

# Support system of active learning for hearing impaired student by using head mounted display

**Shuichi Seto**<sup>†</sup>

Department of Business Administration  
Kinjo College, Hakusan, Japan  
Tel: (+81)76-276-4411, Email: [seto@kinjo.ac.jp](mailto:seto@kinjo.ac.jp)

**Hiroyuki Kawabe**<sup>1</sup> and **Yuko Shimomura**<sup>2</sup>

Department of Social Work, Faculty of Social Work  
Kinjo University, Hakusan, Japan  
Tel: (+81) 76-276-4400, Email:  [{<sup>1</sup>kawabe, <sup>2</sup>shimo}@kinjo.ac.jp](mailto:{<sup>1</sup>kawabe, <sup>2</sup>shimo}@kinjo.ac.jp)

**Hidetaka Nambo**

Faculty of Electrical and Computer Engineering, Institute of Science and Engineering  
Kanazawa University, Kanazawa, Japan  
Tel: (+81) 54-279-2371, Email: [nambo@blitz.ec.t.kanazawa-u.ac.jp](mailto:nambo@blitz.ec.t.kanazawa-u.ac.jp)

**Abstract.** Usually Congenital hearing impaired students can understand contents of a story told by a speaker by looking at his mouth. Since, hearing impaired students cannot see the mouths of students who are speaking, because in active learning styles, discussions are carried out with students sitting in a circle. Therefore, hearing impaired students do not know who is speaking. Then, we identify the speaker by processing face images of students sitting in a circle, in which we use the panoramic camera of 360 degrees. The specific method is to detect a speaker by movements' judgment of the lip area. Usually, hearing impaired students wear the transmission type HMD. We have built a system that displays the speaker and his mouth in the transmission type HMD. Hearing impaired students will be able to participate on a class of active learning with the transmission type HMD. This study proposes a system for detecting the speaker in a number of students for hearing impaired students.

**Keywords:** Hearing impaired students, Support system, Active learning, Head mounted display

## 1. INTRODUCTION

There are many hearing impaired students enrolled in higher education institutions in Japan (JASSO, 2015). They are getting studying support from volunteer groups or supporting organizations. In recent years, while a student has a question-and-answer session rather than a teacher speaks about it by one person, advancing a lesson is for a learning effect to increase. Talks are performed into the student group not only a lecture but also the seminar. Such lesson organization is very inconvenient to a hearing impaired student. It is because a hearing impaired person does not understand that a normal student is talking when and where. However we've just started learning support to hearing impaired students in active learning.

We are offering support which can perform lesson participation without a supporter in a hearing impaired student in such a new student participation type lesson (active learning)

(S.Seto, 2013-2015). Here, the support system of the hearing impaired student by using a head mounted display in discussion of a student group is described.

## 2. WHAT IS ACTIVE LEARNING?

The active learning is a one of new learning styles or new teaching methods where students participate actively class. For example, students solve problems, answer questions, formulate questions of their own, discuss, explain, debate, and so on.

In our research, we focus on a group discussion of the active learning, the hearing impaired student is assumed to be one person in the group. Figure 1 expresses such a situation that the hearing impaired student can find the speaker in the group discussion with the support system by using a head mounted display.



Fig.1 Group discussion

### 3. RESEARCH PROJECT

We use a camera which can capture a 360 degree panoramic video. It has a super-wide-angle lens. In the captured movie by the camera, shapes of objects which are located at the periphery of the image are distorted. Therefore, at first, we correct the distortion of the shape. We start from the correction for a still image, then, we correct a movie. After that, we try to distinguish a speaker from the group.

A specification of the 360 degree camera made by OKUDA Surveillance camera inc (see Fig.2) is as follows.

- 1) Built-in color CMOS sensor of three million pixels.
- 2) USB digital output and NTSC analog output.
- 3) Max 15fps.
- 4) Digital automatic monitoring function.
- 5) 360 degree panoramic video.

A specification of the HMD made by Seiko Epson Corp. (see Fig.3) is as follows.

- 1) 960x540 QHD/60Hz dual display.
- 2) 24bit full color (16770k color).
- 3) VGA camera
- 4) Platform: Android [4.0.4]



Fig.2 Panoramic camera



Fig.3 Head mounted display

### 3.1 Connection of camera and correction of distortion in a still image

We connect the computer with the 360 degree camera. Then, we place the camera in the center of the circle. We take pictures of students during group discussion with the panoramic camera. In captured images, the periphery area of the image is distorted. It needs to correct the distorted area by image processing (see Figs.4 and 5). Then, correction of the distortion in movie is gotten by successive corrections of the still images.

### 3.2 Face Recognition

We use a library of OpenCV2.0 for the face recognition (N.Nakagawa, 2012)(H.Kitayama, 2016). OpenCV is developed as a library for the computer vision programming and is developed by Intel corp. OpenCV is a library for C/C++, Java, and Python. Mac OS X, UNIX, Linux, Windows, Android, and iOS, etc. are supported as a platform of OpenCV, and it includes more than 2500 algorithms for computer vision programming.

We develop our system on the Microsoft Windows with the following environments.

- 1) Specification of a notebook PC
  - [1] CPU: intel Core i7, 2.3GHz
  - [2] Memory: 8GB
- 2) Programming environment
  - Microsoft Windows 10 pro, 64bit
  - Visual Studio Express 2013, C# / C++
  - OpenCV- 2.4.10

### 3.3 Speaker recognition for hearing impaired persons

As for a lot of hearing impaired persons, they know a lip reading method. And, they can understand what companions are speaking by the lip reading method. However, to use the method, the companion has to be in front of the hearing impaired person. In other words, if the location of the speaker is not in front of the hearing impaired person, the hearing impaired person can't find the speaker. Our system supports such a situation by zooming up each person's mouth (See Fig.6).



Fig.4 Picture captured by panoramic camera



Fig.5 Distortion corrected image

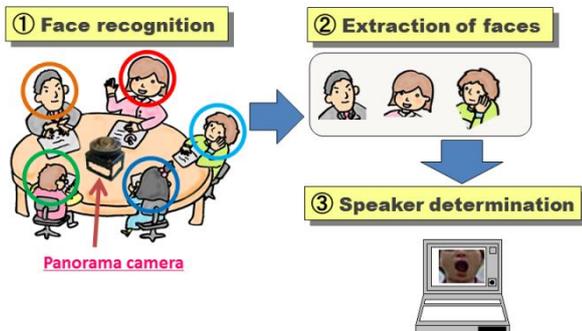


Fig.6 System diagram

#### 4. EXAMINATION OF TECHNIQUE

In this study, we compared by three kinds of image processing. The face was made to recognize by OpenCV and extracted the part of the mouth. By change of the color of the area of a mouth, we have recognized movement of a mouth.

This data is news video. A speaker is a newscaster who appears in news video. We compare a newscaster's video and still picture. By two kinds of image processing, it was judged whether the mouth would move, respectively.

#### 4.1 Image recognition by average color

We used average color as the technique of recognizing movement of a mouth. Average color was calculated in order to detect the surrounding brightness of a mouth. The result is shown in Fig. 7. The horizontal axis of a figure is measurement time and a vertical axis is average color of the mouth area.

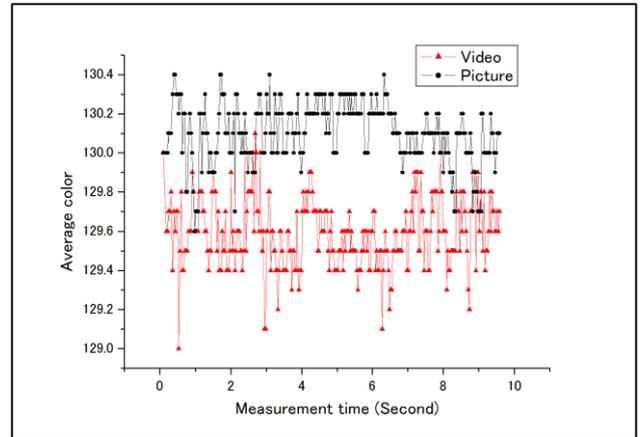


Fig.7 A comparison of video image and picture by average color

#### 4.2 Image recognition by a moment of inertia

We used the moment of inertia as the technique of recognizing movement of a mouth. We introduce a moment of inertia that an origin is the center of the area of the image and a mass is the value of each pixel. The result is shown in Fig. 8.

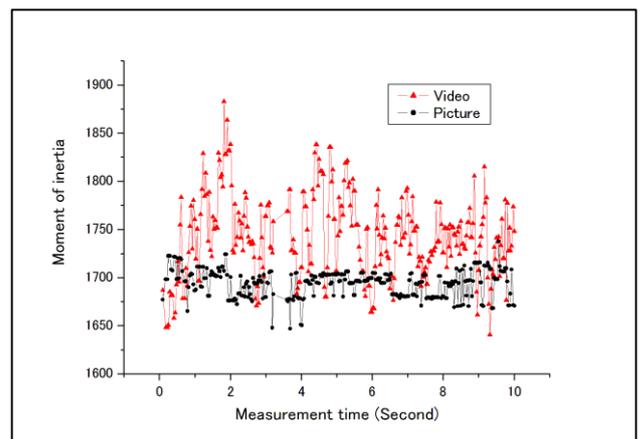


Fig.8 A comparison of video image and picture by moment of inertia

### 4.3 Consideration

We compared by two kinds of image processing by this research. The two kinds are average color and a moment of inertia. Average color did not have good recognition.

We have checked movement of a mouth by the method which used the moment of inertia. The recognition result of the moment of inertia considered calculation of the position of a pixel. Therefore, movement of a mouth was able to be found(See Fig.9)..



Fig.9 Detection of speaker

## 5. SUMMARY AND FUTURE

The purpose of the study is developing the support system of group study for the hearing impaired students. In the system, we extract the facial image of a student sitting in a circle, and present it to the hearing impaired student. Our system outputs an image of student's mouth for the hearing impaired student who can read the lip and specifies a speaker by the image processing.

In this study, we try to specify the speaker from the video with a low cost and a facile device. Moreover, our system can be set up quickly at any classroom. We are aiming at the following two subjects. One is to develop a support system who is a speaker in active learning for the hearing impaired student. And the other is to make the hearing impaired student feel the atmosphere of the class in real-time.

The following are planned as future tasks. First of all, the interface is examined. Next, the system to which the speaker can correspond even by plurals is examined. Moreover, it is necessary to consider the action on the person who cannot do the lip reading.

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