International Journal of Electrical and Electronics Research ISSN 2348-6988 (online)
Vol. 4, Issue 4, pp: (79-86), Month: October - December 2016, Available at: www.researchpublish.com

A Review of Radio Frequency Identification (RFID) System

S.O. Anaza [1], M. S. Abdulazeez[2], I. Anugboba[3], S. I. Anako[4], K. U. Abdullahi[5]

[1, 2,3,4,5] Power Equipment and Electrical Machinery Development Institute, (PEEMADI) Okene, Kogi State, Nigeria

Abstract: **Radio frequency identification (RFID) system is a wireless technology deployed in virtually all spheres of life in to identify objects by means of radio signals. In recent times, the development RFID technology has been alarming with enormous advantages despite its predicament and its been used for several purposes such as: production control, merchandise management, health care services and logistics management. This paper present a preview of the various aspects of RFID by reviewing its applications, limitations, merits/demerits, the standards and the technology involve. The approach produces a unique result which solves the problem of laborious literature survey to obtain basic knowledge of RFID.**

Keywords: **radio, frequency, technology, wireless.**

1. INTRODUCTION

The awaiting storms of potentially distracting technology have found ways to bring comfort in our lives by means of evolution of technology in various aspects. “Smart tags” or “Smart Chip” are interchangeable moniker for this technology. The technology is called Radio Frequency Identification (RFID) technology [1]. The concept of the technology dates to the mid late 1940s, following the technological developments in the 1930s and the development of radar during World War II [2]. Although the foundation of the Radio Frequency Identification (RFID) technology was laid by past generations, only recent advances opened an expanding application range to its practical implementation [3]. RFID is a generic technological concept that refers to the use of radio waves to identify objects [4]

The aim of this paper is to conduct a literature survey of the various aspects of RFID, by reviewing the RFID technology itself and all the necessary standards. The possible areas of application will be enumerated as well as its advantages. The factors which inhibits wide spread of RFID technology will also be discussed.

2. TECHNOLOGY AND STANDARDS

RFID stands for radio frequency identification and is regarded as a new type of automatic identification system. It can be used to remotely store and retrieve item data [5]. RFID systems consist of four elements which are the RFID tags that will be tracked, RFID readers that will detect the tags, antennas and radio and the Computer network used to connect the readers [6], as shown in fig. 1.

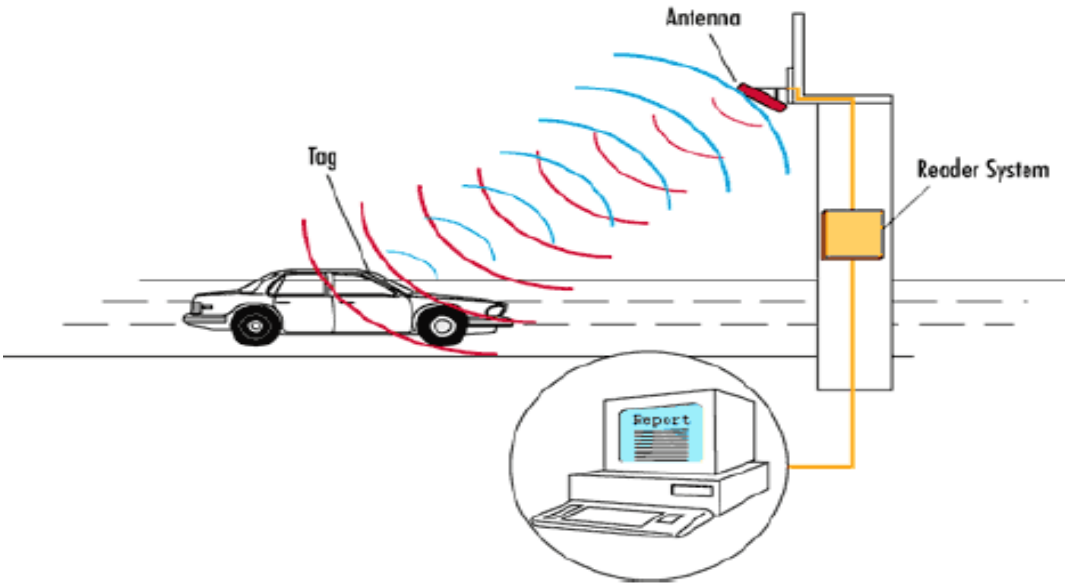

Figure 1: a typical RFID system [7].

2.1 Transponder / Tag:

Each RFID tag consist of the following items, an antenna, small silicon chip including a radio receiver, radio modulator that can send signals back to the reader, internal memory normally a very small amount and most importantly a power supply system unless the tag is a passive tag [6]. RFID tags are of three types which are passive, semi-passive and active tag. Tags that are initiated by the reader are known as Passive tags, while those that do not require external initiation are called Active tags. A Semi-Passive tag exists, which has the features of both Active and Passive tags. Each tag type has its distinct characteristics, which are summarized in table 1.

Table 1: Features of Types of Tags [8].

Features	Types of Tag		
	Passive	**Active**	**Semi-Active**
Read Range	Short (up to 10 m)	Long (up to 100 m)	Long (up to 100 m)
Lifespan	Up to 20 years	Between 5-10 years	Up to 10 years
Battery	No	Yes	Yes
Cost	Cheap	Very Expensive	Expensive
Availability	Only in field of Reader	Continuous	Only in field of Reader
Storage	128 bytes read/write	128 Kbytes read/write	128 Kbytes read/write

2.2 Reader:

RFID reader works as a central place for the RFID system. It reads tags data through the RFID antennas at a certain frequency. Basically, the reader is an electronic apparatus which produce and accept a radio signals [7]. It provides an electromagnetic field to activate the tag and initiates the communication process with one or more tags in range. This field is used by passive and semi-passive tags to power their communication ability as they do not have an on-board power source for this purpose [9]. Readers are electronic devices which can be used as standalone or be integrated with other devices and components/hardware like: Power for running reader, Communication interface, Microprocessor, Channels, Controller, Receiver, Transmitter, and Memory [10].

2.3 Frequency:

The name "radio-frequency identification" already indicates that RFID operates in parts of the radio frequency spectrum which ranges from about 3 kHz to 300 GHz, although mostly frequencies between 30 kHz and 6GHz are used in today's RFID applications [9]. These frequencies are grouped into ranges and designated as shown in table 2, and used for different application according to different standard as shown in table 3. The schematic representation for both high and low frequency is shown in fig 2. RFID systems work at a number of different frequencies including 125 KHz, 13.56 MHz, 2.45 GHz and 5.8 GHz, and for UHF 860-950 MHz [11].

Table 2 Frequency Ranges used for RFID [9].

Frequency	Abbr.	Designation
30 kHz - 300 kHz	LF	Low Frequency
3 MHz - 30 MHz	HF	High Frequency
300 MHz - 3 GHz	UHF	Ultra High Frequency
2 GHz - 30 GHz	-	Microwave

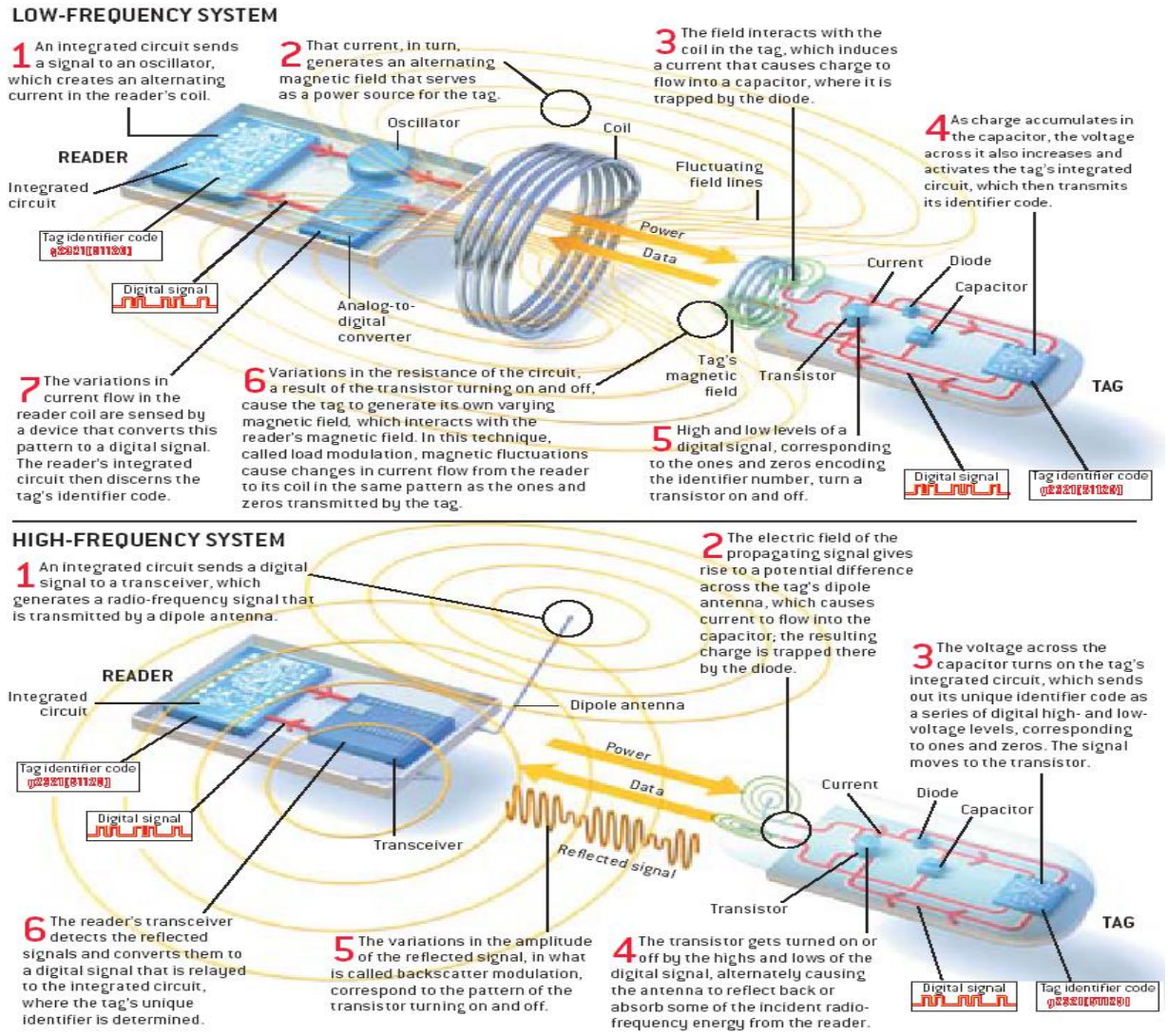

Figure 1: Schematic representation of RFID at low–frequency (LF) and high frequency (HF) [12]

2.4 Standards:

The International Standards Organization (ISO) has several standards for RFID of which is: ISO 14443 (for contactless systems), ISO 15693 (for vicinity systems, such as ID badges), and ISO 18000 (to specify the air interface for a variety of RFID applications) [13].

Table 3: RFID Frequency Ranges, Standards, and their Key Applications [1]

Frequency	Standard	Application
125 kHz	ISO 18000-2	Used for detecting Animals
13.56 MHz	ISO 14443	Used to identify tangible objects like Book, Cloths etc.
400 MHz	ISO 18000-7	Used for Vehicles Center Locking System
868MHz, 915MHz & 922MHz	ISO 18000-6	Used for Inventory/Logistic Applications
2.45 GHz	ISO 18000-4	Used for GPS Localization
5.8 GHz	ISO 18000-5	Used for Vehicles identification and Highway Toll collection

ISO/IEC 15691 and 15692 standards define functionalities of readers and the communication interface between readers and applications. ISO/IEC 15691 defines the commands, responses and error messages, which can be used for communication between the application host and the reader. For writing data from the reader to a tag, ISO/IEC 15692 defines memory mapping rules. This is necessary since the tag's memory is organized in blocks and segments so data can only be transferred in blocks. Therefore the reader preprocesses and segments the data according to ISO/IEC 15692 before sending it to the tag [9].

3. APPLICATION

Modern RFID technology is already deployed in numerous fields: asset utilization, asset monitoring and maintenance, item flow control in processes, inventory audit, theft control, authentication, payment systems, etc [9]. With falling price of RFID tags, increase in application capabilities of RFID is bound to emanate, some this application is discuss in this section.

3.1 Control of access & counterfeit:

One of the most popular applications of RFID technology is security or access control [9]. There are several system designed by exploring the security feature in RFID for access control. Like [14], [15], [16], [10], [17], [18], [19], [20], [21], and [22], explore such feature in their design. They proffer an intelligent approach to access control with the application of RFID. Counterfeit material cut across all spares of life especially high-value materials that can easily be copied such as pharmaceutical materials whose fake ones are injurious to health. A critical tool for fighting with drug counterfeiting and making any improvement for the public, in general, can be achieved today through the RFID technology [11]. Pfizer is one of the pharmaceuticals companies that have turned to RFID to make their supply chain more secure as shown in fig 3.

Figure 2 RFID label on Viagra bottle [23]

3.2 Healthcare:

In health care environments, the potential for improving safety through better process surveillance and reducing human error, together with the possibility of more efficient treatment processes, has led to a number of trials of RFID applications [24]. A 1988 study of the developed system for the hospital had shown that the system helped to reduce medication error rates by 55% [11]. . RFID has been used for numerous applications in health care sector such as Asset Management, Patient Management and Staff Management [25]. The Royal Wolverhampton Hospitals National Health Service Trust in England is also using a real-time RFID-enabled location system to manage three different functions throughout its facility: tracking the movements of patients and staff members, managing the locations of tagged assets, and ensuring hand-hygiene compliance. The hospital is planning to use the solution to track patients as they are registered, moved through various wards and then discharged, to improve the level of staff utilization by better directing staff members as to which services each patient requires next, and so forth [26].

3.3 Tracking:

Companies can put RFID tags on assets that are lost or stolen often, that are underutilised or that are just hard to locate at the time they are needed. Just about every type of RFID system is used for asset management [27]. Like [28], [29], and [30] employ RFID for item tracking in their design. It is worthwhile to note that this is typically not a good theft

prevention method, because RFID readers can easily be inhibited by placing the item in a metal-lined bag for instance. However, this system can work well in an environment where one is more concerned about accidental misplacement of an item than about theft [23].

3.4 Credit Cards:

One of the most popular uses of RFID today is to pay for road tolls without stopping. These active systems have caught on in many countries, and quick service restaurants are experimenting with using the same active RFID tags to pay for meals at drive-through windows [27]. Worldwide established systems are called PayPass (MasterCard), ExpressPay (American Express), and payWave (Visa), and follow the ISO/IEC 14443 standard for identification cards, contactless integrated circuit cards and proximity cards [9]

3.5 Other application:

RFID have found applications in all spheres of life of which includes: Patrolling Log, Toll Road and Electronic Passport. it is also applicable in industries such as Airline Industry, Railways, Manufacturing Industries, Agriculture, Dietetic Applications, Material Management, Livestock, Supply Chain, Food Industry, Pets Identification, Speed Passes Tool, Retail Industry, automobile industry, army etc [11].

4. ADVANTAGES

Similar technology like barcode has been in existence prior to RFID, but RFID is preferred due to its advantages such as: It will be embedded and read with no requirement for line of sight, Tags can be reprogrammed easily, they are also capable of working in suitable and harsh environments, Ready to carry 96 bits of information compare with 16 bits for bar code, fraud control increase, cloning becomes non-existence, improves antitheft protection, better supply chain efficiency, cost saving, profit enhancement, better supply chain and inventory management, reducing counterfeiting, tracking work-in progress, reducing administrative errors, reducing rework and better management of warrantee claims [11]. Some of the advantages and the few advantages are summarize in table 3.

Table 4: Comparison of RFID system [7]

Advantage	Disadvantage
High speed	Interference
Multipurpose and many format	High cost
Reduce man-power	Some materials may create signal problem
High accuracy	Overloaded reading (fail to read)
Complex duplication	
Multiple reading (tags)	

5. LIMITATION

Naturally, there are limitations to RFID. Some limitations are due to the laws of physics [23]. RFID technology faces numerous implementation challenges. The major challenges include technological maturity, global standardization, government regulations, and cost [31] as discussed in this section.

5.1 Cost:

The cost often tends to be an issue with the price of a tag being too high in comparison to the price of the product to be identified or traced. This makes the use of RFID completely irrelevant [32]. RFID technology comes with some major financial drawback as for the use of RFID tags, a particular adopter has to first install RFID reader(s) and computer networks for assessing the information in the RFID tags [33]

5.2 Technological Maturity of RFID:

Inconsistency in technology such as evolving standards in technology, application, data, conference, firmware changes, and tracking methods poses treat to the application of RFID. Though the characteristics of the application and the environment of use determine the appropriate tag, the sparse standards still leave much freedom in the choice of communication protocols and the format and amount of information stored in the tag [3]. Different companies often use different standards making cooperation between suppliers and manufactures difficult [32]

5.3 Security and Privacy Issues:

Depending on the field of application and in some cases, prescribed by law, it may become necessary to prevent unauthorized persons from reading or writing data stored on or transmitted from tags [3]. RFID is a wireless technology and, as such, poses some potential security concerns to users regarding the compromise of data during wireless transmission, storage of data, and security of storage sites [31]. Regardless of its potential benefits, unprotected passive RFID tags face a variety of malicious attacks including eavesdropping and tampering (spoofing), unauthorized tracking, fraudulent tags and readers, and denial of service [34].. Another important privacy concern is the tracking of individuals by RFID tags. A tag reader fixed at certain location could track RFID-labeled materials such as clothes or banknotes carried by people within its vicinity. Governments around the world regulate the use of the frequency spectrum. There is virtually no part of this spectrum that is available everywhere in the world for use by RFID [31]

5.4. Other limitations:

Other limitations include RFID tags been defective, faulty or deficient detection of tags, interference issues between readers which may prevent tags from being read [23]. Collision, Frequency, Quick technology obsolescence and possible virus attacks [3].

6. CONCLUSION

In this paper, a literature survey of important aspects of RFID has been conducted. This includes RFID technology, its standards and possible applications. Its advantages and possible limitation were also enumerated. While the RFID technology is still evolving, awaiting storms of it's potentially capabilities is yet to be predicted

REFERENCES

[1] Hussain S., Zamin M. A. K. and Shiraz A. (2012) "Review of Various Aspects of Radio Frequency Identification (RFID) Technology" IOSR Journal of Computer Engineering (IOSRJCE), Volume 8, Issue 1 PP 01-06 www.iosrjournals.org

[2] Abdul Kadar M. M., Faruk B. and Kazi G.A. (2013a). "RFID Applications: Prospects and Challenges in Bangladesh" Journal of Information Security, 4, pp 73-79 http://www.scirp.org/journal/jis

[3] Ilie-Zudor E., Kemény Z., Egri P., And Monostori L. (2006) "The RFID Technology And Its Current Applications" proceedings Of The Modern Information Technology In The Innovation Processes Of The Industrial Enterprises, Pp.29-36

[4] Yuh-Wen C., David C. Y. and Dong-Her S. (2011) "Importance- Performance Analysis for the Adoption of Radio Frequency Identification Technology" Journal of Information Technology Management Volume XXII, Number 2, pp 30-40

[5] James T. L., Jiang-Liang H., Wei-Ching C. and Chih-Hao H. (2005), "An RFID Application Model for the Publication Industry: A Taiwan Perspective" International Journal of Electronic Business Management, Vol. 3, No. 2, pp. 129-139

[6] Kevin C., Christopher L., (2011) "An Investigation into the Reach-ability of Radio Frequency Identification (RFID) Technologies in Adverse Conditions" Journal of Engineering and Technology Volume 1 No. 2, pp 99-109

[7] Kamran A., Hanifa S. and Paul K. (2010) "RFID Applications: An Introductory and Exploratory Study" International Journal of Computer Science Issues, Vol. 7, Issue 1, No. 3, pp 1-7

[8] Ankita A. and Ashish B. (2013), "Online Attendance Management System Using RFID with Object Counter" International Journal of Information and Computation Technology. Volume 3, Number 3, pp. 131-138, http://www.irphouse.com /ijict.htm

[9] Lukas G., (2013) "Radio-Frequency Identification – Overview" Seminar FI & IITM WS 2012/2013, Network Architectures and Services, pp 25-33

[10] Srinivasa K. R, Varun G. H., Vamsi T. & Pratyusha P. (2013), "RFID Based Security System", International Journal of Innovative Technology and Exploring Engineering (IJITEE), Volume-2, Issue-5, pp: 132-134.

[11] Mehrjerdi Y. Z (2014). "RFID: A Bibliographical Literature Review with Future Research Directions" International Journal of Industrial Engineering & Production Research, Volume 25, Number 2 pp. 151-190.

[12] Lara S. (2005) "Ubiquitous Network Societies: The Case of Radio Frequency Identification", International Telecommunication Union (ITU). http://www.itu.int/ubiquitous.

[13] Ron W. (2005) "RFID: A Technical Overview and Its Application to the Enterprise" IEEE Compute r Society, pp 27-33

[14] Gyanendra K. V. & Pawan T. (2010), "A Digital Security System with Door Lock System Using RFID Technology", international Journal of Computer Applications,Volume 5, No. 11, pp: 6-8

[15] Geoffrey C T. S. (2012), "Automatic access control system using student identification card based on RFID technology", unpublished undergraduate thesis of Faculty of Electrical Engineering Universiti Teknologi Malaysia, pp: 1-4.

[16] Komal K.M. & Dhiraj G.A. (2015), "Campus Access Management System via RFID", International Journal of Innovative Technology and Exploring Engineering (IJITEE), ISSN: 2278-3075, Volume-4 Issue-8, pp: 23-27.

[17] Raghu R.G. & SubhramanyaSarma G., (2013), "locker opening and closing system using RFID, fingerprint, password and GSM", International journal of emerging trends & technology in computer science (IJETTCS), volume 2, issue 2, p:142-145, www.ijettcs.org email, editor@ijettcs.org, editorijettcs@gmail.com.

[18] Prasanna K.R. & Hemalatha M. (2012), "Secure Logistic Management System Using Wireless Technologies", Research Journal of Applied Sciences, Engineering and Technology, 4(12), pp: 1785-1789.

[19] Jaykrishan P., Joyson B., Ketan P., Viral P., & Ramanuj G. (2014), "Armoured Infrastructure using Multiple Protocols", International Journal of Computer Science and Information Technology Research, Vol. 2, Issue 4, pp: 170-174, www.researchpublish.com

[20] Usha K.A. (2013), "Design Of Electronic Toll Collection System On Arm-7 Using RFID Technology'', International Journal of Computer Trends and Technology (IJCTT), volume 4, Issue 9, P 3271, http://www.ijcttjournal.org

[21] Srinivasan. J & Krishnamoorthy M. (2015), "Implementation of GSM Technology in Prison Locker System", International Journal of Emerging Technology in Computer Science & Electronics (IJETCSE), Volume 12 Issue 4, pp: 15-18.

[22] Anitha S. S., Dhiviya R J. & Sumitha M. (2015) "RFID and GSM Based Intelligent Parking System", International Journal of Innovative Science and Modern Engineering (IJISME), Volume-3 Issue-5, pp: 27-31.

[23] Gaukler G, M. and Seifert R.W. (2008) "Trends in Supply Chain Design and Management: Technologies and Methodologies" published by Springer-Verlag London Ltd. Pp 1-22 gaukler@tamu.edu

[24] Knels R. et al ((2010), "Guidelines for the Use of RFID Technology in Transfusion Medicine" Vox Sanguinis International Journal of Blood Transfusion Medicine Volume 98, Supplement 2, pp 1-24.

[25] Wamba S F. (2012), "RFID-enabled healthcare applications, issues and benefits: an archival analysis (1997-2011)" Faculty of Informatics - Papers (Archive), University of Wollongong, http://ro.uow.edu.au/infopapers. pp 1-13

[26] Wamba S. F., Abhijith A., and Lemuria C. (2013) "A literature review of RFID-enabled healthcare applications and issues" International Journal of Information Management 33 pp 875– 891

[27] Mandeep K., Manjeet S., Neeraj M. and Parvinder S. S. (2011) "RFID Technology Principles, Advantages, Limitations & Its Applications" International Journal of Computer and Electrical Engineering, Vol.3, No.1, pp 1793-8163

[28] Ramani R., Valarmathy S., Suthanthira V.N., Selvaraju S., Thiruppathi M. & Thangam R. (2013), "Vehicle Tracking and Locking System Based on GSM and GPS", I.J. Intelligent Systems and Application, DOI: 10.5815/ijisa.2013.09.10., pp: 86-93, http://www.mecs-press.org

[29] Salas K J., Anitha M. X. & Namitha M. (2013), "ARM 7 Based Accident Alert and Vehicle Tracking System", International Journal of Innovative Technology and Exploring Engineering (IJITEE), ISSN: 2278-3075, Volume-2, Issue-4, pp: 93-96.

[30] Ram K. C., Vijayalakshmi B., Ramesh C. & Chenthur P. S (2013), "Vehicle theft alarm and tracking the location using RFID and GPS", International Journal of Emerging Technology and Advanced Engineering, Volume 3, Issue 12, pp: 525-528, www.ijetae.com

[31] Abdul Kadar M. M., Faruk B. and Abul Kalam A. M. (2013b) "Impact of Radio Frequency Identification (RFID) Technology on Supply Chain Efficiency: An Extensive Study" Global Journal of Researches in Engineering Civil sand Structural Engineering Vol. 13 Is. 4 pp 8-16

[32] Mohsen A. (2012) "Critical Success Factors and Challenges of Implementing RFID in Supply Chain Management" Journal of Supply Chain and Operations Management, Volume 10, Number 1, pp 144-167

[33] Tuhin B. and Sugata S. "Technical Analysis of Security Infrastructure in RFID Technology" unpublished online paper from Department of Instrumentation Engineering, Assam Engineering College, Guwahati, India

[34] Suhong L.(2006) "Radio Frequency Identification Technology: Applications, Technical Challenges and Strategies" Management Department Journal Articles of Bryant university pp 1-25 http://digitalcommons.bryant.edu/manjou