

# Handheld solutions for the retail sector

A new handheld system for barcode scanning and stock control in supermarkets has been developed to replace older proprietary hardware in the retail sector. Developers, Sean Coughlan runner-up in the Siemens IEI Young Engineer of the Year competition, and his project supervisor, Dr. John Breslin of the Department of Electronic Engineering, NUI Galway, report.



*The device was developed based on a Palm operating system.*

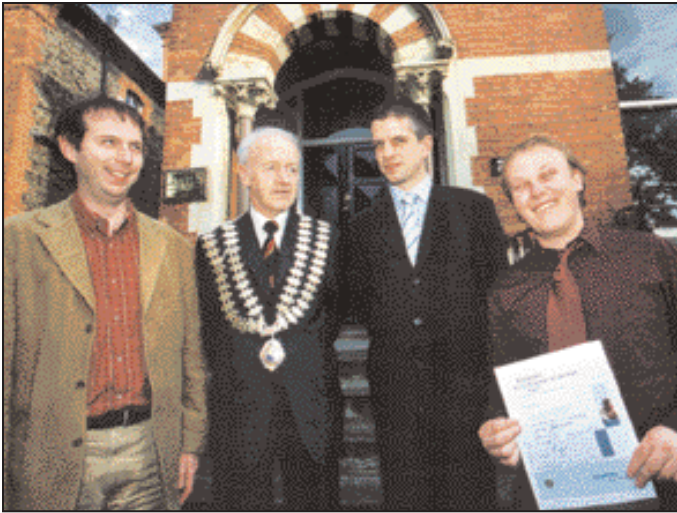
**T**raditionally, proprietary systems for stock control in supermarkets have been limited in terms of price, usability, functionality and speed. The new PDA (personal digital assistant) system, developed as part of a final year degree project sponsored by Merit Solutions in Galway, uses off-the-shelf hardware for which there are multiple suppliers. Hence, its future is secure. The cost to the retailer is potentially one-fifth that of previous proprietary systems. As well as the lower price tag, the handheld is competitive due to the amount of features the system boasts.

The device incorporates a comprehensive set of user-friendly applications, developed for product creation, stock checking, and so on. The speed of the system is instantaneous, solving a common problem with many handheld implementations on the market today. Because the components are more easily obtained, there is a reduced cost in supporting and maintaining the hardware, and there is also a greater opportunity for future development of the product beyond the retail sector. As part of the design, alternative handheld hardware were identified; retail handheld software was written; wireless communication protocols were implemented; server software and utilities to access product databases were written. The system has undergone quality testing and has been successfully used in four live shop environments around the country.

## PDAs for barcode scanning

Barcode scanning handheld mobile computing devices have been commonplace in the retail industry for some time. Most of these devices are specifically made for use only in retailing. They come in two forms: networked wireless and 'batch' (non-wireless, where data must be synchronised via cable before operation). They tend to run some DOS variant on an x86-type architecture. The applications for these devices might typically contain price checking, product lookup and print label functionality. Unfortunately, apart from high cost and weight issues, these systems were traditionally limited to displaying text, making interaction difficult.

The PDA sector has seen solid growth over the last few years, and with it, there has been growth in the number of fields and areas, in which applications have been written. With wireless communications as standard in many PDAs, the retail industry is an obvious choice for the development of PDA applications, allowing remote creation and maintenance of product information on a central database server. Some other benefits of replacing the proprietary device with a PDA include the fact that multiple PDA suppliers are producing many lower-cost devices in this growing market; the software written for them is not limited to one language or look and feel, and they are widely supported with a large range of pre-existing software; PDAs have multiple uses so the retailer is not only buying a retail handheld, but a productivity tool and mobile



Project supervisor Dr. John Breslin from the Department of Electronic Engineering, National University of Ireland, Galway; Peter Langford, IEI President, Damian Murray, Sales Support Manager, Siemens., and runner-up prize in the Siemens IEI Young Engineer of the Year competition, Sean Coughlan.

computer; and once the software for the PDA has been written, there is greater flexibility later for improvement.

### System architecture

In brief, the architecture chosen for the system is as follows.: the PalmOS v4.1 operating system runs on a Symbol SPT1846 PDA device, the 'SuperWaba' Java Virtual Machine (JVM) is installed on this PalmOS, and the handheld software application runs on the SuperWaba JVM.

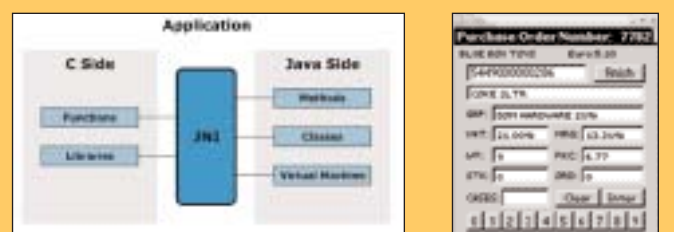
The handheld software initialises the network card, and communicates with the server system (hosting the retailer's product information database) using the TCP/IP network protocol via a wireless access point. The server runs on the RedHat Linux 7.3 operating system, and a custom Java-coded daemon that allows network access from PDA clients is loaded at server start-up. The network daemon is a multi-threaded passive server and can therefore handle multiple handheld connections from staff located around the supermarket or shop floor. The daemon allows communication with a product database via a set of custom libraries, and product or other information is returned back to the handheld in real time.

### Handheld application

The developed handheld application is proprietary to open source software and was developed in a combination of SuperWaba Java, C using GCC and the PalmOS software development kit. Over 15,000 lines of actual source code were created in a complete Linux build and deployment environment. Some custom implementations of many controls exposed by the SuperWaba consortium were necessary and returned to the development community. The system is also secure as each employee has an operator login and passcode. The functionality incorporated in the software includes purchasing, product maintenance, stock count and control, papers and magazines.

### Networking daemon

The software on the PDA communicates over an 802.11b wireless network link to the server. A TCP/IP protocol had to be implemented to



ABOVE: JNI allows Java code that runs within JVM to operate with applications written in other languages.

ABOVE RIGHT: Screen showing the purchasing sub-section.

allow for communication. This protocol specification describes how the PDA, or any other client, can make requests for information retrieval from the server or make requests for information input into the server. It also describes the appropriate responses for all the requests. Many possible scenarios involving errors and warnings with information retrieval/input are taken into account. The multi-threaded TCP daemon was written in Java. A virtual screen is allocated on the server that outputs a log of all communications with the daemon. Every action, carried out on the handheld device, is logged on the server and is effectively stored immediately in the database.

### Database libraries

The databases on which product information was stored are ISAM (Indexed Sequential Access Method) databases, a precursor to relational databases. Since the networking daemon was created in Java, a Java-based method that could read and write to an ISAM database was required, as well as use any other features provided by ISAM. This proved challenging to do as the only way to access ISAM databases up until now was to use a C-API provided by IBM called C-ISAM, and a shared C library, which acted as a wrapper to the static C-ISAM libraries had to be created. Calls to the shared C library could then be made from Java using the JNI (Java Native Interface.)

### System benefits

The system has undergone quality testing and has been deployed successfully in four live shop environments without any major problems. As already mentioned, this system uses off-the-shelf hardware, i.e. the Palm Pilot and the wireless access point. There are multiple possible suppliers for all the hardware used, so the future of the system is secure. Most importantly, the cost to the retailer is potentially one fifth that of previous systems.

A comprehensive set of user-friendly applications has been written. The speed of the system is especially unique; there is no interval between the time a product is scanned and the instant all the product information appears on screen. This is a common problem with many handheld implementations on the market in the retail industry today. The system can easily be updated to incorporate future functionality such as scanning of products at the back door, support for outer case barcodes or shelf replenishment, and there are many opportunities for future development of the system beyond the retail sector. In summary, the new system is more cost effective, more widely available, better supported, and its future development is assured.