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Smart Glass

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Abstract

Smart glass device includes a pair of glasses and an obstacle detection module fitted in it in the center, an output device and a power supply. The obstacle detection module and the output device is connected to the Raspberry pi. The obstacle detection module basically consists of an ultrasonic sensor that detects the obstacle present in front of the man. The information is processed and the output is given as an audio message. Currency detection is achieved using image recognition technique with the help of a night vision camera. This Smart Glass for blind people is a portable device that is easy to use, light weight, user friendly and cheap in price. These glasses could easily guide the blind people and help them avoid obstacles.

Keywords: *Currency detection, night vision camera, obstacle detection, ultrasonic sensors*

INTRODUCTION

Blind people are those people in the society who needs special care and attention. The blind or visually impaired rely largely on their other senses such as hearing, touch, and smell in order to understand their surroundings. It is pretty hard for them to go out alone without the help of another person. Traditional navigation device such as a blind cane, are used by the blind by tapping the ground or walking around the object to determine the direction. The structure is simple, single function, easy to use, but the secondary effect is not very obvious, in fact, will encounter many problems when using the blind such as poor road conditions, uneven, hanging in front of obstacles, ordinary cane cannot be proven accurate, such a serious impact on the safety of blind travellers. Giving blind people the great accessibility to their environment is the objective of the smart glass system. This smart glass system can see the world for them and give voice instructions and hints through headphones. This smart glass system will help visually impaired people gain increased independence and freedom in city life. The main two objectives of the proposed system includes obstacle detection and currency detection. This smart ultrasonic glasses for blind people comprises of a pair of wearable glasses, ultrasonic sensors for detection of obstacles in the way of blind man, an output device to give the sound as per the direction of the obstacle from the man, a central processing unit comprising of Raspberry pi b+ 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 headset, power supply is given to the central unit which distributes the power to different components.

METHODOLOGY

Obstacle Detection

This smart ultrasonic glasses for blind people comprises of a pair of wearable glasses, ultrasonic sensors for detection of obstacles in the way of blind man, an output device to give the sound as per the direction of the obstacle from the man, a central processing unit comprising of Raspberry pi b+ 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 headset, power supply is given to the central unit which distributes the power to different components. The best sensors that can be used will be ultrasonic sensors because ultrasound is 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 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.

Currency Detection

Currency recognition is an important area of pattern recognition. A system for the recognition of currency is one kind of intelligent system which is a very important need of the current automation systems in the modern world such that it helps the visually impaired to identify the currency with ease. In our system, we scan the images of each Currency note and then detect the some of the important features or key features of a Currency note using SIFT (Scale Invariant Feature Extraction) Algorithm and we store the images in the data base and we train our system with the respective key features and the correlation values of each note. Now, the testing sample image comes into picture and the comparison between the original images stored in the database and sample scanned image is done. The comparison is done between the features and correlation values of trained set and new sample images. Then the results are displayed accordingly. If the note is matched, it displays the matched note else no match of the note is displayed. The classification of images is done only on JPEG images only.

COMPONENTS

Raspberry pi

The Raspberry-Pi is a credit card-sized single-board computer developed by the Raspberry Pi to promote the teaching of basic computer science. A modified version of Debian Linux controls the raspberry pi optimized for the ARM architecture. Here, we are using raspberry pi B. The setting up consists of selecting Raspbian OS from prebuilt SD card. The prebuilt SD card consists of Raspbian, arc Linux, pidora, open ELEC and RISC OS operating system. After the OS selection we configure the raspberry-pi using raspiconfig command. We can enter into raspberry pi desktop using startx command. The raspberry pi 3 features a Broadcom system on a chip (SoC), which includes an ARM compatible central processing unit (CPU) and an on-chip graphics processing unit (GPU, a Video Core IV). CPU of 1.2 and on board of 1 GB RAM.

Figure 1: *Rasberry Pi module B.*

Ultrasonic Sensor

The ultrasonic sensor transmits sound waves and receives sound reflected from an object. When ultrasonic waves are incident on an object, diffused reflection of the energy takes place over a wide solid angle which might be as high as 180 degrees. Thus some fraction of the incident energy is reflected back to the transducer in the form of echoes. If the object is very close to the sensor, the sound waves returns quickly, but if the object is far away from the sensor, the sound waves takes longer to return. But if objects are too far away from the sensor, the signal takes so long to come back (or is very weak when it comes back) that the receiver

cannot detect it. The sensor uses the time it takes for the sound to come back from the object in front to determine the distance of an object. The distance to the object can then be calculated through the speed of ultrasonic waves in the medium. The ultrasonic sensor can measure distances in centimeters and inches. It can measure from 0 to 2.5 meters, with a precision of 3 cm.

Figure 2: *Ultrasonic sensor.*

OBSTACLE DETECTION

Smart obstacle detector helps blind people in moving and allowing them to perform their work easily and comfortably. With the large number of sensors available in the market, it is necessary to choose the right sensor. There are certain features which have to be considered when we choose a sensor: Accuracy, Environmental condition, Range, Calibration, Resolution, Cost and Repeatability The ultrasonic sensor transmits and receives sound waves reflected from the object. When ultrasonic waves are incident on an object and diffused reflection of the energy takes place over a wide solid angle which might be 180 degrees. Thus, some fraction of the incident energy is reflected back to the transducer in the form of echoes. If the object is very close to the sensor, the sound waves returns quickly. If the object is far away from the sensor, the sound waves takes longer to return. But if objects are too far away from the sensor, the signal takes so long to come back that the receiver cannot detect it. The sensor uses the time it takes for the sound to come back from the object in front to determine the distance of an object.

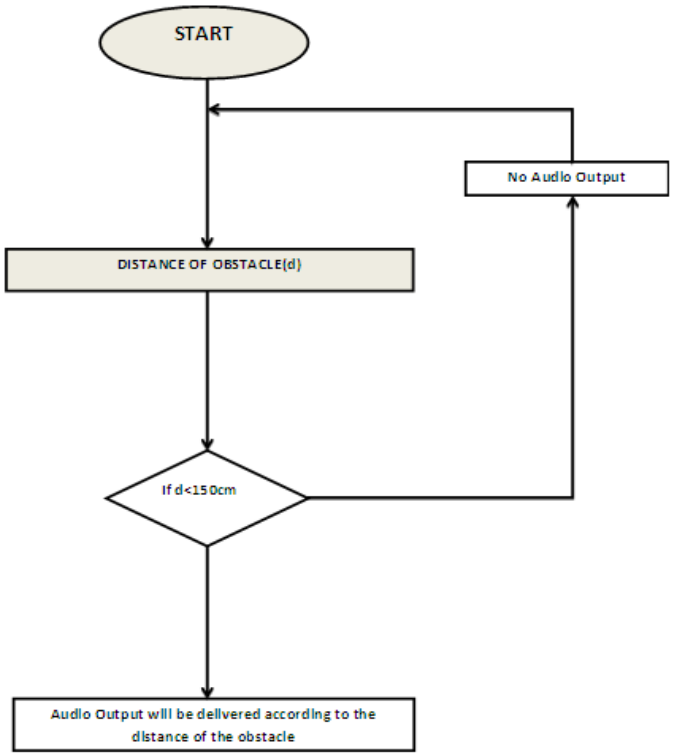

Figure 3: *Block diagram for obstacle detection.*

CURRENCY DETECTION

Currency recognition is an important area of pattern recognition. A system for the recognition of currency is one kind of intelligent system which is a very important need of the current automation systems in the modern world of today. In our system, we scan the images of each Currency note and then detect the some of the important features or key features of a Currency note using SIFT (Scale Invariant Feature Extraction) Algorithm and we store the images in the data base and we train our system with the respective key features and the correlation values of each note. Now the testing sample image comes into picture and the comparison between the original images stored in the database and sample scanned image is done. The comparison is done between the features and correlation values of trained set and new sample images.

Definition of Image

Red, green, blue are the three colour component that constitute the RGB colour space. These red, green, and blue colours combine in a definite proportion to yield a different colour. Here, colour image is captured using a high resolution camera. Data representing a two-dimensional scene. A digital image is composed of pixels arranged in a rectangular array with a certain height and width. Each pixel may consist of one or more bits of information, representing the brightness of the image at that point and possibly including color information encoded as RGB triples.

Image Processing

It deals with images in bitmapped graphics format that have been scanned in or captured with digital cameras. Any image improvement, such as refining a picture in a paint program that has been scanned or entered from a video source. In image processing retrieving image based on colour similarity is achieved by computing a colour histogram for each image that identifies the proportion of pixels within an image holding specific values. Current research is attempting to segment colour proportion by region and by spatial relationship among several colour region. Among different types of low level features, colour is the most straightforward information which can be easily retrieved from digital images with simple and compact description, while others require more pre-processing and computational tasks such as pattern recognition or texture analysis.

While comparing image by colour feature, three properties are usually considered:

- Area of matching: Count the area or number of pixels having same or similar colors. Larger matched area means more similar.
- Color distance – Distance between colors, usually in a perceptually uniform color space. Closer between matched colors means more similar.
- Spatial distribution – Usually used while combining colour with other features such as texture and shape.

Implementation

Pre Processing of Image: The task of pre-processing is achieved by converting colored currency images into gray scale, which facilitates further pre-processing.

RGB to gray scale conversion: RGB Colour image: In RGB colour model, each colour appears in its primary spectral components of red, green and blue. The colour of a pixel is made up of three components; red, green, and blue (RGB), described by their corresponding intensities. I RGB =(fR, fG, fB) Where fR(x,y) is the intensity of the pixel (x,y) in the red channel, fG(x,y) is the intensity of pixel (x,y) in the green channel, and

fB(x,y) is the intensity of pixel (x,y) in the blue channel.

Gray Scale Image: Gray scale is an image carries only intensity information. It has range of shades of gray without apparent colour. The darkest possible shade is black and the lightest possible shade is white.

Prewitt Operation: Prewitt operator is used for edge detection in an image. It provides two masks. One for detecting edges in horizontal direction and the other for detecting edges in vertical direction.

Vertical direction mask: When this mask is convolved in an image, it gives the vertical edges in the image. It simply works like a first order derivate and calculates the difference of pixel intensities in an edge region.

-1	0	1
-1	0	1
-1	0	1

Horizontal direction mask: When this mask is convolved in an image, it gives the horizontal edges in the image. It calculates difference among the pixel intensities of a particular edge.

-1	-1	-1
0	0	0
1	1	1

Feature Extraction

One very important area of application is image processing, in which algorithms are used to detect and isolate various desired portion or shapes of digitized image.

Scale invariant feature transform is one of the low level feature extraction techniques which we use. SIFT is used to detect and describe local features in images and can help in object recognition. We begin by detecting points of interest, which are termed key points. The image is convolved with Gaussian filters at different scales and then the difference of successive Gaussian-blurred images are taken(DOG).The extraction of these features the SIFT algorithm applies a 3 stage filtering approach.

Scale-Space Extreme Detection: This stage of the filtering attempts to identify those locations and scales that are identifiable from different views of the same object. This can be efficiently achieved using a "scale space" function. Hence this algorithm is scale invariant.

CONCLUSION

The paper introduces a prototype system of lightweight smart glass for visually impaired people. We demonstrated how the smart glass was designed, including hardware design and software design, and we have implemented many excellent image processing, object detection algorithms on the new lightweight smart glass system. This system can detect and recognize the object in real time as well as it can detect currency. The smart glass would be useful for the visually impaired people in their city life, and in the soon future, we will implement more useful applications in the smart glass system, such as talking to Wikipedia, google, voice guidance and etc.

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