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HAND HELD COMPUTER: AN INTRODUCTION

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Abstract

Computers have come to our assistance in our every walk of life. Although we consider the computers to be technological marvels, the desktop computer could do many things for us, but if we want computer like assistance as a mobile device, we need a compact hand held computer with processing power, keypad, display and a mini built-in printer. There was drastic achievement of computer technology in 90's. Development of hand held device and their real time application was a remarkable land mark in the decade. The paper focus few basics about hand held device which is developed in the research lab.

1. INTRODUCTION

Despite of rapid growth and development in every aspect the companies or government sector's in 1980's, delivery-confirmation and billing systems have historically relied upon manual systems for collecting and managing data. Sorting, loading and issuing bills were systematic, but required manual data entry at several stages. The personnel at the site carry large volumes of books, files and receipts that contain all the details. The whole process was very much time consuming and confusing also for the new workers. They have to work hard to understand all those details. The cumbersome process was eliminated with the advent of hand held machine [1]. Thus in order to decrease man power and eliminate manual blunders and save time, hand held computer with processing power, keypad, display and a mini built-in printer was excellent solution.

Hawkins and his team developed the GriDPad in 1998, the first successful hand held. It was large and awkward, but it worked [2]. The churning ideas for employing this technology in very small, portable, general purpose computers led to development of latest palmtops.

Hand held computer (HHC) is an electro-mechanical device with limited memory required for the specific function therefore it is quite cheaper than the PDA, Palmtop and laptop [3]. Its affordable price makes it easy to users to have it for its versatile usage. HHC are more rugged and are designed to present the user with a simple one-question one-answer environment rather than the normal windows office automation screens. The application software is so simple that any non-technical common person can use it.

Hand held computer has made lot of impact on society especially in underdeveloped and developing countries in Asia and Africa. The Digital Education Enhancement Project (DEEP) which was started in South Africa is a research and development project, focusing upon transforming the pedagogic knowledge and practice of teachers to the communities in which they live and work was incorporated with the use of hand held device [4].

The first phase of the DEEP project was implemented in primary schools in Egypt and

South Africa, with 48 teachers (two per school) and over 2000 pupils between January 2002 and March 2003 participating teachers carried out and evaluated a sequence of curriculum focused, school based professional development activities using a range of new technologies, including hand held computers . The majority of participants were new to the use of hand held computers [5].

The following sections discuses few advantages and some technical details of development of HHC and finally conclude with the it's real time application as a mobile device to issue water bills at the door step.

2. GENERAL ADVANTAGES OF HHC

Hand held computer (HHC) is a portable compact-computing device. It has user interface to interact with user, it has 16-bit processor and a printer built-in. This can be carried to any field application site. This device works by downloading the application from a desktop computer and carried to the fields to use it. It loads master data from desktop, collects the data, prints the bills at customer site and uploads the data collected from customer onto the desktop computer from hand held computer. As shown in figure1. It is integrated with 36 keys keypad for input, 4X20 LCD matrix screen for display and 24-column dot matrix printer for printing. With all these features and flexible down loadable applications the embedded device HHC can be used in many applications like, on spot bill issue for electricity billings at the consumer site, stock verification in grocery, ticket issue for buses or railways etc.

Few general advantages are listed down.

- It is portable.
- It is scalable.
- It provides mobile data collection.
- It saves time.
- It provides spot billings.
- Elimination of manual blunders.
- Decreases man power.
- Easy and simple to operate.
- Secure.
- Customizable.
- Maintainable.

Figure 1. Hand held computer

3. DEVELOPMENT OF HHC

The primary task is to program the micro controller XAG3 to work as a hand held computer. The detailed study of internal architecture of XAG3[6] and hardware interfaces[7] is essential to write application programs .The micro controller XAG3, member of Philips 80C51 family is used having special features like high speed, low power consumption and high memory capacity and support for multitasking serial communications[8].

The code for the application program is written in Embedded C language [9-11]. But we cannot get the required output with simple application code, for this the drivers of HHC have to be developed. Thus drivers for LCD, printer, RTC, ADC and serial communication have to be developed. These drivers are like subroutines or libraries, which are called by the application programs [12-13]. These device driver programs [14] have to be executed in tasking compiler [15]. Tasking EDE compiler generates a hex code, which has to be is burnt into

XAG3. In this project we have developed device drivers for HHC and application down loadable program. HHC can be used in many applications like, on spot bill issuing, maintaining records and mobile data collections.

Normally software products developed are compiled and executed on the same system but in embedded system we have cross-compilers that are, the program is developed and compiled in one system and is executed in other system.

Tasking EDE compiler is used as a development tool for writing device drivers as well as application programs. The code is written in embedded C .We are making Hex file of the program which has to be downloaded into target device.

3.1. Hardware requirements

Processor (Operating speed 30 MHz)	16bit XA Processor (XA-G3)
Flash Memory:	56K x 8 Bit
Random Access Memory	1024Kx8 Bit.
Keypad	6x6alpha numeric keypad with 36 keys
Real Time Clock (RTC)	PCF8563 (32.768 kHz)
Battery	NiMH battery with 6V and 1.6 AH.
Interface	RJ-16 (2Nos).
Printer	24 column DOT matrix printer
Liquid Crystal Display (LCD)	4/20 Characters with backlight

3.2. Software requirements

Operating system	Win9x, 2000, Me, XP.
Compiler	Tasking EDE Compiler.
Language	Assembly, C, Embedded C.

3.3. XA-G3 Microprocessor

The XA-G39 is a member of Philips 80C51 XA (eXtended Architecture) family of high performance 16-bit single-chip micro controllers. The XA-G39 contains 32 Kbytes of flash program memory, and provides three general purpose timers/counters, a watchdog timer, dual UARTs, and four general purposes I/O ports with programmable output configurations. A default serial loader program in the Boot ROM allows In-System Programming (ISP) of the flash memory without the need for a loader in the flash code. User programs may erase and reprogram the flash memory at will through the use of standard routines contained in the Boot ROM (In-application programming).

3.4. Keypad

The predominant interface between human and computers is the keypad or keyboard. The keypad application program must guard against the following possibilities like more than one key pressed, key pressed and held or rapid key pressed and released. The universal key characteristic is the ability to bounce. The key contacts vibrate open and closed for a number of milliseconds when the key is hit and often when is released. The key may be debounced by using proper time delays in software.

3.5. RTC (Real Time Clock)

The PCF8563 is a CMOS real-time clock/calendar optimized for low power consumption. A programmable clock output, interrupt output and voltage-low detectors are also provided. All address and data are transferred serially via a two-line bi-directional I2C-bus. Maximum bus speed is 400 Kbits/s. The built-in word address register is incremented automatically after each written or read data byte.

3.6. Flash memory

The flash is 5-volt-only in the system flash programmable and erasable read only memory (PEROM). Its 2Mb of memory is organized as 262,144 bytes. Manufactured with Atmel's advanced non volatile CMOS Technology.

Reprogramming the flash is performed on a sector basis; 256 Bytes of data are loaded into the device and then simultaneously programmed. In circuit programming and erasing allows its use when loading an updated version of your program's object code into memory through a serial interface.

3.7. EPROM

The EPROM is a high speed, low power consumption electrically erasable and programmable read only memory organized as 131,072 S8 bits. It requires only one supply in the range of 5V+-5% in normal read mode. This provides an electrical chip erase function.

3.8. RAM

1MB of external RAM (data) is used. RD (read) and WR (write) signals are needed during external RAM accesses. The low mode enables write option whereas high mode enables read option.

3.9. Printer

The printer used here is 24-line dot matrix printer. It consists of a motor, main solenoid (home position) and seven printer solenoids. The motor is used for the movement of the printer head, which must be enabled initially. Main solenoid must also be enabled whenever the printing starts. Initially the printer head must be brought to home position .A printer head has 7 print wires (solenoids) arranged in a vertical column and electromagnetic mechanism able to shoot the wires.

3.10. Power supply

NiMH battery is used as the power supply for the HHC. When the battery is fully charged it contains 6v. We will get the low battery indication at 5.3 Volts. When it reaches 4.8 V it will stop working and we have to charge it completely.

3.11. Software platform to program micro controller

When designing software for a smaller embedded system with the 8051, it is very common to develop the entire product using assembly code. With many projects, this is a feasible approach since the amount of code that must be generated is typically less than 8 kilobytes and is relatively simple in nature. The trouble with projects done with assembly code can is that they can be difficult to read and maintain, especially if they are not well commented. Additionally, the amount of code reusable from a typical assembly language project is usually very low. Use of a higher-level language like C can directly address these issues. A program written in C is easier to read than an assembly program. Since a C program possesses greater structure, it is easier to understand and maintain. Because of its modularity, a C program can better lend itself to reuse of code from project to project. The division of code into functions will force better structure of the software and lead to functions that can be taken from one project and used in another, thus reducing overall development time. A high order language such as C allows a developer to write code, which resembles a human's thought, process more closely than does the equivalent assembly code. The developer can focus more time on designing the algorithms of the system rather than having to concentrate on their individual implementation. This will greatly reduce development time and lower debugging time since the code is more understandable. By using a language like C, the programmer does not have to be intimately familiar with the architecture of the processor. This means that someone new to a given processor can also be able to develop a project and make it run, since the internals and organization of the target processor do not have to be learned. Additionally, code developed in C will be more portable to other systems than code developed in assembly. Many target processors have C compilers available, which support ANSI C.

3.12. Embedded C

The C programming language was designed for computers, though, and not embedded systems. It does not support direct access to registers, nor does it allow for the reading and setting of single bits, two very important requirements for 8051 software. In addition, most software developers are accustomed to writing programs that will be executed by an operating system, which provides system calls, the program may use to access the hardware. However, much code for the 8051 is written for direct use on the processor, without an operating system. To support this, the Keil/Tasking Compiler has added several extensions to the C language to replace what might have normally been implemented in a system call, such as the connecting of interrupt handlers.

Associated Compiler Experts (ACE) announced that C language extensions have been officially adopted and approved as part of the industry specification by the ISO technical committee. The resulting efforts can be found in technical Report 18037[16], extensions for programming language C to support embedded processors. The Embedded C technical report specifies a range of extensions to the ISO/IEC 9899:1999 C language specification, also known as ISO C99 usually known as Embedded C.

3.13. Tasking EDE compiler

The TASKING EDE (cross compiler) differs from a native program development; a native program development is often used to develop applications for systems where the target and the host system are one. Therefore, it is possible to run a compiled application directly from the interactive development environment. In an embedded environment this is no longer true. Of course you can still compile a module and make it compile error free. However, to run an application, a simulator or target hardware is required. TASKING offers a number of simulators and target hardware debuggers. The generic name of the debugger product is Cross View Pro.

EDE is an integrated software development platform that compiles a powerful editor, project manager with a make facility. EDE supports all TASKING tools for all targets and is at the same time designed to be open and extensible (i.e. integrate with third party tools). EDE integration helps to develop your embedded application by providing the user friendly features.

3.14. Downloading code to target processor

The final step in development environment is to down load the Hex code to the target device, which comprises of development processor and target processor. The development processor is nothing but the processor on which we write and debug our programs. This can be an ordinary PC loaded with a tasking compiler (TC) on which we can develop a C-program and convert it into an output format, which the micro controller can understand. As shown in the figure 2 the various C files are compiled/assembled and linked to generate an Obj/Hex file, which is downloaded to the target processor using a device programmer. The Cross-compiler is used here assembles or compiles code on development processor (PC) for use on target processor (here on HHC). The code runs in a real time environment.

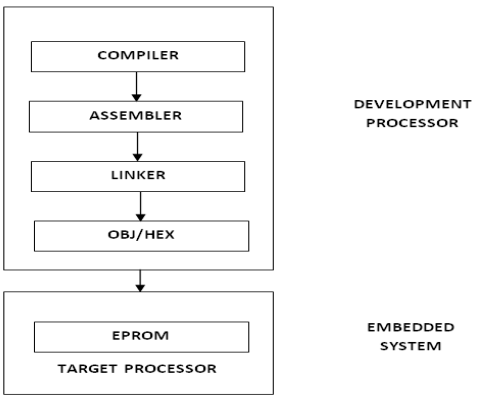

Figure 2. Downloading code to target processor

4. APPLICATION DESCRIPTION

4.1. HHC used for water billing

The real time application developed in our project is spot water billing at the doorstep using HHC. A simple receipt at customer door step is shown in the figure 3.

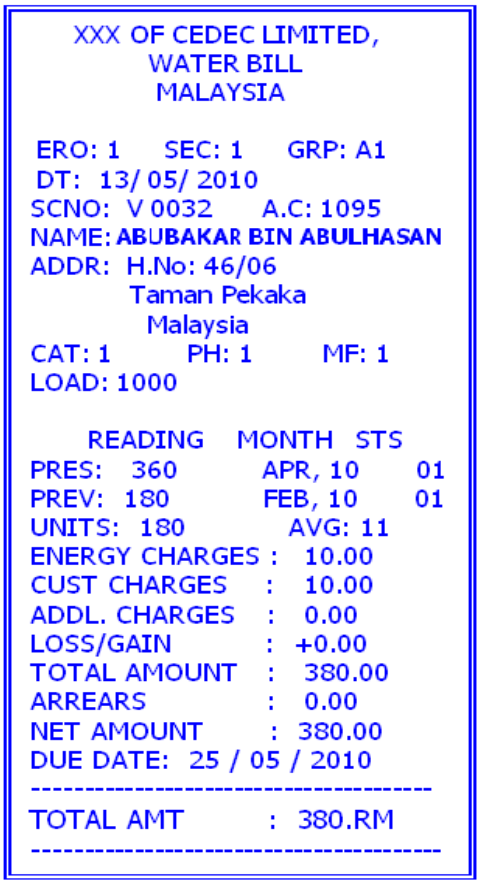

Figure 3. Bill print out

5. CONCLUSION

The results of technology will be fruitful only when it reaches common man. The paper discussed the development of hand held device to collect water bills at spot. Hand held computer (HHC) is such a device that any non technical person can easily handle it. With limited memory required for the specific function it is quite cheaper. Its affordable price makes it easy to users to have it for its versatile usage. HHC are more rugged and are designed to present the user with a simple one-question one-answer environment rather than the normal windows office automation screens. The application software is so simple that any common person could use it. Though it lacks many advance features like internet connectivity but its simplicity compliments it to become a versatile real time data collecting machine.

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