AirTransNote: Augmented Classrooms with Digital Pen Devices and RFID Tags

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Abstract

AirTransNote augments activities in classrooms by sharing student notes written on regular paper using wireless communications. AirTransNote uses digital pens to free students from the need to use PCs for note taking. To improve the effectiveness of the system, we used a portable remote controller with an RFID tag reader. Teachers can select notes for students by using the controller as "magic wand." The selection interface is intuitive for both teachers and students. Also, the system can save time for setting up devices before lectures. The system promotes an augmented classroom, enabling interactive lectures in regular classrooms using natural styles.

1. Introduction

Wireless networking technology increases the degree of freedom in computer-mediated communications and CSCL even in a classroom. Roschelle and Pea[5] described the potential of wireless Internet learning devices (WILD). Liu et al. citeHIC built a highly interactive learning environment using wireless technology. Also, several systems that support notetaking and sharing activities have been developed. Livenotes[2] is a collaborative note taking system based on tablet PCs. NotePals[1] and SEGODON-PDA [7] use PDAs for recording handwritten notes. Collaborative note taking system[6] and C-Notes[3] are also PDA-based, but they focus on sharing text and have additional features for reducing text inputting, such as using an optical text reader. These approaches are effective for augmenting learning activities in classrooms. However, most of the systems force students to acquire special skills to use the equipment. We believe the effort necessary to use a learning system should be reduced.

We developed a system, AirTransNote [4] that requires a minimal effort to use. AirTransNote was designed to augment the activities in traditional classrooms naturally by allowing student notes to be shared. AirTransNote records notes written on regular paper using a digital pen (ultrasonic wave type; Figure 3 right) and transmits them to a central PC immediately. The notes can be used for not only sharing information but also analyzing activities to give feedback to students. Our "paper-centric" design frees users from having to learn any special operations, allowing students to concentrate on learning activities.

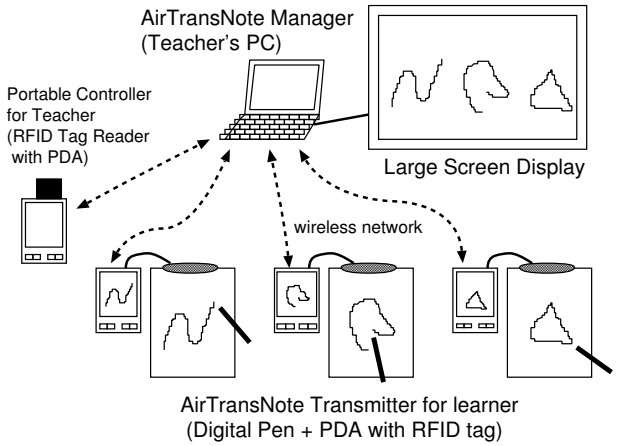

Figure 1. Classroom setting using AirTransNote

However, the former version of AirTransNote required teachers to use a PC during their lectures, which could disrupt normal teaching activities. To solve this problem, we added an RFID technique into the system.

2. AirTransNote with RFID Technique

In a traditional classroom, a teacher often asks questions to check the comprehension of the students. Students reply to the questions, express their own ideas, and copy their

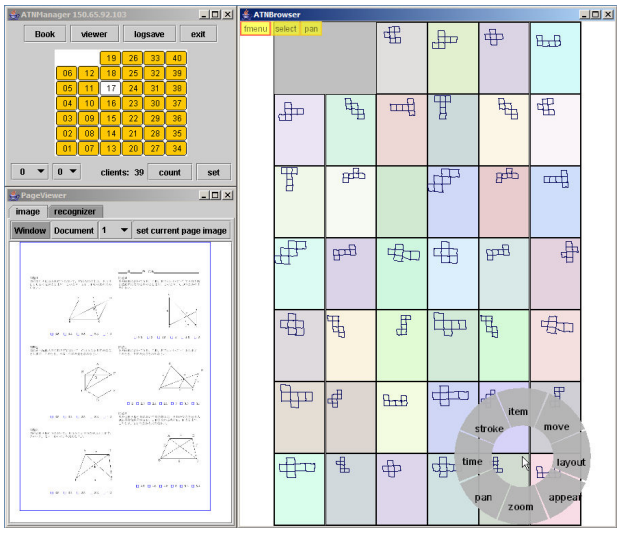

Figure 2. AirTransNote Manager: A note browsing interface for displaying and switching student notes

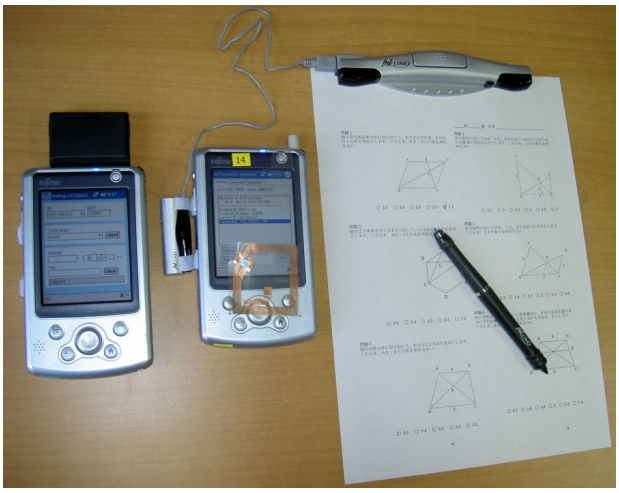

Figure 3. Remote Control with RFID reader (left) and Transmitter PDA (center)

answers onto the blackboard to share with other students. AirTransNote enhances these activities by projecting student notes directly onto a large shared display. A classroom setting is illustrated in Figure 1. AirTransNote Manager allows teachers to browse notes (Figure 2). Initially, the Manager displays thumbnail images of each set of notes as determined by the seating arrangement. When the teacher clicks on a thumbnail or on the seating chart (top-left window of Figure 2), the Manager zooms in to a specific set of notes via a smooth animated effect. The teacher can control the zoom level by rotating the mouse wheel.

In our experiments, some students asked the teacher to "Please close up my answer numbered XX!" for sharing notes. However, we realized the PC-based interface was not enough for teachers, because not all teachers are accustomed to operating PCs. Even though the interface of the Manager is simple, some training is necessary. Also, in our initial design, we predicted that teachers would stay in front of the PC during the class and would check student activities using the Manager. However, teachers preferred to walk around the classroom to instruct students directly. In those situations, teachers are unable to switch projected notes immediately because they would have to walk back to the PC. This disrupted class. Teachers can directly operate student PDAs, but authentication procedures designed to keep students out of mischief make doing so inconvenient. Therefore, we added an RFID reader [1] with a PDA (Figure 3, left) as a remote control for teachers. Also, we put a passive RFID tag sheet on each transmitter (Figure 3, center).

Typically, teachers will walk around the class with the remote control. When teachers want to show a set of notes, they hold the remote over a transmitter. The remote identifies the transmitter and sends a zooming command to the Manager. Finally, the Manager zooms in to the selected set of notes. After that, the teacher often asks the student to explain the idea for other students, and the student tries to express the idea with pointing or drawing on the note. To support the situation, we introduced a tracking function for the Manager. When the student takes notes or draws figures after being selected, the Manager automatically controls the zooming rate and position to show the notes or drawings in detail (Figure 4). Therefore, teachers can easily switch and control the view even if standing right next to the student, and students can immediately explain their ideas or solutions with supplementary notes. The remote selection process is more intuitive than selection using ID numbers and reduces the number of errors. Moreover, the process reduces student anxiety about having their notes projected, since students can see the teacher approach. Thus, the remote control contributes to natural, smooth interaction for note sharing.

In addition, using the RFID technique provides two important benefits to both teachers and students.

a. Reduced effort for setup The remote control and RFID tags reduce the effort necessary for setup. Basically, we eliminated student login procedures from our system because of the simplicity for students. For that reason, teachers had to distribute transmitters to students that matched the transmitter IDs to the student IDs. With the RFID tags,

[1] OMRON V720S-HMF01

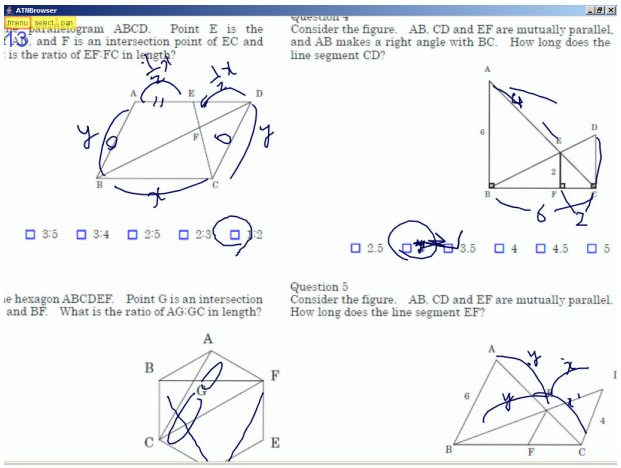

Figure 4. Detailed note view with maximized window size in XGA display mode

teachers can distribute transmitters without worrying about matching the IDs because notes are directly accessible by reading RFIDs. When relating notes to learners or displaying thumbnails in seat order, teachers can use a post-binding method. The post-binding method means to collect the current layout of the transmitters by detecting their RFIDs. If the seating chart of the students is provided, the system can bind the notes to the students, and the arrangement of the thumbnails will be matched. The RFID technique realizes the post-binding method, and it brings flexibility in deployment of student devices.

b. Effective use of shared display The previous version of Manager had a control panel window with seating chart for teachers to select notes. However, this control panel is now obsolete. We can maximize the Manager window and show notes more clearly. Since the resolution of large displays, such as projectors or plasma displays, is not high, the maximized view (Figure 4) is preferable for displaying notes. The control panel with seating chart can be incorporated into the remote controller PDA as a supplementary function.

3. Conclusions

We developed AirTransNote, a system designed for augmenting regular classroom activities naturally. To promote note-sharing activities, we introduced an RFID technique to bring a smart operation in projecting student notes. Also, we described the additional advantages of the RFID technique both during lectures and class preparations. We showed a realistic vision of a future human-centered classroom that is naturally augmented by technology. Though our system is limited to simple note projection, the paper-centric notetaking system with wireless communication easily enhances lectures. We will continue to improve the effectiveness, value, and utility of AirTransNote.

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