

# Pocket PC: a Useful Tool in Electrical and Computer Engineering Courses

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## Abstract

Since Fall 2001, freshman students attending the Electrical and Computer Engineering Department at the University of Minnesota Duluth (UMD) have been integrated into a new handheld computer technology program, which uses the Compact (HP) iPAQ device equipped with wireless internet connections, as a learning tool in some of their courses. The main motivation to use the iPAQ handheld and implement the wireless access at UMD, was to provide computing and network access to the faculty and student body without having to carry a heavy laptop with them, and to make the learning experience for the students more interactive from almost any point inside campus.

In particular, in this paper we describe how we have integrated the use of the iPAQ as a classroom and laboratory learning tool for the Digital Systems Design, and the Microcomputer System Design courses. A set of programs and graphical aids has been developed to take advantage of the features of the iPAQ. The handheld computer provides access to class material and laboratory tools and makes the learning process more dynamic and interactive, and makes difficult topics more accessible and easier to understand to the students.

## Introduction

Nowadays there is a wide range of different opinions among users of handheld computing devices. For some of them, these high-tech mobile devices are an invaluable possession, they find the handheld devices very convenient and powerful, and they use them to do work at any time and place. For others, handheld computers look like a very promising tools, but right now are useless. The authors believe that handheld computers can be very useful and valuable if true users application programs are developed. For example, in academia the handheld devices could be very useful if the application programs center on:

- Increasing the interaction between instructor and students in large classes
- Enhancing communication outside class

- Enhancing active learning and instruction
- Encouraging software development by students for mobile computers
- Facilitating the laboratory data collection and document viewing
- Facilitating the in class assessment and evaluation of students, by means of electronic quizzes and polls
- Promoting in class participation for the students

This paper presents some of the iPAQ application programs that have been developed for two ECE courses: Digital Systems Design, and in the Microcomputer System Design.

## **Main characteristics of the iPAQ**

To ensure standard quality and configuration, the handheld computer required by the ECE department, must have the following main characteristics: Compact iPAQ H3950 (color display, 64MB RAM), Compact WL100 11Mbps wireless LAN PC card. The software available in this model includes: iPAQ Microsoft Windows for Pocket PC operating system, iPAQ Image Viewer, Pocket Word, Pocket Excel, Internet Explorer, Presentation Player, Sound Recorder.

## **The iPAQ in the Digital Systems Design course**

The Digital Systems Design course is an introductory course required for CS and ECE majors. Most of the students take this course in their freshman year. The main uses of the iPAQ in this course have been:

- Having useful data available such as: Syllabus, lecture notes, assignments, lab experiments, data sheets of the components used in the lab experiments (74LSxx family), information about logic gates and logic devices in general, etc. This data can be access during class, in the laboratory, or for assignments (figure 1)
- Having access to the internet using Internet Explorer available in the iPAQ. Students can access the class Web Page, transfer files, answer class exercises, and interactive quizzes that will help them to prepare for upcoming exams. This material is formatted so that it will fit the small display of the handheld computer (figure 2)
- Using Pocket Excel, students can construct and display truth tables, Minterms, and Maxterms information, as well as to store tables with information of electrical characteristics for the TTL family, such as device names, numbers and functions, display input/output voltages, currents, fan-in, fan-out, etc.

- Presentation Player is use to display slides from lectures created in Power Point so that students can follow the lectures, and allows them to review this information later on.
- Sound recording capability allow students to record limited segments of lecture material.
- Using Visual Basic and Java, several programs have been developed. Among the programs are a K-Map solver (figure 3), a Quine-McCluskey minimization program (figure 4), and interactive programs to simulate logic gates and logic devices operations.

## **The iPAQ in the Microcomputer System Design course**

Students typically take the microcomputer design course on their sophomore year. They learn basic microcomputer architecture and assembly language programming for the 68HC11 microcontroller. The main use of the iPAQ is as a lab tool for quick access to information such as ASCII table, instructions mnemonics, codes, execution cycles, etc. Also it can display the basic information to program especial 68HC11 register such as input capture and output compare registers, and to display information about the memory map and interrupt signals. Figures 5-8 show some of the information available to the students in the iPAQ.

## **Conclusions**

From our experience in using the iPAQ, four semesters in the Digital course (2001-2003), and one semester (spring 2003) in the Microcomputers course, and based in surveys from the students, we found that in general the use of the iPAQ is acceptable. The positive opinions and comments indicate that students like to use these high-tech mobile devices, and their use in class increase the student participation, and make the learning process more appealing to them. Students found the iPAQ extremely useful in the laboratory, where they have instant access to information about the components that they are using. They can find this information in handbooks, or the internet, but having this in specific for the iPAQ makes this device really useful and convenient. On the other hand, the main complain is about the cost of the handheld computer. Since the cost of the iPAQ with the components for the wireless communication is very close to the lower end of laptops, this makes the option of buying a laptop more appealing rather than the handheld computer. But the main attraction for the students in using the iPAQ is the real portability over the laptop. We believe that as technology advances, the handheld computers will add more capabilities that will make their use more attractive and universal. Also as handled computers become more popular, the price will tend to decrease. The iPAQ will not

replace a desktop or laptop for general purpose computing, but having custom software written specifically for the iPAQ, will make these handheld devices very useful and valuable tools.

## References

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3. Microsoft Windows for Pocket PC, retrieved June 27, 2003 from the Web Site: <http://www.microsoft.com/windowsmobile/products/pocketpc/default.msp>

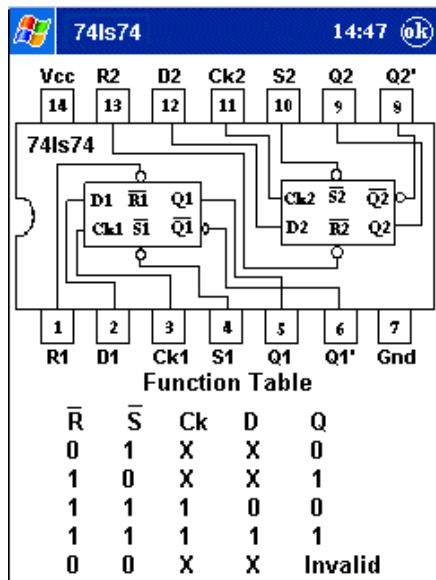


Figure 1. 74LS74 Data Sheet

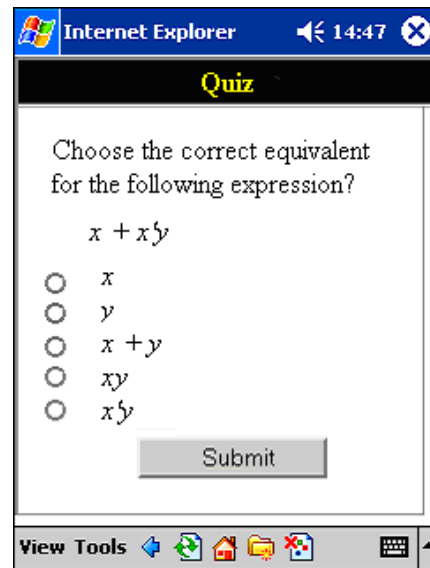


Figure 2. Interactive Quiz

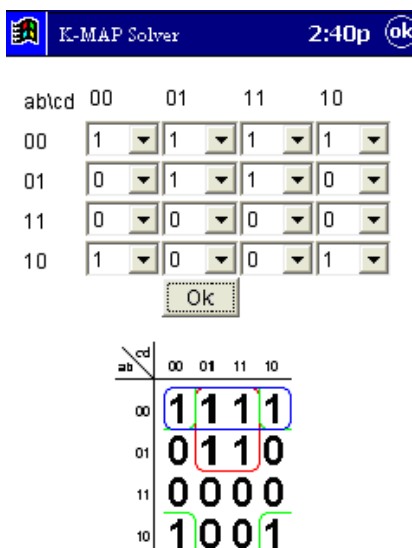


Figure 3. K- Map Solver

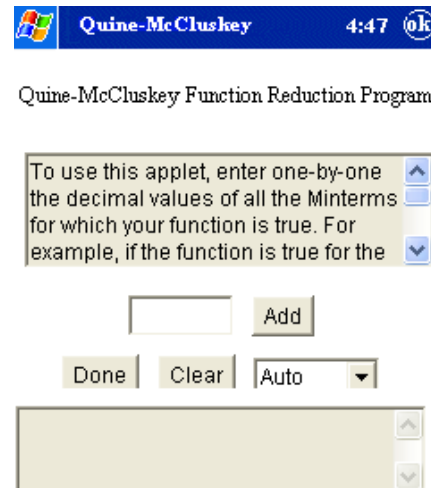


Figure 4. Quine-McCluskey Solver

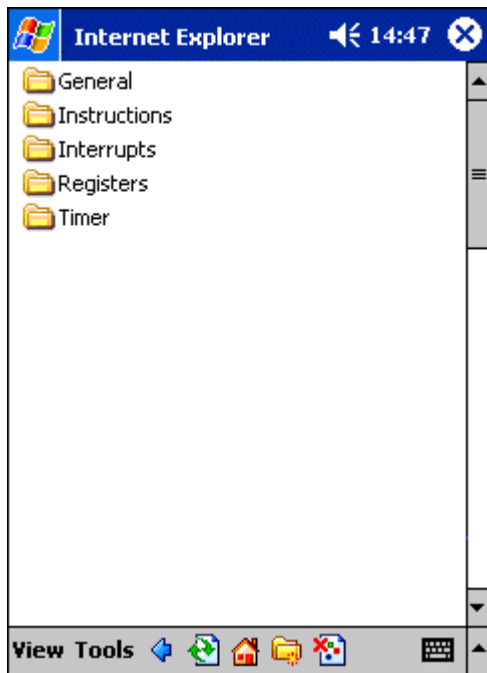


Figure 5. Software Utilities

Instruction Name	Condition Op Code Hex	Number of Bytes	Number of Cycles
ABA	1B	1	2
ABX	3A	1	3
ABY	18 3A	2	4
ADCA	89	2	2
	99	2	3
	B9	3	4
	A9	2	4
ADCB	18 A9	3	5
	C9	2	2
	D9	2	3
	F9	3	4
	E9	2	4
	18 E9	3	5
	8B	2	2

Figure 6. Instructions and Opcodes

Interrupt Vector Table		
ROM Vector Addresses	Local Mask	RAM Vector Address
\$FFC0-\$FFD5	-	
\$FFD6-\$FFD7	RIE RIE TIE TCIE ILIE	\$00C4-\$00
\$FFD8-\$FFD9	SPIE	\$00C7-\$00
\$FFDA-\$FFDB	PAII	\$00CA-\$00
\$FFDC-\$FFDD	PAOVI	\$00CD-\$00
\$FFDE-\$FFDF	TOI	\$00D0-\$00
\$FFE0-\$FFE1	I4/OC5I	\$00D3-\$00
\$FFE2-\$FFE3	OC4I	\$00D6-\$00

Figure 7. Interrupt Vector Assignments

7	A	0	7	B	0	8-bit Regs. A, B
15		D			0	16-bit Register D
15		IX			0	Index Register X
15		IY			0	Index Register Y
15		SP			0	Stack Pointer
15		PC			0	Program Counter
7		CCR			0	Condition Code Register

Bit fields for CCR (bits 7-0):

- SX: Carry/Borrow from MSB
- H: Overflow
- Z: Zero
- N: Negative
- I: I-Interrupt Mask
- 3: Half Carry from bit 3
- X: X-Interrupt Mask
- 0: Stop Disable

Figure 8. CPU Registers