**PROJECT REPORT**

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**RWANDA NATIONAL POLICE ONLINE AUCTION SYSTEM**

*by*

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*Under the guidance of*

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***Submitted in partial fulfillment of the requirements***

***for the award of the degree of***

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****

**Department of Computer Science**

**School of ICT**

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KN 7 Ave, Nyarugenge, Kigali

**[March 2024]**

# **DECLARATION**

We declare that, this project work entitled, “***RWANDA NATIONAL POLICE ONLINE AUCTION SYSTEM***” is original and has never been submitted to any University or other Institution of Higher Learning.

It is our own research whereby other scholar’s writings were cited and references provided. we thus declare that this work is ours and was completed successfully under the supervision of Mr. Dominique Harelimana.

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# **BONAFIDE CERTIFICATE**

*This is to certify that the project work entitled* “***RWANDA NATIONAL POLICE ONLINE AUCTION SYSTEM*”** *is a Bonafede work of “Musabyemungu Albert (Reg No:220009251), Murebwayire Clemance (Reg No:220013611), Ishimwe Regis (Reg No:220006210)”* who carried out the project work under my supervision.

**Date:**

**Signature of head of Department Signature of supervisor**

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# **ACRONYMS AND ABBREVIATIONS**

NBER: National Bureau of Economic Research

RNP: Rwanda National Police

B2B: Business to Business

SSR: Server-side rendering

OTP: One Time Password

FAQs: Frequently Asked Questions

# **CHAPTER 1: GENERAL INTRODUCTION**

## **Introduction**

Technology is most powerful tool in all fields not excluding commerce and all trading activities as digital world reshaping traditional way of commerce and auction sector is not exceptional, traditional buyer and seller in auctioning are facing problems such as time consuming, highest number of staffs, present of both buyer, seller and products and geographical problems to operate auctioning, by these means Online and Live auctioning comes between as solution for the problems with presence of real-time auctioning, full guidance and easy maintenance and management, confidentiality , integrity and availability are provided at 24/7 without forgetting the digitization of data which keep it even for future uses and researches.

## **Background of the study**

The use of information technology in all domains is becoming the foundation of modern world and fast solution of problems around the world, in our country reporting, management of resources, research needs that present high level of technology, talking about domains security institutions is not excluded in this boosting technology.

As Rwanda National Police is dedicated to deliver high quality service, accountability and transparency, safeguard the rule of law and provide safe and crime free environment for all, the idea of digitalizing auction in solving the challenge like limited reach, inconvenient timing, travel costs and time consuming to the buyer who need to attend auctioning.

Mainly Rwanda National Police was facing logistical challenges due to managing, organizing and displaying items in auction which are time consuming, manually information taking which resulting to the increase of errors and higher number of police officers to operate the action.

## **Statement of the Problem**

The significant problems which lead to this research project are logistical challenges due to managing, organizing and displaying items which are time consuming, resource intensive and larger number of staff and manual record taking and keeping which cause errors in personal information, auction details and delay in recording. Eventually, the existing way of auctioning contains other problems related to buyers which are limited reach, inconvenient timing, travel costs and time consuming.

## [**Interest of the project.**](#_Toc244925835)

The arrival of modern technologies has changed various aspects of business operations and e-auctioning is one of domain to witnessed it. Traditional way of auctioning is often constrained by geographical limitation and inefficiencies and time consuming. The proposed of e-auctioning project are seeks for in powering digital platforms to streamline and strengthen the auctioning experience. Additionally, e-auctioning addresses these challenges by providing a robust online platform that enhance transparency, efficiency and accessibility of auctioning.

The successful implementation of e-auctioning system could have far-reaching implications. Rwanda National Police stand to benefit from cost saving, speed in bidding, adequate time of auction, increase bidder participation. Given the change in nature of modern markets and the raising reliance on online platforms, the e-auctioning is timely and justified. The research is pressing need for more effective, available, secure and user-centered auctioning solutions.

## **Objectives of study**

### **General Objectives**

The general objective of initiating online and real-time bidding systems is to enhance secure ways of buying through live bidding, provision of high level of accessibility and well-designed user interface.

### **Specific Objectives**

* Real-time bidding functionalities, this is implemented to keep track in bidding and allowing participants to get updated at the same time.
* Authentication and Authorization system to ensure and improve security, this includes login by using multi-factor authentication and role-based permission.
* Global accessibility, allowing access over the internet, multi-language support and currency options to enhance inclusive.
* Responsiveness of platform on every device level with different screen sizes, including Desktops, Laptops, tablets and smartphones.
* Design auction management tools for administrators, to allow administration for creating, monitoring and managing auction, this includes features of creating bidding rules, item categorization and auction scheduling.
* Implement a transparent history that allows users to view the bidding history.
* Integrate automated notifications system to inform users about the status of favourite items, outbidding scenarios and auction updates.
* Integration of robust security measures to protect user information, include encryption protocols, security of data storage and data transmission.
* Conducting tests, including usability test, security test and performance test, to ensure the reliability, security and optimal performance of system
* Design user support functionalities, include FAQs, guides and responsive customer support.

## **Scope of the study**

The scope of this research project “Rwanda National Police online auction system” is limited to improve security and accessibility of auction, the authentication and authorization of users of the system together with multi-factor authentication and One Time Password. The real-time auctioning at the subscribed items to enhance security and fraud in auction.

### **Geographical Scope/Case study**

The research has been carried out at “Rwanda National Police” Rwanda National Police Headquarter Kigali-Rwanda.

## **Methodology**

Gathering information for research study is maintained by well-known techniques such as Observation, survey and questionnaires to get high quality of information. By considering the factor of nature of our study and data needed, the following are data collection techniques.

Observation is way of gathering data by watching behavior, events or noting physical characteristics in their natural setting. Attending already exists auctioning and watch all activities, means, time taken, requirements, Items and services provided in auction.

An interview is formal conversation between two people, typically with one person, the interviewer asking questions to obtain information, assess qualifications, or evaluate the suitability of a candidate for a job, admission, or other purposes. In Our means the interviewing activities is going to be carried out by including Police staffs and citizens to the interview group for us to get qualitative data from both sides, the aims will be to gather the points of views of these group members about how they experience existing auctioning and the improvement needed for it to be more accessible, secure, manageable and reduction of costs.

The analysis of existing documents plays an important role within a research project. This comprises reading auctioning announcement, requirements to attend auction, data and registration book to analyses the data, attendances even cultural way and law complaints of existing auctioning way.

## **Organization of project**

This collection is composed of 5 chapters categorized as follows

Chapter 1: Describes the general introduction and deals with background of this study, the problem statement and interest of our project, specific objectives and methodology intended to put in place to solve the problems.

Chapter 2: In this chapter literature review is mainly contained which gives the understandings on and reviewing other related works or existing related technologies to our system. In this part also, identification of gaps from related works.

Chapter 3: In chapter three main concern is on research methodology and data collection techniques used in this research.

Chapters 4: Implementation of system show how it works, expected functionalities and diagrams

Chapter 5: Conclusion and Recommendation

**CHAPTER 2: LITERATURE REVIEW**

## **Introduction**

Long before any electronic information systems were in place, people used auctions to trade all kinds of goods and services. In this comprehensive overview of the history of auctions, Cassady (1967) reports auctions of items of almost any size, from jewels and spices to ships and provinces. The range of services that have been auctioned is also enormous, including anything from a dance on a local church festivity to the lifetime work force of a slave. While being widespread, however, auctions were not the most common way of trading because the costs of conducting and participating in an auction were typically too high for the every-day trade of common goods. Evidently, the use of auctions is subject to the trade-off between the advantage of price discovery (i.e. discovering the highest valuation bidder) and the disadvantage of having high transaction costs (i.e. the costs of finding a buyer and negotiating a sale).

Online auctioning is rapidly growing through to the general development of online market systems and enormous amount of freely available field data. Moreover, numerous invention and innovation in auction-functionalities features on platforms such as eBay have initiate great research opportunities. In our study we survey the functionalities, design and integrity of data in bidding strategies which includes timing of bids, winner’s curse effect and seller strategies like reserve-price policies and the use of buy-now options.

## **Definitions of concepts related to e-auctioning.**

An auction elicits information, in the form of bids, from potential buyers regarding their willingness to pay. The outcome who wins and pays how much is then determined based on this information. In a single-object auction, one indivisible object is for sale. There are four single-object auction types, which are widely used and analyzed both in theory and practice, the ascending-price auction (sometimes called English auction), the descending-price auction (sometimes called Dutch auction), the first-price sealed-bid auction, and the second-price sealed bid auction (sometimes called Vickrey auction).

The *ascending-price* auction is probably the best-known auction procedure the price is raised until only one bidder remains. This remaining bidder wins the object at the price at which the strongest competitor dropped out. There are many ways to run ascending-price auctions, having the seller announce prices, the bidders announce prices, or the price continuously rising on a ‘price clock’. In the latter version, which is the one we will refer to when we speak of ascending-price auctions, bidders can quit the auction at any price and observe other bidders quitting. Because the price clock determines the price path, there is no possibility for bidders to speed up or slow down the auction process.

The *descending-price* auction works in the opposite way, the auction starts at a high price, which a price clock then lowers. The first bidder to call out his acceptance of the displayed price immediately stops the clock. This bidder wins the object and pays the price at which the clock stopped. Note that while in the ascending-price auction the winner pays a price determined by his strongest competitor (the price on the clock when the second-to-last bidder exits), the winner in the descending-price auction determines the final price (the price on the clock which he was the first to accept).

In the *first-price sealed-bid* auction, bidders independently submit a single bid, without seeing the others’ bids. There is no open, dynamic bidding. The bidder who submits the highest bid wins and pays a price equal to his bid. In the *second-price sealed-bid* auction, again the bidder who submits the highest bid wins, but here he pays a price equal to the second-highest bid.

In addition to the four types of auctions, there are two standard models of how bidders value an item: the *private-value* and the *common-value* model. In the private-value model, each bidder knows the value (his maximum willingness to pay) that he assigns to the object, but different bidders may have different values. For auctions to be a meaningful selling mechanism, the seller does not know the values of the potential buyers. Furthermore, there is typically asymmetric information among bidders: one’s value is private information to oneself. Provided that there are no entry fees or other costs involved in bidding, the auction winner’s net gain is his value of the object minus the final auction price. The losers’ net gain is zero since they neither get nor pay anything.

In the *common-value* model, the value of the object is the same to all bidders, but bidders have different information about what is the actual value. For example, the ‘true’ value of an antique statue may be very similar to all bidders, but bidders may get different ‘signals’ about whether the statue is genuine or a fake. In such situations, bidders typically want to change their estimates of the value when they learn about the competitors’ signals. In the *private value* model, on the other hand, bidders’ values are unaffected by learning the competitor’s information. There are also more general modeling approaches, encompassing both special cases of private-value and common-value. In these models, each bidder gets a private signal, and the value to the bidder is a function of all signals.

## **eBay auctioning platform**

Online auction (eBay) is platform that creates pathways to connect millions of sellers and buyers in more than 190 markets around the world. the technology empowers customers, providing everyone the opportunity to grow and thrive no matter who they are or where they are in the world. And the ripple effect of work creates waves of change for the customers.

### **Late and incremental bidding in eBay auction**

Bids on eBay, where auctions run typically for a week, often arrive very near to the closing time a practice called “sniping”. For instance, in the sample of computer and antiques auctions with at least two bidders, Roth and Ockenfels (2002) found that about 50 percent of all auctions still have bids in the last five minutes, 37 percent in the last one minute, and still 12 percent in the last 10 seconds. Bajari and Hortacsu (2003) found that 32 percent of the bids in their sample are submitted after 97 percent of the auction has passed. Anwar et al. (2004) noted that more than 40 percent of the bids in their eBay sample are submitted during the final 10 percent of the remaining auction time. Simonsohn (2005) reported that in his sample almost 20 percent of all winning bids are placed with just one minute left in the auction, and Hayne et al. (2002) reported that bidding in the last minute occurs on average in 25 percent of their sample of 16,000 auctions. Regarding the whole distribution of the timing of bids, Roth and Ockenfels (2000) and Namazi (2005) observed that bid-submission times on eBay follow a power-law distribution with most bids concentrated at the closing time. Shmueli et al. (2005) added that the start of an auction also sees an unusual amount of bidding activity.

eBay makes available a software bidding agent, called “proxy bidding,” to make bidding simple for bidders without having to be constantly vigilant or online at the close of the auction. As a consequence, not the last bid (as in ascending-price auctions) but the highest bid wins, regardless of submission time. Furthermore, there is a risk involved in late bidding in online auctions. Because the time it takes to place a bid may vary considerably due to internet traffic or connection times, last-minute bids have a positive probability of coming in too late (after the close of the auction).

eBay explains the simple economics of second-price auctions and the risks involved in late-bidding and comes to the conclusion*: “eBay always recommends bidding the absolute maximum that one is willing to pay for an item early in the auction. (…) If someone does outbid you toward the last minutes of an auction, it may feel unfair, but if you had bid your maximum amount up front and let the Proxy Bidding system work for you, the outcome would not be based on time.”*

### **Multi-item auctions at eBay**

Above literature was about single-item online auctions. However, almost all online auction platforms also offer multi-item auction mechanisms. In recent years, multi-item auctions have received increasing attention, mainly because of their accelerated use in B2B (business to business) commerce and government allocation procedures. Yet, both the theoretical and empirical literature is less developed and contains only few general results. This is partly because when items are heterogeneous or bidders demand multiple items, new difficulties such as market power and strategic and computational complexities arise.

Auctioning multiple items quickly becomes complicated when there are complementarities between items. Complementarities exist when the value of a bundle of items is larger than the sum of values of each object separately. This is the case in many applications including auctions for the radio spectrum, electricity, airport-landing-slot, supply chains, and transportation services. In such cases, a bidder may end up stuck with items that are worth little because he failed to win complementary items (exposure problem), or he may quit early, fearing that he may fail to win complementary items (holdup problem). As a result, inefficiencies are likely to arise in multiitem auctions where bidders cannot ensure winning complementary items.

## **2.4. Tools and programming Languages**

Development of online auctioning combines hardware and software requirements to be implemented. The emphasis of this system is to promote security and higher accessibility of systems over the internet.

### **2.4.1. Hardware requirements (Tools)**

*Computer device* means any device that can be used to access or run software, and includes, without limitation, a personal desktop computer, portable computer, workstation, tablet, mobile device, similar device capable of running computer programs locally (in a physical or virtual operating system environment.

### **2.4.2. Programming Languages**

Implementing Online auction system consists of two critical aspects of application, backend and frontend. Promoting security, accessibility, performance and responsiveness of auctioning applications is key to be considered in selecting programming languages to use. The programming language for both backend and frontend are different. In Backend, python programming becomes the best choice and backend, JavaScript is chosen for frontend.

### **2.4.3. Fast-Api framework**

In backend development of online auction, fast (high performance) and security is a major fact to be considered in building online auction platform. Fast Api has come as a solution by feature of asynchronous or concurrently resolving of user’s requests in a short period of time. Not only asynchronous functionalities, is best solution for real time and web socket which is used for live bidding and scheduling without forgetting notifying users and updating them to the events and auction changes.

**2.4.4. Database Management System (PostgreSQL)**

E-auction needs fast, well schemed relative data, capacity of supporting complex queries. data security and flexibility. PostgreSQL is open source; relational database system supports complex queries and big data retrieving. Auction database development requests mostly need scalability and flexibility of stored data, to solve queries and retrieving data as first as possible.

### **2.4.5. React JavaScript framework**

Responsiveness, flexibility, scalability of online auction web-application make it for users in any device to interact with the system, so react is JavaScript library for best graphic user interface and support for server-side rendering (SSR).

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**CHAPTER 3. RESEARCH METHODOLOGY**

## **Introduction**

It takes a lot of work and concentration to create a powerful and efficient system. The main goal of the new system’s creation is to satisfy user needs and address issues with the current system. It doesn’t always have to be a problem in the existing system that needs to be removed because developers can create a new system to improve the existing one by increasing the functionality of the system and meeting the user's needs. Through research by asking the user about the existing system how it works if it matches with the user needs, and ask the user what can be changed based on their view and that research results in a development of a helpful system that meets the user requirements and that can solve all the issues as it was described.

## **Software Development Process Models**

The method used in gathering the requirements and interacting with the user is prototyping model where prototype is used to understand the user requirements before designing and coding. Prototyping allows developer to build, test and rework until he/she reach an acceptable outcome or match the requirements as it allow developer to interact a lot with the user, by using prototype the clients can get the actual system they wanted because by interacting with prototype enabled us to meet their requirements of the desired system. Prototyping is a good idea for complicated and large systems to use in determining the requirement. By the purpose of providing a system with overall functionality.

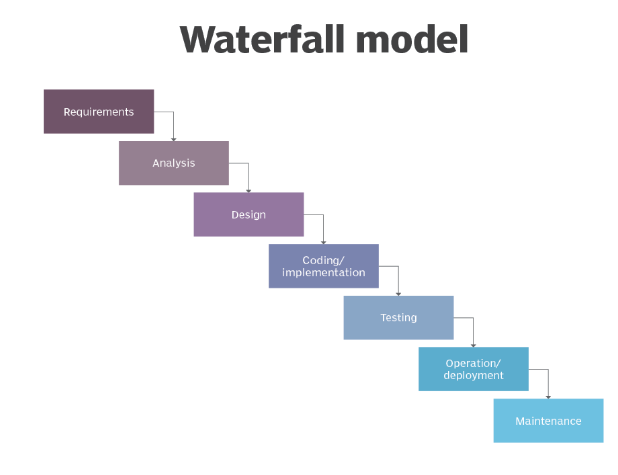
### **Waterfall Model**

Waterfall model is a linear, sequential development process that allows the division of a project into linear sequential phases, each phase relies on the result of the previous phase that means before going to the next phase the previous phase must be complete to accommodate task specialization. The primary goal of the waterfall model is to gather and make clear all the requirements upfront, to prevent the development from going downhill without the possibility of making changes.

Waterfall models have different phases but mainly we use six phases that are requirement gathering, analysis and design, implementation or coding, deployment and maintenance. The project team is likely to spend a lot of time on the requirement gathering phase as very detailed and clear documentation is required.

Waterfall model also is structure, it flows in one direction this model does not allow developers to go back to the previously step as we know “once water fall down, it cannot go back up” that means the developer move to the next step if and only if the previous step is complete, tested and can solve the problem given or match the user requirements.

When using the waterfall model, there are several primary phases that must be followed. As previously said, you may only move to the next phase if the previous phase is done and completed.



*Figure 1 : waterfall model*

**Advantage of waterfall model**

The Waterfall modelallows developers to follow phases without skipping any, it is straightforward and simple to use. This makes it easier for developers to work on projects like this. Waterfall model is simple to understand because every step is laid out and explained from the beginning to the end. All you have to do is follow every step in the project, which begins with a feasibility study and an analysis of the current system to identify problems. We chose to utilize this model since it made it possible for us to talk with the auctioneers and bidders about what is wrong in the existing system. The model is also very easy to manage because you can easily see when a phase is finished and move on to the next, knowing that work on one phase does not overlap with another and that it cannot be undone. The waterfall model makes it easy to organize tasks and phases are processed and completed one time.

* 1. **Data Collection Techniques**

Data collection techniques refer to the methods or techniques used to gather or collect information and analyze different forms of data. Data collection is a process of gathering information on targeted systems and analyzing them, which allows developers to answer the problem that was in the existing system.

The techniques used are:

* Observation
* Interviews
* Document analysis

### **3.3.1. Observation**

Observation is a way of gathering data by watching behavior, events or noting physical characteristics in their natural setting. Attending already exists auctioning and watching all activities, means, time taken, requirements, Items and services provided in auction.

We watch how it’s done, the issues the auctioneers have during the event, which turn into system weakness. In our system, we saw that bidders find it difficult to apply and that it must always be done manually, which means that anyone who wasn’t present in person cannot be a bidder and that bidders cannot view property without physically going to where it is located.

### **3.3.2. Interviews**

An interview is a formal conversation between two people, typically with one person, the interviewer asking questions to obtain information, assess qualifications, or evaluate the suitability of a candidate for a job, admission, or other purposes. In Our means the interviewing activities is going to be carried out by including Police staffs and citizens to the interview group for us to get qualitative data from both sides, the aims will be to gather the points of views of these group members about how they experience existing auctioning and the improvement needed for it to be more accessible, secure, manageable and reduction of costs.

**3.3.3. Document Analysis**

The analysis of existing documents plays an important role within a research project. This comprises reading auctioning announcements, requirements to attend auction, data and registration book to analyze the data, attendances even cultural way and law complaints of existing auctioning way.

The paper utilized in the current system and the manual process employed by Rwanda national police, along with their announcements, requirements, and other relevant documents, will be our main topics of our document study.

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