IMPROVEMENT OF PRISON SYSTEM IN NIGERIA USING QUEUING THEORY

Ojuawo, O. O. and Arowolo, P. O
Department of Computer Science, Federal Polytechnic, P.M.B. 50, Ilaro, Ogun State, Nigeria
olutayo.ojuawo@federalpolyilaro.edu.ngpaul.arowolo@federalpolyilaro.edu.ng
08038417080008068584858

ABSTRACT
The Nigeria prison which was recently changed to "correctional section" are supposed to be a reformation and rehabilitation Centre for convicted prisoners who are convicted for one crimes or the other and not for the non-convicted ones who are still awaiting court trials. However, what has become of prisons today is the congestion of both the convicted and non-convicted prisoners. Overcrowding is a feature of all criminal justice system across the board which poses serious challenges to both developed and developing nations. With adverse consequences on the incarcerated person, prison itself and the community to which the offender returns upon released. This paper as an Application of Queue Theory System on the reduction of prison congestion in the Nigerian Prison Service helps to increase the speed of attending to cases of prisoners awaiting court judgment.

INTRODUCTION
Waiting for service is part of our daily life. We wait to eat in restaurants; wequeue at the check-out counters in grocery stores, and we line up for service in post office. And thewaiting phenomenon is not an experience limited to human beings only. Jobs wait to be processed on a machine, planes circle in stack before getting permission to land at an airport and cars stop at traffic lights. Waiting cannot be eliminated completely without incurring inordinate expenses and the goal is to reduce its adverse impact to tolerable levels

In reality, it is technically proposed that when there is congestion in any system, there is a delay in the service rate and these increases. A good understanding of the relationship between congestion and delay is necessary for designing effective congestion control algorithms.Adetula, Adetula&Fatusin,(2010) said "an extension of the waiting time of inmates in any prison is regarded as a sign of poor quality management and needs tobe improved. Managing inmates awaiting trial create a great predicament for prison wardens seeking to improve condition of inmates on daily basis".

Prison is an institution designed to secure house for people who have been convicted of crimes. These individuals, known as prisoners or inmates, are kept in continuous custody on a long-term basis. Individuals who commit the most serious crimes are sent to prison for one or more years; the more serious the offense, the longer the prison term imposed. For certain crimes, such as murder, offenders may be sentenced to prison for the remainder of their lifetime.

When individuals are accused of violating criminal law, they are tried in a court and either convicted or acquitted. A person who is convicted is then sentenced—that is, assigned a specific punishment. The sentence may involve fines, probation, or incarceration.

There is a term that has assumed the currency of serious discussions whenever the issue of Prison Reforms comes up for mention in recent times. That issue is Prison Congestion. We have come to view the pre-eminence of the term with fear because so many people who use the term do not really appreciate its implication for Prisons and indeed Criminal Justice Sector Reforms.

Decongestion simply means to evacuate, to reduce the volume or numbers in a space. The oxford Outline dictionary defines decongestion as the reduction in the volume of contents or numbers in an existing space. When applied to the Prisons it means measures designed to reduce the number of prisoners in the prisons system.

One can note from the phrase, "*convicted of crimes*" when talking about prisons. Prison is supposed to be a house for convicted criminals, which implies people who are not yet found guilty in court judgments are not meant to be housed in a prison. In Nigeria today the real definition of the word prison as seen from the universal concept is not

applicable because what we have is a houseful of suspects (inmates awaiting trial). Most inmates remain in the prison for years without even presenting their case before the court of law. Problems arise from several reasons such as injustice, missing records, placing superiority over one inmate than the other, etc. All rest on the inability to invent digital means of keeping track of how these inmates arrived at the prison gates before themselves.

Queuing theory is the mathematical study of waiting lines. The theory enables mathematical analysis of several related processes, including arriving at the (back of the) queue, waiting in the queue (essentially a storage process), and being served at the front of the queue. The theory permits the derivation and calculation of several performance measures including the average waiting time in the queue or the system, the expected number waiting or receiving service, and the probability of encountering the system in certain states, such as empty, full, having an available server or having to wait a certain time to be served(Obioha,1995).

This theory will be applied in letting the prison wardens easily be notified about how long an inmate has stayed without being judged, the maximum time an inmate is to stay in the prison awaiting trial, alert on the congestion level of the prison so as to easily make the government decide on whether to free inmates waiting trail for too long, etc.

LITERATURE REVIEW ON NIGERIA PRISON

Prisons are essentially correctional and reformatory; they are not institutions for the dehumanization of the incarcerated. According to the Nigerian Prison Act 1972, which spells out the goals and orientation of the Nigerian Prisons Service, prisons are charged with taking custody of those legally detained, identifying causes of their behaviour and retraining them to become useful citizens in the society. Apart from keeping inmates in custody, the prison officials hardly do any other thing as they are apparently not interested in the rationale behind the actions that got the inmates into prisons or bothered about retraining them.

Davids (2011) states that in other climes, there is a difference between a jail and a prison; a jail is a transitional facility for those undergoing legal proceedings, those awaiting judgment on their trial. A prison, on the other hand, is for those whose judicial fate has been decided; those who have been convicted. Therefore, those whose trials are in progress and those whose trials have been decided should not ordinarily cohabit in the same facilities. However, Nigerian Tribune (2011) revealed that in Nigeria, the same correctional facilities are used both as jails and prisons in the country.

There is no categorization as those undergoing trial (called awaiting trial in local parlance), convicts and those already condemned to death are treated equally. They are all lumped together in various cells and stripped of their dignity. This is really because like all facilities in the country, the prisons amenities have been stretched beyond their original capacities. So, those undergoing trial are not treated any differently from those already convicted despite the fact that they might end up being left off the hook. Thus, the prisons are brimming with inmates as there are more inmates than the original capacity of the prisons. For instance, the total inmates in the prisons in Lagos State are by far more than the number the prisons are meant to accommodate. As of Tuesday 18th of October 2011, there were 5,370 inmates at the Badagry Prison, Kirikiri Maximum, Kirikiri Medium, Kirikiri Female and Ikoyi prisons instead of the 2,945 they were built to rehabilitate (Davids, 2011).

A further breakdown of the inmates in Lagos prisons by the Nigerian Tribune shows that 4,440 of all the total inmates are awaiting trial and are, therefore, not part of the plans of prison officials. The only thing that they get from the prison officials is food. They are not trained or allowed to undergo any vocational work. Just 936 inmates had been convicted and are facing jail terms, with about 70 of them condemned to death.

Quite different from the physical conception, there are other schools of thought that are based on function, framework and label. From the functional perspective, a prison is perceived as a place to punish offenders, where criminals that are removed from the society are dumped to protect the society from further criminal activities of the offenders; and a place to rehabilitate, and teach offenders to be law abiding and productive after their release. Prisons are also perceived as a total institution, from the perspective of framework. (Okunola, 1986 and Goffman, 1961; quoted in Davids 2011).

Prison as an institution is a place unlike free environment or community, houses those who are socially rejected, insane or mentally retarded. It is also said to be an institution where there is a basic split between a large class of

individuals who are restricted contact with outside world and stereotypical behavioural pattern where social mobility is restricted. Yet from the labeling point of view, the prison is a place for vagrants, who may pose actual danger to social life in the larger society, which pre-supposes that every person in the prison is a vagrant and irresponsible person (Ojo, 2007).However, in the past few decades, the conception about the Prisons seem to be changing at least in the minds of some people, especially with reference to the erroneous idea that people in the prisons are dregs of the society. This means that it is not only the guilty that are found in the prisons, only some prisoners actually committed offences they are alleged to have committed. This is true of the Nigerian situation where it has become "acceptable" to have most of the prison yards overflowing with awaiting trial inmate population (Nnamdi, 2013).Onyekachi (2010) records that Prison institutions in Nigeria among others in the criminal justice system perform the following basic functions of; keeping safe custody of convicted persons and suspects as well as execute sentences passed on individuals by the courts, ensuring the reformation and rehabilitation of inmates through moral training, education and offering them opportunities to develop other potentials and skills for effective reintegration into the society on discharge, ensuring the welfare of inmates through the provision of good health care, feeding, clothing and recreational facilities in order to create the enabling environment for reformation and rehabilitation programmes.

Available literature indicates that prison reforms in Nigeria have not been as effective as expected. Unlike in the English prisons which have been found to be as reformatory as the schools, Nigerian prisons have been found by studies to be places where the right of the inmates are flagrantly abused. A particular study even found that rather than being reformatory, Nigerian prisons are rather retributive in nature. This often results in the inmates not being interested in rehabilitation activities of the prisons. Studies also found that stigmatization by society against discharged inmates also contribute to their return to prisons hence, the tendency of having more revisits that envisaged.

CHALLENGES OF NIGERIA PRISON

The Nigerian prisons, just like many other government institutions in the country face a lot of challenges. One endemic problem is that of overcrowding, particularly in urban prisons, which results from high percentage of inmates awaiting trial (Jude, 2003). Due to overpopulation of the prison, the Prison Service Commission is faced with loads of challenges which include; poor infrastructure in most prisons, inadequate data due to inadequate record keeping and file management preventing the development of sound policies based on accurate information. Prison conditions are poor, especially for pre-trial prisoners. Hygiene and sanitation in most prisons are impacting on the health of prisoners. Medical services are inadequate, the spread of HIV/AID and tuberculosis (TB) pose a serious challenge, though steps are being taken to address these challenges. Vocational training and educational facilities are inadequate. There is a shortage of welfare and aftercare staff, instructors and trainers, and rehabilitation and aftercare services are limited (Jude, 2003).

The problem of prison congestion in Nigeria is one of the agonizing issues that have continued to confront the nation's criminal justice system, creating the call for an urgent reform of the Nigerian prison service which remained the foremost institution in the country. Prison congestion is linked to the steady rise in the figure of awaiting trial persons who are said to constitute over 70% of the estimates 54,156 prisoner's population in the 235 prisons across the country. Out of the estimated figures, 15,593 are convicted males, 211 are convicted females while 38,352 are awaiting trial, majority of whom, have exceeded the term of imprisonment for which they are accused. The negative effect of prison congestion has led to several incidents of jail breaks in many parts of the country with the attendant security risk as both convicted and detained prisoners often disappear without a trace. Example of this happened recently in Kaduna prison where some inmates escaped.

According to the report, an estimate of 797 prisoners were said to have escaped the prison out of which 539 inmates were awaiting trial and 139 of them were awaiting execution on death row. Another example of prison congestion is that of Awka prison with a building capacity for 238 inmates but has 509 inmates. Out of the 509 inmates, only 28 are convicts while 481 inmates are Awaiting Trial Inmates; also 0nitsha prison also has a total of 847 inmates as against its capacity for 326 inmates. Out of the 847 inmates, 41 have been convicted while 735 inmates are also awaiting trial inmates (Nneoma, 2010).

The Nigerian Constitution provides that a person arrested on suspicion of committing a crime is presumed innocent until otherwise proven by a competent court of law. They have the right to counsel, are privileged against self-incrimination, and should appear before a magistrate or other judicial official within a reasonable time or be released

from custody two to three months from the date of arrest. Holding a person awaiting trial beyond the legally allowed time, or even longer than he or she would have spent had they been sentenced for the offence they have been detained or charged is an infringement of their fundamental human rights which is guaranteed under section 35 of the 1999 constitution (as amended).

HOW TO SOLVE THE PROBLEM USING QUEUING THEORY (METHODOLOGY)

Queuing theory is the mathematical approach to the analysis of waiting lines in any setting where arrival rate of subjects is faster than the system can handle. It is applicable to healthcare settings where the systems have excess capacity to accommodate random variations.

A model is any simplified representation of an object or a system. Models are used for analyzing, understanding, or explaining an object or a system. Models can be classified according to their nature, which can be physical, symbolic (mathematical, numerical), or procedural (simulations). Physical models often have high costs. Symbolic models, though often cheap, are difficult to communicate to people with less mathematical training. Procedural models offer a good balance between costs and use since they are easy to communicate. Most mathematical models contain certain parameters that describe how the model works or what the input or outputs of the model are.

The Queue Model
Queue models can be represented using Kendall's notation. A\B/S/K/N/D where these are:
A is the inter arrival time distribution
B is service time distribution
S is number of servers
K is is the system capacities
N is the calling population
D is service discipline assumed.

The Arrival Rate
The data arrives as packet of data from different inmate wearing the sensor into hub, let C_1 be the inter- arrival time between the arrival of the(i-1)th and the ith inmate the mean (or expected) inter-arrival time is denoted by E(C) and is called $\beta := 1/E(c)$ arrival frequency

erviceMechanism
This specified by the number of servers denoted by (S) each server having its own queue or a common queue and the probability distribution of the inmate service time. Let Si be the service time of the ith inmate, and mean service time of a customer is denoted by $E(S) = \mu = 1/E(S)$ the service rate of a server
Let Di be the delay in the queue of the ith inmate Wi be the waiting time in the system of the ith inmate F(t) be the number of inmate in the queue at a time t, G(t) be the number of inmate in the system at a time t=F(t) + number of inmate served at t, then the measure,

Di =
Wi =

$$\lim_{n \to \infty} \frac{\sum_{i=1}^{i=n} Di}{n}$$

are $\lim_{n \to \infty} \frac{\sum_{i=1}^{i=n} Wi}{n}$ called the steady state average delay and the steady state average waiting time in the system. Also the measure,

$$\lim_{n \to \infty} \frac{1}{T} \int_0^T F(t).dt$$

$$\lim_{n \to \infty} \frac{1}{T} \int_0^T G(t).dt$$

F =
G =

Are called the steady state time average number in the queue and the steady time average number in the system.
Single channel queue

[M/M1]: {FCFSor FIFO} Queue system.

Arrival Time Distribution

This model assumes that the number of arrivals occurring within a given interval of time t, follows Poisson distribution with parameter $(\beta)t$.This parameter$(\beta)t$ is the average numbers of arrivals in time t which is also the variance of the distribution. If n denotes the numbers of arrivals within a time interval t, then the probability function p(n) is given by

$$P(n) = \frac{(\beta)^n}{n!} e^{-x} \qquad n = 0,1,2.... \qquad (1)$$

The arrival process is called Poisson input, The probability of no (zero) arrival in the interval [0,t] is ,

$Pr(0 \text{ arrival in}[0,t]=e^{-\beta t}=P(0)$

Also

P (zero arrival in [0, t]= P(next arrival occurs after t)

There the probability density function of the inter arrival times is given by,$e^{-\beta t}$ for >0 This is called the negative exponential distribution with parameter β or simply exponential distribution. The mean inter arrival time and standard deviation of this distribution are both $1/(\beta)$ where,(β) is the arrival time.

The state of the queuing system can be completely described by the number of units in the system. Thus the state of the process can assume values 0,1,2… (0 means none in the queue and the service is idle).

Let the steady state probabilities be denoted by P_n, n =0,1,2,3… where n refers to the number in the system. Pnis the probability that there are n units in the system. By considering a very small interval of time h, the transition diagram of this system can be seen as:
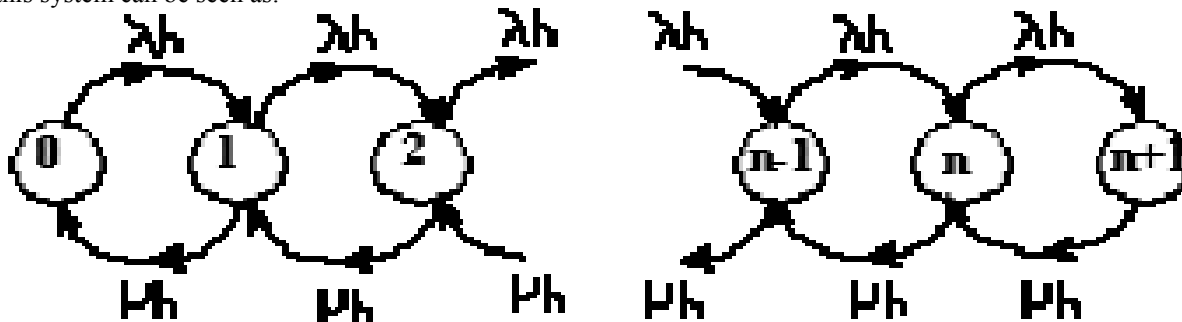

Figure 1: Transition Diagram

If h is sufficiently small, no more than one arrival can occur and no more than one service completion can occur in that time Also the probability of observing a service completion and an arrival time in h is.h2 which is very small (approximately zero) and is neglected. Thus the following four events are possible:

      1. There are n units and 1 arrival occurs in h
      2. There are n units and 1 service is completed in h
      3. There are n-1 units and 1 arrival occurs in h
      4. There are n+1 units and 1 service is completed in h
      For n > 1, (because of steady state and condition

Pr (being in a state n and living it) Pr (being in the other state and entering state n) =Pr (being in state n-1 or n+1and entering state n). Thus

P_n

$(\beta) * h + P_n * \mu h = P_{n-1}(\beta)*h + P_{n+1}*\mu h$

This is the steady state balance equation, for n =0, only event 1 and 4 are possible,

$P_0(\beta)*h = P_1*\mu h$

Therefore

$P1 = P0 \frac{\beta}{\mu}$ $Pn = Pn\text{-}1 \frac{\beta}{\mu}$ $Pn = ()^n\, P0$

This can be determined by using the fact that the sum of the steady state probabilities must be 1. Therefore,

$P_0 + P_1 + P_2 + \ldots + P_n + P_{n+1} + \ldots = 1$

$P_0 + P_0[\frac{\beta}{\mu}] + P_0[\frac{\beta}{\mu}]_2 + \ldots + P_0[\frac{\beta}{\mu}]^n + P_0[\frac{\beta}{\mu}]_{n+1} + \ldots = 1$

$P_0[1 + P + P^2 + \ldots + P^n + P^{n+1} + \ldots] = 1$ $P = \frac{\beta}{\mu}$

This is the sum of a geometric series.
Therefore,

$P_0\left[\frac{1 - P^{n+1}}{1 - P}\right] = 1$ as n $\longrightarrow \infty$

Since P< 1,

$P = (1 - P) = \left[1 - \frac{\beta}{\mu}\right]$ The term P = is equal to the probability that the service is busy, referred to as Pr (busy period).   The average number of units in the system G can be found from

$\frac{\beta}{\mu}$

$G = \text{sum of } [n*Pn] \text{ for } n = 1 \text{ to } \infty$

$G = \frac{\beta}{\mu - \beta} = \frac{P}{1 - P}$ where $P = \frac{\beta}{\mu}$

The average number in the queue is
$F = (G - (1 - P_0))$
Sum of $[(n\text{-}1)*Pn]$ for n = 1 to ∞

$F = \frac{\beta^2}{\mu(\mu - \beta)} = \frac{P^2}{(1 - P)}$

The average waiting time in the system (time in the system) can be obtained from

$W \quad \frac{G}{\beta} \quad \frac{1}{\mu - \beta}$ and   = =

$\frac{1}{\mu} \quad \frac{\beta}{\mu\cdot(\mu - \beta)}$

D = W - =   .
The traffic intensity P (sometimes called occupancy) is defined as the average arrival rate (lambda) divided by the average service rate (mu). P is the probability that the server is busy.

$P = \frac{\beta}{\mu}$

The mean number of customers in the system (N) can be found using the following equation:

$$N = \frac{\rho}{1 - \rho}$$

You can see from the above equation that as p approaches 1 number of customers would become very large. This can be easily justified intuitively. p will approach 1 when the average arrival rate starts approaching the average service rate. In this situation, the server would always be busy hence leading to a queue build up (large N). Lastly we obtain the total waiting time (including the service time):

$T = \frac{1}{\mu - \beta}$

RESULT AND DISCUSSION

At the long run, we designed an application based on our Queuing Theory formulation. The application will be used by the staff or administrator in charge of the prison. This application will perform the following Objectives:

i.   It will help to reduce prison congestion with the application of queuing theory
ii.   Creating a database to enable accelerated and easy referencing of information when needed and easy storage.
iii. Apply queuing theory to design a system that will effectively and efficiently improve the prison services operation by ensuring that no prisoner waits beyond expected time.
iv.   Designing a system that manages the information of prison as well as enable quick planning and decision making on prisons reform.

One issue that is of great importance in discussing the reform capacity in the prison as well as the capacity building programme is the issue of staff strength. Part of what was found out during the focus group discussion is the fact that the prison is highly understaffed. This is an issue to be worried about. This is even more worrisome considering that the prison is highly over populated. For example, the capacity of Enugu prison is 638. However, the current population of inmates stands at 2375. Out of this figures, 1618 of them are awaiting trials. The average awaiting trial in Enugu prison is about 635 days (nearly 2 years). These issues to a great extent, bedevils the reform activities in the prison. Hence the effect of any capacity building programme can hardly be measured.

During the FGD session, it was found that the capacity building programmes in the prisons include skills on tailoring, metal workshop, carpentry/upholstery, laundry, barbing, fine and applied art. There are also attempts to enroll them into formal education like the National Open University, and secondary school exam centres (NECO and GCE). But even with these programmes, there are activities in the prisons that divert attention. For example, one convict runs a snooker game Centre. This is a commercial activity that yields income to the inmate, and engages the other inmates. Most times, gambling is done as the game is going on. Imagine an inmate being engage in gambling inside the prison where he is meant to learn new ideals. Interestingly, this is allowed to exist in the prisons. There are also unconfirmed speculation of cases of sale and use of marijuana and other substances in the prison.

The issue of gaming and its attendant gambling maybe strengthened by the fact that there are no functional recreational facilities in the prison. This is not the only indicator of the poor living condition in the prison. Much as they are meant to be punished for their crimes, the living condition should be such that allows for future easy integration into the society. Upon enquiry during the FGD, it was revealed that there was almost zero Medicare. There is no medical doctor, only one psychiatric doctor (are all the inmates mad?). There are no facilities at the clinic and no drugs as well (inmates pay for their drugs).

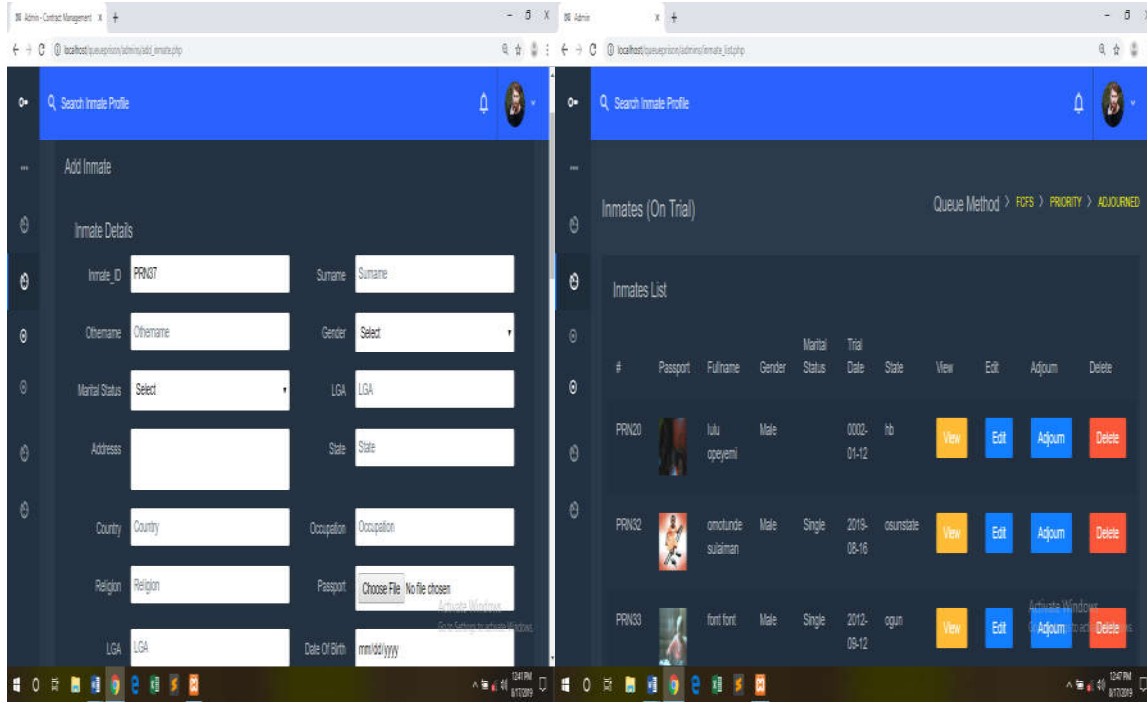**Graphical User Interfaces of the developed System**

Figure 2: platform for Registering of Inmates

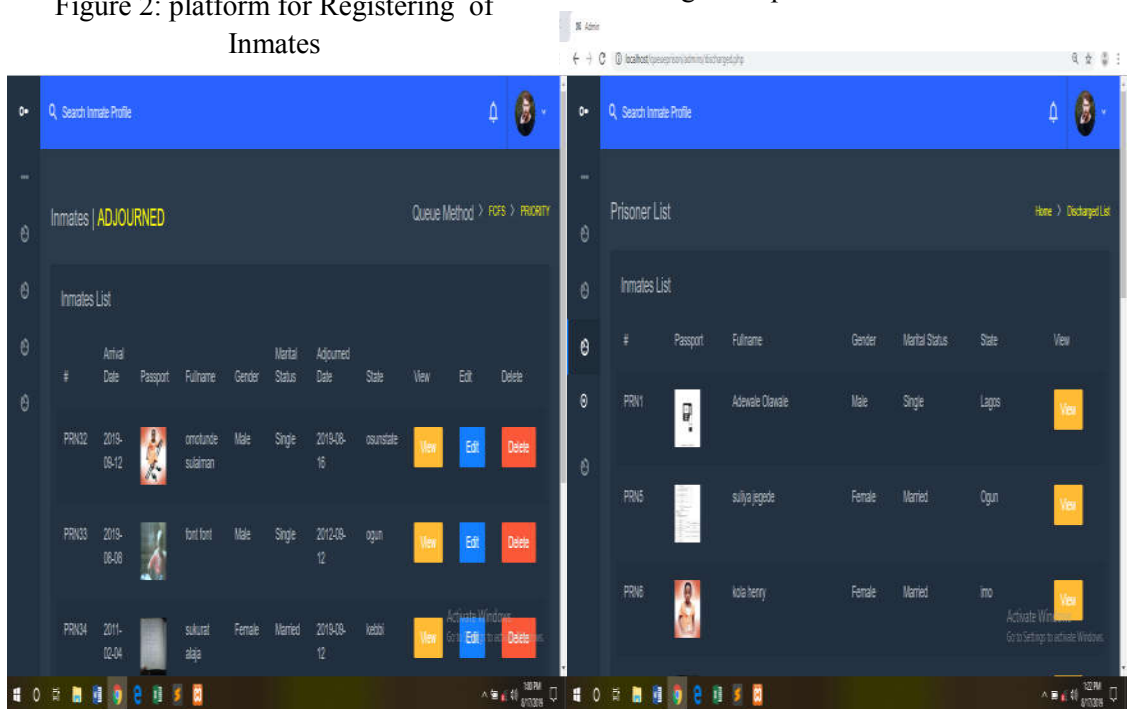Figure 3: platform for Inmates on Trial

Figure 4: platform for Inmates on case adjourned

Figure 5: platform that list all Inmates

not be ... and ...upon ... nt to develop inmates in terms of skill acquisition, knowledge enhancement etc. In short, the programs is meant to change the initial perspective of the prison inmates concerning the society, so that when they come out of prison, they will do better things with their lives. Prison reformatory programmes can also help the prison inmates to imbibe the spirit

of entrepreneurship and positive self-help efforts towards poverty. Having said these, it is important to also stress the need for a proper re-integration plan for the ex-prisoners into the society.

The Prison is a strategic institution for Nation building and security. As long as the society subsists, people will always commit crimes; be found guilty and sent to prison. In prison, such persons are supposed to come to terms with what they did as they embrace opportunities for change offered by Prison programs. When we come together in fora like this, some persons proffer ideas that create the impression that we have come to reinvent the wheel.
One way of ensuring that these works are put in place mechanisms for quick and fair dispensation of justice which sees to it that the innocent are released while the guilty are imprisoned. The establishment of such a mechanism should be the concern of the present drive for Prison and indeed justice sector reforms. To keep people in custody and discharge them after a long stay is a travesty of justice. To hinge justice reforms on decongesting the prison is very short-sighted because the issue of crime and its treatment has not been addressed.

If in other African States, accused persons can get justice within an accepted, short time frame, why is it so difficult for Nigeria to attain such a level? Why do we have to go round promoting programmed that amount to shooting ourselves in the leg? There really is no alternative to having a vibrant Criminal Justice System that can face up to Criminal acts in the land and deal with them according to law.

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