

# A Dialog Based Speech User Interface of a Makeup Support System for Visually Impaired Persons

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**Abstract.** A dialog based speech user interface was designed and implemented for a cosmetic facial makeup support system for visually impaired persons. The system helps visually impaired women to makeup her lips, eye brows, and eye shadows using lip sticks, eye brow pencils, and eye shadows. It works as an intelligent dressing mirror using image recognition technologies to judge her performances and to advice corrections. To communicate between the system and users, a dialog based speech user interface is used. Although the system is still a prototype, it was confirmed that the system is usable and useful.

**Keywords:** dialog based speech interface, visually impaired persons, makeup support system.

## 1 Introduction

Audible user interfaces such as dialog based speech user interfaces are especially suitable for visually impaired persons because they are hard to use visual user interfaces. Thus, considering systems using audible user interfaces is meaningful to implement reasonable accommodations [1] for visually impaired persons.

We implemented a prototype system of a cosmetic facial makeup support system for visually impaired persons with a dialog based speech user interface.

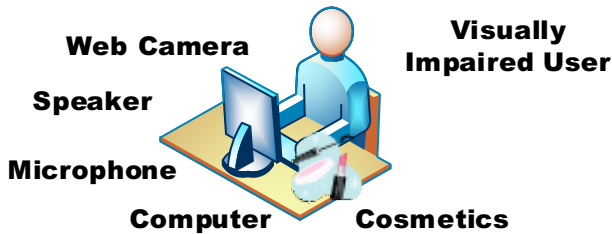
Facial makeup is good not only to go into social activities but also for mental health. Facial makeup lectures are held for visually impaired women. Most of these classes are on the assumption that sighted helpers support the makeup. However, facial makeup is an intimate thing. It is better for a visually impaired woman to do her own facial makeup by herself without anyone's help.

There are some information technology based makeup support systems such as the makeup simulator [2-5] so far for sighted women. But, as far as we know, there are no systems for visually impaired women, although there are prior researches related to facial makeup of visually impaired persons [6]. Therefore, we studied and implemented a prototype system of a cosmetic facial makeup support system for visually impaired women. This paper explains the implemented system and its user interface and discusses usability and technical issues.

## 2 Description of the Facial Makeup Support System

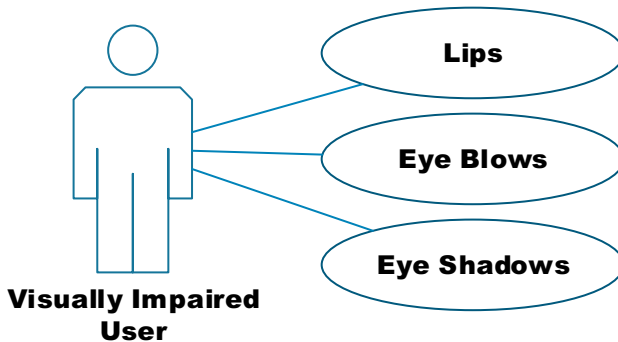
### 2.1 System Overview

The system is for facial makeup with cosmetics of ladies. It helps visually impaired women to makeup lips, eye blows, and eye shadows, using lip sticks, eye blow pencils, and eye shadows. It was implemented on a laptop personal computer with internal web camera, speaker, and microphone. The user prepares her cosmetics and sits down in front of the laptop computer. When the application software is launched, it works as an "intelligent" dressing mirror. The web camera captures her face and a close up face is displayed on the screen. Then, the system guides her makeup with a dialog based speech user interface. Applications with dialog based speech user interfaces can be realized in the current development environment of personal computers or smart phones. Using facial image recognition technologies, feedbacks to her trials are returned by voice. Therefore, visually impaired women can makeup her face by herself without helps from others. Fig. 1 shows the overview of the system.



**Fig. 1.** System Overview. A visually impaired user sits in front of the facial makeup support system consisting of a computer system equipped with speaker, microphone, and web camera. Cosmetics of lip sticks, eye blow pencils and eye shadow are prepared on the desk.

The top level use case diagram of the system in UML is shown in Fig. 2. A user can makeup lips, eye blows, and eye shadows using the system. User can select one of them or do all of them.



**Fig. 2.** Use cases of the system

## 2.2 Dialog Based Speech User Interface

The example dialog is like as shown in Table 1. An example of lip makeup is shown. The original dialogs are in Japanese but they are translated to English in this paper.

At first, the system explains about facial makeup. It includes tutorial introduction of knowledge on the makeup for beginners. Next, it asks user what is the favorite makeup on the day. After the user answered her wish, it instructs how to do the makeup. When she finished her makeup once as instructed, it judges her makeup is well or not. And if needed, it advises suggestion of corrections, until her makeup will be well done.

**Table 1.** Example Dialog (Original is in Japanese. English translation is shown.)

System	User
Let's start lip makeup. Which color do you want to use, today? Red is women like, pink is younger feeling, orange is active, beige is good for general purpose, brown is adult like, rose is sexy. Please choose one from these 6 colors.	Red, please.
Red, isn't it?	Yes.
Next, which type of red do you want to use? Please choose one from strong, normal, and weak.	Normal, please.
Normal, isn't it?	Yes.
Next, which image of shape do you make? Please choose one from sharp, natural, and soft.	Sharp, please.
Natural, isn't it?	No.
Please repeat.	Sharp, please.
Sharp, isn't it?	Yes.
Let's start. Please paint lips, tops and both corners are like acute-angled triangles. When you finish the paint, please say "Finished".	Finished.
There are 2 wrong parts. At first, the color is sticking out at the upper right center position. Please thin it. When you finish, please say "Finished".	Finished.
Well done. Next, the top center is thin. Please make it bold. When you finish, please say "Finished".	Finished.
All done. There is no parts to be modified. Good job.	Thank you.

## 2.3 Graphical User Interface

Even if the system is for visually impaired persons, a simple graphical user interface is supplied, although the main user interface is the dialog based speech. A simple graphical user interface which have large texts on large buttons can be used by low vision users. Also, screen readers usually used by blind persons work on textual labels of the graphical user interface.

The interface works as a magnifying mirror for the facial makeup. A web camera captured image is displayed on the screen in real time (Fig. 3). In addition, some large

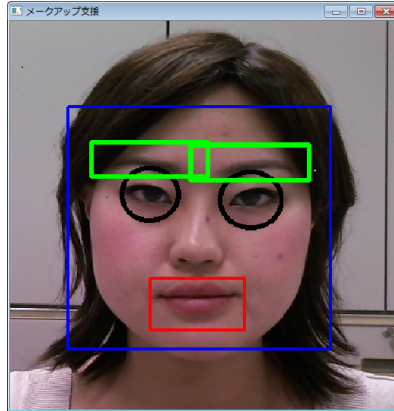


Fig. 3. Facial areas detection from a web camera captured image

text buttons are displayed on a window for simple commands like, start, stop, lips/eye blow/eye shadow selection, volume controls, etc.

## 2.4 Beginner and Advanced Modes

The system supports, so far, beginner and advanced modes. The previous example dialog in Table 1 is in beginner mode. In the advanced mode for daily users, the explanation words are less. In dialog in real situations, already known information is not said. If already know facts or redundant sentences are said, people are depressed and irritated. Or, unknown information is not supplied, it is inattentive and users cannot complete their purpose. Thus, dialog should be designed carefully. In the next stage, we plan to make more varieties and configurations depending on users' characteristics, expertise, and situations.

## 3 Prototype Implementation

### 3.1 Development Environment

The current version of the system has been implemented using Microsoft Visual C++ Express Edition. Programming language used is Visual C++. For camera image input and image processing algorithms, OpenCV [7] (currently, version 2.4.2) is used. For speech user interface, Media class and SAPI (Speech Application Programming Interface) in .NET Framework are used. Running environment is Microsoft Windows 7. A laptop computer with internal speaker and built-in microphone and web camera is used for the system.

### 3.2 Facial Image Recognition Program

An important function of the system is facial image recognition to judge user's performances.

For capturing images from a web camera, OpenCV library [7] is used. For the region extraction of the facial parts, Haar-like characteristics [8] is used. Using a sample program and algorithms proposed by prior researches [9] [10], a program for the extraction of facial, eye blow, and eye areas as shown in Fig. 4 was implemented.

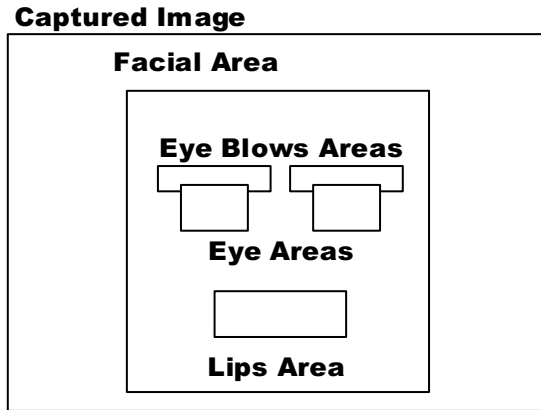
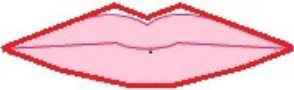
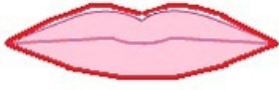



Fig. 4. Facial area detecting by image recognition algorithms

### 3.3 Lips Makeup System

Types of lip shapes by impressions supported in this system is shown in Table 2. Sharp, natural, and soft are used depending on impressions of shapes. When a user say “Finished,” the system judge the shape according the criteria of Table 2. If the system finds sticking out, unpainted, or wrong shapes parts, it advices for the user where and how to correct her drawing. For expressing a specific point on lips, 16 positions shown in Fig. 5 are named such as upper center, upper-right-1, upper-right-2, and so on.

Table 2. Impression by types of lip shape drawings

Impression	Lips shape	Drawing instruction
Sharp		Color in straight lines with acute angles at the end and tops.
Natural		Color along with lip shapes.
Soft		Color with rounded shapes.

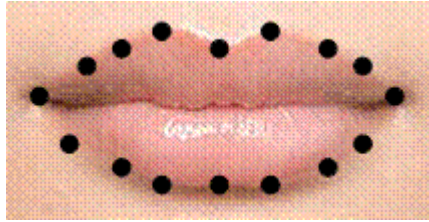




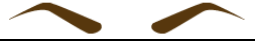
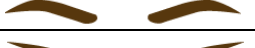
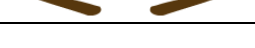
Fig. 5. Lip points for advising corrections

### 3.4 Eye Blow Makeup System

Table 3 shows the supported shapes of eye blows. Well matched eye blow color is closely related to hair color, the system recommends an eye blow color well matched to the user’s hair color, although the user’s own choice can be done.

Since eye blow makeup is difficult for beginners even by sighted women, eye blow templates are used to draw eye blows with an eye blow pencil. Suggested template is recommended by the system after asking the user for her favorite impression of the day.

Table 3. Impressions and shapes of eye blows

Impression	Eye blow shape
Natural	
Soft	
Gallant	
Fresh	
Sharp	

### 3.5 Eye Shadow Makeup System

Eye shadow is painted with gradually changing color in depth. Eye blow ends vertically and corners of eyes horizontally directions should be in deeper color. By detecting color and brightness of the eye shadow area, the system suggests corrections (Fig. 6).

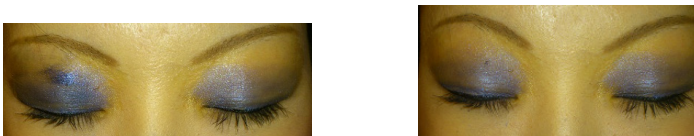


Fig. 6. Correction instructed by the eye shadow makeup system (Before and After)

### 3.6 Speech User Interface

The speech user interface was implemented. The currently supported language is Japanese only. .NET Framework supports speech synthesis and recognition application programming interfaces (API) as standard functions, although a synthesis engine must be installed. The speech recognition used here is for limited words not for dictation of any of natural sentences. This limited word type recognition is usually used for voice commands. Dictation of sentences are not always succeeded to be recognized but limited words recognition is easier and feasible. For example, at the selection of color, only supported color names can be recognized.

The synthesis engine used in the current system is Document Talker [11] popularly used in Japan for Japanese speech synthesizer. The speech synthesis is less fluently than human but it has enough readability.

## 4 Evaluation and Discussion

Although the parts of the image recognition and the judgment to the makeup have not reached to the reasonable quality yet, with the current system, it was tested whether makeup can be done or not, mainly focusing to the evaluation of the dialog parts. Subjects are women with sight and they close their eyes during the experiment. As a result, subjects can do makeup by the dialog system. After the experiment, hearing was done from the subjects. The advanced mode was felt better for repeated use of the system. After routines of testing and improvements, interviews were done from professional members of the staff at a public information and culture center for visually impaired persons. They checked the system and stated their thought and suggestions. As a result, it can be said that the system is useful and good for visually impaired women.

## 5 Summary

In summary, dialog based speech user interface is promising to visually impaired persons support systems. However, the practical know-how to implementations for visually impaired persons has not been accumulated enough, yet. Our work is still undergoing but presenting the details of our prototype system of a makeup support system for visually impaired persons is helpful to researchers and developers of human computer interaction.

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