

# Hybrid Radio Frequency Identification Access Control and Security Monitoring System

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**Abstract**— The ease of light weapons diffusion from armoury has added a dangerous dimension to insurgency in many countries. The growing number of small arms in circulation not only diminishes the prospects of ending on-going unrest, but also increases the probability of new conflicts breaking out. The main problem is that locks designated to restricted access to arms stores and magazines have proved inadequate. This research exploits the use of hybrid Radio Frequency Identification (RFID) to strictly monitor personnel in possession of an organization weapons. The designed algorithm tracked the weapon that is signed from the armoury. In turn, the results demonstrated efficient complexity control and effective tracking of weapon that is outside the armoury for within 3 km radius from the antenna. The application range from controlled of weapons stored in an organization database to the application of secured wireless network.

**Index Terms**— Monitoring, Radio Frequency Identification (RFID), Security, Tracking, Weapon.

## 1 INTRODUCTION

Security of lives and property has remained an important issue of national interest considering the strategic position it takes in the socio-economic development of a nation. The light weapons played a vital role in the maintenance of peace and security in any country. The ease of small arms weapons diffusion from armoury has added a dangerous dimension to insurgency in many countries. The growing number of small arms in circulation not only diminishes the prospects of ending on-going unrest, but also increases the probability of new conflicts breaking out. The main problem is that locks designated to restricted areas access such as arms stores and magazines have proved inadequate [1, 2].

In order to secure these facilities, an access control infrastructure needed to be put in place to complement existing security and monitoring system. This research developed algorithm for efficient access control and monitoring system by exploiting the use of Radio-Frequency Identification (RFID). The RFID can be described as a technology that allows objects to be identified at a distance without direct line of sight using radio waves. Fig. 1 shows the block diagram that

RFID technology to enhance the security, accountability, and efficiency of the arms getting out from armoury. This would facilities the security of arms stores and magazine within with minimal failure rate while maintaining the traditional physical security measure.

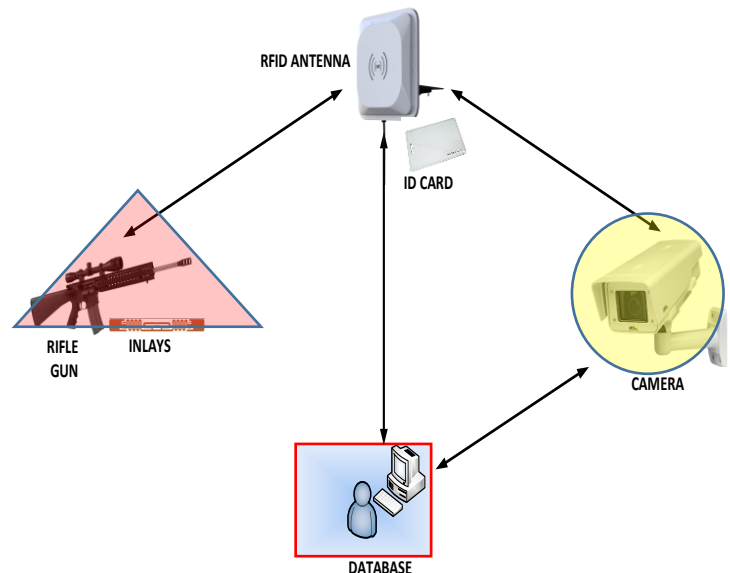


Fig. 1: Hybrid RFID for Access and Security System

Security outfits and security of information, armoury and other vital equipment, is of paramount importance. Conversely, not all personnel in a securi-

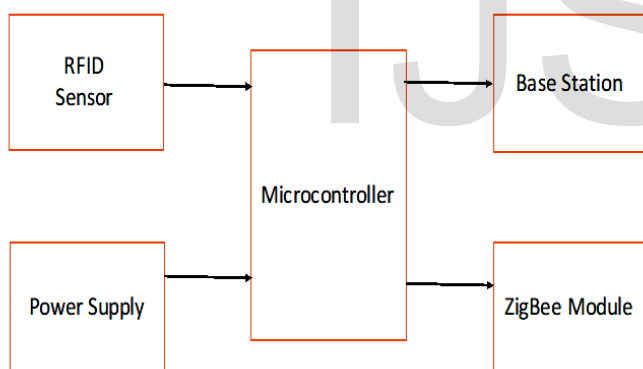
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- uses a database management system connected to an

ty outfit have access to secured compartments. Security, being one of the fastest growing industries today, uses advantages of Information Technology (IT) to produce a more dependable security product. ICT today, offers more reliable, easy to use devices. This eliminates human direct interaction, tracking and records keeping. Furthermore, networking of cameras, computers and other electronic gadgets such as RFID are being implemented to aid and ease security requirements. The RFID system would allow arms store and arms users to efficiently collect, manage, distribute, and store information on inventory, rifle application processes, and security controls.

## 2 METHODOLOGY

The method employed in this work is modular concept. The concept certified that each unit is a standalone module. The module was pre-fabricated, thus, providing supply power and re-programming action. Thereafter, the application level of the ZigBee stack was then reprogrammed with our own application to be able to carry out the required activities. Fig. 2, shows the schematics circuit. A brief narrative of the components functions employed are highlighted

Fig 2. Schematics Circuit

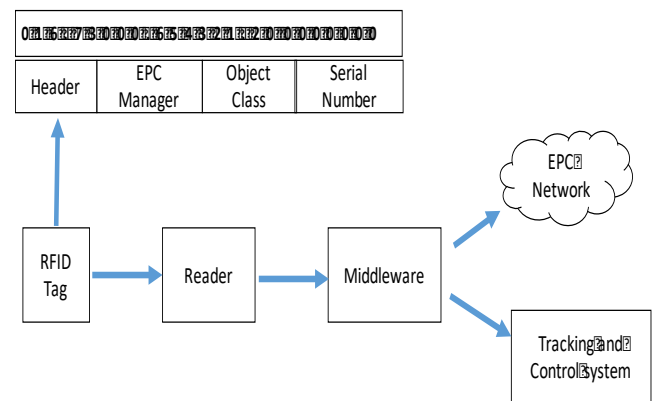


Radio-Frequency Identification: RFID as an emerging technology that has generated enormous amount of interest in the tracking and control of essential items. With the RFID technology, inventory can be track accurately in real time. More significantly, the complete visibility of accurate inventory data throughout the entire supply chain, from manufacturer to warehouses to retail stores is efficiently achieved. In [3], a basic RFID system is composed of three main components: the tag, the reader and the middleware, this is shown in Fig. 3.

The RFID tag is a tiny microchip or an integrated circuit with an antenna attached and embedded into labels. The antenna enables the chip to transmit the label's identification information to a reader [4]. When the reader is prompted, the tag broadcasts the information onto its chip. The reader converts the ra-

dio in waves reflected back from an RFID tag into digital information that can then be passed on to computers or computer mainframes. The central data feature of RFID technology is the Electronic Product Code (EPC). There the information is collected, sorted, and converted into relevant data. [3, 4].

Fig. 3: RFID System Components



Base station: It is a computer system located at a remote place away from the arms store. This base station contained the records of the items in the store, in this case weapons in particular small arms. It also stored the biometrics data information of all the personnel authorized to use the weapons of that particular organization.

Algorithm: The design algorithm do obtained the current Global Positioning System (GPS) co-ordinate and heading reading from compass of the location of the small arms weapon in the organization. Then the destination coordinate is required of the intended user. The monitoring system is achieved by calculating the angle of which the weapon orients with desired direction using simple trigonometric functions. The calculated angle provides the weapon movement control signals. Furthermore, the weapon navigates itself to the desired location. Additionally, the Path planning algorithms are used to decide the path taken. Conversely, an obstacle avoiding algorithm is also incorporated, to ensure the most efficient manner based on the IR sensors values which are obtained

Biometric Authentication: The biometric authentication is the process of comparing data for the person's characteristics to that person's biometric "template" in order to determine resemblance. The reference model

is first store in a database or a secure portable element like a smart card [5]. The data stored is then compared to the person's biometric data to be authenticated. Here it is the person's identity and the small arms serial number which are being verified. The Biometrics automatically identifies a person on the basis of some biological or behavioural characteristics of the individual. Some of the biological characteristics, such as fingerprints, and behavioural characteristics, such as voice patterns, are distinctive to each person.

**Wireless Communication:** Wireless electronic security is operated to control system for access into secured area [6]. To have access through the weapon, one is required to carry a card in the form of identity card. This card carries a unique identification code that modulates a radio frequency (rf) signal in the transmitting module for reception at the receiver. The received signal contains the information for authentication before enabling or disabling access. Furthermore, a distinguishing feature of this system is coding of the pictures of authorized personnel as additional security.

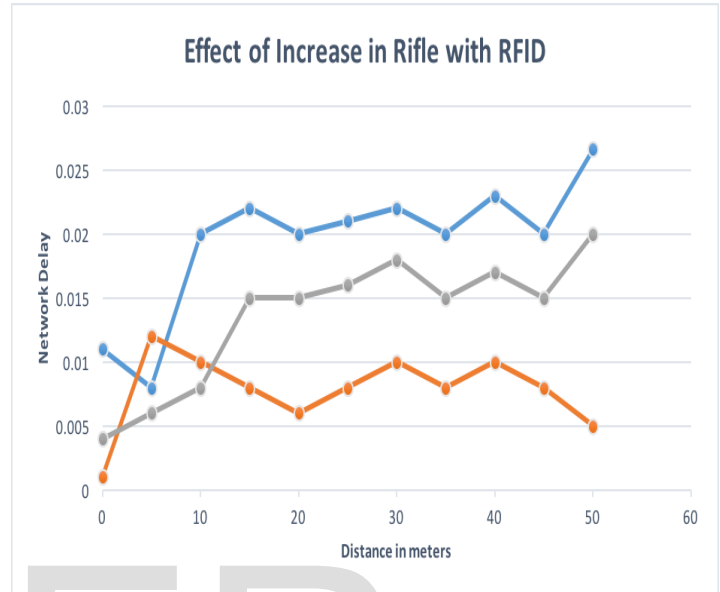
**XBee ZigBee Module:** The ZigBee is a wireless network protocol that is designed to be used with a low data rate sensor and control networks [7]. ZigBee is a protocol that uses the IEEE 802.15.4 standard as a baseline and adds additional routing and networking functionality. The implementation of the XBee ZigBee module provided a remotely operated control system for access into secured area.

### 3 RESULTS

The test application consists of a ZigBee wireless network coordinator and a motion sensor RFID device. The motion sensor device reports the motion detected to the coordinator which lights up the indicator lights or triggers the alarm. The GPS reader reads takes records of the location latitude and longitude of the authorized signed pout weapon from the armoury. The test results from individual point-to-point link between armoury and 3 rifles located within 2km radius show throughput and tracking degradation as the number of rifles continue to increase. This is due to the fact that the randomness and nature of the terrain which was characterized by high build-up area affect the signal Quality of Service (QoS) [8]. From result in Fig. 4, it revealed that, in the 3 rifles tested the total load through the network was efficient. The network plot shows that the higher the number of rifles in the network, the higher the traffic load passing through the network at any point in time. Significant

increase was experienced in delay time when the rifles are increased across the network.

Fig. 4: Effect of Increase in Rifle with RFID in the Network



Privacy and security management control access to and protects both the network and the weapon were achieved. The network system provided link encryption to guard against intentional and accidental abuse, as well as unauthorized access and communication loss. The network security permit confidentiality, integrity and availability

### 4 CONCLUSION

The forces of RFID and impressive advances in enabling wireless technologies have dominated the security agenda that is defining tracking and monitoring capabilities of small arms. The hybrid RFID wireless applications through wireless sensor and ZigBee technology networks are a critical and emerging field. The hybrid RFID designed remotely controls and monitored many number of rifles within 2 km radius. However, due to requirements power of transmission, length of antenna and encryption technique the hybrid RFID is suitable for designated equipment such as small arms.

### REFERENCES

- [1] Badiora, A. I. (2017). Civil Unrest, Insurgences and the Challenges of Community Displace-

- ment in Sub-Saharan Africa: A Silhouette of selected states in Nigeria. *International Journal of Criminal Justice Sciences*, 12(2), 302-318. <https://doi.org/10.5281/zenodo.1034678>
- [2] Shehu Mohammed, I. (2018). Post Boko Haram Insurgency, Nigeria's National Security, and Emergent Threats. *Humanities and Cultures Studies R&D*, 3(2), 1-15. Retrieved from <https://www.jsrd-humanities.com>
- [3] Yacine Rekik. The Impact of the RFID Technology in Improving Performance of Inventory Systems subject to Inaccuracies. *Engineering Sciences [physics]*. Ecole Centrale Paris, 2006.
- [4] J. A. Wolff. Rfid tags - an intelligent bar code replacement. Technical report, IBM Global Services, 2001. 1.1
- ternational Journal of Production Research, 6:615-631, 1981. 7.2.1, 7.4 [81] P.H. Zipkin. Foundations of Inventory Management. 2000. 7.3.1
- [6] Sagir Lawan and Abdul H. Sadka "Robust Adaptive Intra Refresh For Multiview Video" *International Journal of Computer Science, Engineering and Applications (IJCSEA)* Vol.4, No.6, December 2014 DOI: 10.5121/IJCSEA.2014.
- [7] Sagir Lawan and Abdul H. Sadka "Robust Multi-view Video Streaming through Adaptive Intra Refresh Video Transcoding," *International Journal of Engineering and Technology Innovation*, vol. *International Journal of Engineering and Technology Innovation* vol.5.no4, 2015, pp. pp.209-219, 2015.
- [8] Confino and A. Elmore. RFID fundamentals. Technical report, Chariot Solutions, PPT Consulting, Inter mec, Penn State Great Valley, 2004. URL [http://www.chariotsolutions.com/javalab/slides.jsp.\(document\), 1.1](http://www.chariotsolutions.com/javalab/slides.jsp.(document),1.1)
- [5] H. Schneider. Effect of service-levels on order-points or order-levels in inventory models. In-