Automatic Identification Technology Tracking Ammunition Allocation System Using Visualization

Ibegbu Kelechi.[1], Amanze B.C[1]., Agbakwuru A.O[1] & Agbasonu V.C[1]
[1]Department of Computer Science, Faculty of Physical Scieneces,
Imo state University, Owerri, Nigeria.
amanzebethran@yahoo.com

DOI: 10.56201/ijemt.v9.no3.2023.pg136.153

Abstract

This work focused on developing a system to track ammunition allocation in security agencies. Due to non-tracking of ammunition allocation among the security agencies, a lot of problem has been arising from it which includes lack of proper inventory of arms and ammunitions purchased by security agencies, and also illegal trafficking, possession and misuse of weapons and ammunition by non-state actors. So, in this paper, a cloud-based security agencies ammunition allocation tracking system using data analytics and visualization was developed. The developed cloud-based application can keep inventory record of ammunition purchases by security agencies using HTML, CSS, Php and JavaScript. The application also integrated a platform that can track ammunition allocation and identify security personnel in possession of ammunition at any given time. Also, modules that can track a range of time in months to the expiration date, shelf life, maintenance and renewal dates of explosive weapons which will serve as early warning guide or information to avoid catastrophes was implemented.

Keywords: *Visualization. Ammunition, Security Agencies and OOADM*

Introduction

The increasing rate of hired assassins in Nigeria has become a source of worry and serious security threat to its citizens. Kidnapping has remained one of the major security challenges in Nigeria. In recent time, the country has witness series of high profile kidnapping cases like the wife of the CBN governor, Mrs Margaret Emefiele, Lagos Monarch, ObaYushauOseni, Osun State Permanent secretary, Mrs AdebimpeOgunlumade, formal Finance Minister, Chief OluFalae, Professor James Adiche and a host of other. Some have been kidnapped and huge ransom paid for their release. Records have shown an increasing rate of armed robbery cases across the states. Criminal elements have continued to give security agencies and citizens sleepless nights [1]. Armed robbery attacks in banks, on the high ways, in the homes and in other places have continued

to increase in rate and sophistication in recent times nationwide. The security situation continues to worsen as no true solution has been devised. This is precisely because the security agencies or agents entrusted with the duty of fighting the terrorists as with other crimes have been compromised. Mention could also be made of a number of criminals arrested at one time or the other with different security uniforms and weapons that were acquired by security agencies [2]. These years of armed violence, compounded with weak governance, have left a number of African States transitioning from conflict with weakened security apparatuses and limited operational capacity to exercise safe and secure management of weapons and ammunition. These fragile contexts are prone to political violence and criminality and are at a high risk of relapsing into conflict, with many of the key drivers remaining unaddressed, including weak control over national stockpiles and the illicit circulation of weapons and ammunition. Weak weapon and ammunition management (WAM) poses a significant challenge to peace, security and development. Illicit arms and ammunition are enablers of urban violence, displacement of people, human rights violations, and organized crime [3]. Their misuse poses barriers to delivery of humanitarian services, protection of civilians and critical infrastructures, as well as investment and economic growth. In countries such as the Central African Republic, Côte d'Ivoire (during time of war), the Niger and Somalia, national stockpiles, either of the State itself or of its neighbours, represent the primary source of weapons and ammunition for non-state armed groups, including terrorists. Conflict and armed violence also have a significant impact on the security sector and on the conduct of a nation's security forces. Inadequate WAM can contribute to the misuse of arms and ammunition by security forces and exacerbate situations of weak accountability and impunity.

As a result, WAM is increasingly understood to be a fundamental component of recovery efforts and conflict prevention, as reflected by the increasing amount of WAM programming being implemented across the globe, the development of international guidance and standards, including the International Ammunition Technical Guidelines (IATG) and the Modular Small-arms control Implementation Compendium (MOSAIC), and the number of signatories to international and regional arms control instruments [3]. Also, the above-mentioned challenges and problems have been easier and possible because there has been insufficient tracking system for legally acquired weapons and ammunition's and real-time feature to detect or identify weapons' shelf-life, maintenance period as well as expiry date. Hence, the need to develop a system to tackle the above problems becomes paramount. Therefore, this work is aimed at curbing the excesses of our security agents by tracking weapons officially assigned to them and preventing self-detonation of explosives devices as a result of inadequate maintenance. Due to non-tracking of ammunition allocation among the security agencies, a lot of problem has been arising from it. The problems include:

1. Lack of proper inventory of arms and ammunition's purchased by security agencies
2. Destabilizing transfers of arms and ammunition to fragile contexts without proper records
3. Diversions from national stockpiles to unauthorized end-users resulting to reckless use of firearms for terrorism and banditry
4. Illegal trafficking, possession and misuse of weapons and ammunition by non-state actors.

The aim of this paper is to develop a cloud-based security agencies ammunition allocation tracking system using data analytic and visualization. The specific objectives include:

1. To develop a cloud-based application that can keep inventory record of ammunition purchases by security agencies.
2. To integrated a platform that can track ammunition allocation and identify security personnel in possession of ammunition at any given time.
3. To incorporate in the application a system that can identify the make, type, model, serial number, date of manufacture, the date of purchase and the purchasing officer for all the ammunition's.

Review of Related Works

Methods of Tracking Weapons

Tracking Weapons using Forensics: In tracking of ammunition's, ballistic finger printing can equally be employed [4], ballistic finger printing refers to a set of forensic techniques that rely on marks that firearms leave on bullets to match a bullet to the gun it was fired with. In addition to recording the markings from guns used in crimes, the system is designed to record markings from the test firing of every new gun. If the database does eventually contain the majority of firearms manufactured, it would be possible for the police to start the trace process with nothing more than a bullet or a casing left at a crime scene. He stated further that it is a subset of forensic ballistics (the application of ballistics to legal questions) and internal ballistics (the study of events between the firing of a gun and the bullet leaving the barrel).

Ballistic Fingerprinting Techniques and Aids: [4] identified ballistic fingerprinting techniques as based on the principle that all firearms have inevitable variations due to marks left by the machining process, leaving shallow impressions in the metal which are rarely completely polished out. Also, normal wear and tear from use can cause each firearm to acquire distinct characteristics over time

Missile Guidance: Missile guidance refers to a variety of methods of guiding a missile or a guided bomb to its intended target. The missile's target accuracy is a critical factor for its effectiveness. Guidance systems improve missile accuracy by improving its "Single Shot Kill Probability" (SSKP), which is part of combat survivability calculations associated with the salvo combat model. These guidance technologies can generally be divided up into a number of categories, with the broadest categories being "active," "passive" and "preset" guidance. Missiles and guided bombs generally use similar types of guidance system, the difference between the two being that missiles are powered by an onboard engine, whereas guided bombs rely on the speed and height of the launch aircraft for propulsion [4].

Visualization Technology

Graphical representation of information and data is referred to as Data Visualization. This can be achieved by using visual elements like charts, graphs, and maps. Data visualization tools provide an accessible way to see and understand trends, outliers, and patterns in data. In the world of Big Data, data visualization tools and technologies are essential to analyze massive amounts of information and make data-driven decisions. Also, data visualization can be seen as the presentation of data in a pictorial or graphical format. It enables decision makers to see analytic presented visually, so they can grasp difficult concepts or identify new patterns. Because of the way the human brain processes information, using charts or graphs to visualize large amounts of complex data is easier than poring over spreadsheets or reports [5]. The main point of big data display technology lies in: the result information from the statistical analysis of big data is displayed to the user in an intuitive way, and it is convenient for the user to understand while displaying complex data information. Authentication is the front line countermeasure of ensuring that only the genuine user is granted access into the cloud storage, and accordingly a robust authentication technology should be provided in order to accomplish a confidential cryptographic framework. Given encouraging outcomes from transparent biometric verification in terms of accuracy and usability being demonstrated, it can be combined with two-factor authentication with a view to ensure a trusted, secure and reliable access. In the meantime, while the cloud user undertakes particular cloud storage service activities, his/her biometric data, which does not require the explicit interaction with the system, are collected in a non-intrusive manner. Cloud-based storage activities can be Add, Delete, Edit, Download, Update, Rename, Read, Write, or any other activity that could be undertaken by the cloud subscriber. The biometric modalities are acquired via the Biometric Collector Agent and then directed into a number of input sampling channels. Following this, a number of the feature extraction techniques are applied to generate the optimal feature vector – this stage represents the Feature Extractor Agent. Both the Biometric Collector Agent and the Feature Extractor Agent belong to the Biometric Engine. Subsequently, the Communication Engine sends over the feature vector into the cloud provider which undertakes all remaining processing and responsibilities with the aim of setting out the key generation process for multiple users' devices. The contribution of this research has enhanced the security and usability issues of cloud storage technology. On the other hand, further research suggestions related to the current scope of the study can be taken into consideration for future work [6]. [7] titled "Device fingerprinting identification and authentication", the researchers said that Network security has always had an issue with secure authentication and identification. The solution proposed requires use of device fingerprinting and can help secure a network if properly understood and properly executed. The research into this area suggests a solution which is the use of device fingerprints including clock skews to identify the devices and a dual- authentication process targeted at authenticating the device and the user. So, failure to authenticate part of the entity means the whole is denied access to the network and its resources. The paper was just a proposal and was not implemented. Also, the cost from fingerprinting all devices will be very high and this is the research gap identified in the paper [7]. [8] proposed an Improved Authentication Technique with OTP in Cloud Computing" proposed for an authentication system using OTP. They proposed authentication method used is two-factor authentication with a one-time password.

The user's mobile phone will work as the authentication device, in which the user has to enter a 4-digit PIN code to generate an OTP that can be used for login. This is done by a Java-application running on the phone. The OTP that is generated on the mobile phone is based on three components which will be hashed together with MD5. The solution proposed was able to increase the security of the cloud environment by the two-factor authentication still have loop holes for security breaches. [9] titled "Securing the Cloud Environment Using OTP". Dynamic mobile token application was introduced. This is the application in mobile phones which is used to generate a code with the help of OTP (One Time Password). This OTP code is used only for one time to login session. In the paper, they describe one of the methods of OTP. There are two phases in it Registration phase and Login phase. User first register itself by fill credentials in the form and then enters to the Login phase. In login phase, OTP will generate for the login session. OTP is generated by three parameters: The current time, 4-digiti PIN code and Init-secret. This code is valid for three minutes only. This ensures protection against eavesdropper's attack and man-in-middle attack. Hence, they prove OTP is very secure [9]. [10] developed a web-based healthcare data visualization system. The system they developed was called Health-Terrain and it is based on a Notifiable Condition Detector (NCD) use case. In their paper, two new visualization techniques were used; a spatial texture-based visualization approach for multi-dimensional attributes and time-series data, and a spiral theme plot technique for visualizing time-variant patient data. The result they obtained showed that for public health data with large patient databases, the rich set of tools available to support web-based user interface, graphics, and data communications, was efficient to develop a web-based visualization system. [5] presented a paper on data analysis and visualization in big data. They introduced the workflow of deep learning algorithm. The paper also analyzes the system for big data medical information resource sharing. The big data medical service system was constructed based on the medical information collection and sharing, data mining and knowledge management level. Using Echarts, HCharts and other data visualization technology, according to the design of specific modules, the visualization and display of medical data was realized, which has certain promotion effect on the research and development of medical big data visualization analysis.

Methodology Adopted

Object-oriented analysis and design methodology (OOADM) was adopted in this work and it is a set of standards for system analysis and application design. It uses a formal methodical approach to the analysis and design of information system. Object-oriented design (OOD) elaborates the analysis models to produce implementation specifications. The main difference between object-oriented analysis and other forms of analysis is that by the object-oriented approach we organize requirements around objects, which integrate both behaviors (processes) and states (data) modeled after real world objects that the system interacts with. In other or traditional analysis methodologies, the two aspects: processes and data are considered separately. For example, data may be modeled by ER diagrams, and behaviors by flow charts or structure charts. The primary tasks in object-oriented analysis (OOA) are finding the objects, organize the objects, and describe how the objects interact, define the behavior of the objects and define the internals of the objects. For effective implementation of this thesis, some web application languages were used to design

the cloud-based security agencies ammunition allocation tracking system. These includes; Hypertext Markup Language (HTML), Hypertext Preprocessor (PHP), MySQL, Cascaded Style Sheet (CSS), Java Script, Dream weaver, and Fireworks. Dream weaver is an HTML-based application that is used to generate graphical user interfaces. The scripting language behind the development of the system is PHP and JavaScript. JavaScript is used to add functionality beyond standard HTML to a web page. It adds interactivity to website. MySQL is used together with PHP in website development and is open source software. These are the materials needed to actualize the projects objectives. For the tools used, there are numerous development environments for PHP. These include Integrated Development Environments (IDEs) and text editors, and hybrid environments that combine multiple tools and processes into one. For this paper, the following tools were utilized to develop the application.

Users/Personnel Use case Diagram

This use case is for the personnel/users of the system. The privileges of this module would be assigned by the administrator. This set of users can create Personnel, Create Weapons' Information, Check periods (expiry, maintenance etc), Receive Alert or Notification, Assign Butt Number, Sign In/Out Weapons

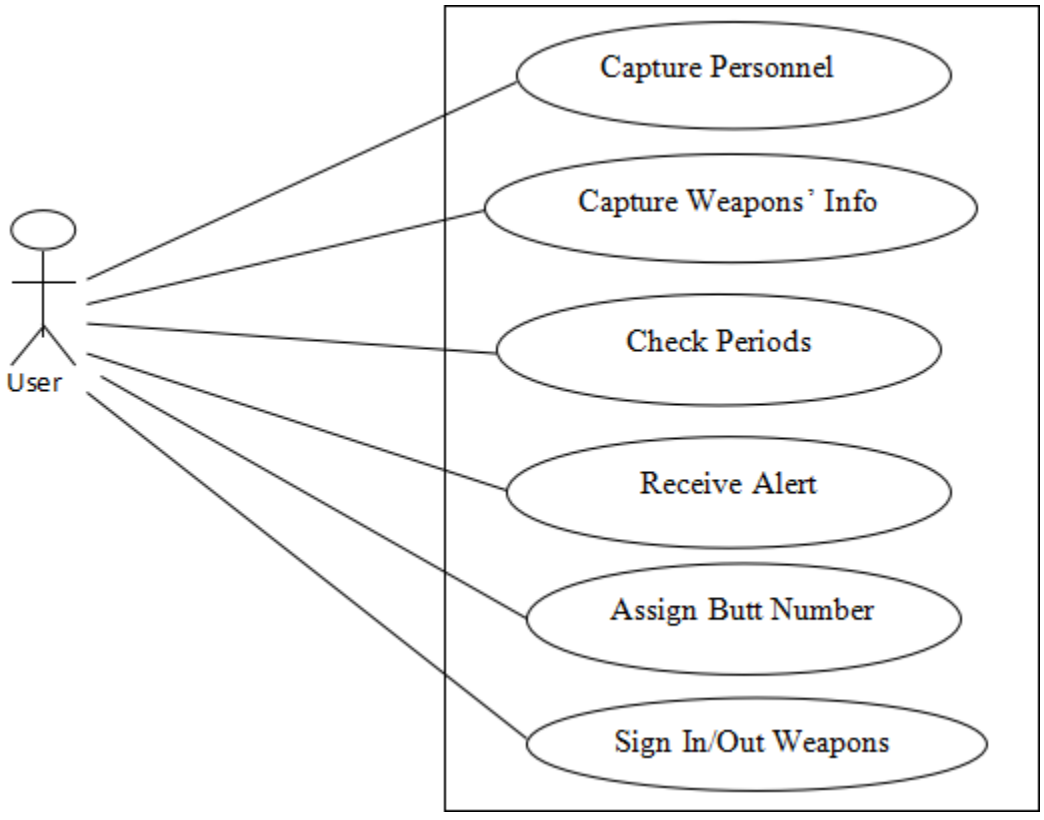

Figure 1: User Use Case Diagram

Sequence Diagram

The sequence diagram of the New System login process is shown in figure 2 below:

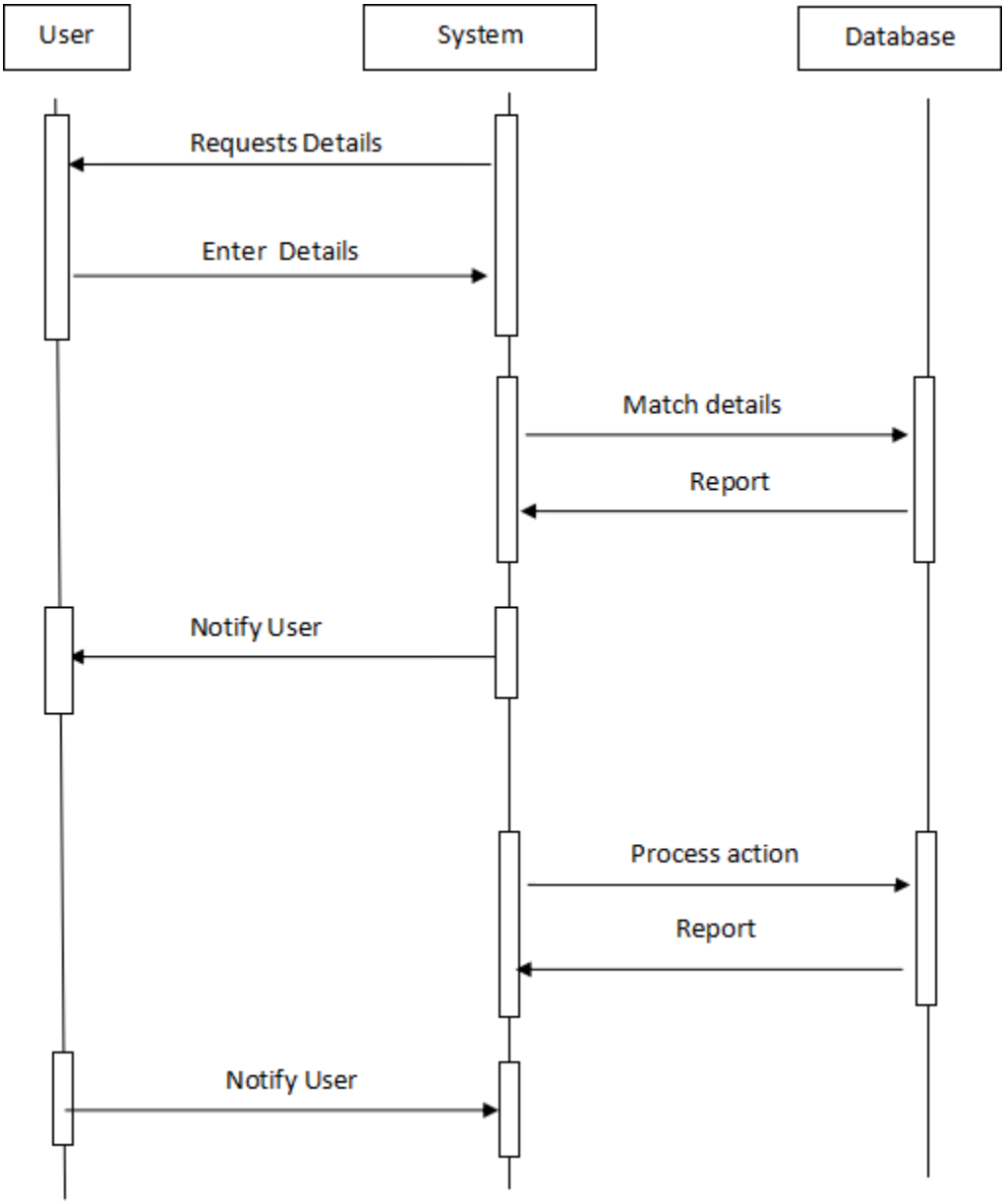

Figure 2: Sequence Diagram: User Login

Sequence diagram of the personnel/weapon creation process is shown in figure 3 below.

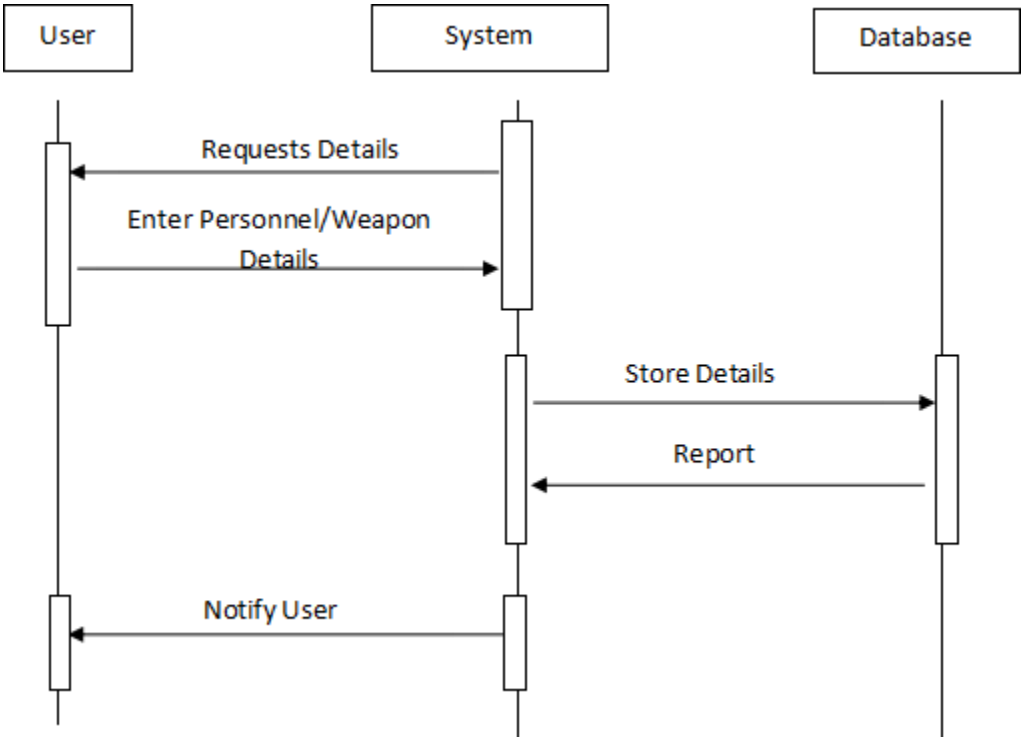

Figure 3: Sequence Diagram for Personnel Creation/ammunition Registration

Sequence diagram for ammunition sign in/out process is shown in figure 4

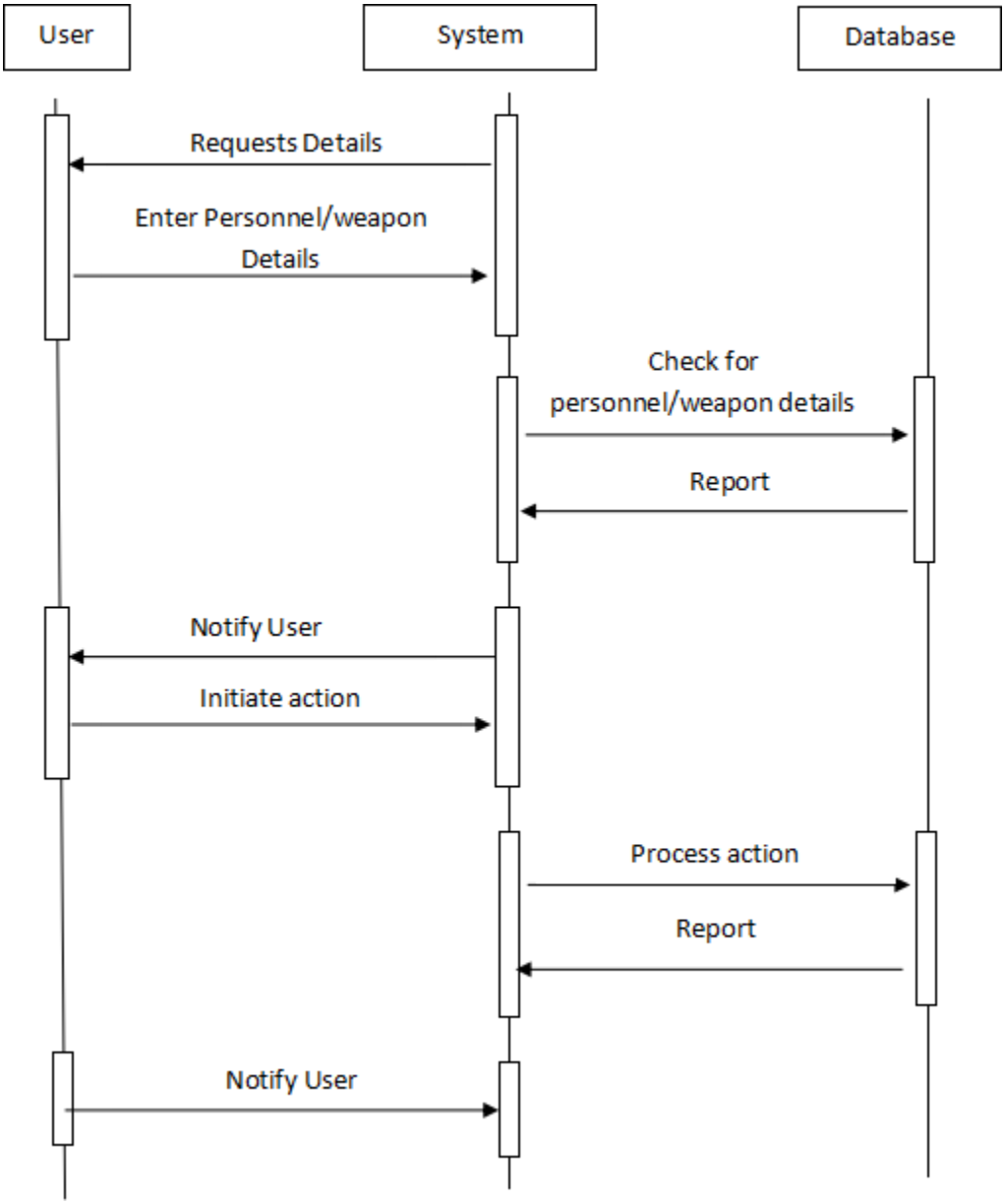

Figure 4: Sequence Diagram for ammunition signing (sign In/Out)

Sequence diagram of the weapon check processes of the new system is shown in figure 5 below

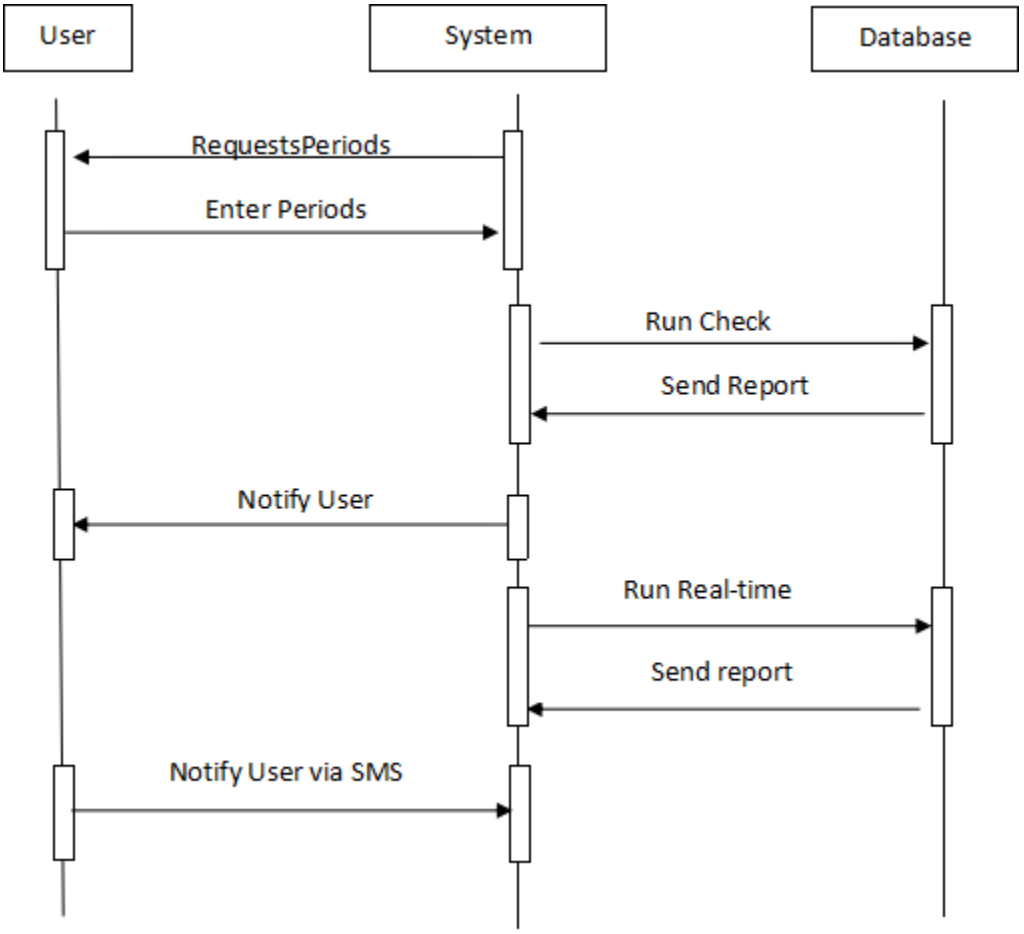

Figure 5: Sequence Diagram for ammunition check processes

Activity Diagram

The section presents the Activity Diagrams of the new system. The component diagram of the user creation process is shown in figure 6.

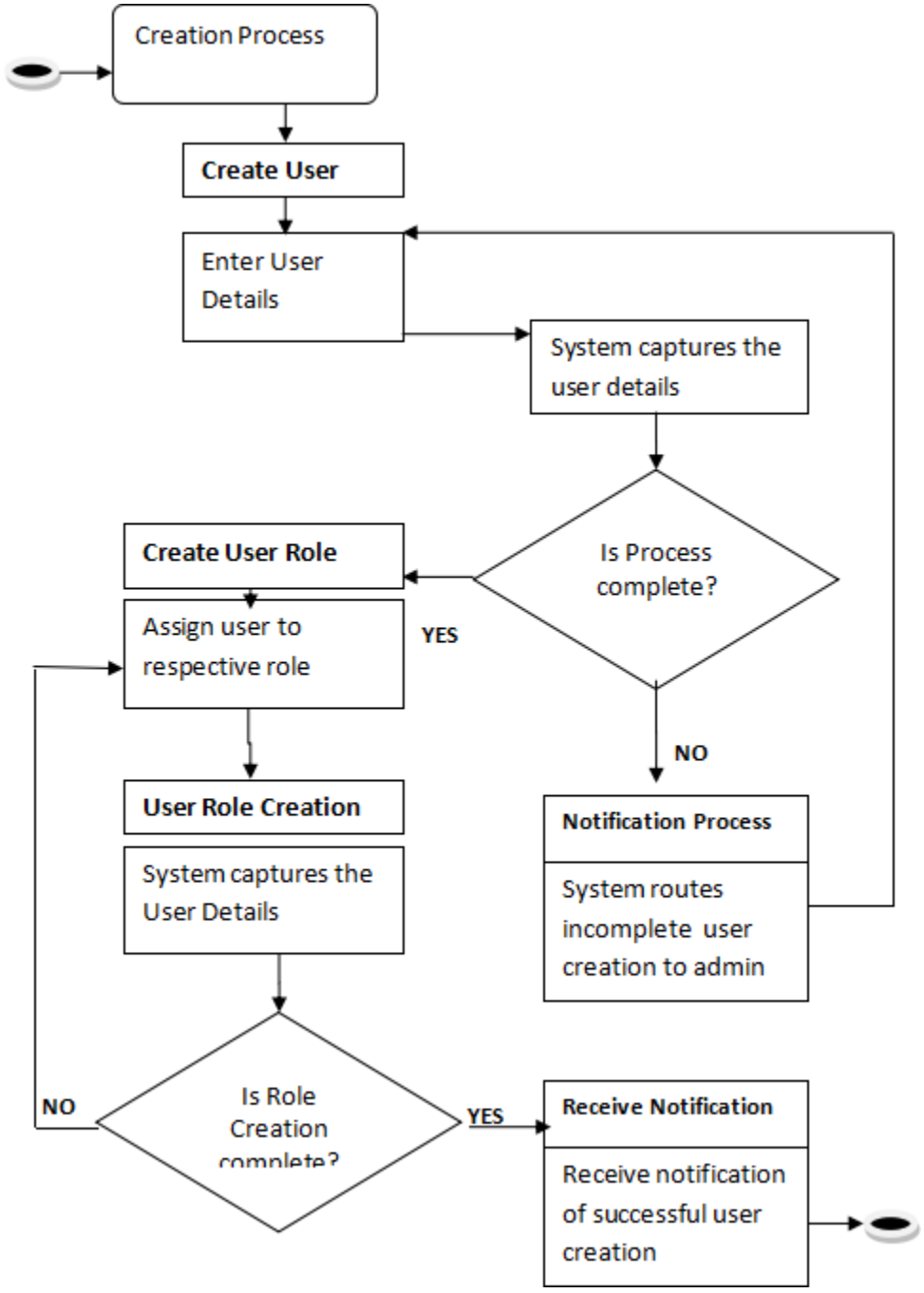

Figure 6: Activity Diagram: New User Creation Process

The activity diagram of the ammunition creation process is shown in the figure 7 below:

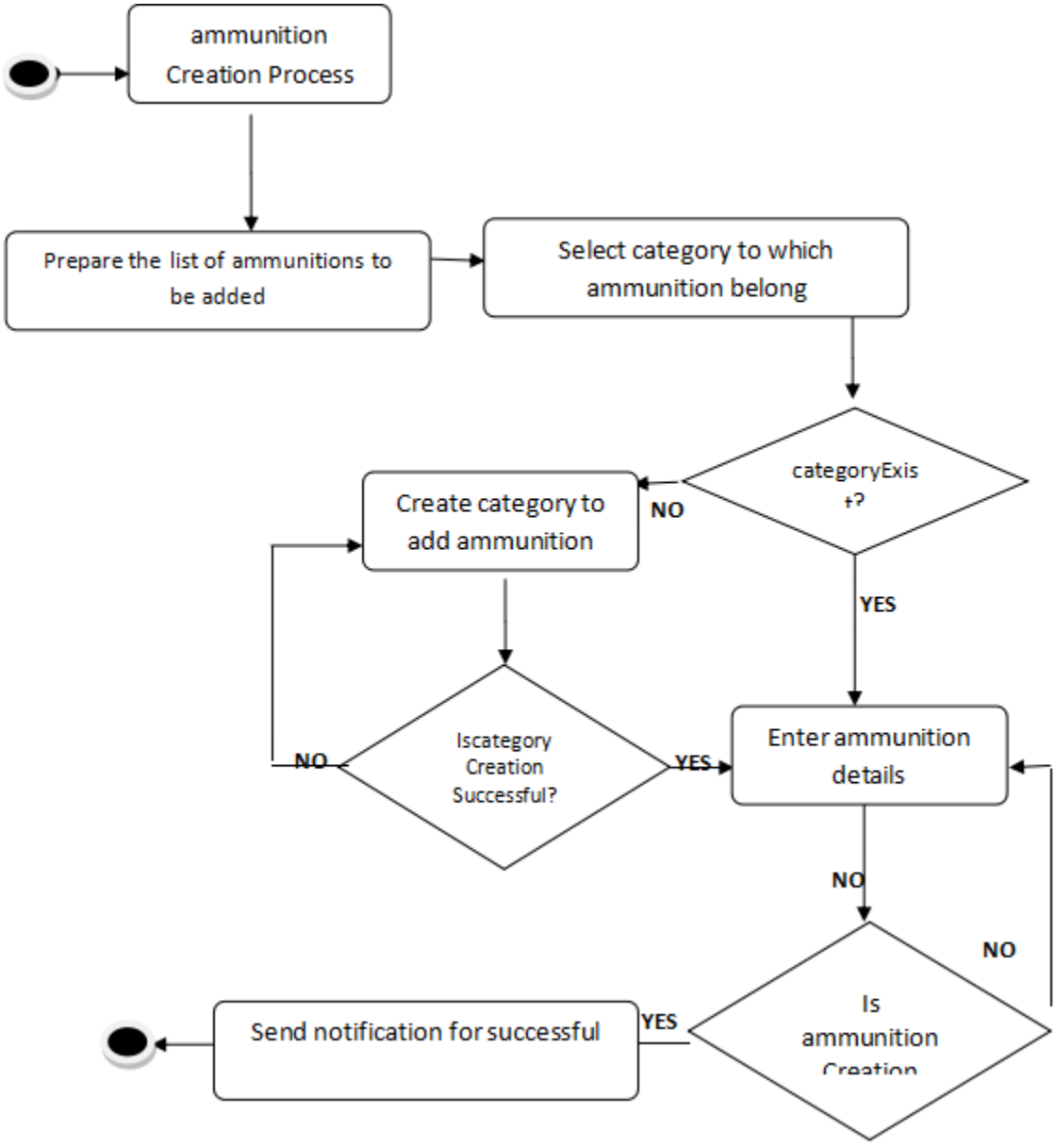

Figure 7: Activity: Ammunition Registration Process

The activity diagram of the alert notification process is shown in figure 8 below:

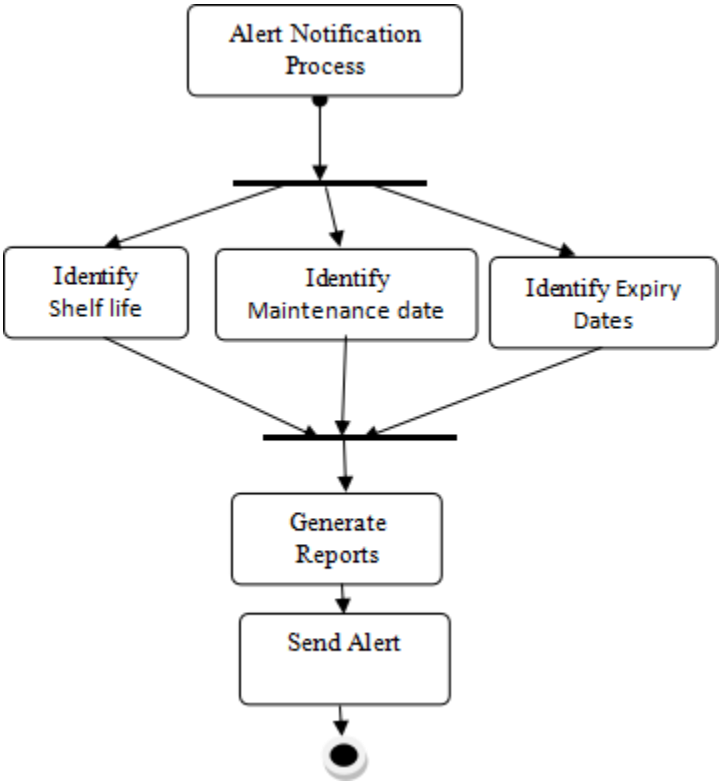

Figure 8: Activity Diagram: Alert Notification Process

Conceptual Model of the Proposed System

The conceptual, navigational and interface model of the system is shown in figure

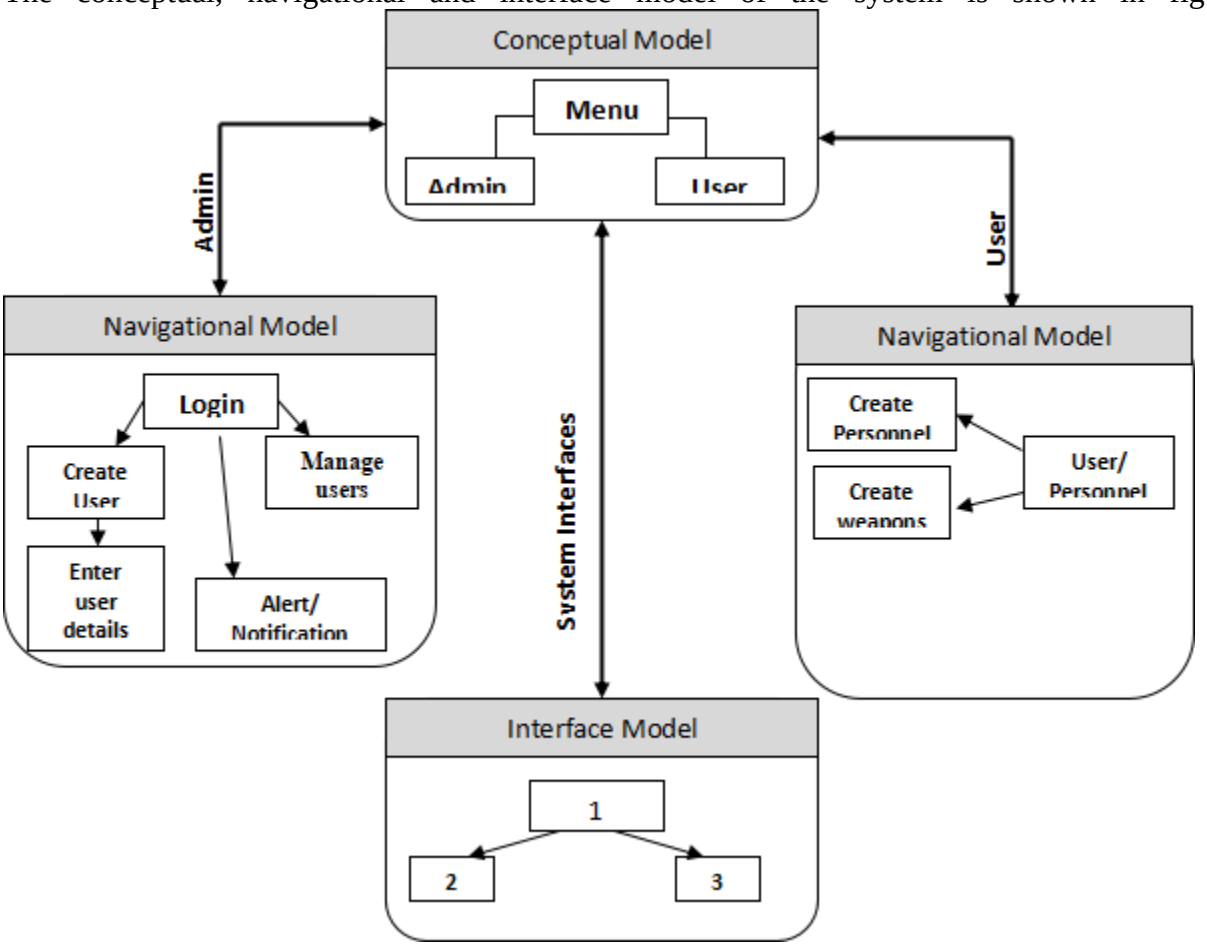

Figure 9: Conceptual Model of the Proposed System

Analytic **and Visualization of Number of Ammunition Registered**

This KPI is used to find the total number of ammunition registered in the database. Table 1 shows a statistical analysis of the ammunition registered while figure 10 shows the visualization of the ammunition's.

Table 1: **The Total Number of Ammunition Registered in the database**

Ammunition Type	**Total Available**
Hand Guns	145
Machine Pistols	67
Assault Rifles	300

Sniper Rifles	36
Sniper Rifles, 50 Cal	78
Heavy Machine Gun	20
Recoilless Rifle, 84mm	14
Grenade Launchers	5
Armourd car	10
Total	**675**

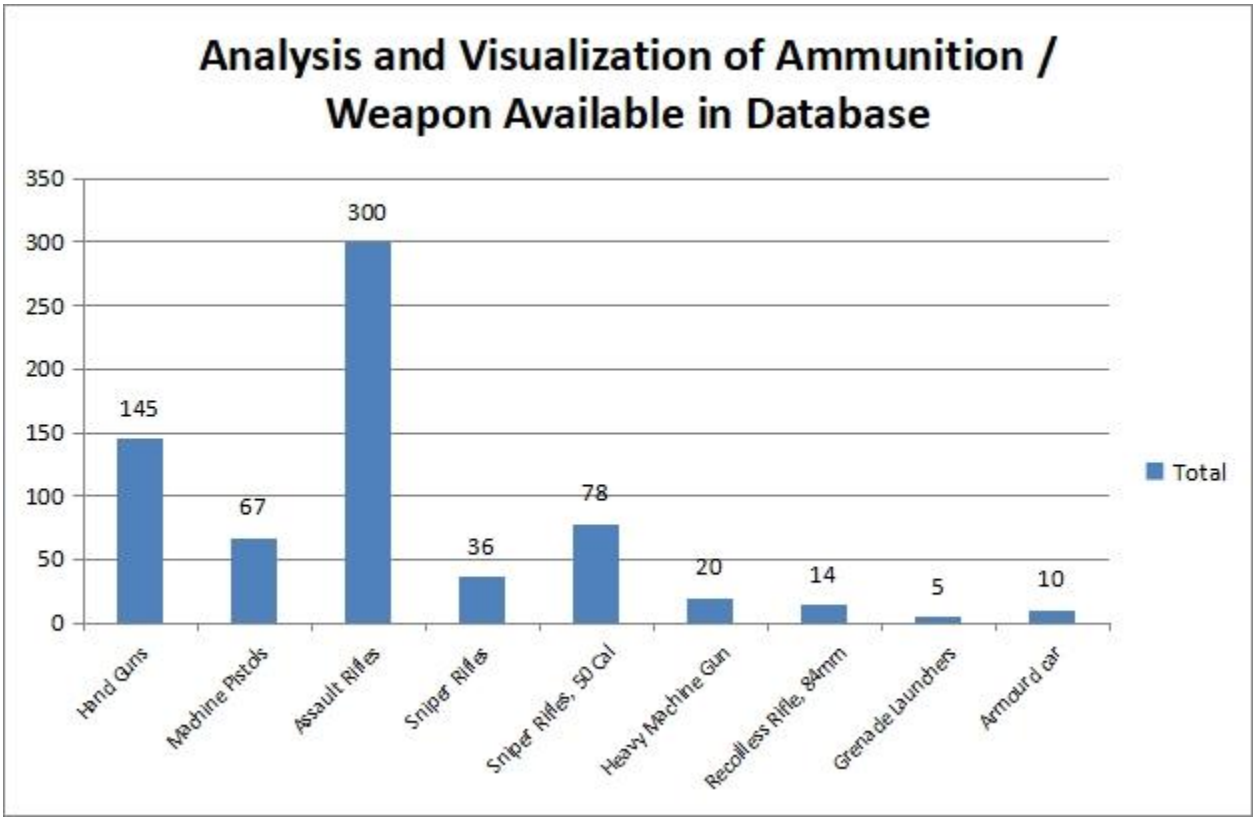

Figure 10: The total number of ammunition's registered

From figure 10 we can see the various types of ammunition and the quantities available as recorded in the database.

Analytic and Visualization of Number of Ammunition Allocated

This KPI is used to find the total number of ammunition allocated to security officers. Table 2 shows a statistical analysis of the ammunition allocation while figure 11 shows the visualization of the ammunition's allocated.

Table 2: **The Total Number of Ammunition Allocation in the database**

Ammunition Type	**Total Allocation**
Hand Guns	96
Machine Pistols	60
Assault Rifles	150
Sniper Rifles	30
Sniper Rifles, 50 Cal	50
Heavy Machine Gun	5
Recoilless Rifle, 84mm	4
Grenade Launchers	2
Armourd car	4
Total	**401**

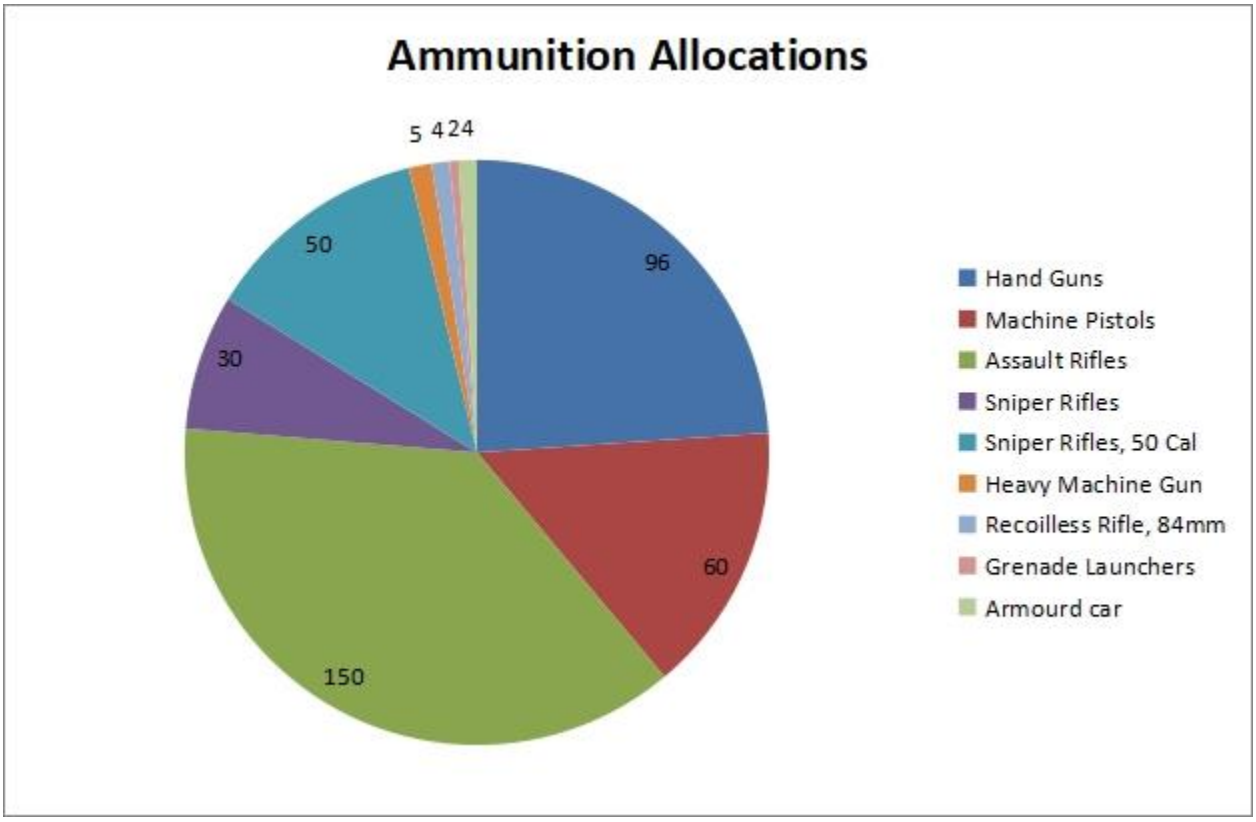

Figure 11: The total number of ammunition's Allocation

Conclusion

In this paper, one have demonstrated how datasets can be presented in a more meaningful format using data analytic and visualization. The datasets used in this work was visualized using tables and graphs. The result generated shows the descriptive statistics of the datasets. The work is significant because ammunition allocation tracking system will be a valuable tool for the security agents in tracing ammunition used in crimes and the people involved. It will be also helpful in tracing the connections between potential terrorists and suppliers. The required information can be obtained by analyzing weapons (firearms, bullets or cartridge (shell) casings) recovered at crime scenes and tracing them back to source.

References

[1] Bosun, A. (2012) Security challenges pose risk to Nigeria. Coastweek Newspapers Ltd. December 21, 2012

[2] Bisola, B. O. (2012) Issues of Insecurity: How complicit are the security agencies – A comprehensive resolution of Nigeria's security issues. Vanguard Newspaper, June 27, 2012

[3] Boutellis, A. (2018) The Changing Role of Conventional Arms Control in Preventing and Managing Conflicts, UNIDIR

[4] Kopel, D. B. (2018) Ballistic fingerprints. In Ayn Embar-seddon, Allan D. Pass (eds.). Forensic Science. Salem Press

[5] Ying, Y. and Tao, C. (2019) Analysis and Visualization Implementation of Medical Big Data Resource Sharing Mechanism Based on Deep Learning. School of Management, Xinxiang Medical University, Xinxiang 453003, China

[6] Leith , H.(2019) Securing Cloud Storage by Transparent Biometric Cryptography. University of Plymouth, https://pearl.plymouth.ac.uk

[7] Lien, T. H. (2017) Automatic identification technology tracking weapons and ammunition for the Norwegian Armed Forces. Master's Thesis, Monterey, California. Naval Postgraduate School

[8] Paul, E. M. (2016) Device fingerprinting identification and authentication: A two-fold use in multi-factor access control schemes. Graduate Thesis and Dissertations. 15968. https://lib.dr.iastate.edu/etd/15968

[9] Vishal, P., Vimmi, P. (2013) An Improved Authentication Technique with OTP in Cloud Computing. International Journal of Journal Scientific Research in Computer Science and Engineering. Research Paper Vol-1, Issue-3 E-ISSN: 2320-763

[10] Pandey, V. (2017). Securing the Cloud Environment Using OTP. International Journal of Scientific Research in Computer Science and Engineering

[11] Jiang, S., Fang, S., Bloomquist, S., Keiper, J., Palakal, M., Xia, Y. and Grannis, S. (2016) Healthcare Data Visualization: Geospatial and Temporal Integration. DOI: 10.5220/0005714002120219 In Proceedings of the 11th Joint Conference on Computer Vision, Imaging and Computer Graphics Theory and Applications (VISIGRAPP 2016) - Volume 2: IVAPP, pages 214-221 ISBN: 978-989-758-175-5