IOSR Journal of Electronics and Communication Engineering (IOSR-JECE)
e-ISSN: 2278-2834,p- ISSN: 2278-8735.Volume 13, Issue 5, Ver. I (Sep.-Oct. 2018), PP 71-77
www.iosrjournals.org

Steering of Circular patch antenna in RFID Application towards Positioning, Navigation, and Location Based Services (PNLBS)

Arma Amir Mehdi, Dr. Anil Kumar
Electronics & Communication Engineering
Sam Higginbottom Institutie Shepherd Of Engineering & Technology
Corresponding Author: Arma Amir Mehdi

Abstract: *This paper presents optimization and explanations of the main features of the latest RFID technology which have rarely or unclearly been presented for example, the longest reading range of RFID systems, the smallest tag size and overall commercial application fields. ,the circular patch microstrip antenna (CMPA) with coaxial probe feeding, have been used . The proposed antenna operates in the frequency range of (2.4-2.48) GHz RFID band and fabricated on FR4 substrate with size of 50mm × 50mm × 1.6mm. The simulations method use HFSS antenna simulator. Therefore, there is an issue of optimization in determining the antenna parameters for best performance therefore JAVA developers used to communicate directly with RFID without converting protocols and data representation*

Keywords—*RFID, PNLBS , CMPA , JAVA developer .*

Date of Submission: 13-10-2018 Date of acceptance: 28-10-2018

I. Introduction

Radio frequency identification (RFID) systems in (PLBS) band have attracted many researcher's attention for their popular applications in manufacturing companies and service industries. Radio frequency identification (RFID) technology allow users to uniquely identify tagged people or objects . RFID employs electromagnetic (EM) waves to exchange information between readers and tags for the purpose of identification and tracking . Microstrip antennas are used in many application because of its low profile, ease of fabrication and low cost. Circular patch or disk is the one of the popular configuration to design a Microstrip patch antenna.

Radio Frequency Identification (RFID), which uses radio waves to wirelessly transmit the identity (e.g. a unique serial number) and other information of an object, is an emerging technology for indoor positioning (Ahuja & Potti 2010). RFID was invented during the Second World War II and was first used by Britain to identify aircraft as part of the refinement of the radar. It was during the 1960s that RFID was first considered for the commercial world, RFID products started to be available in 1980s and its wider spread usage was only in recent years. Earlier RFID applications were mainly applied to identifying assets in a single location. In 1998, researchers at the Massachusetts Institute of Technology (MIT) Auto-ID Center began to investigate new ways to track and identify objects while they were moving between different locations, when is considered as the third era of RFID (Holloway 2006b). Since 2000, RFID has experienced a rapid evolution and broad implementation throughout the economy. It has become a worldwide and rapid-evolving technology, which has been combined with other emerging technologies worldwide. . As intelligent RFID technology continues to develop, in conjunction with intelligent sensor technologies, RFID has been becoming the core technology of the (PNLBS) (Holloway 2006b). Research and developments of RFID has been rapid, however, challenges remain, particularly in standards development, security compliance and privacy concerns (Choi et al. 2011).

II. Positioning , Navigation , and Location based services (PNLBS)

In the past decade, technological advancements have facilitated the manufacturing of compact, inexpensive, and low-power consuming receivers and sensors for smart devices (e.g., GPS, WiFi, MEMS sensors, RFID, UWB, BLE, etc.). This arises the fast development of Positioning, Navigation and Location Based Services (PNLBS), and leads them become much broader than just providing a location or navigation.

These positioning technologies and their enabling integrated systems have been promoted into the RFID world such as asset tracking, autonomous parking, virtual reality, context awareness, condition monitoring, geolocation, smart manufacturing, as well as smart cities. In fact, PNLBS have become indispensable to the future of RFID application. On the other hand, RFID systems create limitless possibilities for PNLBS, due to their sophisticated technologies, powerful big data analysis, and embedded multi-sensors.

The aim of Radio frequency idendification for provisioning PNLBS is to design an accurate, low-cost, low-power, reliable, and scalable solution for cutting-edge applications. To achieve this goal, several challenges should be addressed, such as improving positioning accuracy, reducing the power cost, handling to track millions of devices as well as transmitting and processing big data. sourcing) to automatically generate wireless fingerprinting database for positioning .

III. Radio frequency identification technology (RFID)

RFID technology is an emerging technology that allows for mobility tracking of objects or people. There are mainly three types of RFID systems: passive, semi-passive and active systems (Berthiaume, Donahue & Romme 2011). A typical RFID system contains tags (also referred to as transponders, smart tags, smart labels, or radio barcodes), a reader (also called writer, decoder, interrogator ,transmitter , receiver, or transcevior), and a host computer and software/infrastructure. The reader and the host computer communicate through either a wire or wireless link.

Figure 1 shows the work principles of a typical passive RFID system (Ahuja & Potti 2010; Kefalakis et al. 2011; Kuester et al. 2011; Weinstein 2005). The power source of a passive tag is provided by the reader. When a radio signal is sent from a reader, when the tag enters the signal field of the reader, it will be powered on by the signal, the reader then captures the ID and data from the tag and sends this information to the host computer. The computer, with RFID middleware installed on, processes the data and sends it back to the reader; the reader then transmits the processed data to the tag. Passive RFID systems are normally used for applications in shorter reading ranges

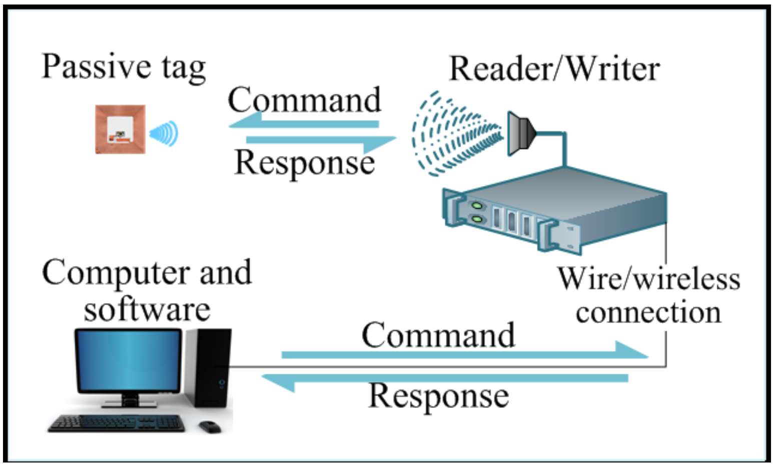

Fig-1 Passive RFID system

The principles of an active RFID system are slightly different from a passive system as shown in Figure 2. An active RFID system usually uses active RFID tags (with a battery built in) and each tag periodically transmits its data which may contain identification and other application-specific information such as location, price, colour, and date of purchase. The RFID reader will cross-reference the tag's data within its self-contained database. Compared to a passive system, an active RFID system can simultaneously read several tags in the field, its reading range is longer and its power required is less. The distance between the reader and the host computer is normally under 500 m if they are connected wirelessly (Long range RFID readers and tags 2012; Berthiaume, Donahue & Romme 2011)

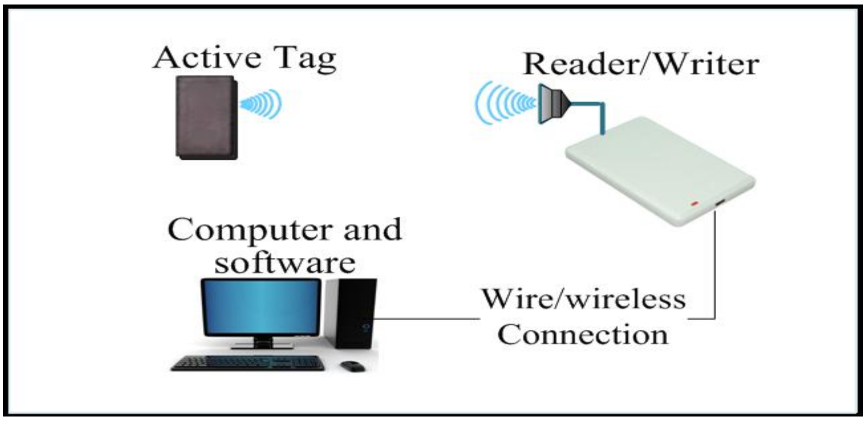

Figure -2 Active RFID system

The principles of a semi-passive RFID system are similar to that of the passive system, except that there is a battery embeded in the semi-passive tag. The battery provides an on-board power source for the telemetry and sensor asset monitoring circuits of the tag so that the tag have more power to communicate. However, the on-board power is not directly used to generate radio frequency (RF) electromagnetic energy.

3.1- RFID reader & tag

An RFID reader reads data from RFID tags and it acts as a conduct or bridge between RFID tags and the controller or middleware. The most important feature of a reader is its reading range, which can be affected by a number of factors such as the frequency antenna gain, the orientation and polarisation of the reader antenna, the transponder antenna and the placement..

RFID tags can be also classified into three types: passive, active and semi-passive (also known as battery-assisted passive, or BAP). A typical RFID tag consists of a microchip attached to a radio antenna mounted on a substrate. The microchip can store data from 26 bits to 128 kilobytes (Intermec 2012; OECD 2008; Weinstein 2005).

Although both active and passive tags use RF energy to communicate with a reader, they are fundamentally different in the method of powering the tags. An active tag uses an internal power source, usually batteries, within the tag to continuously power the tag and its RF communication circuits, whereas a passive tag completely relies on RF energy transferred from the reader. This distinction may have significant impact on the functionality of the system (Ahsan, Shah & Kingston 2010; Holloway 2006b; OECD 2008). Semi-passive tags overcome two key disadvantages of pure passive RFID tags, one is the lack of a continuous source of power for the circuits and the other is the short reading range. **S**emi-passive tags are ideal for rapid development of customised RFID tags since they are not required for Federal Communications Commission (FCC) certification (Folea & Ghercioiu 2010; Intermec 2012; Ramli 2010). There are two basic types of chips available for RFID tags: read-only and read-write. Read-only tags are cheaper and their required infrastructure is also less expensive they still deliver on one of the main promises of RFID, which is the reduction of operator involvement. The size of RFID tags varies largely with the purpose of applications. For example, RFID tags used for truck location in shipping ports, can be as big as a building brick (Ahsan, Shah & Kingston 2010; Ruhanen et al. 2008), Others, like the tiny powder-type or called dust-type RFID tags produced by Hitachi, can be as small as a fine powdery particle. These may be some sixty times smaller than the "mu-chip" as shown in Figure 3 (Hitachi develops RFID powder 2007).

FIG-3 Hitachi powder-type tiny RFID tags (in contrast with a human hair) with a 128-bit of read-only memory and a size of 0.05mm × 0.05mm × 0.005mm

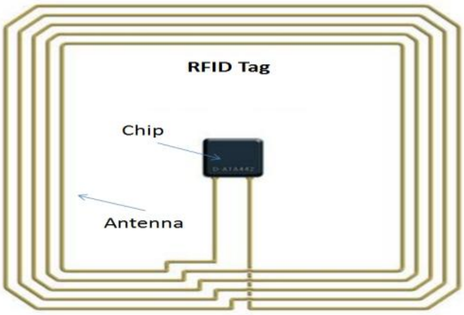

FIG-4 RFID reader

3.2-Reading range and Frequency

Nowadays, short-range communications have undeniably evolved with technological advances. As one of the short-range communication technologies, RFID has operated at ranges from low- and high-frequencies to microwaves, and has provided longer reading ranges than other short-range communication technologies and services. The specific electromagnetic spectrum, frequency, wave-length and energy used for RFID are shown in Table 1 (Holloway 2006b; OECD 2008

Table 1. Ranges of RFID frequency and wave-length

Band	LF	HF	UHF	SHF
Frequency	30-300KHz	3-30MHz	300-MHz-3GHz	3-30GHz
Wavelength	10-1Km	100-10m	1-0.1m	10-1cm

RFID systems also operate in several regions of the RF spectrum. Different regions tend to be used for different applications and no one frequency is good for all applications, all geographies, or all types of operating environments. Generally, there are four primary frequency bands allocated for RFID uses: Low Frequency (LF), High Frequency (HF), Ultra High Frequency (UHF) and Super High Frequency (SHF)/microwave. Research has shown that all the frequency bands can be used for both passive and active tags. The characteristics and performance of standard radio frequency ranges used for RFID are summarised in Table 2 (OECD 2008; Weiku 2012). Typical applications of LF systems are pet recovery, cattle tagging, access cards and car immobilisation systems. The HF systems are frequently used for smart shelf applications, access control and smart cards. Related technologies such as near-field communications (NFC) also use the HF band. Due to the advantage of the F tunable field shape of HF, its reading pattern can be precisely controlled.

	LF	HF	UHF	SHF
FR (MHz)	<0.135	3~28	433-435, 860-930	2400~2454 5725~5875
RR(P)	≤0.5m	≤3m	≤10m	≤6m
RR(A)	≤40m	≤300m	≤1Km	≤300m
TRR	Slower		Faster	
ARMW	Better		Worse	
FR: Frequency Range RRP: Typical Reading Range of Passive Tags PRA: Tag Reading Rate ARMW: Ability to Read near Metal or Water				

Table -2 Characteristics of different frequencies for RFID systems

4-Work of Antennas in RFID Applications

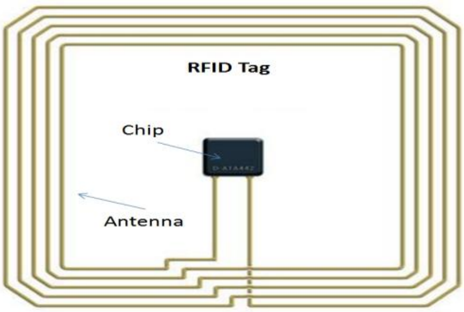

FIG-4 RFID reader

As part of the design of the RFID antenna, parameters such as the radiation resistance, bandwidth, efficiency, and Q all need to be considered, so that the resulting design for the RFID antenna meets the requirements and allows the required level of performance to be achieved. RFID antennas are tuned to resonate only to a narrow range of carrier frequencies that are centered on the designated RFID system frequency.

As shown in figure 4 RFID antenna propagates the wave in both vertical and horizontal dimensions. The field coverage of the wave and also its signal strength is partially controlled by the number of degrees that the wave expands as it leaves the antenna. While the higher number of degrees means a bigger wave coverage pattern it also means lower strength of the signal. Passive RFID tags utilize an induced antenna coil voltage for operation. This induced AC voltage is rectified to provide a voltage source for the device. As the DC voltage reaches a certain level, the device starts operating. By providing an energizing RF signal, a reader can communicate with a remotely located device that has no external power source such as a battery. According to the different functions in the RFID system, the RFID antennas can be divided into two classes: the tag antenna and the reader antenna.

4.1 Circular Microstrip Patch Antenna for RFID Application

The antenna geometry consists of circular patch with square cut inside the patch area to achieve circular polarization. The coaxial probe feed is applied having location x = 4 and y = - 4 to the circular patch radiator. The circular patch radius (α) and ground plane area of the antenna are 14.5 mm and 50mm × 50mm, respectively. The proposed antenna is designed on a FR4 substrate with thickness, h = 1.6mm, dielectric constant, εr = 4.4. The diagonal corner of circular patch has been cut with dimensions of 6 mm × 8mm. The antenna resonates at 2.46 GHz for RFID (2.4-2.48) GHz band. The geometry of circular microstrip patch antenna is depicted in fig.5

The circular patch radius (α) is given in the following equation,

$$\alpha - \frac{F}{1+\frac{2h}{\pi\varepsilon rF\left[\ln\left(\frac{\pi F}{2h}\right)\right]^{1/2}}} \qquad (1)$$

Where F is

$$F=\frac{8.791x10^{2}}{fr\sqrt{\varepsilon r}} \qquad (2)$$

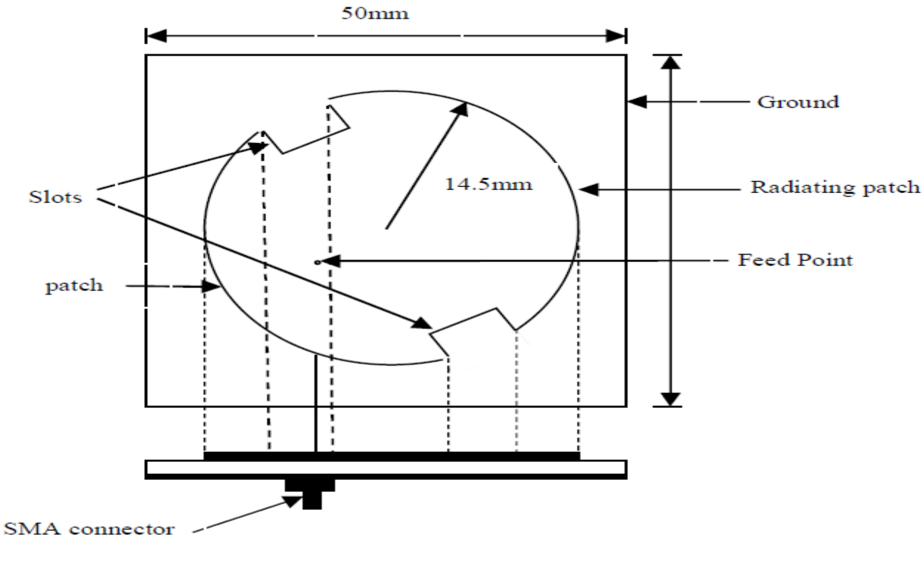

Figure 5-geometry of proposed CMPA

Performance of circular microstrip patch antenna is dependent on different parameters such as radius of patch, size and location of rectangular slots, shape and size of ground plane. For designing a circular microstrip patch antenna for (2.4 - 2.48) GHz, it is required to maintain the position of rectangular slots.They are rotated in 30˚ from vertical axis. Size of rectangular slots is selected as 6mm × 8mm. For rectangular slot of size 5 mm × 7 mm the resonant frequency shifts towards lower band while for slot size of 7 mm × 9 mm resonant frequency shifts towards upper frequency band. Hence optimized slot dimension in order to satisfy the (2.4 -2.48) GHz band is 6mm × 8mm. The feed location is optimized and hence location selected is in between center and edge of the circular patch. The selected location of feeding for proposed antenna is, at x = 4 mm and y = - 4 mm, as depicted in the fig.5.

4.2 - JAVA & RFID tag

The main purpose of using JAVA with the RFID technology is to accomplish these objective, we are going to follow these points:

- Setting up the system for working with usb to serial conversor.
- Checking the reading distance and discuss about the interference problems.
- Medium Access Control in RFID devices.
- The privacy problem.

Here we use the Java reader client to control devices, program RFID tags, read and write user memory and tag identification on RFID transponders (tags) using the Java .. This application communicates directly with the RFID Event Manager by using Java RMI (Java Remote Method Invocation) without the need to convert between protocols and data representation.

If we take a look at the code we can distinguish these main parts:

1. The main libraries used in this program are the java.util general library, that contains classes for normal work in java and the gnu io library, used for the communication (input/ouput) with the environment
2. After importing these main libraries the program continues with the declaration of the main class, in which port List and port Identifier are declared to interact with the device connected in the COM1 port.

```
import java.util.*;
import gnu.io.*;

public class Main {

    private static Enumeration portList;
    private static CommPortIdentifier portId;

    /**
     * @param args the command line arguments
     */
    public static void main(String[] args) {
        System.out.println("*** main started ...");
        portList = CommPortIdentifier.getPortIdentifiers();
        while(portList.hasMoreElements()) {
            portId = (CommPortIdentifier) portList.nextElement();
            if(portId.getPortType() == CommPortIdentifier.PORT_SERIAL) {
                if(portId.getName().equals(args[0])) {
                    System.out.println("");
                    System.out.println("Listening on port " + portId.getName() + "...");
                    System.out.println("");
                    System.out.println("");
                    System.out.println("# \t | Bytes \t | Type \t | RFID");
                    System.out.println("=================================================");
                    RFIDTagRead reader = new RFIDTagRead(portId);

                }
            }
        }
    }
}
```

3. After this step, port identifiers are located and labeled. According to this code, the program can support several RFID readers. While the program locates a reader, it remains in the loop printing the basic output interface and creating RFID tag reader objects from the RFIDTagReader class which I will describe in the following program
4. After invoking the object of the RFID reader class, the communication parameters are set and the program gets the reader stream over the serial port. This statement is protected by a try-catch state
5. Finally, the recovered data is converted to an hexadecimal value, using a for loop, and printed in the screen.

IV. Conclusion

In this paper ,we explain some RFID technology and application used in positioning , navigation, location based services with examples and the use of Circular patch antenna designed and its performance to improved from antenna design in terms of Antenna return loss and Gain .Designed antenna can be used for RFID application in PNLBS in this paper we use **JAVA** programming in **RFID and PNLBS** system consists of an antenna (**CMPA**) and transceiver, which read data transmitted by a transponder through radio frequency (RF). The combined transceiver and antenna are called the **" RFID reader** ".

5.1 Future work

Therefore, the research can be conducted on not only PNLBS but also new RFID architectures and chip design technologies. However, research efforts on their combination remain open and require further investigations, such as how to accurately track millions of devices by consuming low power, how to use RFID technique (e.g., crowd sourcing) to automatically generate wireless fingerprinting database for positioning, how to design low-power positioning chip/system .

References

[1]. 1 .Applications," International Journal o Emerging Technology and Advanced Engineering, Vol. 6, pp. (132-136), July 2016.

[2]. 2 .C. A. Balanis, Antenna Theory: Analysis and Design, 3rd ed. New York, NY, USA: Wiley, 2005.

[3]. 3 .Jimenez, AR, Seco, F, Zampella, F, Prieto, JC & Guevara, J 2011, 'Ramp Detection with a Foot-Mounted IMU for a Drift-Free Pedestrian Position Estimation', paper presented to 2011 International Conference on Indoor Positioning and Indoor Navigation (IPIN)

[4]. 4.Jui-Han Lu and Sang-Fei Wang, "Planar Broadband Circularly Polarized Antenna with Square Slot for UHF-RFID reader," IEEE Transactions on Antennas and Propagation, Vol.61, No.1, pp.(45-53), Jan 2013.

[5]. 5 Kefalakis, N, Soldatos, J, Mertikas, E & Prasad, NR 2011, 'Generating Business Events in an RFID network', paper presented to RFID-Technologies and Applications (RFID-TA), 2011 IEEE International Conference on, 15–16 Sept. 2011.

[6]. 6.Koyuncu, H & Yang, SH 2010, 'A Survey of Indoor Positioning and Object Locating Systems', *IJCSNS International Journal of Computer Science and Network Security*, vol. 10.

[7]. 7.Kuester, DG, Novotny, DR, Guerrieri, JR & Popovic, Z 2011, 'Testing passive UHF tag performance evolution', paper presented to RFID-Technologies and Applications (RFID-TA), 2011 IEEE International Conference on, 15–16 Sept. 2011.

[8]. 8.Mathiassen, K, Hanssen, L & Hallingstad, O 2010, 'A low cost navigation unit for positioning of personnel after loss of GPS position', paper presented to Indoor Positioning and Indoor Navigation (IPIN), 2010 International Conference on, 15–17 Sept. 2010.

[9]. 9.Meadati, P, Irizarry, H & Akhnoukh, AK 2010, 'BIM and RFID Integration: A Pilot Study', paper presented to Second International Conference on Construction in Developing Countries (ICCDC-II), Cairo, Egypt, August 3–5, 2010.

[10]. 10.Merico, D, Bisiani, R & Mileo, A 2010, 'Situation-Aware Indoor Tracking with high-density, large-scale Wireless Sensor Networks', paper presented to Indoor Positioning and Indoor Navigation (IPIN), 2010 International Conference on, 15–17 Sept. 2010.

[11]. 11.Nilsson, JO, Skog, I & Handel, P 2010, 'Performance characterisation of foot-mounted ZUPT-aided INSs and other related systems', paper presented to Indoor Positioning and Indoor Navigation (IPIN), 2010 International Conference on, 15–17 Sept. 2010.

[12]. 12.O'Connor, MC 2009, *Michigan Students to Develop RFID-enabled Robotic Guide Dog*, RFID Journal, viewed 26 June 2012, <http://www.rfidjournal.com/article/view/5214>. pp.(1275-1282), May 2009.

[13]. 13.R. Want, "An introduction to RFID technology," IEEE Pervasive Comput., vol. 5, no. 1, pp. 25−33, Jan. 2006.

[14]. 14. V. Hunt, A. Puglia, M. Puglia, RFID: A Guide to Radio Frequency Identification, New York, NY, USA: Wiley, 2007.

[15]. 15.Yi-Fang Lin, C. Lee, S. C. Pan and H. M. Chen,"Proximity-Fed Circularly Polarized Slotted Patch Antenna for RFID Handheld Reader,"IEEE Transactions on www.ijraset.com Volume 5 Issue VI, June 2017 Antennas and Propagation, Vol.61, N0.10, pp.(5283-5286), Oct .2003..

[16]. 16.Yi-Fang Lin, C. Lee, S. C. Pan and H. M. Chen,"Proximity-Fed Circularly Polarized Slotted Patch Antenna for RFID Handheld Reader,"IEEE Transactions on Antennas and Propagation, Vol.61, N0.10, pp.(5283-5286), Oct 2013.

[17]. 17.Zhi-Ning Chen, X. Qing and H. L. Chung, "A Universal UHF RFID Reader Antenna," IEEE Transactions on Antennas and Propagation, Vol.57, No.5,

IOSR Journal of Electronics and Communication Engineering (IOSR-JECE) is UGC approved Journal with Sl. No. 5016, Journal no. 49082.

Arma Amir Mehdi, " Steering of Circular patch antenna in RFID Application towards Positioning, Navigation, and Location Based Services (PNLBS) "IOSR Journal of Electronics and Communication Engineering (IOSR-JECE) 13.5 (2018): 71-77.