Implementation of Microcontroller as a Virtual Vision to the Blind

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Abstract: Loss of sight is a state of missing the visual perception due to functional or nerve-related/brain-related factors. The fractional blindness represents the lack of incorporation in the growth of the optic nerve or visual centre of the eye, and total blindness is the full of the vision restriction. In this proposed project work, a simple, cheap, user friendly, virtual eye is to be designed and employed to improve the ability to move around of both blind and visually damaged/weakened people. The proposed project work includes a wearable equipment consist of a head band which can help the blind person to travel alone safely and to avoid obstacles and also this head band can detect the alpha-numeric-based values, whether fixed or mobile, to prevent any possible. The main part of this system is the ultrasonic sensors which are used to scan an area around blind by the emission of opposing or the reflecting waves. The reflected signals received from the objects are used as inputs to Arduino microcontroller. The microcontroller carry out the allotted commands and then it communicates the position or the status to the Earphones using Raspberry pi speech synthesizer.

Keywords: Arduino microcontroller, Earphones, IR Micro camera, Photovoltaic panel, Raspberry pi speech synthesizer, Ultrasonic sensor

I. INTRODUCTION

In belief of human being, we as a common person think that with or without certain things one can't live in this universe. Coming to the point of visualising something we may consider it by getting into the world of nature i.e. admiring the beauty of nature will be possible only with the help of the god's greatest gift to the human kind is the pair of EYES, yes without eyes one can't see anything, one's eyes defines the vision and also the beauty of a person. Some peoples are there who are born blind and some get visually impaired at the time of some unusual circumstance that may even be a critical one.

So, for these issues there are many ways for correcting eyes, that too in this modern world we could see the medical advancement at a drastic elevating point. The service which will be provided in this proposed project work will be acting as a Virtual vision or simply we can say it as an implementation of electronic device which holds a virtual machine for the blind and we can say it as a Virtual eye too. The use of this electronic gadget is exclusive only for the visually impaired or basically for the blind persons.

Here we are using Ultrasonic sensors; these sensors are used for detection of objects in and around the blind person. An Infrared (IR) Camera which will be used for capturing images or texts or videos where these medias contains alpha-numeric characters, and further these are forwarded to the Optical Character Recognition system in the device and the prescribed characters alone are manipulated for further tasks. In this device we mainly concentrate on the internal systematic which holds with the Arduino Microcontroller, Raspberry Pi Speech Synthesizer, and Earphones with a connection to the main power supply unit and this power supply. This paper covers the following sections, first section shows the Introduction, second section holds the Related works, third section of the paper contains the Proposed design, fourth section contains the Working operation, fifth section contains the Advantage of the project, sixth section contains the Future works, and finally the seventh section contains the Conclusion for the whole work done in this proposed project work, also at the end included the References taken to complete this project and the Biography of the authors are also detailed.

II. RELATED WORKS

This section contains the related works to the proposed project work. As per the literature and the physical survey it is seen that there are several other works which his correlating to the proposed system. Eventually we have found that, other systems are very complicated as compared to our design. There are certain latest technologies which are developed in past few years. These pre- developed are used for a certain task to be accomplished for that time alone, and in later developments even it can save the received data.

- Assisted vision smart glasses, this was developed by a professor from the University of Oxford. This gadget is made up of OLED display with navigation system with the help of GPS tracking system.
- AI Glasses, this was developed by CINVESTAV in Mexico. This gadget combines with Computational geometry and Artificial Intelligence system and Ultrasound technologies. This is gadget is used for recognition of places and objects.
- Finger Reader, a MIT media labs project proposed and developed for easy interaction with the characters in a book, or may be over an image.

III. PROPOSED DESIGN

In order to sustain our proposed method and to overcome the existing system technologies then also to provide cost effective and user accessible system for the blind and the visually impaired persons, the navigation and also for accessing the alphabets and numeric values either in form of video frame or the board view, and for this the following design is proposed.

Fig. shows that this project mainly consist ultrasonic sensors, Optical Character Recognition(OCR),Arduino Microcontroller, Raspberry pi, Headphone, Power supply .

- In this we consider with 5 Ultrasonic sensors, which are directly connected to the Arduino microcontroller.
- The Power supply unit consisting a battery, rectifier, filter, regulation and a photovoltaic cell as an alternate measure is connected to the arduino microcontroller. This power supply unit acts a major role in whole system.
- In either part of the Arduino microcontroller an Optical character recognizer or Raspberry pi Speech Synthesizer is connected.
- The Optical character recognizer is directly connected to Raspberry pi Speech Synthesizer too.
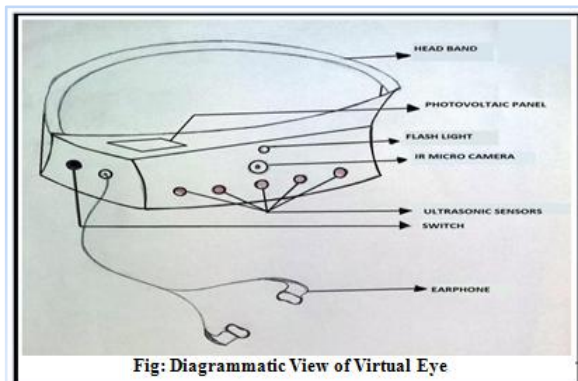- The Raspberry pi speech synthesizer is finally connected to the headphone.

Fig: Diagrammatic View of Virtual Eye

Proposed Algorithm:
Algorithm –Alphanumeric Character Extraction

Begin
Function OCR
Input: Video file (.avi), Image files (.jpeg/.png),
Output: Image or Frame
Access: Pre-processing Convert RGB =grey;
Sobel (horizontal, videoframe/image); Cany (vertical, videoframe/image); Plot (octagon);
Plot (rectangle);
Dilate (videoframe/image); for i=1:m
for j=1:n
FindText (min(n), max(m), min(m), max(n));
end; Joincharacparts (FindText); end;

Algorithm – Alphanumeric Character Verification

Begin
Function T or NT
Input: Four coordinates of the dilated region (X, Xa, Y, Ya) and the edge map image (H)
Output: T or NT for i= X:Xa
for j= Y:Ya hcount=hcount+1
end tcount=(Xa-X) * (Ya-Y) Ratio=hcount/tcount
If (Ratio>=0.065) Result= TRUE (Its T) End

a) Ultrasonic sensor
In corresponding with the obstacle avoidance and to detect the alpha-numeric values, this Ultrasonic sensor(s) is used. The Ultrasonic ranging provides a non-contact measurement in and about 2cm-500cm (approx.) and the ranging accuracy can reach up to a minimum of 2.5mm. , it includes the following accessing nodes i.e. transmitters, receiver and a control circuit.
The Ultrasonic pointers uses Input/output trigger for higher level signals. The Ultrasonic sensor, spontaneously sends eight 40 KHz and spots whether there is a pulse signal back, and finally there is a pulse signal back, then the time of high output duration is the time from sending ultrasonic wave in return. For this we are using Receptors, one of the receptor on the walking stick bottom end and another on a pen which will be carried in the shirt pocket by the blind/ visually impaired person.

b) Optical Character Recognition (OCR)
It is a system to which it initiates itself to recognise the alphabets and numeric string values of characters by a computing system. It involves with the photo-scanning of the texts phase by phrase by recognising the characters written.

The analysis involves over a scanned-in image, and finally after the analysis the character image is optimized to a character code, such as ASCII, which is commonly used in data processing and system analysis of the given data model.

c) Arduino Microcontroller

Arduino is a microcontroller and it is a single-board, which is intended to enable or makes an application of any interactive objects or environs more accessible. This hardware constitutes with an open-source hardware board which is designed around an 8-bit ATMEL AVR microcontroller, or may be with a 32-bit ATMEL ARM. In the present, these features with USB interface, 6 analog input pins, and also with 14 digital I/O pins, which enables the user to attach several extension boards. It has 16 MHz crystal oscillator, a USB port, a power jack, an ICSP header, and finally with a reset button. It moulds with everything to which it can support the microcontroller. It basically a mono access computing board.

d) Raspberry pi Speech Synthesizer

The text generated by a distance measurement module will be stored in an accessible folder. The speech analyser analyses the texts or the characters from the accessible folder and spells out it as an output in an exact way in a voiced signal form. Blind persons can hear it through a microphone or the given headphone. A technological system used here is said to be the Raspberry pi Speech Synthesizer. This can be initiated over to software, hardware or even both. The quality of the speech is analysed by the similar tone of human voice and also the clarity is effective while listening. Festival text-to-speech (F-TTS) software is installed in Raspberry pi enables and allows the persons with visual impairment to listen the written or printed texts/ characters. This F-TTS software is a multi-lingual speech synthesis workbench can run over multiple-platforms which offers an entire text-to-speech system with varied API's, as well with an environment for the future Research and Development of speech synthesis techniques. The programming is written in C++ with a systematic scheme like command interpreter for general customization and extension.

e) Earphone

The earphone is used for enabling the visually impaired person to be guided and to navigate independent i.e. if there is an obstacle found the Raspberry pi speech synthesizer sends the voice to the headphone and also sends the voice if there is any text found in the object or a book or printed form of characters (alpha-numeric values).

f) Power Supply

As we are aware all electronic circuit work only with low direct current voltage. So, thereby we need a power supply unit with a provision of suitable voltage supply, here we are using Photovoltaic cells as an alternative, the reason behind this is if there is a failure in the power provided by the battery of the main power supply unit, at that time this Photovoltaic cells will give an alternative support to the whole system.

g) IR Micro Camera

It is a camera which initiates its working while the initiation of the Arduino Microcontroller starts. Here we are going to use IMAGER TIM 400, which works efficiently with higher optical resolution of about 328x288 pixels (approx.). It has an excellent Thermal sensitivity. It constitutes with an option for changing lenses. The power supply is through the USB port.

IV. WORKING METHODOLOGY

Our project is an innovative idea to which it can showcase an intelligent systematic operation. It basically works for certain tasks i.e. for Character recognition and Obstacle detection. The Ultrasonic sensors in this electronic gadget will sense the material or the object which is surrounded in and around the visually impaired/ blind person and checks if there is any character found and if found the characters are recognised by the OCR and the Raspberry pi speech synthesizer sends the information or the data in the form of voice signal to the microphone or the headphone and if no character or text found Raspberry pi speech synthesizer sends an intimation voice to the microphone or headphone.

- The Power supply unit initiates the whole system.
- The Sensor transmitter transmits the frequency, which is reflected from the obstacle. The sensor receiver corresponds with the received frequency to the arduino microcontroller for further task completion.
- The Arduino microcontroller correspondingly interacts with the OCR and then to Raspberry pi speech synthesizer.
- The Raspberry pi speech synthesizer sends the voice signal to the headphone.

Experiments and Results:

Alphanumeric Extraction from an Image
(OPTICAL CHARACTER RECOGNITION):
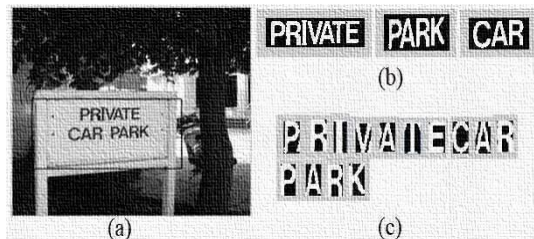
Sample Images (With Scene Text and Superimposed text)	Number of Characters in an Image	Total Number Of characters Detected, Recognized and Extracted			
		Text Detection Phase	Detection Percentage (%)	Text Recognition, Extraction Phase	Recognition, Extraction percentage (%)
10.avi	15	15	100	12	86.72
5.avi	95	91	97.87	86	91.32
mgl.avi	43	43	100	40	97.56
s2.avi	110	110	100	102	91.91
2.avi	11	11	100	11	100
sample.avi	62	60	98.18	63	98.78
blank.jpg	10	09	99.09	10	100
txt.jpg	18	18	100	17	88.89
The Overall Detection percentage of OCR based system for 08 sample images is 99.35%					
The Overall recognition, extraction percentage of OCR based system for 08 samples is 92.45%					

Table: Performance analysis of the data

V. ADVANTAGE OF THE PROJECT

- The production cost is lesser than expected.
- The gadget can be used in any kind of environment.
- The detection of the alpha-numeric values/ characters and obstacle is accurate up to certain extent.
- The clarity of the voice heard is crystal clear.
- Power consumed is very less and if there is any power failure when the battery is drained the automatically the Photovoltaic cell enables itself.
- The time consumed for designing the gadget is very less.
- Space required is very less as the electronic gadget is handheld.
- The gadget can be easily wearable as it is designed as a head band.

VI. FUTURE WORK

- Neural network technologies can be included.
- In addition we can add Music player attached to the microcontroller, for entertainment purpose.
- As we have included OCR which is a part of image processing, so in future inclusion of face detection is possible.
- Inclusion of Radar can be useful for the measurement of long range target objects.

VII. CONCLUSION

In this proposed project work there is new technological base system is designed with the use of Microcontroller as a Virtual Eye for the Blind/Visually impaired persons. It is a reliable for common man use. As specified reliable, we made the design in such a way that it is feasible for ease of usage and also cost effective. It acts as a parallel assistance to the blind persons. The efficiency of the system depends on the usage of the proposed electronic gadget. The accuracy level of the OCR system is bit higher comparatively. This electronic gadget can scan any type of object an if there is any existence of characters/ text it will notify the person.

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BIOGRAPHIES

P. Shivapriya is pursuing Bachelor of Technology in the dpartment of Electronics and Instrumentation Engineering, Vel Tech Dr. RR & Dr.SR Technical University. She is working on many sorts of project under the guidance of the Professors and other company R&D analysts.This girl can work under any sort of environment until the completion of the Research work. Her research areas and interests are Artificial Intelligence, Image Processing and Computer Networking espicially in Network security. Her present R&D works are based on the development of Medical intruments using Artificial Intellingence techniques.

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E. Kamalanaban presently working as Associate Professor in the department of Computer Science and Engineering, Vel Tech Dr. RR & Dr.SR Technical University. He served as Dean and presently he is focusing his research works on WLAN Security (Network Security). He guided many of his students and also co-lecturers on R&D works. His research interests are Network Security, Artificial Intelligence, Image Processing and Digital Electronics.