AIDING VISUALLY CHALLENGED INDIVIDUAL FOR OBJECT DETECTION AND NAVIGATION USING ASSISTIVE TECHNOLOGY

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Abstract

Visual impairers are not a new augury for the society. It is a condition of deficient visual perception. Accessibility in the anonymous environment for the visually challenged individuals is more critical. They are more prone to fall in accidents since they cannot discern their surroundings. The wide availability of equipment's which help the blind people are quite expensive and cannot be easily expanded. Moreover the most of the techniques prevailing to aid them with the help of IR sensors do have a drawback i.e. in the presence of the sunlight it won't produce an efficient result. For overcoming these drawbacks, the current paper contributes two concepts. The First concept deals with the identification of hindrance such as trees trunk, opened doors, stair case, etc. This is done with the help of an Obstacle Detection Unit (ODU) which discovers the obstacle that are against the visually impaired by capturing the image of the object present. In the latter case, Navigation Tracking Device (NTD) delivers route for the impaired where they wish to proceed without any human assistance.

Keywords: *Visually impaired, White cane, Obstacle Detection, Navigation, SURF detector.*

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1. INTRODUCTION

Visual is considered to be most essential than all the other sense. Blindness is a condition of lacking visual perception and it is always described as severe visual impairment with residual vision. The blind people's life and activities are greatly restricted by loss of eyesight. They can only walk in fixed routes that are significant in their lives, with blind navigation equipment's and the accumulated memories in their long-term exploration. People lacking sight suffers from various problems [5]. And moreover they always need to depend on the other people for their basic needs in their day today day tasks. Research work for the past years has helped in meeting their desired needs.

The mobility is retained by getting some assistance from the vision person, or by using a dog for their consistent navigation paths or using a white stick to travel without getting the assistance of the other people [15, 6]. But the white cane cannot predict the obstacles that are1m ahead of it. Moreover it cannot guess the obstacles that are at the knee height levels, (tables or chairs, sudden shallow surface, staircase, lower branch of the tree, etc.). Visually impaired are used up to their indoor arrangements but cannot predicts the rapid changes that occur in the environments which are unpredictable. The blind object detection equipment must be able to compensate all these drawbacks and also should be comfortable for the user who uses it.

Several devices in the modern inventions find their way in improving the facilities of the visually challenged individuals. Some of the devices that are in use can be listed as ultrasonic sensors, Palm sonar [3], and IR sensors [7] etc. These devices are in practice for a longer period. Though these devices assisted them, it couldn't meet their necessities. It lagged in many situations; IR Sensor and Ultrasonic sensors cannot locate openings that are wide enough. In addition IR sensors don't produce better result in the presence of the direct sunlight. Whereas in the case of Ultrasonic sensors; they are more prone to multiple reflections which degrade the capability to predict obstacle [2]. The sensors cannot find the shallow path in the roads.

The major disadvantages using these sensors are
1) These devices can only detect the obstacle (which is in the distance less than 5m from the cane) but it is not efficient in providing the description of the obstacle i.e., the physical characteristics of the object.
2) They are unable to detect the obstructions that go above the knee level and also at the ground level such as a hole, or a shallow path [11].
3) Multiple reflections would degrade the quality in finding the object and moreover it doesn't suits best for the outdoor environments, which changes rapidly.
4) These sensors don't produce good result in the presence of the sunlight. [8, 9].

Taking these drawbacks into account the proposed system provides two concepts for providing the visually impaired to walk confidently without getting depending on others and moreover they can also walk in the environments which are unfamiliar to them.

2 METHODOLOGY

2.1 Obstacle Detection Unit

In the proposed method the web camera which has Wi-Fi connectivity is fitted in the white cane at a certain height above the ground level. This camera is supported by a battery power, always detects the objects that are against the visually impaired for a certain long distances. Then this captured image is send to the PC via wireless camera directly [1,13]. The PC has the MAT LAB programs predefined for certain specific images which are more likely to be in the outdoor environment. The image send to the PC is compared it with the image that is with its database images [14]. If the image is one among the image captured or data log it produce a signal to the microprocessor –ARM, which produce a sound with the a small description of the image and tells the location of the image from the user through a headphone which is connected to the visually impaired persons to their ear.Fig.1 gives the block diagram for object detection phase.

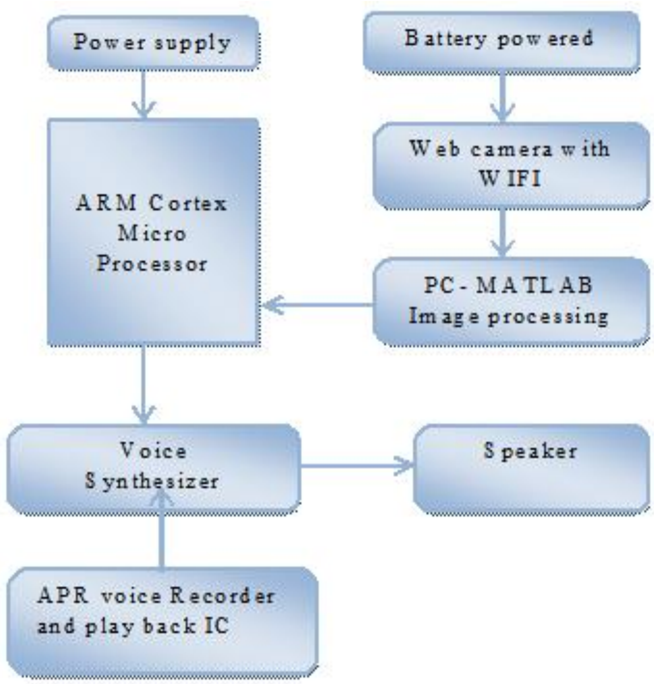

Fig 1: Block diagram for the object detection phase.

2.2 Algorithm for Image Identification

Object detection in turns finding the features of the two images to be similar. When must be able to extract the possible features in different image irrespective of the transformations, mainly rotation, background, color etc. this is done through 3simple steps[10].

The first step is to find the interest points in an image captured this must be done automatically. When there exists some points then that must be marked with a unique point. The second step is to provide description about the point of interest marked [3, 4, 12, and 16]. Final process is to map the image obtained in the database image with that of the image that was captured.

SURF (Speeded Up Robust Feature) Algorithm is utilized here. It uses a Hessian based blob detector to find the interest points. SURF divides the scale space into levels and octaves. An octave relates to twice of σ .[17] The interest points are surrounded by eight neighbors. The determinants of a hessian matrix express the extent of the response.

$$H(x,\sigma)=\begin{bmatrix} Lxx(x,\sigma)Lxy(x,\sigma) \\ Lxy(x,\sigma)Lyy(x,\sigma) \end{bmatrix} \quad (1)$$

$$Lxx(X,\sigma)=I(\mathrm{x})*\frac{\partial^2}{\partial x^2}g(\sigma) \quad (2)$$

Where,

$$Lxy(X,\sigma)=\mathrm{I}(\mathrm{x})*\frac{\partial^2}{\partial xy}g(\sigma) \quad (3)$$

Lxx (x; σ) in equation 2 is the convolution of the image with the second derivative of the Gaussian.

$$I(\mathrm{x})=\sum_{i=0}^{i\le x}\sum_{j=0}^{j\le y}I(\mathrm{x},\mathrm{y}) \quad (4)$$

An Integral image I(x) is an image at each point x = (x; y) ^{T} Eqn (4) is for the summation of all interest points in an image. When the points are been matched then we have to find the strongest points that are matching. In this paper three conditions are discussed

2.2.1 300 Strongest Feature Points from Database

The first and foremost step at once when the picture is taken is to find the specialized feature points or interest points with the help of SURF detector. The Surf detector extracts the strongest features that are available in the image which is captured. These points are unique one which differs from the other. A maximum of 300 points are been marked and the same is saved. The images are compared with these interest points only. The fig.2 gives the output for the strongest feature detection.

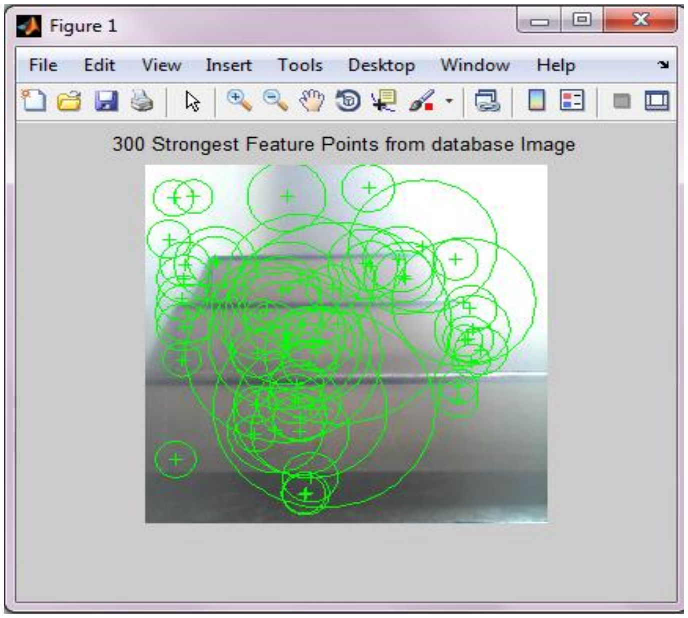

Fig 2: Simulation output in Mat lab for strongest feature detection.

2.2.2 100 Strongest Feature Points from Database

If there are interest points which are more than 90 and less than 150 then they result in 100 strongest feature points. These feature points resulted under this does not favor in finding the object the obstacle when compared with that of the database images.

2.2.3 Putatively Matched Points

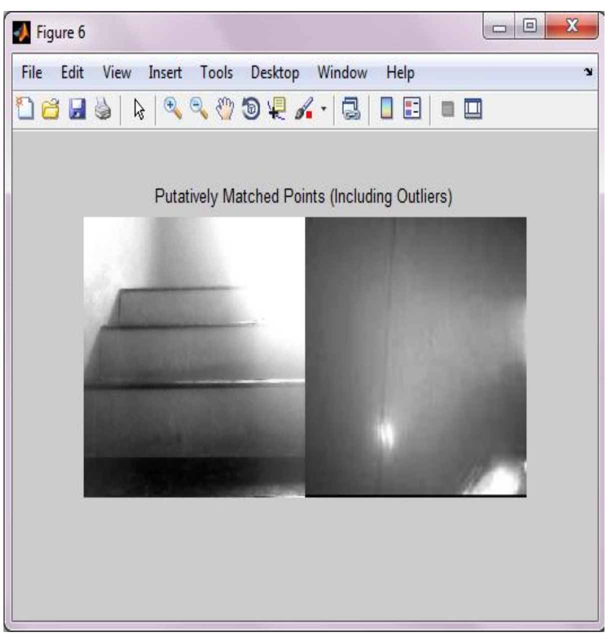

Fig.3 Simulation in Mat lab for putatively matched

The image captured compares with all the images in the database one by one. The comparison takes place by measurement of the similar feature in both the images. This condition is followed for all the pictures. Fig.3 shows the output for putatively identified compared with others.

2.2.4 Final Output

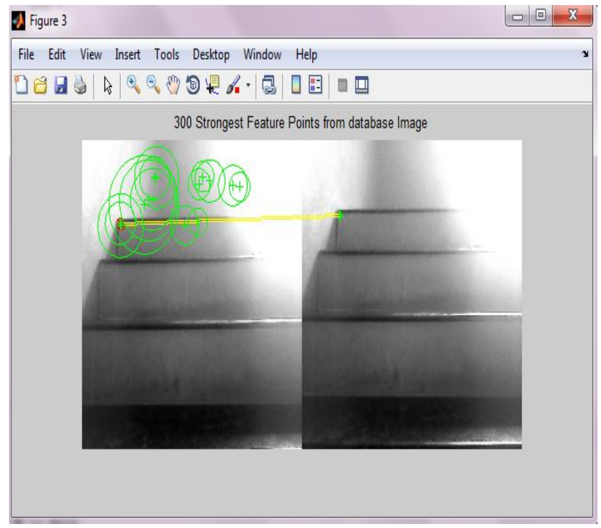

Fig 4: Output after detecting two similar images.

The Fig 4 gives the final simulation output with the help of Mat lab, when comparing the image taken with all the images in the database.

2.3 Navigation Unit

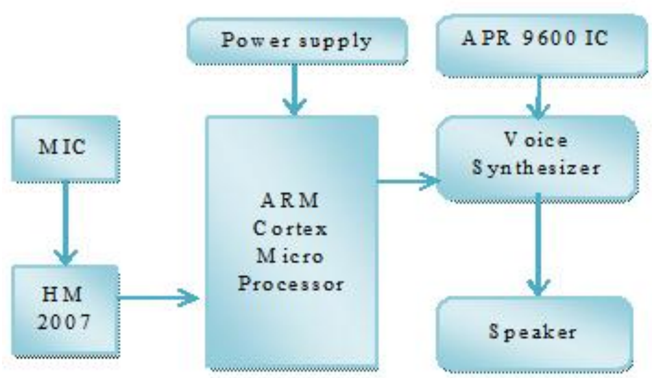

Fig.5 Block diagram for Navigation tracking

The other concept of this proposed paper is to make the life simple for the visually impaired by aiding them to navigate freely in unknown environments without pleading assistance from others. Fig 5 depicts the block diagram for the navigation. It consists of a microphone to record the voice of the user. This voice is stored with the help of WS2. This voice is hereafter identified when the user speaks out.

HM2007 helps in programing the codes for the direction of the routes .in this there are 2^8 combinations. The first pin is considered for DATA IN, second pin for DATA OUT, third pin for RESET, and the eighth pin is to do the operation of PLAY and RECORD. Remaining pins are used for DATA STORAGE.

The road locations are calculated and prerecorded. In this paper for an instance five locations address were recorded and tested out. At once the visually impaired tells the location name which is in the database, the Voice recognizer recognizes it and will produce an audio output of the location say 5m west and walk straight. This voice output is via a speaker.

3. EXPERIMENTAL RESULTS

The results obtained with the help of the ODU are compared with the existing sensors such as Infrared sensor, Ultrasonic sensors. Table 1 shows the different output for various sensors.

Table 1 SURF based object detection

S.no	Objects	No. of Images	Correctly detected	Wrongly identified	Accuracy
1.	Staircase	10	8	2	80%
2.	Tree trunk	10	6	4	60%
3.	Chair	10	8	2	80%
4.	Table	10	7	3	70%
5.	Pole	10	7	3	70%
6.	Pit	10	5	5	50%
7.	Pavement	10	6	4	60%
8.	Open door	10	6	4	60%
9.	Road	10	5	5	50%
10.	Dustbin	10	7	3	70%

4. HARDWARE OUTPUT

The above picture is the hardware output for the NAD. The output of the location will be printed in the LCD display as the visually impaired walks of. Whenever the user is in need of clarification of the route, location name is spoken out .Voice recognizer will identify that and gives out the necessary details.

Fig 6: Hardware snapshot

5. CONCLUSIONS

Thus the walking stick with a sensor can help them to avoid the obstacles better without tapping the object or ground. Thus the proposed model enables the visually impaired person in Obstruction Detection &Navigation System with the help of web camera. So far the image acquisition and database creating using the captured image from the web camera and with the help of SURF detector the image identification was done. The Accuracy obtained in this proposed model is about 65%.

FUTURE WORK

The image identification as of now describes about the obstacle that are present .it may be expanded to determine with the distance away from the cane and also help the visually impaired to take the safest direction from the obstacle through a voice output. Face recognition system will also be added to the system .This will be more useful for the blind people to identify the people who are around. Similarly the GPS system provided the correct location where ever the visually impaired individual walked autonomously in unfamiliar environment without the assistance of others

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