Application Note

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e-MedLab: A Distance Learning Medical Laboratory via a Tablet PC

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Abstract
Aim: To present a distance learning solution for medical laboratories. *Material and Method*: The recent developments in tablet computers and network technologies show ideas which can be useful for application applied in medical laboratories. *Results*: Here is suggested an important solution based on the recent tablet computer technology combined with mobile WiMAX 2 standard. *Conclusions*: The suggested idea can be easily used today and can be generally useful in the learning process and not only for medical laboratories.

Keywords: Distance learning; Tablet PC; Medical laboratory; WiMAX 2

Introduction

The evolution of computer science and telecommunications in particular has supplemented traditional education methods with distance learning. However, distance learning can be applied more readily to theoretical rather that practical sciences. For instance, using distance learning in medical laboratories may not be as effective as the traditional methods. Previous research [1] has shown that there is no significant difference in student performance between traditional and distance learning in clinical laboratory sciences. However, the human presence is important in distance education as is stated by Gunawardena and Zittle [2] and confirmed by Rovai et al. [3] and Esani [4]. Therefore, that a combination of traditional and distance learning methods will be a suitable solution for modules where laboratory work is necessary without missing out in education quality. It is not difficult to conclude today that the highly expensive laboratories and the increased number of students lead to a need for distance learning for medical laboratories. Even though there exists a variety of places for laboratory research [5], distance learning is necessary to cover the needs of all researchers. Nowadays there is a plethora of distance-learning modes for medical laboratories [6-11]. Here will be presented a combination of on-campus and distance learning modes based on the recent tablet computer technology.

Tablet Computer Technology

Here are presented some features of Tablet PC which will help us in fitting e-MedLab solution.

Tablet Computer

Tablet PC technology was introduced during 2000s by Microsoft. However, since the release of iPad in 2010 by Apple Inc. its popularity has rapidly increased. Therefore other manufactures have started to invest on tablet computer technologies improving both price and efficiency. As a result, the tablet PC is quickly becoming the ultimate computing device.

Some of the most characteristic features of Tablet PCs are:

- *Touch Screen*: A common component among tablet computers is the touch input. Therefore the user can find it pleasurable to use a finger or a pen to operate it.
- *Portability*: No keyboard or mouse required. All hardware is behind the screen and they are very thin and lightweight.
- *Mobility*: Combined with wireless communication they give great mobility and access to network facilities.

In fact, a tablet computer combines the technology of a laptop and a smartphone. Therefore, it is taking the advantages of both those technologies. Tablets offer nearly the same features as laptops but more portability.

Although the users were wondering about the high price of Tablet PCs in the beginning, both technological improvements and user needs have led to cheaper devices available to everyone [12].

An interesting feature is the use of 3-D cameras on Tablet PCs [13]. That can be quite useful in the case of medical laboratories.

Why Tablet PC and not Laptop

Although it is possible to suggest laptop as a solution for a distance medical laboratory, the following advantages of tablets over laptops lead us to tablet PCs [14, 15]:

- Tablet PCs are lighter than most laptops.
- Can be laid flat on the working surface contrary to laptops whose screen needs to be kept somehow vertical.
- A Tablet PC can run more hours than a laptop.
- Text can be added with a help of a special pen. Therefore, the user handwriting is the input.
- Easy screen rotation in Tablets allows for a better understanding of image information.

It is obvious that Tablet PCs are quite simple and portable compared to laptops. They are also great for note-taking during meetings/group activities.

Solution e-MedLab

Tablet PC has been already suggested as a classroom learning partner [16, 17]. However, at particular article a different approach for a medical laboratory is presented.

Distance Laboratory

Our basic premise it to allow as many students as possible to attend a medical laboratory. However this cannot be always feasible in most cases either due to the large number of students or to the high cost laboratories. Believing that distance learning can be more efficient if it is combined with on-campus learning, here is suggested a combination of both learning methods based on tablet technology. Firstly is suggested that only a small proportion of students to be physically presented in the lab. The rest of the students who are not in the lab can attend online via a tablet PC. In addition, if a student has been physically presented at one lab then will be able to attend the next lab from a distance via a tablet PC. Therefore all students will be given the chance to participate in the labs in both ways. The proportion of physically presented and distance learning could not be

stable per each student and will depend on the number of students per lab course and other parameters. For example, one student can be absent and replaced by a distance student. In the case that the physical presence of all students is required in a particular lab, the lecturer can choose students at random to participate in a particular lab and then repeat the lab or divide the students from the start into groups of participants.

With the help of a tablet PC students can:

- make online queries to the lecturer.
- keep notes on it.
- keep a digital backup of the lab for future use.
- process 3D medical images retrieved from 3D tablet camera.
- attend the lab online if they are unable to be there in person. That can also be useful for students who have to attend a different module at the same time.
- have online access to other digital facilities of the university.
- attend the lecture in their own language. That may be necessary for visiting students/lecturers.

Some students may find it expensive to own a tablet PC. In such cases the library of the university can rent one to them. However, the price will soon cease to be a problem and tablets will be available to anyone [12].

Wireless Communication through WiMAX 2

Although Wi-Fi communication has becomes ubiquitous among tablets, a highly promising wireless technology named WiMAX2 is suggested.

Mobile worldwide interoperability for microwave access WiMAX standard, IEEE 802.16e [18], can offer a powerful wireless communication for providing high data transfer rate for broadband access in metropolitan area networks. WiMAX forum [19] was established in 2001 as a non-profit cooperation to promote and certify broadband wireless products. Recently has been deployed an upgraded version of the WiMAX 2 based on IEEE 802.16m standard [20], first demonstrated at CEATEC in October 2010 [21]. Side-by-side feature comparison of WiMAX2 and WiMAX are presented in table 1 [22].

	WiMAX	**WiMAX 2 (20MHz channel)**	**WiMAX 2 (40 MHz channel)**	**WiMAX**	**WiMAX 2 (20MHz channel)**
Download speed	40 Mbps	165 Mbps	330 Mbps	40 Mbps	165 Mbps
Upload speed	10 Mbps	55 Mbps	110 Mbps	10 Mbps	55 Mbps
Max moving station speed	120 KM/h	350 KM/h	350 KM/h	120 KM/h	350 KM/h
Duplexing method	TDD: 10MHz	TDD: 20MHz	TDD: 40MHz	TDD: 10MHz	TDD: 20MHz
MIMO	2 × 2	4 × 4	4 × 4	2 × 2	4 × 4
Modulation type	64 QAM 5/6	64 QAM	64 QAM	64 QAM 5/6	64 QAM

Figure 1. From WiMAX to WiMAX 2 [22]

The improvement of WiMAX features such as increased speed, reduced latency and increased coverage and VoIP capacity leads to WiMAX 2, a true 4G network [23, 24]. Based on those features, WiMAX 2 can be a useful tool not only for education but also for multimedia, business, army and several other areas where wireless communication is necessary. Therefore, the WiMAX 2 is a suitable solution for the particular case, since can easily be incorporated into a tablet turning it into a powerful device. For example, in order for a student to be able to attend a surgery online during a medical lab class high-quality data with high-capacity should be transmitted into the tablet PC.

Conclusions

Easily can be concluded that the widely spread tablet technology can improve university facilities. However the basic ambition is that digitization should not put an end to the physical presence. Physical presence is necessary not only in laboratories but generally in education. Therefore a combination of on-campus and distance learning is suggested. The future target is to determine the proportion of physical presence instead of distance presence when combination of them is used. Such a combination will mostly depend on the nature of the module.

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