Classroom teaching using Tablet PCs

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by

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Abstract

This document describes the proposed implementation of a new classroom teaching system using tablet PCs without using blackboards. The idea is based on the growth of hand-held devices e.g. tablet PCs which can be used to make notes during a class by directly writing on screen with the help of a stylus pen. This system will provide the students with easy access to teaching material with easy to use note-taking capability along with the facility to make use of internet during the class. This project will also make teachers’ task much easier by reducing major fraction of teaching overheads.
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Chapter 1

Introduction

With class sizes continuously increasing, the classical teaching system needs to be made adaptable to the current needs of teachers and students. With students, coming from diverse academic backgrounds, effective communication between teachers and students is becoming very challenging. Teachers can’t always give personal attention to all the students and it becomes really difficult to track the progress of each student. In the classical teaching system that uses blackboards, students often get unengaged with the class and are busy in copying contents from the blackboard most of the time. Also, students coming from different linguistic backgrounds are sometimes hesitant to ask questions in front of the entire class. On the other hand, teachers find it difficult to monitor the activities of all the students in the class. At the time of class quizzes, the overhead in distributing, collecting and correcting the quiz papers of all the students is increasing continuously. This clearly indicates the need of a change in the education system in order to improve the in-class experience of teachers and students.

Technology is constantly improving and has made a great contribution in education by means of e-learning. But it has been used mainly in distant education programs. It’s also possible to introduce this technology in the field of classroom teaching by means of hand-held devices or PDAs. One reason for emphasizing hand-held devices is that laptops are not affordable to everyone. Furthermore, laptops with attractive slide making softwares can be used for teaching using presentations but they can’t provide user friendly note-taking features. Devices, e.g. Tablet PCs with a stylus pen can be extremely beneficial for making on the fly notes [1][2]. With tablet PCs being made available at low prices to educational institutes, the challenges pointed out in the first paragraph can be taken care of to a great extent. Students and teachers can carry their personal tablets in the classes and by setting up wireless networks within and across classrooms, teaching can be made much friendlier to both students and teachers.

This project aims at introducing teaching and learning using tablet PCs in classrooms. It
includes setting up wireless networks as per the requirements of the class, installing client and server programs to facilitate effective communication between teachers and students, and effective control of teachers’ over students. It should be noted that this system just needs initial costs. Once it is set up, it won’t require much expenses.

The rest of the document is structured as follows: the next section describes the work already done in this field along with improvements which need to be done, then the structure and functions of the target system are described.
Chapter 2

Related work

This chapter describes similar work done previously. In [3] and [4], similar experiments of classroom teaching using tablets with stylus pens are presented. Experimental details and students’ feedbacks for the same are also presented. At the end, some key issues which need to be taken care of are pointed out along with possible solutions. Enhancements which should be done, from the students’ point of view, are also presented.

2.1 Constituents of the system

The system, proposed in [3] consists of a tablet PC for each student and teacher, a server machine, a server software, a client software for teachers and a client software for students. The system structure is shown in figure 2.1

Each student and teacher is given a tablet. A Wireless LAN is set up in each classroom. The required number of Access Points is configured. All the Access Points in a classroom are connected to the server via a hub. Similarly, networks of all the classrooms are connected to the server machine.

Server software is installed on the server machine. Teachers upload teaching material on the server and students can download it. The software consists of server software, client software for students and authoring software for teachers. Server software maintains an up-to-date session information of all the clients (teachers and students). It also grants special privileges to teachers. The authoring software for teachers synchronizes with the students. With the help of it, teachers present themselves at the server and upload and distribute teaching material to the students.
2.2 Functions

Initially, a user has to login to the server. At the time of logging in, the client will be presented to login as a student or as a teacher. After choosing the type of user, the user has to enter his/her user id and password which would have been created earlier. After logging-in, the user chooses the classroom and enter a passkey for that classroom if the classroom has been made passkey-protected by the teacher.

After successfully entering the classroom, the user will see an interface which will provide the user with common paint functions, e.g. line size selection dialogue, color chooser, text input, free style pen, eraser etc. On this interface, the user can see the teaching material and make on-the-fly notes on it with the help of stylus pen.

2.2.1 Functions for students

A student, after logging in, will have to select the course along with applicable passkey to enter the classroom. After entering the classroom, a student can download the already uploaded teaching material from the server. In [4], two modes of operation have been proposed for such a system.
• **Free mode**: In the free mode, the students can watch the screen of the teacher, but can’t write on it. The teacher can always see the students’ screen and give hints or comments on their work.

• **Collaboration mode**: In the collaboration mode, the students can watch the screens of the teacher and the nominated student can also write something or solve some problem on the teacher’s screen which can be projected live on the big screen from the teacher’s computer.

A student can ask a question anytime to the teacher by writing on his/her screen, the teacher gets a notification on his/her screen and answers the question. Also, the student screen will have a search option so that a student can search any word on internet.

### 2.2.2 Functions for teachers

A teacher, after logging in initially with his/her user id and password, creates a passkey for a lecture. This passkey is one time, and will be valid for that lecture only. A teacher can anytime create a new course on the server. When teacher does that, a folder for that course gets created on the server. The teacher uploads study material in this folder so that students can download it from here. The main functions of a teacher are as follows:

- A teacher can see the thumbnail view of all the teaching material for a particular day. Out of it, the teacher can select any teaching material and upload it on the server.

- The teacher can see the thumbnail view of the screens of all the students. He/she can track the activities of any student at any time without roaming in the classroom. He can also write comments on any student’s screen using his stylus pen.

- The teacher can ask a question or give a problem to any student at any time. If the answer or solution is correct, he/she can project it on a big screen using a projector that is connected to his/her system. In [5], a tiled display system has been proposed to optimize teaching with presentations using projector.

- The teacher can upload a quiz at the beginning of a lecture. The students can download it and submit the solutions at the end. The teacher can download the solutions of all the students and correct them. The teacher can also run a script to correct the quizzes if it’s a programming quiz.

- The teacher can choose between free mode and collaboration mode. In the collaboration mode, he/she can allow any student to write on his/her screen.
2.3 Implementation and evaluation

Implementation of such a system is presented in [4]. They implemented it for a class of 40 students. Each student was given a tablet PC with Windows XP tablet addition, Intel Centrino processor(1GHz) and 12-inch XGA display. The server was set up on a machine having Intel Pentium 4 processor (3GHz) with Windows Server Operating System. The tablets were connected to the server via 802.11a/b wireless LAN. 3 Access Points were set up for 41 tablets. These APs were connected to the server via a 100BASE-TX hub.

A pilot study was conducted to evaluate the performance of this system. After conducting 6 classes a questionnaire was prepared and student feedback on a rating of 5 was taken based on that. The result of this questionnaire is shown in table 2.1.

<table>
<thead>
<tr>
<th>Question</th>
<th>Mean score</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Better than keyboards?</td>
<td>2.9</td>
<td>0.97</td>
</tr>
<tr>
<td>Better than using notebooks?</td>
<td>3.1</td>
<td>0.91</td>
</tr>
<tr>
<td>Concentration on class?</td>
<td>3.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Concentration on writing?</td>
<td>3.3</td>
<td>0.93</td>
</tr>
<tr>
<td>Easy to immediately correct my mistake?</td>
<td>3.5</td>
<td>1.0</td>
</tr>
<tr>
<td>Becoming more efficient?</td>
<td>3.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Easy to use?</td>
<td>4.5</td>
<td>0.83</td>
</tr>
<tr>
<td>Improvement of the system response?</td>
<td>3.5</td>
<td>1.1</td>
</tr>
<tr>
<td>Improvement of the operability of the system?</td>
<td>2.8</td>
<td>1.2</td>
</tr>
<tr>
<td>Would you like to use?</td>
<td>3.2</td>
<td>1.1</td>
</tr>
</tbody>
</table>

Table 2.1: Result of the questionnaire

A similar system is described in [3], which was implemented as a web based application using HTML5, JavaScript and PHP. The authors used a tool named xampp which includes Apache server, MySQL, PHP, HTML5 Perl etc. to develop web applications. After conducting a pilot study, 4 questions were asked to the students and 4 questions were asked to the teachers in order to evaluate the student and teacher satisfaction.

Students:

Q.1: Was is easy to operate the screen?
Q.2: Was it easy to write on the screen?
Q.3: Was it easy to draw figures (sketches) on the screen?
Q.4: Was it easier to learn as compared to learning using a blackboard?

Teachers:

Q.5: Was it easy for you to operate the screen?
Q.6: Was it easier to track each student’s progress?
Q.7: Did you find this system more useful for effective teaching?

The teachers were asked to rate the system on the basis of the above questions. The summary of the feedback got from the teachers and students is shown in figure 2.2. In this evaluation, students were also asked to give suggestions on the enhancements that can be made into this system. Many students told that they would like to have a group discussion feature in this system. Also, some of the students felt that the response time of the system was too long. Overall, more than 90% of the students and teachers were satisfied with the way the system performed.

Figure 2.2: Feedback: Image source: [3]

2.4 Issues and solutions

In [6], a few issues that can arise in this kind of teaching system are pointed out. Solutions for the same are also proposed.
2.4.1 Issues

- **Flexible internet access**: The choice of providing internet accessibility to students differs from teacher to teacher. One teacher may want to keep internet access available entirely for all the students, another teacher may want to restrict the internet access to only a few sites, while another teacher may not want to allow any internet access to the students for the duration of a class. It’s a challenge to make the internet accessibility flexible and based on teachers’ choice.

- **The next room problem**: The access points set up in one classroom don’t just cover that classroom, they may cover some area outside the classroom. Some students can make use of this fact by staying outside and pretending to be inside the classroom. In such a case, managing class attendance can get very cumbersome for teachers.

- **Undesirable ad-hoc networks**: Students inside a classroom can form illegal ad-hoc networks between each other or even with someone outside the classroom. This sort of situation is completely unacceptable, especially in quizzing scenarios, when students can form such ad-hoc networks to cheat.

2.4.2 Solutions

Solutions to the above-mentioned problems are also proposed in [6]. For making internet access flexible based on teachers’ choice, some kind of firewall or proxy server can be set up on the server. When the teacher logs in at the beginning of the class, this proxy server would ask teacher of what type of internet access he/she wants to provide.

For the next room problem and undesirable ad-hoc networks, a Fireclass server is proposed. It will be installed on the server machine. It’s a property of wireless networks that a device can be connected to a network in either infrastructure mode or ad-hoc mode but not in both. By-default all the students in a class are connected to the network in infrastructure mode. If a student wants to form an ad-hoc network he/she will have to first disconnect from the existing network. Since the server maintains the session information for each student, whenever someone disconnects, it can quickly notify that to the teacher and the teacher can then take the suitable action.

In the solution described above, the next room problem can be avoided. Teacher, at the beginning generates a pass-key for that lecture. He/she can announce this pass-key manually so that everyone present in the classroom can use this pass-key to register himself/herself present.
in that class. Without entering the pass-key, neither the attendance of a student is registered, nor can he/she access any study material, which is provided in that class.

### 2.4.3 Other challenges:

Apart from the above mentioned issues, there are a few generic challenges, that can arise in the implementation of such a system. While working on small hand-held devices, the device power and processing speed is always an issue. Some of the students have also pointed out the need of improving the processing speed of the devices used. Also, such a system demands a steady TCP-IP network maintained for the duration of a lecture. During the initial use of hand-held devices, typing or writing on small screen can be slightly unfriendly to students.

### 2.5 Other aids in teaching system

In [7], a teaching system using conceptual maps is proposed. The authors have named it TAGGE (Teacher Assistant Guideline Generation Engine). It’s a system proposed to help teachers. This approach is based on modeling the teaching or knowledge concepts as per the requirements of a teacher for a specific course. TAGGE is tool in which the teaching requirements are fed and it outputs the teaching guidelines based on the requirements and instructional and technological domains.

In [8], a synchronous distributed learning environment is proposed. The system is similar to the one described in the previous sections, but it facilitates classroom learning and distance learning together.
Chapter 3

Problem definition and solutions strategy

3.1 Goal

Given one Aakash-2 tablet for each student and one tablet PC with a larger screen for each teacher, the goal is to implement and test an effective classroom teaching solution which overcomes all the challenges faced in classical teaching system.

3.2 Solution strategy

One Aakash-2 tablet will be given to each student. These tablets can also be given to the teachers but seeing the way it would be used by the teacher, it’s better to have a tablet with a larger screen (12-inch) for each teacher. First, a network needs to be set up for all the classrooms. Since the class sizes and growing, the solution needs to be implemented for classes having a capacity of at-least 100 students.

3.2.1 System structure

The structure of the system will be similar to the one described in section 2.1. Considering that one access points can handle 30 wireless clients [9], at least 5 APs are needed to support a class of 100 students. For classes of less capacity, e.g. 40, 3 access points would suffice. All these access points would be connected to the server via a switch. A DHCP server would be set up in order to assign private IP address to the clients in each classroom. There will be one server for the entire campus and connections from different classrooms would be connected to this server via another switch. A proxy server would also be set up on this server which would be used to
change the internet accessibility in each classroom as per the choice of the respective teacher. The server program will be run on this machine.

3.2.2 Functions

The system will have all the basic functions described in section 2.1. It will provide the client with a paint-like interface in which all the basic tools, e.g. drawing, erasing, entering text, changing line width and type, choosing color etc. It will provide specific features to students and teachers. A client will initially login to the server. The login page is shown in figure 3.1

![Login page for clients](image)

**Figure 3.1: Login page for clients**

**Functions for teachers**

After logging in, a teacher will see a page where he/she will be able to enter a course with a passkey for that lecture. A teacher may or may not assign a passkey for a lecture. After entering the course, he/she will see an option to upload the teaching material. The page would be as shown in figure 3.2. The uploaded teaching material will be saved in a folder named with the course name, on the server. This folder may or may not be password protected depending upon the teachers choice at the time of creating the course. A student can download the teaching material from that folder.
After uploading course material initially, the teacher will see a page with multiple tabs having different options. Some of the options are described below.

- **Default**: This will be the default tab selected. In this tab, the teacher will see different options for drawing or typing something. The topic will be taught in this tab. The page will look as shown in figure 3.3.

- **Thumbnails**: In this tab, the teacher will be able to see the thumbnail view of the screens.
of all the students. The teacher can also go to the screen of any student and put comments on it. The thumbnail view is shown in figure 3.4.

![Thumbnail view](image)

Figure 3.4: Thumbnail tab shown to the teacher

- **Switch mode:** This tab provides a teacher with the option of switching between free mode to collaboration mode and vice-versa. These modes are same as the ones described in section 2.2

Apart from the above, the teacher is also provided with the options for uploading more teaching material, giving a quiz to the class, asking a question to any student or the entire class or starting a group discussion. Whenever a teacher asks a question, gives a quiz or starts a group discussion, concerned student/s will get a notification. When the teacher asks a question and if someone is able to solve it correctly, the teacher may also display the solution on the big screen using a projector connected to his computer.

### Functions for students

Initially, a student will also be presented a login page as shown in figure 3.1. The default mode of operation of the system will be free mode. After logging in, a student will see a page with two tabs which are described below.
• Default: This is the default working tab for a student. In this tab, the students will be able to see the topic being taught in class at any point of time. The students can also make notes in the material using various note-making functions. After making notes, a student can also save the material and later transfer it into a USB flash drive. A search option will also be provided to the students to search any technical keyword on web. The default tab for a student will look as shown in figure 3.5.

![Default tab shown to the student](image)

Figure 3.5: Default tab shown to the student

• Ask a question: A student will be provided with the option of asking a question anytime. When a student asks a question, the teacher will get a notification. After that, the teacher may answer it or put it as a group discussion topic.

When a teacher switches to the collaboration mode and gives write access to any student, the student will be able to write on the teachers screen, which can then be shown on the screens of all the students and even on the big screen.
3.2.3 Providing flexible internet access to students

In order to provide flexible internet access to students, a proxy server will be configured on the server machine as shown in section 2.4. While logging in at the beginning of a lecture, the teacher will specify his/her choice in terms of the internet access that would be provided to the students during that lecture, i.e he/she will specify the names of sites that should be allowed to access or sites that should be blocked. Based on the choice entered by the teacher, the server program will make necessary configuration changes in the proxy server.

3.2.4 Dealing with next room problem and undesirable ad-hoc networks

The passkey that the teacher enters at the time of entering a course, will act as a key to take attendance of students. After entering the course, the teacher will announce the passkey for that lecture and all the students present in the class will have to enter that passkey to register his/her attendance and enter the course.

The problem of illegal ad-hoc networks can be handled as described in section 2.4. The server will notify the teacher whenever a student disconnects himself/herself from the server in order to form an ad-hoc network with any of his/her classmates.
Chapter 4

Conclusion

In this document, the literature survey done for the implementation of a classroom based teaching system using tablet PCs without the use of blackboards is described and the structure and functions of the planned system are also described.

This system will allow teachers to easily distribute teaching material, monitor students’ activities in a class, track each student’s progress, evaluate and assess students without the overheads of roaming in the class.

Students will also be benefited by this project. Students having different academic and linguistic backgrounds will not feel hesitant to ask questions. Note-taking will become a lot easier and students will be able to concentrate more in the class instead of just copying the contents of the blackboard. Also, activities like group discussion will encourage collaborative learning in students, although it’s yet to be seen how much appreciation this group discussion gets when compared to the traditional method of group discussion.

There are a few challenges in implementing this system as per planned. The most important of them is the limited capacity of hand-held devices. Aakash-1 had a 256MHz. processor and most of the people who used it, were not satisfied with it’s processing speed. Though Aakash-2 is much better in terms of processing speed than it’s predecessor and has a 700MHz processor, it’s yet to be seen how good it performs in the proposed scenario.

Hopefully this project will introduce an altogether new way of teaching and learning which will be better than the traditional style.
Bibliography


http://en.wikipedia.org/wiki/Wireless_access_point