algorithms available for object detection, however we choose yolo because to its quickness and superior accuracy. Two-stage is slower than one-stage because of this, so the one-stage detecting algorithm is employed. This is adescription of the algorithm for identifying and detecting items. Remaining blocks: the picture is first divided into a number of m×n- sized grids. Every grid has the duty to find things as they enter the grid. Regression spotlights of an object's surrounding area shape, and each of these clusters has a height (bh),breadth (bw), center of the reassertion by letter c(such as an individual, a car, or a cup) and the surrounding rectangle (bx and by).

$y= (pc,bx,by,bh,bw,c)$

It is employed as a crossroads to produce a complete outclass of the environment around the item correctly. Integration rather than unity explains how well the compartments are interspersed. Also, each cell is in charge of identifying items on the photos and accurately displaying the confidence score. The system begins by accepting a picture as data, to determine the characteristics and object classification, the one detector is used. Density

predictor is then used to forecast the items. The system incorporates a module for identification and recognition, which is divided into two sections called object recognition

5. Speech Processing

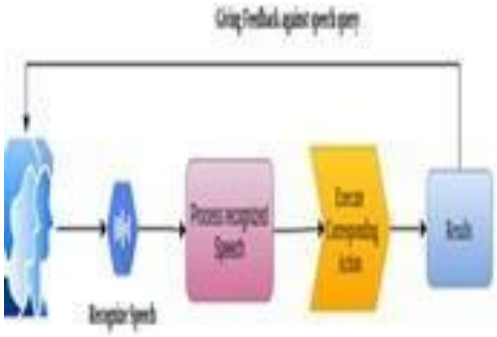

Fig4.The voice recognition device's operational process

Natural Language Processing has been employed in the proposed study for Vocal synthesis, understanding of human speech, and creation of human speech. A subject ai - based, language, andcomputer science "natural language processing". The technology converts the user's spoken requests into machine-readable instructions that may carry out the desired activity. These commands include ones that ask him questions and those that tell him where he is and what's in front of him. Using voicecommands that the blind can comprehend, run then give him the findings of this inquiry. The speechrecognition architecture is displayed in Figure. There are additional ways to guide the blind person andmanage the system. In addition to the aforementioned integrations, this system makes use of a blind-location GPS module. A web application and an android application have been created to ensure that the blind traveler is adequately safe, & his guide may keep an eye on him from any location. When theblind person is faced with challenging or urgent circumstances, the guide or employees can converse with them using these programmer

Table 1. Hardware Specifications

Components			
Ultrasonic Sensors	5V	2cm – 40 cm	15 degree
Raspberry Pi 3	1.2 GHz Quad Core	1GB RAM	802.11n Wireless Lan
GPS	Media Tek MT 3318, 51 Channel	Frequency is L1, 1575.42 MHz; C/A Code	Baud Rate of 9600bps (default)

6. Modules

6.1. RaspberryPi

The recommended setup makes use of the Raspberry Pi, a little computer approximately the size of a credit card that runs Linux on an ARM processor. The disputed item is the Raspberry Pi 3 Model B+. Four USB ports, an Ethernet port, an HDMI output, an audio output, two-band Wi-Fi, Bluetooth 4.2, Bluetooth Low Energy, four USB ports, an Ethernet port, an HDMI output, and 0.1-spaced pins that provide access to GPIO (general-purpose inputs and outputs) are also included. The Raspberry Pi requires an operating system-equipped microSD card. There are several sample projects and online resources available as a result of the Raspberry Pi's popularity.The complete library of ARM GNU/Linux distributions, including Snappy Ubuntu Core, Raspbian, Fedora, and Arch Linux, can be run on the Raspberry Pi in addition to Microsoft 10 IoT Core. The Raspberry Pi was developed as a cheap platform for learning and teaching programming by the Raspberry Pi Foundation. Programming, spreadsheets, HD video, gaming, and word processing are just a few of the things the Raspberry Pi is capable of handling. It can also perform a wide range of additional functions that a standard desktop computer can. The details comprise:

Fig5.Raspberry Pi3 Module

6.2. Camera

Blind people can utilize cameras as a substitute for eyes. Web Camera is a universal camera that isavailable from any location in the world. The Raspberry Pi camera module can record HD video more over to motionless photographs. A thin (25 mm by 20 mm by 9 mm), flexible ribbon wire connects the camera's mother board to the Raspberry Pi's (CSI) port. The optical viewfinder of the dslr features a fixed focus lens and a native resolution of five megapixels. The camera's software supports videoresolutions of 1080p30, 720p60, and 640x480p60/90 as well as full resolution still photos up to2592x1944. The range of focus is narrowed by the broader opening at lower f-stops, blurring the background while sharpening the foreground. A high depth of field produced by a narrow aperture makes things appear to be in focus at a variety of distances from the camera.[11].In the suggested system, a raspberry pi camera is employed to identify the types of objects in front of us as well as their names.

Fig6. Web camera Device

6.3. Ultra Sonic Detector

A detector is a piece of equipment that measures the distance to a target object by emitting ultrasonic sound waves and then transforms this audio which is bounced into a power signal. The device is mainly employed as

proximity detectors. Auditory wave propagates once at quicker speed as electromagneticfields do. An detector mainly comprises of an emitter (that produces a signal utilizing piezoelectricmaterial) as well as the recipient. Ultrasonic sensors were commonly used in conjunction of sensingdevices. These can be found in collision prevention systems and automobile innovations enable self-parking. With comparison to infrared (IR) sensors, ultrasonic sensors are less vulnerable to damage bydust, gasoline, or other air pollutants in vicinity application areas. Ultrasonic sensors additionally serveas detection systems to identify, track, and manage fluid flow. These methods repurpose classifiers to carry out ranging. Other real-time object detection algorithms by a significant margin adopt a fundamentally different strategy from prior object detection algorithms, which repurposed classifiers to conduct detection.

Fig7.Ultrasonic Sensor Module

6.4. Power Source

A power source is a piece of hardware that offers electricity is used to run electronics like computers. It transforms the electricity drawn from a power source, like a receptacle, using a battery or turbine, a device receives the information in the right manner. So it regulates the voltage that is sent to the processor in an effort to avoid scorching. Several electricity sources are while others are constructed from separate standalone parts of equipment into the burden of the appliances they power. Examples include desktop computer power supplies and consumer devices

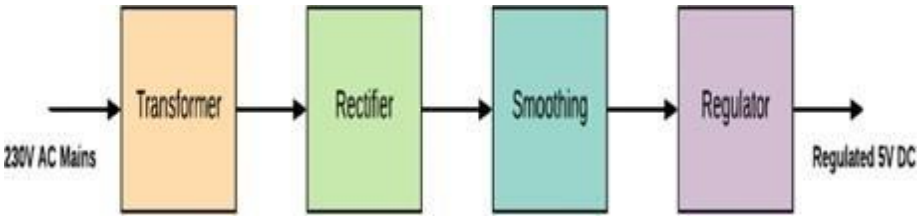

Fig8. Power Source of the Proposed System

6.5. YOLO Algorithm

Popular object detection model YOLO is renowned for its quickness and precision. The problem ofobject detection in computer vision is locating and identifying things in pictures and videos. The R-CNN (Regions with CNN features) model was one attempt to use deep learning to solve the object detection problem. It is distinct from the strategy used by earlier object detection algorithms, which used classifiers as detectors. Using a completely distinct approach to object detection, YOLO outperformed existing real-time object detection algorithms and produced cutting-edge findings. Whereas faster RCNN methods operate by first employing the Regional Proposal Network to identify potential regions of interest, and then separately doing recognition on each of those regions. YOLO uses a single fully connected layer to carry out all of its predictions. While YOLO only requires one iteration, methods use the exact image is replicated over and over again through suggested system. The You only look once algorithm uses a straightforward deep convolutional neuralnetwork to identify

objects in an inputimage. By adding a temporary average pooling and fully linked layer, ImageNet is used to pre-train thefirst20 convolutionlayers.

7. Result

The proposed navigation system has been created to improve the independent mobility of blind people.This paper uses MATLAB to detect and recognize traffic sign boards in video streams. With the point out approach,the features are extracted using the SURF characteristic. It comes close to and sometimes even performs better than the earlier proposed approach in terms of repeatability, competence, and resilience. It can also calculate and compared at a considerably more quickly. Instead of just beeping the buzzer, we are able to warn the user using visual processing to distinguish between different traffic signs. We also intend to use an ultrasonic sensor-based voice alert system. The user gets informed as soon asthe distance exceeds the threshold. In order to pinpoint the user's location, we intend to extend it to GPStracking devices in the future. As technology develops, we anticipate that the complexity of traffic sign detection and identification systems will reduce. A high-end sensor will soon be produced in large quantities and become less expensive thanks to technological advancements.

The system was tested in Real-time with the blind patients and it was very useful to them for their safenavigation. The issue of traffic signal detection will be much simpler than it is right now if every blind navigation device is outfitted with a high resolution RGB camera, GSM module, a GPS receiver, and other sensors in the future. Yet, due to the ongoing requirement to keep manufacturing prices in check, the development will likely go slowly.

Fig 9. Full implementation of theproposal

Fig10.The device can recognize the road signs

8. Conclusion

The suggested approach is anticipated to help the blind navigate more successfully. It is practical, economical, and really helpful. In conclusion, the technology has several functions available. Anything that can act as an enhancement to the conventional systems or an option that the competitors don't completely provide. In this system, the model was trained with various images from different instances and its overall accuracy was 95% and loss was 0.1628. The proposed method is expected to effectively assist the blind in their navigation. It is practical, economical, and really helpful. In conclusion, the system offers a wide range of extra functions that the rival systems do not completely support and canserve as a great replacement or improvement for the traditional ones. Many instances and a RaspberryPi 3 module were used to train the suggested methodology. More instances of the Raspberry 0 W Pi ,which is smaller and more efficient than the existing one, will be used to train the facial recognition module

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