A CONVENIENT SCREENING APPOINTMENT SCHEDULING SYSTEM: A CASE STUDY OF PENSION TRANSITIONAL ARRANGEMENT DIRECTORATE (PTAD)

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Abstract

This study observed that the management of the screening exercises of pensioners under the old pension scheme still suffers from the problem of long waiting periods that sometimes extends into days for some pensioners. And this is in-spite of the efforts and investments, especially in information technology, that the new management of the Pension Transitional Arrangement Directorate (PTAD) has made and is still ongoing. From the brief interview had with a functionary of PTAD and some pensioners who are relatives, the study noted that the problem was due to the approach normally employed in the scheduling of screening exercises which has not changed reasonably despite the investments. To address this problem, this study reviewed and analyzed some related literature on the subject of appointments scheduling and from the insight gained, it adapted an appointment scheduling scheme by assuming a reasonable historical data of the processing times in pensioners screening into the robust optimization framework appointment scheduling scheme. The study then used this adapted framework to develop a system equipped with mobile features that could schedule the appointment times of pensioners to the details of days and time per pensioner, and deliver the unique date and time to individual pensioners. This design was accomplished using the Agile software development method. The developed system had the facility to communicate the unique date and time generated to individual pensioners as mail or simple text messages on their mobile phones. The study strongly believed that with this detailed screening appointment schedule per pensioner, the long wait time problem will be ameliorated.

Keywords: Pension Management System, Appointment Scheduling, Long Wait Time, Agile Software Development Method, Adapted Robust Optimization Framework

1.0 Introduction

Simply put, pension is a series of regular payments by government or former employer to a former employee who has served out the required number of years of employment, or has attained a designated age requirement. It is a statutory requirement intended to sustain the retiree.

The management of the old pension scheme payments in Nigeria remains a thorny issue several years down the line that technology (especially information technology (IT)) has reached the critical mass stage in its deployment level.

Prior to the setting up of the Pension Transitional Arrangement Directorate (PTAD) by the Federal government of Nigeria, there was strong evidence to suggest that a haphazard approach was in use in the maintenance of pension information. This fact is gleaned from the incessant arbitrary calls by government or its relevant agencies for screening of pensioners. Another reason that may also be adduced for this development was the low level of technology deployment, then.

Now, the PTAD has been making substantial investment in technology, especially IT in a bid to address the problems of the past that has caused the pensioners so much.

It is the strong believed of this study that the PTAD can evolve a viable means of identifying their retirees, or passing and receiving information from them, without them having to travel long distances all the time, using technology. And should they need to travel

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for screening exercises (which must of necessity arise), the agency should be able to schedule the screening exercise, considering the locations of the pensioners to eliminate the pains of long waits (or having to spend days) just to get screened.

To this end, this study proposes the development of an information system equipped with mobile features and an appointment scheduling system. The mobile features will support the use of mobile phones Subscribers Identification Module (SIM) as a device identification means for identifying individual pensioners. It will also enable the agency to reach them through general or unique bulk messages or calls. The appointment scheduling system will help to determine the number of persons that can be screened within designated time periods, and then, dynamically allot specific time slots which will be communicated to each individual as a text message.

2.0 Related Literature
Reliable Pension Management Systems
The increasing share of the elderly in the population worldwide makes implementation of sustainable pension systems difficult. Planners must consider numerous options in pension system design and choose the combination of policies that will optimize coverage, benefits, and financing given a country's demographics, history, practices regarding family support of the elderly, political system, extent of informal labor, and fiscal situation [1].

In describing the tardiness in pension disbursement in Nigeria,[2] deplored the less than dignifying manner with which the senior citizens are treated. One observes how weak and frail-looking elderly citizens are compulsorily required to travel long distances to the point of pension payment. Worse still, they are left, under inclement weather for long hours and sometimes for days, before collecting their stipends. Some pensioners were claimed to have died while standing in a queue waiting to receive pension money.

Overlooked Issue
One important issue that [2] and [3] observed is the disregard for the welfare of the aged pensioners who are consistently made to travel long distances and to wait for long periods that sometimes extends into days before being screened. It is common knowledge that pensioners spend days to receive attention in a screening exercise that takes less than 5 minutes per pensioner.

To conceptualize a technology based solution to this waiting problem, this study reviewed literature on how technology has been attempted to solve or minimize this problem in some agencies and sectors. The reviewed literature show that the healthcare sector has received extensive attention compared to others. The facts gleaned in the course of this review is presented next.

The increasing usage of mobile applications, as a veritable means to minimizing the waiting problems, is widely documented and it is projected to grow very rapidly. Several organizations, businesses and agencies are opting for mobile applications as a means of engaging their customers or clients, and pension agencies can adopt this strategy too [4]. In this author's view, the benefits of this option will be a win-win for pension agencies and pensioners alike.

Typically, a mobile application can provide a pension agency with the ability to:
i.   Provide members with the most up-to-date account information, instantly
ii.   Send alerts directly to members
iii.   Be "available" to members at all times

Pension members can benefit from a mobile app by being able to perform tasks such as:
Maintaining contact information
Updating beneficiary information
Viewing annual statements
Accessing tax statements
Changing tax withholding
Updating direct deposit information

This position of [4] expands the views of [5] who in their study noted that the pension system problem being encountered in their case study region at the time could be solved by a software basedinformation technology solution for managing pension business as a whole.

And coming from the health care sector where waiting problem have attracted so much attention, [6] argues that "patient wait times may seem like a small part of the patient experience, but they can have a powerful effect on overall patient satisfaction". In a Software Advice survey of over 5,000 patients conducted as a part of her studies, it was found that a staggering 97% of respondents were frustrated by wait times at the doctor's office, and virtually every patient has experience wasting time away in a medical office. She then proffered some effective strategies for reducing patient wait times. These are:
i.   Gather patient information before their scheduled appointment.
ii.   Delegate documentation to other trained staff.
iii.   Use secure messaging.
iv.   Create a policy for no-shows and late arrivals and stick to it.
v.   Design a survey to identify bottlenecks.
vi.   Implement a mobile queue solution.
vii.   Embrace telehealth solutions.
viii.   Provide a comfortable reception area.
She still insists that even all these can never be enough, and threw her wait behinds appointment scheduling and reminder systems that could keep patients in their homes or offices till their turn to receive attention draws near.

Appointment Scheduling Systems
An effective appointment scheduling system is very critical to ensure effective and efficient service delivery. To achieve an effective and efficient appointment scheduling design, there is a need for appropriate management and quality evaluation of the scheduling system. And whatever system of appointment scheduling is being considered, it is largely believed that they must incorporate mobile technologies regardless of the agency or sector [7,8].

Tackling Appointment Scheduling Problem
Appointment scheduling problems are most times approached from the perspectives of queuing models, continuous stochastic models and discrete stochastic models. They are also approached using advanced techniques such as Monte-Carlo simulations or submodular function minimization. While some others opt for robust optimization models. This is largely because it is believed that appointment scheduling is an optimization problem as a result of its required computational efforts [9-14].
Typically, optimization problems involves computational effort at three levels:
i.   Evaluating the cost of a given schedule
ii.   Finding the optimal schedule for a fixed sequence of customers
iii.   Determining the optimal arrival sequence for customers having distinct attributes

And in the literature, the most popular solution appears to be the combination of simulation and genetic algorithm (GA) [15-23].
Appointment systems are used in many customer service applications to increase the utilization of resources, match workload to available capacity, and smooth the flow of customers. The problem structure can be used to derive upper bounds that are independent of job duration distribution type. And the use of discrete simulation models as an approach to gaining better insights to the problem is recommended [24].

Materials and Method
The research method used in this study can be classified as literature search, brief interview and conceptualization of an optimal solution to the problem at hand
Literature Search: Literature search focused on appointment scheduling schemes and technologies that have been proposed or used to proffer solution to the problem at hand.
Brief Interview: The brief interview section was used to elicit some basic information to help in understanding how the present system and its attendant problems is managed. To ascertain this information, an unofficial interactive session was had with a functionary of the Pension Transitional Arrangement Directorate (PTAD) who volunteered the information that was used to articulate the section on analysis of the existing system in 3.3. An interactive session was also had with a few pensioners who were relations, who corroborated the information provided by the PTAD functionary. The interaction with this pensioners also provided information on their ordeals of having to travel long distances and spend long hours and sometimes day just to show their faces and documents that the directorate already had.
Conceptualization of an Optimal Solution to the Problem: This phase of the study drew from the information garnered from the literature search and the brief interview sections. First, the study focused on how to ensure that only the number of pensioners that could be screened within designated time periods were invited for screening. Second, the study looked into how to dynamically allot different time slots to pensioners or group of pensioners so that the wait time before screening will be minimal. Third, the study considered how to manage pensioners who may miss their allotted time slots and special cases that may need concessions to be screened instantly without prior time slot schedule.
To address these questions, this study evaluated some approaches used for solving appointments scheduling problem. The approaches evaluated and the final outcome are presented, next.

Consideration of Approaches to the Appointment Scheduling Problem
Some couple of appointment scheduling approaches were reviewed in an effort to reach anappropriate approach that will provide an easy to implement algorithm that will provide good result. While most of the approaches to addressing the appointment scheduling problems are based on queuing models, continuous stochastic models and discrete stochastic models, other approaches require the use of advanced techniques such as Monte-Carlo simulations or submodular function minimization. These techniques are difficult to apply in practice in many situations.
Meanwhile, in the stochastic models, the processing times of the jobs are assumed to be independent random variables, and the objective is to find an appointment schedule that minimizes the expected cost. These models assumes complete knowledge of the distribution of the processing times of the jobs, an assumption which may be false for many service settings, thus limiting the utility of the stochastic models. Often, there is insufficient historical data of the processing times of the jobs to get a reasonable estimate of the probability distributions. Also, because the cost function in the stochastic model is based on non-linear function of several random variables, the computational cost of finding an optimal schedule is very high.
This leaves us with the option of the robust optimization modelswhich are often more tractable when compared to the corresponding stochastic optimization models. Robust optimization models appear to be particularly useful in appointment scheduling as they attempt to reduce the cost, rather than taking only the average into account. It takes into account the possibility of several delays.

Adapted Appointment Scheduling Solution
Therefore, this study adapted the robust optimization framework for its appointment scheduling task. The study also employ an intuitive method for scheduling that assumes reasonable historical data of the processing times in pensioners screening and hence a reasonable estimate of the probability distributions of the entire screening process. This assumption was premised on the fact that

the operators of the pension system have enough background knowledge based on past experiences.

Analysis of the Existing System

Appointment scheduling under the existing system involves inviting pensioners based on some general criteria. The popular criteria are:

Year of Retirement: Year of retirement is used to schedule invitation for screening of pensioners. Under this arrangement, all pensioners whose retirements falls within designated dates, are required to appear for screening on such dates. The invitation does not normally take into consideration the locations of the individual pensioners, it does not take into consideration the specific time (possible time) that individual pensioners are likely to get attention. The result is that most pensioners not only travel long distances, but end up being stranded for a day or more, just to get screened.

Cadre While in Service: The various cadres while in service is used to schedule appointments of pensioners for screening. This approach suffers the same problem of the use of year of retirement.

Ministries, Agencies and Parastatals: This is another criterion used in scheduling pensioners for screening appointments. This criterion has the same drawbacks as in the use of year of retirement and cadre while in office.

Local Government and State of Origin: This criterion takes location into consideration but it does not take the possible time the individual retirees are likely to get screened. The outcome therefore is the same as in the use of the other approaches.

These are the four basic criteria and there are variations in there use from time to time and for designated purposes.

Short Comings of the Existing System

The short coming of the existing system as already stated in the first approach is the fact that the retirees locations are not taken into consideration, the specific time each retiree is likely to get attention is not considered.What this means is that the agencies and persons responsible for conducting screening have consistently being following a routine process or procedure of getting the list of retirees to be screened and then invite them over. This existing routine process or procedure shows that the level of planning made by the agency or persons responsible for planning have not changed overtime, even with the increasing cost of screening exercises for both the retirees, the agency as well as the government.

Need for a Better System

To avoid these costs, and to minimize the incidence of tragic collapse and sometime, death of retirees while waiting endlessly to be screened, the organization of a more convenientscreening exercise based on a better appointment scheduling technique is highly desirable.

3.6 Requirements Specification of the Proposed System

a. The proposed system will take the location of retirees into consideration.

b. It will project the total number of retirees that can be taken within designated periods.

c. It will take the likely time individual retirees are likely to receive attention into consideration

d. The system will generate and communicate these individual time slots and dates to each retiree.

e. At the administrative level, the persons conducting the screening are expected to get all relevant documents required for the screening exercise ready and well updated, and they are expected to be punctual and adhere to screening slot periods.

Design and Development of Proposed System

Agile design methodology was employed in the proposed system design and this choice was informed by the fact that the methodology is quick and iterative and often results in good designs. It is highly suitable for applications that requires elaborate features. And the specific Agile methodology adopted was eXtreme Programming, whose basic activities are: Designing; Coding; Testing and Listening. And following these activities tenaciously, the desired system was accomplished. A description of how these activities were implemented is discussed, next.

Design Activity: The design aspect of the methodology was accomplished using a process flowchart.This process flowchart depicts the sequence of processes, actions and activities at each point in time in labeled rectangular boxes. Some of the boxes are associated with smaller rectangular boxes depicting data bases from which needed information is retrieved or stored.Figures 1 illustrates this design.
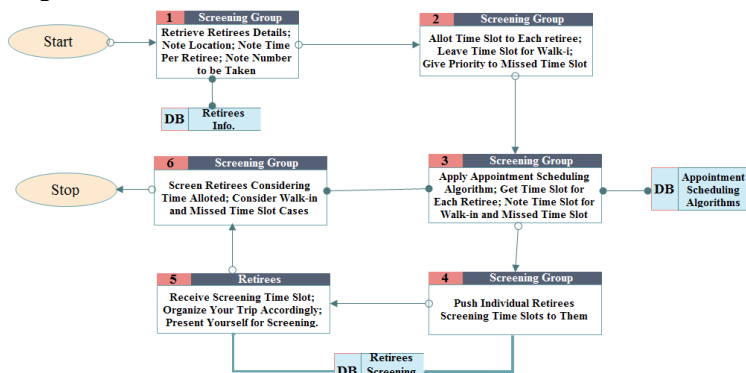

Figure1: Proposed System Process Flow Diagram

Coding Activity

The coding activity aspect was actualized using Laravel Integrated Development Environments (IDE) that supported all the required software tool, programming languages and scripting languages. This LaravelIDE is briefly described as follows.

LARAVEL IDE: Laravel is a free, open-source Hypertext Pre-Processor (PHP) web framework that is very suitable for the development of web and mobile applications. Laravel framework comes with some standard software tools and programming/scripting languages needed for application development. It also supports the incorporation of the other required tools and programming/scripting languages that did not come with it. These tools and programming/scripting languages and the aspects of the coding activity they were used to implement are presented as follows.

Software Tools: The specific software tools used as part of the systems implementation are:

Database Management System: The framework had MySQL database management system which is an open source database management system that is very proficient and stable. This was used to implement the system data store.

Apache Tomcat Web Server: The framework also had Tomcat web server as an integral component. Tomcat web server is an open source web server that is very proficient and stable. It was the web server used for the local hosting and deployment of this system.

Messaging Gateway and Mobile Information Server: The framework supported the incorporation of third party messaging gateways and mobile information server. It does this by allowing the integration of these third party Application Programming Interfaces (API's) into the written codes so that the system can push and pull email messages and simple text messages. Some open source API's were used to implement this messaging features in this study.

Programming/Scripting Languages: The exact programming/scripting languages employed in the system business logic coding are described next.

HTML5: HTML5 is a markup language used for structuring and presenting content on the internet. It is also used for cross-platform web applications, because it includes features designed with interoperability in mind. The system graphical user interfaces was done substantially using HTML5

Hypertext Pre-Processor (PHP) Programming/Scripting Language: PHP was used to develop the business logic aspect of the system. PHP is an easy to used scripting/programming language. It allows for simultaneous development and testing of applications.

Cascading Style Sheet (CSS): CSS is a markup language that is popularly used to augment the PHP programming language to enhance the performance of the system. It was used to implement some aspects of the system businesses logic that performed repetitive functions.

JAVASCRIPT: Java Script is a scripting language. It was used in this system to implement pop-up windows.

Testing Activity

As already explained, AgileeXtreme Programming methodology allows iterative development and testing till a desired development level is attained. In this study, a series of coding, testing, debugging and testing was done until the desired features were working properly. The screen shots of the core features that distinguishes this system from what exist are used to illustrate the testing activity aspect of the system development.
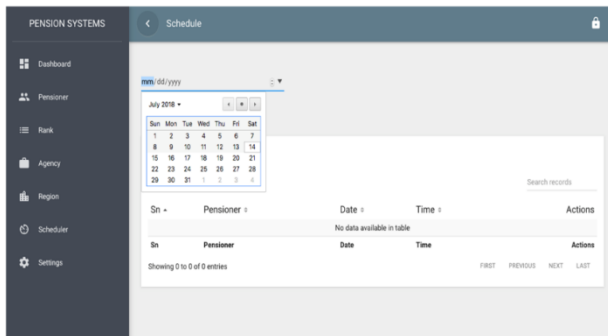

Figure 2: Home Page of the System

Home page displaying the various applications that comprised the system on a dark color left panel. When the schedular icon is clicked, the schedular window pops up as shown in Figure 3. And when the schedule new appointment icon on the schedular window is clicked, it pops up the prejection window for number that can be screened within designated periods as shown in Figure 4. The input parameters are the time it takes to screen one pensioner, the screening exercise start and stop times.
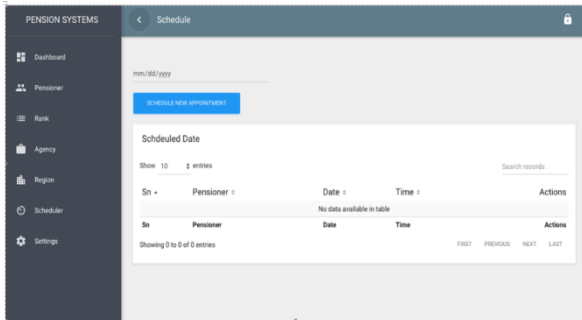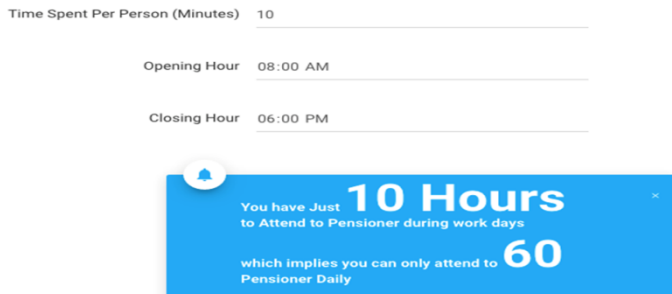
Figure 3: Scheduler Window

Figure 4: Projection Window for Number that can be screened within Designated Periods

On this interface, the agency functionaries can project the time it may probably takes to screen one pensioner bearing in mind other factors that could cause delay in mind. The issue of breaching the rule to attend to pensioners who missed their original time slots and pensioners who require concessions is expected to be factored into the screening time projection. Having successfully done the projection and the numbers that could be taken within designated periods, the outcome is applied to designated cadre or categories of pensioners whose records are already in the database. The invocation of the scheduler outcome on a sample database is shown in Figure 5, showing the names of some hypothetical pensioners and their appointed screening date and time.
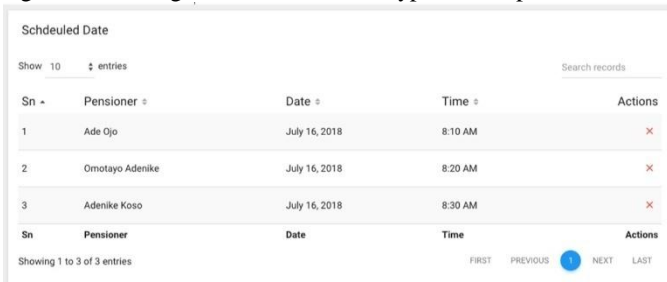

Figure 5: Sample Scheduled Pensioners Screening Appointed Date and Time

This scheduled date and time can be saved back to the system to be communicated to the pensioners affected later, or instantly through mail message or simple text message. Samples of two messages received based on the scheduling periods as shown in Figure 5 are shown for the first two pensioners on the list in Figures 6 and 7.
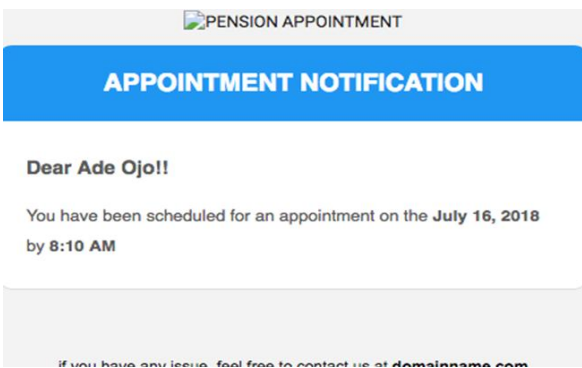

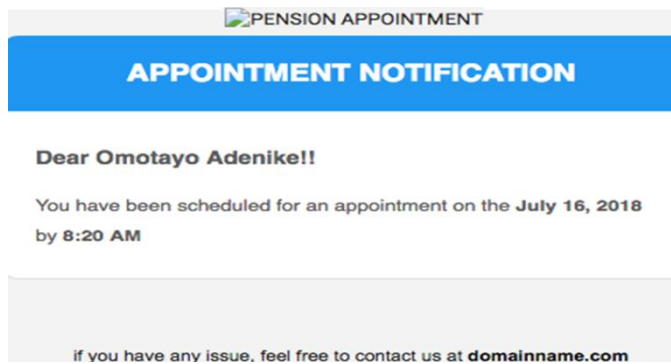Figure 6: Sample Screening Appointment Notification Received One Pensioner

Figure 7: Sample Screening Appointment Notification Received Another Pensioner

Listening Activity

The last activity of the study adopted system development methodology is the listening activity. This activity was actually observed in-depth in the course of the system testing phase. While testing the system for desired features and functionalities, the little fixes relating to aesthetics and ease of use constituted this activity. Ideally, this phase is executed based on the application user's feedback, complaint and suggestions.

4.0 Conclusion

This study identified the persistent problem of the difficulties pensioners suffers on the occasions of their regular screening exercises. Though the government have made effort to minimize the suffering, of the pensioners by scheduling screening appointments based on different criteria such as local government of origin, cadre, year of retirement etc. but the problem does not seem to be getting addressed.

Going back to some important observations of authors like Bloom and McKinnon, (2013) who insists that the implementation of sustainable pension systems are urgent even though they are difficult, and Abdulazeez (2014) who is not pleased with the less than dignifying manner the Nigerian pensioners are treated, evolving solutions that will ameliorate the problem are imperative.

The PTAD has shown commitment to employ information technology as part of its policy mix towards finding solution to the problem. The directorate has been building a comprehensive database of pensioners under the old scheme that are the responsibility of the government. And as thing stand, this scheme will still last a reasonable long while. This makes solutions that will aid the PTAD to achieve its desire of accurate records of pensioners, and a dignifying way of managing their routine screening exercises, germane.

To this end, and bearing in mind that the PTAD has and is working on a comprehensive database of the pensioners under its purview, this study has designed a system that can help to properly schedule the routine screening appointments of the agency in an optimal manner down to the niceties of the specific time any pensioner is expected to show up using a robust optimization framework for appointment scheduling enhanced with an intuitive method for scheduling that assumes reasonable historical data of the processing times in pensioners screening. And the intent is to be able to provide a reasonable estimate of the probability distributions of the entire screening process.

And with this, the screening agencies can properly plan their exercises with information on the number of pensioners that can be screened, the time for individual pensioner's screening, and hence minimize the agony pensioners currently face.

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