

The Shopping Jacket: Wearable Computing for the Consumer*

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Abstract. As part of the Bristol Wearable Computing Initiative we are exploring location sensing systems suitable for use with Wearable Computing. In this paper we present our findings, and in particular a wearable application - the 'Shopping Jacket' - which relies on a minimal infrastructure to be effective. We use two positioning devices, 'Pingers' and GPS. The Pinger is used to signal the presence of a shop, and to indicate the type of shop and it's website. The GPS is used to disambiguate which branch of a high street chain we are passing. The wearable uses this information to determine whether the wearer needs to be alerted that they are passing an interesting shop, or to direct the wearer around a shopping mall.

The shopping jacket integrates a wearable CardPC; GPS and Pinger receivers; a near-field radio link; hand-held display; GSM data telephone; and a speech interface into a conventional sports blazer.

Keywords - wearable computer, location sensing, GPS, pinger, shopping jacket.

1 Introduction and Background

Wearable computers have the potential to enhance the day-to-day activities of the user. Applications that support many specialised activities have been explored and demonstrated in fields as diverse as aircraft maintenance [1], virtual conferencing [2] and in the medical field [3]. We are interested in the day-to-day use of wearable computers which use contextual information to assist the interaction between the user, the wearable computer and the internet [4]. Our first application was designed to display pages of tourist information at relevant locations around the City of Bristol. While this application successfully demonstrated the effectiveness of situated computing, it was limited by the accuracy of the GPS data.

In this, our next project, we sought to explore increased interaction and to address the shortcomings of GPS. We developed a short range transmitter - or Pinger, see Section 3 - which transmits an IP Address and a type identifier, to work in conjunction with a Shopping Jacket which assists with the shopping activity.

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2 The Shopping Jacket

The Wearable Computer, combined with the internet, presents many opportunities for aiding shoppers. With this design, we are not interested in e-commerce on the internet - we wish to employ the internet, together with a wearable (or PDA), to aid people who want to visit shops to browse and to select goods for purchase. This application enables the integration of three types of information:-

- The presence of pinger data is used to identify that the wearer is in the vicinity of an interesting place or object - in this instance, a shop.
- The pinger data carries information about the type of shop, as well as the IP address of the shop's web site. The wearable can contact the website to obtain details about the shop.
- GPS data is used to disambiguate between several shops on a high street chain. We are not concerned about the accuracy of the GPS data as shops of a similar chain are usually not close together.

We have explored two scenarios, and are investigating a number of additional related services, to make shopping an easier and more effective experience.

2.1 Subliminal Shopping

In this scenario, a shopping list is stored on the wearable computer either by using a remote keyboard/PDA or by recording audio notes. The shopping list can be compiled or added to at any time the user wishes.

The proximity of a shop is sensed by a pinger which enables automatic contact to be made with the shop's IP address. We used GPS to identify particular branches of high street chains. Combining the pinger data and the GPS data in this way has many advantages. Without the pinger data we would need a database of shops and their locations; this database would be large and out of date as soon as it is created. Pingers are local by their nature and can move around with the shop. Using GPS data with the pinger means that we reduce the amount of information that the pinger needs to transmit.

We configure the pinger to transmit only the elementary data i.e. which shop is this (IP address), and the services that this shop offers (200 categories from the yellow pages). If the jacket decides that the wearer may be interested in those services, the GPS data is used to find out exactly which branch of a shop it is, and the shop's web site is then used to find out whether any of the items on the wearer's shopping list are actually available in this branch.

The wearable computer sends the shopping list to the shop's server. By matching the text on the list, or by using speech recognition to analyse the pre-recorded notes, the shop server carries out a search on its database and returns an audio prompt to the wearer if goods on the list are available. The wearer thus is only alerted when passing a shop stocking an item of interest.

2.2 Active Shopping

Here the wearer has intentionally approached a shopping precinct or mall. Again the wearable is alerted to the presence of retail services but this time contacts a server with access to data relevant to all the shops in the vicinity - this includes the goods stocked in the shops, their prices and locations. The Wearable Computer sends a shopping list to the shops in the area and, if the user wishes, a personal profile. The list again is analysed and in this case more detailed information is sent to the wearer. The information is sent either as audio notes, or for display on a hand held device. As well as a list of items available and comparative prices, the wearer is directed to the appropriate locations or told not to bother because an item is not in stock.

The possibility also exists for personalised advertising. By sending the user's profile to the shop server, the wearer can be alerted to new products and special offers of personal interest at the shopping centre. In conjunction with the shop's web-site, the hand held display acts as a sales assistant giving interactive information about the shop and its goods for sale. This provides an alternative to searching a store for a particular item or queuing with a query for a (real) shop assistant. The need for shoppers to search around to find the items they need at the best prices, and to find which shops actually have the items in stock is eliminated. Using shortest route algorithms, the most effective route could also be plotted within or between the shops.

2.3 Enhancements

A short-range wireless data link - the Footbridge [5] - has been used with a hand held display to display the results of the search and to provide more explicit information about the shop. Bluetooth also provides a solution for a wireless personal area network, which could also access information posts. Electronic money and loyalty cards to pay for the shopping can also be taken care of by the wearable. Finally, the till receipt can be transferred to the jacket to update the shopping list and personal accounts.

3 The Pinger

The concept of a short range messaging system has already been explored by M.I.T. [6] and H-P Labs [7] using infra-red devices. Our pinger design - shown in Figure 1 uses radio frequency to eliminate the need for line of sight contact. It transmits the IP address associated with the location/object; a type identifying code; and a checksum. This data format minimises the transmission time and hence the possibility of collisions occurring; it also helps conserve the battery life.

A PIC microcontroller generates the identifying IP address and type reference number. This is coded to provide a serial data signal, as well as security, by a remote control coding IC. The resulting signal is passed to a 418MHz licence exempt FM transmitter. Operating in the general purpose telecommand/telemetry

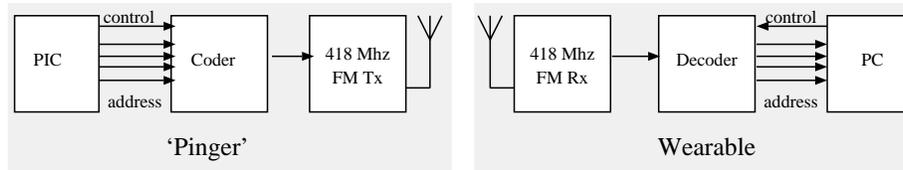


Fig. 1. Pinger Design.

band, the transmitter has a range of up to 100m and can be configured to provide a signal to within 10m of a shop front. The pinger transmits a short code once every five seconds. The receiver alerts the wearable computer to the presence of a shop, or something else which may be of interest to the shopper, such as a pillar-box or bus stop. The received address enables the wearable to connect to a relevant web-site with related information.

4 Implementation

The factors used to select devices for this project were low cost, ready availability and the need for relatively simple construction techniques. A conventional sports blazer is used to house the computer and devices that make up the 'Shopping Jacket'. Power is provided by Sony NP550 LiIon batteries, and the processor used is an Epson CardPC486 with a sound card. A throat microphone with speech recognition software provides the user input for commands and audio notes, and audio messages are output to an earpiece using MBROLA TTS. A 12 channel GPS receiver using the Rockwell Zodiac Chipset provides the additional location data to complement the pinger.

A GSM phone which, despite connection delays and relatively low data rates, provides a low cost method of providing a mobile connection to the internet. The effectiveness of the 'phone link is improved considerably by caching data such as images from the web-sites of regularly visited shops. In the future, UMTS will provide a faster service.

We have used the Footbridge design to enable localised, reliable transactions to take place. The 10MHz transceiver is built into the jacket cuff. The mobile 'phone gives a low bandwidth link at any location, whereas the Footbridge is high bandwidth, but highly localised. Together, they provide timely data.

Our software design uses an event management structure running on a Linux operating system. A sensor module is programmed to respond to the particular pinger types which we are interested in. When the sensor module receives a signal of the right type it creates an event which triggers the 'shopping' application. This architecture [8] has been adopted to take advantage of potential power saving opportunities when there are no events present.

5 Conclusion

We have integrated pingers, GSM 'phone, GPS and the Footbridge into a wearable solution to aid the shopping process. We have demonstrated the use of pingers as a fast and reliable solution for providing pointers to relevant information sources. The GSM mobile phone datalink, when connected, worked reliably though the delay in connecting often meant that the wearer of the shopping jacket had to backtrack to return to the shop. This proved to be the main drawback of the design. The Footbridge with it's higher data rate is a useful tool working in most situations.

This wearable configuration demonstrates a potential application which will be fully viable with both the introduction of 3rd generation mobile telephony and the widespread adoption of Bluetooth technology.

References

1. J.J. Ockerman and Pritchett A.R. Task guidance in aircraft inspection. In *Proceedings of The Second International Symposium on Wearable Computers*, pages 33–40, October 1998.
2. M. Billinghamurst, J. Bowskill, M. Jessop, and J. Morphett. A wearable spatial conferencing space. In *Proceedings of The Second International Symposium on Wearable Computers*, pages 76–83, October 1998.
3. E.J. Lind, R. Eisler, S. Jayaraman, and T McKee. A sensate liner for personnel monitoring applications. In *Proceedings of The First International Symposium on Wearable Computers*, pages 98–105, October 1997.
4. R. Hull, P. Neaves, and J. Bedford-Roberts. Towards situated computing. In *Proceedings of The First International Symposium on Wearable Computers*, pages 146–153, October 1997.
5. P. Neaves and J. Bedford-Roberts. Dynamic connection of wearable computers to companion devices using near-field radio. In *Proceedings of The Second International Symposium on Wearable Computers*, pages 156–157, October 1998.
6. T. Starner, D. Kirsch, and S. Assefa. The locust swarm: An enviromentally-powered, networkless location and messaging system. In *Proceedings of The First International Symposium on Wearable Computers*, pages 169–170, October 1997.
7. H-P Labs. The web: it's not just for desktops anymore. <http://cooltown.hp.com/>.
8. H. Muller and C. Randell. An event-driven sensor architecture for low power wearables. In *Workshop on Software Engineering for Wearable and Pervasive Computing*, June 2000.