Wearable−HOWTO.

Table of Contents

Table of Contents

Table of Contents

Wearable−HOWTO.

Lionel, trollhunter Bouchpan−Lerust−Juéry <trollhunter@linuxfr.org>

v0.0.9 November 2000

Nomadism is one of the major trends of our society, now most of the people can work with a laptop computer, but few did the next step: to live, or if you prefer to wear one computer that is a wearable.

---

1. Foreword

I am not a guru in wearable computing, simply after some years using HP95LX and HP200LX palmtop computers more like wearables than like a PDA (thanks to DOS 5, the HP200LX even allowed me to do a semester CS project using turbo pascal while commuting in the subway), and living with a palm IIIx and a laptop running Linux, to me the next step is having a wearable running Linux, thus I have spent more than a year reading various informations on wearable and taking a little part in the wear−hard mailing list. As more an more people will be interested in the wearable concept I have decided to start this HOWTO in order to help them (At the time of this writing I am building my own wearable using my laptop (Toshiba 430CDT) with a twiddler keyboard, emacspeak, and camcorders batteries.)

Some people may, at least, be surprised to find the "In the army now" section so I would like to explain my position: I am trying to write this HOWTO both as a journalist and a scientist would do: this implies as a journalist to look for information from every source available, and as a scientist to be neutral: and as the US Army is willing to purchase more than 30.000 units one can hardly overlook this user group. This document is intended to be the starting point of a long term work. If you have any information (that can be checked) that you think is of interest, do not hesitate contact me.

---

2. What is a Wearable anyway ?

Well, as it name implies a wearable is a computer you are supposed to wear, actually very few wearables fill this definition. On a more practical point of view one can define a wearable as a computer you can use on the run relying only on its power supply (see the power supply section for more information). So with such a definition PDAs, palmcomputers, customized laptops are wearables too. As Wearable computing is a new field, there is no standard definition for a Wearable computer, but you may find Professor Steve Mann's definition very . To me medical devices such as pacemakers too are Wearable computers and they don't fit in Professor Steve Mann's definition (actually Professor Steve Mann is one of the Pionneers in Wearable computing) On the Wearcomp website there is also a FAQ trying to define what a Wearable is.

I am not a specialist in wearables, simply I have a very strong interest in nomadic computing and I studying a lot its implementations both from a technical point of view and from the way nomadic computing is going to change our every day life and the way we interacts as we are getting more and more connected.

This text is included in the LINUX DOCUMENTATION PROJECT http://www.linuxdoc.org/HOWTO .

The latest version of this document is available in HTML format at
http://infonomade.linuxfr.org/Wearable−HOWTO.html or at
http://www.thewearables.com/mirrors/Wearable−HOWTO/Wearable−HOWTO.html

, you can retrieve the postcript format at

http://www.thewearables.com/mirrors/Wearable−HOWTO/Wearable−HOWTO.ps.gz

If you wish to mirror it or to translate it, please contact me.

Lionel, Trollhunter Bouchpan−Lerust−Juéry <trollhunter@linuxfr.org> or at <boucli27@altavista.net>

3. Advocacy

Some people may want to know why you want to build a wearable or you may have to sell your idea to the people who are responsible for the purchase. Here are some ideas you may use.

3.1 Why ?

Because, you want to experiment by yourself, because you think that Human Computer Interaction is not a matter of designing the n−th windowmanager, because you feel that enhanced reality is the cutting edge of your evolution.

3.2 The Wearable concept is not a revolution, it is just an evolution.

Some people are afraid of revolutionary or so called products, thus the good news is that the wearable may look like a revolutionary concept but it is actually just an evolution of the computing hardware. Let me explain that : At first there was the Mainframe, then came the desktop computer enabling people to work in their office, latter the PC enabled these people to work at home too, as time passed the portable PC enabled people to work in a Hotel room, or everywhere they could find a power plug (yes an Osborne or an IBM's convertible were definitively not laptop computers), at the same time some pocket computers appeared on the market : Sharp PC1500, Canon X07, Casio PB100 then the first one weighted less and less, the second one disappeared but the LCD screen was, with other things their legacy allowing the laptop to emerge, as the laptop went mainstream, its size went smaller allowing people to work in the train, at the library ..., then palmtop PC's such as the HP95LX and PDA's appeared, (at this time the most successful is the PalmPilot family and its clones) allowing people to work on the move, so the wearable is just the next step in this move towards miniaturization. (If you want to learn more about Laptops and Linux you should read the Laptop−HOWTO, the latest version can be found at Werner's Heuser Homepage)

3.3 The Wearable may give its user an edge.

In today's competitive world it is very important to get an edge over the other company, thus for example in a plane repair company the engineers who are using wearables do not waste time in asking for blueprints but instead have the blueprint and the technical data at will while performing their job, thus they will be able to repair the planes faster. You may choose an example in your job.

3.4 The Wearable concept: a stealth menace.

When they made their first appearance on the market, some products or technologies were, to say the least, less than perfect. This is a stealth menace, if you read Clayton Christensen's book "The innovator's dilemma: when new technologies cause great firms to fail" or Andy's Grove "Only the paranoid survives" you will see that some corporations that relies on a product and that have a king of the hill may fall down because they overlooked a new product/technology that was clumsy at its beginning and was at first in a market niche, then the contender took over the market.

3.5 Wearable computing: an emerging industry.

The people who decide to fund your project are not always very found about technical details, thus you will have to use other arguments, otherwise your pet project will be sent to /dev/null. If one reads again chapter 2 of AP Sloan's book: "My years with General Motors" it is obvious that the Wearable industry is going into the same changes as did the automobile industry in the US at the turn of the century : it turned from a Hobby with some small manufacturers to a mass market Industry. It took nearly 30 years to the automobile industry to change, but the wearable industry should have done this changes in less than 5 years, so if they don't invest on this product others will do.

---

4. What CPU ?

4.1 PDA based Wearables

Usually they use non Intel CPU (except the HP95/100/200LX) See the PalmPilot : a new breed of wearables section.

4.2 PC/104 and laptop based Wearables.

Theses devices are using usually an Intel or Intel compatible CPU. Some model even feature a `Cyrix Media GX CPU`.

What is PC/104 ?

PC/104 is an industrial standard, for PC based systems that can be stacked together in order to create an embedded system. The footprint of theses boards is 4"x4" so as you can see it is a good base in order to start a wearable project.

What about PC/104−plus ?

It is a PCI addition to the PC/104 standard. you can read the PC−104 FAQ

4.3 Transmeta's processor the Crusoe.

It seems that Transmeta hasn't build the fastest chip on the market but has indeed focused on power saving making its processor and ideal choice for a wearable project, moreover it seems that motherboards will be available very soon as Phoenix Bios released their Bios for this chip.

4.4 Misc

Last year there were some alpha based Multia sold for around $100, but it seemed AFAIK that nobody ever managed to build a wearable around one of theses devices.

---

5. Power supply

There is plenty of choice as long as you use batteries. But be careful __NEVER__ use liquid acid filled batteries it is a Health Hazard for this application.

Now the four main sources for information on batteries and batteries are:

- The Sanyo batteries
- The camcorders batteries; you may browse
    - Canon
    - Hitachi
    - JVC batteries
    - Panasonic
    - Sony batteries

  and other manufacturer's websites
- The hoby models manufacturers such as
    - Graupner
    - Robbe
    - Tamya
- Radioshack

---

6. OS.

For the people whose Wearable is based on a PDA, there is little choice : most of the time they have to do with the PDA's manufacturer OS, AFAIK Linux on Psion series 5 is not mainstream. a commercial solution called WindStone primary targeted to palmpilots with a project to port it to ARM based computers it is made by OSK, so and see. For Mips based PDA type; some of them seem to be able to run NetBSD (it is a member of the *BSD family of unices running on a lot of platforms).

For those using a PC derivative, the choice seems to be between Microsoft products or Linux, Well, Microsoft products are not exactly the best choice and DEBIAN/GNU Linux is the winner (I don't think that for general purposes one has to use a posix .4 compliant kernel).

There is another contender QNX, but is more industrial oriented, so for hobby or research it is not the best choice.

---

7. The Sulawesi project.

Sulawesi: An intelligent user interface system for ubquitous computing.

7.1 Background

A few years ago, wearable computers were dedicated systems constructed by and for a single person. The machine was customised to suit the owners personal preferences using alternative input/output devices to achieve different interaction techniques, and until now most of the interfaces used on these machines have been an amalgamation of existing desktop user interface systems and novel input/output devices.

The ideal human−computer interface for use in a mobile/ubiquitous environment would be one which listens for its user, understands what the user has asked it to do using speech recognition, gestures, machine vision and other channels of information, carried out the users request automatically, and presented the results back to the user when it is most appropriate and in a suitable format. For example; a machine which could monitor the users respiratory levels, heart rate and movement, the user could ask ``when I fall asleep could you turn off those <user pointing> lights''. This type of interaction with a mobile device or an ubiquitous environment, using spoken sentences and gestures, fall under the category of multi−modal and intelligent user interfaces; and Sulawesi is a framework which provides a basic multimodal development system.

7.2 The Sulawesi Architecture

The Sulawesi system that has been designed comprises of three distinct parts,

- An input stage, which gathers raw data from the various sensors.
- A core stage, which contains a natural language processing module and service agents.
- An output stage, which decides how to render the results from the service agents.

Programming API's allow third partys to create new input, service and output modules and integrate them with Sulawesi.

The input stage

The system gathers real world information through a well defined API. The current implementation includes a keyboard input, a network input, a speech recognition input, a video camera input, a G.P.S. input and infra−red input. The inputs do not do any pre−processing of the data, they only provide the raw data to the core of the system for interpretation by the services within.

The core stage

The core of the system contains a basic natural language processor which performs sentence translations. This converts a sentence into a command stream from which two pieces of information are extracted, which service to invoke and how the output should be rendered. A service manager is responsible for the instantiation and monitoring of the services, it also checkpoints commands to try and provide some kind of resiliance against system failures. The services produce, where possible, a modal neutral output which can be send to the output stage for processing.

The output stage

The output stage takes a modal neutral result from a service and makes a decision on how to render the information. The decision is made based on two criteria, what the user has asked for, and how the system percieves the users current context/environment.

If the user has asked to be shown a piece of information, this implies a visual rendition. If the system detects that the user is moving at speed (through the input sensors) an assumption can be made that the user attention might be distracted if a screen with the results in is displayed in front of them. (imagine what would happen if the user was driving!).. In this case the system will override the users request and would redirect the results to a more suitable renderer, such as speech.

7.3 Sentence translations

When humans recognise speech they do not understand every word in a sentence, sometimes words are misheard or a distraction prevents the whole sentence from being heard. A human can infer what has been said from the other words around the ones missed in a sentence, this is not always sucessfull but in most cases it is satisfactory for the understanding of a conversation. This type of sentence decoding has been called semi−natural language processing and has been implemented using a few basic rules, the example below explains how the system converts human understandable sentences into commands that the system understands :

- `could you show me what the time is`
- `I would like you to tell me the time`

It can be argued that in practice these sentences result in similar information being relayed to a user. The request is for the machines interpretation of the time to be sent to an appropriate output channel, the result is the user receiving the knowledge of what the time is. Closer inspection reveals that almost all the data in the sentences can be thrown away and the request can still be inferred from the resulting information.

- `show time`
- `tell time`

In the example above there has been a reduction to 1/4 and 2/9 of the number of words (data) in the sentences, while it can be argued that close to 100% of the information content is still intact.

The system implemented allows sentences to be processed and interpreted. The semi−natural language processing is achieved through a self generated lookup table of services and a language transformation table.

The service names have to be unique (due to the restrictions on the file system) and this provides a simple mechanism to match a service such as ``time'' within a sentence. It is impractical and almost impossible to hard code all predefined language transformations, and such a system would not be easily adaptable to diverse situations. The use of lookup tables provides a small and efficient way in which a user can customise the system to their own personal preferences without having to re−program or re−compile the sentence understanding code. The system knows what the words '`show`' and '`tell`' mean in the sentences by referring to the lookup table to determine which output renderer the results should be sent to.

Example of a lookup file.

```
|tell|speak|
|read|speak|
|show|text|
|display|text|
|EOF|
```

The top entry in this lookup table specifies that the first time the word "say" is encountered in a sentence the results of the service should be sent to the "speak" output renderer.

The use of lookup tables inherently restricts the use of sentences, in order to create a sentence which is to be understood the following rule must be adhered to.

```
<render type> <service name> <service arguments>
```

7.4 Summary

The above system enables a sentence like ``I would like you to turn the lights on when it gets dark''. The system interprets the sentence as a request to invoke the `light' service and to render the output using some kind of light controller device to turn on or off the lights. There are two points which need to be emphasised here, the first is on the machine inferring a meaning from a relatively natural sentence rather than the user having to adapt to the machine and remember complex commands or manipulate a user interface. The second is on the machine being asked to perform a certain task when certain conditions are met in the real world, ``when it gets dark'' requests that when the computers interpretation of the current lighting conditions cross a certain threshold, it should respond and send a message to the light controller output.

The Sulawesi system provides the flexability to achieve this type of interaction but it does not provide the underlying mechanisms for controlling lighting circuits, that's the part you have to code up ;)..

Online documentation and downloads can be found here:− http://wearables.essex.ac.uk/sulawesi/

---

8. `CLI` only

8.1 What is `CLI`?

`CLI` is a shorthand to the Comand Line Interface. When you are installing Linux on your computer without X, you will work in `CLI`−mode! Perhaps you will shout "oh... that's horrible", but your computer will shout "yeah... I have more %CPU and %mem to work and to play!".

8.2 Why does one talk about `CLI` here?

Some wearables may have problems with graphics chipsets, disk and memory space and battery−life. If you work in text−mode, you will save battery−life and disk usage as well as lot of memory and CPU Cycles. And if you don't have to install graphic interfaces, you will save a little disk−space too. Consequently, you gain some space for your data. But you may feel that in text−mode, nothing can be done. As you will see the same things can be done in text−mode and graphic environment. Only things are thought differently.

8.3 What can be done in text−mode?

We have to think with what we have few programs who can communicate between them by input/output canals. This type of environment implies that we must use all our fingers to work, we can even get rid of the mouse. As in `X`, you have editors (`Vi`, `Emacs`, `Jed`...), games (BTW wearables are the game by themselves), viewers/browsers (`?less`, `?more`, `lynx`, `links` ...), file managers (`mc`...) and more. Also, some people may believe that `CLI` is cool but it's difficult to learn all configurations and options of all commands. The learning curve is acutally steeper, but when you have learnt that, you will work faster and the faster the work is done the better it is with a wearable . We'll see examples which accelerate our personal work.

8.4 Bunch of utilities

Shell and script−language

Bases of `UNIX` are its powerful shells. With shells you can do more than the poor batch−language of Microsoft. `UNIX` gives a lot of powerful shells (`tcsh`, `ksh`, `bash`...), but I always work with `sh`. I know it is old and less featured than its big brothers but it is on every Unices. In `sh`, there are often used functions/commands (`echo`, `test`). Why do I say that? You can notice that `GNU` gives a program `echo` and `test` and I say: "if we can eliminate these programs, we can free disk−space... ok, not too much but about 20k.". And some versions of `sh` are very economical. The language of shell (script) is like a small programming language: you can used loops (`for`, `while`), user interactions (`read`), I/O (< >)... To learn scripting, you just have to type: `man sh` (or `tcsh`.... but more complex...). Stupid example of a little script: `for i in * .[^.]*; do echo $i; done` (simple `ls`).

Must I learn `sed` and `AWK`?

In the Unix's world, we hear a lot about `AWK` and `sed`. These programs are generic and can be used for a lot of things. `GNU` gives a bunch of utilities that can replace `sed` and `AWK` (`dd`, `cut`, `seq`, ...). Why `dd` will you ask ?

`dd` have a little function that is fine: conversion low/up case. An example:

There are names in this directory that are in uppercase but you want to change them to lowercase. With `AWK`, you must type: `for i in *; do mv "$i" "`echo $i | awk '{print tolower($0)}'`"; done`; with `sed` you must enumerate all letters; with dd, it's very easy, I think: `for i in *; do mv "$i" "`echo $i | dd conv=lcase`"; done`

`cut` is a program to print columns of a text. Also, if you must print different columns of a line, you can use `cut`. `cut` performs better than `AWK` in this case if you want the job to be done fastly and efficiently because `cut` is dedicated to this work. For the same task, you may use the shell's internal commands too (you can, if you assign a value to the `IFS` variable). Here is an example in `AWK`, `cut` and `sh`. We want only to display a list with `login : identity` fields:

* in AWK:
```
awk −F: '{ print $1" : "$5}' /etc/passwd
```
* with `cut`:
```
while read line; do echo "`echo $line | cut −d: −f 1` : `echo $line | cut −d: −f 5`"; done < /etc/passwd
```

- only with sh:
```
IFS=':'; while read a b c d e f; do echo "$a : $e"; done < /etc/passwd; IFS=' '
```

Generally, you haven't to learn `AWK`. I think that you can always do things without `AWK`. (OK, sometimes, `AWK` is easier.)

About `sed`, the drawback is that you must work with temporary files. If you want to save disk−space and to edit files in command−line, you can use `ex`, the script version of `vi`. Also, `sed` can be used but not necessarily.

Redundancies in utilities?

If disk−space is very important, you can delete certain programs which perform task that can be done by others programs. For example: if you have to use `dd`, you don't need `cat`, if you have `vi`, you don't need `ed` (help me to find other examples...).

8.5 Aliases or scripts?

Scripts are more powerful than aliases. But scripts eat disk−space and are loaded each time they are used. Aliases eat memory−space and if you are in `CLI`, you have all the memory for you! Aliases are faster than scripts because they are loaded from memory and not from disk.

Generally, shells offer you another alternative for aliases/scripts: functions. Functions have power of scripts with the convenience to eat only memory−space. To learn aliases and functions, you can look at the manpages.

---

9. Input

9.1 Variations around the keyboard

Mini keyboards

Usually theses devices are on the wearer's forearm or wrist.

The WristPC Keyboard and the Arm mount micro keyboard from the Phoenix Group Inc. are typical from this concept.

One hand keyboard.

IMHO it is the best concept because it doesn't require you to look at the keyboard while typing is the less intrusive when you have to deal with other people, and in order to be accepted by other a Wearable wearer's must have the lowest visual signature.

The archetype of this concept are the Twiddler and Twiddler2 and all of their clones.

At first using a twiddler may seem to be a little bit confusing. The very first thing to do is to read the manual (don't forget to plug the keyboard or the PS/2 adaptator or your twiddler won't work because it will get no power supply.) The reference card may, at first, seem confusing because when you are working with your twiddler you are behind the buttons and the reference card show you the buttons from the front side not from the rear so you will have to switch right and left. When you have passed theses steps you will quickly learn how to use it and IMHO it feels very comfortable to use. The way the integrated mouse operates is very natural too.

---

10. Audio Output

When your system doesn't output too much data, or in order to signal some special events an audio output can do the job. Most laptops come with a Sound Blaster compatible sound card and a lot of PC−104 cards are sold with such a sound card on board or you should buy a sound module. The next step is to redirect your text output to a text_to_speak program.

As a lot of input is done using emacs, it seems to be a good idea to use Emacsspeak

---

11. Visual Output

11.1 Head Down displays.

Wristwatch type

Commercial Solutions.

Some manufacturers (eg Seiko, Citizen, Casio) manufactured Wristwatches that could be linked to a computer, (I remember that in 1982 Seiko showed a prototype of a wirstwatch TV (monochrome LCD)).

Casio has a broad set of wristwatches, some of them could be descibed as Wearables that can display time among other things, of interest are the

- The PC Unite that can exchange data with a computer using an infra red link.
- The ATC1200−1V Forester features an electronic compass. plus thermometer and barometer. I used to own one of these it is a great piece of hardware
- The Technowear products have different features including voice recording, IR remote control, Databank...
- The GPS watch is one of the most intruiging watch I have ever seen

The Wristwatchcomputer.

In 1998 S. Mann displayed a Wristwatch videoconferencing computer, it runs GNU/Linux and uses an XF86 Server, there is a pinhole video camera on the watch itself. This device is to say the least impressive, some of the software, is downlable and GPLed.

It is also possible to use a 4 lines LCD display connected to the serial port of your laptop (numerous paper or online electronics magazine offer schematics).

PDA type

PDA's seem to be a cheap and efficient way of sending and displaying data for a wearable, actually any PDA with a VT100 emulation program and a serial link can be used effectively as a terminal (I have successfully used my HP200LX running kermit

as a terminal for my desktop, giving me an emergency access to it if the display failed)

11.2 Head UP displays

The distinction between obstrusives an non obstrusives ones is not from the wearer point of view but from the other people, that is is the display forbid to see the wearer's eyes

Obstrusives displays

Hacks with LEDs

Some people managed to use blinking LEDs in order to retrieve information from their device. This is one of the simplest display one can imagine : a LED or a row of LED blinking.

Sony GLASSTRON

Sony sells a device called the Glasstron; in Paris, France the FNAC Montparnasse sells the PVD−V30 glasstron 55 at 13999F (this is about US $2333).

The M1

Tekgear manufactures the M1.

The VRD (Virtual Retinal Display)

With this device a manufactured by Microvison a LASER LED draws the image on the wearer's retina, the US Navy tested it in the summer 1999, at Hawaii (see in the army now).

Nonobstrusives displays

The Microptical corporation manufactures two displays the Integrated Eyeglass display and the ClipOn display.

---

12. Comms

AFAIK Most of the time it is with a radio link, should it be with a radio transceiver or via a cell phone.

It seems that IBM's Personal Area Network or the Bluetooth technology will enable building LANs of Wearables very easyly. (actualy IBM is also a member of the Bluetooth SIG).

---

13. How can I have my Wearable ?

13.1 Commercial Solutions.

Some companies sells Wearables ready to use out of the Box, hereafter is a list of them.

- Genesys Technology manufactures a Wearable that uses a HMD display.
- handsfreemobile sells the Mid Riff Brain, it is mostly an LCD touchpad based solution and the unit is in a pouch fixed on the waistband.
- Teltronics sells the Mentis. It is a modular wearable.
- Via sells the VIA II PC a Wearable that is worn on the waistband.
- Xybernaut sells the Mobile Assistant IV (MA IV) available with RedHat Linux 6.1, Suse Linux ,Windows 9x and Windows NT4

13.2 Do it yourself.

As wearable computing is in its very early beginning you should make various experiments and share them with your peers. Doing this with an open and versatile OS such as Linux should give you a lot of fun (after all, desktop computer is just a plain vanilla computer), because you play with both the OS and the hardware. If you are unsure of the technical decisions you are going to make, you can start with a proven design. On the net you can find the specifications of some wearable systems thus you will not have to reinvent the wheel and you will avoid some pitfalls. (the designs are sorted by alphabetical order).

- The Lizzi ; it is the MIT's wearable design.
- In the UK you can find the Vase Lab Wearable it is from Neil Newman at the University of Essex.
- In Canada, the Wearcomp is a proven design, by Prof. Steve Mann at the University of Toronto.

---

14. PalmPilot and its clone (IBM, HandSpring, TRG): a new breed of wearables.

14.1 The palm family.

The PalmPilot family and its clone is a hit among PDAs, but less known is the fact that it is more than a PDA it is one of the first off the shelves wearable. You can connect it to your cell phone, When on the move you may need an input device more convenient than Graffiti: a keyboard for example, one device exists that allow you to plug a PS/2 keyboard in your palm: Happy Hacking cradle Specially for the Palm.

PFU Happy Hacking sells a PS/2 adapter for the Palm, thus one should be able to hook any PS/2 keyboard on this device. It is battery (2 AA) powered.

It seems that someone has managed to get a twiddler keyboard working with the PalmPilot. If you want to do land navigation it exists an electronic compass you can plug into your palm it is called Palm Navigator and it is manufactured by Precision Navigation They even sell a weather station.

If you have more money to spend or want more precision you can purchase a GPS receiver called Earthmate; it is manufactured by Precision Navigation Some of you may want a software only solution: this can be done.

If you have some highly specialized needs like commuting without having the subway map and want a readily made solution you can use a program like Route Expert, I use it on a daily basis, it works great with Paris's subway and I will test it with Berlin's subway at the end of the year (of course it exists other programs but this one is the one I am using). I guess everyone can find the North using the sun and a wirtswatch, a PalmPilot can do it with more precision using readymade programs such as T.J's Sun−Compass (once again there exists other programs but this one is the one I am using).

The most important with the PalmPilot for the Linux community is the fact that there exists two ports of Linux for it (DragonBall is a member of the 68000 family after all). One is GPLed

You can find more information at : uClinux

the second one is commercial, it is based in Korea. WindStone it is based on uClinux and it is coming with its own GUI and widgets.

Thus with the next generation of Palms, the CPU speed will be twice today's speed, and with Linux on board we will be able to run a lot of software that are hardware independent and have been written for today's x86 Linux based wearables.

14.2 PDAs runing Linux.

Samsung displayed a PDA named the Yopi runing Linux. It is an ARMLinux based PDA, 32 MB RAM, featuring a voice recorder, mp3 player,IrDa port, compact flash slot, a 4" color TFT and HandWritting Recognition, plus Serial and USB interface. Word has spread that it should be sold this summer but unti then wait and see.

It exists a Mips based PDA info Center This site focuses both on NetBSD and LinuxCE on MIPS based PDAs.

You can find some information on the LinuxCE port; and you may wish to read the LinuxCE FAQ With theses PDAs one should be able to consider building a nice PDA based Wearable.

---

15. How to carry my wearable ?

Depending on your wearable's family (eg Palm, palmtop computer, laptop based, PC/104) there seem to be 3 convenient ways of carrying it around. You can carry it on tour wrist, or in a backpack or you can hang it on your waistband.

---

16. Applications with Wearables.

As a rule of thumb the first people who are going to use extensively the wearables are the people whose work is a matter of life and death.

16.1 In the army now.

It is very important in an army to have an edge other the enemy, that is what we have always seen in history, and moreover the army is known to spend vast amount of money in order to get this edge.

Some years ago the infantryman was ordered to carry different pieces of ordnance that came from different sources and were not part of a whole thing, and to try to do his best with theses (looks like Frankenstein to me). With theses new projects the infantryman is the centerpiece of a coherent, complementary weapons and equipment system.

- Australian Army.

  In Australia there is a program called Land 125 Soldier Combat System (formerly "Wundurra" (the aboriginal word for Warrior)), there is some information on DTSO's website; and according to the ATSE this project should be on phase 2 on year 2000/2001.

  According to DTSO the soldiers should have intra−section radios, night vision and sighting capability and head up display.

- French Forces.

  In France there is a project called FELIN (Fantassin à Equipement et Liaison Integrées (Foot soldier with integrated equipment and links))

  in order to enhance the efficiency of the soldier a set of devices had been developed with very careful limitations : historically the foot soldier has been a beast of burden, thus the FELIN project wishes to limit its load at 25kg. The soldier has got a radio link, a computer and a camera on his weapon (allowing him to open fire from cover). The display is done with a monocular HMD.

- UK Forces.

  The FIST (Future Integrated Soldier Technology) project: Early tests were conducted on Salisbury Plain to determine if the soldier could access information either 'Head Up' (in a helmet display), 'Head Down' (on a wrist mounted display), via a palmtop computer or if necessary a map

  lessons learned (in L'armement issue 67 September 1999)

  - There is no scope for enhancing soldier performance through the provision of tactical information unless the soldier can access information 'on the move'
  - The preference, both by day and night was the helmet display.

  The FIST Digitization Trials will be conducted on Salisbury Plain in June and November 2000. The June trial addresses information flow, the November trial will address the benefits of enhanced information to determine if there is a consequent increase in the 'Tempo of Operation'.
- US Forces

  - The land warrior program

    It is a system made of 5 subsystems cooperating together.

    - A Pentium Computer/Radio Subsystem (C/RS) made by Motorola featuring an integrated GPS receiver
    - The Protective Clothing and Individual Equipment Subsystem (PCIE) made by Gentex
    - The Weapon Subsystem (WS) made by Raytheon

- ◊ The Software Subsystem made by Raytheon
- ◊ The Integrated Helmet Assembly Subsystem (IHAS) made by Honeywell

The location of each squad member will be available through the IHAS, as well as digitized maps and tactical information. Every soldier will have an integrated GPS as well as video recording capabilities. Of course the soldier will have night vision capability as well as deported sighting. Tests should take place during year 2000. More info on the Land Warrior program at

http://www.sbccom.army.mil/programs/lw/index.htm

(There is even a FAQ and pictures). AFAIK this is going to be the biggest test for the wearable concept because the Army is planning to purchase 34000 units plus spares.

- ♦ The navy.

During the summer 1999 news poured that the US Navy tested the Virtual Retinal Display at Hawaii. The explanation is that there doesn't seem to be enough space in the fighting ships because of the numerous CRT, so it is conceivable for the crew to wear VRDs

Needless to say, that some very low profile and highly specialized units should have adopted the wearable concept but as far as we cannot have evidence we can only speculate on that.

16.2 At the hospital

The Microvison's VRD has been delivered to the Wallace Kettering Neuroscience Institute, Dayton Ohio, for neurosurgery applications. This is not a full featured wearable solution but it is a big step toward the adoption of wearables in health care activity. (on the website you can view a simulated image).

16.3 With the firefighters

Firefighters are using thermal cameras in order to see through the smoke, in the next years theses devices should be miniaturized and with a wearable firefighters should have both hands free and will have real time access to data such as the map of the building and numerous helpful informations.

16.4 Wearable for the disabled.

One can easily think that a wearable computer can be very helpfull for the disabled people, for example for blind people a wearable with a GPS receiver, some maps of the surroundings and even more, interacting with its surroundings by means of active beacons can be a very good substitute for a dog, the elements exists for a long time.

This should be easily done : the linux comunity has good text to speech applications, voice recognition is quite ready for this application , the IrDA or Modem radio drivers are OK, the same applies to the GPS programs, we have to develop an electronic blind walking stick in order to detect the obstacles at a much reater range and last, but not the least to convince the autorities.

17. A borg's life.

This section deals with Human−Human interaction. As the wearable is quite new for the layman one has to expect some strange reactions from the other people. When I go out and read my PalmPilot's screen while walking or in the subway people have one of the following reactions :

- No reaction: because they are in their own world or because they don't care.
- Curiosity: they come to me and ask me questions like "what it is", "what are you doing with it" and "how much does it cost ?"
- Disdain : they may think I want to draw attention.
- Hostility/Fear : "this guy is nut: avoid him".

Steve Mann Gave an interview in the New Scientist magazine and as he was one of the first to test the waters, so he has a long experience in this field. The second problem is that the wearable's hardware is quite expensive and some predators will spot a new device that can be easily stolen and sold at a good price, or just in order to have one of them. As a conclusion you have to be very cautious.

---

18. Nanotechnology: one step beyond.

At the time of this writting, we are in a transition era: the nanotechnology is an emerging science that is going to change a lot of things in the computing field.

For more information on nanotechnology, the http://www.nanodot.org website is a good place to start.

---

19. Sources of Information.

19.1 Non commercial

A good starting point to gather information is to subscribe to the wear−hard@haven.org mailing list, you have to send a message with the word subscribe in the subject to wear−hard−request@haven.org.

The archive of this mailing list is mirrored at Wearable Central This site was founded to be an archive center for the mailing list and the newsgroup. It is maintened by R. Paul McCarty.

You can also read one of the very good FAQs such as the wearcompfaq or you may go to the wearable webring (at the time of this writting the webring lists 35 sites).

19.2 Commercial.

You can find information on the web sites of the company cited in the various sections of this document and as stated earlier in this document : The companies quoted here are just for your information only, I do not endorse any of their product, this just in order to help you.

19.3 Reading.

Some science fiction books can be a good introduction to Wearable computing. Among other books one can think of (alphabetical listing):

- Diamond Age by Neal Stephenson (a lot of nanotechnology too).
- Snow Crash by Neal Stephenson
- Virtual Light by Willian Gibson

---

20. To do List.

This section is about things that have to be done for the next releases if you wish to contribute it is a good place to look at.

- Organic Leds are very interesting, I should cover theses too.
- To expand the input/visual output sections.
- To expand and reorder the advocacy section.
- To have an "in the car" section.
- The concept of an UW wearable seems viable lets think about it.
- List and describe all projects.
- List and describe all products.
- To get some sleep ;−).

---

21. Revision History.

- v 0.0.9 November 2000, 3rd release
    - Fixed: What is a Wearable anyway section: Typo in URLs
    - Expanded: What CPU section.
    - Expanded: Power supply section.
    - Rewritten: OS section.
    - Rewritten: Sulawesi section rewritten by The sulawesi project founder Neill Newman. <njnewm@essex.ac.uk>
    - Added: `CLI` only section written by Manu Coutris. <coutris@ie2.u−psud.fr>
    - Added: One step beyond section.
- v 0.0.7 March 2000, second release.
- v 0.0.5 December 1999, first release.
- v 0.0.1 November 1999, first draft.

---

22. Thanks and Credits.

- I would like to thank among other people:
    - Werner Heuser <wehe@snafu.de> for the work he has done maintaining his Laptop−HOWTO
    - The people of the Wearable mailing list which proved to be very informative and open minded.
    - My friend Manu Coutris for his never ending patience and kindness.
    - "Old Crocodile" Virgile for his wyse and smart advices.
    - The people of the Wearable community whose discussion and web sites strengthen my confidence in the wearable concept.

    - ♦ Professor Steve Mann for his patience and for beeing one of the pionners in the Wearable Computing field. I also wish to thank him for the wearcompdef, wearcompfaq and wristwatch wearable links.
- The The Sulawesi project. section is written by Neill Newman <njnewm@essex.ac.uk>
- The `CLI` only. section is written by Manu Coutris <coutris@ie2.u−psud.fr>

---

23. Copyright, Disclaimer and Trademarks
