Building a Color Recognizer System on the Smart Mobile Device for the Visually Impaired People

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Abstract—**One of the most important characteristics of a developed country is to take care and promote the life quality of handicapped people. There are more than 55,000 registered visually impaired people in Taiwan, and the population is growing year by year. The amount of the assistive devices or systems for the visually impaired people, which are designed and made locally in Taiwan, are very few. Most of the assistive devices and systems available to the vision-impaired people in Taiwan are imported and expensive. It means that more and more visually impaired people in Taiwan have to face various difficulties in life, which are difficult to handle by themselves, without any help from assistive devices or systems. Therefore, it is important to develop assistive devices and systems for the visually impaired people in Taiwan. It is very difficult, or impossible, for blind persons to identify object's color. The problem might cause inconvenience or further serious danger in life, for example, wearing wrong-color cloth or taking wrong drugs. The problem on color identification can be simply solved by the assistance from sighted people. But, it is an infeasible solution because of the heavy loads and cost in human resources. In this paper, a color recognition system for blind people will be developed. The system is built on the smart phones with a camera device, and, therefore, is very portable. With an accessible user interface and the text-to-speech technology, the blind people can easily access the color information from the system. The blind people can identify object's color anywhere and anytime by using the color recognizer. The developed system provides a feasible solution to the problem of color identification that the blind people faced before. Moreover, the developed system will help the blind people to increase their life quality and decrease their need for scarce sighted assistance. The color recognizing system can help the blind people identify object's color themselves.**

Keywords- Visually Impaired People; Text-To-Speech Technology; Color Recognizer; Mobile Assistive System.

I. INTRODUCTION

Vision is an important and natural way for humans to receive information from the environment. We rely on vision to handle most things in daily life. Due to the defect in vision caused by congenital disease or accidental injuries, visually impaired people, especially totally blind people, have to face lots of inconvenience in their daily life. Therefore, it is an important issue to develop assistive devices or systems for blind people. The assistive technology for the blind has been developed for a long time in some developed countries, such as those in Europe and America. Their functions are appropriate and useful. However, the assistive devices for blind people are very few in Taiwan. In Taiwan, the assistive devices available to the blind people from Europe and America are too expensive.

A day in our life, we often faced with many choices, such as pick out an object with correct color to use from many objects. It is really common for us which have normal vision function. For visually impaired people, they face the problem again and again every day. For example, a cup, a book, maybe visually impaired people can touch their shape to know what it is and guess function. But, the blind people are still unable to know the object's color. It is too difficult to know what the object's color is it if he or she wants. To solve the problem, listen to other people is a way to help blind people know whether it is a white cup, or that a book's front cover is red. But they still can not complete the work by themselves. When blind people go to school or go to work or attend meetings, they need to use conveniently wear lounge suit, about white shirt, black suit trousers, purple tie. It is very easy for most people to pick it with correct color. But, this is very difficult for visually impaired people. As a result, family members must be a role of the eyes and stay with visually impaired people to help them. In this way, family's burden will increase. The government must to prepare a budget and train many people who to help visually impaired people. It consumes considerable money and human resources. This paper focuses on assisting visually impaired people for self-management their daily life. We develop a mobile color recognizer (MCR) for blind people. They can use it to recognize object's color correctly. To use it conveniently, MCR must have portability and practicality. Therefore, we built the system on the smart phone which has a camera device. Consider the person who is usual Chinese, we use text-to-speech (TTS) technology [1, 2, 3, 4, 5] with Chinese voice. MCR will work and output Chinese voice message, the visually impaired people can easily control the system to obtain the information which they need anywhere and anytime.

II. COLOR RECOGNIZER

Color recognizer [6] is a software which people can use to identify object's color. The recognizer is a system that

combines the computer, camera device and recognizer application. There are many similar products and technologies nowadays, such as face recognition system, picture recognition. Image identification applications have been used universal in daily life. However, building a color recognizer in the computer or laptop still has some problems. It is too large and weight to take along. Therefore, some products have built the color recognizer on the smart device. In this paper, we refer to the color recognizer developed by CodeFactory company [7]. Provide a new way for visually impaired people to obtain colors information around. But, this product also has some shortcomings, for example, it just work on nine kind of cell phone which use Symbian system. Moreover, the assistive system uses the English voice text-to-speech engine. It is inconvenience for many visually impaired people which use others language.

III. STATE OF ART

The color recognizer from the CodeFactory company is a mobile assistive software which developed for blind people to recognize object's color. It uses a camera device to capture images and feedback voice to user. The software's main functions have:
- It can recognize eleven kinds of colors.
- It has a simple function that determines with the light level, such as bright, dark or normal.
- Support voice feedback, the software can read the recognition results by voice.

However, the color recognition system from the CodeFactory has the following drawbacks:
- The software just can work on few phones which use Symbian OS. It is inconvenience, if I use others platform, such as Android, Windows Mobile.
- The software is too expensive, for Taiwan people, the blind people must cost 4000NTD to buy it. And, it just can use on the only one phone.
- It is only available for English voice output; for visually impaired people who usual Chinese, maybe it is unfriendly for them.

Ours system can reduce the expenses for blind people who use Chinese. Because we can product this assistive system ourselves, it is cheaper than import it from other countries.

The MCR system uses the text-to-speech engine with Chinese voice. For people who are Chinese, they can accept and control the MCR system easily.

IV. SYSTEM ARCHITECTURE

The mobile color system is a convenience assistive device for blind people. The blind people can use the camera device which is on the smart phones to take photos from the object and save it in memory. It could be a JPEG or a BMP format file. When the system gets a picture, it will analyze the picture automatically and identify the object's color. Then output the text-based messages to the TTS
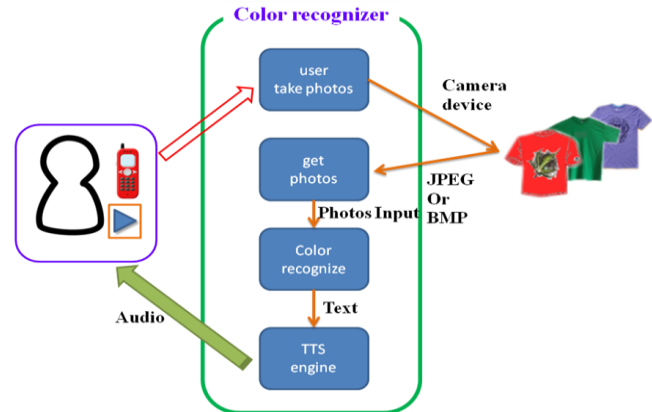

Figure 1. The system architecture

engine. TTS engine transforms the text-based message that becomes an audio-based message, and play it, providing the blind people another way to get information of colors without other people's help.

The MCR system is composed of three modules: the smart device, color recognizer and TTS. The MCR system is implemented in Java-based technology. We use the TTS with Chinese voice, which can be on the smart phones. The system architecture is presented in Figure 1.

The smart devices must have the camera because the users need to control the camera device to take photos. Considering the assistive devices' price and the available tools for blind people, we choose the smart phones from NOKIA to be the platform for our system. The smart phones use the Symbian S60 series operating system [8,9,10]. The Mobile Speak for Symbian which is a widely known screen reader software, which works on the Symbian operating system. This software can access most of information in operating system. On the other hand, the blind people can use this software to control the system easily.

We use the Java language to develop the MCR system. Java ME [11, 12, 13] is a kind of language which provides the developers with programming tools for the mobile devices. We can implement a program to drive the camera and take object's photos. When users take the photos, the system will save them in JPEG or BMP format in the memory.

The MCR system gets the images from memory and recognizes the color information automatically. Then the MCR system output the text-based message to the TTS engine with Chinese voice. TTS engine handles the text-based message and convert it to the audio-based message. As a result, the blind people can hear the audio-based message to know what the color of the objects is. In fact, they can identify the object's colors by themselves.

When this system is implemented, we hope to achieve the following results:
- Because we use Java language, the MCR system can easier transplant to other smart phones which unused Symbian operating system.

- Color recognition is the main function of this system, and the visually impaired people can use the system to identify their cloths color.
- Have a special and easier user interface for the blind people to control the MCR system, and they can use the system without other people's help.
- The price is cheaper, so the blind people can reduce expenses to buy the MCR assistive system.
- We hope the system is able to reduce human resources.
- The system is able to work on the mobile devices. Let the system has provided with portable property and make the life be convenience for the visually impaired people.

  With the text-to-speech function that the MCR system can output recognition result in Chinese voice message. It lets the visually impaired people who use Chinese to easily to control this system.

V. REAL IMPLEMENTATION

When we get pictures from a camera device and save them in memory, the developers are able to use the Java APIs that number JSR-135 package to drive the camera device. The MCR system will access memory to take the pictures and call the program of color identification. After that, the color recognition algorithm analyzes the pixels which a block in the pictures, and compute the RGB values. Because we hope the MCR system can work on the different platforms, we use the Java language to develop it. After obtaining the computed RGB values (which can compare with color space to know the colors information), the system provides the text-based results, and then, the Mobile Speak for Symbian screen reader software (which runs on the background) is able to access the text-based messages and provide them to TTS engine. The TTS engine converts the text-based messages to the audio-based messages, and feedback to the users.

VI. RESULTS

We are going to implement a mobile color recognizer prototype with Chinese TTS on the smart phones to support and solve the difficult problems of object's color recognition. Via the camera device, we can take the photos and save them in smart phone's memory. The color recognizer will analyze when it got the photos. Last, the text-based recognition results will be output to the TTS engine. The TTS converts the text-based message to the audio-based in Chinese voice, and play it.

We have driven the camera device successfully. Using the camera device to take photos and save them in smart phone's memory. Currently, we focus on the implementation of the color recognition algorithm. We survey some literatures about image processing or color identification. We should to know how to apply these technologies?

In the future, we face some problems when we designing the MCR system; we must to solve these problems:

- Because the assistive system is designed in Java language, we must search some APIs that the smart phones support (to read the APIs documents to know the functions and how to use them).
- We must to understand the property of the smart devices. And attempts to drive the camera device.

VII. CONCLUSIONS

In the paper, we use the NOKIA's smart phones, NOKIA 5800 to equip the MCR system. We have been completed to drive the camera device which use the JSR-135 package, and a really simple color recognition function. The color recognition algorithm analyzes the pixels and compute the RGB values to compare with the color space. At now, the color recognition function has been completed to recognize red, blue, green three basic colors. On the other hand, the screen reader software, we can download the Mobile Speak for Symbian from the Internet and use it. Currently, we survey literatures about image processing and color identification. We fix the programs and enhance the color recognition ability. When the color recognition algorithm is implemented, the MCR system is able to work well.

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