Convenient Clothing Pattern and Colour Recognition for People with Vision Impairment

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ABSTRACT

The objective of this paper is to design and implement a prototype which is capable of recognizing clothing patterns in four categories (plaid,plain,irregular,striped) and identifies 12 colors. Choosing clothes with complex patterns and colors is a challenging task for visually impaired people. We have developed a camera-based prototype system that has an integrated camera, a microphone, a computer, and a Bluetooth earpiece for audio description of clothing patterns and colors. The clothing patterns and colors are described to blind users orally. This system can be controlled by speech input through microphone. To recognize clothing patterns, we propose a novel Radon Signature descriptor and a schema to extract statistical properties from wavelet sub-bands to capture global features of clothing patterns. To evaluate the effectiveness of the proposed approach, we used the CCNY Clothing Pattern dataset. Our approach achieves 90% recognition accuracy which significantly outperforms the state-of-the-art texture analysis methods on clothing pattern recognition.

Index Terms: convenient system, clothing pattern recognition, global and local image features, colour and texture analysis, people with vision impairment.

1. INTRODUCTION

Based on a survey there are 285 million people estimated to be visually impaired worldwide out of which 39 million are blind and remaining 246 million have low vision, about 90% of the world's visually impaired live in low-income settings and 82% of people living with blindness are aged above 50. Globally, uncorrected refractive errors are one of the main cause of moderate and severe visual impairment; cataracts remain the leading cause of blindness in middle- and low-income countries. Colors play a major 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. Choosing clothes with required colors and patterns is a challenging task for blind or visually impaired people. They manage this task with the help of family members, using plastic Braille labels or different types of stitching pattern tags on the clothes, or by wearing clothes with a uniform color or without any patterns. There are many challenges in developing a system that helps the visually-impaired people with the task of determining clothing colors and patterns. Firstly, people perceive a pattern class or color 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 color, depending on lighting conditions and adaptation state. Thus, object colors 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 thus cause errors. Thirdly, the images of clothes can be captured from arbitrary viewing directions. Methods of matching patterns require the input pair of images must be pattern rotation-invariant. Lastly, many clothes have designs with complex patterns and multiple colors, which increase difficulty of identifications. A system that overcomes these issues, could give blind people greater independence as they would be able to carry out certain tasks that they are currently unable to perform unaided.

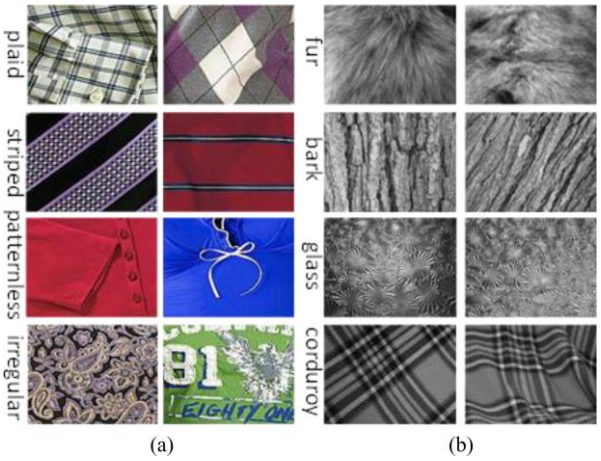

Fig. 1. Intra-class variations in clothing pattern images and traditional texture images. (a) Clothing pattern samples with large intra-class pattern and color variations. (b) Traditional texture samples with less intra-class pattern and intensity variations.

Fig. 2. Overview and architecture design of the camera-based clothing pattern recognition system for blind and visually impaired persons.

2. Reviews on Related Research

Convenient systems of different kinds are being developed for people with vision impairment to improve the quality of life and safety of such people including indoor navigation and way finding, display reading, banknote recognition, rehabilitation, and many more. Xiaodong Yang developed a system for blind people to select clothes based on cloth pattern and colors in a cloth shop independently. This is a camera based system that can recognize clothing patterns into four categories (plaid, stripped, pattern-less, and irregular) and identify 12 colors: red, brown, orange, yellow, green, cyan, blue, purple, pink, black, white and grey. Faiz.M. Hasanuzzaman proposed a system to automatically recognize banknote of any currency to assist people with vision impairment. This is also a camera based computer vision technology. This system has features like high accuracy, robustness, high efficiency, with ease of use. This system is robust to conditions like occlusion, rotation, scaling, cluttered background, illumination change, wrinkled bills, and also eliminating false recognition and can guide the user to properly and correctly focus at the bill to be recognized using Speed Up Robust Features(SURF). Dimitrios Dakopoulos and Nikolous developed a vision substitution system for travel aid for blind in. Out of the three main categories of navigation systems (Electronic Travel Aids, Electronic Orientation systems, Position Locator Aids), they focus on Electronic Travel Aids. In all these works, the needs of blind people are considered. But, the main area where a colorblind person faces a problem other than the traffic signals is in a cloth shop for selecting clothes of desired colors and patterns without the help of another person. The proposed assistive system here depicts the same.

3. METHODOLOGY

The accuracy of the system depends on the features extracted. In this paper, 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.

1. Pattern Detection

Pattern recognition is the assignment of a label to a given input value. We use the concept of supervised learning and train our pattern recognition module from labelled training data acquired in the form of images from CCNY dataset.

Fig.3 Sample Cloth Image

After analyzing the voice command for the system start-up, image is captured using the camera. It is then converted to Grey scale and is split into 4 quadrants or parts. Processing is done separately on each section and parameters are accumulated, which will be used for deciding the pattern. Next Step is the edge detection methodology. Edges of each Section are calculated based on a pre-defined value of a set threshold.

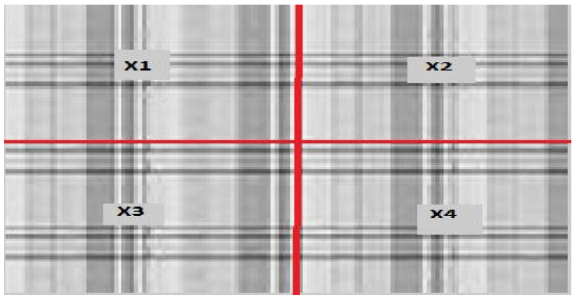

Fig.4 Clothing Image divided into Quadrants

The sum of edges for each section is calculated and stored in separate variables. Difference in the number of edges in each section to all the other sections, is computed and stored as matrix.

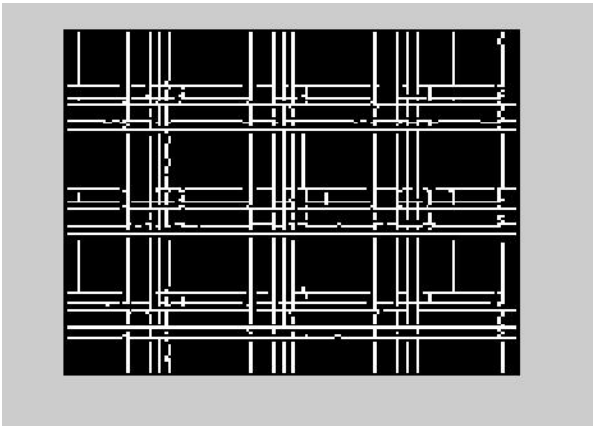

Fig.5 Edges of the image

Variation function of this matrix is calculated twice (once on the difference matrix and then on the resultant matrix). Sobel edge detection function is used on the entire image to find any cross over edges (exclusively for the categories plaid and striped). Based on the edges, a decision about the processed image pattern is taken and an audio output regarding the same is given. B. Color Detection is the most vital visual feature for humans. A space is defined as a model representing in terms of intensity values. Each of these has got specific applications and also has got advantages and drawbacks. In this system, RGB color model is used.

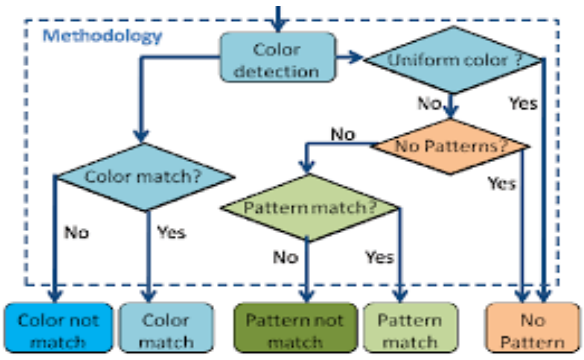

Fig.6 Methodology

4. SYSTEM AND INTERFACE DESIGN

The camera-based clothing recognition aid prototype for blind people integrates a camera, a microphone, a computer, and a Bluetooth earpiece for audio description of clothing patterns and colors. A camera is used to capture clothing images. The clothing patterns and colors are described to blind users by audio output. The system can be controlled by speech input through a microphone. In order to facilitate blind users to interact, speech commands input from a microphone are used to provide function selection and system control. As shown in Fig. 7, the interface design includes basic functions and high priority commands.

Basic functions: A blind user can verbally request the function he/she wants the clothing recognition aid to perform. The recognition results will be presented to the blind user as audio outputs including recognized, not recognized, and start a new function. As for the recognized function, the next level functions include pattern/colors to announce the recognized clothing pattern and dominant colors; repeat results to repeat the recognized result; and to save the clothing image with associated pattern and color information in the computer.

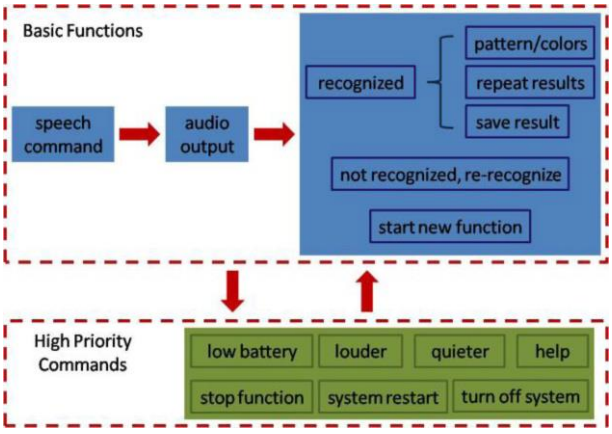

Fig.7. System interface design for the proposed camera-based clothing pattern recognition system by using speech commands. The high priority commands can be used at any time to overwrite the basic functions.

High priority commands: A blind user can set the system configuration by several high priority speech commands such as system restart, turn-off system, stop function (i.e., abort current task), speaker volume and speed control commands (e.g., louder, quieter, slower, and faster), and help. The high priority commands can be used at any time. A user can speak help, and the clothing recognition system will respond with the options associated with the current function. Small wireless Bluetooth speakers can be employed to protect privacy and minimize background sounds. The battery level will also be checked and an audio warning is provided if the battery level is low.

Audio output: As for audio display, we use an operating system speech facility that is standard in modern portable computer systems and smartphones. We currently use Microsoft Speech Software Development Kit which supports scripts. A number of configuration options are also available according to user preference, such as speech rate, volume, and voice gender.

5. PROTOTYPEOVERVIEW

The prototype that we have developed is a camera-based system to help visually impaired people to recognize clothing patterns and colors. The system contains three major components:

1) a camera for capturing clothing images, a microphone for speech command input and speakers (or earphones) for audio output; 2) data capture and analysis to perform command control, clothing pattern recognition, and color identification by using a computer which can be a desktop or a portable computer (e.g., a laptop or a smart-phone); and 3) audio outputs to provide recognition results of clothing patterns and colors, as well as system status.

A Logitech C170 web-camera is used to capture clothing images. The clothing patterns and colors are described to blind users by a verbal output through earphones for minimal distraction to hearing. The system can be controlled by speech input through a microphone. As for the recognized function, the next level functions include pattern/colors to announce the recognized clothing pattern and dominant colors; repeat results to repeat the recognized result. All the modules are implemented using MATLAB and the processing is done by a computer. Also, in this prototype, we have used a Logitech web-cam and 3.5mm jack stereo earphones to keep the cost low. High-end computer -compatible cameras and Bluetooth earphones can also be used for increased clarity. Future work may also include improving the input range and detection accuracy, scaling down the system for easy & portable use and reducing the cost.

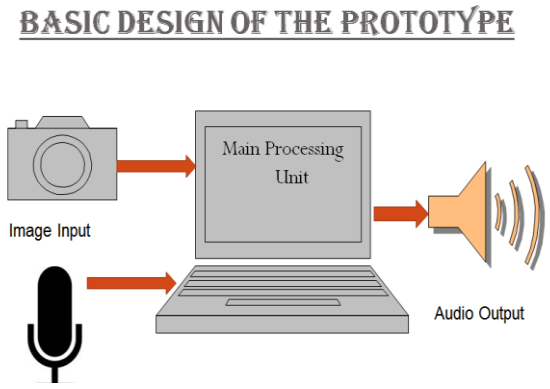

Fig.8. Basic prototype

6. CONCLUSION

In this paper, we have proposed a novel system to recognize clothing patterns and colors to help visually

impaired people with outfit selection in their daily life. The developed prototype has significant detection accuracy and is robust to rotation, illumination, scaling and other such challenges that exist in this domain. Experimental results demonstrate that our proposed method is much simpler than many existing ones and significantly outperforms the state-of-the-art methods in clothing pattern recognition. Furthermore, the performance evaluation on traditional texture datasets validates the generalization of our method to traditional texture analysis and classification tasks. This research contributes to the study of pattern analysis color detection and leads to modifications over existing methods in handling complex clothing patterns with large intra-class variations. Our research proves to be a small contribution towards the task of bringing the blind and the visually-impaired people into the mainstream by providing independence to them and thus helping them to lead a successful life.

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