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By Ogbeide Oluwatosin Lara & Akingbesote Alaba.O

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Keywords: FRSC; driver's license, automated engine, server.

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DESIGNING A FRONT-BACK END SOLUTION FOR THE ISSUANCE OF DRIVER'S LICENSE BY FRSC IN NIGERIA

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I. INTRODUCTION

A driver's license or driving license is an official document permitting a specific individual to operate one or more types of motorized

vehicles, such as a motorcycle, car, truck, or bus on a public road. In 1901 the idea of introducing drivers' license to motor users started [1]. The purpose for the introduction was to ensure the proper use of motor vehicles on our roads. This was achieved by the use of manual system. See detail in [2][3]. This purpose of issuance of license was defeated as reported in [4]. Among the reasons given include the corrupt practice by the Licensing unit and the VIO, also that of delay and others. With the spread of ICT to most cities in Nigeria in early 80s, the idea of automating the Licensing unit came up. This allows the usage of computers for information storage and retrieval [5][6][7]. With the use of this basic ICT tools, report reveals that accident in Nigerian roads are increasing on daily basis. For example, in 1985 the accident was 30% above the previous year as reported in [8][9]. One of the root causes of this is due to indiscriminate and non-challant attitude of most drivers on Nigerian roads [10]. This could be traced to the corrupt Licensing unit officials that issue license to drivers without undergoing the due process [4]. As stated in [11][12], see Table 1, most road users in the country do not learn driving from the driving schools accredited by government rather they pay their way through to get a driving school certificate to commence their application for the driving license.

Table 1: Source: [12] Road transportation and traffic law Enforcement in Nigeria

	Responses	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Driving School	39	26.7	26.7	26.7
	Private Lesson	37	25.3	25.3	52.1
	Through a member of family	34	23.3	23.3	75.3
	Through a friend	34	23.3	23.3	98.6
	Others	2	1.4	1.4	100.0
	Total	146	100.0	100.0	

Examining the above table, we realize that 80% of the individuals operating vehicles on our roads did not learn driving skills through the Driving Schools. They end up driving with little knowledge on the appropriate use of road. Another is that of delay in the issuance of this license which in turn gives room for unqualified drivers who cannot wait to pass through the training in a driving school. They take law into their hands and

acquire a driving school certificate through the wrong procedure. These are the types of drivers that lack the knowledge of proper road use and drive recklessly [13][10] there by increasing the rate of accidents. To reduce the problem of accident on Nigerian roads, the Federal Government of Nigeria introduces the Federal Road Safety Corps (FRSC). Among the works given to this unit is that of issuance of Nigerian Driver's License to Nigerian road users [3].

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In pursuance of this goal, the FRSC introduces a front end application management system[5][14]. This application is a web based system designed using PHP. The home page consists of several important links. Some of these links are non-functional for example the accredited driving schools link, the payment link etc. These links, involved some vital steps which were not properly considered in the FRSC slated application procedure. These loopholes give room for extortion of the applicants by the officials of the Licensing unit. One of the main reasons of this front end system was to be sure that all the processes involved are undergone by the applicants. That is passing through the nine steps as reported in[15] . Secondly, to reduce the rigor or some

of the bottle necks involved. For example, going to queue for license form collection and submission etc. Another is that of eradicating the direct payment of cash to all the processing units involved. The first and the third points are very important because these will play a very significant role in accident reduction and corrupt practices in Nigeria. With the introduction of this mechanism, report still shows that the accident rate is increasing. For example, the report by National Bureau of Statistics (NBS) in August 2018 reveals that no fewer than 1,331 perished in road accident across the nation in the second quarters of 2018. The statistics is depicted in Fig 1.

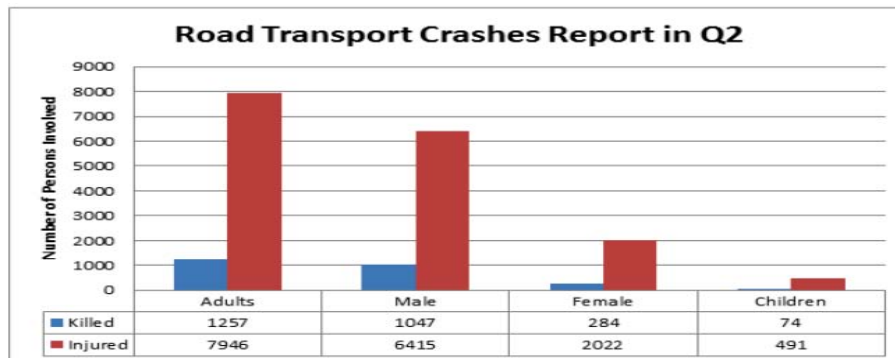


Figure 1: Road accident in second quarter 2018 in Nigeria

Source: <https://www.pmnnewsigeria.com/2018/08/28/1331-nigerians-die-in-road-crashes-in-second-quarter-nbs/>

This front end system has been able to achieve partial success in tackling the second problem, but that of the first and third are yet to be addressed. That implies that this front end mechanism has not been able to tap into the full potential of modern information technology to improve services delivery, efficient and accountability[16]. Our findings from scholars reveal that most people in Nigeria do not undergo the various processes. For example, in [4], the author as depicted in Table 1 itemized various means through which some Nigerians use in learning how to drive.

In addition to this is the issue of the payment system that has no link to the driving school of the applicant or other various units. After the FRSC payment, the applicant will have to go and pay to the account of other units involved. This is because the FRSC has not set procedure for ensuring that the applicants have actually attended one of the accredited Driving Schools that are listed on the FRSC Driver's license Official Website. This is a bottle neck and sometimes the applicant may just pay and get certificate without undergoing any test. That implies that with the current existing system, it is possible for applicant to apply in two days, complete the whole process and be awaiting license. Therefore, a mechanism is needed to be put in place to link all processing units involved. The mechanism should be able to monitor all the processing units, does the payment transaction from the main

source to all processing units and others. This will be able to reduce the aforementioned problems. This is the focus of this research.

This research proposes a front-back end mechanism that addresses the issue of on driver's license issuance in Nigeria. This research introduces the concept of back end mechanism to the existing front end. This method uses the back end automated engine as the link between the front and other units involved. A prototype demonstration of this research is carried out using some quality of service metrics which are response time, size of job and processing cost. A comparison of this work with the existing one is carried out. The results of this work perform better than the existing methods based on the used metrics.

The remainder of this paper is organized as follows. Section II discusses the related work. Section III introduces our model description. In Section IV, we have our results and discussion and we have the conclusion in Section V.

Related works

The history of issuance of driving license in Nigeria dated back to 1920. Traffic laws and regulations were inherited from the colonial administration and it was stated in the Road Traffic Ordinance Of Lagos Colony and Southern Protectorate of Nigeria which was applied to the operation of all motor vehicles until the country was demarcated into regions[17]. Thereafter,

each region was empowered to promulgate its traffic regulations. Regions were later subdivided into States. Each States were empowered to enforcement their own road traffic regulations Issuance of the license at that time was done through the manual process as discussed in [18]. Also see[2][19][7]. Because of the problems highlighted in[5] which include production of different types of driver's license as the number of States in the Federation, lack of centralized National Driver's License Database and others. The idea of using modern information technology was introduced. The utilization of modern information technology in the driver's license application management system is to enhance the efficiency, transparency and accountability in the procedure of acquiring a driver's license in this country[5]. There exist a handful of published research articles that uses the adoption of information technology both in the driving test and Motor licensing system in this country. See for example[16][19][20][21][22].

Adewale, et al[21] in their work titled "An Analytical Framework for Vision Testing in Driving License Allocation in Nigeria" proposes an automated licensing test technique and vision screening measures. This is against the standard visual acuity testing for assessing all drivers as proposed in[23][24]. The use of AMP (Apache, My SQL, and PHP) as implementation tools is proposed. The idea of the authors is to identify the major factors responsible for poor driving culture in Nigeria. The authors also discusses on the crude vision testing system being used. They concluded that in the process of acquiring the driver's license, an automated vision test must be conducted before the driving test. The strength of this work is the improvement in vision screening of all driver's license applicants and renewals, also, the provisioning of software that allows retesting of disqualified drivers before regaining their licenses. While these authors have contributed to the body of knowledge with the use of these tools to achieve their objectives, however, the fact remains that vision screening test can't be relied on to provide the same results as a comprehensive eye and vision examination[25]. For example, if the screening indicates a vision problem then they are referred for further evaluation. Also, the revelation from scholars for example[25][23] has shown that the vision screening test has little effect on the present state of the driving license application management in Nigeria.

In [18], the author adopted Wireless Sensor Network and the multi sensor fusion detection mechanism proposed in [17]. The idea of this author was to apply this mechanism in the context of driving license test. The proposed system works by allotting the test vehicle for test drive with the number of embedded sensors connected. The Global Positioning System (GPS) and ZIGBEE devices are used as a gateway sending data for processing. The decision making process of this mechanism was based on the use of

Bayesian logic classification algorithm and feature extraction algorithm. The result was obtained by invoking the data mining technique. The proposed mechanism has been able to contribute to knowledge through the adopted mechanism. However, the issues of security and resources limitations are major challenges[26][27].

Gopinath, et al[28] proposed a system of automating driving License test with Android Application. The concept of the work was to test the driving skills of a new driver while giving a driving test hereby generating real time results. In addition, the work also made provision for measurement of the result of driver in multiple parameter like reverse time, lane cutting etc. The authors use the automated testing machine integrated with Android. The strength of the work is the increases the level of transparency in the driving skill test process and also decreases the rate of corruption in the process of issuing the driving license. However, the results of an android device are not reliable as there may be an interruption in the connection of an android device hereby resulting in inaccurate results at the end of the driving test[29]. Also, the use of an android device in driving test has little effect on improving the present state of the driving license application management system[30].

Oliji[16] designed and presented the implementation of an online motor vehicle licensing system. He identified the basic problems facing motor vehicle licensing system in the Nigeria as follows: lack of proper security in the system that creates avenue for fraud and manipulation of stored data in the system and poor performance of the system during information retrieval due to inefficient storage of data. He developed software that created interaction on the computerization and implementation of the motor licensing authority at the three levels of organization; Vehicle Inspection Office (VIO), Federal Road Safety Corps (FRSC) and the Board of Internal Revenue

This system employed the use of Java as the Software Design tool, the My SQL as the Database tool and ODBC (Object Database Connectivity) Data Source to supports all database relation with the object-oriented programming language. The strength of this work was the enhancement of database but there was no mechanism provided for feedback between the various levels in the motor licensing authority. This poses a big question on how accountable the various levels of organization involved in issuance of motor licenses in this country are.

The works of these authors have given us the opportunity to make our contributions. For example, our argument for using the front-back end model was born out of the work of[16][22]also the work of [31] helps us to further forge ahead by viewing the front end as networks of units. However, our opportunity to contribute is due to certain observations we noticed in some of

these works. For example, in the work of [22], the issues of security and resource limitation are yet to be addressed. Also, the work of [16][19] focuses on identification of the basic problems facing motor vehicle licensing system in the Nigeria. These include fraud, manipulation of stored data in the system and poor performance. However, how these problems could be tackled to reduce accident rate was never addressed. The work of [19] focuses on testing the driving skills of a new driver. The idea is to increase transparency. However, this work concentrated on only one of the units involved in processing of drivers' license. The other units that address the issue of payment of the amount stipulated by the Federal Government of Nigeria to the right destination accounts of each organization involved were not discussed. The current web-based system designed by FRSC is a front end system similar to that of [14]. It gives room for obtaining and filling form online. While this has achieved to a degree of making sure that all the processes involved are undergone by the applicants. The issue of reducing the rigor or some of the bottle necks involved and eradicating the direct payment of cash to all the processing units involved is yet to be addressed.

The research proposes a front-back end mechanism that addresses the issue of on driver's license issuance in Nigeria. This research introduces the concept of back end mechanism to the existing front end. This method uses the back end automated engine as the link between the front and other units involved.

This work is differentiated from others in that the proposed system:

- Ensures that all the processes involved are undergone by the applicants.
- Reduces the rigor or some of the bottle necks involved. For example, going to queue for license application form collection and submission etc.
- Eradicates the direct payment of cash to all the processing units involved.

Addressing these three main challenges will surely play a part in areas of accident reduction, proper accountability, transparency and efficient monitoring of various driver licensing units. This to the best our knowledge is yet to appear in the literature.

II. PROPOSED ARCHITECTURE

The architecture of our model is depicted in Fig.2 below

This is a three layered architecture comprising of the application layer, Front end unit and the back end layer. The application layer takes care of applicants who want to apply for drivers' license. This applicant is expected provide information as proposed in the work of [31]. The second layer architecture is the front end layer. This is a web based unit that allows the applicant layer to communicate with it. The information is needed

by this unit. These include applicant name, email address, phone number, current address, permanent address etc. See <https://www.nigeriadriverslicence.org/> for detail. One additional thing we have added in this unit is to allow the direct online payment to be done as against the going to bank syndrome that was introduced by the existing system. The important part of this work is in the third layer which is the back end layer. The back end comprises of various units. These include the VIO unit, Driving School unit. Details are depicted in Fig 2.

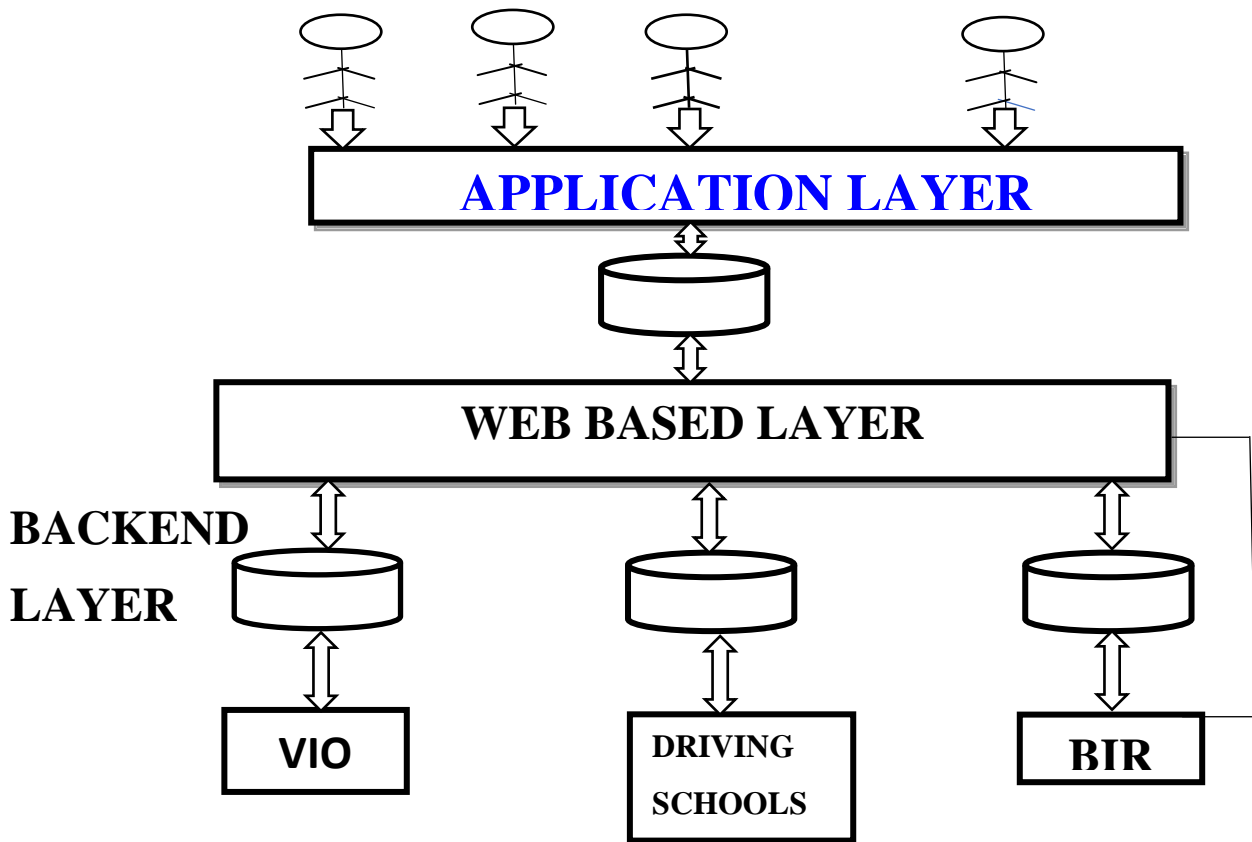


Figure 2: The front-backend driving License application management system Architecture

The back end receives information from the front end and link with the necessary units under it. For example, if applicant fills the online form and payment is made, the percentage of the amount to be made to various units is done through the back end engine. This will reduce the rigor of applicants going to various banks for transaction. In addition the back end does other works which include:

- Link with Driving school to set three months' time table for applicants
- Link the driving school with the VIO for testing of applicant after the expiration of the three months provided the applicants meet the attendance requirement
- Inform the applicants' the driving test day via the GSM or email

Various algorithms are developed to solve this problem. For example the algorithm below represents the procedure for the application from payment in the driving Schools to the end of training

```

If R>2500
    Demand for refund before further processing
Else if R = 2500
    Get applicants' name, others
    Set time table for applicants'
    
```

```

Return
Else
    Write "unable to accept amount"
Return
End If
Do
    Check date
    Write applicant on date
If applicant attend
    Get applicant Biometric info
    Send info and date to backend
END
Till the end of application
    
```

This will ensure that all the processes involved for the issuance of drivers' license to applicants are undergone through our proposed automated back end engine. This is against the already existing method that is not automated. The procedure for acquiring Driver's license goes thus:

When an applicant opens the Front-backend driver's License portal, there are several options on the page. An already existing user Login directly with his/her email address and password by clicking on the User login option on the Index page has shown below:

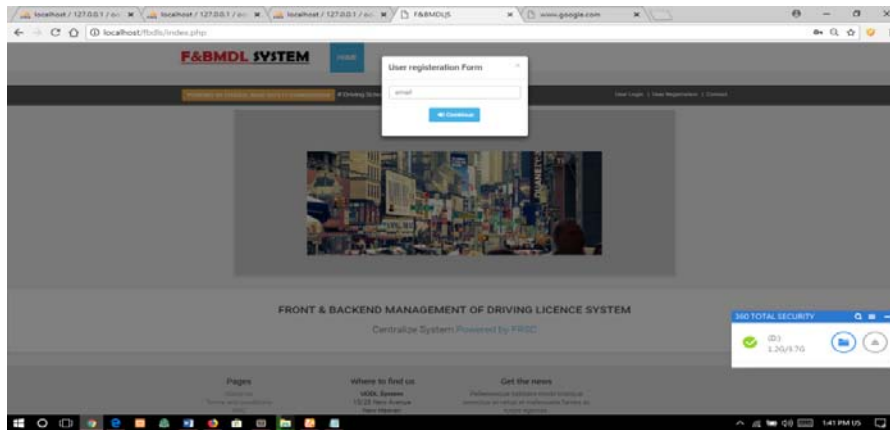


Figure 3: Index page of the system

Step 1: Click on the User registration option on the index page.

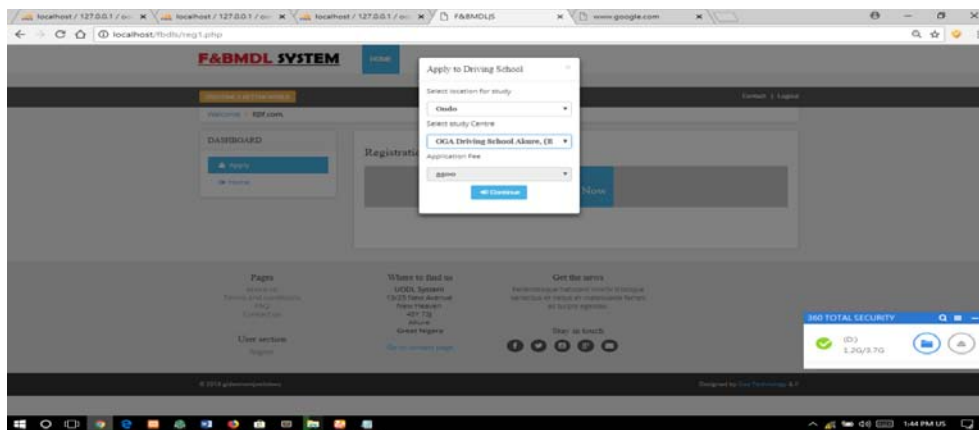


Figure 4: Driving School Selection Page

Step 2: The user's homepage is opened and the user will then select the Driving School of their choice. The fee of the chosen driving school is displayed.

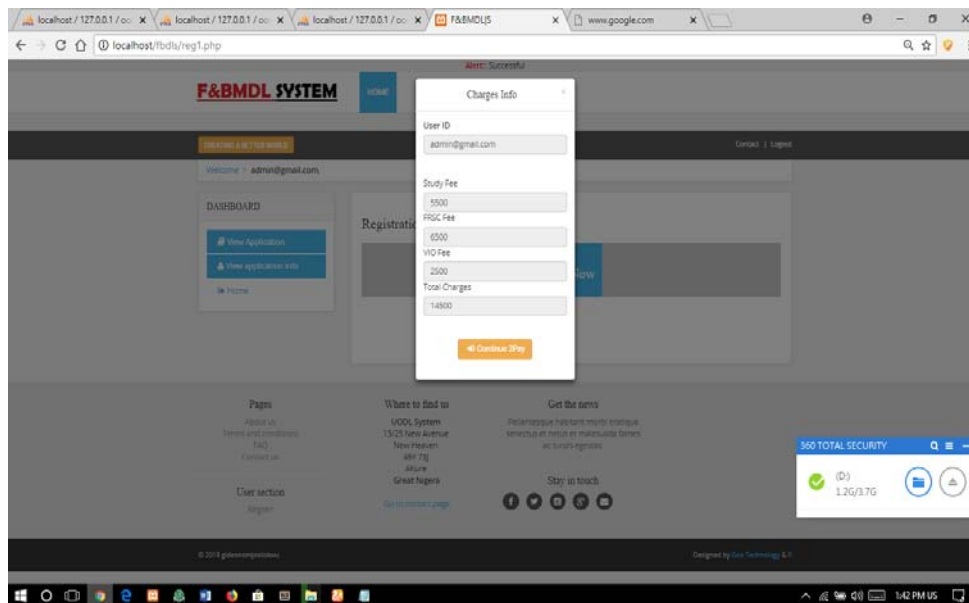


Figure 5: Page for display of Total Charges

Step 3: The breakdown of the amount to be paid and the total charges is displayed on this page.

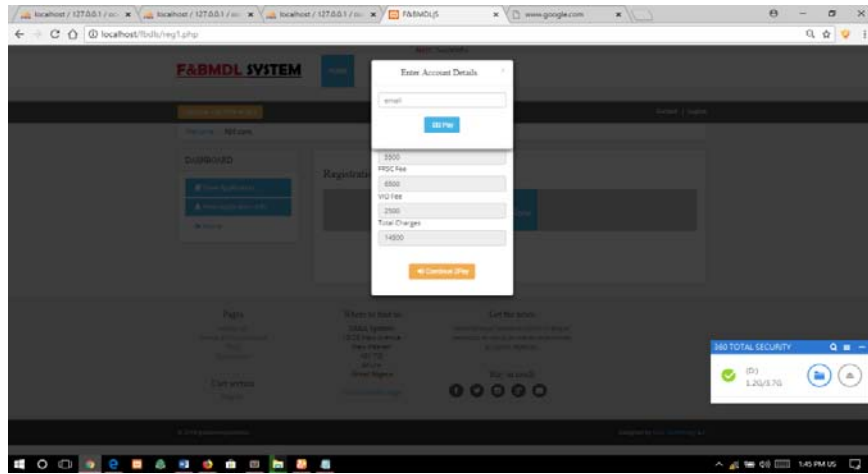
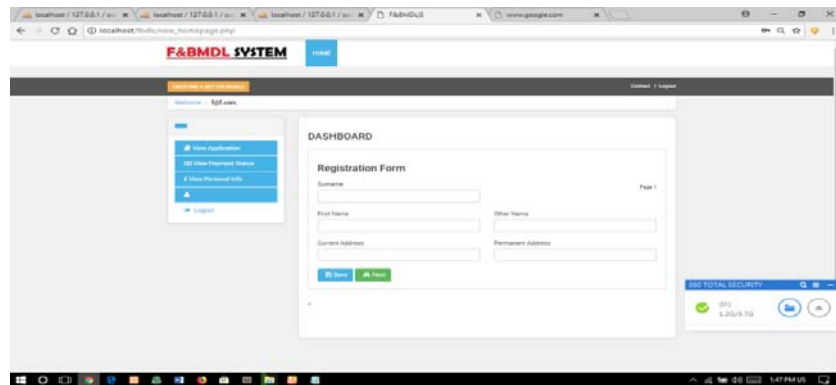


Figure 6: Payment transaction page

Step 4: The applicant enters his or her account details



Step 5: On this page is the User's bio data registration.

A new applicant gives the necessary information required in the form and submits the form. After these, the applicant's personal page is automatically displayed. This page enables the applicant to view his/her application status with the VIO, the FRSC, the Board of Internal Revenue and the Driving

school. At the Administrator level, this page displays the necessary information about the Applicant's status.

On the other hand, each of the stakeholders involved in the processing possess there means of access to view their account status as shown below:

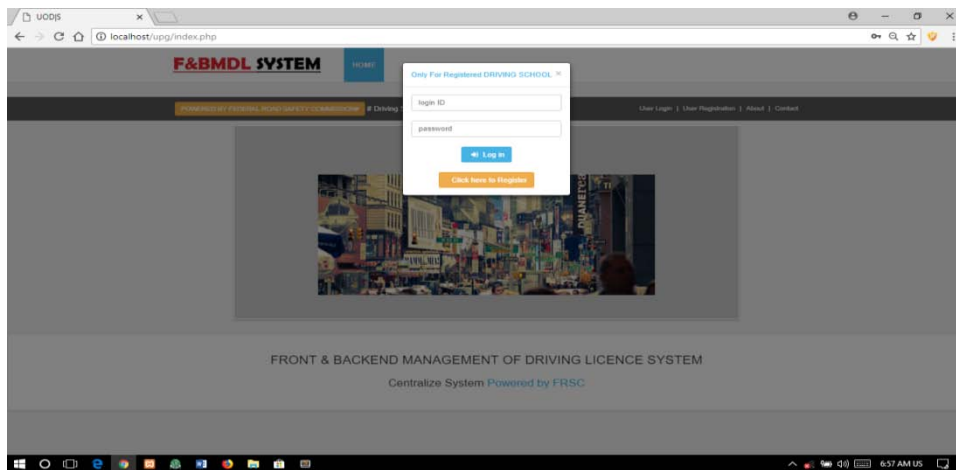


Figure 7: Driving School Login Page

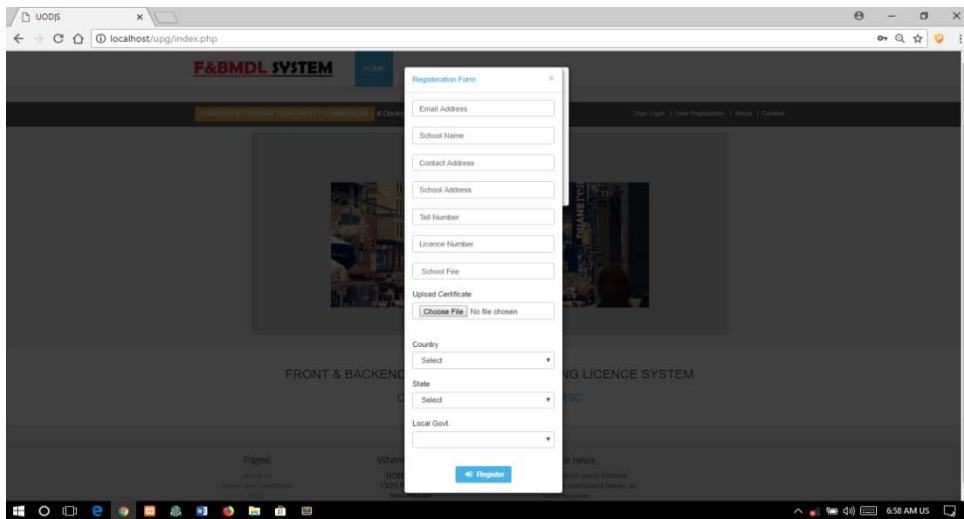


Figure 8: Driving School Registration Page

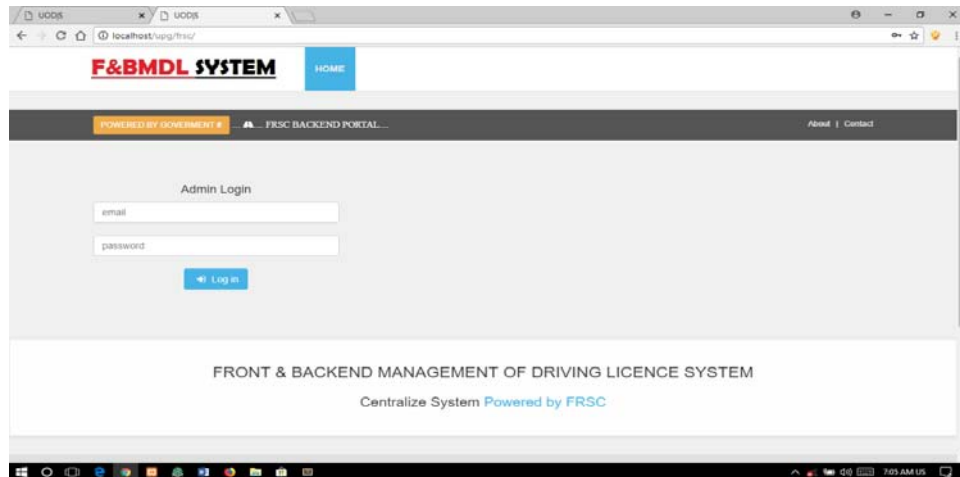


Figure 9: FRSC login page

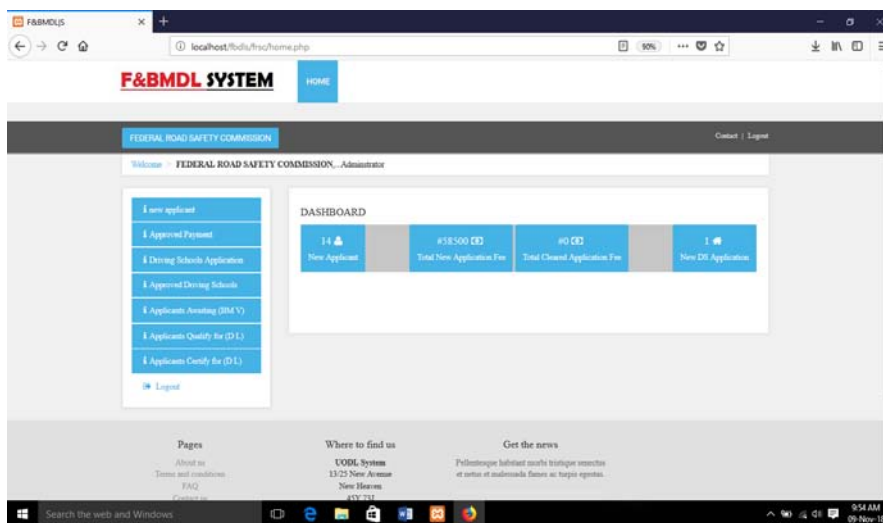


Figure 10: FRSC Dashboard page

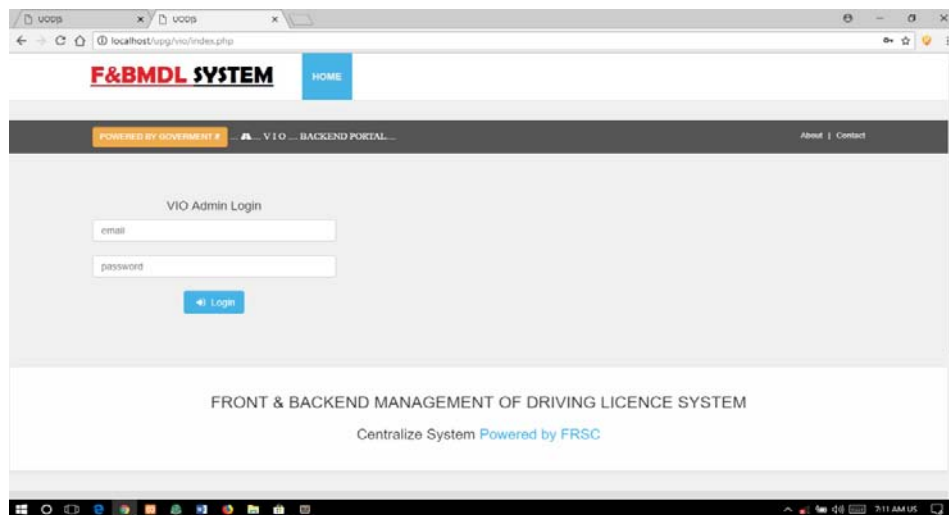


Figure 11: VIO login page

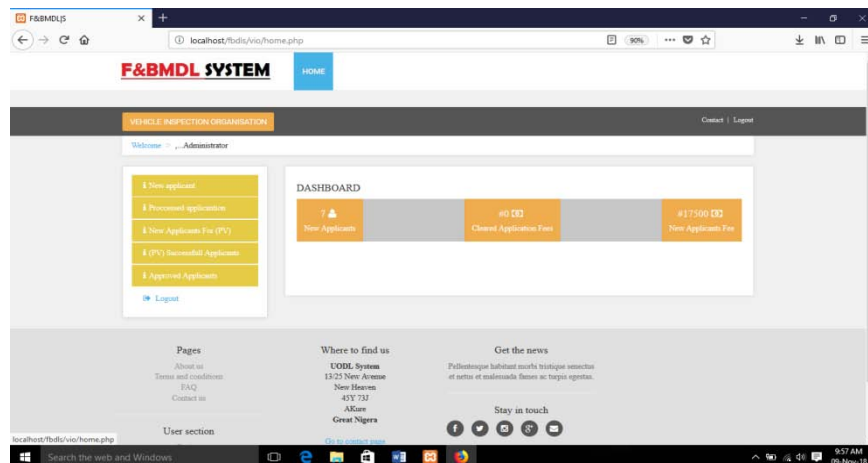


Figure 12: VIO Dashboard page

III. RESULTS AND DISCUSSION

In our work, we made use of PHP because PHP is flexible for database connectivity. It is an open source coding language. It provides plenty of scalability and gives developers the ability to create the applications easily.

We had a prototype demonstration of implementation with some applicants under our work. We used the same number of applicants for the existing front-end. We used the Response Time, Size of Job and Processing Cost as our performance metrics for the two systems. The existing system was subjected to the same conditions with our developed model.

At first, we tested both the developed system and the existing system using response time i.e. time spent from the applicant's date of application to Date of acquisition of Driver's License. An interview was conducted using 10 people and discovered that the inconsistency in the time taken for the acquisition of

Driver's license using the existing model is high. The highest response time was 330 days while the least response time was 60 days. This is depicted in the Table 2 below

Table 2: Performance evaluation of the existing system and the developed model in days

Applicants	Frontend	Front-backend
1	270	97
2	240	104
3	60	102
4	210	97
5	300	111
6	240	101
7	330	94
8	90	118
9	300	97
10	210	104

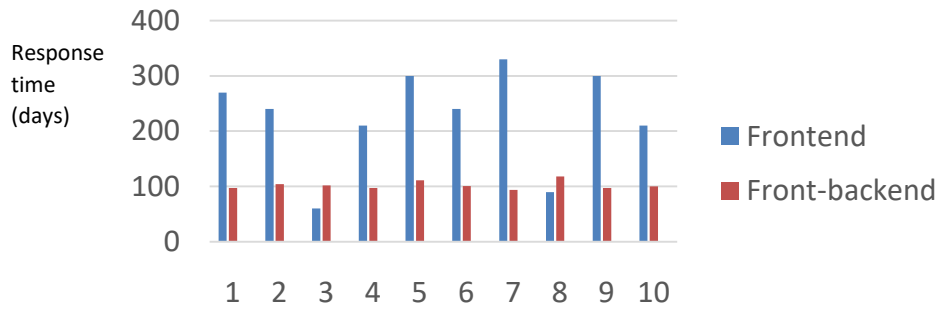


Figure 12: Performance of front end and front-backend mechanism represented on a chart

In the developed system, the variation in time taken is minimal, the maximum response time was 118 days while the least response time was 94 days

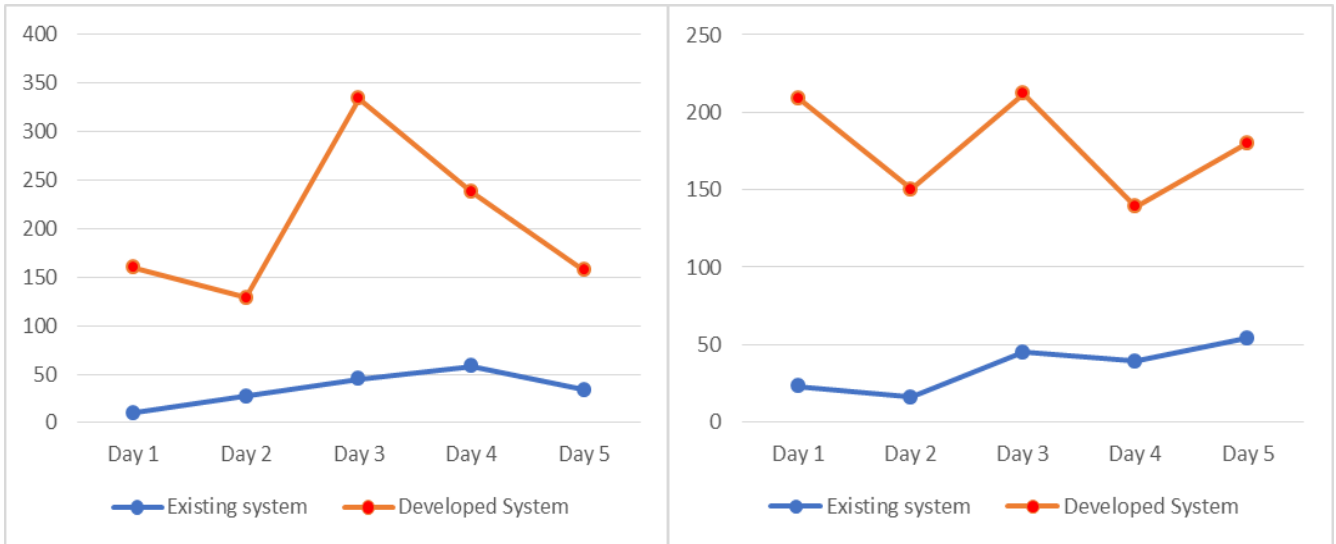
Research was conducted on the size of job i.e size of application processed per week over a period of one month at the Driver's license centre using the DLC at Ikaré as a case study. The acquired data is as follows:

Also, in order to evaluate the performance of both the existing system and the developed system.

Table 3: Performance Evaluation of the existing system and developed system using Size of Job

First week	Existing System (size)	Developed system (size)	Second week	Existing system(size)	Developed system(size)
Day 1	10	150	Day 1	25	195
Day 2	27	102	Day 2	16	100
Day 3	45	289	Day 3	52	234
Day 4	58	180	Day 4	40	200
Day 5	34	123	Day 5	38	153
Developed system	Fourth week	Existing system	Developed system		
102	Day 1	35	102		
190	Day 2	28	234		
119	Day 3	34	132		
204	Day 4	56	202		
130	Day 5	23	145		

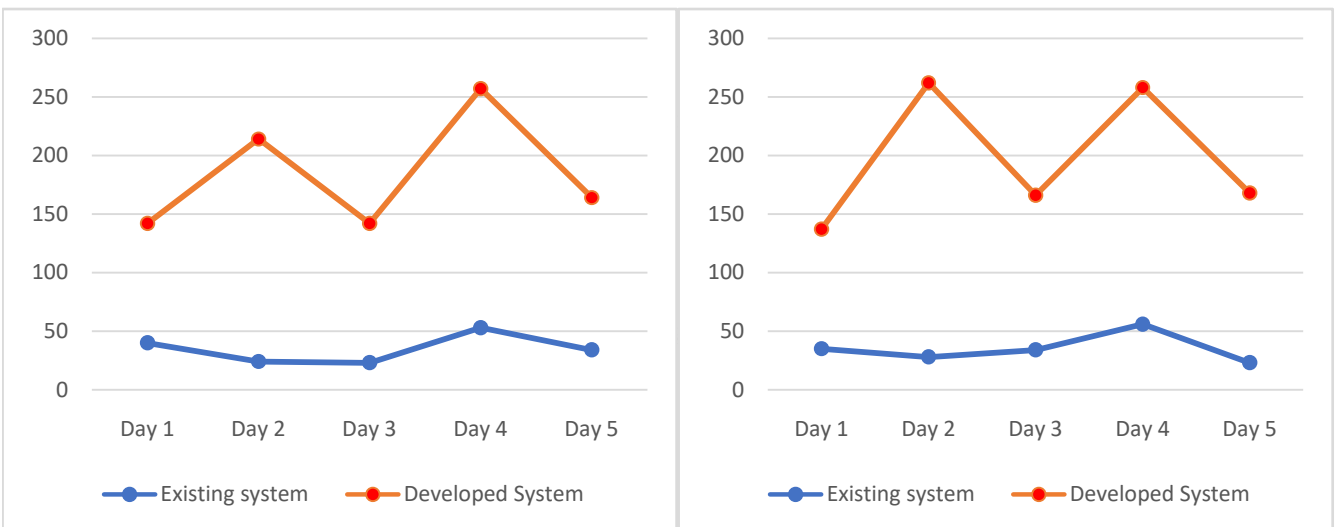




First week

Second week

Figure 13: Performance of the frontend and front-backend using cost



Third week

Fourth week

Figure 14: Representation of the frontend and front-backend on a graph

Furthermore, the processing cost was also used in comparing the performance of the existing system and the developed model. Interview was conducted using 20 applicants in order to determine the variation in cost of processing using the Existing system and the developed model. The data acquired is shown in the following Table:

Applicants	Existing System	Developed System
1	20,000	6,500
2	21,500	7,500
3	22,000	6,500
4	21,000	8,500
5	20,000	6,500
6	25,000	6,500
7	21,500	7,500
8	26,200	6,500
9	27,000	6,500
10	21,500	6,500
11	23,000	6,500
12	23,200	6,500
13	22,000	6,500
14	20,000	6,500
15	20,500	6,500
16	24,000	8,500
17	22,500	8,000
18	21,000	7,500
19	23,000	8,500
20	22,500	7,500

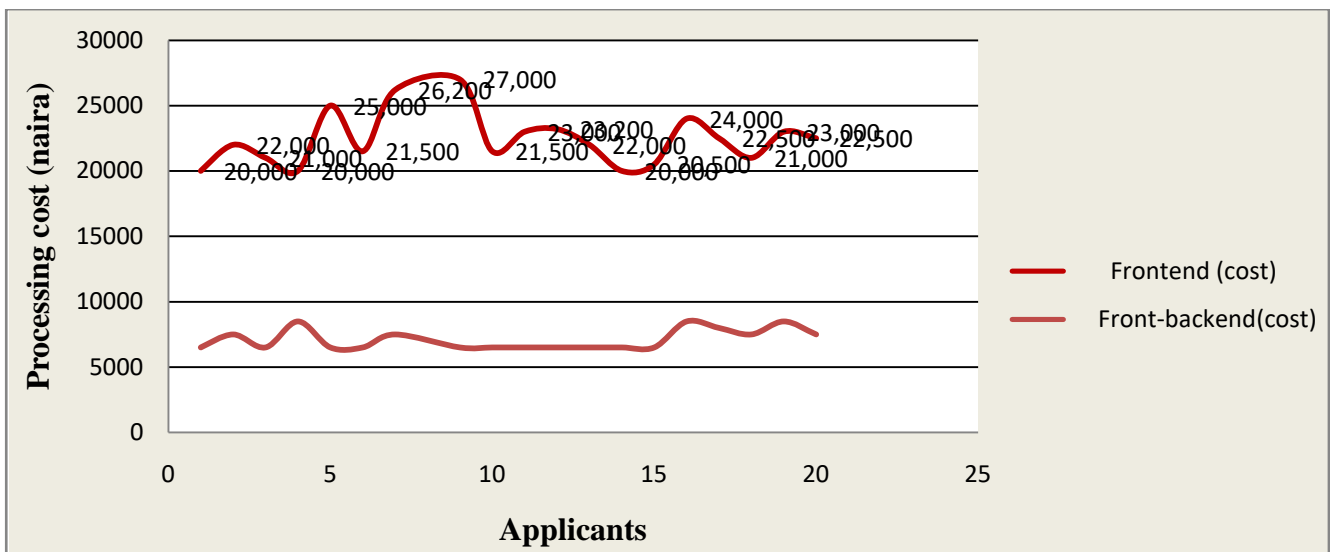


Figure 14: Representation of the frontend and front-backend on a graph

In comparison of the performance of the two systems using the response time, size of job and the processing cost, we can deduce the following:

- The variation in response time of the developed system is minimal.
- Increase in the size of Job processed per week using the developed system
- Processing cost has been considerably minimized

IV. CONCLUSION

The indiscriminate ways adopted in the procedure of acquiring driver's license in Nigeria has become a major cause of accident on our roads. The present Internet based methods adopted by FRSC is a forward end based approach. In this approach, clients still need to interact with other units directly before a final submission and collection are done. This approach is

still opening for corrupt practices and delay as a result of the direct link between clients and various units involved.

[32][32][31][31][30][30][30] The need for an efficient and optimum Driver's License Application Management system in a society cannot be overemphasized. Its contribution as a significant impact on the growth of such society due to the fact that it positively ensures the provision of efficient and safe transportation. The developed system offers some varieties of advantages over the existing one among which are elimination of delay in response time, increase in size of job processed per day and minimized processing cost through the elimination of all forms of direct payment to agents. This system ensures that the right amount is paid to the right authorities involved at each stages in the process. This front-backend

mechanism is therefore recommended for adoption and implementation. It will provide improvement over the current method especially for the reduction of stress, easy implementation and it will give room for transparency and accountability.

Also, the back end automated engine serves as the link between the front and other units involved which inturns makes it easier to monitor the application status of applicants and to keep the applicants records in the Driver License Application Management system. This work is a step towards developing a robust backend portal/mechanism which is adoptable by the relevant authorities for the stated purpose. As of now, we still believe that this work is still open for further improvement.

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