UNIVERSITY OF LAGOS, NIGERIA

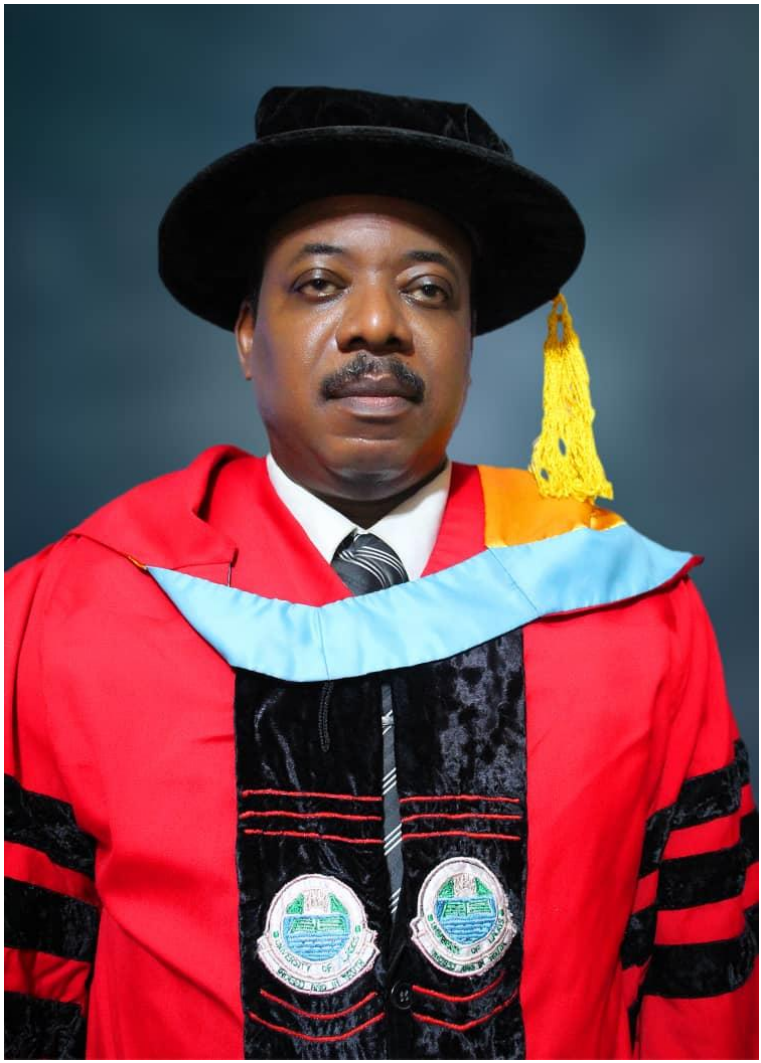
Inaugural Lecture Series 2023

TOPIC:

AUTOMATA AND INTELLIGENT AGENTS: ENGINEERED SYSTEMS THAT MAKE LIFE EASIER

By

PROFESSOR OLUMUYIWA SUNDAY ASAOLU



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B.Sc. (Civil Engineering), *M.Sc.*, *Ph.D.* (Engineering Analysis)
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AUTOMATA AND INTELLIGENT AGENTS: ENGINEERED SYSTEMS THAT MAKE LIFE EASIER

An Inaugural Lecture Delivered at the University of Lagos
J. F. Ade-Ajayi Auditorium on Wednesday, 17th May, 2023

By

Professor Olumuyiwa Sunday ASAOLU
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DEDICATION

This Inaugural Lecture is dedicated first to the memory of my dear father Mr. Ebenezer Oyewole Ashaolu who transited to glory on 9th June 1989, and to my loving mother Mrs. Elizabeth Oladunni Ashaolu. Second, to all individuals who helped me to be what I am today. Finally, to UNILAG where I have grown from being an Undergraduate to a Professor.

Outline

PROTOCOL

The Vice-Chancellor,
The Deputy Vice-Chancellor (Development Services),
The Deputy Vice-Chancellor (Management Services),
The Deputy Vice-Chancellor (Academics and Research),
The Registrar,
The Provost, College of Medicine,
The Bursar,
The University Librarian,
The Dean, Faculty of Engineering,
Deans of other Faculties,
Members of the University Senate,
The Head of the Department of Systems Engineering,
Other Heads of Department,
Professional and Academic Colleagues,
Non-academic members of staff (Administrative and Technical),
Your Lordships Temporal,
Dear Students and Alumni,
Members of the Mass Media (Press, Broadcast and Virtual),
Distinguished Guests, Ladies and Gentlemen.

> *This is the LORD's doing; it is marvelous in our eyes. This is the day which the LORD has made; we will rejoice and be glad in it.*

I express sincere gratitude to Professor Folasade Ogunsola, the thirteenth Vice-Chancellor and first female VC of the University of First Choice and the Nation's Pride, for graciously approving my request to deliver this lecture today.

PREAMBLE

An inaugural lecture is a formal address by a **newly** appointed or promoted University Professor to highlight his scholarly contributions to his discipline. That is what it is supposed to be, and I am grateful this lecture is within the fifth month of my "visible elevation" to the position. Although my promotion was formally announced on December 20, 2022, it took effect on October 1, 2021.

Madam Vice-Chancellor, distinguished audience, this Inaugural Lecture is the 42nd in the Faculty of Engineering, (the 4th in the linage of the defunct Engineering Analysis Unit,) the 1st in the Department of Systems Engineering, and of course the 18th in the 2021/2022 Academic Session in the series of inaugural lectures of the University of Lagos.

In arriving at the topic of this lecture, I considered the role of a Systems Engineer in society, current trends in technology, and my efforts to impact practice and policies by creating innovative models with Artificial Intelligence (AI) applications.

Automata and intelligent agents: engineered systems that make life easier

Let me first describe some terms related to the topic.

Automata refers to automation; software or hardware or machine configurations that are scheduled to follow a predetermined sequence of operations automatically, with little or no direct human intervention. Examples include computer antivirus, washing machine, escalator, etc.

Operators usually set or reset such devices which are good at performing certain routine tasks. Automata expedite actions, help minimize manual labour, and reduce human error or bias in repetitive work.

Figure 1: Escalator
Source: Fletcher C Johnson via http://ift.tt/1U1Eyq9

An intelligent agent is a program or device that can make decisions or act based on its environment, user input, and its experiences. An entity is considered intelligent when it uses sensors to gather data, a processing unit to reason with the data, and actuators to achieve its goals. Examples include autonomous vehicles, smart traffic lights, bots [like ChatGPT, Siri, Alexa], robots [like Omeife, Sophia], etc.

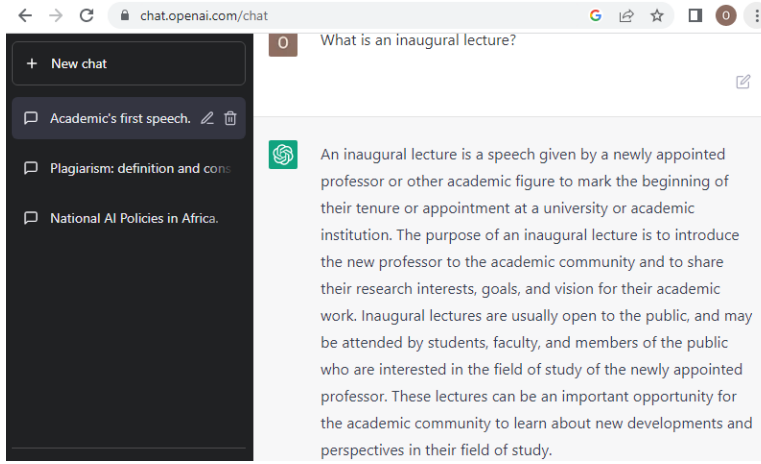

Figure 2: A Bot [ChatGPT] defines ‘Inaugural Lecture’
Source: OpenAI via https://chat.openai.com/chat

A system is defined as an arrangement of elements working together in synergy to produce a composite output that is greater than the sum of the individual outputs of the components. An “engineered system” is a system that works artfully to attain an objective. It may be constituted by people, products, services, information, processes, and natural elements or any combination of these.

Systems Engineering is a transdisciplinary and integrative approach to enable the successful realization, use, and retirement of engineered systems, using systems principles and concepts, scientific, technological, and management methods (INCOSE, 2023).

Systems Engineering encompasses all other types of engineering. Available expertise in my department includes Systems Modeling and Simulation, Systems Management, Artificial Intelligence and Robotics, Engineering Analysis, Engineering Design, Energy and Power Systems, Systems Control and Visualization, Systems Optimization, Software Engineering, Computational Mechanics, Bio-Engineering, Operations Research/Manufacturing, and Agric. Engineering.

While all Engineers by training are skilled in harnessing the forces and materials of nature for human comfort via the application of scientific principles, the Systems Engineer is more versatile since he maintains a holistic view of a project.

At the visible level, the universe seems more automated rather than random; a system that functions inherently on principles, many of which mankind has discovered. Hence, universal laws or “*the laws of nature*” are observed rules based on generalized, immutable principles.

Man exhibits ultimate intelligence in this material world. Every human is a complex entity; a soul having a physical body comprising various systems: skeletal, muscular, nervous, circulatory, respiratory, digestive, reproductive, etc. He lives on earth which is part of a solar system. Neither the universe nor man could have evolved from nothing without an adequate cause. Engineers believe that things are made!

The cosmos, and the earth with its intricate, diverse flora and fauna, must have had a Maker for two apparent reasons:

1. The universe functions with physical and moral laws, which implies a Lawgiver.
2. Every natural system exists for a purpose.

Thus, it is reasonable to claim that such Maker must be self-existent *outside* the universe, and necessarily transcends both space and time. Since man has a metaphysical or spiritual outlook aside the natural; he is wonderfully made and could have been created in the image of *The Supernatural*.

If the aforesaid is valid, has our Maker imbibed us with the ability to emulate Him? Perhaps, an answer may be gleaned as I deliver a summary account of my Teaching, Research and Community Service; an exposition of my intellectual "offerings, sacrifices and levies" unto what I profess.

These three duties of a lecturer are intertwined, and assessed to appoint a professor. Ill-advisedly, the outgoing Federal Government pretends during industrial disputes, as if Teaching is the only thing we are engaged to do.

MY TEACHING

Madam Vice-Chancellor, for over two decades as a Lecturer in UNILAG, I have been an instructor to about twenty thousand students; cumulatively served as an examiner for three Diploma courses; twenty-two undergraduate courses and six Postgraduate courses in Engineering, aside one Postgraduate course in the Management Sciences. I have successfully supervised seventy-nine undergraduate final year students, thirty-six Masters Theses, one MPhil Thesis, and four Doctoral Theses. As a Visiting Scholar at the University of Tennessee [UT], USA, I served as an examiner for two Engineering undergraduate courses and one Postgraduate course. At UT, I developed an elective course in Visual Computing. At UNILAG, I developed courses in Engineering Mathematics, and in Artificial Intelligence.

Many of my students would recall my **maxim:** *Equations have meanings.* If anything can be modeled with heuristic rules, or logical or mathematical relations, then it can be programmed to simulate and solve a wide variety of problems.

I try to explain concepts using familiar phenomena. I formulate interesting class examples, and examination questions such as the mathematical, state representation of:

1. Evader-Pursuer problem e.g. the trajectory of a cat chasing a rat with the cat's immediate velocity directed at the prey's instantaneous position.
   [I explained to 100 Level students in an Applied Engineering Mathematics course that the same concept is utilized in the control system of the *Patriot missiles*; the most expensive and valued arsenal of the USA. I later developed and published generalized solutions that are more realistic and tractable than the classical approach.]

2. Periodic functions e.g. a lady's menstrual flow that builds up linearly to a maximum value q within two days, and likewise dissipates; only to reoccur every twenty-eight days, barring pregnancy or menopause. Such a model is useful for fertility and birth control pills formulation-simulation. The menstrual flow is as illustrated below:

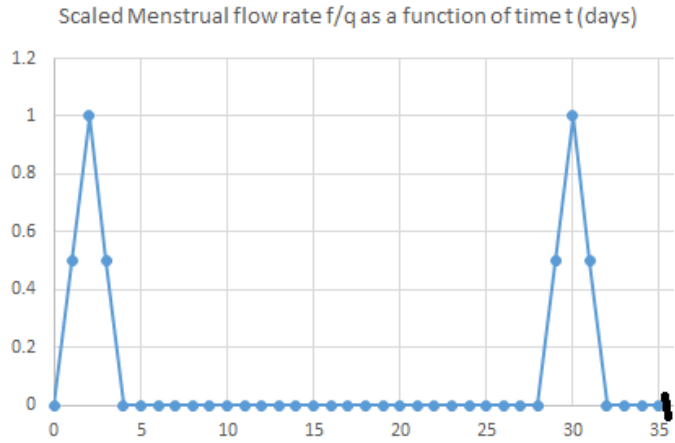

Figure 3: Plot of observations used to general Math. model

I would require 300 Level Engineering students to show during *Operational Methods* exam. that the Math. representation is:

$$f(t) = q\frac{t}{2};\ 0 \le t < 2$$

$$= 2q - q\frac{t}{2};\ 2 \le t < 4 \qquad \text{Eqn (1)}$$

$$= 0;\ 4 \le t < 28$$

And that it has an **even** Fourier Series expansion,

$$f(t) = \frac{q}{14} + \frac{14q}{\pi^2}\sum_{k=1}^{\infty}\frac{[1 - Cos(\pi k/7)]Cos(\pi k(t-2)/14)}{k^2} \qquad \text{Eqn (2)}$$

Sometimes, software is used to simulate theoretical concepts in class since students comprehend better with visualization and enjoy hands-on practice. A former Postgraduate student once disclosed that he utilized the *Analytical Hierarchy Process* taught in my Decision Analysis class, and its demonstration software to evaluate his girlfriends so as to select a spouse! He is happily married for the last eighteen years, and hopefully will remain so.

Madam Vice-Chancellor, in June 2019, while you were the pioneer DVC Development Services, I facilitated and, you expedited the signing of an ***Agreement for Cooperation*** between UNILAG and the University of Dayton, OH, USA. Thereafter, Dr. Sharon Bommer and I, served as lead-instructors for the Collaborative Online Interactive Learning (COIL) program. Engineering undergraduates at UNILAG and UDayton took an Industrial and Systems Engineering middle-level course where alternately, we taught both set of classes synchronously using Zoom and UDayton LMS technology.

In October of the same year, online collaborative teaching was one of the recommendations of panelists at UNILAG's debut "International Week." Indeed, the COIL experience was invaluable as it prepared my department for remote classes when the whole university, nay the whole world had to resort to virtual learning during, and after the COVID-19 Lockdown.

I am fulfilled as a Lecturer because my theory translates to practice even amidst my students. They are mostly well taught, and many have won national and international student contests. Some are headhunted immediately after they graduate. In 2002, I recommended two of my undergraduate students to the Library Automation Unit to help the Unit resolve some issues. The duo performed very well and were

then contracted to design and develop the first *unilag*.edu website.

Figure 4: The first set of undergraduates admitted into Systems Engineering (2000/2001 Session) on an excursion to The Cyberschuul, Lagos.

Figure 5: My Postgraduate Class at the University of Tennessee (2004)

MY RESEARCH

Madam Vice-Chancellor, initially, I carried out studies out of curiosity, and a desire to resolve issues. Later, I heard of "publish or perish." I was not satisfied with just not perishing but wanted to flourish. Every university lecturer is expected to groom students in initiating, conducting and reporting research activities. I endeavor to do so despite the usual constraints, and the demotivation fostered by the FG-ASUU spats. Thus, apart from normal hours with undergraduate project students, I put in much more time to brainstorm with serious postgraduate students. I also encourage my doctoral supervisees to make presentations at local conferences.

Students must be trained on how to seek answers to probing questions, and to proffer better solutions whenever they are not satisfied with the status quo. This is intrinsic to conducting ***good*** research. However, in academia, ***excellent*** research is the pathway to innovation, fame, and at times, wealth. The types of problem one addresses also matters. Breakthrough research must be impactful on society or be of great interest to the academic community, or both. I may have influenced some of our graduates positively in this regard.

Some of my trainees have proceeded after NYSC, to build technology firms around the final year project that I proposed or supervised. One group became a vendor of a solution for the Tertiary Students' Records Management System and, another for Home Automation Services. Others came up with their own ideas, years after graduation, and invited me to the Board of their Companies at incorporation or afterwards. I counseled, accepted and invested in their Shares / Equity, trusting that they will succeed.

Madam Vice-Chancellor, as a Researcher, I have co-edited four academic books, contributed chapters to three other books, published thirty-seven articles in scholarly journals, partaken in over twenty-four local and international Conferences and Workshops, obtained one Patent, and publicly released fourteen software innovations.

Permit me Madam Vice-Chancellor, to highlight *selected* research projects that I have participated in over the years, and our results.

i. **Object and Path Tracking**: In this class of problems, we investigated a sighted prey pursuit, intelligent path planner for mobile robots in the presence of moving obstacles, and trajectory generation for manipulators, and microsatellites launch vehicles (Ibidapo-Obe *et al.*, 2001; Asaolu *et al.*, 2011; Raji *et al*., 2022; Fashanu *et al.*, 2022). These have extensive applications in robot development, game design, missile deployment, etc.

   For the pursuit problem, the new technique formulated involves the specification of an arbitrary escape function having real zeros, in the integrating factor for solving the differential equations in time, along the spatial dimensions. For robot obstacle avoidance, we considered the robot as sweeping out an elliptical region. The path to transverse consists of the shortest routes along un-intercepted edges of the instantaneous graph generated by the free regions in the environment. It was established that our solution approaches were faster and more versatile than the classical approaches.

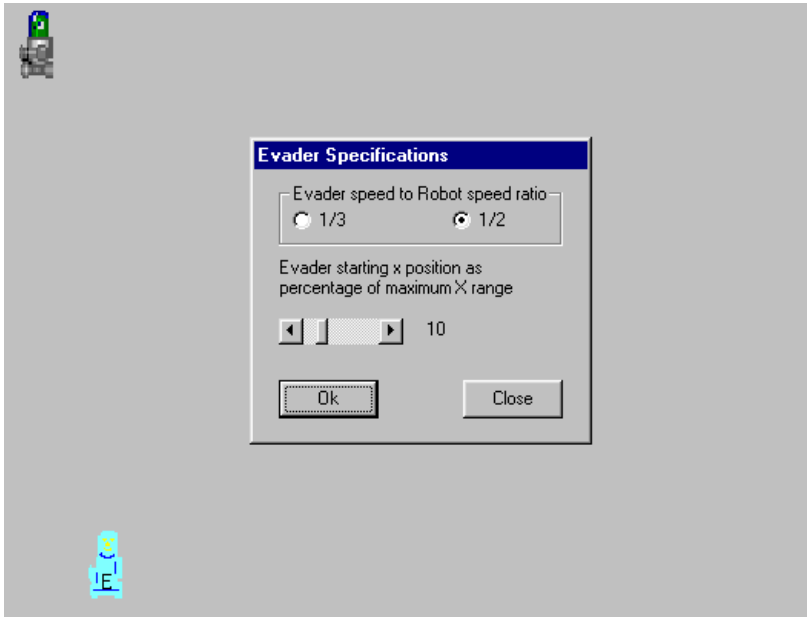

Figure 6: Robot-Evader configuration

Figure 7: Robot-Evader interception classical approach

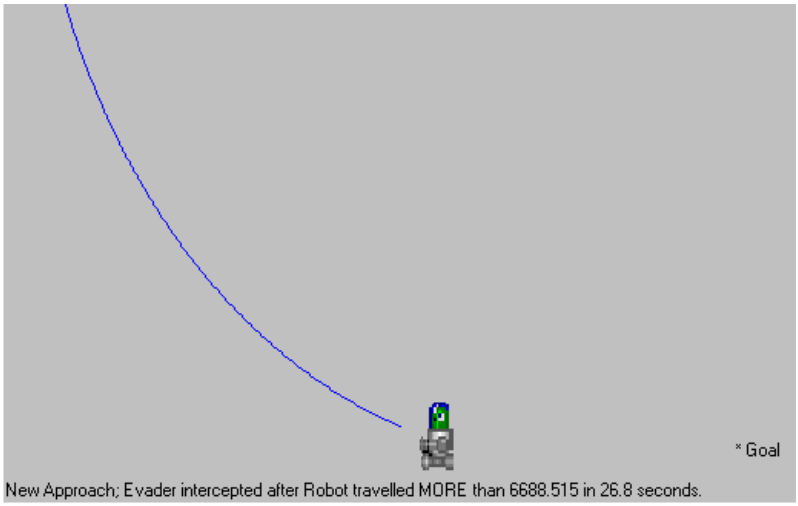

Figure 8: Robot-Evader interception new approach

Figure 9: Robot-obstacles avoidance new approach

ii. ***Simultaneous Nonlinear Equations*** (SNE): To unravel the SNE that describe the practical speed constraints within our pursuit model, we developed a new technique to solve SNE (Ibidapo-Obe *et al.*, 2002). We recast the problem into the iterative solution of a parametric linear system coupled with a nonlinear single variable equation. We also developed a technique to estimate a feasible starting point for SNE roots, which is useful if the likely range is unknown. It involves evaluating the system Jacobian with initial guesses constrained to yield minimal values. The source code is available for free on the web. It is being used as a demonstration tool in Numerical Analysis by many educators across the globe.

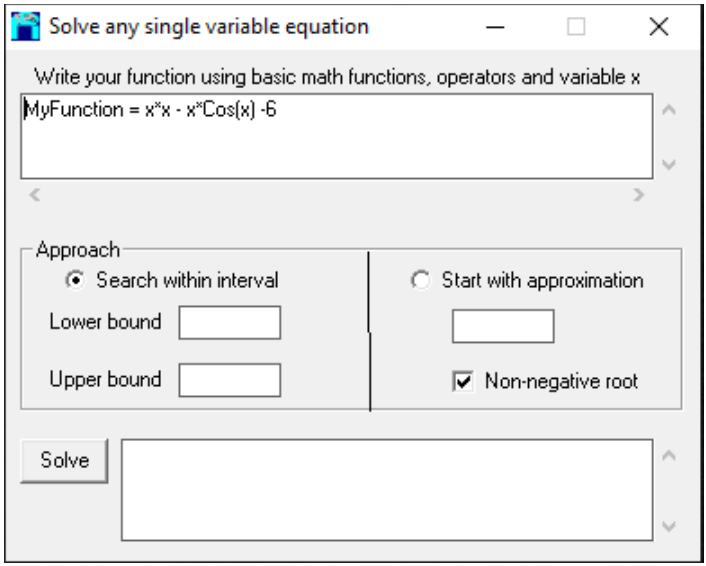

Figure 10: Equation solver for real roots

One of my team's present work is on tracking partially occluded objects.

iii. **AI-driven Analysis and Design of Trusses and Pipelines**: We utilized Conventional approaches, and Expert Systems approach to design beam structures (Ibidapo-Obe *et al.*, 1998; Ibidapo-Obe & Asaolu, 2006; Salau *et al.*, 2011; Akano & Asaolu, 2018). It was found that to obtain similar load-bearing stability and safety results, material and time savings abound using Artificial Intelligence modeling compared to the classical methods.

iv. **Adoption of ICT for Routine and Educational Activities**: This series of studies investigated the use of computer technologies in the society (Asaolu, 2006); ICT utilization for teaching, learning and educational administration in Lagos Secondary Schools (Asaolu & Fashanu, 2012); the integration of software development for Engineering education in Nigeria (Asaolu, 2012); and the deployment of ICT for electronic exams in Nigeria (Asaolu, 2015).

The first study concluded that a major technological challenge being addressed is making information and computing power available all the time, everywhere and on all platforms.

The second study revealed that ICT facilities are relatively lacking in public schools compared to private schools. It also outlined the perceived benefits of using ICT in schools including making teaching-learning interesting, enhancing the speed and quality of work by the management, the teachers and the students. However, the core challenges were: paucity of funds for the purchase and maintenance of equipment, inadequate manpower skills and irregular power supply. It recommends periodic retraining of educators, and administrators on ICT skills acquisition.

Thirdly, the profile of engineering faculties with regard to computing integration was presented with UNILAG as a case study. Local efforts in the development and usage of software packages relevant to the engineering profession were identified, and found to be inadequate. Associated problems and potential solutions were enumerated to enhance the software integration process for engineering education in Nigeria.

The fourth study investigated the readiness of the society viz students, teachers and examination bodies to migrate the WAEC/NECO/JAMB examinations from paper-based to wholly Computer Based Test (CBT). We found that CBT has made some in road with JAMB's UTME, and made suggestions to enhance the migration of all paper-based post-secondary examinations to standardized CBT.

v. **Natural Language Processing**: It was an extensive exercise to research and develop a computer application for word-processing, and translating Nigerian languages. The effort produced a commercialized product (Lingua®) that could process English, Hausa, Igbo, Yoruba and any custom language for which the User is able to extend the provided in-built dictionary. It has a familiar and friendly Graphical User Interface (GUI). Since 2001, Lingua was adopted by religious, cultural and other organizations including publishers such as the maker of the Yoruba tabloid ***Alaroye***. A few years later, the software's impact and prospects was studied, and published (Asaolu, 2006). In 2002, the then First Lady of Cross Rivers State; *Mrs Onari Duke* commissioned the inclusion of Kalabari and Efik languages in the product. Between 2003 and 2009, I updated the product to explicitly process Kalabari, Efik, Dutch, French, German, Italian, Spanish, and Swahili.

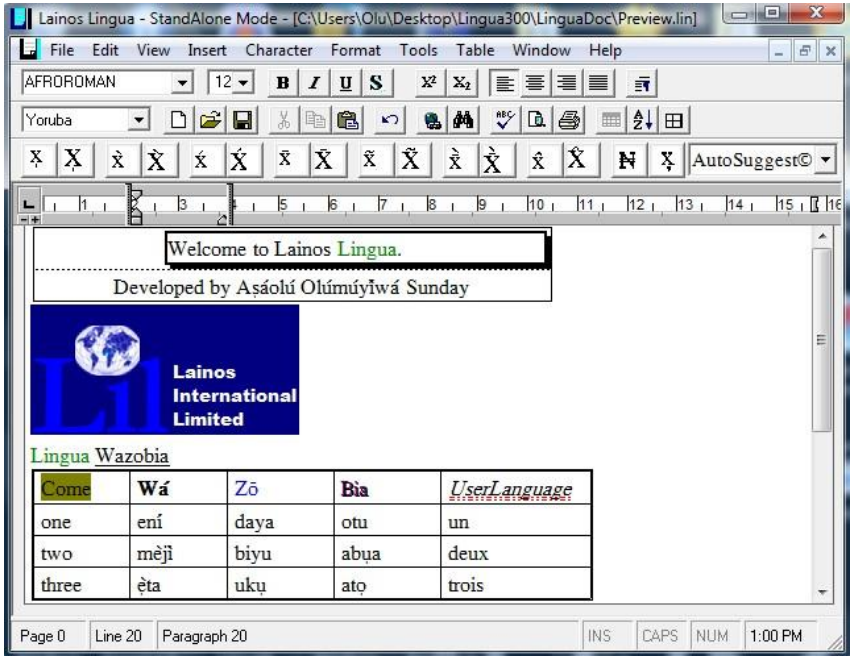

Figure 11: Lingua GUI

vi. **Use of instructional multimedia games for learning in secondary schools**: This involved a series of survey studies and software development.

Firstly, we ascertained if secondary school students and teachers would be receptive to using multimedia games for e-learning in the classroom setting. Upon verification, we proceeded to develop a *Shareware* game engine (Paradigm3DVR® ActiveX library) since the existing ones cost hundreds and thousands of dollars to license. [Shareware means the software could be shared by anyone. The material is distributed free but users are encouraged to pay the developer a token fee for the

continued support of the software. A Canadian university utilizes this ActiveX tool for a Computer Graphics course.] Thereafter, a multimedia and interactive system (Lainos World®) was developed, which offers instructional geopolitical knowledge on all sovereign countries while engaging the user in a virtual reality game mode as well as traditional application tutor and quiz modes. It provides textual, audio and visual information. The app was equally assessed by the select schools as to its effectiveness and motivational values. The edutainment product was adjudged as innovative and beneficial by the vast majority of the participants (Asaolu, 2011).

Madam Vice-Chancellor, subsequently I won a $10,000 grant from the duo of **Inter Academy Panel** [IAP] and **The World Academy of Sciences**, and its equivalent in Naira from the **Nigerian Academy of Science** [NAS], to localize the product into several international languages, and evaluate its effectiveness as a learning tool. By adapting Unicode resources, and engaging the services of translators, I rebuilt the intelligent; multimedia geography tutor and game software to support English, French, Spanish, German, Portuguese, Russian and Simplified Chinese. A user can select any of these languages.

Afterwards, multilingual online surveys were set up, to which High School students across the world were invited via emails to schools, targeted adverts and recruitment on Facebook, Google, etc. 1125 respondents from several nations completed both the initial and final surveys. The effect of the software on students' geographical knowledge was analyzed through pre and post achievement test scores. In general, the mean scores

were higher after exposure to the educational software for fifteen days, and it was established that the score differences were statistically significant (Asaolu, 2012).

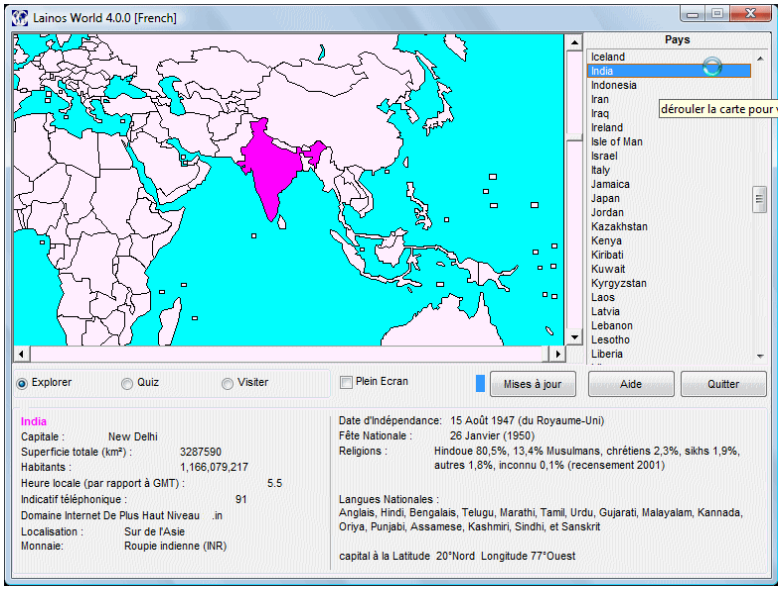

Figure 12: Lainos World GUI (Normal mode: French)

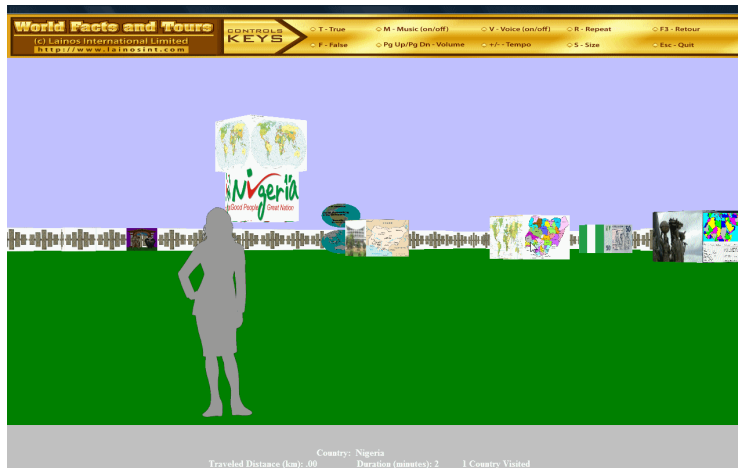

Figure 13: Lainos World GUI (Virtual Reality mode: English)

vii. **Scientometrics**: One of my research teams; the one comprising the members of the Editorial Board [2016-2019] of the *Annals of Science and Technology*: A Journal of the Nigerian Young Academy, reviewed the various approaches, and metrics for evaluating scholars. Our work addressed the pressure to fit into the Western-imposed research model despite the deficit of support infrastructures in Africa. An online survey was conducted with the data analyzed through descriptive and inferential statistical methods. The survey results indicate that the majority of African academics desire a paradigm shift from institutional administrators, and policy-makers. Several flaws in the rating and ranking of researchers, and institutions respectively were highlighted. We concluded that indigenous knowledge production and sharing for national development must be promoted (Atolani *et al*., 2019).

Moreover, we developed the **U-Index** for measuring contributions to academic knowledge (Asaolu *et al.*, 2022). The U-Index is an intrinsically normalized metric suitable for inter and cross-disciplinary research evaluation. It factors in authorship role and actual citations compared to expected citations over time. From synthesis, and via an analytical and statistical survey of the publication portfolio of a mix of scholars from diverse fields, it was demonstrated that ranking such researchers based on U-Index is distinct from, and preferred to ratings that use H-Index. We also developed the free ***U-Index Calculator software*** for seamless evaluation on the PC.

Our next goal is to make the Calculator a Web Service that could be integrated with any scholarly indexing platform.

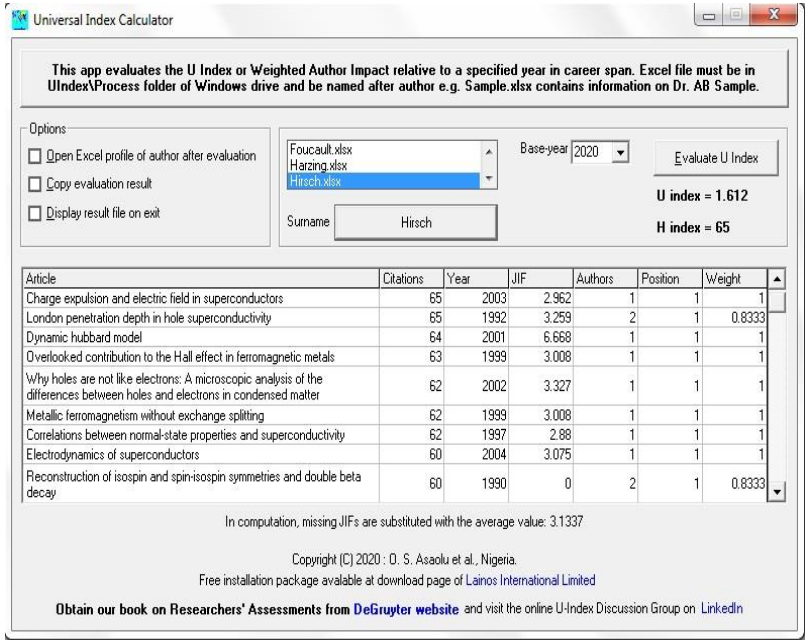

Figure 14: U-Index Calculator GUI

viii. **New Models and Simulators**: My research teams also built new models and prototype AI software for Eyewitness Information Management System (Badiru *et al.*, 2005), Basin Irrigation (Asaolu & Ogbemhe, 2009), Signature Verification (Asaolu, 2009), Forecasting in Operations (Asaolu, 2013; Akano & Asaolu, 2017), Mobile Financial Services (Asaolu, 2016), Improved Traffic Light Control System (Osigbemeh *et al.*, 2017), Prediction of Blood Glucose Level in Type 1 Diabetes Miletus Patients (Orieke *et al.*, 2017; Orieke *et al.*, 2019; Asaolu *et al.*, 2019), Mobile Navigation App (Oduwole *et al.*, 2019).

ix. **Biometrics**: Madam Vice-Chancellor, due to personal experiences, and Genesis 18:10-15, I suspected that

laughter is a trait for person identification. When a bright doctoral candidate showed interest, I put her and some undergraduates on various aspects of the task. We curated the appropriate dataset and developed the framework for this new technology. Volunteers were enrolled with laughter samples extracted under forced and natural conditions. Noise was filtered from the recorded audio signals, and the novel Dynamic Average Mel Frequency Cepstral Coefficient (DA-MFCC) features were trained using various Machine Learning classifiers.

Over 90% accuracy was obtained with the Gaussian Mixture Model (GMM) and Support Vector Machine (SVM) classifiers. For the first time in literature, laughter, which hitherto was considered noise in speech processing has become a viable tool for forensics in acoustics analyses. It has much promise for deployment in multi-modal biometrics and gender recognition. (Folorunso *et al.*, 2019; Folorunso *et al.*, 2020; Popoola *et al.*, 2020; Folorunso *et al.*, 2020b; Asaolu *et al.*, 2021). Several outlets acclaimed the news of the published research, including US Homeland Security Newswire, US Department of Defense on Twitter, Russian TechNews, UK Sciencespot, etc.

x. **Handbook Development**: Badiru & Asaolu just authored a Handbook of Foundations for Artificial Intelligence, scheduled for release in June 2023.

Madam Vice-Chancellor, participating in studies, and presenting research findings have afforded me an opportunity to attend several **intellectual summits** around the world. I have also been blessed to receive some *awards*.

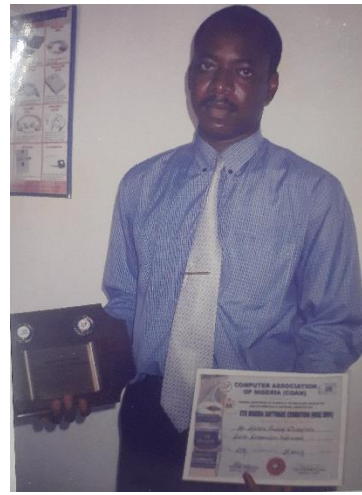

Figure 15: At Fifth Nigeria Software Exhibition by COAN (now Nigeria Computer Society) in Lagos, March 2001. Lingua® was awarded "*The Most Commercially Viable Software*." I won "*Best Software Developer"* prize (Researcher Category).

Figure 16: At Pan-African Localization Workshop, Casablanca, Morocco in 2005.

Figure 17: At the Gathering of Young Scientists, World Economic Forum in Dalian, China with Dr. Emmanuel Unuabomah. I received "*The IAP / TWAS Young Scientist Award*" for 2009

Figure 18: As Acting President at the First International Conference of the Institute for Operational Research and Management Science of Nigeria, in Uyo (2018)

MY COMMUNITY SERVICE

Madam Vice-Chancellor, permit me to highlight a few...

Roles within UNILAG

- Member of some Faculty and University Committees.
- Elected Member, Faculty of Engineering "Faculty-Industry Advisory Board," April 2018 to April 2023.
- Facilitator, Collaboration between UNILAG and the INCOSE *Foundation* (**MOU** was signed in February 2023). Staff and students now benefit from the pact with this affiliate of the International Council on Systems Engineering.
- Facilitator, the endowment of the Professor Adedeji Bodunde BADIRU Prize for the Best Graduating Student in Systems Engineering UNILAG; ₦200,000:00 per annum for ten years, July 2021.
- Co-chairman, University-wide *Artificial Intelligence Research Group*, Research & Innovation Office, 2019.
- Acting Head of Department, the Department of Systems Engineering, August 2010 - July 2012 and August 2014 - July 2017.
- Member of UNILAG Senate elected by Congregation, August 2008 - July 2010, August 2012 - July 2014.
- Faculty of Engineering Examinations and Time-tabling Officer, December 2007 to December 2008.
- Departmental Postgraduate Programme Coordinator, August 2006 to December 2007.
- Administrator, Faculty of Engineering Computing Facility (NIGERDOCK donated Laboratory), University of Lagos, May 1996 to December 1998. [*Due to incessant requests for assistance, I **automated** how any novice could learn about PCs. Once the system boots, the user is presented with a Menu and only needs to press an indicated key to undergo a tutorial about Computers, Typing, Windows, Programming, etc. Many staff and students benefitted*.]

Service to Profession

- Foundational member of several groups including: Global Young Academy (2009); Nigerian Young Academy (2010); Institute for Operational Research and Management Science of Nigeria (2015); Society for Automation, Control and Instrumentation of Nigeria (2018); Operational Research Society of West Africa (2022); Nigerian Institution of Industrial, Systems, and Production Engineers (2023).
- 1st Vice President, Institute for Operational Research and Management Science of Nigeria (IORMS), since November 2015. (Served as the ***Acting President*** between July 8, 2017 and March 16, 2018.)
- Representative of ASUU on the Committee to review The Regulations Governing the Conditions of Service of Senior Members of Staff of the University of Lagos (the Yellow Book), since December 2021.
- Member, Expert Consultation Forum of NEPAD on *Artificial Intelligence*, towards policy building and developing continental strategy for member states of the African Union, since March 2019.
- Reviewer, Proceedings of the Nigerian Academy of Science, since March 2021.
- Member, the Editorial Board of UNILAG Journal of Medicine, Science and Technology, since April 2021.
- Sectional Editor, Computer Science, Engineering & Technology, AST, January 2016 – January 2019.
- External Assessor to Universities since 2020.
- Facilitator at Continuous Development Programs (on ICT) of the Nigerian Society of Engineers, since 1998.
- Invited Speaker (since 2018) on AI and its applications, at Workshops by CAPDAN, CMUL, and NAS.
- Initiator and Convener, First Workshop & Exhibition on Systems Engineering in Nigeria, November 2011.
- Mentor and Referee for numerous graduates since 1996.

Service to Society

- **Volunteering**
  - *Staff Adviser & Bible Study Teacher* - The Church of Christ UNILAG, since 2013
  - *Chairman of Constitution Drafting Committee* - Emily Akinola Residents' Association, Akoka (2014) & Parent Teachers Association, CIFMAN College, Sabo (2017)
  - *Selected Mentor* - SCHLUMBERGER science project (SEEDS) for Nigerian High Schools (2013-2015)

- **Advisory Board Member**
  - Data Science Nigeria, 2018
  - KJK Africa, since 2019
  - Researcher Ecosystem [Division of Cactus Inc. India], since 2021

- **Consultancy**

A. Trainer

Consult for clients in the ICT sector, Oil & Gas industry, Manufacturers, SMEs, the Military, etc. (since 1996) via UNILAG Consult, Stoics Consortium, AB Intl. Consulting Services, etc. as:

- Resource person in Operational Research / Project Management Training
- Member of Interview Panels

B. Software Solution Provider

- Around the year 2000, several ***Business Center*** owners were worried that they were being fleeced by their shop attendants as to the number of pages printed on a printer especially with respect to colour prints. They requested a solution to automatically monitor and report printing activities. It was required that the attendants would not be able to manipulate such reports. I resolved this situation by developing

the Paradigm PrintWatch® application as a service that auto-starts whenever someone boots the computer. It cannot be arbitrarily closed but records an encrypted and hidden log of all print activities on a computer server. The system Admin could open the detailed report whenever desired to know who sent a print job, from which PC to what Printer, at what time, whether colour, number of pages, etc.
[Unfortunately, after a few years the app could not function effectively on new PCs as "the Operating System Vendor" suddenly changed some things in their product API but refused to document same!]

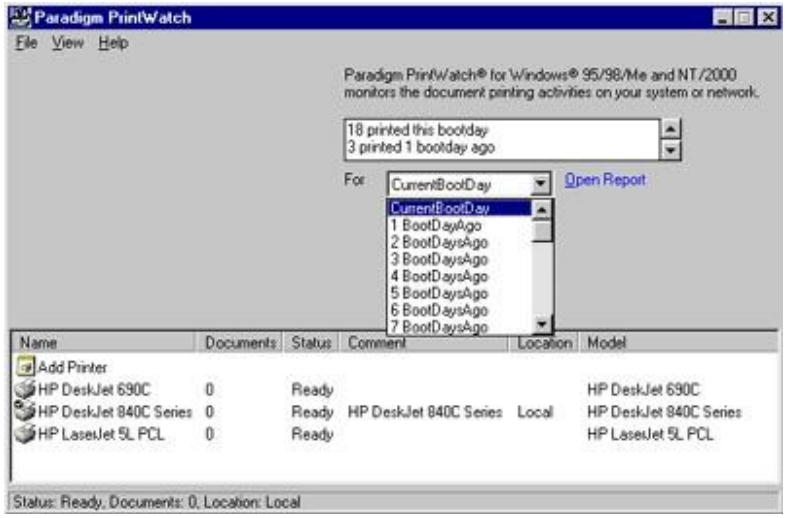

Figure 19: PrintWatch GUI

- Many years ago, generating reports from databases was a very cumbersome process. The most viable tool for doing so was a very expensive product. Therefore, I developed an affordable **PiHyper® ActiveX library**. Using this tool, a coder may programmatically or visually allow a user to promptly generate customizable database reports on the spur.

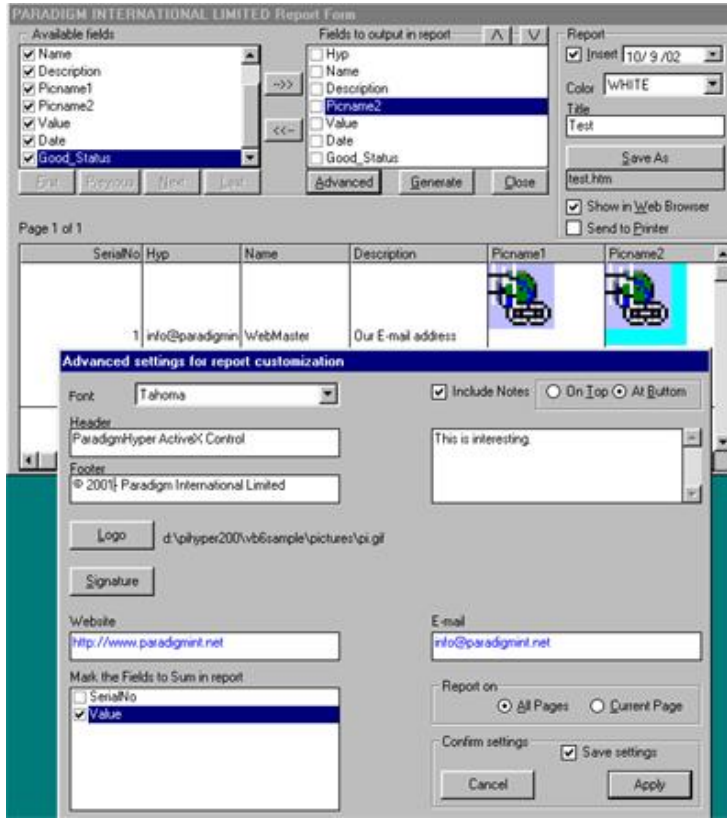

Figure 20: PiHyper runtime Forms

- Some years ago, the Cooperative Thrift & Credit Society for the workers of a big manufacturing firm, requested an application to automate their operations. Their processes were studied, and their requirements were received. Thereafter, I designed, coded and supplied the requested package. The Lainos CoopManager® was so robust that after initial configuration, and members' enrollment, the app could auto-process most activities and be used to send emails and reports to members. Some other

cooperatives have since acquired the package.

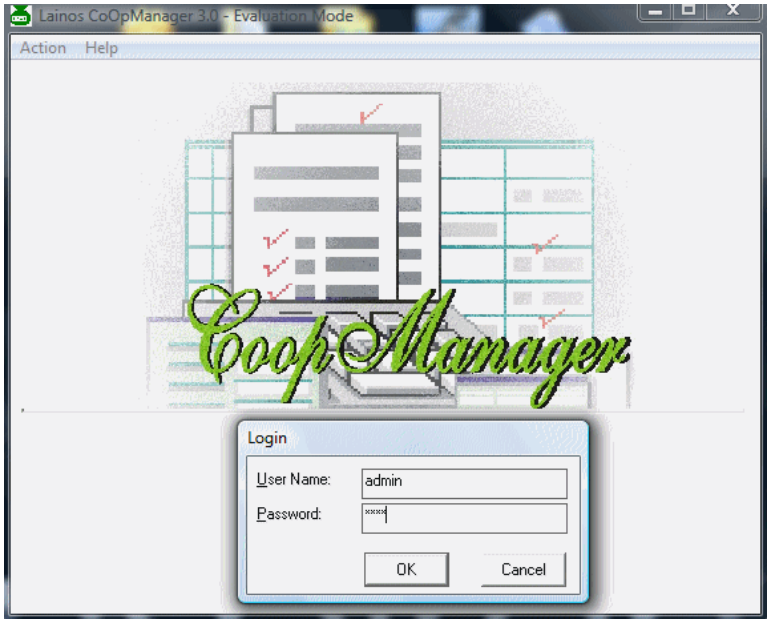

Figure 21: Cooperative Manager GUI

- A decade ago, we created ***Andrews Challenge****; a test portal for selecting qualified candidates for scholarships or jobs*. Employers, NGOs, and Candidates register and create profiles on the site. Any adult, government or organization may sponsor contests on the website. It has an auto-screen feature to ensure only those who meet specified criteria may view and take an online test. Prizes by contest Sponsors are verified/escrowed while Candidates must upload verifiable institutional or govt.-issued ID.

Table 1: Sponsor specifications for an online contest

Initiator will specify the following (* implies compulsory field):

	Test Parameters	Preferred Personality	Job Attributes
1	* Number of slots available for reward	Age range (e.g. 18 to 35)	* Interest / Speciality (e.g. Telecommunications)
2	* Number of candidates to shortlist	Nation of residence	Minimum years of experience
3	Number of questions and duration to answer them	State of residence	Position Keyword (e.g. Project, Manager, Head)
4	Cut-off mark (percentage)	State of origin	* Type (e.g. Full-time)
5	Whether test candidates may view the performance based Highscores (shortlisting) during a contest	Local Govt Area of origin	* Location (e.g. Lagos)
6	Whether a qualified candidate may not view the shortlisting until after attempting the exam	Educational Category (e.g. Graduate)	* Salary Info (e.g. Negotiable)
7	When to make Highscores viewable throughout the portal - N days after the contest	Educational Level (e.g. POST-NYSC to 800L [Masters])	Field of Study / Qualification (e.g. Engineering, Science)
8	* Number of Attempts allowed a candidate for a test	Academic Standing (e.g. UPPER_CREDIT to DISTINCTION_PG)	
9	* Number of eligible candidates that should attempt a test	Family Situation	
10	* Test entry-mode (e.g. Free, Password, AccessCode, Fee)		
11	* Number of equivalent tests per selected category in a Contest		
12	* Proposed Contest Start-Date		
13	* Contest Interval (the number of days it will be on)		
14	Number of questions you will contribute for the Contest		
15	* Whether there is a physical CBT (Finale Contest) afterwards		
16	* Nature of Rewards and Other Comments (e.g. Scholarship amounts or Vacancy description & Job duties)		

Participants strive to be the best and the fastest in answering multiple-choice questions across various subject areas. The portal could sort and display results in a variety of ways for scholarship or job offers. Initially, participation was free, and we gave out handsome prizes to winners of the scholarship contests for the Secondary and Tertiary Categories.

Nationwide, many parents and students were amazed it was not a scam. In Tertiary Category, UNILAG students won the first prize multiple times.

Table 2: Andrews Challenge Season2 Results

ANDREWS CHALLENGE

Top Contenders

Take a Test | Reports Manager | Administration | Sign Out

Snippet of Season2 Highscores as at [Nigerian Time]
Wednesday 14th of August 2013 08:09:49 AM

Secondary Challenge top results for completion under 421 Seconds, based on 10 questions

SN	Username	Duration (s)	Score (%)	Residence	Category	Institution
1	oladeleobende	67	90	lagos	Secondary	Woodland Hills High School, Akowonjo,Lagos.
2	Jessy	81	90	Lagos	Secondary	St. Gloria's College, 28/29 Adekunle Fajuyi Way, G.R.A Ikeja
3	Vicky	97	90	Lagos	Secondary	St.Gloria's College
4	blessingoladipo	97	90	lagos	Secondary	command secondary school
5	Calm_down	225	90	lagos	Secondary	action health incorporated
6	Babaslimkid	310	90	Akoka	Secondary	Action Health Inc. 17 Lawal St, Off Oweh St, Yaba
7	liztal	156	70	Yaba	Secondary	Action Health Incorporated

Tertiary Challenge top results for completion under 421 Seconds, based on 10 questions

SN	Username	Duration (s)	Score (%)	Residence	Category	Institution
1	kellyobende	101	100	lagos	Tertiary	university of lagos
2	OLORIADE	402	100	LAGOS	Tertiary	University of Lagos
3	joshitoemento	117	90	lagos	Tertiary	University of Lagos
4	praiseobende	190	90	Lagos	Tertiary	University Of Lagos
5	bigttyme07	218	90	Abuja	Tertiary	Ahmadu Bello University Zaria Kaduna State
6	amadiwati	401	80	PORT HARCOURT	Tertiary	UNIVERSITY OF PORT HARCOURT
7	Chikah	141	70	Lagos	Tertiary	UNIVERSITY OF LAGOS (UNILAG)
8	Shorinwa Ibukun	157	70	Port Harcourt	Tertiary	COvenant University Ota, Ogun State.
9	chijindu	198	70	OTA	Tertiary	UNIVERSITY OF LAGOS
10	AMARACHI	244	70	LAGOS	Tertiary	YABA COLLEGE OF TECHNOLOGY

Andrews Challenge Scholar Secondary Category

Andrews Challenge Scholar Tertiary Category

The Awardees for Season2

The Awardees and their families

Figure 22: Andrews Challenge Season2 awards

Figure 23: Andrews Challenge Season1 awards

- Periodically, I **donate** Lingua and World software to educational and non-profit organizations e.g. Local Schools; the Department of Linguistics, African and Asian Studies, UNILAG; the Schools Debate programme aired on TV Continental and Nigerian Television Authority; Teachers Associations; Several organizations e.g. Human Development Initiative, Lagos; Mobible, Europe; Center for Art & Culture, Germany; Researchers e.g. Ayo Salami, a UNESCO scholar who subsequently authored "*IFA: A complete divination*" with the entire IFA corpus made available in both English and Yoruba languages.

CONCLUSIONS

Madam Vice-Chancellor, mankind especially Engineers try to imitate our Maker. We seek immortality in sound health, seek to dominate the earth, explore space, and thereby build systems that make life easier. We create bots and robots in our image or in the image of other things. The Bible declares WHO made **time**, **space,** and **matter** as well as created **man**.

> *In the **beginning** God created the **heaven** and the **earth** …So God created man in his own image, …male and female created he them. And God blessed them, and God said unto them, be fruitful, and multiply, and replenish the earth, and subdue it.. . Ye are gods; and all of you are children of the most High* -Genesis 1:1, 27-28; Psalms 82:6 [KJV]

Artificial systems mimic a living thing or a natural phenomenon or try to automate a manual procedure. For example, feature or action correlates with each of the following:

- Motorcycle – Ant
- Car – Cat
- Lorry – Camel
- Military Tank – Scorpion
- Excavator – Crab
- Elevator – Spider
- Train – Snake
- Aeroplane – Bird
- Helicopter – Wasp
- Dirigible – Floating Cotton
- Hovercraft – Crocodile
- Submarine – Dolphin
- Robot – Human
- Andrews Challenge - HR Officer
- CoopManager – Thrift Collector
- PrintWatch – Cafe Supervisor
- Lingua Translator - Interpreter
- Lainos World – Tour Guide

Aside from qualitative contributions to theoretical knowledge, I also engineer systems: *Automata and Intelligent Agents*, to make life easier. My research involves model development and software encoding. My teaching helps produce Engineers who possess even greater potential than myself. My community service is value-addition in different assemblies.

RECOMMENDATIONS

Madam Vice-Chancellor, my recommendations are diverse.

To Government:

1. Provide special funds for Science, Technology, Engineering and Mathematics (STEM) education so as to achieve rapid industrialization and meaningful development. Government needs smart people to build *smart cities*.
2. Challenge, and patronize Nigerian Engineers.
3. For management of complex engineering projects by MDAs, Systems Engineers should have the oversight.

To Society:

1. Only qualified Engineers should carry out facility, equipment or technological systems design. Contact the local Nigerian Society of Engineers [NSE] Branch/website or the nearest University to be acquainted with an experienced expert. For design, fabrication and maintenance of systems, such an Engineer could lead a team of Technologists, Technicians and Artisans.
2. Impress upon the government, the need to adopt a local engineering solution where such is available or offered. Foreign experts cannot understand a system better than the local specialists who operate therein. E.g. *IPPIS versus UTAS controversy is a sore point*.
3. As we automate and embrace a virtual world, and spend time in online communities, let us realize we still live in a real world; with family, friends and neighbours. Remember to keep in-person interactions alive.

To Engineers:

1. The Systems Engineer should be seen as a *buddy*, not as a *threat*. It is not his fault that he knows a little about every aspect of engineering, he still needs other engineers just as they equally need him!
2. Practical mentorship of young professionals must be prioritized. One way of doing this is for busy, top consultants to sub-contract aspects of their jobs to startups to engender growth.

To UNILAG:

1. The Department of Systems Engineering should be amply staffed. Our workload is high since we teach more general engineering courses (GEGs) even to students in Environmental Science and Education Faculties.
2. Just like the curriculum, each of our laboratories ought to be revamped at regular intervals, and the time to start is NOW.
3. There is a need to streamline and automate our system beyond what we have previously achieved (Asaolu, 2017). Fortunately, the current VC is set to realize this goal hence we should embrace and support it. For an example of easier ways to improve individual and overall systems performance: *anyone set to occupy the full professorial position should submit a draft of his/her inaugural lecture along with an acceptance letter of offer of appointment or promotion. Such must immediately liaise with the Secretary, Ceremonies Committee to select a date for the delivery of the inaugural lecture*. <u>So, inaugurals will truly inaugurate</u>.

ACKNOWLEDGEMENTS

My Mentors

Table 3: Mentors and what I learned from each

Mentor	Impact
Prof. O Ibidapo-Obe[#*]	Academic and administrative grooming, exposure
Prof. VOS Olunloyo[#*]	Example as teacher, examiner and researcher
Prof. AB Badiru	Perseverance for excellence
Engr. Titi Omo-Ettu	Professional development, simplicity
Prof. MA Salau[*]	Can-do-it and speak-up attitude
Prof. FO Akingbade[*]	Consultancy, professional development
Dr. I Bello-Fadaka	Firmness in decision-making
Prof. EE Okon	Analytical tenacity, motivating students
Mrs. CO Labiyi	Self-confidence to be outstanding
Miss Olasiji	Leadership, diction
Mrs. EO Ashaolu	Foundational scholarship, moral compass

= My Ph.D. Supervisor; * = now deceased

My Roots

Forever grateful unto my parents: **Mr. & Mrs. E. O. Ashaolu** who nurtured me to blossom. I appreciate my siblings (Yinka Lawrence [late]; Niyi Johnson; Akin Oluyomi; Gbenga Ayodeji; Sanmi Eniola and Ronke Funmilayo). I thank the **Ashaolu-Fowowe family of Ilesha** as well as the Daramola and Obafemi families on my maternal side.

My In-laws
I thank the **Ibimodi family** of Aiyetoro-Gbede, Kogi State especially my parents-in-love Joel and Janet Ibimodi as well as daddy Ezekiel Ibimodi and Ayo (brother-in-law) for their prayers and support over the decades.

My Brethren
I appreciate **The Church of Christ** especially the congregation that meets at Education Science Theatre, UNILAG. Likewise, the Udu Road, Badarawa, Palmgroove, Akoka, Woodale, and West-End congregations. I also acknowledge those workers in the ministry whom I regularly interact with on social media platforms.

My Schoolmates
Lauded are my friends near and far, too numerous to mention, some of whom are present physically or virtually.

Primary School: my foundational mates from United Mission College Demonstration Primary School, Molete, Ibadan (1981 Set led by the Headboy - Barr. G Falade).

Secondary School: Ibadan Boys High School, Oke-Bola (1986 Set led by my Asst. Senior Prefect - Dr. BS Awoyinka).

Tertiary Institution: Faculty of Engineering UNILAG especially the Civil Class (1991 Set led by Dr. I Akiije); the Engineering Analysis Unit [EAU] postgraduate students ("Nigerdock family") of mid-1990s. This included FO Ogunwolu, OOE Ajibola, TA Fashanu, OO Aina, IO Afe, AM Ajofoyinbo, OA Egbetokun and two friends; JA Ogunade & AB Olaomo.

Thanks to the University of Oklahoma, USA, which accepted me as an Exchange doctoral student for Spring Semester in 1999. Likewise, to the University of Tennessee, where I had my *Postdoctoral training* between Nov. 2003 and Oct. 2005.

My Academic & Professional Colleagues

Special thanks to the immediate past VC, Prof. OT Ogundipe, whose administration processed my professorship. Thanks also to Prof. FT Ogunsola and her management team that announced it. I appreciate the support of my Dean, Prof. OM Sadiq along with Prof. FA Falade, Prof. OA Fakinlede and all other Engineering members of staff especially everyone who has ever been a part of EAU & Systems Engineering. Thanks also to Prof. OB Familoni and Prof. NN Chinwuba. I am grateful to the ***Organizing Committee(s)*** for the lecture, donors and all well-wishers.

My Dear Students

I appreciate my students (past and present), the unique personalities, ASES & ULES EXCO, the ***Doctoral Mentees***; Dr. KN Ojoko of Civil & Envr. Engr., Dr. NO Nnanna of Microsoft, Dr. LM Adetoro of NASRDA, Dr. CO Folorunso of Systems Engr. Dept., the ***Technopreneurs***; OC Dada (CEO of PEAS Ltd.) and O Oduwole (CEO of Alajo Technologies Ltd.), who invited me to the Board of their companies.

My Professional Groups

I thank the Professional Groups with whom I am associated; NCS, IISE, GYA, NYA, NICE, NIISPE, NSE, COREN, IORMS, SACIN, INCOSE, and ASUU UNILAG.

My Beloved Family

Madam Vice-Chancellor, the family is an invaluable base that every lecturer ought to prioritize even as we worry about our classes, our research, and the next promotion or service appointment. ***No amount of success at work can compensate for failure at home*!**

My family bore with my being busy on the system for so long. By that I mean not only for spending numerous hours on the computer (programming or writing manuscripts) but also for choosing to become a professor at UNILAG when I could have relocated abroad a few years ago. I am thankful for their unparalleled support.

My beloved children: **Alexander and Benjamin**, I say: "*Thanks, you are blessed. May the LORD grant you favour all around!*" I am thankful that you are exceptionally good children.

My Wife: Madam Vice-Chancellor, I now acknowledge my true love; the *Eleto* of my home, my one and only spouse for life - **Helen Mojisola Kikelaya Asaolu,** AKA "*Honey: Alaye mi Heluno*."

Honey, I recall how we first met when you mentioned after I taught a Bible Class in *Palmgroove Church* that, *"I like your lesson, you teach well*." We chatted, I invited you to UNILAG, and the rest is history! From that time, people noticed an improvement in my dressing, my comportment, and even in the arrangement of my then one-room apartment. Your care, counsel, and prayers have upheld me: I do not take it for granted. You are my helpmeet "*in deed and in truth.*" Thanks dear, be blessed for affording me the needed peace of mind, and encouragement to attain the peak of this profession.

My God and Saviour

Finally, unto the First Engineer and Systems Encoder; the Creator, the everlasting Father who revealed Himself as **the Lord Jesus Christ**, unto Him alone be glory, honour, and praise, now and forever, Amen!

Madam Vice-Chancellor, distinguished audience, thank you all for the attendance, and the attention.

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