

Radio Frequency Identification for Staff File Tagging, Detection and Management: A Case Study of Yobe State University, Damaturu Nigeria

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Abstract

The essence of this research is to manage staff files virtually; tags were created like barcode to wirelessly manage, trace and detect each staff files with their location per time. It will offer intelligent applications with multiple functions cutting across embedded system, pervasive computing and networking which will avail the management of the university 24hours in a week monitoring, surveillance and detection services for staffers records whenever need arises. To achieve these objectives for Yobe State University, current technology of Radio Frequency Identification (RFID) was adopted including frequency ranges and standards with privacy and security catered for.

Keywords: Tags, Intelligent applications, Embedded system, Pervasive computing, Networking, Monitoring, Surveillance, Detection RFID, Privacy

Introduction

In recent time much of data processing which were done manually have migrated to electronic or digital approaches for example letters that were written with hands and typed manually or most small-scale businesses that keep their record in proprietor's head with reinforced notes scribbled on scraps of paper or an operator of stationery service who buys and supplies materials to three or four vendors and careless about electronic record keeping. Nowadays, the advances in technology have change how record are kept, digitalization has moved beyond record keeping and now to the monitoring and security of information and other related record.

When it comes to office management and technology, there are certain structures and facilities that must be put in place for proper operation and management of daily activities, one peculiar characteristics of the information age is that companies, organizations and universities are maintaining their files electronically but most of the institutions in developing nations are still keeping their records manually or combination of manual and electronic filing system. Files are indispensable item for students, staff or matters of concern to the growth and management of the university and contain information in set of papers, documents or records. Personnel files of Yobe State University are kept manually hence need to keep track or update these files is highly significant, in most cases these files are moved physically from one desk to another within the university or among departments in the university.

Radio Frequency Identification (RFID) is an automatic identification technology with contact-less technique of identifying objects (movable and immovable), locating lost items, livestock or human which can be combined with biometric features and RFID is becoming prevalent because of its diverse application and benefits over previously used technologies such as barcode technology, OCR, MICR, etc. and can identify items, livestock or human from a distance without line of sight [1, 2]. It offers effective and efficient ways of recording, tracking, retrieving and management of files and documents of staffers that are move from one place to another within an organization, the challenges with the movement of these files is that they are intentionally or unintentionally misplaced or lost and retracing them could become impractical or difficult which is the source of the motivation for this research work. Electronic solution is offered to staff file tagging, tracking, retrieving and management and consequently enhance productivity and performance of Yobe State University [3]. RFID tags are attached to staff files with sample of passive tags with reduced size and without battery and aid file identification from one office to another; it would be the basis for Internet-of-Things (IOT).

Tags are small transponder that have unique id which respond to queries from reader by wirelessly transmitting the id or serial number and comprises of microchip, inbuilt antenna, case and battery (for active tags only). Faraday's principle of magnetic induction for Near-Field (NF) coupling between the tag and employee's file was used to track files in this citadel of learning in Northern Nigeria which were previously transferred physically from one desk to another within a department or between departments in the university [4, 5], RFID will offer clear visibility for the movement of files within the institution and afford some of the drawbacks of existing system

such as misplacement of files (intentional and unintentional), missing documents and invariably reducing any corrupt practices, favoritism and nepotism that are prevalent in almost all government parastatals including higher institutions of learning [6, 7]. This research work intends to use RFID technology to track, manage file movement, retrieval and update of information in employees' files.

Yobe State University comprises of the following cadres of staff namely Senior academic staff, Junior academic staff, Senior non-academic staff and Junior non-academic staff and file movement are done primarily for promotion for all member of staff, processing of employees' leave (annual, sick, maternity etc.), appointments (as the case may be for different administrative level within the university such as HODs, Deans etc.) and disciplinary matters [7]. Two types of files are created for each staff member (moving and fixed files) and monitoring of the files is done manually and duplication of record is inevitable [8]. Environmental features and interference were considered before deployment of this technology in Yobe State University, cheap RFID labels were employed for cost-effectiveness of this research work and the testing of configured technology with variety of RFID tags, equipment [9]. This research work will be beneficial to all stakeholders concerned such as government, governing council and members, management, staffers, etc.

Literature review

Related works have been carried out by many other authors who handled automated data collection technology and ranges from bar codes, OCR and other potential applications for business activities, security and privacy matters [1]. This review focuses on different reports published and presented in view of findings between RFID technology, its applications, its advantages, its disadvantages, principles, privacy and security, challenges, components, business aspects and other technical features of RFID [10]. The criteria for literature and journals inclusion were Applications of RFID, Automated Data Collection and Discussion of RFID technology, RFID future service cost, implementation, best practice, deployment and adoption [2].

Objectives

There are challenges in the realization of this research but because of its inherent benefits to the university community, RFID technology overcomes most of today's predicament such as identification of items or objects, categorization of items or objects and tracking of objects or items. The objectives of this research are to

1. Examine problems facing tagging, monitoring and detection of files' movement from place to place in Yobe State University
2. Design RFID for employee files' tagging, processing and detection with consideration to environmental features and interference
3. Implement designed RFID technology within the university

Methodology

The staff number serves as means of identification for members of staff of Yobe State University's file and in the existing record keeping approach, indexing is indispensable, identifies unique staff and sorts the files in an orderly manner for easy retrieval. These existing record keeping approaches fail to provide feedback like

1. Who used a particular staff file?
2. When was a file used?
3. What was a staff file used for?

In the course of this research, it was observed that different file can

be used differently by one or more users, two or more individuals will never use the same file the same way, the same user may not use the same file the same way at different times, a file can be used several times by a particular individual, a user may use file or document differently compared to another user and user may use the same document differently given a time frame. RFID technology for file tagging, tracking and management was designed based on the findings in the existing system in the university and all-inclusive conceptual framework that catered for gaps identified are modeled.

Hardware Components are Raspberry Pi 3, RFID reader, monitor, keyboard, USB-to-VGA converter and NFC tags which are to be implemented using PHP, HTML, JavaScript, Apache and MySQL. A file of staff stored in MySQL server. The proposed block diagram of RFID system for tagging, detection and management of staff files as depicted in figure 1.

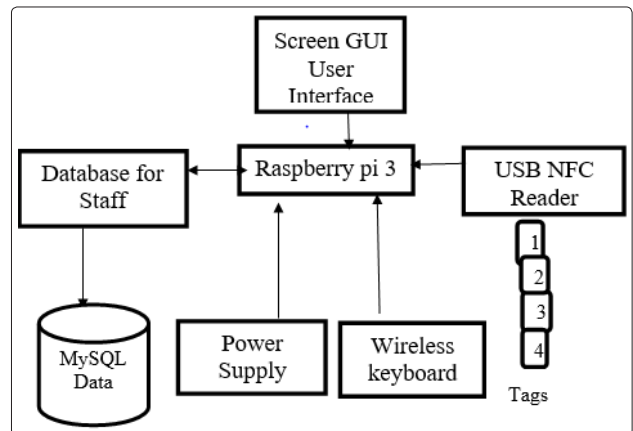


Figure 1: The proposed RFID File Tracking System

Conceptual Model

This diagram represents entities and attributes of the developed RFID tracking system, the manual files of staff of the university were attached different tags that represent staff ID in the file bank which henceforth identifies each staff file whenever a user need them. The user of a particular file may be management staff or any high rank officer in the university and may need to obtain all the basic information of the staff, academic qualification and any other necessary dossier that may be needed to take decision when need be.

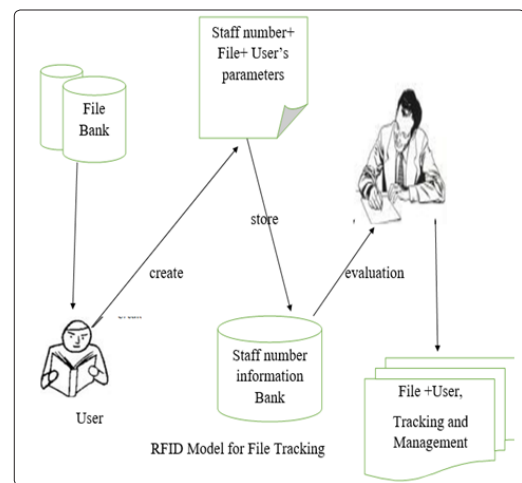


Figure 2: Conceptual model for Yobe State University RFID Staff file tracking

Mathematical Representation

Existing manual file tagging, tracking and management of Yobe State University were studied and the application of RFID technology applies these basic parameters for each staff- Users, Files and Time. Series of accessed files with their staff number that are used over a period of time by one or more users can be evaluated to determine the use of the staff file and its purpose to the university officials. The mathematical representation of tracking staff file is depicted below

$$TS = \iiint_1^n \mathbf{x}d\mathbf{U}d\mathbf{T}d\mathbf{F}$$

where \mathbf{X} represents any information needed in a particular file or the entire file of a staff, $d\mathbf{U}$ represents variance of user, $d\mathbf{T}$ represents variance of time and $d\mathbf{F}$ represents variance of staff file and this mathematical model make any staff file that is consulted to be subject of interest in this research work.

Discussion

This technology did not only tag, track and manage staff file in real-time but also provide information about details of each staff, most varsities and other institutions including the pilot university are planning to implement RFID systems to enhance their productivities and competitiveness in management of human resources and the potential to change management of human resource of the university from the previous archaic and stereotype means. The expectation of the application of RFID in staff file tagging, tracking and management will aid staff file tracking, file identification and reduce file location uncertainty. The registry department that used to keep two types of files for their staffers (moving and fixed files) is henceforth discarded. The experimental design represented below show how the connection of Raspberry Pi with USB NFC reader, its Operating System is Raspbian OS with its library files and its coding is done with open source PHP for tracking and tagging of each file of staff as shown in figure 3.



Figure 3: Experimental design of RFID for Yobe State University Staff file tracking

Its implementation is done on WAMP Server 3.0.6 with the following IDE tools Java script, HTML and Raspbian OS that comprises of terminal icon, wastebasket and start menu. The login screenshot is depicted in figure 4 where user is granted an access into the RFID management interface by allowing the user to input the username and password and will eventually lead prospective user to an interface where four main components of staff files are dealt with which include file, search, location and person, in file submenu, user can view the file, delete or create a new file, other submenu location can view where particular staff file is and the purpose for which it is being view, other submenu search can locate particular staff file at a particular time, the last submenu person typify the person responsibility on a particular file, its comment, date and time and what initiated its responsibility on the staff file as shown in figure 5.

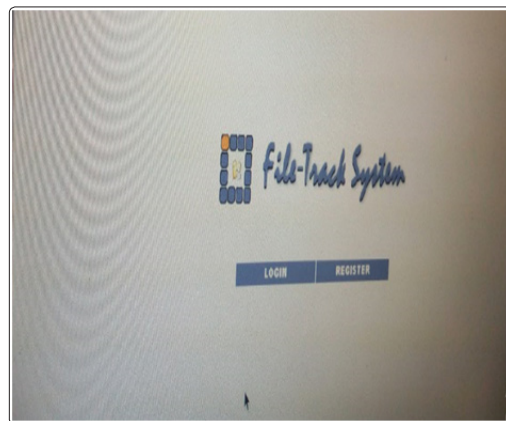


Figure 4: File Tracking System Login

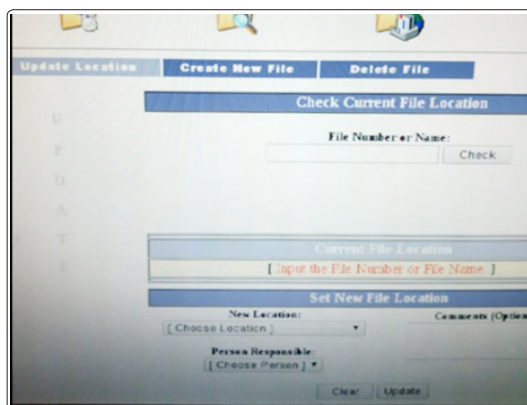


Figure 5: Submenu components of File Tracking System

Conclusions

This research work has discussed the design and implementation of Radio Frequency File Tracking System for Yobe State University, the system kept track of staff file and eliminate delay in finding staff file while obliterating nepotism and favoritism, hence missing cases of staff file are gone. RFID for staff file tagging, tracking and management enhance the day-to-day activities of registry department within the university and consequently aid strategic, tactical and operational decision of the university. It avails adequate feedback and feed forward for each member of staff of this institution. The implementation of the RFID was based on the findings of the objectives of the research as well as the gap identified and it has contributed to the application of RFID to tracking of item or human [11-15].

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