

## Design and Development of a Virtual University Application Using Cloud Computing

**Damiete Bigdad Briggs<sup>1,2</sup>**

<sup>1</sup>*Faculty of Science, National Open University of Nigeria, Nigeria*

<sup>2</sup>*Glendale University, USA*

[stdamietebriggs@yahoo.com](mailto:stdamietebriggs@yahoo.com)

### ABSTRACT

This research project is themed on using cloud computing to design and develop a virtual university application that is expected to revolutionise distance learning and virtual education worldwide. A plethora of frameworks exist for the development of applications, nevertheless, the cloud model was chosen considering the fact that it is relatively new and so makes the news. Being a paradigm of evolutionary prototyping, the cloud computing framework which consists of the following layers: platform as a service layer, infrastructure as a service layer and software as a service layer, equips one with all the tools pre-requisite for the successful execution of the project. Starting from a well understood set of requirements, and carefully following an elaborate set of process activities, and from a well organized development environment, structured methods were used to design and develop the virtual university application which for the purpose of this research is named the Utopia University Application (UUA). After a series of unit and system tests, results proved that the UUA was efficiently functional, withstood operational constraints and conformed to specification. This result obtained, leads one to draw the inference that modern information technology systems like cloud computing have defied simplicity, buttressed and reverberated the capability, potential, and sophistication of information technology, and have a positive and strong impact on education and learning and other facets of contemporary society that is beyond the ambit of human expectation and exceeded the threshold of scientific knowledge.

### ARTICLE INFO

Received : Mar. 2, 2026

Revised : Mar. 27, 2026

Accepted : Apr. 15, 2026

### KEYWORDS

*Cloud computing, Design and development, Information technology, Software engineering, Virtual university application*

### Suggested Citation (APA Style 7<sup>th</sup> Edition):

Briggs. D.B. (2026). Design and Development of a Virtual University Application Using Cloud Computing. *International Research Journal of Science, Technology, Education, and Management*, 6(1), 14-47. <https://doi.org/10.5281/zenodo.19675421>

## INTRODUCTION

### Background of the Study

This research project in Information Technology aims to demonstrate methodologically the use of cloud computing to design and develop a virtual university application. Advisedly, to achieve professional and technical clarity, a prologue of the concepts involved will suffice to a large degree. Therefore we will take-off by shedding light on the principles that make-up the project headline. The web authority Wikipedia describes a virtual university as a university that provides higher education programmes through electronic media typically the internet. “Some are bricks-and-mortar institutions that provide online learning as part of their extended university courses. They are regarded as a form of distance education. The goal of virtual universities is to provide access to the part of the population who would not be able to attend a physical campus, for reasons such as distance - in which students live too far from a physical campus to attend regular classes; and the need for flexibility- some students need the flexibility to study at home whenever it is convenient for them to do so” (Wikipedia, 20012). It went further to say that “the idea of a virtual university as an institution that used computers and telecommunications instead of buildings and transport to bring students and teachers together for university courses was first published in works like ‘De-Schooling Society’ by Ivan Illich that introduced the concept of the use of computer networks as switchboards for learning in 1970”. In a related manner, some analysts see the Virtual Campus as a metaphor for the teaching, learning and research environment created by the convergence of new powerful instruction and communication technologies (Dusen, 1997). In apposition some other scholars describe virtual universities in these words: an institution which is involved as a direct provider of learning opportunities to students and is using information and communication technologies to deliver its programmes and courses and provide tuition support (Farrell, 2005). A professional reviewer, expatiates on the concept by saying that the virtual university can be said to be a multimedia network learning environment that differs from more traditional learning environments in that it is customisable (Anderson M, 2017). Accordingly some researchers also hold the view that virtual universities support the design and delivery of courses and programmes for any form of post-secondary education, which could include university degrees, corporate education, professional development, and work place training (Harasim et al., 1995). More scholars suggest a similar definition. They state that “the vision of any form of learning environment (ie. a virtual university) is to; redraw the physical boundaries of the classroom; enable more teamwork; allow learning to be a continuous time-independent process; and to enable multilevel, multispeed knowledge creation through the use of information technology” (Leidner and Jarvenpaa, 1995). Saarela elucidates further by saying delightfully that although the medium used for teaching is different, virtual studies are actually quite similar to ordinary studies. Virtual study modules are completed by essays, exams, and theme discussions on the internet (Saarela, 2017). Be that as it may, I think this introduction will be incomplete without recourse to the scholarly work of Griff who in his book - A Guide to Virtual Universities for Policy-makers, argued that a virtual university is a university that:

- (a) Provides increasing number of online access to both formal and informal learning on an unprecedented scale.
- (b) Are international in scope and only limited by the barriers of culture, language, internet connectivity and commerce.
- (c) Have the potential to increase higher education capacity without the costs and delay of building bricks-and-mortar institutions.
- (d) Disrupt the traditional delivery and business models of both campus based universities and ODL universities.
- (e) Thanks to modern e-learning tools, relatively easy and inexpensive to start up and offer course over the internet (Griff, 2015).

Sequentially, for the purpose of this research and from the breadth of my pedagogy, I choose to explicate on the concept of a virtual university by stating that, it is a new generation online based university that uses the infrastructure of the world wide web and other multimedia systems to administer, control, manage, monitor,

oversee, regulate, and run the day to day curricular and non-curricular activities of its teeming student population. Therefore congruently and epiphenomenally, from my point of view I can describe a virtual university application as a web based application software, with an adroitly engineered structure that houses, administers, and manages the day to day activities and running of a modern, next-generation virtual university.

Pertinently, in this project I propose to use cloud computing to design and develop a project model of a virtual university application. But before I proceed, I deem it necessary to demystify the concept of cloud computing I mentioned earlier, and have preferred for the project execution. The National Institute of Standards and Technology defines cloud computing as a model enabling ubiquitous convenient on-demand network access to a shared pool of configurable computing resources (networks, servers, storage, applications and services) that can be rapidly provisioned and released with minimal insignificant effort or service provider interaction. Wikipedia on the other hand holds the view that cloud computing is an information technology (IT) paradigm, a model for enabling ubiquitous access to shared pool of configurable resources ( such as computer networks, servers, storage, applications and services), which can be rapidly provisioned with minimal effort, often over the internet. Not just that, Wikipedia went on to say that cloud computing allows users and enterprises with various computing capabilities to store and process data either in a privately-owned cloud, or on a third party server located in a data centre - thus making data-accessing mechanisms more efficient and reliable. In a related development, Salesforce added that cloud computing is a kind of outsourcing of computer programs. Using cloud computing, users are able to access software and applications from wherever they need, while it is being hosted by an outside party- in the cloud (Salesforce, 2017). Google is a giant information technology company based in the United States of America and also a major stakeholder in the cloud computing industry. Its cloud variant, Google Cloud is a force to reckon with in the private cloud business. In its recent publication, the company didn't fail to show its usual versatility with a quite interesting and unique view of the subject of cloud computing. Google stated that in cloud computing, the capital investment in building and maintaining data centres is replaced by consuming IT resources as an elastic, utility-like service from a cloud "provider" (including storage, computing, networking, data processing and analytics, application development, machine learning, and even fully managed services). As a complement, Vangie in one of his books, posited that cloud computing is a type of computing that relies on sharing computing resources rather than having local servers or personal devices to handle applications (Vangie, 2017). These works are as enlightening as that of Aktham of the Syrian Virtual University, who in an harmonious tone stated that the concept of cloud computing is not a new technology but the development of the concept of parallel computing, where "processing and storage" moved to the cloud platforms and provides everything as a service (Aktham, 2014) .

Coherently, Cohen concurred by saying that the new cloud computing software model is a shift from the traditional single tenant approach to software development, to that of a scalable multi-tenant, multi-platform, multi-network, and global (Cohen R, 2017).

Finally from my perspective and in my own words, I think cloud computing is an ingenious and innovative software engineering paradigm in which the cloudy internet framework is used to design, develop and manage a software engineering project.

Now that we have known the aim of this project, and its stratagem to use cloud computing to design and develop an application, the really topical question arises: why choose cloud computing when there are a variety of infrastructures? A famous professor and computer scientist concisely answered this question in his popular laws:

- (a) The law of continuing change – which states that e-type systems must be continually *adapted* or else they become progressively less satisfactory.
- (b) The law of declining quality- which states that the quality of e-type systems will appear to be declining unless they are rigorously maintained and *adapted* to operational environment changes (Lehman, 1980),.

Ivar in his book - Business Agility and Software Engineering Excellence, vindicated Lehman by saying that change is what software development is very much about. Changes in the software being built, changes to the team

members, *changes because of new technology*, changes of all kind that may have an impact on the product they build or the project that creates the product. He did not stop there. He went further to say that the pervasiveness of change is the primary driver for agility (Ivar, 2013). Furthermore, Pressman as a general advice added that software engineers must be quick on their feet if they are to accommodate the rapid changes that Jacobson described (Pressman, 2005). In concordance, some authors share similar views with Jacobson by saying that surveys indicate that after reliability, changeability is considered the most important attribute of large, multi-purpose software systems (Chand, 2003). Nonetheless, from my own point of view, I feel harmoniously that the answer to the afore-raised question is the constant nature of change and the professionalism in adopting newer technologies. Computer and information technology professionals the world over know that the world of computing is changing with each changing new day, and new changes are made to the ever changing crop of hardware and software components. This trend is in consonance with Moore's law (which states that processor speed and overall processing power for computers will double every two years): leading to the production of newer technologies and systems that change old ones. Software application development has an incredibly amazing, dynamic, and interesting history. First, it was all about writing tedious and voluminous lines of code using command-line interfaces, followed by the transition to the more user-friendly graphical user interface, and eventually computer aided software engineering (CASE) tools emerged.

The emergence of case tools marked the beginning of a new era in software application development. The degree to which the difficulty encountered in developing application software was decreased was terrifying and could be only imagined. Applications that took years to develop were now developed in seconds using controls embedded in integrated development environments in CASE tools. Though the systems developed using existing infrastructures were reliable and efficient, and brought software application development closer to the door steps of non-professional developers, change and innovation, moreover in computing cycles like Moore rightly stated is inevitable.

This inevitability of change paved the way for the evolution of the technologically overwhelming and relatively pristine innovation referred to as cloud computing. The application and scope of cloud computing is as limitless as the cloud is limitless. It has been proven to be a reliable, realistic, and dependable option for the development of tested and trusted software products that range from blogs to virtual learning environments and virtual university applications. To say it is an ergonomic innovation is an understatement, hence it is pertinent to say that it makes application development and deployment comfy. Coupled with its innovative novelty is its versatility and cost, yet its ease of use and user-friendliness cannot be auxiliary to its versatility.

Therefore, if one of the ethics of professionalism entails adopting newer technologies, it is thus expedient to embrace the inherent benefits of cloud computing- ease of use, efficiency, and low cost. This is what I have resolved to do in this project: methodologically demonstrate how cloud computing can be used to design and develop a virtual university application in Nigeria.

### **Statement of the Problem**

The relevance of an effective and efficient virtual university application as an invaluable tool for managing the daily increasing number of online university students and for enforcing the United Nation's charter on human rights with respect to the right to education for all in Nigeria to be particular and the world at large cannot be overemphasised. Prior to the inception of the internet, when there were only traditional universities and distance was a critical factor that militated against the acquisition of qualitative education, a reasonable proportion of potential students were disenfranchised and their dreams and aspirations towards acquiring qualitative education unwillingly aborted. Furthermore potential students had to travel painstakingly through cities, states, nations, and continents and also spend aeons of time in distant climates to obtain information about universities of their dream and complete often cumbersome and complex registration processes. This situation was not only fatiguing but also gave rise to unnecessary waste of scarce resources, money, and time. A recent study revealed that in the early 80's in Nigeria and other countries in sub-Saharan Africa, due to the digital and inter-continental divide, only about 10%

of the student population that intended to start a course of study overseas, eventually achieve their aims. Because they were not resident overseas, they were required to travel to and fro at exorbitant cost each time information on their proposed course was required. As a case study, after leaving Senior Secondary School, I intended to study Medicine and Surgery at the famous University of Ibadan. Although Ibadan was my first choice in the Joint Admissions and Matriculation Board examination, when the results were released I made a rethink and opted for the College of Health Sciences of the University of Port Harcourt and easily and comfortably completed my registration (and thus became a medic of the school) considering that University of Ibadan was very far from me in the west and as such, I couldn't make such fatiguing and uphill journeys to and from Ibadan every now and then.

Fortunately, the advent of the internet and the concomitant development of advanced and modern multimedia systems reversed this trend by bridging the hiatus hitherto created by traditional university systems and ensured the deployment of universities and college applications online (to the web) so as to meet the global demand for qualitatively better education. To buttress this argument, a stakeholder highlighted that virtual universities stops the degradation of efficiency due to building bricks, and smashes boundaries of culture, distance and nations (Jadeja, 2016). Following closely is the work of O'donoghue, Sing, and Dorward, who presented a bootstrapped view by saying that access to the internet allows for distance learning that encourages people to return to education who would not otherwise due to other personal commitments (O'donoghue et al., 2001). In tandem some analysts feel that online education benefits non-traditional students who might not have any option for further education (Schibrowsky et al., 2007). Nonetheless, some academics concluded by saying that the enthusiasm for distance education has grown rapidly with the application of internet based information and communication technologies (Moor, 2003).

In the light of this, to ensure that students regardless of their location or remoteness in Nigeria have access to universities and university education and in order to excellently and expeditiously develop university applications with a worldwide reach, the efficacy of cloud computing is harnessed, employed, and utilised in this thesis.

### **Significance of the Study**

In Nigeria to be particular and Africa in general, statistics show that about a third of academically excellent and bright students, with the greatest potential for success in academics, are wrongly and irrationally constrained by one factor or the other from acquiring qualitative and modern education and thus reaching their full potential of becoming graduates and professionals in their different fields of endeavour. This logically anomalous and ugly trend cannot be disassociated from the unreasonably high cost of education and administrative bottlenecks coupled with the geographical remoteness of most preferred tertiary institutions. Consequently, this project seeks to reverse this trend by using cloud computing to design and develop a virtual university in Nigeria that is billed to make tertiary education affordable and accessible to a broad range of students unlimited by distance nor location.

Before the introduction of cloud computing, programmers had a plethora of complex options to successfully develop and implement tested and trusted software products. Earlier, programmers would write numerous lines of code just to build and run a simple application, others had to spend beyond their limits to acquire often expensive CASE tools that were usually difficult to install on work stations and often required additional skills like proficiency in database management to operate optimally. This project, also proposes to address these underlying shortcomings and inadequacies by employing a newer technology 'cloud computing' which unlike the previously existing systems, is relatively inexpensive, requires zero or no code, does not require complex installation on work stations, does not require a separate database management system and is easily managed. Therefore because the method of creating software has changed to keep pace (Chand, 2003) much light exist in the tunnel. So therefore, these exploited advantages and change will undoubtedly decrease the rigour in software development to an elemental level, decrease the developmental time to a minimum, increase the quality and usability of the software product to an exponential degree, and also ensure that the finished software product is easily managed.

## **Scope of the Study**

This dissertation in practical terms is a software engineering project that involves applying software engineering methodology to design and develop a virtual university application. The gradual transition from analogue to digital systems is felt in almost every facet of contemporary society: from banking to commerce, to government administration, to electioneering, and to human resources management. Even in the world of computer and information technology, the trend is the same: there is a gradual shift in paradigm from the offline favouring the online platform as the user's favourite. Fortunately and as a case study most popular universities in Nigeria today currently have a web application or portal for managing the different aspect of their administration. This development has no doubt made it possible for students to obtain crucial information on their courses in a prompt and timely manner without having to leave the comfort of their homes and also bypass the usually fatiguing administrative bottlenecks associated with the hassle to physically or manually register for their courses. In one of its recent publications, the United Nation's Educational Scientific and Cultural Organisation (UNESCO), was quick to acknowledge the importance of virtual education in developing countries by heralding three trends justifying its inevitable relevance. The highlighted trends included: a new demography, an increasing world population, growing urbanisation, international migration, globalisation, technology, economic exchange, political integration, cultural gaps between countries, knowledge growth, information technology, and revelation of technology. Hence, this project seeks to collaborate with existing efforts by offering a supposedly more efficient system that promises to make the process of university application development simple by employing a prototyping model in cloud computing. When this is done it will ensure that not only popular universities in Nigeria have a portal for their day to day administration but every university and tertiary institution in Nigeria enjoy the upgrade to effective online systems and thus own and manage a web application portal. This proposed cloud computing model will guarantee rapid application development by ensuring that the application is developed within the shortest time possible, without writing unnecessary code and with the greatest ease possible. Therefore as a consequence, the researcher is optimistic that in the near future, software developers will no doubt find it as an invaluable tool for the production of industry standard and real-time software products. To consolidate this argument Chouldharry and Singh, in their paper- Scope of Cloud Computing in Indian Technical Education (Chouldharry and Singh, 2015), observed that cloud computing is gaining popularity throughout the IT industry worldwide and its importance and enthusiasm is also spreading in the IT needs of Indian educational institutions. In their conclusion they summarised that the cloud infrastructure was the future technology for technical education.

## **Limitations of the Study**

Although feasibility studies on this project show a viability of about 80%, from a professional point of view it will be difficult to reach this threshold due to some underlying constraints. Firstly it is usually difficult to subscribe to a cloud provider with all the tools needed including desired prototyping and after-sales service to successfully install use and manage acquired software modules. Even when the right cloud provider has been found, the difficulty with having to pay predominantly American owned dollar based companies with debit cards from Nigeria can be an Achille's heel. Despite these observed constraints extensive research proved the Nowdad Cloud platform with its robust structure and customer oriented service system, to be the platform of choice that breaks the jinx by providing a pragmatic user-centred platform for the production of verified and valid fault-free software.

## **Literature Review**

### **Overview**

This chapter explores, examines, and analyses existing works on the proposed project: designing and developing a virtual university application using cloud computing. Although cloud computing is a relatively nascent infrastructure for software and system development, a lot of research on its use for application development have been done and are ongoing and thus go further to show its rising relevance and potential to supersede in the no

distant future. As a practical example, Forbes in one of its recent publications announced that 67% of enterprise IT infrastructure and software could be cloud based by the end of 2020. This prognosis was proven to be correct when it was published that by the end of 2020, 83% of companies workloads were on the cloud (Flexera, 2020). This drastic crave and preference for cloud computing models is in no small measure unconnected with the efficiency and utility of the platform. It was highlighted that 80% of companies report operational improvements within the first few months of adopting the technology (Flexera, 2020). Therefore, obviously there is no need gainsaying the fact that these recorded operational improvements, are the catalyst responsible for the preference of cloud computing by modern software developers, and the main motivational factor for its adoption for the execution of this project.

## **Review**

In this curtain raiser, Kramer, a lecturer at the famous Fern University Germany, proposed a new model for the open – long distance university with the expectation that it would exploit the vast e-learning resources in the cloud for academic and other related activities in the school, rather than use the previous traditional long distance system that existed. In planning this new model, they identified some inadequacies in the existing system which included: the total absence of inter-communication between students and between students and lecturers (staff); the difficulty in collaborating among staff and students; and the near absence of teaching modules which is overtaken by disbursed study materials. The proposed model prompted by the utility and robustness of the internet, aims to solve the observed problems by incorporating a mechanism that enables:

1. Multimode and adaptive presentation of content.
2. Interactive learning among students and lectures
3. Novel forms of organised teaching and learning
4. Communication and cooperation among students through available user interfaces.
5. Easy brokering and distribution functions.
6. Information related services like digital libraries, e-learning boards etc.
7. Effective school administration at all levels.

The system development took-off in two phases. In the first phase, a digital university platform was developed with the principal aim to provide all functions of a virtual university via advanced information and computer technology which included virtual learning modules and cloud systems. The main feature of this platform was its possession of a database with interfaces for both lecturers and students which made it easy to upload/present and download/ course content and materials. To achieve greater efficiency, an online payment system and an online shop were added later. The second phase which was called the consolidation phase, was fuelled by the general acceptance of the first model which earned an over 90% acceptance and endorsement from both staff and students. During this phase fifteen different sub-modules were acquired to consolidate on the gains of the existing model. These modules were geared towards two directions:

1. Enhancing the existing multimedia content
2. Enhancing the platform through added value using tools including synchronous and asynchronous collaboration.

Hence, as a consequentiality, learning management systems, chat bots for tutorial support, computer based test services, and web based information and communication systems were integrated, thus increasing the system's scope, capacity, and efficiency for qualitative education, training, and general human-capital development. The produced model is shown in the diagram below

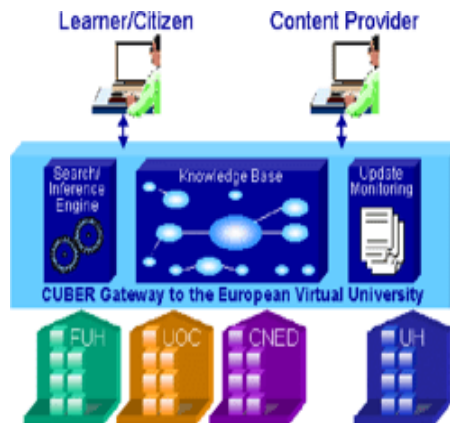


Figure 1.1 Fern's university architectural model (Kramer 2000)

While Kramer was analytic, Gartein and Sood, in their work: Cloud Computing Platform for a Virtual University Providing E-learning, were more theoretical and identified quality of service (SOS) as the bedrock for the development of any virtual education system. They argued that quality of service entails providing service differentiation and performance assurance for internet based applications. They conceived a three layer platform that includes: infrastructure layer; integration layer; and application layer for the development of a web based IT system as shown in the diagram below.

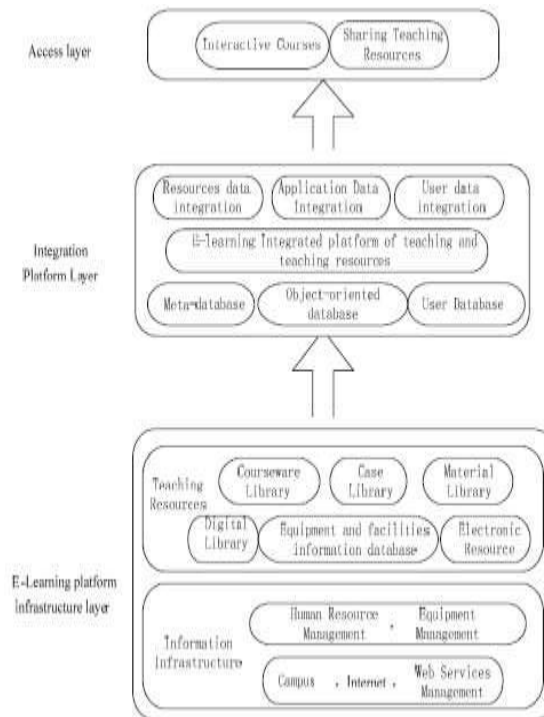


Figure 2.2: Cloud computing platform architecture for e-learning; structural model (Gartein and Sood 2012)

After carrying-out extensive analysis, a software requirement specification was developed that proposed the under listed services for the system:

1. Login service
2. feedback service
3. Maintenance of the content service.
4. Multimedia/communication service.
5. Course service/ translated course service

6. Publishing service
7. Online examination and evaluation service
8. Donation service
9. Error handling service
10. Performance evaluation service
11. Working procedure service
12. Search service
13. Directory service
14. Acknowledgement service
15. Scholarship service

At the herald of the project different web services were then used to transform the system specification to an operational web application.

Although the system presented by Gartem and Sood was comprehensible, Albaqami in his PhD thesis, consequent upon the unreasonably high number of secondary school graduates in Saudi Arabia compared to the number of tertiary institutions in the country and the limited yearly capacity of such schools, was more elaborate by proposing a third generation virtual university application using cloud computing. This model was billed to offer integrated services to its students including different types of online learning modules, specialised virtual centre for the development of educational courses, library and administrative functions, interactive environments and online collaboration as a one stop solution to the imbalance observed in the trade-off between high student's demand and the availability of admission slots in Saudi Arabian universities. The feasibility, practicality, and desirability of establishing a virtual university and applying the existing framework in the United Kingdom to Saudi Arabia were explored painstakingly. As an aid to the research, numerous questionnaires were used and popular universities that strongly supported virtual learning in the UK like the International Virtual University, the Open University, and Oxford University were studied. In a step by step approach, he investigated the major technologies which were currently used, examined current virtual models in some universities in Europe, and the existing communication infrastructure in the UK and thus relied on his findings to derive the best solution for a virtual university and thereby further develop the scope and standard of virtual education not only in Saudi Arabia but the world at large. The outcome of his study was an array of options that included new and existing technological infrastructures like SOAP, transport protocol, remote procedure call, web services, hyper-text transfer protocol, simple mail transfer protocol, XML, JMS and transactions, peer to peer multicasting, and service oriented architecture (SOA). During the phase of architectural design, the process was divided into three stages:

1. Stage of highlighting the web services facilities of registering and discovery
2. Integration of the web service with the virtual university system.
3. Stage of securing web service.

The developed web service model is shown in the diagram below.

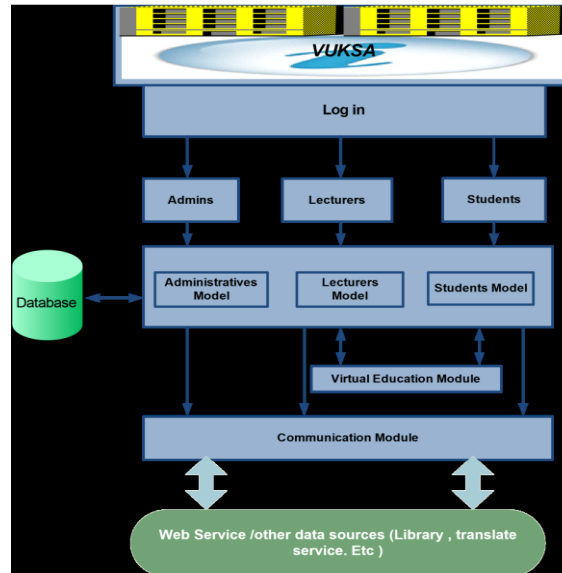


Figure 1.3: Web service model for a virtual university (Albaqami 2014)

After this logical stage, the services were then integrated into the system thus eventually giving way for the phase of system security. At the end of this process a functional model is produced that withstands rigorous unit and system tests.

Despite the fact that Albaqami was extensive in his research, a lot of researchers still hold the opinion that the breadth of knowledge is vast and unlimited and thus feel that there are boundless dimensions to proffering solutions to a technical problem. Therefore it was against this backdrop that Elhasan and Ahamed presented a systematic approach that utilised the existing cloud layers: infrastructure as a service to generate customised virtual machines for educational course and assignments; platform as a service to provide a means of deploying applications; and finally software as a service to make online learning and development tool available for users. The proposed model is explained in detail using the diagram below.

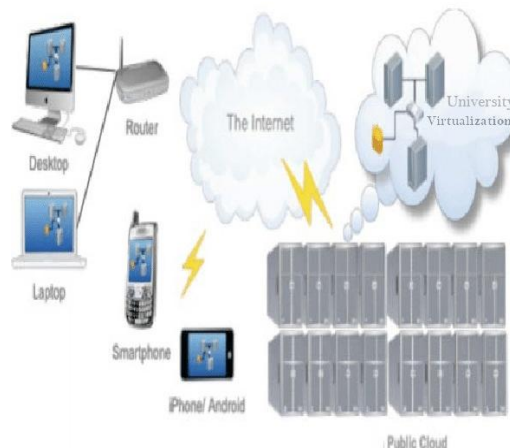


Figure 1.4: Proposed architecture (Elhasan and Ahamed 2018)

In conclusion, the merits of the cloud infrastructure which included agility and flexibility were highlighted, and served as the primary driver for transforming the proposed system architecture into an error free functional system.

Nevertheless, in a congenial manner, Hegazy, improvises on this supposed model and employed a system that exploits application programming interface (API) to design and develop a cloud based university application. This model is precipitated on the need to address the discovered problems and set-backs such as: difficulty to respond to user’s need and ineffective communication systems present in existing solutions. In including social media API for authentication and auxiliary storage, a functional system with a dynamic scope for staff and students is presented.

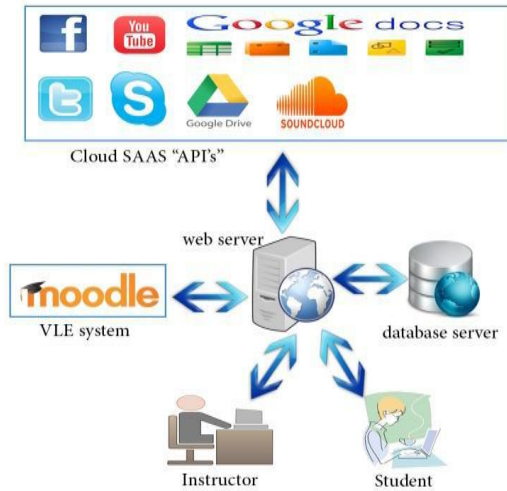


Figure 1.5: Overview of the proposed framework components (Hegazy et al, 2015)

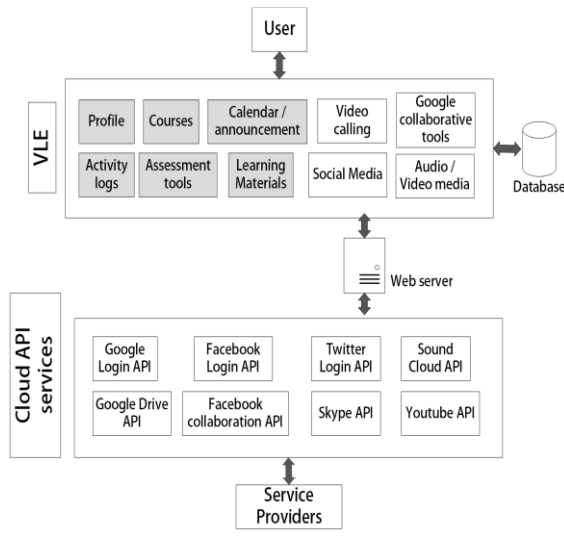


Figure 1.6: Proposed framework architecture (Hegazy et al 2015)

From a no greatly different dimension, Kravtsova and company chose to display their proven expertise in system development by assessing and unravelling the optimality and validity of the cloud infrastructure and using that as a point of reference to emphasize its propriety for the development of virtual learning environments. They revealed that the cloud’s innate structure that allows for easy integration of varied modules and access to resources coupled with its capability to provide instantaneous solution to software development problems was a critical factor rousing its requirement for contemporary system and software development. In course of the study, they employed an expert method to access the prospects of using cloud services in the educational process. Ten experienced teachers from the Kherson State Maritime Academy were selected and interviewed with the outcome of the interview accurately recorded. Using the concordance model, results obtained showed an above average degree of

consensus of experts with regards to the usability of the cloud system. With reference to results obtained, it was found out that the cloud model was feasible and could be employed for system development. With this assurance, the team went on to develop a use case diagram of a typical cloud based university application which is shown in the diagram below. This diagram presents a blueprint for the development of the system in context.

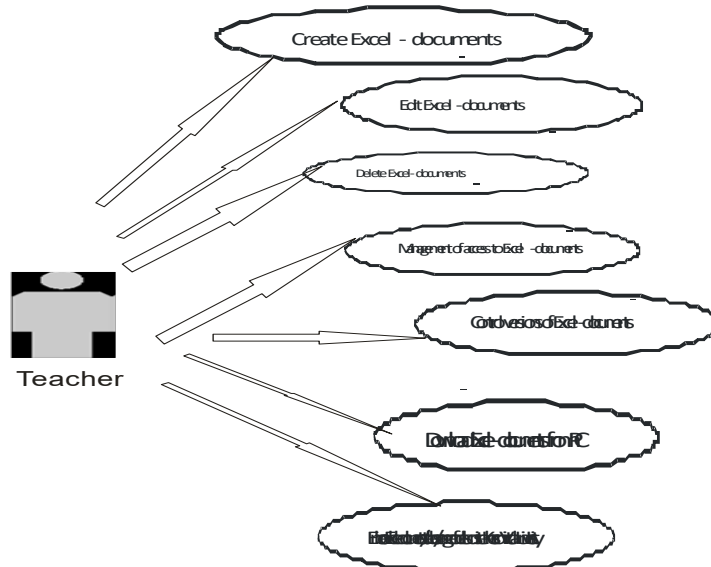


Figure 1.7: Use case diagram “Teacher Features in Excel Web App” (Kravtsova et al 2020)

In a correlated development, Pardeshi reached a confluence with earlier researchers and as a result of his study acknowledged that cloud computing has emerged as a reliable and trusted solution to the challenges posed by shrinking IT budgets and escalating IT needs. After carefully studying the present trend he noted that the pivot in higher education is gradually shifting towards cloud service adoption and expects a bright future. Unlike preceding authors, he discovered a strategy for the implementation of a cloud environment in education that is shown in the diagram below.

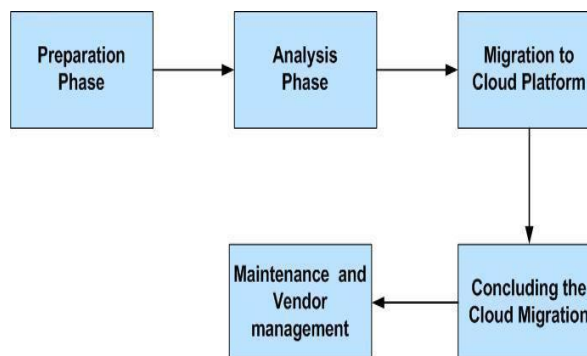


Figure 1.8: Strategy for transforming higher education through cloud computing (Pardeshi (2014)

In the third phase of the strategy an architectural model was developed and served as a guide for the development of the system.

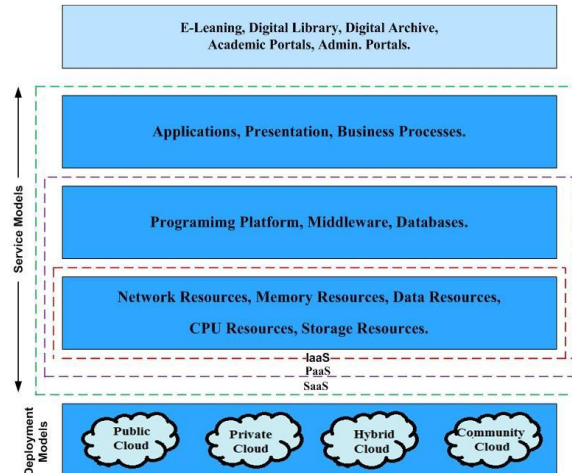


Figure 1.9: Architecture of Cloud environment for HE institutes (Pardeshi 2014)

But Miseviciene and his team had a slightly differentiated approach. In driving towards a solution, they started by analyzing the benefits of the cloud model – ability to expand the accessibility of education and its modernity and based on that, forecasted that the future of distance education and software development and deployment was hinged on cloud computing. Even though some risks like security were identified in the cloud model, those observed risks when traded off with the inherent advantages became virtually insignificant. After this important phase of risk analysis, the system proceeded to the design stage. From this stage a logical model was produced and formed the basis for the development and implementation of the application.

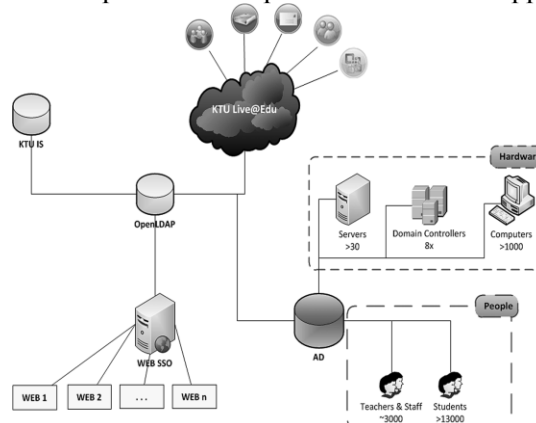


Figure 1.10: Infrastructure of cloud technique of Kaunas University of Technology (Miseviciene et al 2011)

In a somewhat similar but localized example, Ogedebe and others in their work: cloud based e-learning model for open and distance learning in Nigeria, examined the scope of virtual learning in Nigeria citing the example of the National Open University of Nigeria (NOUN). They were quick to review the growing demand for more universities in Nigeria which was necessary to adequately accommodate the daily increasing number of students in the country. They are of the view that a deficit exists and suggests the adoption of the cloud model to bridge this gap through accelerated and rapid application development of virtual learning systems and centers. In their solution they developed a model that incorporated the following:

1. Infrastructure layer – as a dynamic and scalable physical host pool.
2. Software resources layer – that offers a unified interface for e-learning developers.
3. Resource management layer – that achieves loose coupling of software and hard ware resources.
4. Service layer – that consists of the levels of service.
5. Application layer – that provides content production, content delivery, virtual laboratory, collaborative learning, and assessment and management features. This is explained in the diagram below.

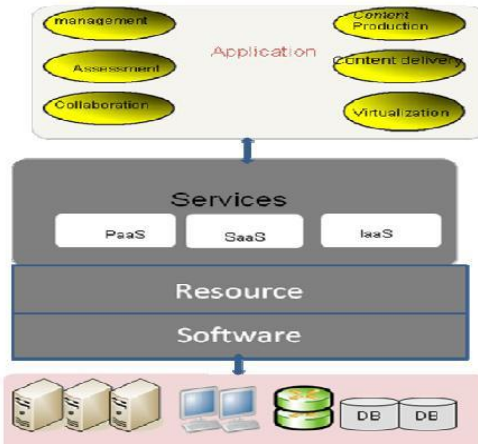


Figure 1.11: E-Learning cloud architecture - Source: (Masud& Huang, 2012)

Whereas Ogedebe et al, suggested a layered approach, Souley and his associates on the other hand were enthusiastic about the possibility of a client server solution. They patiently studied the history and evolution of software development and the concomitant development of the cloud industry, accurately recording their impact on the development of education in Nigeria and information technology in general. In course of their research they utilized the 3 tier client/server application architecture module to develop a functional framework for mobile education in Nigeria. From an initial specification, an architectural model was developed and served as a guide for the system's development. The model is described in the diagram below.

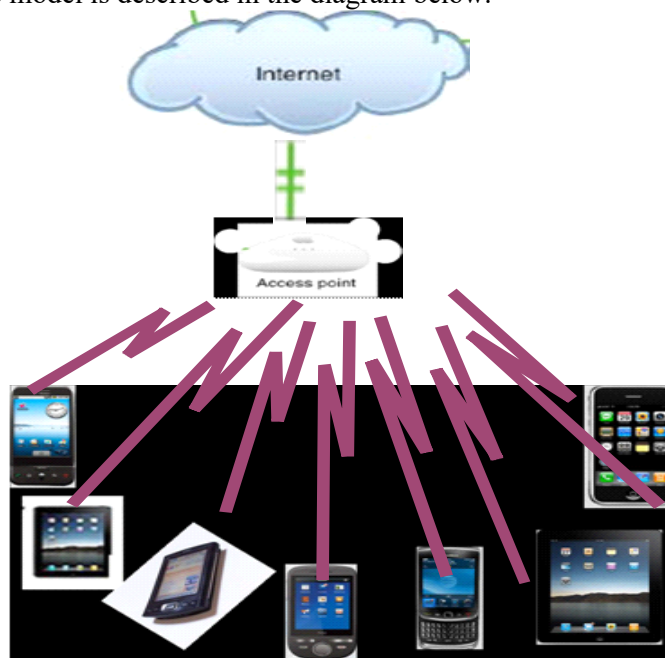


Figure 1.12: Cloud computing mobile application framework for learning (Souley et al 2014)

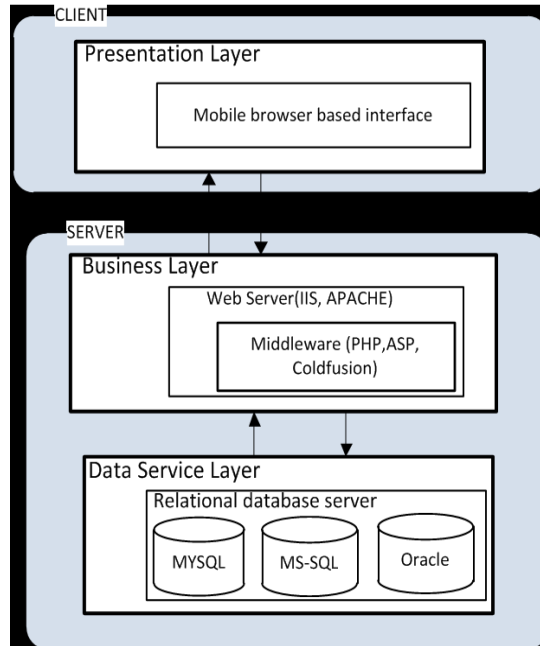


Figure 1.13: Main system architecture (Souley et al 2014).

Furthermore, in a near congruous study, Wang and friends with a concerted effort, in no small measure increased the volume of knowledge available in the field by introducing a new dimension to cloud computing which involved its conjugation with mobile learning. At the high point of their research, they extensively investigated the impact of cloud computing on learning and found out that because of the high cost of devices, networking, and limited resources, mobile learning was not widely adopted. Yet, cloud computing tends to make-up for this shortcoming by providing an easily accessible and easily available medium to effect a change and revolution. Their study focused on the Moodle variant of the cloud infrastructure which incorporated a clearly defined set of features for administering and processing virtual learning from a virtual environment and perspective. This supposed system was then configured into the cloud framework thus providing and creating an efficient forum for administering and managing controlled and productive learning in a cloud environment.

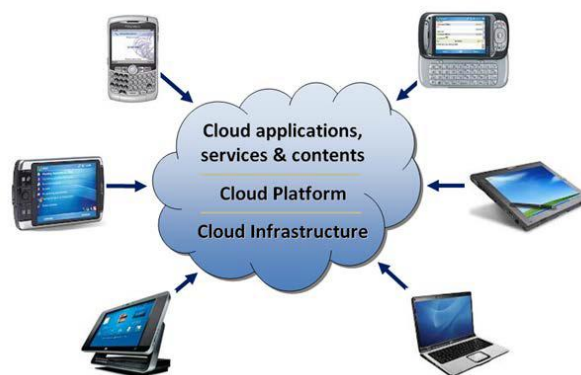


Figure 1.14: The concept of mobile cloud learning (Hirsch & Ng, 2011)

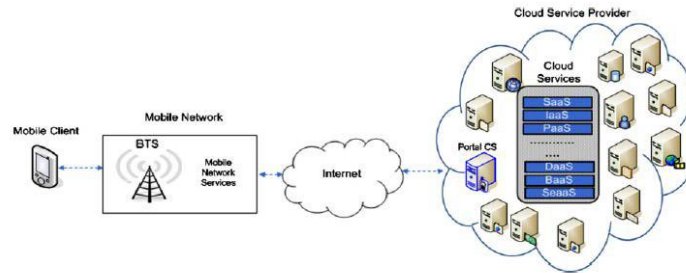


Figure 1.15: Mobile cloud learning architecture (Khan, Kiah, Khan, & Madani, 2012)

These highlighted systems when juxtaposed together, reveal a nearly parallel approach to the design and development of a virtual university application from the cloud computing perspective and horizon.

## METHODOLOGY AND SYSTEM ANALYSIS

### System Analysis

This project is undertaken with the intent to design and develop a virtual university application using cloud computing. For the purpose of this research and in course of this study, the proposed application will be named the Utopia University Application (UUA). The use of cloud computing to proffer solution to the project is justified and premeditated on the fact that cloud computing is an emerging and new trend in system development, otherwise other techniques and tools exist. Because it is an innovation in system development, adopting its infrastructure for the development of the project will in no small measure ensure that the system developed conforms to modern standards and meets modern specification. The cloud computing model is composed of three layers. Each layer plays a unique role in the system development life cycle. The infrastructure as a service layer provides the structural utility to design and develop systems. The platform as a service layer provides the environment for system development, and the software as a service layer provides a virtual work-space and repository of data in the cloud environment. This structure of the cloud model presents a more formidable dimension to software and system development, in that unlike previously existing and utilized systems, it evades the cumbrance of excess time requirement for installing software, and is equipped with an easily configurable, manageable, and usable database management system. These added and modern features, spontaneously makes it every developer's choice. No wonder in 2020, 85% of businesses had most of their workloads in the cloud (All-cloud, 2020).

Thus we are convinced that the cloud model has all the facilities required for the development of the UUA that is billed to administer and manage the day to day activities of an online virtual university.

### The Evolutionary Prototyping Method

The evolutionary prototyping method which encapsulates cloud computing was chosen for the development of this virtual university application, considering its inherent benefits: reduced time and cost; continuous refinement; embodiment of a functional system; and increased user involvement. Evolutionary prototyping models which include cloud computing platforms like the Zoho Creator, Google Cloud, and Microsoft Azure, have simplified the software development process to an elementary degree. In a shift away from previous stand-alone tools like the Microsoft Visual Studio which required installation on the developers work station, cloud systems do not require such rigour. Rather, a developer logs on to the internet and is authenticated by a public cloud provider and after that uses the tools on the platform to not only develop applications, but also deploy applications to the internet. This is excitingly the magic of cloud computing.

### Investigation and Analysis of the Existing/Present System

Prior to the inception of the internet, university applications were developed either by writing and running codes from individual work stations or by using more ergonomic development environments in CASE tools such as Microsoft Visual Studio, Java Beans, Cake Php, and Enterprise Architect. Although these tools were reliable and productive, they were also amazingly expensive, complex, and cumbersome. Fortunately, modern trends have emerged for system development, which offer an all-round more efficient approach to system development that is gradually superseding and supervening existing tools and insidiously referring them to museums of antiquity with reference to the near future.

**Data Flow of the Existing System**

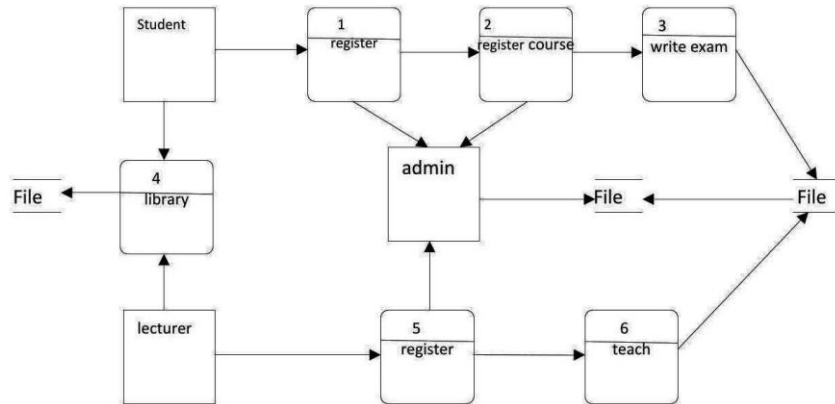


Figure 2.1: Data flow of existing systems

**Strength of the Present System**

The most interesting feature in the existing systems I mentioned earlier is the fact that they were a leap forward from the era of developing applications from excessive coding. Before their invention, application development was too complex for the average professional. Programming cum software development required writing not just voluminous but painstaking and time consuming lines of code which were also retrogressively cumbersome to run, debug, and execute. But with these newer tools, applications that required years to develop were developed in days. Secondly, these tools consisted of controls – not controls alone but also features for modeling, testing, prototyping, and debugging, which were not available before. With these controls thousands of lines of code were replaced with a click of the mouse. Therefore, with these newly integrated features, system modeling, prototyping, debugging, testing, and deployment are without the existing intricacies and rigors and really paved the way for the era of rapid application development.

**Weaknesses of the Present System**

The adage that the only thing that is constant is change is popular. Change is everywhere: change of our cars, change of our homes, and change of almost everything with time. Each day changes and brings new changes even in the world of application development. The new undoubtedly is the news. As a result, there is a natural tendency to forsake or discard old systems and subscribe to new ones. This natural and expected desire for new systems is the primary disadvantage of the systems that previously existed. They are gradually and slowly forced by nature into their shelves and described as legacy by the passage of time. Secondly, they were complex in that they required a lot of time and skill to install. Furthermore, because they do not possess an integrated database management system, an external database management system was required for application development. These constraints, coupled with the fact that deploying applications using the afore-stated tools was cumbersome, aroused the quest for more formidable platforms.

### Analysis of the Proposed System

In this project we propose to design and develop a virtual university application using cloud computing. After a careful examination, observation, and study of the proposed system, a proper understanding of the functional and non-functional requirements was obtained. Although there were candidate solutions to the problem, cloud computing was chosen based on the professionally and ethically correct reason that it was relatively a new approach to software and system development. From the studied system requirements, the primary function and structure of the system was realised after extensive and intensive analysis and consultation. In the final act, the system was specified for design to administer and manage the daily, curricular, and non-curricular activities of a new and next generation online virtual university.

### Objectives of the New Solution

The cloud computing model is a ubiquitous platform for system development. Therefore, the primary objective of the proposed system - the UUA is to enhance and improve the functionality and structure of university applications with the aim to provide easy and unlimited access to online education. The second motive of the UUA is to show how cloud computing can be used to develop applications that bypass and evade the hitherto existing complexity in accessing, modifying, and updating systems and system information from the back-end. Lastly, the project showcases the expediency and expertise of adapting to contemporary standards and specification in software and system development

### Decomposition and Cohesion of the High Level Model

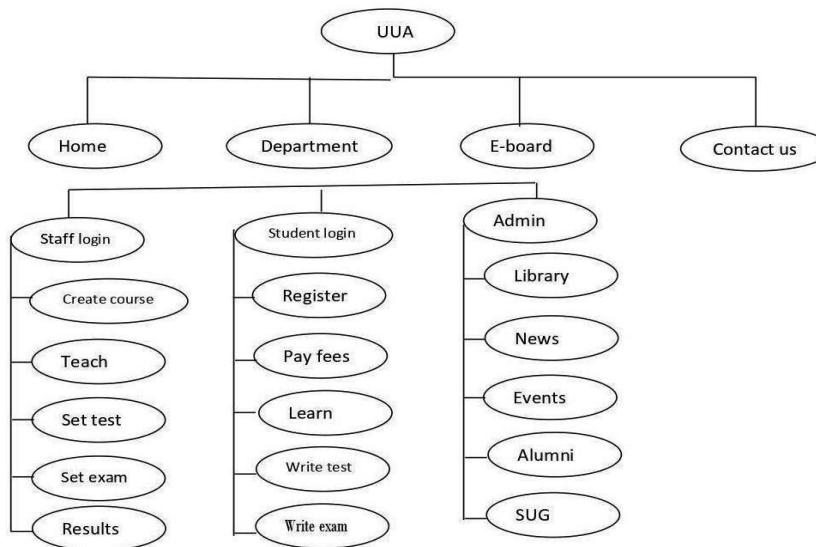


Figure 2.2: Functional decomposition and cohesion of the proposed system (UUA)

### Specification and Design

#### Requirements Engineering

#### Problem Statement

This project confronts us with a task to design and develop a virtual university application using cloud computing.

## **Feasibility Study**

On critical assessment and evaluation of the proposed project, a well-organized feasibility study showed a project practicability of about 80%. Studies on the adopted prototyping model showed a guaranteed success rate in the range of 75% - 80% of cases. These figures obtained, propel one to thus conclude that the proposed project is worthwhile.

## **Requirements Analysis and Elicitation**

This project is themed on designing and developing a virtual university application using cloud computing. Though there exists a trade-off between the cloud model and other systems for software development, and although the cloud infrastructure is relatively nascent and difficult to acquire due to subscription and other bureaucratic bottle-necks, the cloud infrastructure is nonetheless adopted for this project due to its ubiquity, installation-free instant access, ergonomics, and easy deployment.

## **System Requirements**

- R1. The system shall enable users access information on the programmes and courses offered by the university.
- R2. The system shall enable users access information on the requirements for admission into the different programmes and courses of the university.
- R3. The system shall be equipped with web forms to enable prospecting students apply for admission into the different programmes of the university.
- R4. The system shall embed a menu list of courses, departments, and faculties.
- R5. The system shall incorporate an online learning board for course delivery.
- R6. The system shall incorporate an efficient database management system to store and record administrative and other forms of information.
- R7. The system shall provide a user interface with a feature to register new users.
- R8. The system shall possess a feature to enable users to login as students after authentication.
- R9. The system shall possess a feature to enable users to login as staff after authentication.
- R10. The system shall incorporate an online learning board for course delivery.
- R11. The system shall incorporate a simple mail transfer protocol to enable users send mails to the administration server.
- R12. The system shall include a contact page with contact information of essential units.
- R13. The system should enable new and old students to register for courses each semester.
- R14. The system should enable new and old students to register for examinations each semester.
- R15. The system should have a provision to enable students take online based tutor assignments.
- R16. The system should have a portal for both staff and students.
- R17. The system should have a mechanism to enable students pay tuition and other administrative fees.
- R18. The system should possess a news and events board.
- R19. The system should include a provision for an e-library and repository for downloadable materials.

## **System Design**

### **Architectural Design**

In this phase of the project, after careful and extensive analysis and consultation, an architectural model of the proposed application is developed. This model serves as a blue print and guide for the design and development of the system. For the sake of this study, the virtual university application we propose to build is named Utopia University Application (UUA). The diagram below gives an overview of the detailed architectural structure of the UUA.

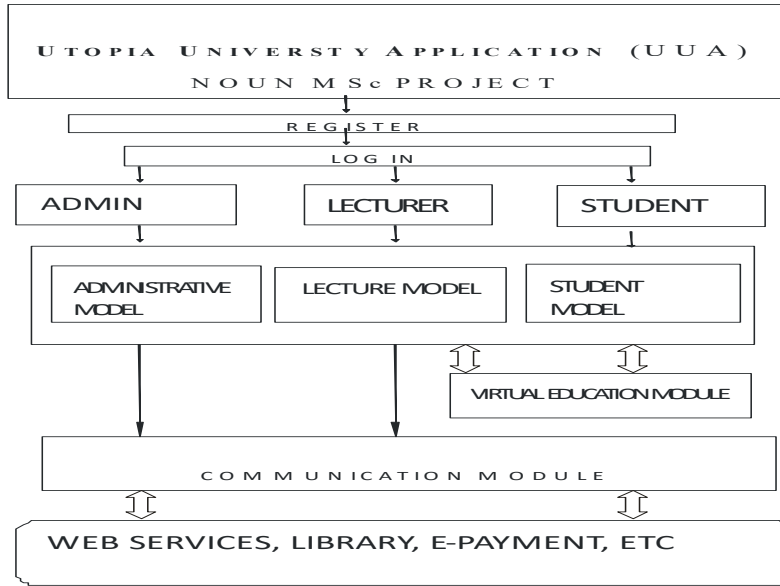


Figure 2.3: Architectural model of Utopia University Application (UUA)

Although the architectural model gives an abstraction of the system, it does not show the system's objects and their different actions and roles in details. To this end a use case diagram was developed to present a clearer picture of the system. This is shown in the diagram below.

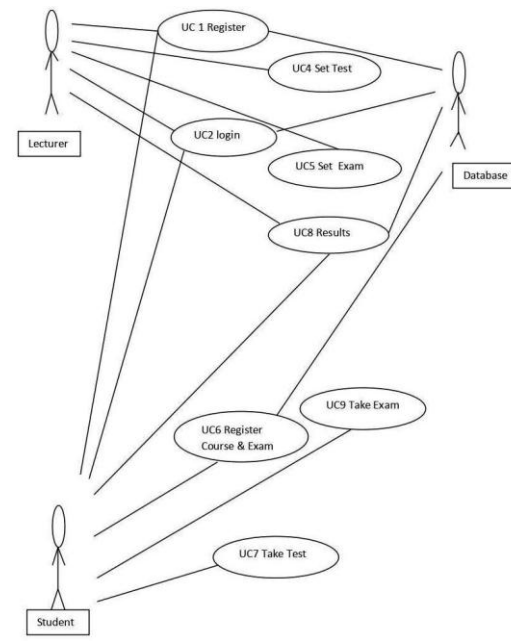


Figure 2.4: Use Case diagram for UUA

### Detailed Design

The phase of detailed design is intelligently further divided into two sub phases. They are the phase of component design and the phase of interface design. We will proceed by first taking a look at component design.

Component Design

This phase is a critical phase from the context of the project at hand. A systematic approach is utilized to achieve productive modularization of the system, and therefore present the system in a clear and easily understandable form while making the development process easier and less error prone. We utilized a structured divide and conquer, top down design approach and by so doing, we carefully and cautiously ensured that the prospect of inter-modular communication was fair in a calculated attempt to avoid the problem of excessive coupling. This developed structural model is used to thoroughly understand the system’s classes, objects, and the interrelationship and intercommunication that exist within these objects. Furthermore, in order to ensure that there was a standard and acceptable level of cohesion among the components of the system, and in a bid to enhance the efficiency of the collaboration among these components, a class diagram was strategically developed from careful analysis so as to achieve overall system completeness that satisfies and meets user requirements.

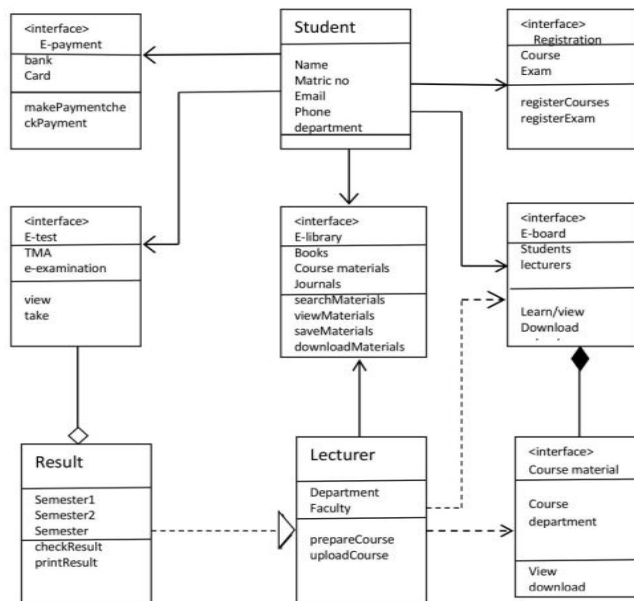


Figure 2.5: Class diagram of UUA

Carefully studying the class diagram presented above, one can observe a clearly defined and reasonable set of classes, and a well-defined and unambiguous interrelation between these classes. In as much as this diagram draws us closer to realizing the system specification, after due consultation with stakeholders, from a professional point of view, it is undoubtedly true that a sequence diagram will suffice and thus further decompose the system to a higher degree of realization. To this end a sequence diagram was meticulously and consultatively engineered and is show in the figure below.

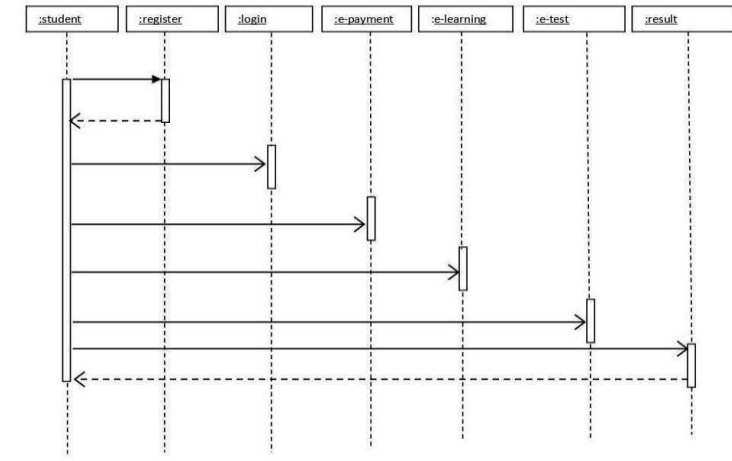


Figure 2.6: Sequence diagram of UUA –

The role data and its flow play in any computer and information technology system cannot be over emphasized. Data flow is the backbone and bedrock of all information technology systems. Therefore, in an attempt to demonstrate the aptness, essence and intrinsic nature of data and data flow, we intensively analyzed the project by decomposing the system into modules and sub-modules and thus by so doing captured the data-type, data source, data sink, data route, and data store in the system and thus further complement, improve, and simplify the ease of developing the system. This systematic process is mapped in a data flow diagram and is shown in the figure below.

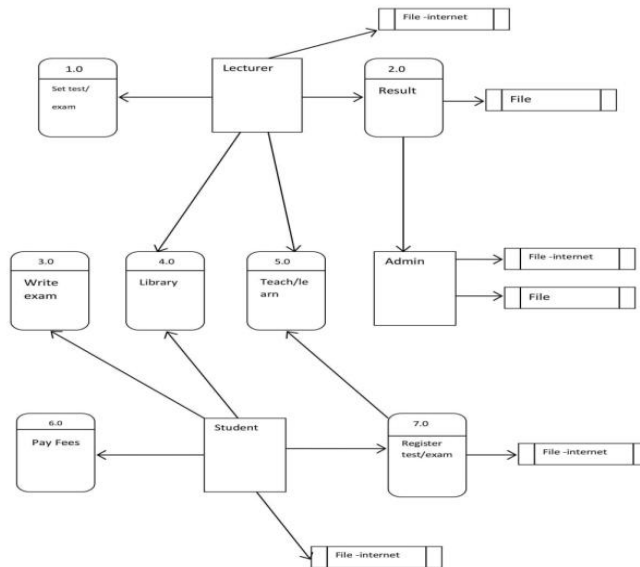


Figure 2.7: Data flow diagram of UUA

### Interface Design

This stage of the system design – interface design, is the phase in which the platform for human-computer interaction is developed. Because it is one of the most important and crucial stages in the system’s development, much attention and care is taken to ensure that the interface designed is friendly and not foreboding and also conforms to the zero-training standard requirement. In using fonts, colour, and contrast appropriately, and with standard labeling, data justification, alignment, and grouping techniques, we set standards and stuck to them and eventually designed a user interface that is not only efficient and navigable, but is also user-centered thus making the user experience and interaction pleasurable.

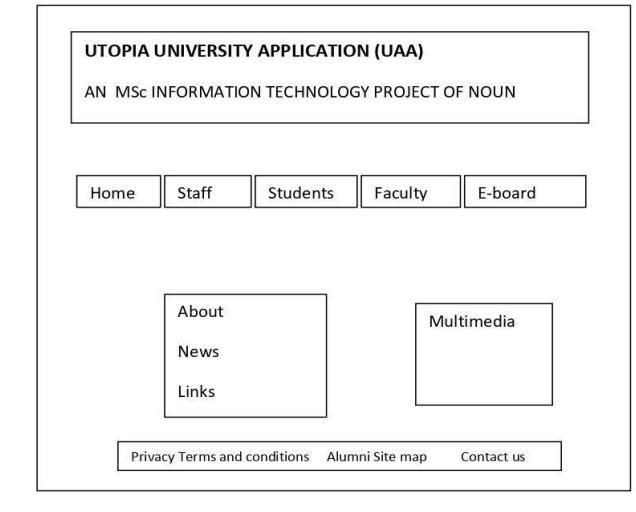


Figure 2.8: Interface model of UUA

### System Flowchart

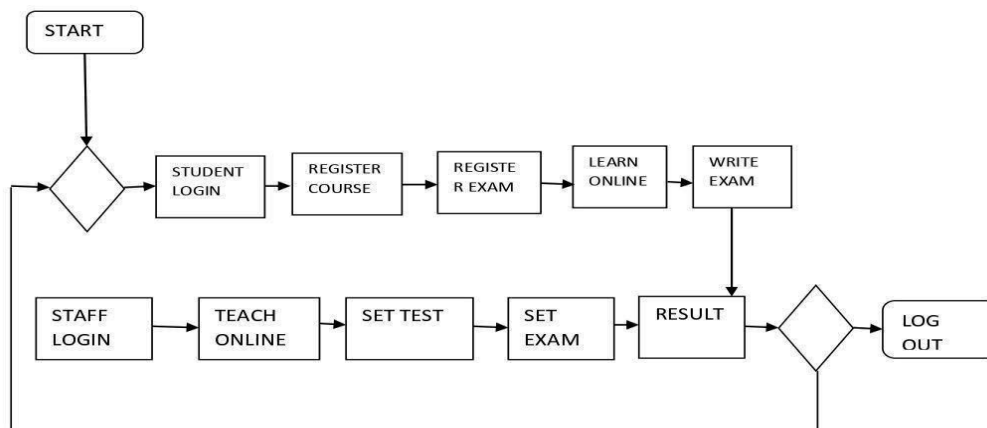


Figure 2.9: System flow chart for Utopia University Application (UAA)

### Overview Description of the New System

Due to the fact that the new system will be cloud based, much of its administration and management will be online. Unlike previous systems used by the National Open University of Nigeria, every facet of admission, registration,, payment, learning, and assessment will be via online modes. The system is expected to include a landing page which will enable first time visitors have an overview of its function, structure, and services. This page will provide a link to courses, departments, and faculties, and also provide a mechanism for proposing students to apply for admission and new/old students to process registration. By integrating a virtual learning module, students are expected to refer to their schedule to log in into the module in order to receive tutorials and interact with both staff and students. At the end of each semester, the progress of students will be assessed through configurable assessment modules. All of these activities are controlled by an admin module that utilizes effective project management components to manage the process of information flow in the system.

## **Summary**

Starting from a set of well understood requirements, we have succeeded in translating a set of logical models to a physical design specification. By employing a public cloud company like the Nowdad Cloud – which is the reference choice for the development of the UUA, the models and modules abstracted through partitioning, decomposition, and modularization, are dexterously incorporated and integrated into a fault-free physical software structure, employing controls, components, modules, protocols, and sub systems present in the development environments of the chosen cloud infrastructure. You undoubtedly, will be amazed how by some clicks of the mouse, and some rudimentary knowledge of HTML and software engineering, and with a drop down system of introducing controls via a design window, and hyper linking objects and pages with the help of the href attribute a perfectly functional and working physical structure of the Utopia University Application is displayed on a graphical user interface, after deployment.

## **RESULTS AND DISCUSSION**

### **New System Requirements**

#### **Hardware and Operating System requirements**

Hardware Requirements:

- (a) a Pentium 4 or higher personal computer or laptop with a processor speed of 2.0GH and above and a memory capacity of 1.5G and above.
- (b) Input devices such as mouse, keyboard etc.
- (c) A modem and routers
- (d) Flash drives

Operating System Requirements:

- (a) Windows 7 operating system or higher versions of windows

#### **Software Requirements**

A cloud service such as the Nowdad cloud.

### **System Testing**

#### **Test Plan**

PROJECT NAME: UTOPIA UNIVERSITY APPLICATION

PROJECT MANAGER: DAMIETE BRIGGS

TESTER	TEST TYPE	1st	2nd	3rd	4th	5th	COMPLETED	SUCCESSFUL
lamiete	Authorisation	i	i	i	i	i	5	5
lamiete	Authorisation	i	i	i	i	i	5	5
lamiete	User interface	i	o	o	o	o	1	1
lamiete	Forms	i	i	i	o	o	3	3
lamiete	CBT	i	i	o	o	o	2	2
lamiete	LMS	i	o	o	o	o	1	1

Figure 3.1 Test plan for UUA

### Test Data

TEST CASE NAME	AUTHENTICATION TEST
PURPOSE OF TEST	TEST OF THE FUNCTIONALITY OF THE LOG IN SYSTEM
TEST FOCUS	INTERFACE
TEST TYPE	BLACK BOX ALPHA UNIT TEST
TEST PROCESS	1. A SET OF STRING DATA WERE INPUT INTO AN INTEGER FIELD AND THE SUBMIT BUTTON WAS CLICKED 2. A SET OF INTEGER AND STRING DATA WERE INPUT INTO CORRESPONDING INTEGER AND STRING FIELDS
TEST RESULT	1. AN ERROR MESSAGE SHOWED THE PRESENCE OF ERROR 2. NO ERROR MESSAGE SHOWSS SUCCESSFUL AUTHORISATION
ACTION	UNIT TEST COMPLETE

TEST CASE NAME	AUTHENTICATION TEST
PURPOSE OF TEST	TEST OF THE FUNCTIONALITY OF THE LOG IN SYSTEM
TEST FOCUS	INTERFACE
TEST TYPE	BLACK BOX ALPHA UNIT TEST
TEST PROCESS	1. A SET OF STRING DATA WERE INPUT INTO AN INTEGER FIELD AND THE SUBMIT BUTTON WAS CLICKED 2. A SET OF INTEGER AND STRING DATA WERE INPUT INTO CORRESPONDING INTEGER AND STRING FIELDS
TEST RESULT	1. AN ERROR MESSAGE SHOWED THE PRESENCE OF ERROR 2. NO ERROR MESSAGE SHOWSS SUCCESSFUL AUTHORISATION
ACTION	UNIT TEST COMPLETE

<b>TEST CASE NAME</b>	<b>FORMS TEST</b>
<b>PURPOSE OF TEST</b>	TEST OF THE FUNCTIONALITY OF THEWEB FORMS
<b>TEST FOCUS</b>	INTERFACE
<b>TEST TYPE</b>	BLACK BOX ALPHA UNIT TEST
<b>TEST PROCESS</b>	1. A SET OF STRING DATA WERE INPUT INTO AN INTEGER FIELD AND THE SUBMIT BUTTDN WAS CLICKED 2 A SET OF INTEGER AND STRING DATA WERE INPUT INTO CORRESPONDING INTEGER AND STRING FIELDS
<b>TEST RESULT</b>	1. AN ERROR MESSAGE SHOWED THE PRESENCE OF ERROR 2. NO ERROR MESSAGE SHOWSS SUCCESSFUL AUTHORISATION
<b>ACTION</b>	UNIT TEST COMPLETE
<b>TEST CASE NAME</b>	<b>CBT MODULE TEST</b>
<b>PURPOSE OF TEST</b>	TEST OF THE FUNCTIONALITY OF THECBT MODULE
<b>TEST FOCUS</b>	INTERFACE
<b>TEST TYPE</b>	BLACK BOX ALPHA UNIT TEST
<b>TEST PROCESS</b>	1. A COMPUTER BASED TEST WAS SET UP WITH A WRONG ANSWER 2 A COMPUTER BASED TEST WAS SET UP WITH THE RIGHT ANSWER
<b>TEST RESULT</b>	1. AN ERROR MESSAGE SHOWED THE PRESENCE OF ERROR 2. NO ERROR MESSAGE SHOWSS SUCCESSFUL AUTHORISATION
<b>ACTION</b>	UNIT TEST COMPLETE
<b>TEST CASE NAME</b>	<b>VLM TEST</b>
<b>PURPOSE OF TEST</b>	TEST OF THE FUNCTIONALITY OF THEVLM SYSTEM
<b>TEST FOCUS</b>	INTERFACE
<b>TEST TYPE</b>	BLACK BOX ALPHA UNIT TEST
<b>TEST PROCESS</b>	1. A SET OF STUDENTS WERE ASKED TO UPLOAD DATA INTO THE SYSTEM 2. A SET OF STUDENTS WERE ASKED TO DOWNLOAD DATA FROM THE SYSTEM
<b>TEST RESULT</b>	1. AN ERROR MESSAGE SHOWED THE PRESENCE OF ERROR 2. NO ERROR MESSAGE SHOWSS SUCCESSFUL AUTHORISATION
<b>ACTION</b>	UNIT TEST COMPLETE

Figure 3.2 Test data for UUA

Using a well prepared test plan and planning for a long time, all units of the system were tested for faults and errors. The process began from small aspects of the system and proceeded to larger aspects. The main strategy of the test was to deliberately insert wrong data and find if the system discovered such errors. If such errors were unraveled then the system is deemed to be reliable. And amazingly this was the observation almost all test errors were detected thus bolstering the dependability of the UUA project. The ergonomics of the cloud infrastructure in no small measure contributed to the negligible level of errors and faults in the system as displayed in the test results obtained.

### Actual Results versus Expected Test Result

A good test plan is in no small measure a highly invaluable tool for the validation and verification of any software product. Taking cognizance of the scholarly nature of the project which is an MSc thesis for the

department of Information Technology, alpha testing was utilized – considering the fact that because I am the developer, the onus is on me to be on the vanguard of any test plan, conduct unit test, integrated test, and system test and thus prove the overall acceptability of the delivered application. Therefore using a well-planned principle and strategy which involved starting from small aspects of the system and then to larger sections, the entire system including all facets were operated and analyzed with the intent to discover and unravel bugs, errors, and faults and also assess and evaluate the system’s functionality and operation against the system’s specification and expected user requirements.

Results obtained from the above stated test process, showed an 80% level of conformity of the system to user expectation and requirements, and an 85% level of completeness, consistency, and achievement of technical feasibility. This outcome was anticipated considering the nous decision of the project developer to utilize cloud computing for the development of the project. The cloud model is simply simplistic and encompassing and has once again proved itself with the efficacy, ergonomics, and usability of the application developed herein. Furthermore, this plausible and positive development and outcome of the project, is in tandem with results obtained from other studies utilizing the cloud model, and undeniably explains the reason behind the shift in paradigm to the cloud platform. The efficiency of the cloud model as displayed in the ingenuity and practical usability of the application developed in this thesis, leads and prompts one to make the prediction that in the near future, cloud computing models will completely supersede other methods for the development of both private and industry standard software.

### **Performance Evaluation**

From the alpha system test conducted in the preceding section, the system expectedly exhibited an about 80% degree of user requirement satisfaction and an 85% level of operational efficiency and technical feasibility. Despite the fact that the Utopia University application (UUA) was conceived as an MSc research project, as a result of its aesthetics, completeness, consistency, ease of use, ergonomics, user-friendliness, and user centeredness, results from surveys and polls conducted, showed UUA having a clear, glaring, sharp, and unrivalled lead when compared to or contrasted with existing university applications both locally and internationally irrespective and regardless of the benchmark, method, metric, and standard used for the assessment and evaluation. Consequently, the outcome of this survey and the deftness and robustness of the application even under stressful environments and operational constraints in the first few weeks of its implementation and operation goes further to prove the validity of the UUA as an application (software) that was developed rightly, rightly developed, and rightly functional and operational.

### **Limitations of the New System**

Laws of thermodynamics make it impossible to build a perfect system. Nevertheless, the novelty of the cloud model encapsulated by its relatedness with the trending internet of things attempts to dispute these sacrosanct and existing laws of production. From the traditional perspective, cloud computing is as limitless as the cloud is limitless. The only identifiable limitation lies in the high cost of the cloud infrastructure and the usual complex administrative bottlenecks associated with subscribing to a cloud service. Although security breaches and unreliable internet service may pose as limiting factors, modern cloud systems come with tools and modules to adequately address possible security concerns.

### **SUMMARY CONCLUSION AND RECOMMENDATION**

Starting from a project topic cum problem statement, we navigated through the phase of requirements analysis and elicitation, which involved gathering both functional and non-functional requirements and evaluating constraints on the project’s development and operation. Moving on from there, we progressed into the design phase which included development of logical models that were then converted into physical designs that satisfied the system and user requirements.

Thus a thorough appraisal of the UUA project and its result or output; an efficient user-friendly, usable, maintainable and perfectly working virtual university application, testify to the veracity of cloud computing and the ingenuity of computer and information technology systems and computer and information technology as vital tools inextricably needed for the general development of education and pedagogy, not only in Nigeria but the world at large. Not restricted to the traditional perspective, but also extending to the virtual horizon. Ducker (1997), gave a similar prognosis when he foretold that thirty years from then (1997), the big university campuses (traditional university systems) would be relics.

## **Conclusion**

The successful design and development of the UUA, goes a step further to reiterate the efficacy, efficiency, reliability, and scalability of cloud computing for application (software) development. The essential and invaluable functionality and structure of the cloud model, as demonstrated in the successful design, development, delivery, and evolution of the UUA, triggers me to draw the conclusion that cloud computing and the cloud model, is incontrovertibly and incontestably the development environment of choice for the design and development of tested, trusted, and maintainable bespoke\customized application (software) systems. Scientific extrapolations and analysis foresee a future in which cloud computing and the cloud model will form the epicenter of software and system development, in as much as research in the field is still nascent. Finally, software maintenance is a crucial stage in the application (software) development process or life cycle to be more professional and involves about 80% of the total life cycle of a software product. Maintenance itself is not viewed as a separate phase in the system development life cycle but is expected to be implemented at any time during the product life cycle and is a continuous process. The system analyst is expected to keep a good record of changing user needs and requirements and also changes or improvements in software development technologies and best practices with a bid to ensure that the system designed is changed, improved, or reviewed to adapt to these recorded changes in user requirements and development technologies. Therefore, this software development process is incomplete without proper maintenance and maintenance policies. To this end, it is advised that adequate and proper maintenance measures that include review of developments in software research, conjugated with frequent review of customer requirements be carried out to insure the continuous functioning and operation of the AAU system, developed in this project.

## **REFERENCES**

- Albaqami, N. (2014). Critical investigation of virtual universities: applying the UK structure to Saudi Arabia. A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy (PhD) at De Montfort University United Kingdom.
- All Cloud (2020). Retrieved from <http://solutionreviews.com>
- Anderson, M. (2017). Virtual universities – future implications for students and academics.
- Cohen, R. (2008). Describing the Cloud.
- Chouldharry, N. & Singh, B. (2015). Scope of cloud computing in Indian technical education.
- Elhassan, A.Y. (2018). Implement a virtual university in education based on cloud computing. *International Journal of Science, Environment and Technology*, 7(1), 31–38.
- Farell, G. M. (2005). *The development of virtual education: A global perspective*. The Commonwealth of Learning.
- Flexera (2020). Retrieved from <http://flexera.com>.
- Gautam, N. & Sood, M. (2012). *Cloud computing platform for virtual university providing e-learning*. *IOSR Journal of Computer Engineering (IOSRJCE)*. ISSN: 2278-0661, ISBN: 2278-8727 Volume 6, Issue 2 (Sep-Oct. 2012), PP 47-53.
- Google (2017). Retrieved from <http://cloud.google.com>.
- Griff, R. (2015). *A guide to virtual universities for policy makers*. The Commonwealth of Learning.
- Hegazy, A., et al. (2015). *An adaptive framework for applying cloud computing in virtual learning environments in education: A case study of AASTMT*. In *Proceedings of the International Conference on Communication, Management and Information Technology (ICCMIT 2015)*. *Procedia Computer Science*, 65, 450–458.

- Hwang, D. (2016). *The development of an educational cloud for IS curriculum through a student-run data center. Information Systems Education Journal, 14*(1).
- Jacobson, I. (2013). *Business agility and software engineering excellence.*
- Jadeja, M. (2006). *Virtual universities: The new perspective for higher education.*
- Jararweh, Y., et al. (2012). *Teach cloud: A cloud computing educational toolkit.* In *Proceedings of the 1st International IBM Cloud Academy Conference* (April 19–20, North Carolina, USA).
- Kramer, J. (2000). *Fern university strategy to build a virtual university.*
- Kravtsova, L., et al. (2021). *Cloud service in the distance learning system for future sailors.*
- Lehman, M. (1980). *Programme life cycle and laws of software evolution.*
- Miseviciene, R., et al. (2011). *Application of cloud computing at Kaunas University of Technology: MSlive@educase. Informatics in Education, 10*(2), 259–270.
- Mohammed, A. (2014). *Moving virtual university from traditional web to cloud computing: A case study of the Syrian virtual university.*
- Moor, R. (2003). *Virtual university: A century of distance education in the US.*
- National Institute of Standards and Technology (NIST). (2011). *The NIST definition of cloud computing* (Special Publication 800-145).
- O'Donoghue, J., et al. (2001). *Virtual education in universities: A technical imperative.*
- Ogedebe, M., et al. (2013). *Cloud-based e-learning model for open and distance learning in Nigeria. International Journal of Science and Research (IJSR).*
- Pardeshi, V. (2014). *Cloud computing for higher education institutes: Architecture strategy and recommendation. Procedia Economics and Finance, 11,* 589–599.
- Pressman, R. (2005). *Software engineering.*
- Prosynkova, K., et al. (2016). *A virtual university: Characteristics of the concept (by the example of the Syrian virtual university).*
- Salesforce. (2017). Retrieved from <http://salesforce.com>
- Schibrowsky, J., et al. (2007). *Interdependence of the factors influencing the perceived quality of the online learning experience: A causal model.*
- Souley, B., & Anuobi, D. (2014). *A framework for mobile education system for higher education institutions in Nigeria. Journal of Software Engineering and Applications, 7,* 791–816.
- Vangie, B. (2017). *Cloud computing.*
- Wikipedia. (2021). Retrieved from <http://wikipedia.org>
- Wang, M., et al. (2020). *Mobile cloud learning for higher education: A case study of Moodle in the cloud. The International Review of Research in Open and Distance Learning.*

APPENDIX A  
SAMPLE OUTPUT

The image is a screenshot of a web browser displaying the Utopia University website. The browser's address bar shows the URL <https://www.uuonline.us>. The website features a dark blue header with the Utopia University logo on the left, which includes a shield with various symbols and the motto "sapientia est principalis". To the right of the logo, the text "UTOPIA UNIVERSITY" is displayed in white. Further right, there are navigation links for "HOME", "APPLY", and "CONTACT". The main content area is a large image of a lecture hall filled with students, with several lines of white text overlaid: "... A university in the cloud for cloud learning and cloud degrees", "Find next-generation courses methodology delivery and next-generation degrees", "Launch into cloud nine with our cloud courses and degrees", and "make the sky your limit with our degrees". At the bottom center of the image, there is a white button with the text "APPLY NOW".



**UTOPIA  
UNIVERSITY**

HOME APPLY CONTACT

## Available Courses

Faculty	Department	Course
Engineering	Computer Engineering	Computer Engineering
Engineering	Software Engineering	Software Engineering
Engineering	Computer and Software Engineering	Computer and Software Engineering
Science	Computer Science	Computer Science
Science	Maths Statistics and Computer Science	Maths Statistics and Computer Science
Science	Information Technology	Information Technology
Science	Computer and Information Technology	Computer and Information Technology
Arts	Management	Business Management
Arts	Management	Business Administration
Arts	Management	Applied Entrepreneurial Studies
Arts	Management	Banking and Finance
Arts	Management	Entrepreneurship and Financial Management
Arts	Management	Finance and International Trade
Arts	Social science	Sociology
Arts	Social Science	Political Science
Arts	Social Science	Public Administration
Arts	Social Science	Political Science and Public Administration
Arts	Social Science	Advanced Government Administration
Arts	Social Science	Economics
Arts	Social Science	Econometrics and Macro-economics
Arts	Social Science	Diplomacy and International Trade
Arts	Social Science	Diplomacy and International Relations
Arts	Education	Administration and Management in Education
Arts	Education	Chemistry Education
Arts	Education	Mathematics Education
Arts	Education	Physics Education
Arts	Education	Biology Education
Arts	Education	Geography Education
Arts	Education	Economics Education

APPLY FOR ADMISSION

## About Us

Here at Utopia University, we believe strongly in creativity, dedication, and excellence. It is for this reason the school's academic system is structured so as to ensure that students study for degrees without severing the comfort of parents, family, friends and loved ones, and also without the risk of isolation from available protection and comfort at home. Course work for the whole year is made available to students at the start of each term and students are assessed (online) at the end of each year. A final graduation examination that incorporates all the courses taken is a prerequisite for graduation and will form a larger percentage of the cumulative grade point average. This novel system and academic structure ensure that the student chooses his pace, and if is able to complete all of the required courses satisfactorily, graduates faster than expected and on time. Its just wow! One of a kind, and the best among equals. Nothing can be more exhilarating and extraordinary. It is simply just beyond pioneering the future of education and has reached the ambit of cloud-education and cloud-learning..



**A Citadel of Quantum Learning  
Research and Serenity**



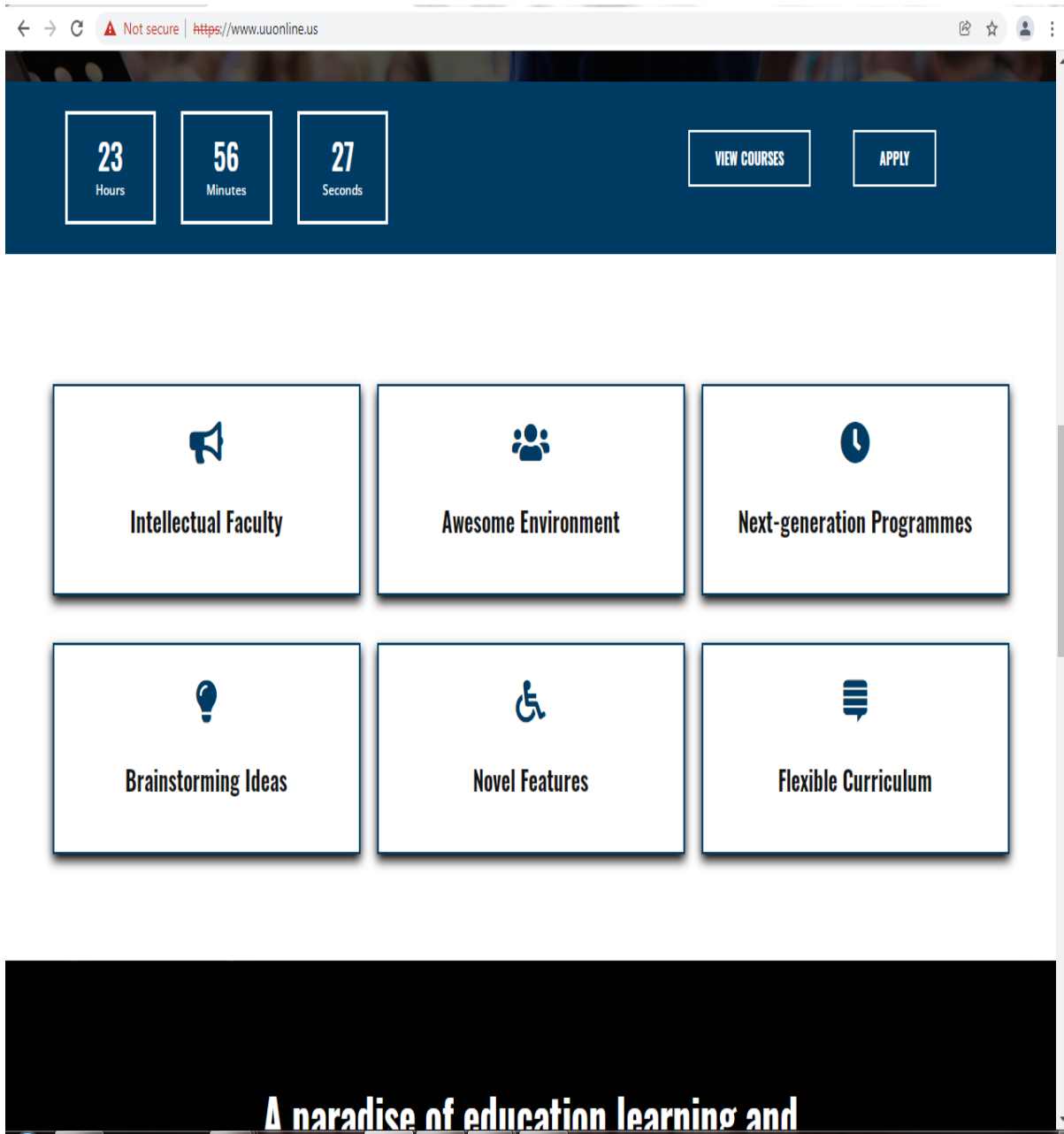
**A Perfect Paradise**



**An Heaven and Theater of  
Intellectualism**



**Endless Possibilities**



← → ↻ ⚠ Not secure | <https://www.uonline.us/contact/> 📧 ☆ 👤 ⋮

**UTOPIA UNIVERSITY** HOME APPLY CONTACT

We love to hear from you.

## Leave a Message

Name  Subject

Email

Message

**SEND MESSAGE**

## Keep in Touch

✉ admin@uonline.us

☎ +1-800-346-8921

📍 1345 West Estes Avenue Apartment A-L  
Chicago Illinois 60626 USA

New York  
New York, USA  
View larger map  
Directions