Abstract: - This paper purpose the study on tools aimed to assist blind and -blind people in their daily activities. Blind people face a number of challenges when interacting with their environments because so much information is encoded visually. Text is pervasively used to label objects, s carry special significance, and items can easily become lost in surroundings that cannot be quickly scanned. Many tools seek to help blind people solve these problems by enabling them to query for additional information, such as or text shown on the object. Our mission however not only solves this problem but also holds an edge over its counterparts. These ideas also useful for blind and -blind can detect and drivers drive as safely as drivers with normal vision. -blind drivers have difficulties recognizing traffic and vehicle signals. However, simple and practical solutions such as changes to the design and shape of signals will aid these drivers. A Matching function has been implemented as well that can be used to determine whether two objects have matching s or not.

Index Terms— RGB, Identification Tools, CCD Camera, Object Scanned, Patten Recognition, Speech Recognition,

I. INTRODUCTION

It is estimated that 161 million people around the world (about 2.6% of the population) are visually impaired. This figure consists of 124 million people who have low vision and 37 million who are blind. According to the World Health Organization (WHO), low vision is defined as visual acuity of 20/200 or less in the better eye with best correction possible. (WHO. 2004). At the same time, approximately 10% of the male population in Europe suffers from some form of vision deficiency (blindness), the most usual case being an inability to distinguish between certain s (e.g. red/green, blue/yellow). In extreme situations, only shades of grey might be distinguishable. Colour plays an important role in the everyday life of a normally sighted person. Normally sighted people use as the basis of a number of everyday tasks, for example matching socks, choosing between different clothes.

Such activities, however, could prove to be challenging for both blind and blind persons. From this point onwards, the term ‘blind’ will be used to describe people who have low or no vision and people who are blind. A more advanced system however could be designed to identify the s of objects it is presented. Software could be developed to use the input of an imaging device (CCD) to recognize and announce of an object it is presented with. Such a system could give blind people greater independence as they would be able to carry out certain tasks that are unable to perform unaided. There are several critical issues for successful clothes matching. First, people perceive an object to be the same despite even very large changes in the spectral composition of light reflected from the object. (Conversely, objects that reflect identical spectra are often reported as being of different s, depending on lighting conditions and adaptation state.) Thus, object s determined from a camera image may not always correspond perfectly to those reported by a human observer. Secondly, shadows and wrinkles may be confused as part of the texture patterns or imagery of the clothing and therefore cause errors. Thirdly, the images of clothes can be imaged from arbitrary viewing directions. Methods of matching patterns require the input pair of images must be perfect rotation-invariant. Lastly, many clothes have designs with complex patterns and multiple s, which increase difficulty of identifications.

II. BACKGROUND

A number of papers have been published regarding portable recognition devices for use by blind people. Furuno, F. (1990) developed a sensor that could distinguish between 12 different s with a claimed accuracy of 85% - 90%. The device spoke the name of the sampled to the user. The system built by Furuno was a surface contact device, meaning that all ambient light was blocked from the sensor and the hardware provides its own source of light from which measurements are acquired. The sensor implemented by Furuno used a filament lamp as its light source, which lead to a limited battery life due to the relatively large current required to drive the lamp. The system also made use of six amplifiers to measure the light level being detected by the sensors. These amplifiers also added to the load on the battery and thus reducing its lifespan. In later research by Bowman B.C et al. (n.d.), a surface contact device sensor with speech output was designed. Light Emitting Diodes (LEDs) were used as the light source for the device instead of a single filament lamp.

![Fig. 1: The Architecture Overview Diagram (AOD)](image-url)
LEDs take much less current to drive thus the battery life of the device is greatly extended. The use of LEDs as the light source of the device has only been made viable since 1997 when high luminosity blue LEDs became available. The high luminosity LEDs allow the sensor to have a wider operating range due to the fact that there is a larger separation in the voltages obtained for dark and light samples. In the research carried out by Bowman B.C et al. (n.d.), a photodiode is used to detect the amount of light being scattered due to the of the test object. The advantage of using a photodiode instead of an LDR is the speed at which it adjusts to the amount of light it receives. However there is one major drawback when using an LDR in that its response time when dealing with light-dark transitions is relatively slows (~5 seconds). Depending on the values can be translated to a meaningful output message to the user.

III. THE SYSTEM OVERVIEW AND PROPOSED WORK

The robustness of the system depends on the features extracted. In this paper, the experiment was carried out on 10 different classes of. The process of classification is performed in two phases; the first one is the computation of features and second is the classification of with the help of extracted features using suitable classifiers. The original images used for the experimentation are captured under natural light and are resized to 1024x1024. The K-NN and minimum distance classifiers are used for classification using extracted global, local and features shown in fig. 3.

A. Model Conversion

Colour is the most vital visual feature for humans. By representation we mean the overall of image content when used as a “global” feature. A space is defined as a model representing in terms of intensity values. There are different s models: RGB, Lab, HSV, HSI, YCbCr, etc. Each of these has got specific applications and also has got advantages and drawbacks. Based on our application we need to convert from one space to another. All the images are in RGB model, because of the non-uniformity of RGB space we need to convert them to the suitable space. The HSV and L* a* b* models are commonly used in image retrieval system. The non-uniformity of RGB model is eliminated by L*a*b*, HSV, HIS and YCbCr models.

1) RGB to L*a*b model conversion:

L*a*b* is an international standard for measurements, adopted by the Commission International d’Eclairage (CIE) in 1976. This model creates a consistent regardless of the device used to generate the image. ‘L’ is the luminance or lightness component, which ranges from 0 to 100, and parameters a’ (from green to red) and ‘b’ (from blue to yellow) are the two chromatic components, which range from 120 to 120. The transformation equations for RGB to Lab model conversion are:

$$\begin{align*}
X &= \begin{bmatrix} 0.42356 & 0.362390 & 0.179347 \end{bmatrix} \begin{bmatrix} R \\ G \\ B \end{bmatrix} \\
Y &= \begin{bmatrix} 0.21267 & 0.715160 & 0.072169 \end{bmatrix} \begin{bmatrix} R \\ G \\ B \end{bmatrix} \\
Z &= \begin{bmatrix} 0.01933 & 0.119193 & 0.950227 \end{bmatrix} \begin{bmatrix} R \\ G \\ B \end{bmatrix}
\end{align*}$$

$$L = 116 \left( g \left( \frac{Y}{Y_n} \right) \right), \quad a = 500 \left( g \left( \frac{X}{X_n} \right) \right) - \left( g \left( \frac{Y}{Y_n} \right) \right),$$

$$b = 200 \left( g \left( \frac{Y}{Y_n} \right) \right) - \left( g \left( \frac{Z}{Z_n} \right) \right),$$

$$g(t) = \begin{cases} t^{\frac{1}{3}} & \text{for } t > 0.00882 \\
7.83 + \frac{16.3}{117} t & \text{for } t \leq 0.00882 
\end{cases}$$
The prototype sensor was initially designed to be battery powered as the long term usage of battery is to be avoided. In order to obtain usable data from the LDR regarding the light level different LEDs were used in a potential divider configuration so that a portable colour sensor could then be converted to an 8 bit digital signal. The microcontroller which would receive light by both diffuse and specular reflection from the object. From this point, diffuse reflection produced by the LEDs would be the only source from which the LDR was used in a potential divider configuration so that it is identifying the other LEDs equally affected by the different LEDs. In order to obtain separate from the LDR, to ensure that the LDR will be equally affected by the different LEDs. In order to obtain

IV. SENSOR PROTOTYPE

The first attempt of the sensor prototype consisted of four high intensity LEDs and a single LDR. The s of the LEDs selected was Red, Green, Blue (the additive primary s of light 2.3.2.1.1) and White to give a measure of specular reflectivity. This approach follows in the steps of all previous attempts of building a colour sensor in that the device must be in contact with the surface that is identifying the colour of, with all ambient light eliminated. The light produced by the LEDs would be the only source from which the LDR would receive light by both diffuse and specular reflection from the object. From this point, diffuse reflection will be referred to as 'scatter' and specular reflection as 'reflectivity'. Each LED would be lit in turn and a reading recorded from the LDR. The arrangement of the LDR and LEDs is shown in Figure 4. Figure 8 shows the LEDs equally separated from the LDR, to ensure that the LDR will be equally affected by the different LEDs. In order to obtain usable data from the LDR regarding the light level detected, the LDR was used in a potential divider configuration so that a voltage output was measured from the sensor. This voltage could then be converted to an 8 bit value using an ADC on a microcontroller which would represent the RGB values for the three channels. The prototype sensor was initially designed to be battery powered as the long term aim is to build a portable colour sensor device. The battery selected was a standard PP3 (9V) as a temporary source of power until the

\[ h = \cos^{-1}\left\{ \frac{0.49[(r-g)+(r-b)]}{\left[(r-g)^2+(r-b)(g-b)\right]^{1/2}} \right\} \]

\[ h \in [0, \pi] \text{ for } b \leq g, \]

**RGB to HSV model conversion**

The HSV stands for the Hue, Saturation and Value. The value represents intensity of a, which is decoupled from the information in the represented image. The hue and saturation components are intimately related to the way human eye perceives. HSV is often called HSB (B for brightness). Hue varies from 0 to 1 when goes from red to green then to blue and back to red. H is then defined modulo 1 as is seldom monochromatic. Value (V) does not depend on the, but represents the brightness. So H and S are chrominance and V is intensity. The transformation equations for RGB to HSV model conversion

\[ S = \frac{V - \min(R,G,B)}{V} \]

**RGB to HSI model conversion**

The HSI stands for the Hue, Saturation and Intensity. The HSI space is very important and attractive model for image processing applications because it represents similarly how the human eye senses s. The HSI model represents every with three components: hue (H), saturation(S), intensity (I). Before converting from RGB to HSI model, we normalize RGB values as follows.

\[ r = R / (R + G + B), \quad r = G / (R + G + B), \quad r = B / (R + G + B) \]

Each normalized H, S and I components are obtained by the following expressions.

\[ S = 1 - 3 \min(r, g, b); \quad s \in [0, 1], i = (R, G, B) / (3 \times 255); \quad i \in [0, 1] \]

h, s and i values are converted in the ranges of [0,360], [0,100] and [0,255] respectively by

\[ H = h \times 180 / \pi; \quad S = s \times 100 \text{ and } I = 1 \times 255 \]

**RGB to YCbCr model conversion**

Y is the luminance component and Cb and Cr are the blue-difference and red-difference chroma components. The conversion equations from RGB to YCbCr model is given below.

\[
\begin{bmatrix}
Y \\
Cb \\
Cr
\end{bmatrix} = \begin{bmatrix}
0.23765 & 0.64113 & 0.16934 \\
0.61516 & 0.71516 & 0.17917 \\
0.27157 & 0.87216 & 0.07216 \\
0.30933 & 0.60933 & 0.08127
\end{bmatrix} \begin{bmatrix}
R \\
G \\
B
\end{bmatrix} + \begin{bmatrix}
16 & 128 & 128
\end{bmatrix}
\]

**Features Extraction**

The conversion is performed before extracting features. The images are recognized by quantifying the distribution of throughout the image and change in the. The quantification is obtained by computing mean and standard deviation for a given image. The features represent the global characterization of an image. The mean and standard deviation are the features extracted as features. The standard deviation and mean are calculated using the formula as given below.

\[ H = \frac{G - B}{6S}, \quad \text{if } V = R; \quad H = \frac{1}{3} + \frac{B - R}{6S}, \quad \text{if } V = G; \quad H = \frac{2}{3} + \frac{R - G}{S}, \quad \text{if } V = B; \]

The total four colour features are extracted from each of two colour channels from colour model. In L*a*b colour model,

\[ h = 2\pi - \cos^{-1}\left\{ \frac{0.49[(r-g)+(r-b)]}{\left[(r-g)^2+(r-b)(g-b)\right]^{1/2}} \right\} \]

\[ h \in [\pi, 2\pi] \text{ for } b > g, \]

'a' and 'b' are the colour channels hence two features from each colour channel are extracted. Similarly, ‘H’ and ‘S’ in HSV and HSI colour models and ‘Cb’ and ‘Cr’ from YCbCr colour model respectively.

\[ \text{Standard deviation } = \sigma = \sqrt{\frac{1}{N} \sum_{i=1}^{N} (x_i - \mu)^2}, \]

\[ \text{Mean } \mu = \frac{1}{N} \sum_{i=0}^{N-1} x_i \]
final power source was designed. This type of battery was chosen as it is relatively small and compact for the amount of voltage and power it produces. The voltage supplied by the battery is 9V, however microcontrollers generally run at 5V. However, 5V batteries are not readily available. Therefore, a conversion from the 9V provided by the battery to the 5V required by the microcontroller had to be used. The simplest solution to the problem was to use a linear voltage regulator. Linear voltage regulators are not very efficient when it comes to generating voltages as they dissipate the excess power as heat. An improved solution would be to use a DC-DC converter. This subject is further discussed in 4.

VI. EXPERIMENTAL RESULTS DISCUSSION

Based on requirement it was necessary to be able to reason about the relative ‘accuracy’ of the particular algorithms in the project specification in terms of how well they represent human opinion. The term accuracy is a subjective term and to avoid ambiguity, accuracy is replaced with a Turing test in the form of ‘reasonability’ which is defined from this point forward as: A sample that has been assigned a descriptor by an algorithm was considered as ‘reasonable’ if for all humans with normal vision, there exists a human who would assign the same descriptor. It was first necessary to get an approximate measurement of reasonability for the various algorithms in the project specification. A set of input numerical data was chosen which varied across the full set of descriptors identified in the natural evolution of systems is to progressively define an increasingly granular hierarchy of descriptors. Many of the descriptor sets used in industry contained a large number of descriptors. With so many names for s their meaning becomes ambiguous and may confuse a blind person. For example, consider the descriptor ‘teal’. Teal is a type of dark green-blue; however, if the blind person did not know this then that descriptor would be of no use to them. In addition, teal can be described fairly unambiguously using ‘green-blue’. It would seem that being able to describe many variations on descriptors such as brick red, scarlet and maroon is not a prerequisite for accurate and unambiguous human description. It was necessary to define a small set of descriptors which could unambiguously be understood by blind people and hence be used as an output to the recognition algorithm. The aim was to reduce ambiguity in distinction whilst providing an adequate number of descriptors. It was decided that the following set of descriptors would be used. These are specified below and were later refined. For each algorithm in the project specification, this data was used as an input and the resulting descriptor i.e. classified was documented. A small scale, single person reasonability test was then performed for each algorithm based on how well they classify the data.

VII. OUTPUT COLOUR

The resulting space sample data was utilized in a prototype of the lookup algorithm above for 50 randomly selected (HSL) samples. The results implied a reasonability of over 80% for the 50 samples it returned. However, it was noticed in areas such as the edges of the space dimensional cube, where a reduced number of fixed points are used to determine the modal, errors were experienced more frequently. In addition, modal descriptors became less popular as samples resided on boundaries shown in table 2.

VIII. CONCLUSION

The final solution designed is portable and capable of identifying the colour of objects made of a range of materials.
It can also distinguish between reflective and non-reflective objects and report this information to the user. The device is simple to operate, as it can be used with just two buttons. It also makes use of a speech output to interface with the user. A volume control allows the user to adjust the output to a comfortable level and also includes a headphone jack. At the same time, the user has the option of choosing between a rechargeable unit and a unit that uses alkaline batteries. The rechargeable unit can also run from a mains adaptor. In order to reach the solution described above, a number of problems had to be overcome. The final solution uses photodiodes which are more expensive than the LDR that was used at the first prototype. At the same time, the difference in surface reflectivity of materials caused unexpected variations on the readings taken. The introduction of the second photodiode did not help in solving these issues; however, it is used to give an indication of the reflectivity of the sampled surface. The diffuser that is used in the final solution helped in achieving better results on a wider range of surfaces, however it did not fully eliminate the problem.

IX. FURTHER WORKS

This section will now talk about some of the further work that could be carried out to improve the deliverables of this report. This report has tackled several problems and has gone down paths that have sometimes proved to be wrong. However, going down the wrong path often helps to better understand the problem, bringing light to new avenues and methods of solving the problem. Below are a few areas where further research could be carried.

REFERENCES


