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THOMSON REUTERS

[Mishra* *et al.*, 6(7): July, 2017]
IC™ Value: 3.00

ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

IJESRT

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

RFID INTEGRATED SYSTEM FOR TAGGING AND IMPLEMENTATION

Dr Alok Mishra[*1] & Dr Kamlesh Singh[2]

[*1]Department of Applied Science, Ambalika Institute of Management & Technology, Lucknow
[2]Department of Mechanical Engineering, Ambalika Institute of Management & Technology, Lucknow

DOI: 10.5281/zenodo.834491

ABSTRACT

At the very simplest level, Radio Frequency Identification (RFID) technologies allow the transmission of a unique serial number wirelessly, using radio waves. The two key parts of the system that are needed to do this are the RFID 'tag' and the 'reader'; attaching an RFID tag to a physical object allows the object to be 'seen' and monitored by existing computer networks and back-office administration systems.

So far, the key driver for the development of RFID systems has been the desire to improve efficiency in globalised supply chains but implementation of the technology has been problematic. This is partly due to the manufacturing costs of tags, which are currently too high to justify widespread deployment across supply chains in the way that was originally imagined, and partly due to concerns over the potential for infringing the privacy of consumers who purchase RFID-tagged products. In addition, there are concerns about the health implications for staff employed in RFID-enabled workplaces, although this has not received as much attention in the press

I. INTRODUCTION

The history of RFID (Radio Frequency Identification) can be tracked as far back as the 1920s with the birth of radar systems (the word radar is an acronym for radio detection and ranging). The development of the technology, a combination of radar and radio broadcast technology, is messy and convoluted but there is consensus that it developed from the work carried out during WW2 to identify enemy aircraft, known as 'Identification: Friend or Foe' (IFF) systems.

II. WHAT IS RFID? THE BASICS

An RFID system has two main components: the RF reader (known also as the base-station or interrogator) and the RF tag (or transponder)shown in figure(2). When RFID tags are attached to physical objects they enable those objects to identify themselves to RFID readers through the use of radio frequency communication. In principle, and on the very simplest level, RFID tags allow objects to say, “Hello, I’m here and my name is …” The main purpose of an RFID tag is toact as 'glue' to a digitally mediated world are basically two types oftags - Passive tags typically have anywhere from 64 bits to 1 kilobyte of non-volatile memory. Active tags tend to have larger memories with a range of, typically, between 16 bytes and 128 kilobytes (figure1)

A. Radio Frequency

RFID is fundamentally based on wireless communication, making use of radio waves, which form part of the electromagnetic spectrum (i.e. frequencies from 300kHz to 3 GHz). It is not unlike two other wireless technologies, WiFi and Bluetooth. The three technologies are all designed for very different uses and therefore have different functionalities but there is shared ground between the three, with some hybrids starting to appear. RFID systems can utilise both WiFi and Bluetooth and need not see them as competitors.

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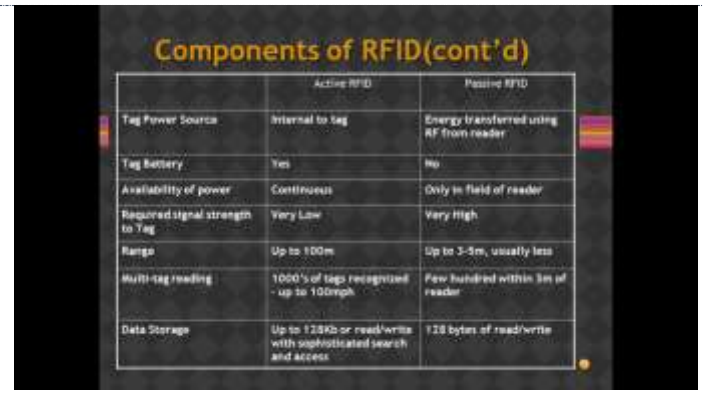

Figure1.Components of RFID

B. RFID Technologies

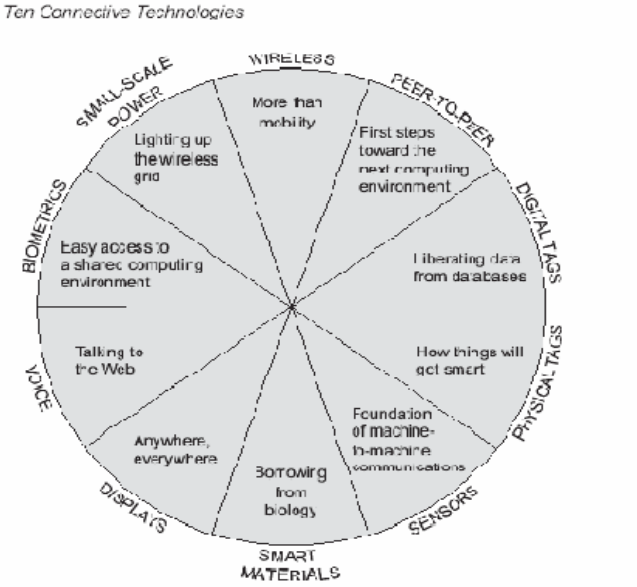

Figure2. RFID technologies

C. Why RFID Is Becoming Important: Barcodes On Steroids

RFID has a wide and growing range of potential uses throughout industry, commerce, education and the public sector more widely. The main driver for the development of the technology is the capability to identify and track the movement of products through the supply chains

Firstly, barcodes are usually printed on paper labels or packaging, and are therefore prone to damage. Secondly, although barcodes can provide inventory data to the level of product category, they can not provide additional data such as 'sell by' dates; this type of extra functionality has the potential to be developed further for things like home automation, where, for example, RFID tags embedded in clothes

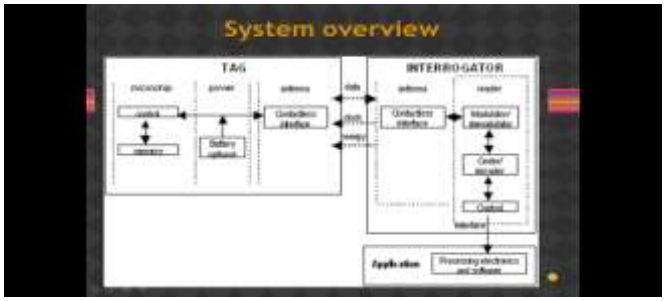

Figure3.System of RFID

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Table 1: RFID class structure.

Class	Class Layer Name	Functionality
1	Identity Tags	Purely passive, identification tags
2	Higher Functionality Tags	Purely passive, identification + some additional functionality (e.g. read/write memory)
3	Semi-Passive Tags	Addition of on-board battery power
4	Active *'ad hoc'* Tags	Communication with other active tags
5	Reader Tags	Able to provide power for and communicate with other tags i.e. can act as a reader, transmitting and receiving radio waves

III. RFID APPLICATIONS

Figure4.Rfid applications

A. General Applications

i. RFID in Education

It is clear that the majority of envisaged commercial applications for RFID revolve around improving the supply chain, stock control and logistics and that as consuming entities universities and colleges will increasingly be handling and working with physical equipment and resources that involve RFID labelling and tagging (for example, expensive medical equipment is beginning to be tagged in large hospitals to allow tracking and prevent loss).

ii. RFID in Libraries

For many years, libraries have used a combination of technologies to reduce the likelihood of theft, improve stocktaking, and speed up issue and return procedures. The advantage of using RFID is that it is capable of incorporating and improving upon existing systems within one technology. For example an RFID reader does not need a direct line of sight, which means that books do not have to be tipped out or even pulled out completely as with barcode scanners, so inventory checking is faster and can be done more frequently.

iii. People tracking and tagging

There could be a number of applications for RFID within education related to security and the identification of staff andstudents, but this, of course, is controversial as there are serious concerns over privacy. RFID technology can be used for the identification and location tracking of a person carrying the tag (which can be embedded into an identification card) and can sed to verify a person's right to enter a particular building or even to access a service.

B. Research Applicatrions

i. Research Equipment

Products are becoming available that incorporate RFID into laboratory equipment for research and medical work. The use of RFID tagging on, for example, test tubes, is designed to reduce human error. In addition,

processes are much faster because RFID tags can be read in large quantities and data can be synchronised with client databases.

ii. Research activities

RFID tagging is being increasingly used as a research tool in experiments and investigations. This is particularly true in biology and ecological studies where tagging of wildlife and monitoring of feeding and migration has been carried out for some years using forms of remotely monitored tag. One example of this type of use is Digital Angel's RFID system in Colombia, Ohio (USA) to monitor the movement of salmon within the river system and at dams.

C. Socio-cultural implications

i. RFID and privacy

The introduction of RFID tags, particularly into the consumer supply chain, has not been without controversy, although the US has borne the brunt of this so far.Most of the concerns stem from the fact that once individuals move around in a world of widespread tagging, the products they buy, wear and consume will be capable of being identified and recorded by a widespread network of readers. Such information could provide a great deal of intelligence on a person, their habits, likes and dislikes and movements.

ii. Approaches to Privacy Protection

In a consumer scenario the most obvious solution to the RFID privacy problem is to disable the tag at the point of sale. However, this is meaningless if the deactivation system is not completely reliable. Also, while it may be appropriate to disable some tags at the point of sale, other tags, e.g. passive tags in library books or active tags used in road toll systems have to remain 'live' while in the possession of the customer.

Disabling RFID tags in consumer environments at the point of sale also means that the tag cannot be used by consumers as an enabling technology for ambient intelligence applications, for example, in advanced recycling applications where the tag's unique ID could be used to automatically sort recyclable material and could also be used to levy waste charges on the manufacturer based on the nature and volume of rubbish collected. Passive RFID tags used in consumer environments could also be used to deliver after sales services for product service records or to provide warranties.

IV. THE FUTURE AND THE BIGGER PICTURE: TOWARDS AN INTERNET OF THINGS

"Conceptualizing them simply as ID tags greatly underestimatestheir capabilities, considering some have local computing power, persistent storage, and communication capabilities"

A key concept in this development trajectory is the **Internet of Things**. A term first coined by RFID developers in the Auto-ID Center in the late 1990s, it is also sometimes referred to as the Product Internet, T2T (Thing to Thing) network, or the M2M (Machine to Machine) network. In this vision, increasingly large numbers of our everyday objects and gadgets will have some kind of simple communication technology embedded into them, allowing them to be connected to each other within local networks and, ultimately, connected to the wider network of networks – the Internet

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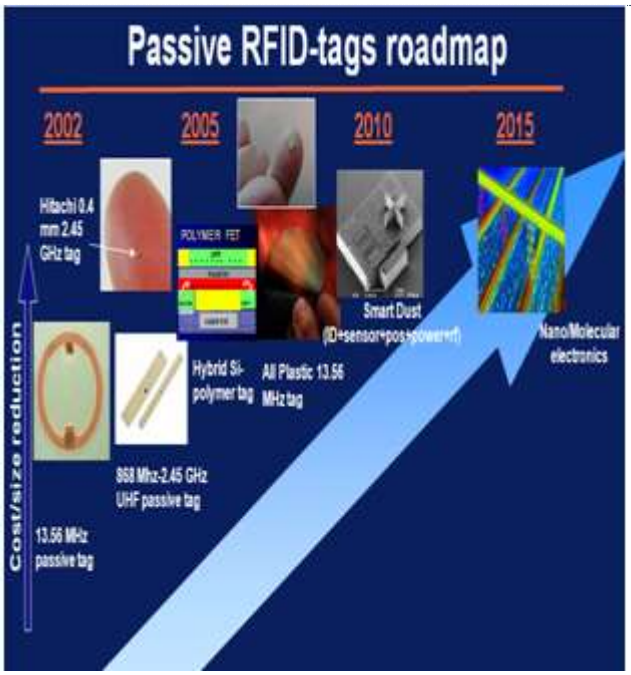

Figure5. RFID tags Roadmap

Table 2: RFID operating frequencies and associated characteristics.

	LF	**HF**	**UHF**	**Microwave**
Band	**Low frequency**	**High frequency**	**Ultra high frequency**	
Frequency	30–300kHz	3–30MHz	300 MHz–3GHz	2–30 GHz
Typical RFID Frequencies	125–134 kHz	13.56 MHz	433 MHz or 865 – 956MHz 2.45 GHz	2.45 GHz
Approximate read range	less than 0.5 metre	Up to 1.5 metres	433 MHz = up to 100 metres 865-956 MHz = 0.5 to 5 metres	Up to 10m
Typical data transfer rate	less than 1 kilobit per second (kbit/s)	Approximately 25 kbit/s	433–956 = 30 kbit/s 2.45 =100 kbit/s	Up to 100 kbit/s

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Characteristics	Short-range, low data transfer rate, penetrates water but not metal.	Higher ranges, reasonable data rate (similar to GSM phone), penetrates water but not metal.	Long ranges, high data transfer rate,	Long range, high data transfer rate, cannot penetrate water or metal
			concurrent read of <100 items, cannot penetrate water or metals	
			Specialist animal tracking	
Typical use	Animal ID	Smart Labels	Logistics	Moving vehicle toll
	Car immobiliser	Contact-less travel cards		
		Access & Security		

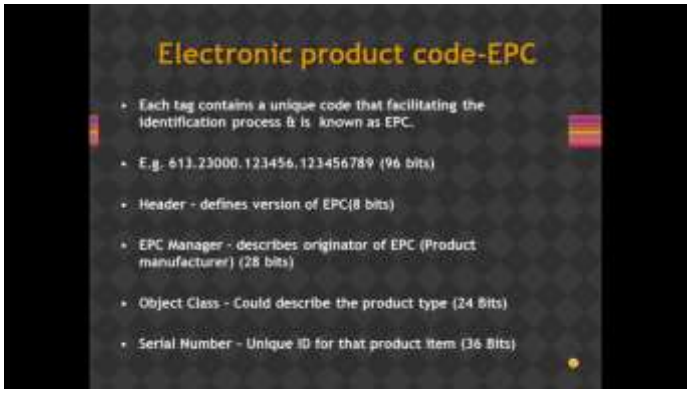

Figure6.Standard codes

V. DATABASE CONNECTIVITY

Information scanned from a RFID label can easily be saved to a database. The data can be extracted partially or fully from all components of the RFID information .A user-friendly database wizard built in query builder,and even a custom SQL scripting are available to retrieve data from any type of database-enterprise or local. Whether the database is a plain ASCII text file,Excelspreadsheet,or enterprise database(like oracle or SQL server),there are no limitations to connectivity options.

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Figure7.Database Connectivity

VI. DATA STREAM CONNECTIVITY

Nice Watch provides an affordable middle-ware solution when automatic printing is required in a multi-operating system network or complex application environment. Nice Watch can monitor and detect data in many different formats to trigger the start of label production without operator intervention. One of the standard scenarios involves writing data or command files from an ERP system to a shared drive. Even with the rich functionality development is done in a quick and easy manner requiring no extensive knowledge or training.

Figure8.Datastream Connectivity

VII. A LIST OF RFID ATTRIBUTES FROM A VARIETY OF SOURCES

- RFID tags come in a wide variety of shapes and sizes.
- Its brains are a tiny embedded digital memory chip, currently about the size of a pinhead.
- These tags are very cheap, approximately 30 cents U.S. each, which means that they are becoming inexpensive enough to be used widely.
- It is easier to scan than a bar code.
- One of its most promising attributes is its ability to have the data in its memory change as it moves along the supply chain from manufacturer to end consumer.
- Passive tags have a wire coil that react to radio signals and allow data collection, while the more expensive active ones contain batteries and emit radio signals.
- A basic RFID system consists of an antenna or coil, a transceiver (with decoder), and an RFID transponder.
- RFID systems are also distinguished by their frequency ranges.
- Current developments that will see the light of day in the next few years, are likely to drastically reduce the production price, allowing far greater commercial penetration of RFID technology.

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VIII. CONCLUSION

As a fledgling technology RFID is starting to make an impact on the core business of F&HE. Libraries are likely to initiate most of the activity over the next five years or so, but applications within administration and research are also likely to increase. It is, as yet, unclear to what extent RFID will impact on teaching and learning other than within specialist projects and it is probably more likely that these applications will develop alongside more general ubicompdevelopments.RFID has the potential to be a hugely significant technology within the ubicomp vision. However, the benefits of a pervasive computing environment are unlikely to be realised unless the technology can be trusted. Where that trust does not yet exist, or is likely to be undermined by problems that may arise as the consequence of ill-considered or malicious implementation of parts of the technological 'jigsaw', the ubicomp vision will also be negatively affected. The F&HE community cannot rely on the relative ease with which RFID has so far been implemented in the UK – it is widely acknowledged That there are genuine concerns around the implementation of the technology and it would be wise for JISC to make good use of its position within the pan-European HE/ICT community to initiate a pro-active approach to developments that will impact positively on UK F&HE.

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Mishra, Alok , Dr, and Kamlesh Singh, Dr. "RFID INTEGRATED SYSTEM FOR TAGGING AND IMPLEMENTATION." ***INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY*** **6.7 (2017): 766-73. Web. 25 July 2017.**