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**An Interactive Web-Based Extranet System Model for
Managing Students' Academic Records**

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Abstract

The effectiveness of electronic transactions in institutions of learning in recent past is highly contingent upon an information and communication technology infrastructure. Such infrastructure enhances information management, cooperation and coordination during e-transactions. The infrastructure that allows such transactions to thrive and grow is a model for an interactive web-based Extranet system and not just a site for transactions. This infrastructure must be carefully planned and modeled from the outset of Extranet modeling, particularly in a web-based environment. This research adopted

an interactive web-based Extranet system for students' academic records in Ambrose Alli University, as a research domain, which depicts a positive trend towards achieving objectives for students, lecturers and parents to access and compute results online rather than maintaining physical documents. The database will serve as repository of students' academic records over a long period of time. The methodology of the special software to be developed involved the collections of main modern tools and technologies, such as Apache Web Server, PHP and MySQL which can work on any platform, such as windows and Linux.

Key words: Extranet-Model, Interactive, Web-Based, Students, Academic, Records.

Introduction

Organizations or institutions have been running manual method of keeping records. This manual method in use leads to one form of error or the other. These errors include transcription, transposition and mathematical or arithmetic truncation (Ballard, 2012). The combination of any of these errors in course of manual computations of students' results for instance, is a clear manifestation of the inability of some members of staff to handle numerical computation accurately. More importantly, the manual method adopted by the institutions has posed several problems to both students and staff, which include result computation; transcripts generation; lack of sharing knowledge and resources amongst users; abysmal failure of existing Extranet Systems; and manpower shortage. The manpower shortage is one of the serious problems affecting every other sector of human endeavour including Ambrose Alli University (AAU), Ekpoma. To this effect, the yearly increase in number of students gaining admission into the institution, also leads to high number of students' academic records to be processed manually, which places extra responsibility on the few members of staff available.

It is no longer in doubt that a well-planned and modeled Extranet system plays a great role in the success of the establishing institution. Many institutions invest in the Extranet system building, but only to have their effort met with abject failure. (Daintry Duff, 2010). He argued that this failure is due to lack of proper infrastructure, strategic planning, inadequate executive sponsorship, lean financial support and inconsistent management content. An Extranet system offers content and services to the users and has a link to the internet, but cannot be accessed by the general public, though some outside users may be granted access on certain criteria. As web publishing tools proliferated, the users started cracking out the content (Bill Dykes, 2012). He argued further that there were no longer consistent design templates, style guides, navigational techniques or structured database to provide any semblance of order.

In order to eliminate accessibility problems, Extranet System is introduced and has become the most feasible solution to optimize and manipulate data (Daly and Miker, 2008). The current practice is to gather the data that is needed in an optimized Extranet system, regardless of the number of different applications and different platforms that

are used to generate the source data. But when the infrastructure for the establishing institution of learning is developed properly, the result is the ability to support long term growth of Extranet systems, new applications, change to existing applications, interpretation with existing Extranet system and so on (Dodge, 2010). The evolution of web-based Extranet system is categorized into intranet, extranet and internet. The internet is also a World Wide Web, publicly accessible series of interconnected computer network that transmits data by packet switching using the standard Internet Protocol (IP), (Wikipedia, 2013). It is a network of networks that consists of millions of smaller domestic, academic, business and government networks which together carry various information and services, such as electronic mail, online chart, file transfer and the interlinked web documents (pages) and other resources of the World Wide Web (WWW).

An Extranet system which is our research focus has captured world attention in recent past. The Extranet in reality is the growth of internal networks based on internet technologies. It is outpacing the growth of the global internet itself (Lamee and James, 2009). An Extranet is a private network designed for communicating information within an organization. It is similar in appearance to World Wide Web and is navigated in the same way as a website. The key difference is that access is limited to internal users only (i.e. the host organization or institution). The main function of a school Extranet for example is to make resources available to students and staff. It however requires continuous maintenance issues surrounding content, security and access need to be managed on a full-time basis. Extranet may provide a gateway to the internet by means of a network gateway with a firewall, shielding the Extranet from unauthorized external access (Adeya and Oyeyinka, 2012). The gateway often also implements user authentication, encryption of messages, and Virtual Private Network (VPN) connectivity for offsite employees to access host organization information, computing resources and internal communications. Increasingly, Extranets are being used to deliver tools and applications, for example, students' academic records computations, collaboration to facilitate working in groups and teleconferencing, school portals, sophisticated corporate directories, sales and customer relationship, management tools, project management to advance productivity. Suffice to note that due to the scope, variety of content and the number of system interfaces, Extranet of many host organizations are much more complex than their respective public websites (Rahardja, 2006).

A record is the collection of fields or individual data items that relate to a single unit or entity (Wada and Bail, 2010). In Ambrose Alli University, Ekpoma, students' files which contain their academic records are kept in various departments. In examinations and records department, students' files are kept in separate units based on the various departments of the students. And each unit is divided into various sections according to the year of admission. This is usually indicated by the student matriculation number

(which is the primary key). Though computerization has been introduced in some sections of the University, such as the administration, the importance of the method of providing data and information service throughout the University with the introduction of Extranet and web services is very much lacking. We hope that with the interactive web-based Extranet system when introduced into the University system, students' academic records should be stored electronically in a computer database for easy access and results computations, also be done online.

Literature Review

In this section, apart from passive observation undertaken by the researchers, there is need to review the literature of related works of past and presents authors to have a better understanding of the architectural model of interactive web-based Extranet system for managing students' academic records which is the subject of discourse in this research work.

Requirements for Web-Based Extranet System

The first requirement in establishing Extranet system, is a computer network. To build a network, the network topology is first chosen as per the need and goals of the establishing institution to determine how the computer will be physically connected. A computer network is a collection of hardware components, connected by communications channels that facilitate communications among users and allow users to share resources with other users (Kalakuta & Whinston, 2006). Network may be classified according to a wide variety of characteristics. This paper provides general overview of types and categories and also presents the basic components of a network as emphasized by Gerald and Aderson, (2004):

Scale Method: is when the network is classified according to scale, Local Area Network (LAN), Wireless Local Area Network (WLAN), Campus Area Network (CAN). Each computer or device on the network is a node. Campus Area Network (CAN) is our research focus and it is a network that connects two or more LANs, but that is limited to a specific and continuous geographical area, such as University campus.

Connection Access Method: this is according to the hardware technology used to connect the individual devices in the networks, such as Ethernet. Ethernet uses physical wiring to connect devices such as hub, switches, bridges, and/or routers.

Functional Relationship Method: this is according to the functional relationship among the elements of the network, such as client server computing. This method describes the relationship between two computers programs in which one program, the client, makes a series of request from another program, the server, which fulfils the request.

Network Topology Method: this is according to the architecture upon which the network is based, such as bus, ring and star. In a star network, all devices on the networks are connected to a central computer, thus forming a star. The central computer that provides a common connection point for devices on the network is called hub. All data, which are transferred from one computer to another in the network, pass through the hub, as depicted in Figure 1:

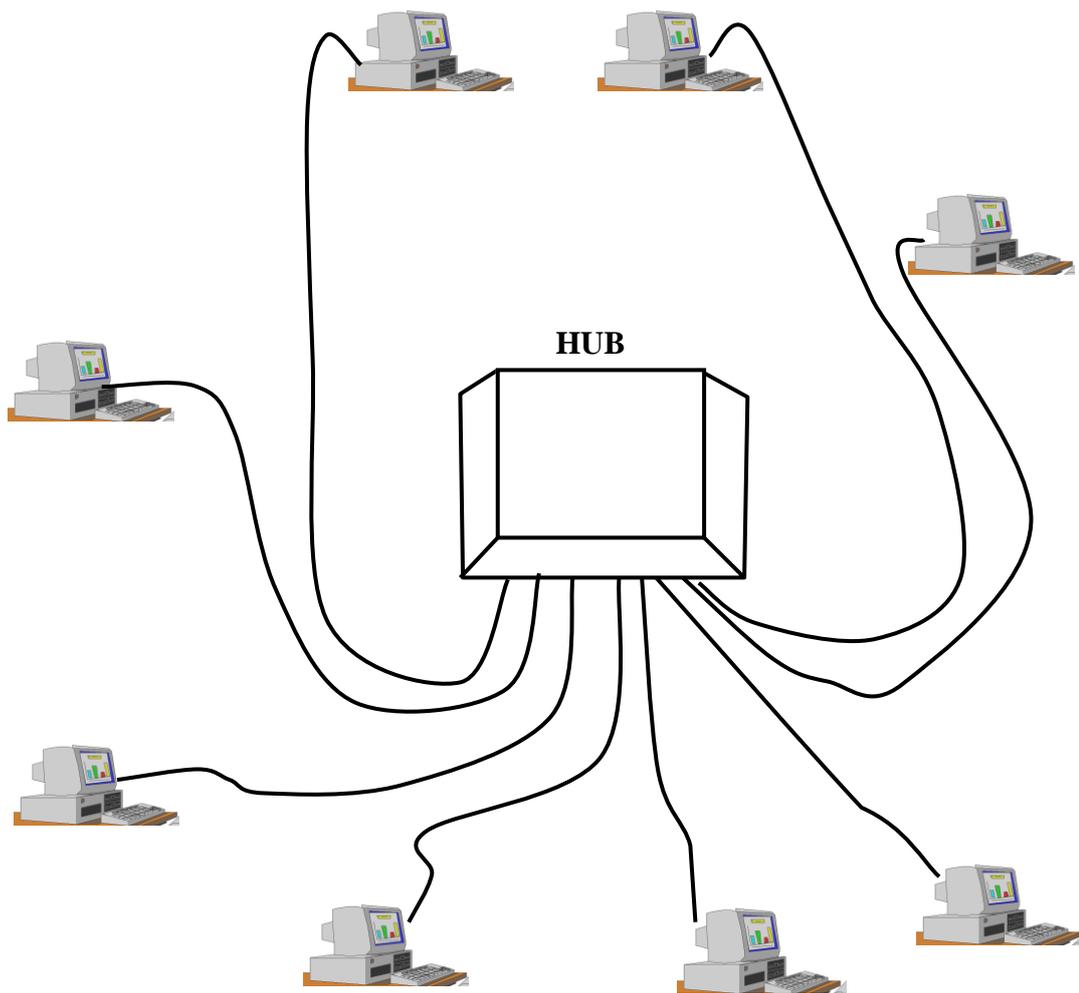


Fig 1: Star Topology Architecture (Source: Gerald and Anderson, 2004)

In a star topology, there are no direct connections between computers. Multiple hubs may be used to increase the number of computers connected to the network. Despite the high cost of the hub and additional wiring, star topology has become the most popular network topology. The main advantage is that a communication breakdown between any computer and hub does not affect any other node on the network. In addition, data must travel through the hub during transmission which enables the network administrator to monitor the status of all connected nodes. The weakness of the star topology is that the whole network goes down if the hub breaks.

After establishing the computer network of the Extranet system to determine how the computers are physically connected, there are software components that need to be established for the Extranet system to function properly:

Network Operating System: this controls how different hardware and software in a network function together properly and controlled by server machines. Large organization such as a university mostly use high-speed Unix-based primary servers while small and medium enterprises use less expensive Intel-based servers. Currently, the primary choices of network operating system are Unix, Windows NT and Novell's Netware.

Network Protocol: Extranet assigns an Internet Protocol (IP) address to each computer, that is, computer exposed to the internet, hence Transport Control Protocol (TCP) and Internet Protocol (IP) have to be used on the network. Most computer networks allow clients to communicate with servers using different network protocols.

Web Server Software: this is required to handle requests from browsers. Apart from the cost of a web server, how the server software supports the web developers must also be considered. For small operations, an Extranet can first be built with servers' platforms that are easy to use and maintain and then move to high performance servers' platforms as the Extranet system users increase. The performance of the Extranet depends more on the performance of the server platform than on the server application programme.

Web Browser: the most popular browsers currently are Netscape Navigator and Internet Explorer. We do hope that in the near future, Microsoft may integrate the browser's functionality into all of its transaction application program and make the browser part of the operating system. However, on the Unix side, the market will probably continue to be dominated by Netscape.

Hypertext Markup Language: in addition to the aforementioned hardware and software requirement, knowledge in creating Hypertext Markup Language (HTML) document is a necessity in setting up an Extranet system. HTML is a programming language used to create documents on the World Wide Web (WWW).

Data System Modelling

A data system model is an abstraction tool because it can be used to understand and simplify the ambiguous data relationship in the business world and complex system environment (Erickson, 2003). In the past, two data system methods exist, namely Entity Relationships (ER) and Dimensional modeling (DM). They are both relevant in a web-based system for electronic transactions. ER modeling produces a model of the specific area of interest. It uses two basic concepts: entities and relationship between those entities. It also contains attributes which can be properties of either the entities or the relationships. Dimensional modeling uses three basic concepts: measures, facts and dimensions. The model is powerful in representing the requirements of the business user in the context of object tables in the data system. That is, it is a methodology for conceptualizing and visualizing data system models as a set of measures that are described by common aspects of the organization. Dimensional modeling focuses on numeric data such as values, counts, weights, balance and occurrences.

Modern technologies have revealed modern tools and techniques in the areas of software system modeling methods which include Build and Fix model, Waterfall model, Increment Process Model, Evolutionary Process Model, Unified Process Model and Selection of a Life Cycle Model (Aggarwal and Singh, 2008). The ultimate objective of these conceptualizations of software system building processes of modeling is to produce good quality maintainable products within reasonable time frame and at affordable costs. For the purpose of the research study, web-based modeling should be concerned with dimensional data modeling methodology; characterized by integrations and OLAP (Online Analytic Processing) operations for proper conceptualization and visualization of electronic transactions environment. Waterfall Model would be used as an existing design process software platform:

1. Waterfall Model

The waterfall model should serve as an existing design process platform for the proposed model for an interactive web-based Extranet system for managing students' academic records in institutions of learning. This is a model of five phases, namely: Requirement analysis and specification, Design, Implementation and testing, Integration, Operation and Maintenance, as depicted in Figure 2:

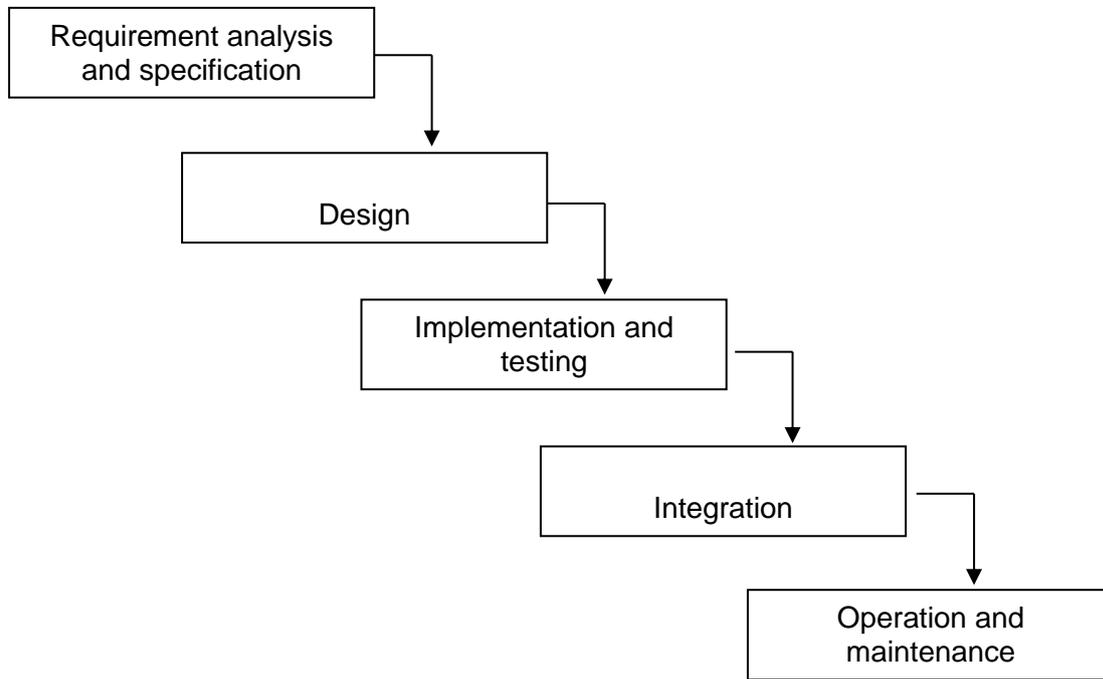


Figure 2: Waterfall Model (Aggarwal and Singh, 2008).

2. Limitation of the Waterfall Model

Over the years however, Researchers have observed weaknesses associated with waterfall model, particularly when used for database architecture in a web-based environment and its familiarity with community of software developers. These weaknesses according to Aggarwal and Singh, (2008) include the following: Difficulty in defining requirements at the outset; Non-suitability for accommodating change; Not scale up well to large projects; Projects are rarely sequential; and A working version of the system is appreciated late in the project's life. Hence our proposed data system model is enlisted with special features to serve as a bridge to the observed gap in waterfall model. These features include: Department Architecture; system Academic Records; System Portal; Parents Portal; and Lecturers' Portal.

Architecture of the Proposed Model

The proposed system model is an interactive web-based Extranet system that will help better manage the students' academic records in Institutions of Learning. It will connect all the departments and units in the University and knits them into a complete whole. The system model is based on modules and in order to ensure that there is reliable

security in the proposed system, rules and access permissions are created according to module, such that even a user who has access-right to a particular module of the system cannot access other modules or alter documents when they have been uploaded and updated. For example, a student can only access student portal, academic records and general information modules relating to the student. Course level adviser can access and upload relevant modules only if the departmental board of studies has approved such results and the Head of Department (HOD) has updated such records in the central database and cannot edit. The HOD serves as the Database Administrator (DBA) to the system, being the head of the department.

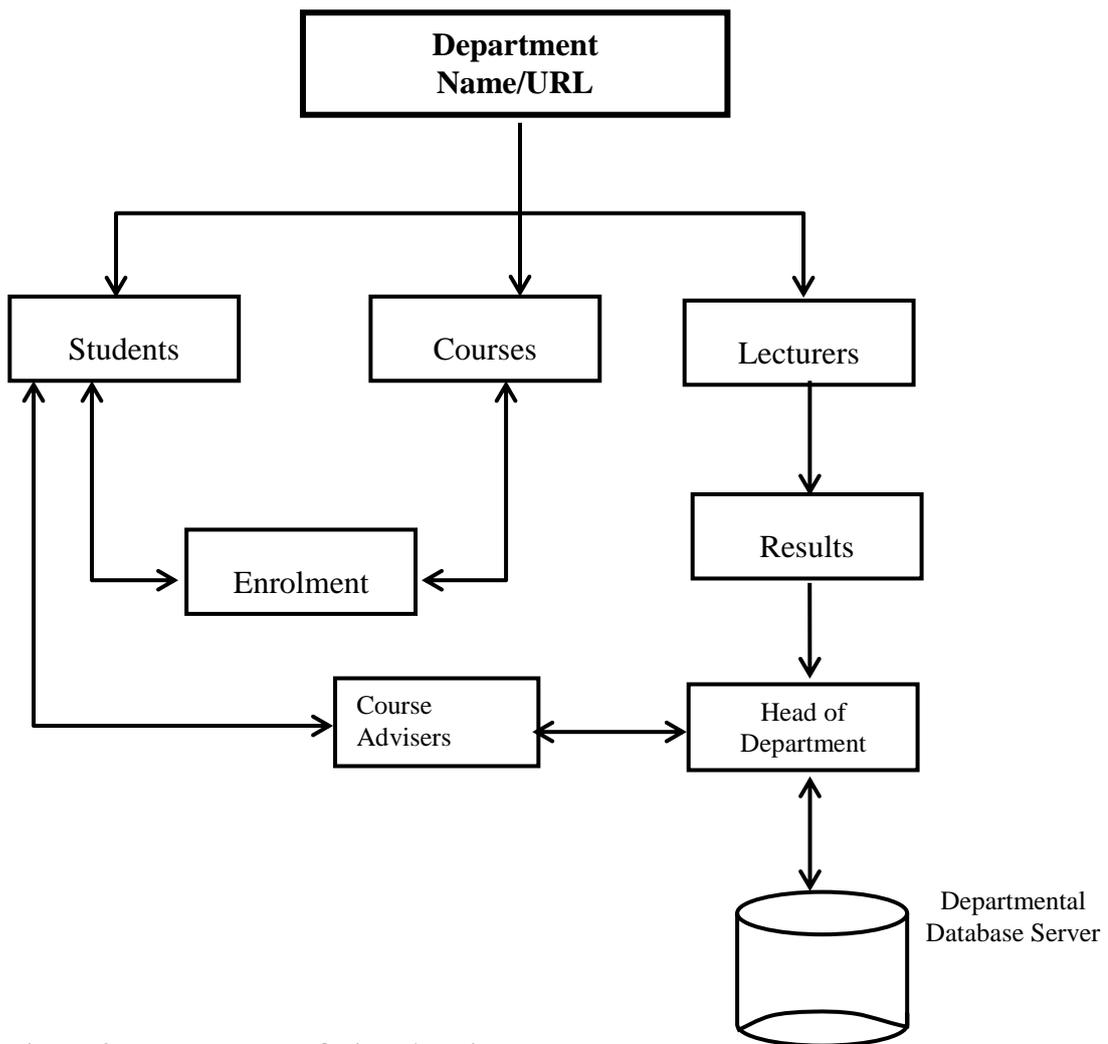


Figure 3: Departmental Object Architecture

We present here the architecture of the object “Department” and its corresponding dimensions involved in the University undergraduate student course enrolment, results computation and database server. There is a relationship amongst the various dimensions of the object and is exhibited in the form of cardinality. Cardinality represents the strength of the relationship of the dimension to the object. For example, the cardinality of a dimension can be used as an indicator or the degree of participation of that dimension for indexing purpose.

Proposed System Modeling Operation

Our proposed system model interfaces consist of three-tier interactive web-based Extranet system for managing students’ academic records in a university environment. The web-based system research method for hosting the application program database consists of three main modules, which are installed and configured independently. These modules include: front-tier, middle-tier and end-tier. The system is modeled to run in an Extranet Network environment in the university with a view to ensuring the online and real time access to relevant data of the application program by all subscribed departments of the university:

Front-tier

This is the presentation layer. It is made up of series of web pages, presented to the user with the aid of a web browser. Some web pages consist of purely general information contents and do not require the user of the system to be authenticated, while some web pages require explicit authentication and authorization of the users.

Middle-tier

The middle-tier is the component of the web system that contains the logic of data processing. It makes decisions such as what page and function is available to what type of users. It performs the actual authentication and authorization of users of the web system. It also serves as a bridge between the user/client at the front end of the application program, that is, the presentation layer and the data at the back-end (data system). It also performs all computations of results and how the information derived from processing the data system is summarized and reported to the recipient.

End-tier

This is the result data system layer or server of the web system. There are several data system servers which support web programming and data processing in the Extranet environment. These include Oracle Database Server, Microsoft SQL Server, IBM DB2, My SQL and Postgre SQL. The choice of data system server is the prerogative of the DBA.

Proposed System Model

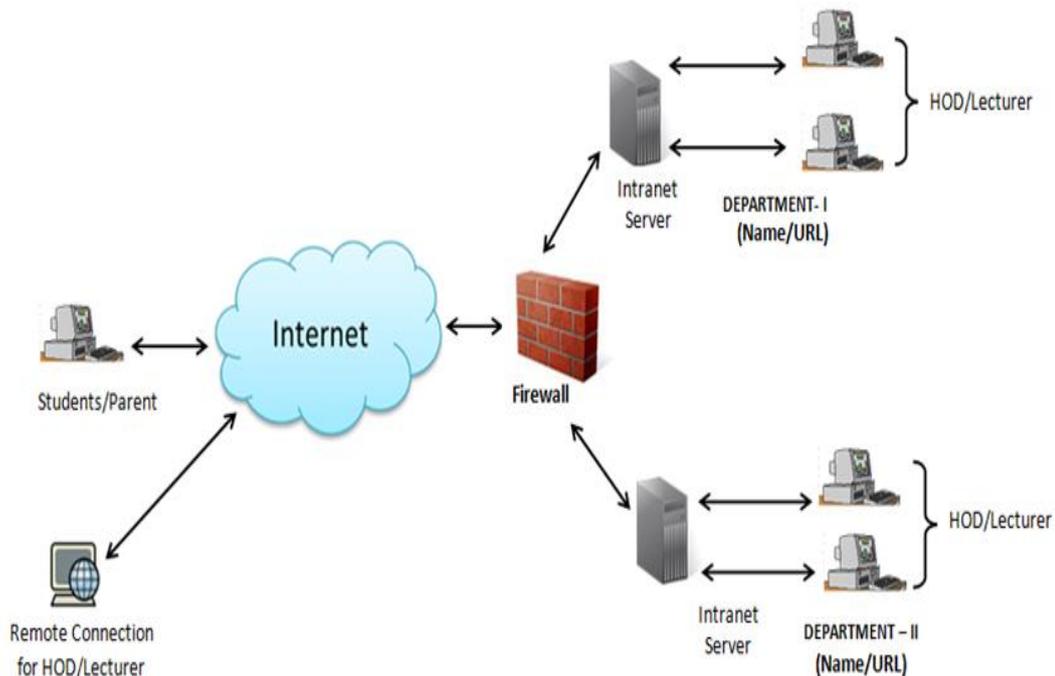


Figure 4:

Interactive Web-Based Extranet System Model

Conclusion

The importance of a well-planned modeled interactive web-based Extranet system in a university environment in today’s electronic transactions cannot be over emphasized. Although an Extranet system is an evolving environment, but getting the basic strategic requirements and information needs, well modeled and qualified, will avoid becoming a disused, isolated island of non-information, particularly for results computation in a university environment. This is what our well planned modeled interactive web-based Extranet system intends to achieve. That is, having a proper institution, such as the university of flow of information among the users for computation of result online. Students’ academic records are made available from different academic platforms for the needs and goal of the institution and that will make the Extranet system an island of useful information.

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