Preface

OVERVIEW

This edited book project began when our colleague, Dr. John Ayoade visited us from what was then his post at the University of the South Pacific. Both Auckland University of Technology and the University of the South Pacific have growing postgraduate research degrees in Information Science and both Universities offer a course in contemporary issues and ubiquitous computing. There are many conference formats such as the annual ubicomp conference that attracts an international body of researchers. However, we had found a lack of information on applications of RFID.

At the time of inception of this project, RFID was beginning to return from a cycle of ridicule caused by over hyping and overselling the capabilities of RFID during 2004 and 2005. Therefore, we felt it was timely to draw on the advances made in the RFID hardware development field and to showcase some of the very important work in the field.

We edited this book with our postgraduate research students in mind, to demonstrate some of the applications of RFID technology and to show that it is not just a glorified barcode that will eventually hold the universal product code of every item in the supermarket. Whenever we socialised the concept of RFID with our students, they fairly quickly came up with the concept of being able to walk a trolley of groceries through a portal at the supermarket and have the technology tally and total the order in a matter of seconds. As favourable as this may seam, RFID has far more potential than this, and will reach much further than Wal-Mart and will have more profound effects on the economy other than simply helping Gillette have less stock shrinkage.

This book is essentially about applications of RFID and smart technologies which has arisen out of our own fruitless search for published applications of RFID. In our work since 2005 we have worked with many different RFID hardware and tag suppliers and we have noticed that as researchers and industry have developed more applications that push the edge of RFID capability, more innovative, portable and multi-function versions of RFID hardware have emerged. In our research with assisted living, our first prototypes struggled with readers that simply did not have the read range or power capacity to do what we wanted. We then moved to more powerful readers, but these were too large, heavy and too hard to supply power to. Only now are we finding more portable equipment. However, we regard this as an important cycle of application development feeding back into the hardware development and design. Therefore, through encouraging authors to publish their work on RFID application development we hope to help hardware developers to fine-tune their designs further to meet the application needs better.

WHERE THE TOPIC FITS IN THE WORLD TODAY

In the information age, consumers have access to instant, detailed information about the products and services that they purchase. There is so much more information available about our individual health. Also, our world seems to be under threat from animal and human diseases, the cost of fossil fuel and the effects of global warming. Consumers want to know more about the status of their own health so that they can seek alternative treatments. Consumers want to know where their food comes from so that they can made informed decisions about buying local and buying disease free food. Consumers also have more reactions to processed food and therefore want to know more about the contents of the foods that they eat. The world today is demanding more information than can fit on a label. Hence, there is a place for RFID and other smart technologies to provide more local information. Imagine, for example, being able to verify the geographic area where your T-bone steak originated from or if you could have your own personal health heart tick on your personal digital assistant that will quickly guide you on what food to purchase in order to live better as you browse the supermarket shelves.

The developed world is heading down the carbon neutral path. Australia and New Zealand already have voluntary carbon emissions trading schemes that are listed on the stock exchange. In 2010, tracking carbon emissions will begin to become compulsory. Information that can be stored in central databases can be difficult to access and might be bared by stakeholders or may not be accessible do to incongruent data standards. Because products cross many of the natural boundaries in our world such as companies and countries, the probability that one countries data will not be accessible by other countries is high. On the face of it, carbon emissions trading schemes appear to allow dirty companies to simply pay for their emissions and continue on their way without addressing it. However, market competition will place pressure on companies and countries with high emissions as they will need to lower their costs in order to compete with other cleaner competitors.

Storing data on tags or other low cost solid state storage alternatives so that it can be read easily be each company in the supply chain will allow statistics about the product including carbon emissions data to travel with the product. Therefore, possession of the product will also mean possession of the data. Having the tags travel with the product will also enforce standards and require the installation of RFID readers that can read many different types of tag. RFID tags have the advantage of being about to communicate their data wirelessly and without line of sight. The can also potentially hold much more data than can be coded into a barcode or magnet strip.

THE CHAPTER SUBMISSIONS

Chapter I starts by setting the scene for the rest of the book by giving a information-oriented view of the development of RFID. This work is covered by Chin Boo Soon from The University of Auckland in New Zealand. Chin Boo's interest in supply chain management shows through in this first chapter and readers are treated to a thorough and intelligent summary of automatic identification technology and the development of RFID. Although we don't focus blindly on RFID, most of the chapters are concerned with it, and so by setting the scene up front we managed to avoid unwanted repetition throughout the book and we also provide a very valuable introduction to the topic area for postgraduate students who might be considering several research areas before making a final choice for their dissertation topic. Course leaders might also use some of the material from this chapter in their introductory sessions with students.

Around 2004, Nokia released a mobile phone with a RFID reader. They developed in-car kits that could allow the user to swipe certain tags to perform a set of activities on their phone. It was envisaged that maybe bill posters could also include RFID tags with URL information that the consumer could download to their phones and access later. Alas, Nokias mobile phone RFID reader was before its time and they discontinued the line as it was a technology looking for an application. However, that time for RFID readers and near field communications enabled phones may be approaching as John Garofalakis and Christos Mettouris demonstrate a wireless system that could be used in supermarkets to push information to users based on their position within the store.

There is a wide range in size of tags ranging from large battery powered tags that are approximately the size of a cigarette packet down to small passive tags that rely on the reader unit for power that can be as small as a grain of sand. Small tags could be embedded in high value personal belongings such as cell phones, plasma TVs and garden equipment which could allow the owners details to be stored with each item. As we discuss in our chapter, finding and verifying the owners of recovered stolen or lost items can be time consuming and difficult. In addition, potential identification of items using very small tags may actually act as a deterrent for would-be thieves. Equally, if the information on the tags is completely open to be read with any reader that uses the corresponding standard may be dangerous if it falls into the wrong hands. We draw particularly on John's framework for encryption and authentication for readers to address this problem.

Experts tell us that by 2020, the world will have difficulty producing enough food for earth's population, as the current cropping methods become less efficient against global warming and the current fields become less fertile. There is also the added threat of diseases. Honey bees can be attacked by mites and other vegetable and fruit crops can be attacked by mould, but perhaps the most serious threats are posed by diseases in animals such as mad cow and foot and mouth. In an outbreak, the movements of stock must be traced over the incubation timeframe and in the current environment were permits to move stock are not necessarily enforced and are either paper-based or stored in separate databases, marshalling such a wide-range of data with any certainty can be so impossible that the only option is for officials to order the mass slaughter and destruction of animals within a "hot zone". A technology such as RFID could alleviate this problem by automatically tracking the movement of stock. Filippo Gandino and colleagues consider the European challenges for management of data that might be collected electronically and then used to trace stock movements in the case of a disease outbreak.

There is something about an aquarium that is soothing and comforting. Many high stress environments use an aquarium to providing a calming environment. The dentist office in the movie "Finding Nemo" is a good example. Lena Mamykina and Elizabeth Mynatt are our only contributors from the United States and interestingly, they use a type of aquarium screen saver idea to convey complex medical data to lay people. Although not about RFID specifically, their work is about interpreting large amounts of complex data in a very meaningful way and in this way, the authors are able to make a fascinating contribution that will be readers interested in design.

RFID is already a major enabling technology for smart buildings and has replaced keyed office buildings to some extent because unlike a key, a RFID badge can be enabled and disabled through a central management system. Instead of needing to rekey a whole office floor in the case of a lost key, administrators can simply disable the lost badge. However, many industries including manufacturing environments and hospitals would like to implement RFID enabled time cards. Time cards would speed clocking on and clocking off and could give management an idea of how many people are on the factory floor and whether they are dispersed correctly, however, some workers unions fear that detailed

information about the specific location of employees whilst at work could invade individual privacy. By way of indepth interviews, Bryan Houliston explores some of the perceptions of using RFID in the healthcare workforce. Health is renowned for its lack of technology update and Bryan's interview data certainly sheds some light on the perceptions of healthcare workers on RFID.

Many of our hospitals are being pushed to breaking point. As changes in healthcare enhance our quality of life and help us to live longer, more people are living for longer and therefore we have an increase in the number of frail elderly people in our community. These are people who want to remain in their own homes and assisted living systems can help. In our article we look at different ways to interpret information from RFID tags and readers to better understand placement of objects within a map of landmarks within the home. Our initial work was with a much larger "industrial sized" reader and passive HF tags (the reader is 1.6kg) and required a large batter pack for portable power supply. Our more recent work involves a smaller UHF reader with a more portable design.

RFID tags themselves are quite robust. The antenna and microprocessor can be encapsulated with plastic or glass. Tags are made to withstand commercial laundry processes as well as being inserted into flesh. That is why Ashir and Ly-Fie consider RFID in their work in emergency management which covers response to all kinds of natural disasters including some of the most destruction forces of fire (in a bush or wild fire for example) and water (in a tsunami for example).

Video surveillance data is collected in case it is needed. When needed, humans sift back through it to find significant data. Imagine what might be possible if real-time online tracking of video data were possible. Bin Shen and Yu-Jin Zhang work on this problem and provide details of a prototype system that is unique in the way it samples video frames, thus cutting down on the overhead required to track objects in real-time data.

In our anecdotal experience, "land-line" infrastructure in homes is being overtaken by mobile cell networks and voice-over-IP. Technologies that rely on telecommunications infrastructure in the home now need to cater for both the possibility of a mobile telecommunications link as an alternative to a fixed telecommunications link. This signifies the beginning of a need to develop frameworks and approaches for fixed-mobile convergence. John Ayoade begins very important work in canvassing the existing work in the literature.

The final chapter reports on important work being undertaken at AUT around the new challenges with data management. Smart technology at the local site can allow more manipulation of the data to be undertaken and more consolidated, useful information can be made available. Also, storing data locally allows critical data to travel with the object it describes and so access to that data is not reliant on access to a communications network and central data repository. However, this ability to store and manipulate data locally also presents challenges in terms of data manipulation of time sensitive data and tools needed to model and develop. This chapter explores these challenges, consolidating existing work completed in the area and recommending future work.

In the final section, we have assembled a selection of six readings that will provide further information on RFID applications. These applications include examples from library management systems.

Much of the work in object location systems has relevance to library information systems. Although RFID is considered a candidate to replace barcodes in borrower systems, there is far greater application for keeping track of tangible resources (books, CDs and so on) that become misplaced in the building and are not recoverable. Maryam Purvis, Toktam Ebadi, and Bastin Savarimuthu of University of Otago, New Zealand report on an Agent-based Library Management System using RFID Technology. Their prototype uses an intelligent robot that periodically scans the shelves to check the location of items.

Future applications might also apply the same sort of technology to develop smart shelving that can keep track of resources and interfaces with the borrowing records to verify if resources are on loan or still somewhere in the library. Similarly, resources that are not registered with that shelf can be identified and flagged for reshelving.

As the capability to read, store, and use data from sensors in the environment, so does the information overload. Indranil Bose and Chun Lam of The University of Hong Kong, Hong Kong, address the issues of this overload in their chapter "Facing the Challenges of RFID Data Management". They provide a thorough discussion of the challenges such as false read, data overload, and real time acquisition of data, data security and privacy for readers considering working in this area.

RFID tags are increasingly being used for identification of users in systems. At the time of writing, the Auckland domestic airport in New Zealand has issued adhesive RFID chips to frequent fliers. The chip provides for fast processing of passenger details at automated check-in desks and flight gates. However, the security of such information needs to be ensured as some RFID tags can be effectively skimmed by modern day pick pockets with mobile RFID readers. Masoud Mohammadian of University of Canberra, Australia, and Ric Jentzsch of Compucat Research, Australia, consider the privacy problem where RFID tags are used to store patient details. They argue that the best way to address this problem is to employ a Passive RFID Detection System and they present a research framework based on their work.

The final reading covers much of the history of radio frequency development and considers RFID as a replacement for the ubiquitous barcode. The work by David Wyld, Southeastern Louisiana University, USA, serves as a valuable overview of the technology and along with our introductory chapter, is excellent background reading. However, readers should remember that the replacement of barcodes with RFID tags is just one application of RFID technology and is a specialised research field in its own right.

CONCLUSION

Almost every student knows of what Wal-Mart and Gillette achieved with RFID. But so much more is possible with RFID in that initial uptake has been to use the technology in much the same way as a barcode. New applications of RFID technology are looking at using it in new ways that take advantage of the strengths of the technology. In this edited book we set out to showcase some of the more novel and innovative applications of RFID and smart technologies to show how the technology could add value to business. We believe that we have achieved this. We have attracted authors from an international stage and from varied backgrounds and have brought them together into one book for the benefit of postgraduate students and researchers who want to learn more about RFID worldwide.