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Handwritten Note-Taking System for the Support of Hard-of-Hearing Students

Takuro HATAKEYAMA ^a Takashi WATANABE ^b
Kiriko TAKAHASHI ^c and Kouki DOI ^d

^a Faculty of Human Sciences, Waseda University, Japan

^B Faculty of Health Science, Nihon Fukushi University, Japan

^c Center on Disability Studies, University of Hawai'i at Manoa, USA

^D National Institute of Special Needs Education, Japan

Good Morning.

I'm glad to have a chance to tell you about some of our recent work on the support of hard-of-hearing students participating in lectures.

In Japanese higher education, there is an increasing awareness of the importance of reasonable accommodation for students with disabilities.

Outline

1. Background
 - Common support method in Japan
 - Issues to be solved
2. Proposed handwritten note-taking system
 - Computerized support system
 - utilizing digital pen
3. Results
 - Trial run of the development system
 - System assessment

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In my talk today, I'll first give a little background on common support method for hard-of-hearing students in Japan and issues to be solved. After that, I'll show you the proposed system utilizing digital pen. Finally, I'll tell you about the result of the trial run of the development system and the system assessment.

1. Background

Means of information assurance for hard-of-hearing students in Japan

- Sign-language interpret
- Hearing aid system using FM wireless communication
- Note-taking

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There are some means of information assurance for hard-of-hearing students in Japan.
First of all, sign-language interpret,
Second, hearing aid system using FM wireless communication,
Finally, Note-taking.

Sign-language interpret

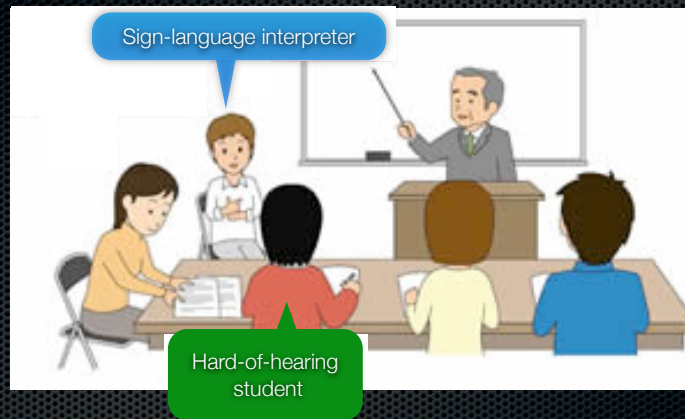


Illustration: http://www.jasso.go.jp/tokubetsu_shien/guide/choukaku_gakushu_jugyo.html

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Sign language interpreting is one important method for providing information to the heard-of-hearing person. But, most hard-of-hearing students entering Japanese universities have not learned sign language, because oral methods of education, particularly training for lip reading and voice production, have become the mainstream in Japan.

Sign language has become increasingly widespread over the past few years, but there are still many schools in which oral methods of communication dominate.

For this reason, information provision through sign language interpreting remains uncommon in Japan.

Hearing aid system using FM wireless communication

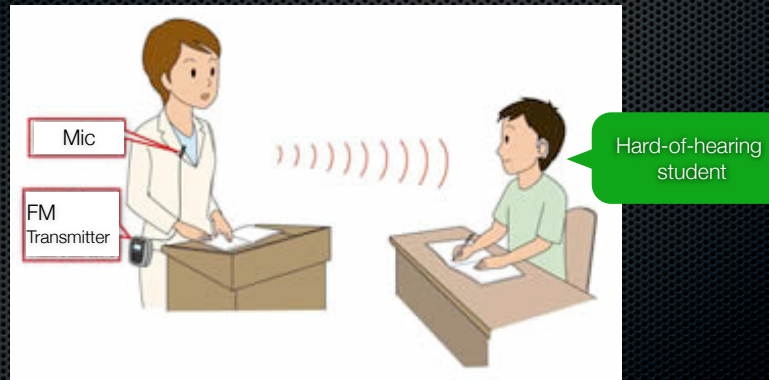


Illustration: http://www.jasso.go.jp/tokubetsu_shien/guide/choukaku_gakushu_jugyo.html

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There are also hearing aid systems for persons who use such devices.

However there are significant differences between individuals in how well hearing aids transmit sound, so many users remain unable to understand lectures.

Also, many people find it tiring to use hearing aids for long periods of time.

Hearing aids alone are therefore often insufficient as an information provision solution.

Note-taking

- Handwritten note-taking
- Computer-based note-taking

There are two types of note-taking: handwritten note-taking and computer-based note-taking.

Handwritten note-taking

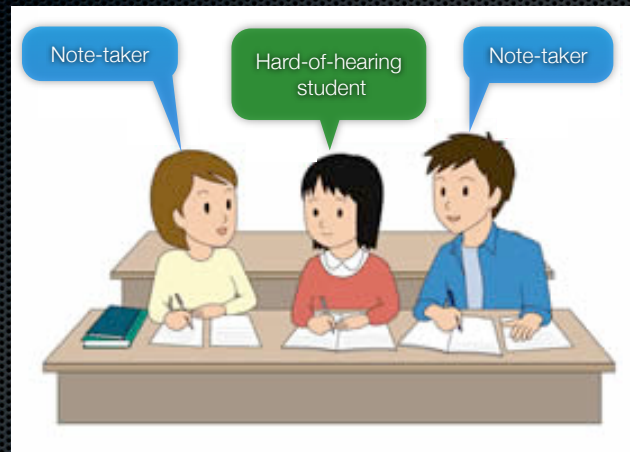


Illustration: http://www.jasso.go.jp/tokubetsu_shien/guide/choukaku_gakushu_jugyo.html

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In case of handwritten note-taking, usually, two note-takers are assigned to sit together with a hard-of-hearing student.

Computer based note-taking

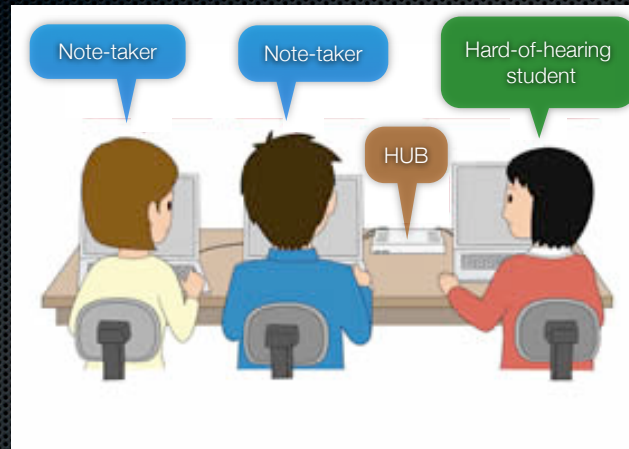


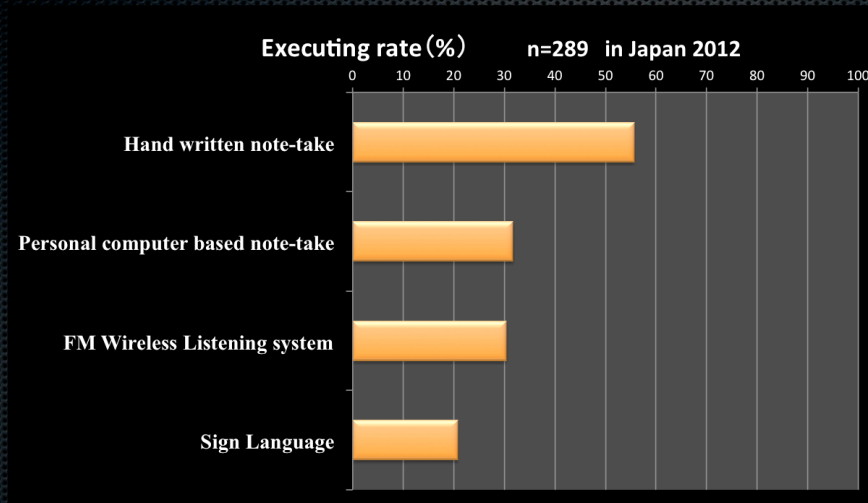
Illustration: http://www.jasso.go.jp/tokubetsu_shien/guide/choukaku_gakushu_jugyo.html

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In case of computer-based note-taking, two note-takers are assigned to sit together with a hard-of-hearing student as well as handwritten note-taking are.

Three PC are connected by HUB. The each phrase which is entered by note-taker send to the PC screen of heard-of-hearing student. Generally, computer-based note-taking can be provided more information per unit time than handwritten note-taking.

Information assurance for heard-of-hearing students

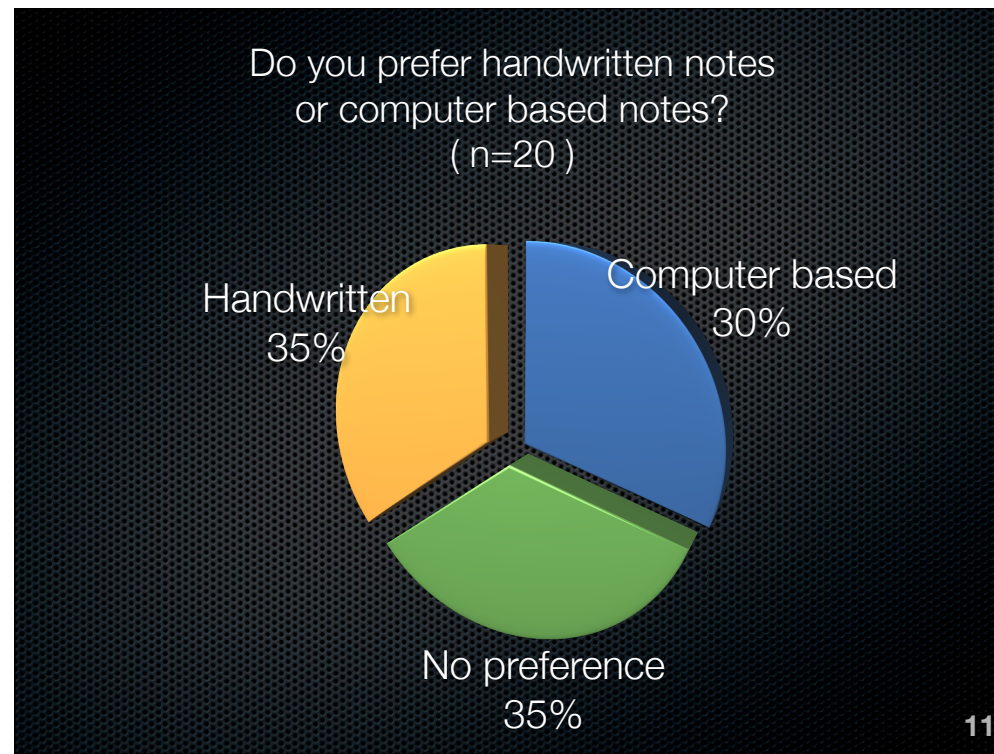


http://www.jasso.go.jp/tokubetsu_shien/documents/report_2012.pdf (P36 Fig.10)

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As you can see from this graph, hand written note-take indicate most high executing rate. On the other hand, the value of sign language is low. As I mentioned before, the reason why the value of sign language is because almost of new enrolled hard-of-hearing students couldn't understand sign language.

Consequently, note-taking support is a common method for information provision at university of Japan.

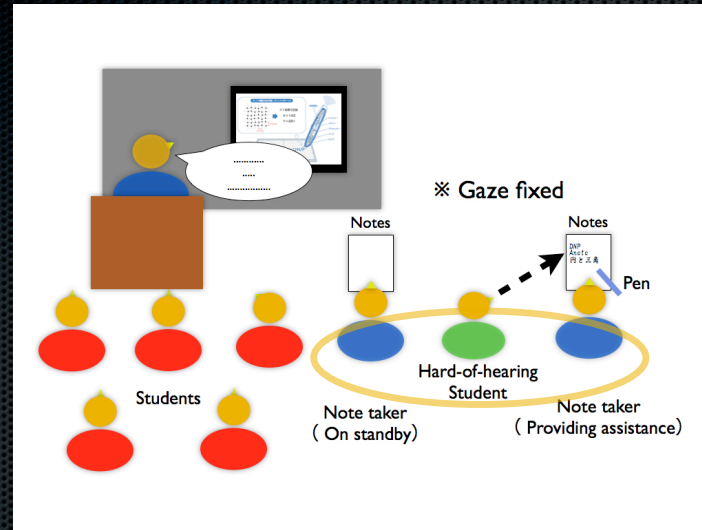


From here, I assign a focus to note-taking.

When 20 hard-of-hearing students were asked whether they preferred handwritten or computer-based note-taking, 7 replied “handwritten,” 6 replied “computer-based,” and 7 indicated no preference.

From this result, we can see that there is persistent demand among students for reasonable accommodation based on handwriting.

General handwritten note-taking



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This three-person group typically sits in the first row of the classroom, away from the rest of the class.

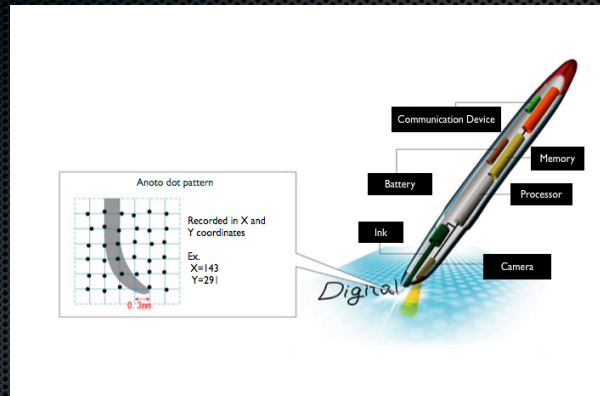
The eyes of the hard-of-hearing student are often focused on their notes and tend to miss the subtle facial expressions of the teacher as well as any visual aids that may be projected on the classroom screen.

These classroom conditions may decrease the sense of involvement or participation in the class for hard-of-hearing students.

To address these issues, we developed a handwritten note-taking system.

2. Proposed handwritten note-taking system

Mechanisms of the Anoto Digital Pen

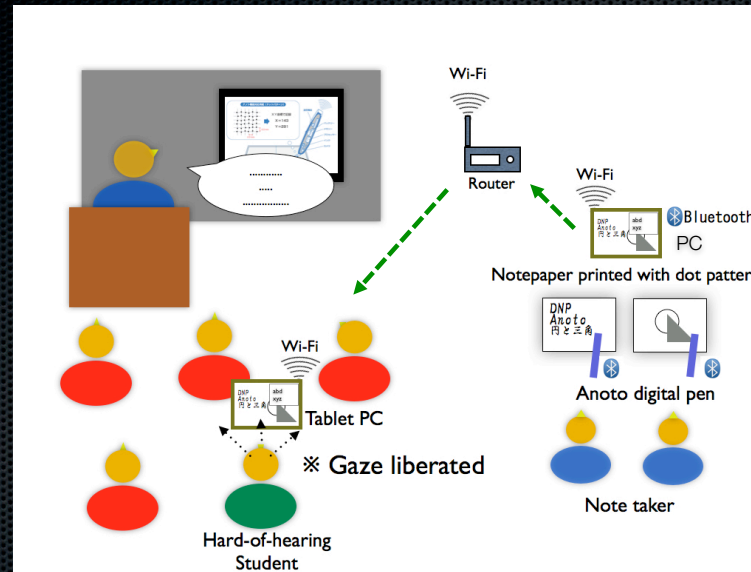


Source: Dai Nippon Printing Co., Ltd. Dai Nippon Printing Co., Ltd.

In order to achieve our goal, we use the Anoto digital pen.

When you draw a picture or a character by a digital pen to special notepaper with a dot pattern, the camera built in pen reads the dot pattern and trajectory data is sent to computer by Bluetooth interface.

Schematic diagram of proposed system



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Figure shows a schematic diagram of the proposed system.

The information created by note-taker is transmitted to a hard-of-hearing student by Wi-Fi.

By utilizing the proposed system, the hard-of-hearing student will be able to be seated in a position like freely with him or her friend and away from note taker.

Demo

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So instead of talking more about this. Let me show it to you.
The system that I will show you is the latest version of the developed system.
But, the previous developed system used a Notebook computer.
Therefore, the previous developed system was heavier and bigger than this latest version.

Example of content displayed on the assisted student's slate device

The image displays four screenshots of handwritten Japanese notes on a tablet device, arranged in a grid. Each screenshot shows a different stage of note-taking or editing:

- Top Left (Note 15):** Handwritten notes in Japanese. The text discusses a person who is a single parent, mentioning 'E-school' and 'Education'.
- Top Right (Memo 15):** Handwritten notes in Japanese, including the phrase 'E-school' and 'Education'.
- Bottom Left (Memo 16):** Handwritten notes in Japanese, including the phrase 'E-school' and 'Education'.
- Bottom Right (Note 16):** Handwritten notes in Japanese, including the phrase 'E-school' and 'Education'.

The screenshots also show the 'Me Sakai's Note Taking Support System' interface, including a 'Hatsuketuki' button and a 'Ver. 0.7b' version number.

This slide show an example of content displayed on the hard-of-hearing student's tablet computer. As you can see, for each page, note-taker's role will change. One note taker will describe the lectures; another one note-taker will make up for what was missing.

3. Results

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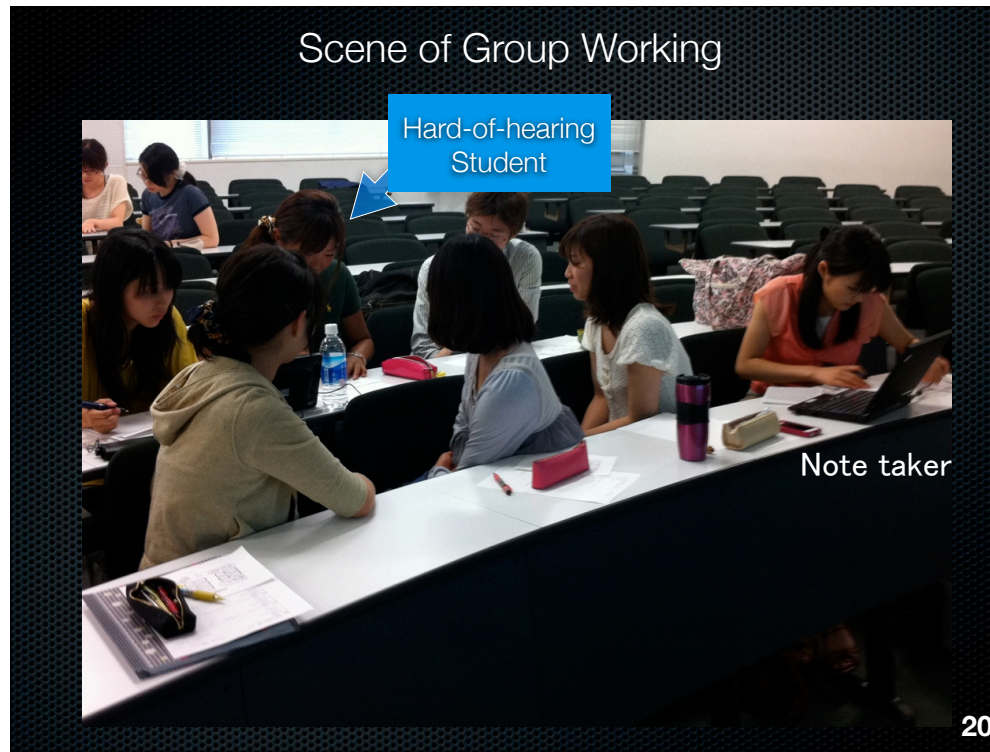
We had tried experiment the developed system in actual class for four months.

Scene from a classroom trial run



The photograph shows a scene from a classroom trial run.
Two people sitting on the left side are note-takers.
A hard-of-hearing student is seated on the right side.
A hard-of-hearing student will be able to see lecturer and screen easily.

Scene of Group Working



This slide shows situations where the system was used in group work.

The hard-of-hearing student has the tablet computer at hand, while the note-takers are located apart from the group. In this way, the hard-of-hearing student can blend in with the other members of the group.

System survey

- Ask the assisted students (n=4)
 - Utility
 - Reliability
 - Expectation

- Ask the assistants (n=3)
 - Operability
 - Reliability
 - Expectation

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We conducted a four-month assessment with the developed system of the former version in an actual classroom environment with the cooperation of 4 hard-of-hearing students.

We also enlisted the cooperation of 3 note-taking assistants, all of who had at least one year of note-taking experience.

We asked the assisted students to assess the system with regard to three aspects:

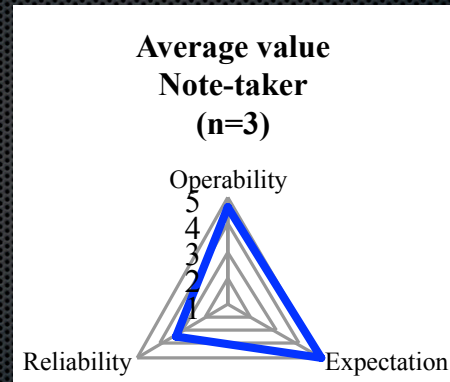
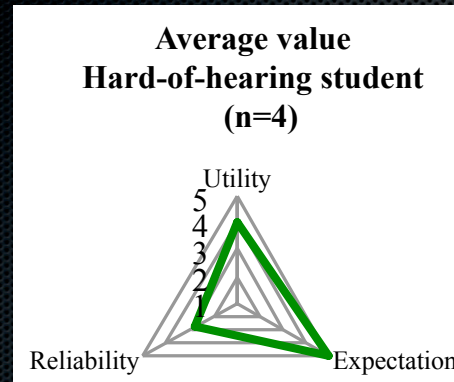
(1) Utility (“Is this system useful?”), (2) Reliability (“Can the system be trusted to work when needed?”), and (3) Expectation (“Are you looking forward to the system being put into common use?”).

We also asked the assistants to assess the system with regard to three aspects:

(1) operability (“Is the system easy to use?”), (2) reliability (“Did the system work when needed?”), and (3) expectation (“Are you looking forward to the system being put into common use?”).

We rated each item on a five-point scale from 1 (lowest) to 5 (highest).

Survey Results



Left side is a data of hard-of-hearing student, and right side is a data of note-taker.

It shows a high value both the utility, the operability, and the expectation in common use. Shortly after the start of the experiment, failure of the system has been frequent.

As a result, reliability in the system is low. However, this problem has been resolved now.

Benefits

a) Assisted students

- Nice to be able to sit with friends.
- Easier to pick up information.
- Makes things much easier to understand.
- Easier on my neck.

b) Assistants

- Can see what the other assistant has written.
- Makes note-taking quite a bit easier.

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Comments from assisted students

It's nice to be able to sit with my friends instead of next to an assistant. It's much easier to pick up information now that the assistant's hand is no longer in the way.

I like the way that the assistant can use various colors to emphasize certain points; it makes things much easier to understand rather than computer based note-taking.

It's easier on my neck, now that I don't have to keep looking back and forth between the notes and the lecturer's screen, or to keep peering down at the notes.

Comments from assistants

I can immediately see what the other assistant has written, so it's much easier to fill in the gaps. Physically speaking, it makes note-taking quite a bit easier, in that we no longer have to contort ourselves into strange postures so that the assisted student can see what we write.

Points for improvement

a) Assisted students

Is it possible to input lecture notes beforehand?

b) Assistants

The digital pen grip is too thick.

The system is too heavy.

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Now, lets look at points for improvement.

First, comments from assisted students

It would be nice if it were possible to input the lecture notes beforehand so that we could see exactly where the lecturer is within his or her presentation at any particular time.

Second, comments from assistants

The grip on the digital pen is too thick. It would be nice if it were thinner, so our hands don't get tired after writing for a while.

The system is heavy, at about 3 kg including the carrying case.

On rainy days, it's hard to make it to the classroom with that in one hand and an umbrella in the other.

System Improvement

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We improved the system so far.

Light weighting and Compactification

3Kg → 1Kg
PC (Windows OS) Tablet PC (Android)

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For the purpose of light weighting a system, we stopped the PC use and had the tablet computer use. As a result, we compactified a system and was able to make weight approximately 1kg.

Slimming of Digital Pen



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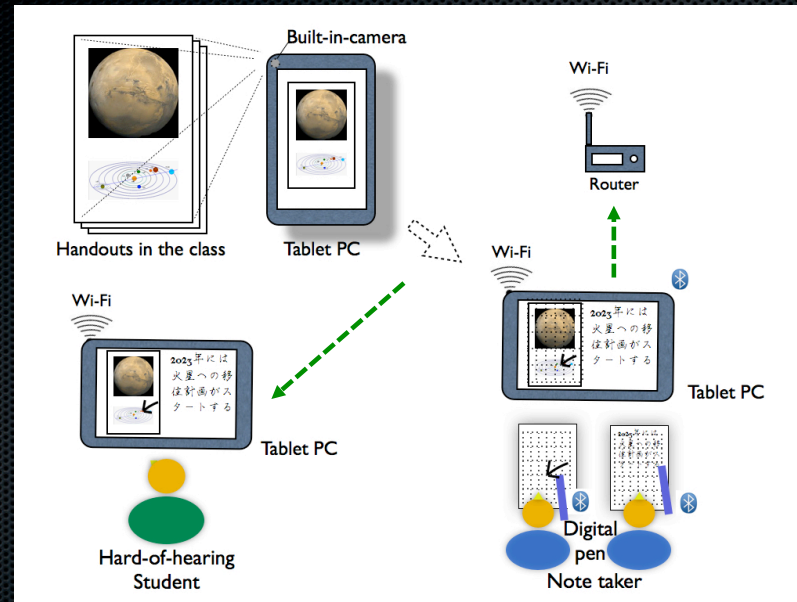
By a technological change, a digital pen slimmed and workload of the note-taking will be decreased.

Capturing the image of distributed document in the classroom

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And, capturing the image of distributed document in the classroom and write in it note.
I show the procedure by the next slide.

Capturing the image of distributed documents



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We therefore developed a method

in which are captured as images classroom handouts and saved on a tablet computer using the tablet's built-in camera, from where the tablet can support taking notes superimposed onto the handout.

In the proposed method, multiple images can be prerecorded and distributed before class on tablets that are handed out to note-takers, who then take notes on dot paper while following positioning elements displayed on the tablet.

Tablets designed to be used by hard-of-hearing student can then display the handwritten notes overlaid onto the recorded graphic images.

Conclusion

1. Made the problems of common support method clear
2. Proposed a handwritten note-taking system
3. Examined the system in an actual classroom
4. Confirmed the effectiveness of the system and made an improvement point clear

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So, let me summarize our study.

We've focused the handwritten note-taking support and made the problems clear.

The problem is decreasing the sense of involvement or participation in the class for hard-of-hearing students.

In order to improve this situation, we proposed a handwritten note-taking system by utilizing a digital pen.

We examined the system in an actual classroom, and confirmed the effectiveness of the system and made an improvement point clear. And we improved the system according to the demand of the user so far in some points.

Acknowledgment

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Finally, we would like to thank these people.

In addition, we received a research grant of these.

We want to commercialize this system in near future.



Thank you very much for your attention.