ShareHandy: Peer Teaching Support System for Online Exercises of IoT Prototyping

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Peer-Teaching

➢ is a learning method that students teach each other.

➤ improves learning effectiveness.

Peer-Teaching Online

➢Online classes have increased due to COVID-19.

- ➢ If all contents are on computer, such as programming, students can share them to teach each other online.
- The issue addressed here is how to peer-teach effectively in classes that handle physical "objects" such as IoT related computer board.
 - Sharing information about "objects" is limited in the following cases:
 - Sharing incorrect electrical circuits and point them out to other students in real-time manner.
 - Sharing the correct circuits between teachers and students or between students.







- An Environment for supporting IoT prototype development exercise held in online.
- By combining the screen and the image of working in a web conference system, teachers can check the status of students.



• Combining the teachers'/students' work and the Node-RED execution in one screen using OBS Studio, which works as a virtual camera in Microsoft Teams

Problem: Difficult to make peer-teaching among students because they could not check each other's work.

[1] Online Training Environment for IoT Prototype Development, S. Kitagami, K. Hasegawa, H. Koizumi, and M. Inoue, Proceedings of the Symposium on Information Education, 2020



- An Environment for students to work in groups on "Rapid Prototyping of Robotics and IoT".
- Wiki makes it easy for students to collect and share information and to work in groups.
- Using Cloud-based systems.

➤mbed and online IDE

≻mbed Wiki

• Problem: Real-time communication in synchronous online classes is difficult.

[2] An Embedded Systems Laboratory to Support Rapid Prototyping of Robotics and the Internet of Things,
James O. Hamblen; Gijsbert M. E. van Bekkum, IEEE TRANSACTIONS ON EDUCATION, VOL. 56, NO. 1, 2013



To promote peer teaching in online exercises,

we provide a support tool for peer-teaching, ShareHandy,

which allows students to **share** the information of their

physical "object" artifacts each other.



Requirements and Usage Scenario of ShareHandy



Requirement	Usage Scenario	Function Name
Setting up rooms for group sharing simultaneously	To allow groups of students to have their own virtual room to discuss some topic.	Room setting
Real-time video streaming of the artifacts among participants	To allow students to get video streaming from many other students videos.	Real-time streaming
Pausing video to deliver a still image	To allow students to explain important steps in detail using paused video images.	pause
Pointing by participants	To allow students to point to a specific position with their individual icon to share the focused point to explain.	pointing
Drawing by participants	To allow students to draw labels and arrows to make annotations.	drawing
Saving captured videos and drawings as still images	To allow students to review the session using images of saved video scenes and drawings.	video capturing





- Developed as a Web Application => Only a browser is required
- WebRTC(Web Real-Time Communication) => Enables to share images & coordinates in real-time
- Implementing Layered Canvas Function

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Layered Canvas Function is a function to keep drawings and images independently and overlay them to display and save as an image.



Display each user's icon in the point where the user is pointing.

Drawing canvas

One canvas per user to support simultaneous drawing.

Circuit image

Place the streamed image of the circuit on the bottom layer.

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- Supporting peer-teaching and collaboration work in real-time.
- Using with web conferencing systems.
- 4 main functions:
- Sharing the circuit at hand by using each participant's smartphone or PC.
- 2. Drawing on video images and captured the images.
- 3. Multiple participants can share their pointers positions on their screens.
- 4. Saving images of captured images.





[CASE]

Some student has a problem on how to build a circuit.

Getting stuck on an exercise assignment.





Using ShareHandy to share the current situation on his circuit with other students. Some skilled students help him find what is wrong with it.

Demonstration video

3 members use ShareHandy and 2 of them share videos of their circuits.

Demonstrate the following function:

- Real-time streaming
- Drawing

- ✓ Pointing
- ✓ Video capturing



Demo Video



To test whether the following 2 hypotheses are true or not.

[Hypothesis 1] ShareHandy can give instructions to correct the problem on the artifact in a short time and accurately.

[Hypothesis 2] ShareHandy can promote peerteaching in online exercises.



 Students used ShareHandy for group work in IoT prototype development exercises.

► Worked with 3 or 4 students per group

➤They used ShareHandy freely during the work.

- After classes and experiment, students answered questionnaire and interview.
- The students were 14 students at Shibaura Institute of Technology and all of them majored computer science and engineering.



Q3. Please answer the following questions in four choices

Q3-1. It was easy to see the other person's hand. Q3-2. Groupmates understood my situation right away. Q3-3. I was able to work efficiently. Q3-4. It was easy to communicate by pointing at the hand. Q3-5. It lowered the barrier for teaching each other. Q3-6. I would use this system again.

Agree

Almost Agree



Q4. Any other comment (Free text)

Analysis of Experimental Results for Hypothesis 1





- All students answered positively to Q3-1 and Q3-2.
- For Q3-3 and Q3-4, 86% of students answered Agree, Almost Agree.

ShareHandy enabled students to give instructions to correct the problem on the artifact in a short time and accurately. [Hypothesis 1]



Q3-5. It lowered the barrier for teaching each other.

- Q3-5. : 100% of Positive Answer
- Q3-6. : **93%** students think **so.**

It is inferred that **ShareHandy promoted peerteaching in online exercises.** [Hypothesis 2]



Interview survey, free text of questionnaire

Positive response

- It was easy to see the circuit at hand of the others, and it helped understand well.
- It was very useful and easy to use.
- > Pointer and writing responses are smooth and never feel slow in communicating.

Negative response

- Sometimes the response and image quality was not good.
- The UI seemed confusing.
- "Full screen" or "pause" can be operated by multiple users at the same time, which may cause unexpected action if there is miscommunication.



• Summary

➢ In this study, we proposed and evaluated the web application "ShareHandy," to apply it to online IoT prototype exercises.

➤ The students could understand the other students' artifacts easily, which made accurate and smooth. This shows ShareHandy has an effect to promote peer-teaching and collaborative work between students.

• Future Issues

➤ To improve the tool and seek more effective application of it.

• Improving its stability and performance.

➤To conduct more experiments to use, considering better evaluation methods and more quantitative data measurement methods.